Fertility and Female Labor Force Participation

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July 2, 2021

Prepared for

Handbook of Labor, Human Resources and Population Economics

Abstract

This paper discusses the relationship between fertility and women's labour force participation. It surveys methods used to obtain causal identification, and provides an overview of the evidence of causal effects in both directions. It highlights the importance of distinguishing between extensive and intensive margin changes in both variables, looking not only at women's participation but also at occupational and sectoral choice and relative earnings, allowing for dynamic effects, analysing changes across the lifecycle and successive cohorts, and recognizing that women's choices over both fertility and labour force participation are subject to multiple constraints. We conclude that while technological innovations in reproductive health technologies have muted the family-career trade-off primarily by allowing women to time their fertility, policy has not achieved as much as it might.

Keywords: Fertility, birth spacing, abortion, ART, IVF, contraception, female labour force participation, gender wage gap, job loss, recession

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1 Introduction

At a global level, gender gaps in labour force participation have narrowed with over half a billion women having joined the workforce in the last 30 years (World Bank, 2012). However, there is enormous variation in women's labour force participation (FLFP) across low- and middle-income countries, and there is no clear understanding of why (Klasen et al., 2021). In this paper, we examine the role of fertility.

Alongside the broad upward trend in women's labour force participation, the world has witnessed a broad downward trend in fertility. This too exhibits considerable variation across countries both in the date of onset of decline, and in the speed of decline. In this paper, we examine the role of women's labour force participation.

We begin with a brief description, in Section 2, of trends in the two key variables. In Section 3, we briefly reference the classical economic theory that has guided empirical work in this area, highlighting the importance of considering extensive vs intensive margins, dynamics, lifecycle vs cohort data, and the many constraints on women's choices. We also underline that while the initial focus of the literature was on women's LFP, as LFP

has begun to stabilize, there is increasing interest in women's choice of sector and occupation and, in the relative wage paid to women compared with men or the gender pay gap, all of which are also potentially influenced by their fertility choices.

Section 4 considers impacts of fertility on women's labour force participation and other labour market outcomes, and Section 5 examines the literature discussing impacts of job finding and job destruction on fertility, looking both at changes in women's actual and prospective employment, and at changes in labour market conditions for men, or for the population as a whole. At the start of Section 4 (Section 4.1), we delineate approaches to identifying causal evidence before we present the evidence. The key econometric issues that we highlight apply in broad terms. As a result, in Section 5, the discussion of statistical approaches is brief and worked into discussion of the evidence.

We do not purport to be complete in our coverage either of causal approaches, or of the evidence in the literature, instead we provide a broad sweep sketch. We note that a summary of strategies used to address endogeneity in addressing impacts of fertility on labour market outcomes is provided in Clarke (2018) and a broader summary of this literature, including of mediators, is provided in Finlay (2021). Earlier survey papers by Hotz et al. (1997); Schultz (1997) review models of fertility and fertility choice in developed and developing countries respectively, with considerations beyond its interaction with women's labour market outcomes.

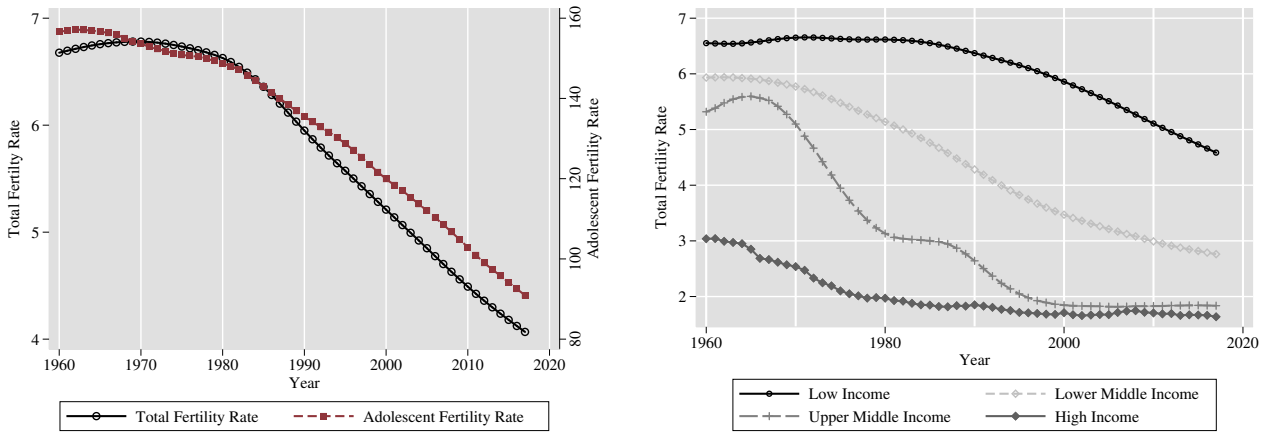
2 Trends in Fertility and Female Labour Force Participation

In this section we examine descriptive trends in fertility and labour force participation rates, and co-movements of these variables, with a particular focus on developing countries. Data on fertility rates are available from 1960 onwards but harmonized data on female labour force participation (FLFP) are only available over the past three decades. We first provide aggregate trends over a shorter time frame, and then consider longer periods of development for two countries with longer comparable measures of FLFP.[1] See Figures 1-2. While the total fertility rate began to fall in higher income countries from the 1960s (and, in some cases, earlier),[2] it only started to decline, on average, across low income countries from the 1980s. The decline accelerated in the 1990s and has been steady since. This transition was substantial, with total fertility falling from around 7 to 4 births per women from the 1980s to the present, and births to teenagers declining by around nearly half, from 150 births per 1,000 teens in 1980 to around 90 births per 1,000 teens in 2018 (Figure 1).

[1] Longer trends in both labour force rates and fertility in other settings have been documented by Sprague (1988) for the United Kingdom (in various age groups) and Engelhardt and Prskawetz (2004) for OECD aggregates.

[2] Standardized data are not consistently available prior to 1960, however historical data from the International Historical Statistical compendium (DOI: 10.1057/978-1-137-30568-8) suggests that a decline in fertility occurred as early as the 1870s in Sweden, or the early 1900s in Portugal (to name a few examples).

