Economic Uncertainty and Fertility Cycles: The Case of the Post-WWII Baby Boom *

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Abstract

Using the US Census waves 1940-1990 and CPS 1990-2010, we look at how economic uncertainty affected fertility cycles over the course of the XXth century. We use cross-state and cross-cohort variation in the volatility of income growth to identify the causal link running from uncertainty to completed fertility. We find that economic uncertainty has a large and robust negative effect on fertility. This finding contributes to the unraveling of the determinants of the post WWII baby boom. Specifically, the difference in economic uncertainty endured by women born in 1910 compared to that faced by women born in 1935 accounts for between 45% and 61% of the one child variation across these cohorts. We hypothesize that a greater economic uncertainty increases the risk of large consumption swings, which individuals mitigate by marrying later, postponing fertility, and ultimately decreasing their completed fertility.

JEL Classification Codes: J11, J13, E32, N30

Keywords: baby boom, baby bust, fertility, economic uncertainty

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1 Introduction

"In sum, economic growth as such played an inconsistent and at most a marginal role in the story of the baby boom." Van Bavel and Reher (2013)

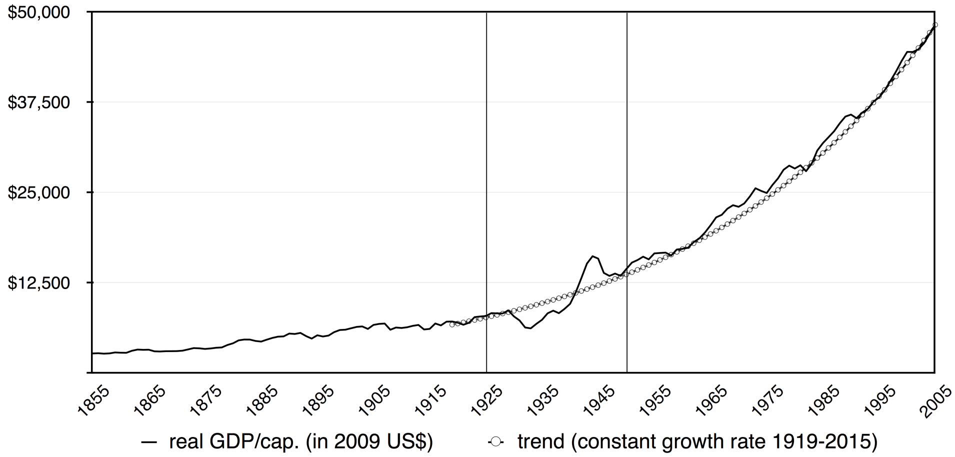
The past two centuries have witnessed drastic demographic changes in developed economies. Taking the US as an example, completed fertility declined from over five children for a woman born in the early 1800 to around the replacement rate, that is two children per woman, for cohorts born in the 1950s, in a phenomenon known as the demographic transition (Chesnais 1992). Figures 1a and 1b illustrate that this decline in fertility went hand-in-hand with a rise in living standards, although the causal link between the two series remains widely debated.

The demographic transition unfolded overall rather smoothly, except for a marked spike of about one child per woman, which occurred for the cohorts of women born between 1925 and 1940. These cohorts were of fertile age roughly from the early 1940s until the early 1970s, thus earning the phenomenon the name of post-WWII baby-boom. The consequences of the baby boom have drawn a lot of attention from demographers and economists. In particular, scholars have extensively studied the effect of fertility cycles on the age structure: a tinier cohort brought about by a drop in the fertility rate is said to yield, first, a demographic dividend as the active population outgrows the number of dependents (Bloom, Canning, and Sevilla 2003), while it puts pressure on pension and healthcare systems (particularly Pay-As-You-Go) as the larger older cohort ages (Weil 2006; Bloom et al. 2015).

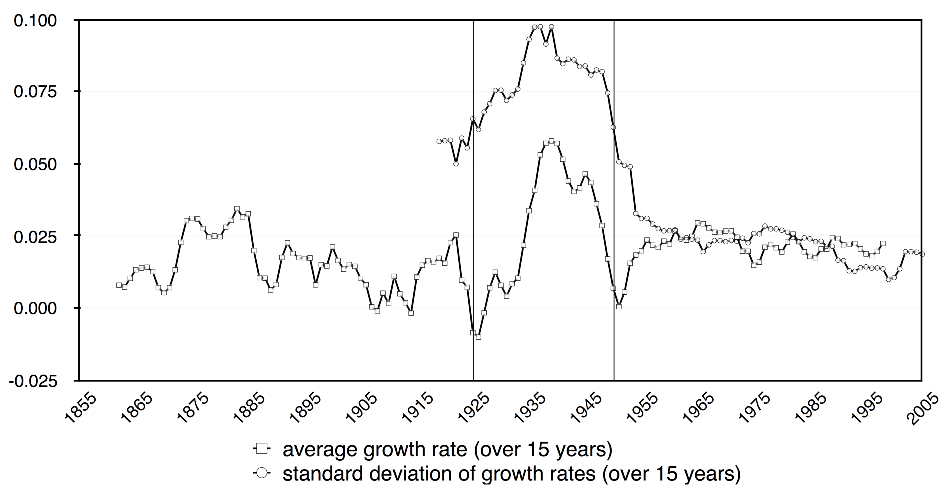
There is however absolutely no consensus about the determinants of the baby boom. We review the literature on the topic in Section 2.1. The main conclusion is that there does not exist a criticism-proof narrative for the post-WWII baby boom. Notwithstanding, uncovering the roots of such swings in fertility would allow to more accurately predict changes in the size of populations, their age structure and, incidentally, the robustness of pension and healthcare systems to these changes. Our contribution to this literature is to give evidence that, during the XX$^{\text{th}}$ century, the economic uncertainty faced by women during their fertile years had an important effect on their completed fertility. We argue that economic uncertainty explains a substantial part of the major swings in fertility rates over this century.

