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in the First Years after Birth

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Abstract

This study uses data from the LSAC and HILDA surveys to examine educational, labour market, health and partnership outcomes of young women who became a mother during their teenage years and compares them with outcomes of women who became a mother in their twenties and those who do not have children yet. We find that while teenage motherhood is strongly associated with poorer outcomes in the first years after birth, a large part of the observed associations is due to selection bias. However, although not all of the observed associations can be attributed to the causal impact of teenage motherhood, the indication is that some of the associations are causal, of nontrivial size, and significant. Propensity score matching analysis suggests that relative to childless women with similar characteristics, teenage mothers are 39 percentage points less likely to complete Year 12, 54 percentage points less likely to be employed and 34 percentage points more likely to be a smoker. Relative to childless women, teenage mothers have \$100 less in weekly personal income and are 8 percentage points less likely to be in good health or better than good health.

JEL classification: J12, J13

Keywords: Teenage mothers, educational outcomes, health outcomes, labour market outcomes

1. Introduction

Teenage motherhood is a critical policy issue in many countries. The major concern is that early childbearing interferes with human capital investment, causing young mothers to be disadvantaged in the labour market and in relationship outcomes, and to be more likely to rely on welfare. This in turn has negative consequences for themselves, their children and society. Indeed, teenage mothers are over-represented in welfare participation. For example, in Australia around one-third of single Parenting Payment recipients with a youngest child less than 6 years old had their first child before age 20, while only 1 per cent of single mothers were teenage mothers (Jeon *et al.*, 2011).

Although teenage motherhood is less common in Australia than in many other OECD countries, socio-economic outcomes for teenage mothers are comparatively poor (see Jeon *et al.*, 2008). Teenage mothers can therefore benefit from well-designed social policy interventions to help improve their outcomes.

Teenage mothers' outcomes have been widely studied. Earlier research tends to establish a link between teenage motherhood and a wide range of outcomes without investigating whether the link is causal. In recent studies, the focus has been on determining whether the poor outcomes experienced by teenage mothers are caused by teenage motherhood or by selection bias.

In Australia, Webbink *et al.* examine whether or not teenage motherhood has a causal impact on smoking, drinking and body size (2008) and on human capital investment (2011). The current study complements those two studies by considering the causal impact of teenage motherhood on educational, labour market, partnership and health outcomes. Thus, this study broadens the evidence base for Australia.

Establishing whether or not there is a causal link between teenage motherhood and later outcomes has important policy implications. If causality is found, then policies that prevent early childbearing can help improve later outcomes for disadvantaged women. However, if poor outcomes are due to selection bias, a different type of policy may be more relevant: for example, addressing the underlying factors driving teenage motherhood and poor outcomes later in life.

The rest of the paper proceeds as follows. Section 2 summarises the literature on outcomes of teenage mothers. Sections 3 and 4 respectively describe the methods and data. Section 5 presents the estimation results while Section 6 summarises and concludes.

2. Literature overview

Education is a major pathway through which teenage motherhood could affect a woman's later outcomes. The late teenage years is when young people prepare for high-school completion and make decisions regarding further education. Pregnancy and motherhood during this period may raise the opportunity cost of schooling to the young woman, reduce her investment in it, and thus worsen her educational outcomes (Levine and Painter, 2003). However, on the reverse, leaving school early may also lead to teenage motherhood due to a low opportunity cost of time, or early school leaving and teenage pregnancy are both caused by another (unobserved) factor. In fact, Jeon *et al.* (2011) observed that most teenage mothers seemed to have left school before becoming pregnant, potentially supporting one of the latter two relationships.

Teenage motherhood can affect a woman's labour market outcomes through its impact on her education and/or work experience, as childbearing and caring are likely to keep her out of the labour market for some time (indirect effects). Fletcher and Wolfe (2008) find that teenage mothers have lower annual earnings in adulthood than other comparable women. This could be due to lower education and/or less work experience, but motherhood could also reduce the energy a woman has for other activities, thus lowering her productivity (direct effect). Poorer labour market outcomes will thus necessitate greater welfare reliance among teenage mothers.

A woman's standard of living also depends on the presence and 'quality' of a partner. Since men are often still the main breadwinners, partnership can be an important pathway for women to escape from poverty and disadvantage. Teenage mothers are likely to be more constrained than other women in their choice of a partner. This could be because childbearing and caring responsibilities reduce the amount of time that a young mother has to search for a partner, or because children from a previous relationship discourage potential partners. As a result teenage mothers may be less likely to be partnered (Bradbury, 2006) or they are more likely to have a poorly educated and unemployment-prone partner (Ermisch and Pevalin, 2005).

The effect of teenage motherhood on health outcomes is theoretically ambiguous. On the one hand, teenage motherhood could adversely affect health outcomes. This could be because

childbearing and caring responsibilities at an early age, usually as a single parent¹ and with limited resources and experience, are stressful and detrimental to a woman's mental and physical health. An alternative pathway for the effect could be through reduced choices and opportunities. For example, poor educational, labour market and partnership outcomes may affect teenage mothers' mental health, and induce unhealthy behaviours or lifestyles. On the other hand, teenage motherhood could also have a positive effect on health outcomes. This is because early motherhood may change the priorities of young women, steering them away from risky behaviours for the sake of their children.

There is ample evidence that teenage motherhood has significant negative impacts on a range of outcomes, even after selection bias is accounted for. For example, using a matching method, Chevalier and Viitanen (2003) find that teenage motherhood decreases the probability of continued schooling after age 16 by 12–24 percentage points. Using biological fertility shocks to instrument for age at first birth, Miller (2011) finds an increase of 9 percent in earnings per year of delay in motherhood, with 3 percent being due to an increase in wages and 6 percent to an increase in work hours. Webbink *et al.* (2008), who use Australian twins data and an instrumental variable (IV) method to account for selection, find that teenage mothers smoke on average 2.6–4 years longer and are less likely to quit smoking than their (twin) sisters. Teenage motherhood is also found to raise the probability of being overweight, especially at age 40 or older.

In contrast, several other studies find little causal impact of teenage motherhood. For example, using the difference-in-difference method, Brien *et al.* (2002) find that while teenage mothers have lower test scores than their counterparts without children, the effects of motherhood itself are negligible. In a more recent study using Australian twins data, Webbink *et al.* (2011) find no difference in educational attainment between teenage mothers and their identical twin sisters, suggesting little evidence of a negative causal effect of teenage childbearing on educational attainment. Geronimus and Korenman (1992) find no significant effect of teenage childbearing on the probabilities of employment and welfare participation once unobserved family characteristics are taken into account (using sibling data). Using similar methods to Webbink *et al.* (2008) on 25-year-old Americans, Fletcher (2012) finds

¹ In the US, 83 percent of births to teenagers are outside a marriage, and among Blacks this rate is 96 percent (Hamilton *et al.*, 2005).

that teenage motherhood has little effect on smoking and obesity, but may reduce drug use and binge drinking in the short term.