Figure 1: Fertility Trends, 1960–2018



(a) Fertility Rates in Least Developed Countries

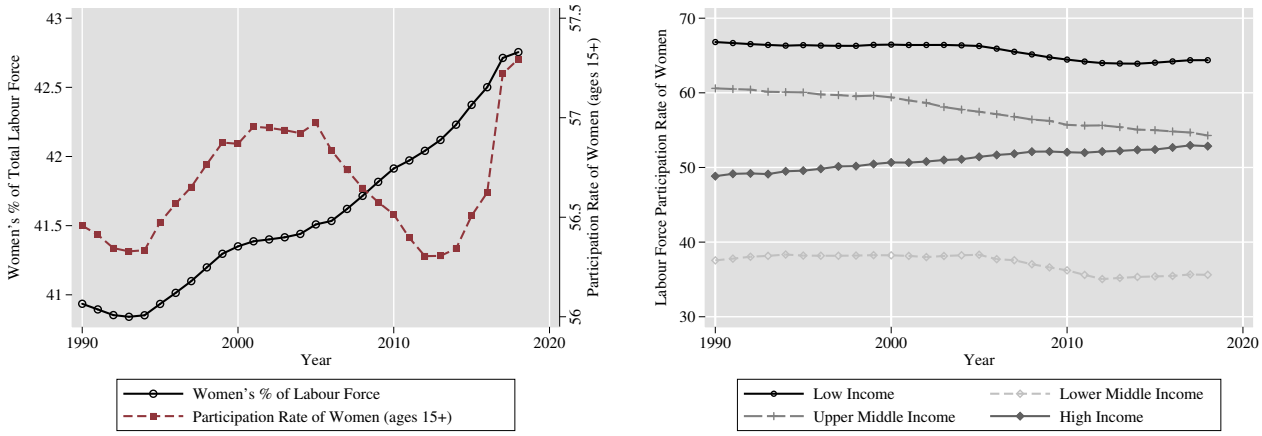
(b) Fertility Rates by Country Income Level

Notes: Fertility data are drawn from the World Bank Databank. Total Fertility Rate refers to the total number of children projected to be born to a women if she were exposed through her lifetime to the age-specific fertility rates prevalent in a given year. The adolescent fertility rate refers to the number of births per 1,000 women aged 15–19 years. "Least Developed Countries" in panel A are based on the United Nations classification of LDCs in each year. Country income groups in panel B are based on the World Bank's classification in each year.

Trends in women's labour market participation are displayed in Figure 2. Aggregates by country levels suggest relatively stable trends from 1990 onward. However, comparing trends by income-groups, we observe the stylised fact of a U-shaped (or more precisely, an inverted-J shape) relationship between female labour market participation and economic development (Goldin, 1994). Rates of FLFP are highest in low-income countries and lowest in lower middle income countries, the rate for higher income (high income and upper middle income) countries being in the middle. Focusing on the least developed countries (panel (a)), the proportion of women as a percent of the labour market grew but only from 41 to around 43 percent, while rates of FLFP remained between 56-57.5% among women aged 15 and above. The decline in women's share of the labour force between about 2005 and 2012 of just more than 1 percentage point is consistent with the steady if slow rise in women's participation, recognizing that men's participation increased slightly more rapidly in these years.

We now focus in on trends in fertility and LFP available for Mexico from 1960 and for the United States from 1950. This not only allows us to examine co-movements over a longer period of time, it also avoids aggregation over countries which can veil country-specific movements. See Figure 3. In both cases, the broad picture is of a declining trend in fertility and an increasing trend in women's LFP. Since 1960, fertility has fallen in Mexico from 7 to 2 births per woman and, in the United States, from 3.5 to about 1.75 births per woman. In Mexico, the decline only started around 1970 but has continued since. In the US, fertility decline was steady from 1960 to about 1975, after which fertility has fluctuated, and in 2020 was at a level similar to that in 1975. Women's

Figure 2: Women's Labour Market Trends, 1990–2018



(a) Female Labour Markets in Least Developed Countries

(b) FLFP by Country Income Level

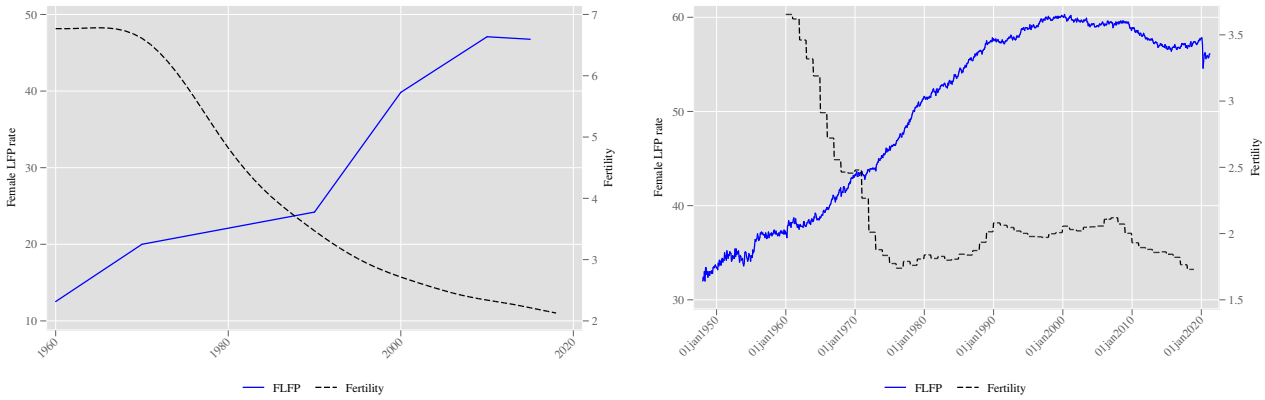
Notes: Labour market figures are drawn from the International Labour Organization, ILOSTAT database and World Bank population estimates. "Least Developed Countries" (LDC) in panel A are based on the United Nations classification of LDCs in each year. Country income groups in panel B are based on the World Bank's classification in each year. The LDC designation recognises both income as well as economic vulnerability and indicators of nutrition, health, school enrolment and literacy while the low income country classification is based on a single income threshold, such that 'Low Income' and LDC countries are not the same classification.

labour force participation has risen from about 12 to 48% in Mexico and from about 32 to 58% in the US.[3] In both countries, FLFP has risen steadily from 1960 and 1950 onwards, but levelled off in recent years. In Mexico it has levelled from 2010 and in the US from 2000 onwards. Studying co-movements of the two variables, we see that, in general, rates of FLFP have continued to rise after fertility has fallen to quite low levels, with both measures reaching more stable levels over later periods in data in both countries. In the US, FLFP showed a steady rise 1975-2000, a period during which fertility exhibits no secular trend. In Mexico, FLFP was rising during the 1960s when fertility was level and when FLFP accelerated from 1990 onwards, the rate of fertility decline slowed albeit fertility continued to decline. Overall, it seems clear that, in neither country do trends in fertility and FLFP mirror one another.

This is unsurprising as these trends move in concert with many other variables. In the following sections, we discuss economic theories delineating potential links between these variables, and then review a literature which aims to isolate causal links between fertility and women's labour market outcomes in both directions.