Figure 1 summarizes the main argument of this paper. Most of the literature has focused on the abnormally *high* levels of completed fertility of the cohorts born between 1925 and 1935. In contrast, we share the view of Jones and Schoonbroodt (2016) that cohorts born between 1900 and 1925 have first experienced abnormally *low* levels of fertility (Figure 1a). However, while they explain this bust by the procyclical nature of fertility, our contribution is to document the causal link running from the large levels of economic uncertainty during the interwar period to the low fertility rates. One implication of our finding is that what needs to be explained is less

(a) Completed fertility per cohort of birth in the US
Source: US Census 1900-1990 & CPS June supplement 1990-2010



(b) Real GDP/capita and trend in the US
Source: Samuel H. Williamson, 'What Was the U.S. GDP Then?' MeasuringWorth, 2016.



(c) Growth and volatility of GDP/capita in the US
Source: Samuel H. Williamson, 'What Was the U.S. GDP Then?' MeasuringWorth, 2016.

Figure 1: Completed fertility and economic variables over 150 years

the one child per woman increase during the baby boom but rather the equivalent decrease in the previous generation.

To give support to this hypothesis, we link the completed fertility of women to the levels of economic uncertainty during their fertile years, as measured by the standard deviation of income per capita growth rates in their state of residence (Figure 1c).[1] The 1900-1925 cohorts were of fertile age mostly between 1925 and 1950, a period marked by several episodes of soaring economic uncertainty such as the Great Depression and World War II. We show in this article that an episode of prolonged economic uncertainty, particularly in a context where instruments to insure against adverse shocks or smooth consumption across fertile and non-fertile periods were rare, can delay conceptions enough to ultimately decrease completed fertility substantially.

Figure 1b shows real GDP per capita since 1855 and its best log-linear fit over the period 1919-2015, which is the range of data we use in the analysis. It is striking that income per capita has increased very steadily over the past 150 years, not departing much from a balanced growth scenario. The only substantial blip away from the balanced path was produced by the Great Depression and the recovery from it. Figure 1c tells us that the mean of the growth rates faced by the cohort of women who experienced the baby bust during their fertile years were first low and then high. Instead, their standard deviation was consistently high during the whole period and decreased substantially thereafter. This supports the opening statement we borrowed to Van Bavel and Reher (2013) that "economic growth as such played an inconsistent and at most a marginal role in the story of the baby boom". Our paper shows evidence that economic uncertainty instead did play an important role.[2]

From a theory standpoint, one can think of several channels linking either positively or negatively economic growth and its volatility to fertility. For instance, in bad economic times, households may either postpone fertility plans, if they feel they will not be able to cope with the expenditures required by child rearing, or pre-pone them if they think instead it is the right moment to be out of the labor market for one of the partners. Both of these mechanisms could apply to economic growth as such, but to its volatility too, as being unsure about future economic prospects could yield either a fertility depressing or enhancing response depending on the relative risk aversion associated to consumption and fertility. Ultimately this is an open empirical question that we aim to tackle in this chapter. We review the theoretical contributions as well as the empirical analysis on the topic in Section 2.2.

[1] We only show estimates of the volatility of GDP per capita growth rates for the period 1919 onwards because GDP data relies heavily on decennial observations that are then interpolated before that date. This feature makes the comparison of pre- and post-1919 volatility inconsistent.

[2] Appendix B also provides historical uncertainty levels using the Economic Policy Uncertainty index, as developed by Baker, Bloom, and Davis (2016). In the same appendix, we also show data for the crude birth rates over time, taken from Mitchell (1998). We see that both fertility measures follow similar patterns, which reflects that fertility swings were not only driven by changes in the timing of births.

We exploit within state-cohort cell (across birth years) variation in standard deviation of the growth rates of income per capita in the US to identify the effect of economic uncertainty on completed fertility. We construct 5-year cohorts of women who have most likely completed their life-cycle fertility (age 40 to 59) using the US Census waves 1940-1990 and the June fertility supplement of the CPS 1990-2010. We associate each of these women to indicators of the economic conditions that prevailed in her state of residence during her fertile period. We take ages 21-35 as a benchmark for fertile years and investigate the sensitivity of our results to a change in this age range in Section 5.2.