Some authors argue that teenage motherhood only brings forward motherhood in time, so over the life cycle, the effect of teenage motherhood is not different from the effect of later motherhood. Using miscarriages as an IV, Hotz *et al.* (2005) show that while teenage mothers appear less likely to receive a high-school diploma, they appear to offset this by being more likely to obtain a General Educational Development certificate later in life and by working much more over their early adulthood than if they had delayed childbearing. Hotz *et al.* (2005) also find teenage mothers to have higher levels of earnings during adulthood than if they had postponed motherhood. Moreover, while teenage childbearing seems to increase public aid expenditures immediately after a teen birth, this ‘negative’ consequence is short-lived, in that teenage mothers use less public aid in their late twenties as their earnings rise and their children age. On the one hand, these findings concur with Bronars and Grogger (1994) who, exploiting the natural experiment of ‘twin births first’, find that the short-term adverse effects of unplanned births on labour force participation, poverty and welfare reciprocity dissipate over time for white unwed mothers. On the other hand, Hotz *et al.*’s (2005) findings disagree with Taniguchi (1999), who finds that women who experience early childbearing are more likely to experience a higher wage penalty.²

Most of the empirical studies on teenage motherhood focus on educational and labour market outcomes. Recently, there has been rising interest in the impact of teenage motherhood on partnership and health outcomes. Selection bias seems the strongest with respect to educational outcomes, with much evidence indicating that teenage mothers would have low educational outcomes even if they had not had a child as a teenager. This is consistent with Jeon *et al.* (2011) who, based on Australian data, find that the majority of teenage mothers had already left school before they were pregnant.

There is considerable evidence that results differ a great deal by method. Studies that use the IV method tend to find much stronger negative estimates of the effects of teenage motherhood than those that use sibling difference to control for unobserved family characteristics.³ This could be because the sibling method relies crucially on the assumption

² Bronars and Grogger (1994) examine the effect of unplanned births while Taniguchi (1999) considers the timing of births on women’s wages. Neither study focuses specifically on teenage mothers.

³ Ribar (1999) confirms this by applying the two methods to the same data. He argues that if the unobserved individual-specific factors influencing fertility and socio-economic status are at least as strongly related as the

that the only unobserved characteristics that affect teenage motherhood are related to family background. The assumption that siblings do not differ with respect to unobserved individual characteristics, such as innate abilities and motivation, is especially strong when the siblings are not identical twins.

Overall, even though the evidence is mixed, the balance of the evidence suggests that teenage motherhood has an adverse causal impact on a wide range of outcomes, including school completion, educational attainment, employment, earnings, welfare reciprocity, partnering status, quality of partner and health.

3. Methods

To examine the effects of teenage motherhood on outcomes, a reduced-form model is specified:

$$Y_i = \alpha_i + \beta_T T_i + \beta_X X_i + \varepsilon_i \quad (1)$$

where i indexes individuals, T is a binary variable capturing whether or not a woman had a first birth at ages 15-19, and X is a vector of controls. α , β_T and β_X are parameters to be estimated, with β_T capturing the total direct effect of teenage motherhood on the outcome in question, holding constant other observable factors.

A methodological issue arises because teenage motherhood is potentially endogenous. Thus, while a significant negative relationship between teenage motherhood and an outcome may show that teenage motherhood is associated with a poorer outcome, it is unable to determine whether or not teenage motherhood *per se* leads to the outcome. Ignoring the potential endogeneity of teenage motherhood may lead to biased and inconsistent estimates of its impact on later outcomes.

To address endogeneity due to selection on observables, this study uses the propensity score matching (PSM) method. PSM estimates the treatment effect (of teenage motherhood) by comparing a treated person (teenage mother) with a control person (non-teenage mother) who is as similar to the treated person as possible. Specifically, the PSM process involves three steps. The first step obtains the propensity score, which is the predicted probability of being a teenage mother given a woman's characteristics. The second step matches a teenage mother

unobserved family-specific factors influencing fertility and socio-economic status, then the sibling difference estimates represent a lower bound on the estimated effects of teenage motherhood.

with a non-teenage mother based on their propensity scores. Individuals that can be matched to a teenage mother form a so-called ‘matched’ sample (the control group). In the last step, the average treatment effect (impact of teenage motherhood on outcome) is estimated as the mean difference in the outcome between a teenage mother and a non-teenage mother in each pair.

Two methods will be used to match a teenage mother with a non-teenage mother. In the first method (kernel matching), a ‘synthetic’ counterfactual is created for each teenage mother, based on the kernel-weighted average of the characteristics of the nearest non-teenage mothers with closer neighbours receiving higher weights. The second method (calliper matching) matches a teenage mother with one or more non-teenage mothers if the difference in propensity scores between the teenage mother and the non-teenage mother is less than a specified limit. For both methods, the likelihood of a match can be raised by setting a larger bandwidth, but this would be at the expense of the match quality (resulting in higher standard errors).

As such, PSM can in principle estimate the causal effect of a treatment in the absence of a randomised experiment. The more explanatory variables are available for the estimation of the propensity score equation, the more plausible it is that the estimated effect using PSM can be interpreted as causal. Previous studies which have used PSM to estimate the impact of motherhood include Levine and Painter (2003), Chevalier and Viitanen (2003), Goodman *et al.* (2004), and Simonsen and Skipper (2006).

4. Data

4.1. Data sources

This study draws on data from two surveys: the Longitudinal Study of Australian Children (LSAC) and Household, Income and Labour Dynamics in Australia (HILDA).

HILDA is a longitudinal survey of Australian households collecting information on all individuals for a number of randomly selected households on a yearly basis. HILDA started in 2001 and has been run annually, with each year corresponding to a wave. It covers approximately 13,000 individual respondents living in more than 7,000 households. HILDA collects information on a large number of individual characteristics, such as education, health, labour force participation, income, and a broad range of characteristics for all adults

living in the household; and household characteristics, such as the number and age of children, and the number of adults in the household.⁴

LSAC is a panel data survey that follows around 10,000 children and their families. At the time of the study, 6 years of information over 4 waves were available. There are two birth cohorts of around 5,000 children each. Children in the birth (B) cohort were 3-19 months old when the study began in 2004, while children in the kindergarten (K) cohort were 4-5 years old at the start. This study only uses the B-cohort. Data are collected from the children's parents, childcare providers or teachers, and the child once they are old enough. Information is collected on many early childhood issues, such as health, parenting, family relationships, education, childcare, family support, and separated families, but also on the well-being and labour market participation of the parents.⁵

In LSAC, the focal children are followed over time, and information on the mothers of the children is collected when available. All women in LSAC are thus mothers, either teenage mothers (i.e. women who have become a mother during their teenage years) or older mothers (i.e. women who have become a mother in their twenties or later). HILDA, in contrast, tracks all adults living in selected households over time. HILDA data do not only contain teenage mothers and older mothers but also childless women.