[3]Female labour force participation rates increased rapidly from the 1940s to the 1980s in OECD countries, with particularly large increases between 1950 and 1980 for married women. For instance, FLFP increased 27 percentage points from around 25 percent to 52 percent between 1940 and 1980 in the US, and from 35 percent to 52 percent in the UK between 1950 and 1990 (Costa, 2000).

Figure 3: Longer fertility and labour market trends in Mexico and the United States



(a) Mexico

(b) United States

Notes: Women's labour force participation measures are drawn from Bhalotra and Fernández (2021) (Mexico) and U.S. Bureau of Labor Statistics (2021) (USA). Fertility rates are provided by World Bank (2020).

3 Conceptual Framework

Economic theory predicts that shocks that increase a woman's fertility, other things equal, will increase her reservation wage and thereby tend to decrease her labour force participation. Conversely, shocks that increase her offered wage (or the opportunity cost of her time) will tend to increase her labour force participation and lead her to have fewer children. The pioneering economic model of fertility describes it as a resource (time) allocation problem that is responsive to prices (Becker, 1960; Schultz, 1969; Willis, 1973), and an extended model that incorporates the idea that the number of children a woman decides to have is co-determined with the investments she plans to make in each child is in Becker and Lewis (1973).

Identification is a challenge because a woman simultaneously decides how much to invest in her skill development, how many children to have, if any, whether to participate in the labour force, and in which sector and occupation to seek work.[4] Changes in the policy or natural environment that occur earlier in a woman's life may therefore have greater potential to influence her trajectory than any interventions or shocks that are incident after some of these choices are made. Most of the research we discuss examines how tweaking the decision on one of the multiple outcomes causes adjustments along the other decision margins.

In this paper we restrict attention to studies that take the individual's education and other skills as predetermined, and focus attention on the bi-directional relationship between fertility and FLFP. To the extent that women anticipate fertility they will tend to invest less in education and to sort into occupations or sectors that are

[4]We recognize that women in India and South and Southeast Asia, who constitute a large fraction of women in the world have preferences not only over how many children they have but also over the sex of their children. We abstract from this in our discussion.

consistent with parenting schedules. Estimates that condition upon women's skills and occupational choice will therefore provide a lower bound on the true cost of having children.

Some studies examine impacts of fertility not simply on labour supply but on sorting into occupation or sector. For instance, Goldin (2014), Le Barbanchon et al. (2021), Wasserman (2019), Bhalotra et al. (2021a), Chinhui and Rubinstein (2021) among others, show that women sort into more flexible occupations and, in doing this, incur a wage penalty. On another track, several studies find that women tend to select into the non-profit sector including the public sector, see for instance, Gregg et al. (2011) and Bhalotra et al. (Forthcoming) although it is not clear that this is driven by a demand for flexibility, a competing explanation being that women are mission-oriented and public sector jobs like nursing and teaching attract workers with intrinsic motivation. In any case, the cited studies do not look at the event of birth of a child but instead at female-male differences in occupational or sectoral choice and so they essentially capture impacts of fertility intentions on labour market choices and, ultimately, on relative wages or the gender pay gap.

In reading the evidence it is relevant to consider other variations around the simple theme. First, we will underline that these relationships can vary with whether either or both of the response variable and the stimulus variable (fertility or labour force participation, as the case may be) indicate a change on the extensive vs the intensive margin. We discuss the evidence below but point here to an important revision to the Beckerian model proposed in Aaronson et al. (2014). Second, we shall highlight that our understanding of observed patterns in fertility and female LFP is enhanced by allowing for timing or dynamics in the decision process. In particular, we may find meaningful adjustments to birth spacing in response to labour force participation even in cases where the total number of children does not change. Similarly, women may delay joining the labour force or drop out for varying durations around childbirth. These adjustments will be invisible or muted in studies that rely upon data that capture whether the woman has ever worked or whether she has worked in a fixed interval preceding the date of survey or enumeration. Third, a related but distinct point is that the relationship between fertility and women's LFP over the lifecycle (during which age and calendar time vary) can look quite different from the relationship across cohorts at any given age. Fourth, the initial focus of the literature was on women's LFP but, as LFP has begun to stabilize, there is increasing interest in women's choice of sector and occupation and, related in their relative wage or the gender pay gap, all of which are also potentially influenced by their fertility choices.

Finally, standard economic theory assumes no constraints on choice other than a budget constraint which captures the fact that FLFP produces earnings and that there is a cost to bearing and rearing children. In fact women face a plethora of constraints on their choices. There is a large unmet demand for contraception, the instrument by which women can limit, delay and space fertility. On the other side of that coin is a large unmet demand for abortion, particularly but not only in developing countries. Women who successfully delay fertility

may go on to have a demand for IVF, access to which is also severely limited for most women. The barriers to women accessing contraception and abortion are often financial, religious and political. There may additionally be social barriers, and male partners may have different preferences from women, and dominate these decisions – e.g. Ashraf et al. (2014), Doepke and Kindermann (2019), Doepke and Tertilt (2018).

There are similarly an array of barriers other than fertility to women's labour force participation. There is evidence that women's work is inhibited by social norms that couch the view that women belong in the home and/or that the man is the breadwinner (Bursztyn et al., 2020; Tur-Prats, 2019; Erten and Keskin, forthcoming; Bhalotra et al., 2021b), and that it is inhibited by women having limited control over the income they earn (Field et al., 2021). There is further evidence that in many regions of the world women feel unsafe walking or commuting to work in public spaces (Borker, 2020). Recent evidence shows that workplace sexual harassment inhibits women's work (Folke and Rickne, 2020).

4 Impacts of Fertility on Women's Labour Market Outcomes

Women's labour force participation – and other labour market outcomes – depend upon supply side factors including education, fertility, and marital status and on demand side factors including changes in the sectoral and occupational composition of employment (which proxy underlying changes in technology and trade). Structural change, or shifts in workforce composition from agriculture to goods and service industries have been associated with increases in the demand for women's labour (Olivetti and Petrongolo, 2014; Ngai and Petrongolo, 2017). Changes in occupational structure – which reflect non-neutral technological change and changing skill requirements in the economy – have also tended to favoured women in many settings (Acemoglu and Autor, 2011; Blau and Kahn, 1997; Black and Spitz-Oener, 2010; Juhn et al., 2014; Deming, 2017). In this paper we focus in on the role of fertility.

In this section we first summarise the key methodological approaches underlying the empirical results provided by the literature, and then summarise a range of available estimates.