To measure economic conditions, we use the information on income per capita by state, at a yearly frequency, from the Bureau of Economic Analysis (BEA) for the years 1938 to 1990, enriched by Fishback and Kachanovskaya (2010) for the period 1919 to 1938, using data from the National Industrial Conference Board published by Martin (1939).[3] To proxy for economic uncertainty, we assign to each woman the standard deviation of year-to-year income per capita growth rates in her state of residence over her fertile years. To make sure the effect goes through uncertainty, we control for both the trend level of income per capita, as well as for the average growth rate in the state of residence over the same period.

We include 5-year cohort times state fixed effects in order to control for potential confounders that are state and time specific, but slow moving (readjusted every five years), such as the urbanization rate, the healthcare infrastructure, legal systems, family policies or even cultural norms. This way, we use only local, both in a geographic and a temporal sense, variations for identification: we correlate fertility to economic uncertainty for women living in the same state and born within the same 5-year interval. To threaten this identification strategy, one needs to think of a correlate of economic uncertainty within a cohort-state cell that would also be correlated to fertility. Section 4 provides the main results of the analysis. We find that the drop in uncertainty during the reproductive lives of women born in 1910 and that born in 1935 explains about 60% of the one child variation across these cohorts.

We also provide evidence in Section 4.2 that an important channel through which people have lowered fertility is a lower probability to ever marry and a higher age at marriage. Following the comparison between the 1910 and 1935 cohorts, differences in uncertainty can explain up to 46% of the 2.5 year drop in the age at first marriage. The decline in uncertainty also increased the probability of every marrying by 1.6 percentage point.

Section 4.3 investigates the heterogeneity of the effet along several dimensions. Specifically, women of intermediate levels of education, African American women, and women residing in the most developed areas were the most sensitive groups to economic uncertainty. Noticeably, we fail to find any effect for women born after 1945.

[3] We are grateful to Price Fishback for sharing the data with us.

The effect we find slightly decreases in magnitude when we include controls for alternative mechanisms, such as infant and maternal mortality, or female labor force participation. However it always remains statistically significant and economically meaningful as it can still account for 46% of the observed variation in fertility (down from 60% prior to the inclusion of additional controls). Furthermore, we check in Section 5 that our results are not driven by (i) selective cross-state migration, (ii) the choice of the age range during which economic conditions affect fertility (21-35), (iii) our definition of cohort sizes (5 years of birth), (iv) our choice of measurement for economic conditions and (v) the large number of observations with respect to the number of explanatory variables.

We believe that the effect of economic uncertainty on fertility that we identify actually captures a lower bound of the true effect. Indeed, our strategy of using cohort times state fixed effect, though convincing in terms of identification, is likely to downward bias our coefficient of interest as a substantial part of the variations in economic uncertainty actually occurred nation-wide, which is netted out by the fixed effects.

2 Literature review

We first provide a literature review on fertility over time in the United States, distinguishing between studies that have looked at the trend in fertility from those who have analyzed the cyclical movements of fertility rates, including the baby boom. We then discuss the literature regarding the relationship between uncertainty and fertility.

2.1 Demographic transition and the Baby-Boom

To date, just a few papers deal at the same time with the demographic transition and the baby boom. Demographers generally divide the demographic transitions into two separate parts. The first, pre-WWII, demographic transition goes hand-in-hand with declining infant mortality rates, urbanization and secularization (Thompson 1929; Landry 1934; Notestein 1945; Davis 1945). The second, post-1970, demographic transition, arises with the diffusion of individualistic norms and the spread of birth control methods (Lesthaeghe 1983; van de Kaa 1987). Economists have also provided complementary explanations to this general decline in fertility. These are the decline in the gender wage gap (Galor and Weil 1996), technological progress (Greenwood and Seshadri 2002), a higher demand for human capital (Galor and Weil 2000), rural exodus, and the agricultural revolution (Baudin and Stelter 2018), or youth mortality and sector specific productivity (Bar and Leukhina 2010).

The roots of the baby-boom that happened in between the two transitions described by the demographes are still hotly debated among demographers (Van Bavel and Reher 2013), but also among the few economists who studied the question.

The first attempt to theorize the baby boom was made by Easterlin (1966) who suggested that fertility cycles were driven by the relative economic conditions young adults face with respect to those in vigor when they were children. If the economic opportunities that young adults dispose of surpass their material aspirations, then fertility tends to increase. This hypothesis gave rise to a large literature trying to test it, which was summarized by Macunovich (1998). Hill (2015a) recently offered a rigorous test using cross-state variation in the US and found that the Easterlin hypothesis can account for 12% of the post-WWII baby boom. We can actually see this theory as a formalization of the common view that the end of World War II opened an era of general optimism that was conducive to childbearing.

Another way to rationalize the post-WWII optimism and its effect on fertility is provided by Jones and Schoonbroodt (2016) who give some evidence of the pro-cyclicality of fertility. Their theoretical contribution is to provide a framework that explains the bust of fertility rates during the Great Depression and the boom for the next generation. They also provide a parameterization of their model in which the Great Depression generates a baby bust of 58% of that seen in the U.S. in the 1930s, followed by a Baby Boom of 77% of that seen in the U.S. in the 1950s.