To make HILDA mothers roughly comparable to LSAC B-cohort mothers (whose children are aged between 3 and 19 months in 2004) while still retaining a sufficiently large number of teenage mothers, we only include HILDA mothers whose children are up to three years old in the 2004 wave. Since the number of teenage mothers aged 15-29 in each survey is not very large (fewer than 200 in each survey) and since LSAC does not contain childless women, we pool both data sets. In particular, most of the analysis is based on LSAC B cohort wave 1 and HILDA wave 4 (both carried out in 2004). Our pooled analytical sample has just over 300 observations on teenage mothers. For robustness checks, using outcomes at slightly older ages, we also include LSAC wave 2 and 3, and HILDA waves 6 and 8 (carried out in 2006 and 2008 respectively). The analytical samples are restricted to women up to age 29 in 2004, 31 in 2006 and 33 in 2008.

⁴ Detailed information on HILDA is available on the website <http://melbourneinstitute.com/hilda/>. For discussion of the design of the HILDA Survey refer to Wooden and Watson (2007).

⁵ More information is available from <http://www.growingupinaustralia.gov.au/>.

4.2. Key variables

We consider nine outcomes, which are classified into four groups:

- Educational outcomes: Year 12 completion and having a post-school qualification, where a post-school qualification can be a university degree or a non-degree qualification
- Labour market outcomes: employment status and personal income
- Health outcomes: health status and smoker status
- Partnership outcomes: partnering status, partner's employment status and family income (family income is the same as personal income if the woman is single, and it equals her personal income plus her partner's income if the woman has a partner)

Furthermore, we apply a lower age limit for most of the analysis, as some ages are too young for certain outcomes to have been achieved. In particular:

- Year 12 completion, having post-school qualification, employment status, personal income and family income are analysed for women aged 20 or above;
- Having a university degree is analysed for women aged 23 or above;
- Health status and smoker status are analysed for all women;
- Partnering status is analysed for women aged 20 or above with children only;⁶
- Partner's employment status is analysed for partnered women aged 20 or above with children only.

4.3. Descriptive statistics

Table 1, which contains the means of the regression variables for our 2004 analytical sample, shows that childless women are less likely to have a partner than teenage mothers, who are in turn less likely to have a partner than older mothers. For the other eight outcomes, teenage mothers have poorer outcomes than older mothers, who in turn have poorer outcomes than childless women. For most outcomes and characteristics, the means for older mothers and childless women are statistically significantly different from the means for teenage mothers.

⁶ Partnership outcomes are only considered for women with children, since for childless women, not having a partner when they are aged 20 to 29 cannot be interpreted as a good or a bad outcome. However, when children are present, having someone with whom to share the caring responsibilities is likely to make partnered women better off than single women.

Table 1: Descriptive statistics of LSAC and HILDA analytical samples

	LSAC		HILDA		
	Teenage mothers	Older mothers	Teenage mothers	Older mothers	Childless women
Outcomes					
Completed Year 12 ^a	0.321	0.647***	0.250	0.604***	0.808***
Post-school qualification ^a	0.396	0.611***	0.214	0.462***	0.572**
Employed ^a	0.151	0.443***	0.250	0.413***	0.862*
Personal income ^a	235	254***	84	172	495
Having good or better health	0.838	0.906***	0.800	0.897**	0.910***
Being a smoker	0.618	0.286***	0.598	0.302***	0.237***
Partnered ^{a,b}	0.704	0.864	0.464	0.782***	.
Partner employed ^{a,b,c}	0.784	0.937	0.846	0.920***	.
Family income ^a	529	881***	292	697***	785***
Control variables					
<i>Own background characteristics</i>					
Age	18.878	25.965***	18.538	26.624***	20.872***
School completion (ref: Year 9 or less)	0.252	0.057***	0.214	0.051***	0.061***
Year 10-11 only	0.564	0.296***	0.604	0.346***	0.304***
Year 12 ^d	0.184	0.647***	0.182	0.604***	0.635***
Post-school qual. (ref: No qual.)	0.736	0.389***	0.846	0.538***	0.645***
Non-degree qualification ^c	0.264	0.416	0.154	0.257***	0.171***
University degree	0	0.195***	0	0.204***	0.184***
Religion (ref: No religion)	0.433	0.236**	0.346	0.240***	0.266***
Catholic	0.201	0.276***	0.109	0.176**	0.206**
Other Christian	0.250	0.389***	0.128	0.374***	0.245***
Other religion	0.104	0.093	0.013	0.057	0.038**
Religion not known	0.012	0.005***	0.404	0.154	0.245***
Indigenous Australian	0.159	0.038***	0.207	0.038***	0.031***
Migrant status (ref: Australian born)	0.915	0.817***	0.929	0.866***	0.854**
Migrant from an ESB country	0.030	0.058	0.045	0.042	0.036
Migrant from an NESB country	0.055	0.125***	0.026	0.092***	0.110***
Residence (ref: Metropolitan)	0.390	0.502***	0.449	0.549***	0.690**
Regional residence	0.530	0.443***	0.506	0.422**	0.292*
Remote residence	0.079	0.054**	0.045	0.029	0.018
<i>Parental characteristics</i>					
Par. migrant status (ref: No migrant parent)	0.722	0.582***	0.735	0.634***	0.603**
One parent is migrant	0.136	0.148	0.129	0.164	0.181
Both parents are migrants	0.142	0.270**	0.135	0.202***	0.216*
<i>Family characteristics</i>					
Mixed family ^f	0.530	0.134	0.410	0.088***	0.390***
Number of children	1.195	1.709***	1.103	1.444***	
<i>Age of youngest child (ref: 0 years)</i>					
1 year	0.116	0.141***	0.141	0.253	
2 years			0.096	0.165	
3+ years			0.045	0.145	

Table 1: Descriptive statistics of LSAC and HILDA analytical samples

	LSAC		HILDA		
	Teenage mothers	Older mothers	Teenage mothers	Older mothers	Childless women
<i>Partner's characteristics</i>					
Partner's employment (ref: No partner)	0.393	0.136***	0.441	0.231***	0.755***
Partner employed	0.491	0.810***	0.355	0.708***	0.223***
Partner not employed	0.117	0.054***	0.204	0.061***	0.022***
Observations	164	1,700	156	455	2,654

Sources: LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only

Notes: *, ** and *** denote sample means that are significantly different from the means for teenage mothers at the 10%, 5% and 1% level respectively. (a) Outcome measured for women aged 20 or over only; (b) Outcome measured for women with children only; (c) Outcome measured for partnered women only. Partnership outcomes for all women aged 15-29 are shown under 'partner's characteristics'. Control variables are measured for all observations for which data are available. (d) Excludes non-school Year 12 equivalent qualifications; (e) Includes all certificate- and diploma-level qualifications; (f) A mixed family contains other people living with a couple or a nuclear family (which includes parent(s) and dependent child(ren) only), or at least two people who are not part of a couple. Notes (a)-(f) also apply to Table 4 and Appendix Table 4.