4.1 Estimation

Empirical models directed at estimating the impact of fertility on labour market outcomes (or the career costs of fertility), typically take the form:

$$\text{labour supply}_i = f(\text{fertility}_i, \boldsymbol{X_i}, \varepsilon_i) \tag{1}$$

specifying that the labour market outcome of woman i is a function of her total number of children—here $fertility_i$—as well as potentially other observed factors, indicated here by the vector $\boldsymbol{X_i}$ and unobserved factors ε_i. A linear functional form is frequently imposed, which implies that additional children have a constant impact on the outcome, irrespective of parity:

$$\text{labour supply}_i = \beta_0 + \beta_1 \text{fertility}_i + \boldsymbol{X_i'}\boldsymbol{\Gamma} + \varepsilon_i. \tag{2}$$

However, most commonly identification strategies rely on changes at particular margins and heterogeneity analysis can be conducted to examine changes in the number of children at different margins. The causal parameter of interest β_1 measures the labour market impacts of a marginal birth. Causal estimation is complicated by the fact that family size is a choice variable that depends upon both unobservable and observable factors such as preferences and career-related expectations, moderated by constraints including access to contraceptives or beliefs over their use (Rosenzweig and Schultz, 1985).

Instrumental Variables Commonly used instruments for fertility include twin births (Cáceres-Delpiano, 2012; Rosenzweig and Wolpin, 1980; Jacobsen et al., 1999; Bronars and Grogger, 1994) and the sex mix of the first two births (Chun and Oh, 2002; Cruces and Galiani, 2007; Angrist and Evans, 1998; Ebenstein, 2009; Bisbee et al., 2017). Recent studies have also used success rates of artificial reproductive technologies (Lundborg et al., 2017), policy reform mandating single rather than double embryo transfers for in vitro fertilization (IVF) (Bhalotra et al., 2019), or infertility shocks (Agüero and Marks, 2011; Hotz et al., 1997; Bratti and Cavalli, 2014). With the exception of the single embryo transfer mandate, all of these instruments essentially appeal to exogeneity of biological drivers of fertility.

The twin instrument was introduced in the pioneering work of Rosenzweig and Wolpin (1980). Women expecting a birth typically expect a single child, so the occurrence of a twin birth creates the shock of an additional child. The premise is that twin births are conditionally randomly assigned across women. The sex mix instrument was proposed in Angrist and Evans (1998). The instrument takes the value of one if the first two births of a woman are same-sex, and is zero otherwise. Leveraging the stylized fact that many women desire at least one child of each sex, the authors show that women are more likely to move on to have a third (or higher order) child if their existing children are of the same sex. The premise is that child sex is randomly assigned. Other papers have used miscarriage and/or stillbirth (Hotz et al., 1997; Bratti and Cavalli, 2014) or self-reported infertility as instruments for fertility (Agüero and Marks, 2011), on the premise that these shocks are randomly assigned or can be used to form bounds.

The identifying assumption is that the instrument shifts fertility (relevance), while being unrelated to unob-

servables which are correlated with fertility and labour market outcomes (validity). The aforementioned instruments have been shown to increase fertility in a number of settings, so that we can be confident of their relevance or the strength of the 'first stage' in the IV procedure. However, the validity of these instruments has come under considerable scrutiny. The sex mix of the first two children and the occurence of twin birth are both natural experiments that flow from biological mechanisms but they have nevertheless been shown to fail the validity condition. Even if the sex of the first birth is quasi-random, as suggested for the United States in Dahl and Moretti (2008); Almond and Edlund (2008) and for India in Bhalotra and Cochrane (2010); Anukriti et al. (2021), the sex composition of the first two children is potentially correlated with unobservable preferences. Dahl and Moretti (2008), for instance, argue that it is a function of fertility and divorce decisions.

The occurrence of a twin birth has been comprehensively demonstrated to be correlated with a plethora of indicators of maternal health including height, diet, hypertension or local availability of public health care in large representative data samples from 72 countries, including rich and poor (Bhalotra and Clarke, 2019). The authors argue that maternal health cannot be comprehensively measured and they demonstrate that failing to account for unobservables correlated with maternal health and the outcome of interest will result in the IV estimator under-estimating the influence of fertility on women's labour market outcomes. They nevertheless demonstrate (Bhalotra and Clarke, 2020) the usefulness of partial identification. Essentially, the power of the twin instrument in predicting fertility can be leveraged to estimate bounds on the IV parameter that allow that the instrument is plausibly exogenous if not strictly exogenous.

In a similar vein, recognizing that the miscarriage instrument is random for some women but potentially correlated with relevant behaviours among other women, Hotz et al. (1997) adapt results from Horowitz and Manski (1995) on identification with data from contaminated samples to construct informative bounds on the causal effect of teenage childbearing. Overall, best-practice for papers looking to address the endogeneity of fertility using instrumental variables must involve conducting sensitivity tests and providing partially identified bounds allowing for deviations from IV validity.

Setting aside potential issues with validity of the instrument, consider now the interpretation of IV estimates. IV techniques result in estimation of a Local Average Treatment Effect (LATE) which captures mean impacts among individuals whose fertility behaviour is shifted by the instrument. This implies that the estimate is specific to compliers, namely, individuals who if the instrument were switched off would not have had another birth, but who cross the margin into having a birth when the instrument is switched on. In the case of a categorical variable such as fertility, it further implies that the LATE is driven by changes in fertility at the particular margins which the instrument shifts. This is described by the Average Causal Response (ACR) function of Angrist and Imbens (1995), which describes the range of variation in fertility traced out by the particular instrument. Thus, when

IV estimates are presented, to understand the variation in fertility that the estimates refer to, it is illustrative to present the ACR function, see Angrist et al. (2010); Bhalotra and Clarke (2020) for examples applied to estimates of fertility shifts.

An important distinction arises between extensive versus intensive margin changes in fertility. It seems entirely plausible that moving from having no child to having one has a different impact on labour market outcomes than having an additional birth after having at least one child. Studies using the sex mix instrument necessarily estimate intensive margin impacts, and on a potentially selected sample of women who have had at least two births and are on the cusp for whether or not to have a third or higher order birth. Studies using the twin birth instrument estimate intensive margin impacts, the shock of a twin changing the number of children from 1 to 2. In addition, twin IV estimates capture impacts not only of having an additional birth but also of having two simultaneous births (no birth spacing) (Rosenzweig and Zhang, 2009). Studies that use infertility shocks as an instrument Agüero and Marks (2011); Cristia (2008) estimate impacts of extensive margin changes. These differences are germane when comparing estimates across setting and interpreting them in any setting. Lundborg et al. (2017) rest identification on the randomness of success conditional on IVF, comparing women who do and do not succeed in having a first birth. They thus capture extensive margin effects which they show are larger than the intensive margin effects estimated in other studies. In Bhalotra et al. (2019) the treatment is an IVF policy reform which results in a switch from twin births to singleton birth – a decrement in fertility by one. This is an intensive margin change but, similar to the case of the twin instrument, and acting in the reverse direction, it captures a change in the number of births that is simultaneous with a change in birth spacing.