Greenwood, Seshadri, and Vandenbroucke (2005) provide an explanation for both the secular decreasing pattern of fertility and the baby boom. According to them, the decreasing trend in fertility is caused by the rise in real wages (as may be observed in Figure 1a and 1b). It increased the opportunity cost of being out of the labor market and therefore of having children. The baby boom instead is the response to an atypical increase in technological progress in the household sector with the appearance of electric appliances, which lowered the cost of having children. This theory has however been rejected by Bailey (2011), who uses two arguments: (i) electrification and fertility at the county levels are negatively correlated; (ii) the Amish community also experienced a baby boom, despite their limited use of modern household technologies.[4]

Another possible explanation of the baby boom is the improvement in maternal health. Albanesi and Olivetti (2014) support this thesis using cross-state variation in the magnitude of the decline in pregnancy-related mortality. The rise in fertility rates comes as a direct consequence of the decline in the risk of dying during delivery. The subsequent decline in fertility rates, at the end of the baby boom, is due to the increased investment in human capital by younger women in response to the permanent fall in maternal mortality risk. Overall the decline in maternal mortality can account for more than 50% of the boom and subsequent bust.

[4]See also Greenwood, Seshadri, and Vandenbroucke (2015) for a reply to Bailey (2011)'s comments.

Doepke, Hazan, and Maoz (2015) suggest that WWII increased the demand for female labor and this had a persistent effect on female labor force participation after the war. These women who remained in the labor force after the war, made the competition for jobs tougher for younger women. This asymmetric effect on the female labor market between the older and the younger cohorts was responsible for the baby-boom, generated by these younger women who remained out of the labor market.

Using a similar argument, Bellou and Cardia (2014) show that the Great Depression induced the cohort of women born between 1896 and 1910 (the “D-cohort”) to enter the labor force. This pushed wages down and reduced labor opportunities for younger cohorts. These younger cohorts faced a low opportunity cost in terms of foregone labor income and stayed at home and had children (generating the baby-boom). Using commercial failures per state as a proxy for the impact of the great Depression, they show that the baby boom was larger where the Great Depression hit harder. Once the D-cohort retired and freed female labor positions, then younger cohorts entered the labor force and this increased the opportunity cost to childrearing and hence produced a bust in fertility rates. A caveat of both these explanations is that female labor force participation displays a pattern of steady increase over cohorts and can therefore hardly explain the large swings in fertility of the XXth century.

Other attempts to explain the baby boom were proposed by Murphy, Simon, and Tamura (2008) and Hazan (2015). The former insist on the drastic decrease in the cost of space brought about by the post WWII suburbanization phenomenon. Their quantitative exercise however attributes to suburbarinization only a modest fraction of the baby boom. The latter instead proposes a formal test of the channel running from wars to swings in fertility and finds inconclusive evidence.

2.2 Economic conditions, uncertainty and fertility

A number of studies have looked at the impact of economic uncertainty on fertility outcomes, both from a theoretical and an empirical perspective.

From a theory standpoint, economic growth and development can have contradicting effects on fertility (Butz and Ward 1979; Jones, Schoonbroodt, and Tertilt 2010; Baudin, de la Croix, and Gobbi 2019). The main reason is that good economic conditions may improve at the same time male and female wages. On the one hand, a higher male wage implies a larger family income, which therefore relaxes the budget constraint limiting fertility. On the other hand, a higher female wage increases their opportunity cost of being out of the labor force, thereby stimulating female labor force participation at the expense of fertility. In the same spirit, bad economic conditions, especially for women, could be thought of as the right time to leave temporarily the labor market and have a child. This asymmetry between male and female wages crucially hinges upon the fact that child-related activities either biologically or culturally require more female than male time, which is probably less the case nowadays (Bianchi, Robinson, and Sayer 2004). Another effect through which economic conditions may relate to fertility goes through the so-called *added worker effect*. In bad economic times, women enter the labor force to make up for the potential job loss of their husband, thus raising their opportunity cost of time. The magnitude of all these effects, and the elasticity of female labor force participation to labor market conditions, should govern the overall sign of the relationship between economic conditions and fertility.

Economic uncertainty is viewed as a risk upon future consumption streams that may be mitigated by not committing to large expenses, such as those generated by having children. Ranjan (1999) formalizes the channel running from uncertainty to low fertility making use of the irreversibility of expenditures associated to the birth of a child. In a context of high uncertainty, parents tend to postpone their fertility to when uncertainty is resolved. The author suggests that this mechanism may explain the drop in fertility that occurred in the former Soviet Republics and Eastern European countries after the transition from a controlled to a market economy. In the same spirit, Sommer (2016) develops a more elaborate model where children represent consumption commitments. An increased earnings risk tends to postpone childbearing and ultimately reduce fertility as the ability to bear children declines with age. Pommeret and Smith (2005) incorporate the fertility choice into a stochastic growth model. They find that if the inter-temporal elasticity of substitution in consumption is small (lower than one), a higher level of uncertainty should affect fertility negatively.