5. Results

5.1. Basic regression results

Before presenting the PSM results, we first report the results from simple regressions of the relevant outcomes on teenage motherhood and older motherhood status while controlling for as many relevant characteristics as available in the data. Summary results are presented in Table 2, with full results available in Appendix Tables 1 and 2. These provide a reference point for the results in the following subsection.

Table 2: Effects of motherhood status on outcomes in the first three years after birth^a

Outcome	Mean outcome in estimation sample	Number of teenage mothers	Effect of motherhood status ^b		Number of observations	(Pseudo) R-squared
			Teenage mother	Older mother		
Year 12 completed	0.683	77	-0.457***	-0.170***	3242	0.060
Post-school qualification	0.576	77	-0.116*	0.022	3239	0.043
Employed	0.583	77	-0.434***	-0.401***	3165	0.264
Personal income	331.9	77	-46.6	-228.8***	3152	0.348
Having good health	0.897	223	-0.019	0.041**	3605	0.038
Being a smoker	0.298	196	0.216***	0.019	2782	0.125
Partnered	0.837	77	0.023		2139	0.128
Partner employed	0.931	48	-0.028		1763	0.137
Family income	846.97	77	-91.4	-222.5***	3164	0.376

Source: Estimated from LSAC (wave 1) and HILDA (wave 4)

Notes: a) Full results are available in Appendix Tables 1 and 2. b) Reference category: childless women.

* significant at 10%, **significant at 5%, ***significant at 1%.

These results show that, mostly, outcomes for teenage mothers are worse than for older mothers and childless women. Outcomes for older mothers are also generally worse than for

childless women, at least with regard to labour market outcomes and income, which is as expected due to the presence of young children. These negative associations are often substantial and significant for several of the analysed outcomes. For example, comparing the negative association of teenage motherhood with Year 12 completion with the average rate of completion in the sample, we observe that the completion rate is decreased by about two-third.

The next section investigates how much of these associations remain after matching teenage mothers to similar women in the older mothers and the childless women categories.

5.2. PSM results

First we estimate propensity score equations. Table 3 presents the average marginal effects of a range of characteristics on the probability of being a teenage mother within the sample that we use for analysis. The probability of being a teenage mother serves as the propensity score in the PSM estimation. The distribution of the propensity score (both in terms of frequency and density) presented in Appendix Figure 1 shows that the propensity to become a teenage mother is less than 20 percent for most women in the sample (even for those women who became a teenage mother). The difference in outcomes between a teenage mother and a non-teenage mother with similar propensity scores is attributed to teenage motherhood.

Several background characteristics are associated with the likelihood of being a teenage mother. For the pooled sample combining the HILDA and LSAC samples (column 1), Year 10 completion is associated with a reduction by nearly 15 percentage points in the probability of being a teenage mother, while women with Christian beliefs are 4.8 to 5.5 percentage points less likely than non-religious women to become a mother in their teens.⁷ Own migrant status and parental migrant status have almost zero, and insignificant, associations with the probability of being a teenage mother. Indigenous status is a strong predictor of teenage motherhood, with Indigenous women being 8.9 percentage points more likely to become a teenage mother than non-Indigenous women. Residents of regional areas and remote areas are respectively 3.6 and 3.1 percentage points more likely to be a teenage mother than metropolitan residents. Similar results on the probability of being a teenage mother are obtained when using the HILDA sample only (Table 3, column 2).

⁷ Given that we only consider teenage mothers who had their first childbirth at age 15 or over, completion of Year 10 should have occurred before childbirth.

Table 3: Marginal effects on the probability of being a teenage mother

	HILDA and LSAC pooled (1)	HILDA only (2)
At least Year 10	-0.147***	-0.110***
Religion (ref: No religion)		
Catholic	-0.048***	-0.043***
Other Christian	-0.055***	-0.046***
Other religion	-0.006	-0.052
Religion not known	0.002	0.019
Indigenous Australian	0.089***	0.085***
Migrant status (ref: Australian born)		
Migrant from an ESB country	0.002	
Migrant from an NESB country	-0.015	
Parental migrant status (ref: No migrant parent)		
One parent is migrant	-0.016	-0.016
Both parents are migrants	-0.013	-0.003
Residence (ref: Metropolitan)		
Regional residence	0.036***	0.037***
Remote residence	0.031*	0.025
Observations	4190	2352
Pseudo R-squared	0.107	0.131
Number of teenage mothers	304	142

Source: Estimated from LSAC (wave 1) and HILDA (wave 4)

Notes: *significant at 10%, **significant at 5%, ***significant at 1%.

Applying the PSM approach appears to work well in making the treatment group (teenage mothers) and control group (non-teenage mothers) more comparable. When comparing the treatment and control groups in terms of their mean characteristics before and after applying the weights, obtained through one of the PSM approaches, the means in the two groups have become much more similar after applying the weights.⁸

Applying the PSM method allows us to attribute difference in outcomes between a teenage mother and a non-teenage mother to the effect of teenage motherhood, conditional on the treatment and control group being sufficiently similar on observed and unobserved characteristics after the PSM weighting. Computing the average difference in outcome across all teenage mothers for each outcome, we obtain the Average Treatment effect on the Treated

⁸ Appendix Table 3 compares the means of the treatment and control groups before and after the matching. Most explanatory variables are statistically different between the two groups before the matching, but no significant differences remain after the matching.

(ATT). The ATT estimates for 2004 (including women with children up to the first three years after birth) are presented in Table 4. For each outcome, there are six estimates.