Natural Experiments and Structural Models An alternative identification strategy is to exploit policy or natural experiments that impact fertility. Policy experiments include reproductive health policies and legal reforms that result in variation in contraception, abortion and IVF provision. The natural experiment that has been leveraged in this literature is the event of birth of a child. We also briefly point to research that estimates structural models of women's labour force participation that endogenise fertility.

Led by Bailey (2006), a stream of research has used variation in consent laws across the states of the US to evaluate impacts of legal access to the pill before age 21, see also Bailey et al. (2012), Lindo et al. (2020). Among authors leveraging abortion reform are Angrist and Evans (1996) who use state variation within the US and Bloom et al. (2009) who leverages variation in country-year data for 97 countries observed through 1960-2000. Lundborg et al. (2017) and Bhalotra et al. (2019) gain identification of the impact of fertility on women's earnings using administrative data on ART births. Lundborg et al. (2017) rely upon the assumption – defended on the administrative Danish data they use – that IVF success is independent of a woman's labor market history.

This allows them to effectively instrument fertility with IVF success using the universe of women who attempt IVF. Since IVF births are often but not always multiple, their estimator captures the difference between having no child and having a successful pregnancy resulting in one or more children at once. Bhalotra et al. (2019) also rest identification on a feature of IVF births, but they exploit a policy reform implemented in Sweden in 2003 that mandated single embryo transfers for women undertaking IVF. The reform resulted in IVF births being significantly and substantively less likely to be multiple births. What they capture therefore is changes in outcomes flowing from an exogenously driven shift in fertility from two births to one birth, other things equal. Godefroy (2018) consider impacts of a reform in Nigeria in 1999 that diminished women's rights, lowering the value of women's testimony in court. Casting the event of birth of a child as a natural experiment in longitudinal data that contain within-mother variation, Kleven et al. (2019b) estimate event study models of labour market outcomes surrounding the time of child birth in Denmark. In the results section we discuss evidence from a number of other countries that replicates this pattern.

These designs are similar to instrumental variables strategy, where the reform can be considered as an instrument for fertility, and indeed, this argument is at times presented explicitly. Other studies instead present reduced form estimates of labour market outcomes on the reform, backed by an explicit first stage demonstrating the impact of the reform on fertility. The IV estimate is the ratio of the reduced form and the first stage coefficients.

Identification of causal effects in these settings generally relies upon the assumption that the time of adoption of the reforms is as good as random. Some studies exploit a single nationwide reform, others exploit staggered adoption of the reform across sub-national regions, be these states (Bailey, 2006; Angrist and Evans, 1996; Godefroy, 2018) or countries (Bloom et al., 2009). Difference-in-difference designs or event studies are estimated, with an examination of pre-trends allowing for partial tests of the validity of the identifying assumption. Threats to validity include that adoption may owe to broader social norms that motivate adoption and that also directly affect women's labour market behaviour.

A recent literature demonstrates that dynamic treatment effects estimated using the standard two-way fixed effects model may be biased in settings where the timing of the reform is staggered and treatment effects are heterogeneous. Under these conditions, some treated units might enter the double differences estimating the treatment effect with weights of opposite signs in different time periods. The estimated treatment effect can then diverge from the average treatment effect, and it is not clear that it is representative of any relevant population of interest (de Chaisemartin and D'Haultfœuille, 2020). This problem is most severe when all or a large share of individuals in the sample are treated at some point. This problem can therefore be mitigated by including a large share of never-treated units. The share of units with negative weights can be estimated following the procedure set out in de Chaisemartin and D'Haultfœuille (2020), and reported as a diagnostic. Goodman-Bacon

(2021) provide an approach to decomposition of the averaged two-way FE estimates into components defined by different treatment-control pairs. In addition to diagnostics, the literature provides new estimators that are robust to these concerns. In addition to de Chaisemartin and D'Haultfœuille (2020), see Borusyak et al. (2021); Sun and Abraham (2020); Callaway and Sant'Anna (2020). Going forward, the literature on fertility and women's labour force participation will, similar to the broader literature, need to adopt these recent innovations in testing for and addressing bias.

Structural models that endogenize the fertility decision in models of women's labour market outcomes include Adda et al. (2017) with data form Germany, Michaud and Tatsiramos (2011) with data from seven European countries, and Francesconi (2002) with data from the United States. A range of strategies are taken in these papers to identify the impacts of fertility on labour market outcomes. Fertility and labour market choices are considered as joint decisions, where optimal decisions are determined by comparing between all possible alternatives related to fertility, career choices, savings and so forth which are permitted by the model. Career costs of fertility can be calculated based on estimated structural parameters, for example observing life-time utility losses associated with exiting the labour market upon child reading (Francesconi, 2002) or by considering counterfactual simulations, for example calculating the cost of child bearing as the difference between optimal choices, and simulated choices where fertility is fixed at zero (Adda et al., 2017). Michaud and Tatsiramos (2011) document the variation of findings from discrete dynamic choice models depending on the assumptions relating to fertility choices, including cases where variation is leveraged from a sex mix instrument, providing an overview of the importance of the nature of identifying and modelling assumptions in these settings, as well as linking structural estimation to assumptions made in the reduced form literature discussed previously.

4.2 Evidence

Turning to empirical estimates of the relationship between fertility and mother's labour supply, an impressively broad picture is provided by Aaronson et al. (2020). Using census and survey data covering 103 countries as early as the 1780s and as late as 2015, they provide estimates of the link between fertility and labour supply across the developed and developing world. Their results are drawn using both the twin and sex mix IV techniques described earlier. They find that women's labour supply and fertility are more tightly linked in more developed countries. In particular, Their evidence suggests small or even null trade-offs at low levels of economic development, alongside large trade-offs at higher levels of development.

Consider the magnitudes and the variation in their estimates, using a twin instrument and focusing on current labour market participation of women with at least two children. Aaronson et al. (2020) estimate that a third birth results in essentially no change in women's labour market participation rates averaged across countries with a

real GDP per capita of $0-$2500, $2500-$5000 and $5000-$7500 (all expressed in constant 1990 dollars), while a trade-off gradually emerges in countries with real GDP p.c. of above $7500. This trade-off is estimated at around a 3 percentage point (pp) fall in participation in countries with between $7500 to $10000 real GDP p.c., monotonically increasing to around a 10 pp reduction in countries with GDP p.c. above $20,000. These patterns are observed to be quite stable over time and similar if using a same-sex rather than twin IV strategy.