On the empirical side, both fertility and birth timing have been linked to measures of economic uncertainty, ranging form individual-level perceptions to macro aggregates. In general, higher levels of uncertainty tend to delay childbearing and decrease fertility. Fertility postponement may imply lower fertility through two mechanisms. First, women who become mothers later have accumulated human capital and work experience, rising their opportunity cost of raising children. The second mechanism is due to the biological decline in women's fecundity as they grow older, which could prevent them to reach their desired fertility. With either mechanism at play, a cohort of women facing high uncertainty during their early reproductive years end up having fewer children. de la Croix and Pommeret (2018) model childbearing postponement assuming that having a child is both irreversible and risky (biologically and for a woman's career). They show that insuring mothers against income risk lowers the age at first birth.

Using German panel data, Hofmann and Hohmeyer (2013) use a major reform of the unemployment benefit system to show that the probability of getting pregnant is negatively affected by strong economic concerns. Schneider (2015) looks at the effect of state-level economic conditions on birth rates in the US during the Great Recession. He finds that the negative effect of the crisis on fertility goes through both increased economic hardship as well as higher economic uncertainty. Hondroyiannis (2010) uses European panel data and shows that economic uncertainty has a negative impact on fertility. Additionally, without linking it explicitly to uncertainty, Currie and Schwandt (2014) use US data from 1975 to 2010 to give evidence of a short and long-term negative effect of unemployment on fertility.[5] Quite closely related to our contribution, Hill (2015b) finds that the severity of the Great Depression in the US has brought about a postponement of marriages, which back then represented a powerful form of contraception. Caucutt, Guner, and Rauh (2018) link the much lower marriage rate of Blacks in the US to the substantially higher risk of unemployment and incarceration black males face.

The following section shows preliminary descriptive relationships between uncertainty and fertility over time. Section 4 gives evidence for a causal relationship running from uncertainty to fertility.

3 Data and sample description

We use three sources of data. Individual level data comes from the US Census for 1940 to 1990 and the June supplement of the CPS from 1990 to 2010. State-level income per capita since 1919 was taken from the Bureau of Economic Analysis (BEA) complemented by Fishback and Kachanovskaya (2010). Finally, to control for infant and maternal mortality at the state level, we rely on data from the US Life Tables, gathered by Albanesi and Olivetti (2014) .

Fertility

Fertility data are taken from the 1940-1990 Censuses as well as the 1990-2010 Current Population Surveys (CPS) fertility supplement and were downloaded through the IPUMS.org website (Ruggles et al. 2017; Flood et al. 2018). Our sample includes women aged 40 to 59, so that the answer to the question regarding the number of children ever born is a good proxy for their completed fertility. For the CPS data, women who were older than 65 for the June 1990 and 1995 samples, and women older than 44 in the June 1992, 1994, and 1998-2010 samples were not asked about the number of live births they ever had.

We obtain a sample of around 3.5 million women, who were born between 1898 and 1970. For these women, on top of their age and fertility, we also extract information about their educational attainment and their state of birth and residence. There is a small discontinuity in the sample selection as the children ever born question was asked only to ever-married females

[5] Some papers instead find mixed evidence. Kind and Kleibrink (2013), for instance, also using German Data for the period 2001-2011, show that uncertainty at the individual level leads to a postponement of the first birth. On the contrary, they show that uncertainty at the macro level induces women to anticipate their first birth.

in the 1940 to 1960 Census waves. This issue though is likely have a minor impact on our results as a large proportion of women had been ever married by age 40 up to 1960.

Economic conditions

We use state-level income per capita data for the years 1919 until 1999, provided by the Bureau of Economic Analysis (BEA) and complemented by Fishback and Kachanovskaya (2010).

In order to separate the effect of economic development from that of the business cycle, we start by measuring the trend in income per capita. The classic methodology for detrending is to use the Hodrick-Prescott filter. We choose not to follow this strategy because using the accepted smoothing parameter for yearly data amounts to putting a large portion of what we consider to be useful cyclicality in the trend component.[6] The remaining cyclical component is then very noisy and not well correlated to the medium to long-run cycles, which, we believe, matter for fertility decisions over the life-time. Moreover, in a recent paper, Hamilton (2016) finds that the HP filter produces series exhibiting spurious dynamic relations. Consequently, we turn away from the HP filter and choose to detrend the series using the best log-linear fit.

We assume that, in each state s at time t, income per capita, $y_{s,t}$, fluctuates around a balanced growth path, with a constant growth rate γ_s such as,

$$y_{s,t} = \text{trend}_{s,t} + \mu_{s,t}, \tag{1}$$

where μ is the business cycle component and

$$\text{trend}_{s,t} = \bar{y}_{s,0}\, e^{\gamma_s t} \tag{2}$$

where $\bar{y}_{s,0}$ is a constant and t are years between 1919 and 1999. We estimate $\bar{y}_{s,0}$ and γ_s by minimizing the square of the distance between the series and the trend

$$\sum_{i=1919}^{1999} \mu_{s,i}^2.$$

Our benchmark measure to capture the cyclicality of income per capita relies on its growth rates. We denote the growth rate of income per capita $y_{s,t}$ in state s between the year $t-1$ and t as

$$g_{s,t} = \ln(y_{s,t}) - \ln(y_{s,t-1}).$$

We proxy the cyclical economic conditions during fertile years, denoted as $\text{cycle}_{s,t}$, by the