Table 4: Effects of teenage motherhood on outcomes (ATT) in the first three years after birth, based on various propensity score matching methods

	Kernel, bandwidth 0.001 (1)	Kernel, bandwidth 0.01 (2)	Calliper, bandwidth 0.001 (3)	Calliper, bandwidth 0.01 (4)	Same as (1) compared with older mothers only (5)	Same as (1) compared with childless women only (6)
<i>Completed Year 12</i>						
Estimate	-0.239***	-0.245***	-0.270***	-0.273***	-0.192***	-0.389***
No. of untreated obs	2462	2462	2462	2462	2065	397
No. of matched untreated obs	2146	2437	173	178	1851	284
No. of treated obs	77	77	77	77	75	57
<i>Post-school qualification</i>						
Estimate	-0.144**	-0.146**	-0.200***	-0.208***	-0.149**	-0.097
No. of untreated obs	2459	2459	2459	2459	2062	397
No. of matched untreated obs	2145	2434	173	178	1845	284
No. of treated obs	77	77	77	77	75	57
<i>Employed</i>						
Estimate	-0.269***	-0.283***	-0.240***	-0.242***	-0.144***	-0.537***
No. of untreated obs	2461	2461	2461	2461	2064	397
No. of matched untreated obs	2145	2436	173	178	1849	284
No. of treated obs	77	77	77	77	75	57
<i>Personal income</i>						
Estimate	-46**	-49**	-60**	-56*	-10	-98***
No. of untreated obs	2449	2449	2449	2449	2052	397
No. of matched untreated obs	2141	2423	174	179	1663	284
No. of treated obs	77	77	77	77	75	57
<i>Having good or better health</i>						
Estimate	-0.073**	-0.064**	-0.092**	-0.086**	-0.068**	-0.080**
No. of untreated obs	2736	2736	2736	2736	1721	1015
No. of matched untreated obs	2656	2733	288	307	1544	988
No. of treated obs	216	222	216	222	209	197
<i>Being a smoker</i>						
Estimate	0.279***	0.255***	0.306***	0.284***	0.228***	0.344***
No. of untreated obs	2248	2248	2248	2248	1569	679
No. of matched untreated obs	2137	2244	230	251	1440	655
No. of treated obs	183	187	183	187	184	161
<i>Partnered</i>						
Estimate	-0.136**	-0.155***	-0.192***	-0.200***	-0.136**	
No. of untreated obs	2065	2065	2065	2065	2065	
No. of matched untreated obs	1851	2033	164	171	1851	
No. of treated obs	75	76	75	76	75	

Table 4: Effects of teenage motherhood on outcomes (ATT) in the first three years after birth, based on various propensity score matching methods

	Kernel, bandwidth 0.001 (1)	Kernel, bandwidth 0.01 (2)	Calliper, bandwidth 0.001 (3)	Calliper, bandwidth 0.01 (4)	Same as (1) compared with older mothers only (5)	Same as (1) compared with childless women only (6)
<i>Partner employed</i>						
Estimate	-0.058	-0.079	-0.092	-0.101	-0.058	
No. of untreated obs	1626	1626	1626	1626	1626	
No. of matched untreated obs	1233	1619	104	116	1233	
No. of treated obs	46	48	46	48	46	
<i>Family income</i>						
Estimate	-214***	-215***	-323***	-321***	-219***	14
No. of untreated obs	2461	2461	2461	2461	2064	397
No. of matched untreated obs	2145	2436	173	178	1850	284
No. of treated obs	77	77	77	77	75	57

Source: Estimated from LSAC (wave 1) and HILDA (wave 4)

Notes: *significant at 10%, **significant at 5%, ***significant at 1%. Sample restrictions described in Section 4 apply. Also see notes of Table 1.

The first two estimates are based on the kernel method (see columns 1 and 2), where for each teenage mother, a ‘synthetic’ counterfactual is created based on the kernel-weighted average of the characteristics of the nearest non-teenage mothers. This method has the advantage of using most non-teenage mothers in establishing the ‘counterfactual’ case for a teenage mother. The kernel weight depends on the propensity score of each non-teenage mother compared to the propensity score of the nearest teenage mother. The closer a non-teenage mother is to a teenage mother in terms of propensity score, the higher is the weight applied to that non-teenage mother in creating the ‘counterfactual’ case for a teenage mother.

Two alternative bandwidths are used for the kernel method: 0.001 and 0.01.⁹ When the chosen bandwidth is smaller, the kernel weight placed on closer neighbours is relatively larger. A bandwidth can be thought of as a ‘tolerable difference’. The higher the chosen bandwidth is, the more likely it is to find a non-teenage mother that can be matched to a teenage mother, yet the less likely it is that they are a good match. The distribution of the kernel matching weights (with bandwidth 0.001) is presented in Appendix Figure 2.¹⁰

⁹ Chevalier and Viitanen (2003) also use these two bandwidths.

¹⁰ Treated observations all have weight one.

The next two estimates are based on the calliper method (see columns 3 and 4 in Table 4). This method matches a teenage mother with one or more non-teenage mothers if the difference in propensity scores between the teenage mother and the non-teenage mother is less than a specified limit (the bandwidth). The calliper method gives equal weight to all matched observations and ignores all unmatched observations. As such, only a limited number of non-teenage mothers are used in calculating the counterfactual outcomes. Again, two bandwidths (0.001 and 0.01) are used for this matching method.

We also compute two other estimates, both using the kernel method with a bandwidth of 0.001. The first estimate is based on a comparison between teenage mothers and older mothers only (see column 5) and the second estimate is based on a comparison with childless women only (see column 6). For all PSM estimations, we only use treated observations whose propensity scores lie in the ‘common support’ region. A teenage mother is said to satisfy this condition if her predicted propensity score is smaller than the maximum propensity score amongst older mothers and/or childless women, and larger than the minimum propensity score amongst this group.

Examining the results in Table 4, we can make a number of observations. First, a comparison with the regression results in Table 2 shows that although several estimated effects have become somewhat smaller, more of the estimated effects are now significant with some effects even remaining of equal size or slightly bigger.

Second, the kernel method (columns 1 and 2) produces larger estimates (in absolute value) for employment status, while the calliper method (columns 3 and 4) produces larger estimates for all other outcomes. However, the two sets of estimates are of the same order of magnitude. For example, the kernel method with a bandwidth of 0.001 suggests that teenage motherhood reduces the probability of employment by 26.9 percentage points, whereas the calliper method with the same bandwidth suggests a smaller (but still similarly sized) reduction of 24.0 percentage points. While the kernel method with a bandwidth of 0.001 attributes 7.3 percentage points of a decrease in the probability of having good or better health to teenage motherhood, the corresponding reduction predicted by the calliper method is larger in magnitude, at 9.2 percentage points.

Third, while increasing the bandwidth always increases the number of matches, its impact on the magnitude of the estimated effect can be either positive or negative. In general, estimates based on the two bandwidths are broadly similar. For example, the kernel method with a

bandwidth of 0.001 (column 1) suggests that teenage motherhood reduces the probability of completing Year 12 by 23.9 percentage points, while the same method with a bandwidth of 0.01 (column 2) suggests the reduction is 24.5 percentage points. Similarly, the calliper method with a bandwidth of 0.001 (column 3) and 0.01 (column 4) suggest that teenage motherhood reduces weekly personal income by \$60 and \$56 respectively.