Looking at effect sizes in a different way, Bhalotra and Fernández (2021) estimate that fertility explains 11% of growth in women's labour force participation in Mexico during 1960-2015. Theirs is a descriptive approach implementing a decomposition analysis using census data. Mexico witnessed a sharp acceleration in FLFP from the 1990s onwards. The authors observe that as much as 40% of FLFP growth in the 1990s, through the spike, is unexplained- neither supply side variables (education, fertility, marriage) nor changes in the demand for women (associated with structural changes in sector and occupation) exhibit sharp changes in this period. They suggest that a potential explanation is changes in social norms around women's work. This is difficult to measure, but the literature has pointed to it (Fernández et al. (2004); Goldin (2006); Fogli and Veldkamp (2011); Fernández (2013)). Now while this literature highlights social norms in LFP, it seems plausible that there are, similarly, social norms driving fertility. We highlight this as it becomes relevant when looking at broad sweep changes, either across countries, or across long periods of time within country.

Returning to the estimates in Aaronson et al. (2020), which refer to intensive margin changes, it is notable that larger impacts are observed when moving from 1 to 2 births, with trade-offs becoming smaller, though still significant and with similar patterns in terms of economic development, when considering marginal changes in fertility up to 5 children. This is consistent with there being variable costs that scale, possibly non-linearly, with the number of children, in addition to a fixed cost of having any children. Many studies focus their attention on labour market impacts of having children under five or of a (or an additional) birth. Using their global sample, Aaronson et al. (2020) demonstrate labour market penalties for women in families with older children. This is consistent with studies (discussed below) that trace dynamics in outcomes over a long period after birth, showing that while the initial divergence between male and female labour market outcomes begins with the event of the first birth, it does persist. This would imply that if one compared women with and without a 12 year old child (for example), all else equal, one would expect to observe a child penalty in the labour market outcomes of the mother of the 12 year old.

Results from Angrist and Evans (1998); Vere (2011) suggest reductions of around 8 to 10 p.p. in rates of women's labour market participation using US Census data from 1980, 1990 and 2000 and IV estimates. However, more varied and in cases muted estimates have been documented in developing countries; Cáceres-Delpiano (2012) estimate a 3-4 p.p. reduction based on a twin birth instrument with data from 40 developing countries,

Heath (2017) finds very small mean effects in Ghana, de Jong et al. (2017) find a reduction in 6 p.p. among non-farm work in Africa, and Cruces and Galiani (2007) find a reduction of between 6-10% in middle income Argentina and Mexico. Work from Nigeria (Godefroy, 2018) using an alternative identification strategy finds small impacts of reform induced fertility change on later labour market outcomes.

While Aaronson et al. (2020) use IV methods which allow them to consider fertility shifts at higher birth orders, a gradient in the elasticity with the level of economic development is also evident when using methods which allow for examination of entry into childbearing. Lundborg et al. (2017) and Cristia (2008), using Danish and US data respectively, estimate large negative career effects of having an extensive margin birth, while Agüero and Marks (2008) find very limited impacts in 6 Latin American countries with data from the 1990s and Agüero and Marks (2011) similarly documents limited impacts when the data are extended to consider 26 developing countries.

In a mould-breaking analysis, Bailey (2006) finds that legal access to the pill for women under 21 significantly reduced the likelihood of a first birth before age 22, and increased women's labor force participation and work hours. Subsequent analysis in Bailey et al. (2012) shows that it can account for a considerable fraction of the convergence of the gender gap in the 1980s and 1990s.[5], although the earnings result does not hold up in the re-examination provided by Lindo et al. (2020). Analysing one of the oldest and largest family planning programmes, Profamilia in Colombia, Miller (2010) finds that it explains only a small fraction (less than 10%) of Colombia's fertility decline during its demographic transition. However, similar to the results for the US, enabling delay of first birth facilitated human capital accumulation and an increase in labour force participation among women.

Bhalotra et al. (2021c) leverage sharp declines in child mortality following the invention and release of antibiotics in 1937 as an exogenous shock to the costs of childbearing and investment in children. Their analysis suggests a shift in preferences in favour of fertility delay, rather than a change in legal access to technology (contraception) that enables fertility delay. They argue that fertility delay was a key factor facilitating increases in women's participation, particularly in skilled occupations in the late 1930s and early 1940s. They also show that fertility delay contributed to increases in childlessness, some of which are likely to have been an unintentional consequence of pursuing a career.

Angrist and Evans (1996) demonstrate impacts of state abortion reforms implemented in 1970 in the US on marriage, fertility and employment using 1980 and 1990 Census microdata. Among white women, the stronger response is a decline in teenage marriage and there is no significant impact on education or labour market outcomes. However black women exhibit stronger declines in teen fertility and out-of-wedlock childbearing and they also exhibit increased schooling and employment rates. The study illustrates not only a strategy by which

[5] 10 percent of the convergence of the gender gap in the 1980s and 30 percent in the 1990s

the relationship between fertility and employment can be revealed, it also shows on a given sample with a given identification strategy, how different demographic groups may respond on different margins. Bloom et al. (2009) similarly leverage abortion reform, using it to instrument fertility in country-year data for 97 countries observed through 1960-2000. They find reductions in fertility that drive increases in women's labor force participation. The direct effect is concentrated among women aged 20-39, the prime childbearing years, and persists over time for that cohort. These authors extend the analysis further to simulate impacts of both reduced fertility and increased labour supply on income per capita, taking into account changes in both the size and the age composition of the population. Analysing impacts of a reform in Nigeria in 1999 that diminished women's rights (lowering the value of women's testimony in court), Godefroy (2018) finds an increase in fertility that reflects both greater compliance with male fertility preferences and an increase in marriage rates. He also finds an increase in women's labour supply, rather than a trade-off, which is consistent with women working under duress.

The increasing availability of assisted reproductive technologies (ART) like in-vitro fertilization (IVF) since 1978 has allowed women to delay fertility. Gershoni and Low (2021) study the impacts of the introduction of free in-vitro fertilisation on women's outcomes in Israel, showing that this led to increased investment in education and improved labor market outcomes. Although they do not report impacts on fertility, their results ratify that technological innovations that extend the effect reproductive period can act to mute the trade off between career and family.

Instrumenting fertility with IVF treatment success and using Danish administrative data, Lundborg et al. (2017) find negative and persistent fertility effects on earnings which are stronger at the extensive margin. These effects are most notable when considering annual earnings in the year of birth and following year, however a small negative impact is still visible 10 years post-birth. Their results for annual earnings are driven by impacts on hourly earnings rather than on labour supply. This is in line with numerous studies demonstrating that women incur a wage penalty by sorting into flexible jobs or jobs that involve a shorter commute in order to be able to combine family and career, see for instance, Goldin (2014); Le Barbanchon et al. (2021); Bhalotra et al. (2021a).