[6] Ravn and Uhlig (2002) recommend that it should be 6.25

average growth rate over a 15 year period around an year t:

$$\text{cycle}_{s,t} = E(g_{s,t})|_{t\in[t-6,t+7]} = \frac{1}{14}\sum_{i=t-6}^{t+7} g_{s,i}. \tag{3}$$

As for the volatility of economic conditions, as in Flug, Spilimbergo, and Wachtenheim (1998), we use the standard deviation of per capita income growth rates as follows:

$$\text{volatility}_{s,t} = \sigma(g_{s,t})|_{t\in[t-7,t+7]} = \sqrt{\frac{1}{15}\sum_{i=t-7}^{t+7} (g_{s,i} - \text{cycle}_{st})^2}. \tag{4}$$

where $\sigma(g)$ denotes the standard deviation of per capita income growth. The implicit assumption is that realized volatility should not differ systematically from perceived uncertainty.

For illustration purposes, Figure 2 shows how we computed the variables we just defined for the cohort born in 1950 residing in the state of California. We assign to each woman the economic conditions when they were 21 to 35, which corresponds to the years 1971 to 1985 (vertical lines). We will call the reference year, here 1978, the year around which the economic conditions were computed, which is the year when women turn 28.

The top panel of Figure 2 shows the income per capita series, in thousands of 1967 dollars and its log-linear fit. The circle on the balanced growth path denotes the trend in California for the reference year 1978, $\text{trend}_{\text{CA},1978}$. The bottom panel shows our benchmark proxy for the cyclical economic conditions and our benchmark measure of volatility, respectively $\text{cycle}_{\text{CA},1978}$ and $\text{volatility}_{\text{CA},1978}$ (Equations 3 and 4). We first compute the annual growth rate, $g_{\text{CA},t}$, from the income per capita series and then the mean and standard deviation for the years 1971 to 1985.

Descriptive statistics

Table 1 shows summary statistics of the data we use, splitting it into three large cohorts. We observe that fertility is indeed higher for the middle cohort, which is composed of women born between 1921 and 1945. Age at survey is higher for earlier cohorts. This reflects two facts: (i) we rely on relatively older women observed in the 1940 Census, which is the first to ask about fertility and education, to construct the earliest cohorts, and (ii) for more recent cohorts, we rely on the CPS fertility supplement, instead of the Census, which asks the children ever born question to a younger set of women. All specifications include a set of dummies for age at survey to smooth out those differences. Average educational attainment increases over time, while the share of women residing in a given region is fairly stable. For illustrative purposes, we show the evolution of marital status. The proportion of currently married declines mostly in favor of the never married. However we do not make use of this data mainly because we observe