Fourth, the impact of teenage motherhood is larger when comparing teenage mothers with childless women (column 6) than when comparing with older mothers (column 5). For example, while teenage motherhood does not significantly reduce personal income compared with older mothers, it reduces average weekly personal income by \$100 compared with childless women. This pattern is consistent with the patterns observed in Table 1 in Section 4, which suggests that the mean outcomes of older mothers lie somewhere between those for teenage mothers and those for childless women.

As a robustness check, we also estimate the impact of teenage motherhood in later years. The results, presented in Appendix Table 4, do not show a clear pattern, with the impact of teenage motherhood increasing over time for some outcomes yet decreasing for others. This could be at least partly because of the small number of teenage mothers that remain in the survey in later years.

The impact of teenage motherhood on educational outcomes worsens over time. For example, while teenage motherhood reduces the probability of Year 12 completion by 24 percentage points in the first three years after birth, the corresponding effect increases to 30 percentage points in the fifth year and 33 percentage points two years later. This could be because childless women are more likely than teenage mothers to accumulate further education as they age, which widens the gaps in educational outcomes between the two groups. In addition, the youngest group of teenage mothers (i.e. the group that had a child before turning 17 years of age) was more likely to be excluded from the analysis of educational outcomes in Table 4 since they would not have reached the age of 20 within three years of their last childbirth. This youngest group is likely to be most affected with regard to their educational outcome. No such effect is found for post-school qualifications.

In contrast, the impact of teenage motherhood on employment diminishes over time. In particular, teenage motherhood reduces the probability of working by 27 percentage points in the first three years after birth, but the effect drops to 24 and 18 percentage points respectively in the fifth and seventh years after birth. This is likely to reflect the increasing

tendency for mothers to increase labour supply as their child grows up. In addition, it may be the case that teenage mothers who do better in this regard are also more likely to remain in the survey.

Overall, the PSM analysis shows that although not all of the observed associations between teenage motherhood and outcomes can be attributed to the causal impact of teenage motherhood, the indication is that several causal effects are present, nontrivial and persistent over time.

6. Summary and conclusion

This study has used data from the LSAC (waves 1-3) and HILDA (waves 4, 6, 8) surveys to examine educational, labour market, health and partnership outcomes of young women who became a mother during their teenage years and compared them with outcomes of women who became a mother in their twenties and those who do not have children yet. Descriptive statistics indicate that on average, teenage mothers have considerably poorer outcomes than older mothers, who in turn have considerably poorer outcomes than childless women.

The PSM approach, which allows comparison of outcomes for women who have similar propensities to become a teenage mother, shows that a large part of these associations are due to selection bias. However, although not all of the observed associations can be attributed to the causal impact of teenage motherhood, the indication is that several causal effects are present, nontrivial and significant. In particular, PSM analysis suggests that relative to similarly characterised childless women, teenage mothers are 39 percentage points less likely to complete Year 12, 54 percentage points less likely to be employed and 34 percentage points more likely to be a smoker. Relative to childless women, teenage mothers have \$100 less in weekly personal income and are 8 percentage points less likely to have good health or better than good health.

Examining outcomes after two and four additional years respectively, the disadvantage with regard to the outcomes listed above has remained to a large extent. The disadvantage with regard to education appears to deepen in the years after birth, while the disadvantage with regard to employment reduces, presumably since the child ages over time. However, the difference in income (both in personal and family income) appears to become larger over time, possibly due to the different career opportunities available to teenage mothers (and their partners, if present) compared to other women.

The results are subject to the limitations in the PSM method. This method rests crucially on the assumption that assignment to treatment (i.e., becoming a teenage mother) is purely random, given the probability of treatment (our predicted propensity score). Thus, it is difficult to precisely pin down the effect of teenage motherhood on outcomes. On the one hand, the observed effect is overstated because several factors, such as unobserved personal characteristics that are important in shaping a woman's outcomes, cannot be controlled for, and unfortunately we have a limited number of explanatory variables to use in the model to predict the probability of teenage motherhood. On the other hand, the observed effect of teenage motherhood on outcomes could be understated if we do not account for the indirect effects because teenage motherhood is strongly associated with educational outcomes and education has a strong effect on outcomes, especially labour market outcomes.

It appears that young teenage mothers are disadvantaged because they have children, which is compounded by the fact that they have children at such a young age. Child bearing and caring responsibilities associated with having children are impediments to a woman's labour market activity while having children at a young age is also an obstacle to human capital accumulation.

Accordingly, policies aimed at reducing early motherhood should help improve outcomes for young women. In addition, there is evidence that labour market outcomes improve as children get older. This indicates that childcare assistance remains an important policy direction to focus on.

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Appendix

Appendix Table 1: Effects of teenage motherhood and other factors on educational and labour market outcomes in the first three years after birth

	Completed Year 12 (1)	Post-school qualification (2)	Employed (3)	Personal income (4)
Mean outcome of estimation sample	0.683	0.576	0.583	331.86
# teenage mothers	77	77	77	77
Motherhood status (ref: Childless woman)				
Teenage mother	-0.457***	-0.116*	-0.434***	-46.585
Older mother	-0.170***	0.022	-0.401***	-228.831***
Religion (ref: No religion)				
Catholic	0.081***	0.038	0.035*	4.410
Other Christian	0.008	0.047**	-0.007	-27.061**
Other religion	-0.009	0.053	-0.079**	-28.865
Religion not known	-0.104***	-0.066*	-0.028	-33.777*
Indigenous Australian	-0.185***	-0.061	-0.104**	51.872*
Migrant status (ref: Australian born)				
Migrant from an ESB country	0.010	0.024	-0.014	45.062
Migrant from an NESB country	0.102***	-0.142***	-0.091**	2.456
Residence (ref: Metropolitan)				
Regional residence	-0.091***	-0.055***	0.046***	-46.193***
Remote residence	-0.091**	-0.005	0.066*	2.379
Par. migrant status (ref: No migrant parent)				
One parent is migrant	-0.025	0.015	-0.019	-19.716
Both parents are migrants	-0.034	0.077***	-0.014	-19.035
Mixed family			-0.011	-33.488**
Number of children			-0.077***	42.361***
Age of youngest child (ref: 0 years)				
1 year			0.093***	
2 years			0.071	
3+ years			0.112**	
Partner's employment (ref: No partner)				
Partner employed			0.112***	-63.209***
Partner not employed			-0.099***	6.427
Age			0.015***	239.048***
Age squared				-4.555***
School completion (ref: Year 9 or less)				
Year 10-11 only		0.132***	0.143***	-9.940
Year 12		0.312***	0.229***	-19.806
Post-school qual. (ref: No qual.)				
Non-degree qualification			0.091***	15.561
University degree			0.117***	98.779***
Employed				259.390***
Observations	3242	3239	3165	3152
(Pseudo) R-squared	0.060	0.043	0.264	0.348

Source: Estimated from LSAC (wave 1) and HILDA (wave 4)

Notes: *significant at 10%, **significant at 5%, ***significant at 1%. Also see notes of Table 1.