Studying impacts of a Swedish policy implemented in 2003 mandating single embryo transfers for women undertaking IVF, Bhalotra et al. (2019) demonstrate a sharp reduction in the probability of twin birth following the reform, with attendant improvements in maternal and child health. They find that women having IVF births following the reform experience a significant increase in earnings in the nine years following birth (the available data window), which in large part appears to be the result of having a singleton rather than a twin birth. This is appreciable both for women having their first birth as well as at higher parities. Thus the authors show that a decrease in fertility by one child, at the extensive and intensive margins, results in women having higher earnings after birth. Similar to Lundborg et al. (2017) they find that this is driven by women with positive earnings or,

implicitly, by earnings per hour and not labour supply. Given the increasing uptake of IVF, it is useful to provide some background to the Swedish mandate. Pre-reform in Sweden, as in most of the world, the modal procedure was to implant two (and in some settings, more than two) embryos in one treatment so as to increase the chances of fertilization. This approach, on a global scale, has led to IVF births being more than 10 times as likely to be twin births as non-IVF births. This is relevant as the children born in a multiple birth are typically less healthy, and their mothers suffer more pregnancy and birth related complications. And it seems plausible that compromised child and maternal health impede a mother's return to work. The Swedish reform was prompted by medical research (discussed in that Bhalotra et al. (2019)) showing that advances in IVF technology meant that the chances of a successful pregnancy were no longer significantly greater with double than with single embryo transfer.

Using event study approaches describing labour market outcomes before and after the birth of a child in Denmark, Kleven et al. (2019b) document that women's labour force participation, hours and wages all decline sharply after the first birth, and that these effects persist for 10 and even 20 years after birth. The authors also document impacts on women sorting into more flexible jobs after birth. There are virtually no gender gaps in these outcomes in the years before the first birth. And, following the birth of their first child, men do not suffer a decline in labour market outcomes. In the case of Denmark, where other sources of gender differences in labour market outcomes have diminished over time, Kleven et al. (2019b) show that the child penalty explains a large and increasing share of the gender gap in wages, hours and participation. The broad pattern of results has been replicated in six highly industrialized countries (Kleven et al., 2019a), in the UK (Costa Dias et al., 2021), four Latin American countries Berniell et al. (2021b), Uruguay (Querejeta Rabosto and Bucheli, 2021), Mexico (Aguilar-Gomez et al., 2019), and a broader range of European countries plus Israel (Berniell et al., 2020, 2021a). These studies ratify the broad generality of the child penalty pattern, confirming persistent impacts on employment and earnings, and a tendency for women to move into informal employment or self-employment, often into less secure but more flexible jobs. This evidence underlines the dynamic nature of childbearing and child-rearing. Demands on parental time and investments in children vary over the child's life course. When parents have several children, they are often relatively closely spaced, resulting in dynamic labour market effects of fertility.

Having underlined the wide scope of the evidence of persistent child penalties in women's labour market outcomes, it is useful to acknowledge that it does of course vary with context. Jacobsen et al. (1999) estimate persistent effects of marginal births on women's labour market participation and earnings using 1990 US census data, but more transitory effects when using the 1980 US census. Descriptive evidence from Piras and Ripani (2005) suggests quite variable wage profiles for mothers and non mothers in four Latin American countries suggesting that the largest impacts are among mothers of children under the age of seven. Herr (2016) finds that the

wage trajectory following birth depends upon when women have their first birth *and* whether they have already entered the labour market at that time. Recent evidence using within-family variation generated by sister fixed effects suggests that early childbearing (teen birth) brings about appreciable family income declines even 15 years post-birth (Aizer et al., 2020).

Structural estimates from Adda et al. (2017) based on German data illuminate reasons for persistent effects of childbirth on women's outcomes. Their estimates suggest that as much as one quarter of the 'career costs of children' owe to wage losses due to lower skill accumulation and depreciation of experience while out of the labour market. This suggests the importance of facilitating a return to work for women who wish to minimize disruption of their careers. Potentially useful interventions include training (which Blundell et al. (2021) show is helpful for women who left education after high school) and subsidised high quality childcare, which is useful when childcare costs rather than preferences for maternal time with children inhibit women working (Cattan, 2016).

5 The Impact of Women's Work on Fertility

A rich literature has explored the relationship between work and fertility, aiming to estimate the impact of jobs and job opportunities (or local labor market conditions) on women's childbearing, and fertility rates. Much of this literature has focused on estimating causal impacts, looking for exogenous variation in job gain or job loss, and exploring subsequent impacts on individual child-bearing and other fertility outcomes such as fertility timing.

5.1 Employment

The impact of employment on fertility for women sheds light on how women trade off career against family. From a theoretical perspective a trade off would be expected if the substitution effect dominates the income effect: better labor market opportunities increase the opportunity cost of childbearing, dampening fertility (the substitution effect), but also entail higher income which could increase fertility if children are a normal good (the income effect). The evidence is ambiguous: some studies find a clear trade-off between having a job and family, while others indicate that job loss is associated with less childbearing.

Jensen (2012) investigates this question in rural India. The author implements a randomized control trial involving young, unmarried women in which the intervention group is offered three years of support in finding jobs in the new business process outsourcing industry, while the control group is provided with no similar support. They find that, compared to the control group, the treated group of women are more likely to enter the labor market

or obtain more schooling, less likely to get married, less likely to have children, and report lower desired fertility as well as stronger career aspirations. This provides clear evidence of a tradeoff between career and family for young women who would normally not have strong labor market opportunities.

A set of papers in alternative settings make use of job loss rather than job gain. Among a sample of Finnish women, Huttunen and Kellokumpu (2016) show that female job loss due to plant closure results in lower child-bearing, with three fewer children born for every 100 women displaced. In an Austrian context, Bono et al. (2012) and Bono et al. (2015) confirm this finding, with the former showing that plant closures lead to lower fertility particularly among women in more skilled occupations, and the latter that being displaced from a career-oriented job reduces fertility for six years after the unemployment event. Bratsberg et al. (2021) shows a similar result focusing on bankruptcies in Norway, and births in the fifteen years following the job loss event.