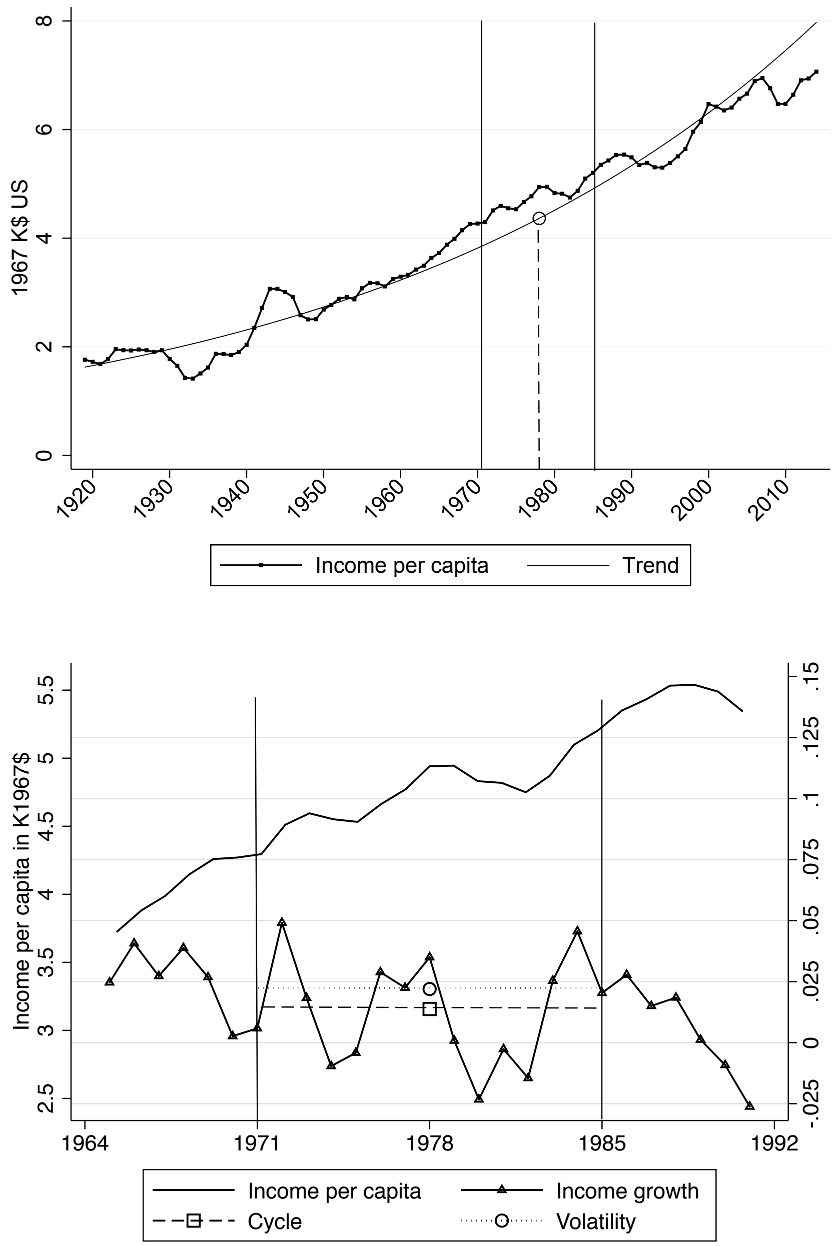


Figure 2: Trend, cycle and volatility measures for California and reference year 1978.

Cohort	[1898-1920]	[1921-1945]	[1946-1970]
Number of observations	427,490	2,592,016	603,633
Sum of weights	49,583,024	115,769,380	143,420,400
1940-1990 US Census & 1990-2010 CPS			
Children ever born	2.39	2.80	1.96
	(0.064)	(0.037)	(0.022)
Age	50.13	49.91	42.27
	(0.047)	(0.047)	(0.008)
Educational attainment			
High school dropout	0.57	0.27	0.10
	(0.016)	(0.010)	(0.008)
High school graduate	0.28	0.42	0.34
	(0.010)	(0.012)	(0.013)
Some college or more	0.15	0.31	0.56
	(0.008)	(0.014)	(0.009)
Region of residence			
New England	0.07	0.06	0.05
	(0.038)	(0.031)	(0.030)
Middle Atlantic	0.23	0.17	0.14
	(0.116)	(0.094)	(0.081)
East North Central	0.21	0.18	0.16
	(0.090)	(0.078)	(0.072)
West North Central	0.08	0.07	0.07
	(0.037)	(0.032)	(0.031)
South Atlantic	0.14	0.17	0.18
	(0.055)	(0.068)	(0.073)
East South Central	0.06	0.06	0.06
	(0.032)	(0.034)	(0.032)
West South Central	0.06	0.10	0.11
	(0.037)	(0.062)	(0.070)
Mountain	0.03	0.05	0.06
	(0.014)	(0.022)	(0.026)
Pacific	0.12	0.14	0.16
	(0.089)	(0.098)	(0.109)
Marital status			
Currently married	0.79	0.73	0.68
	(0.004)	(0.007)	(0.004)
Divorced, separated or widowed	0.18	0.22	0.21
	(0.004)	(0.005)	(0.003)
Never married	0.03	0.05	0.11
	(0.002)	(0.004)	(0.004)
Bureau of economic analysis & Fishback and Kachanovskaya (2010)			
Trend value of income per capita (in 1967 K$)	1.75	2.72	4.31
	(0.096)	(0.116)	(0.117)
Average income growth (in %)	3.52	2.43	1.49
	(0.262)	(0.091)	(0.060)
Standard deviation of income growth	0.09	0.03	0.02
	(0.004)	(0.001)	(0.001)
Vital statistics of the US, collected by Albanesi and Olivetti (2014)			
Infant mortality (per 1,000 births)	57.92	28.60	9.34
	(1.242)	(0.719)	(0.217)
Maternal mortality (per 10,000 live births)	54.68	7.72	1.52
	(1.711)	(0.386)	(0.075)

Robust standard errors, clustered at the state of residence level, reported in parentheses. Sum of weights refers to the sampling weights used to have a representative sample of the population. Trend, average income growth and its standard deviation are computed as described in Section 3 over the period when women are aged 21 to 35. Infant and maternal mortality are those observed when women were 21.

Table 1: **Summary statistics - by data source**

marital status only at the time of survey, which may not be representative of that during fertile years. Furthermore we think that marital arrangements are only proximate causes of fertility choices and therefore decide not to control for them.

Income per capita increases, while average income growth declines. Uncertainty as measured by the standard deviation of income growth was higher for the first cohort, while constant thereafter. Finally, infant and maternal mortality rates were cut sharply over the period.

Figure 9 of Appendix C shows the extent of the geographical variation in our explanatory variable for the reference years 1935 (top panel), 1960 (middle panel) and 1985 (bottom panel). We observe that overall uncertainty was much higher in 1935 than in both 1960 and 1985. Moreover the variation in uncertainty across states decreases sharply over time and is overall relatively small compared to the time-series variation. These two observations together plead to discard the use of year of birth fixed effects in the next Section, which take away the largest part of the variation in our explanatory variable.

4 The effect of uncertainty on fertility

This section discusses the identification of the causal relationship of economic uncertainty on fertility rates. We begin by showing the main findings on this relationship. Then, we study the plausible channels through which uncertainty might decrease completed fertility. We continue by investigating the groups that were mostly affected by high levels of uncertainty. Finally, we look at the complementarity of our results to alternative explanations of the US baby-boom provided in the literature.