Appendix Table 2: Effects of teenage motherhood and other factors on health and partnership outcomes in the first three years after birth

	Having good health	Being a smoker	Partnered	Partner employed	Family income
	(1)	(2)	(3)	(4)	(5)
Mean outcome of estimation sample	0.897	0.298	0.837	0.931	846.97
# teenage mothers	223	196	77	48	77
Motherhood status					
Teenage mother	-0.019	0.216***	0.023	-0.028	-91.416
Older mother	0.041**	0.019			-222.503***
Religion (ref: No religion)					
Catholic	0.011	-0.036	0.043*	-0.010	27.001
Other Christian	0.008	-0.137***	0.058***	-0.009	10.678
Other religion	-0.054*	-0.158***	0.089***	-0.072**	-84.493**
Religion not known	0.043***	-0.037	-0.010	-0.074	-26.751
Indigenous Australian	-0.032	0.122**	-0.174***	-0.182***	49.639
Migrant status (ref: Australian born)					
Migrant from an ESB country	-0.003	0.070	0.027	-0.003	126.441**
Migrant from an NESB country	0.014	-0.161***	0.024	-0.019	-53.263
Residence (ref: Metropolitan)					
Regional residence	0.010	-0.019	0.050***	-0.026**	-72.024***
Remote residence	0.042*	-0.015	0.094***	0.009	63.848
Par. migrant status (ref: No migrant parent)					
One parent is migrant	-0.020	0.024	-0.034	0.008	-21.136
Both parents are migrants	-0.011	-0.011	0.007	0.005	-10.907
Mixed family	0.002	0.038*			-47.732*
Number of children	-0.016*	0.003			31.815**
Age of youngest child (ref: 0 years)					
1 year	-0.001	-0.032			
2 years	-0.040	0.197**			
3+ years	-0.075	-0.032			
Partner's employment (ref: No partner)					
Partner employed					675.966***
Partner not employed					149.705***
Age	-0.001	0.006**	0.017***	0.005**	228.540***
Age squared					-4.108***
School completion (ref: Year 9 or less)					
Year 10-11 only	0.058**	-0.071*	0.156***	0.155***	29.746
Year 12	0.086***	-0.225***	0.218***	0.191***	42.845
Post-school qual. (ref: No qual.)					
Non-degree qualification	0.023*	-0.056***	0.013	0.011	15.416
University degree	0.063***	-0.174***	0.114***	0.039**	188.527***
Employed					244.965***
Observations	3605	2782	2139	1763	3164
(Pseudo) R-squared	0.038	0.125	0.128	0.137	0.376

Source: Estimated from LSAC (wave 1) and HILDA (wave 4)

Notes: *significant at 10%, **significant at 5%, ***significant at 1%. Also see notes of Table 1.

Appendix Table 3: Comparison of treatment and control groups before and after matching

		Mean of treatment group	Mean of control group	Bias between both groups	% of reduction in bias after match	Indication of statistical difference between 2 groups
At least Year 10	Unmatched	0.831	0.948	-37.8		***
	Matched	0.831	0.829	0.8	97.9	
Catholic	Unmatched	0.156	0.254	-24.5		*
	Matched	0.156	0.135	5.3	78.5	
Other Christian	Unmatched	0.208	0.372	-36.8		***
	Matched	0.208	0.201	1.6	95.7	
Other religion	Unmatched	0.130	0.073	18.8		*
	Matched	0.130	0.124	2.0	89.3	
Religion not known	Unmatched	0.156	0.052	34.5		***
	Matched	0.156	0.172	-5.2	84.8	
Indigenous Australian	Unmatched	0.117	0.037	30.2		***
	Matched	0.117	0.083	12.9	57.3	
Migrant from an ESB country	Unmatched	0.039	0.038	0.6		
	Matched	0.039	0.013	13.3	-2066.3	
Migrant from an NESB country	Unmatched	0.078	0.086	-2.8		
	Matched	0.078	0.073	1.7	39.9	
One parent is migrant	Unmatched	0.091	0.168	-23		*
	Matched	0.091	0.088	0.8	96.6	
Both parents are migrants	Unmatched	0.195	0.209	-3.5		
	Matched	0.195	0.202	-1.8	47.6	
Regional residence	Unmatched	0.584	0.438	29.5		**
	Matched	0.584	0.568	3.3	88.9	
Remote residence	Unmatched	0.026	0.044	-9.9		
	Matched	0.026	0.007	10.3	-3.9	

Source: Estimated from LSAC (waves 1-3) and HILDA (wave 4, 6, 8)

Note: *, ** and *** denote sample means that are significantly different between the treatment and control groups at the 10%, 5% and 1% level respectively. Estimates are based on the kernel matching method with a bandwidth of 0.001.

Appendix Table 4: Effects of teenage motherhood on outcomes (ATT) in the first seven years after birth, based on the propensity score matching method

	Years 0-3 (1)	Years 4-5 (2)	Years 6-7 (3)
<i>Completed Year 12^a</i>			
Estimate	-0.239***	-0.300***	-0.326***
No. of untreated obs	2462	2193	2109
No. of matched untreated obs	2146	1896	1888
No. of treated obs	77	70	47
<i>Post-school qualification^b</i>			
Estimate	-0.144**	-0.174***	-0.094
No. of untreated obs	2459	2191	2108
No. of matched untreated obs	2145	1892	1888
No. of treated obs	77	70	47
<i>Employed</i>			
Estimate	-0.269***	-0.239***	-0.184**
No. of untreated obs	2461	2187	2100
No. of matched untreated obs	2145	1889	1879
No. of treated obs	77	70	47
<i>Personal income</i>			
Estimate	-46**	-134***	-125***
No. of untreated obs	2449	2180	2097
No. of matched untreated obs	2141	1900	1877
No. of treated obs	77	70	47
<i>Having good or better health</i>			
Estimate	-0.073**	-0.076**	-0.06
No. of untreated obs	2736	2299	2368
No. of matched untreated obs	2656	2203	2262
No. of treated obs	216	153	95
<i>Being a smoker</i>			
Estimate	0.279***	0.141***	0.217***
No. of untreated obs	2248	2142	2351
No. of matched untreated obs	2137	2026	2295
No. of treated obs	183	124	93
<i>Partnered</i>			
Estimate	-0.136**	-0.121**	-0.056
No. of untreated obs	2065	1802	1663
No. of matched untreated obs	1851	1477	1401
No. of treated obs	75	70	47
<i>Partner employed</i>			
Estimate	-0.058	0.035	0.064
No. of untreated obs	1626	1337	1247
No. of matched untreated obs	1233	1224	1153
No. of treated obs	46	39	26