Thus evidence suggests that job finding leads to fertility delay and reduces fertility and marriage rates, consistent with work capturing the opportunity cost of childbearing. On the other hand, job loss appears to reduce fertility. The income effects of job loss may be larger than income impacts of job finding if job loss creates liquidity constraints, or if individuals are loss-averse.[6] Alternatively, job loss may have negative psychological impacts different to job gain, which can also affect partnering and fertility. Also, women subject to job loss have already selected into the labour force, while women who are offered support for job finding have not, making it plausible that women subject to job loss have stronger preferences over work. Finally, the difference in the results may instead reflect the very different samples analysed, and differences in extensive and intensive margin fertility responses.

5.2 Local Labor Market Conditions

An alternative approach to understanding the impact of work on women's fertility is to look at the impact of labor market opportunities rather than at impacts of individual job status on local area or individual birth outcomes. Schaller (2016) uses a shift-share measure of local labor demand that exploits baseline variation in the gender composition of the workforce across industries interacted with aggregate shocks to estimate the impact of growth in job opportunities on birth rates. She finds that improvements in women's labor market opportunities lead to small reductions in local birth rates, while improvements in men's labor market opportunities have strong positive effects on birth rates. In a similar vein, Aksoy (2016) explores the impact of local gender-specific unemployment rates on fertility in England, and finds that increases in women's unemployment are associated with more births, while increases in men's unemployment are associated with fewer births.

[6] Further discussion of income effects of job loss on fertility is in Section 5.3 below.

A handful of other studies examine impacts of local are unemployment rates on fertility, but without distinguishing unemployment by gender. Currie and Schwandt (2014) show that an increase in unemployment rates for women aged 20-24 in the US leads to a reduction in women's fertility that is not compensated for by the time fertility is complete. Using county level data for North Carolina in 1990-2010, Ananat et al. (2013) find that economic downturns are associated with lower fertility among teenage black women, but not among teenage white women. They provide some evidence that black teens are less likely to conceive and more likely to terminate during a downturn. Similar findings emerging from state-level data are in Dehejia and Lleras-Muney (2004), who analyse of impacts on newborn health of economic downturns in the US. They show that selection into birth operates in opposite directions for black and white women. In downturns, poorer black women avert fertility, consistent with Ananat et al. (2013), so that black children born in downturns are born to mothers of relatively high socioeconomic status (indicated by education and marital status). These results are consistent with income shortfalls discouraging fertility among less well-resourced women. On the other hand, white women averting birth in downturns are negatively selected on education. This is consistent with the timing of birth among white women being determined by the opportunity cost of women's time more than by income effects, and with less educated women experiencing more cyclical employment than more educated women. Using regional variation in economic opportunities across the cycle in India, Bhalotra and Rocha (2018) find that fertility is lower in recessions than in upturns. Women with low levels of education are most responsive and the relationship is attenuated in states that are at a more advanced stage of the demographic transition, consistent with theory. The response is driven by the intensive margin of fertility, and is not explained by birth spacing. Overall, these papers document a trade off between women's work, and fertility, with both labor market opportunities, both generic and specific to women, tending to dampen local birth rates.

Using data from Sweden in the 1880s, Schultz (1985) leverages a natural experiment which results in an increase in the price of butter relative to grains. This generated an increase in the relative wage of women, given that women specialized in dairy produce and men in agriculture. Consistent with the increase in the opportunity cost of childbearing, there was a reduction in overall fertility, which Schultz (1985) argues contributed to the demographic transition in Sweden, explaining up to a quarter of the fertility decline during this period. In another paper studying fertility rates in the long-run with a macroeconomic take on the question, Chatterjee and Vogl (2018) combine survey data on women across various countries to show that long run growth was associated with fertility delay and lower fertility overall, again contributing to the evidence of a tradeoff between work opportunities, and fertility. Taking a structural modelling approach, Caucutt et al. (2002) show that the labor market has provided incentives for fertility delay among young women in the United States.

While most studies analyse changes in the number of births, the timing of births is an important margin of

choice. It is conceivable that labour market incentives change the timing of fertility delay without changing the number of children born to a woman. It is equally possible that they lead to a change in the number of children without any change in timing – age at first birth, or birth spacing. Often, there are changes on both margins, such as illustrated in Jensen (2012), Caucutt et al. (2002) and Bratsberg et al. (2021).

5.3 Men's Earnings and Income Effects

We now discuss research that investigates impacts of changes in men's local labor market opportunities on fertility. Kearney and Wilson (2018) find that the boost in men's earnings and job finding rates as a result of the fracking boom of the 2000s in the US led to higher local birth rates, with no effect on marriage. Autor et al. (2019) analyse impacts of the change in relative labor market opportunities of men and women as a result of the increase in Chinese import competition in the United States. They find that declines in men's relative labor market opportunities reduced both marriage and fertility, with more births taking place out-of-wedlock and to single mothers. The positive relationship between fertility and men's income is confirmed in another setting by Black et al. (2013), who use the exogenous increase in men's earnings due to the 1970s Appalachian coal mine boom and show that local fertility increased as a result. Focusing on men's individual job loss rather than opportunities in the local area, Lindo (2010) shows that overall fertility declines when men lose their jobs.

Taking a more theoretical approach, Baudin et al. (2015) and Baudin et al. (2019) put forward the argument that the relationship between income and fertility depends on the level of income: at low levels of income, poverty reduces fertility and drives childlessness, while at high levels of income, the opportunity cost of childbearing also reduces fertility and increases childlessness. They apply this model to the United States and a set of developing countries and show strong evidence for a U-shape relationship between income and childlessness.

6 Conclusions

On balance, the evidence is consistent with standard economic theory. Shocks or policies that decrease fertility tend to lead to persistent increases in women's labour force participation – and to improvements in women's labour market outcomes more generally. However, there are important variations depending for instance on whether the fertility shock involves transition into first or higher-order birth, and on the demand for female labour – which will vary across regions and cohorts in line with differences in women's skills, the role of technology and trade, and the extent of gender discrimination in hiring and pay.

In the other direction, women's employment tends to dampen fertility although the relative size of the sub-

stitution and income effects varies across regions. There are relevant differences between impacts of job finding and job loss and, also, material differences between impacts of actual changes in individual employment status and changes in labour market opportunities.

The tension of interest is around combining career and family. Advances in reproductive technology have made a significant contribution in this regard – innovations in and coverage of contraception, abortion and reproductive health technologies. The key idea is that allowing women to time their fertility can contribute to women building careers. Policy has, on the other hand, a lot of catching up to do. In this paper we paid only cursory attention to policies that might support families in managing the balancing act of maintaining both women's careers and family. We conclude with a brief observation that policy innovation is in order given that the evidence that maternity leave (Dahl et al., 2013) and universal and subsidized childcare (Havnes and Mogstad (2011); Cornellisen et al. (2018)) is rather mixed. There is somewhat more positive evidence that training programmes (Blundell et al., 2021) help.

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