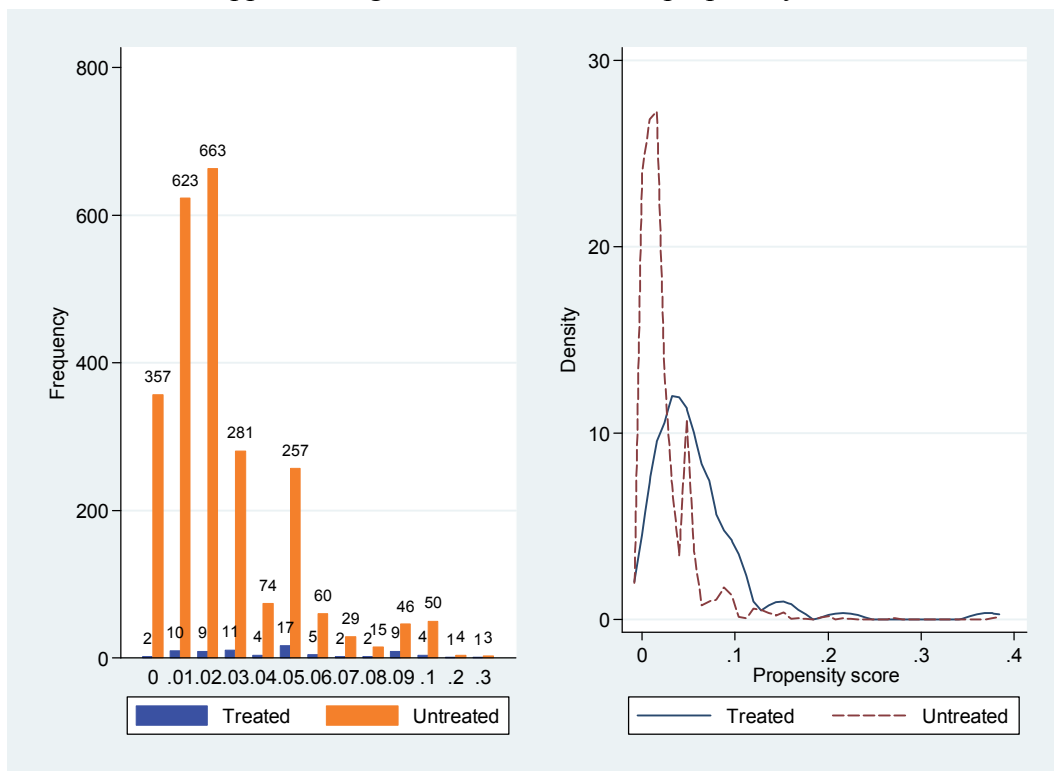
Appendix Table 4: Effects of teenage motherhood on outcomes (ATT) in the first seven years after birth, based on the propensity score matching method

	Years 0-3 (1)	Years 4-5 (2)	Years 6-7 (3)
<i>Family income</i>			
Estimate	-214***	-306***	-262***
No. of untreated obs	2461	2192	2107
No. of matched untreated obs	2145	1897	1886
No. of treated obs	77	70	47

Source: Estimated from LSAC (waves 1-3) and HILDA (wave 4, 6, 8)

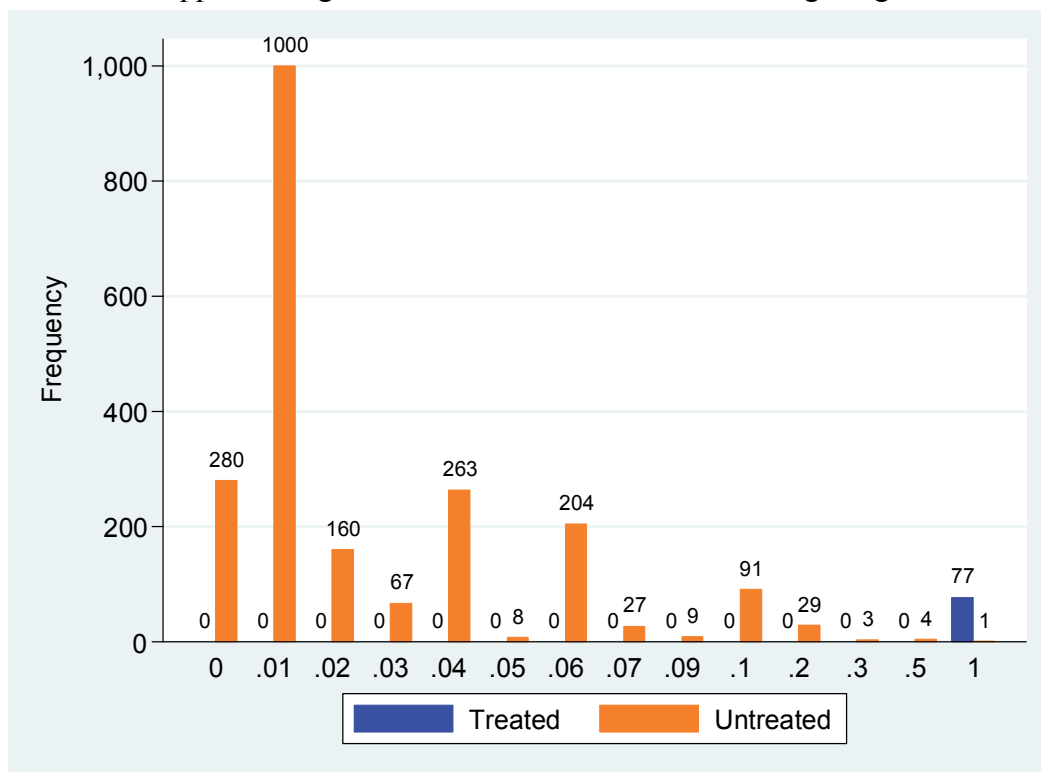
Notes: Estimates are based on the kernel matching method with a bandwidth of 0.001. *significant at 10%, **significant at 5%, ***significant at 1%. Sample restrictions described in Section 4 apply. (a) Excludes non-school Year 12 equivalent qualifications; (b) Includes all certificate-, diploma- and degree-level qualifications.

Appendix Figure 1: Distribution of propensity score



Source: Estimated from LSAC (wave 1) and HILDA (wave 4)
 Notes: Treated: teenage mothers; Untreated: older mothers and childless women

Appendix Figure 2: Distribution of kernel matching weight



Source: Estimated from LSAC (wave 1) and HILDA (wave 4)
 Notes: Treated: teenage mothers; Untreated: older mothers and childless women; bandwidth = 0.001