4.1 OLS Estimates

The relationship between the number of children ever born n to a woman i, residing in state s, born in year b, and surveyed at age a, and the economic uncertainty she confronted during her fertile years 21-29 is given by:

$$n_{isba} = \beta_0 + \beta_1 \text{volatility}_{sb} + \beta_2 X_i + \beta_3 Y_{sb} + \Delta_s \times \Phi_c + \Gamma_a + \epsilon_{isba}. \quad (5)$$

We estimate the coefficients by OLS. Our coefficient of interest is β_1, which measures the effect of volatility of income per capita growth during fertile years on fertility. The key to our identification strategy comes from the inclusion of a set of fixed effects for every 5-year birth cohort times state cell. Indeed, using only variation within such a small cell makes us confident that our variable of interest is uncorrelated to the error term. To improve our confidence in the causal interpretation of β_1, we include X_i, a set of individual level controls and Y_{sb}, a vector of year of birth and state-specific controls. In the benchmark specification, the individual level controls are limited to a 6-level categorical variable for educational attainment, while the year of birth and state specific controls are alternative indicators of economic conditions (trend and cycle). We also include dummies for age at survey Γ_a, which aim at netting out any time-invariant systematic variation in children ever born due to the age at which women were surveyed (40 to 59)[7].

Results are shown in Table 2. All specifications include cohort times state and age at survey fixed effects. Standard errors in parenthesis are robust and clustered at the state level. In columns (1) to (3), we show the association between fertility and our three indicators for economic conditions; volatility, cycle and trend, computed as described in Equations (2), (3), and (4) respectively. The three variables are included together in column (4).

Column (5) includes women's educational attainment. This is the best available measure for the opportunity cost of women's time, which has a large explanatory power in fertility regressions. As expected, a higher education decreases the number of children ever born. However, educational attainment is an endogenous variable because it may be co-determined with fertility. In particular, economic uncertainty may have affected fertility through education. The literature documents that educational attainment tends to be counter-cyclical, as economic booms increase the opportunity cost of studying more than they relax credit constraints.[8] Because uncertainty usually rises during economic downturns, controlling for education would fail to take into account this possible channel running from economic uncertainty to fertility. This would lead to a downward bias in our estimates and we would likely estimate a lower bound. On the other hand, Flug, Spilimbergo, and Wachtenheim (1998) use cross-country estimates to document that economic uncertainty tends to decrease investment in education, as measured by secondary enrollment rates. This would create an upward bias in our estimates. However, the effect that they find is not robustly significant and anyway small in magnitude. We are therefore confident that our estimates are not biased upward.

In all specifications, the coefficient on volatility remains significant and negative. The coefficient does not change substantially with the inclusion of further controls. We can illustrate the magnitude of the effect by using the difference between average volatility for the cohort born in 1910 (the lowest point before the baby boom) and that for the cohort born in 1935 (the peak of the baby boom). This difference is of about 0.077, which multiplied by an estimated coefficients on volatility from Table 2 of about 8, gives a variation of 0.616 in the number of

[7]The idea is that some woman might have had children after being surveyed (though this bias is likely to be rather small), while some others might have not been surveyed because they died before.

[8]See Méndez and Sepúlveda (2012), Betts and McFarland (1995), Dellas and Sakellaris (2003) and Arenas and Malgouyres (2018) for substantial contributions to this literature.

	The dependent variable is children ever born				
	(1)	(2)	(3)	(4)	(5)
Volatility	-7.789***			-8.150***	-8.068***
	(0.715)			(0.714)	(0.730)
Cycle		-0.016***		-0.007	-0.008*
		(0.004)		(0.004)	(0.005)
Trend			-0.154***	-0.184***	-0.144***
			(0.038)	(0.039)	(0.040)
Education					
Baseline: Up to grade 4					
Up to grade 8					-0.323***
					(0.114)
Up to grade 11					-0.633***
					(0.148)
High school grad					-1.093***
					(0.161)
Up to 3 years of college					-1.227***
					(0.174)
College grad +					-1.538***
					(0.173)
Observations	3,623,139	3,623,139	3,623,139	3,623,139	3,623,139
R^2	0.065	0.065	0.065	0.065	0.100

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 2: OLS estimates of the effect of economic uncertainty on fertility

children ever born. This implies that changes in the volatility of annual income growth account for over 60% of the overall increase in completed fertility during the baby-boom.

4.2 Channels

Here, we study the channels that could mediate the effect of uncertainty on fertility. While a growing literature documents a biological effect of environmental stressors, such as conflict, bereavement or unemployment, on conceptions and still births, we believe that there is also a substantial behavioral response.[9] To examine the strength of this response, we examine the

[9]Valente (2015) analyzes data from Nepal using maternal fixed effects and finds that in utero exposure to civil conflict results in a higher risk of a miscarriage and a female birth. Catalano et al. (2005) find a positive association between unemployment and the risk of foetal death among males. László et al. (2013) examine 3 million births over 30 years in Sweden and find that infants of mothers who had lost any first-degree relative the year before or during pregnancy had an 18% higher risk of stillbirth than unexposed offspring. Schliep et al.

decision to get married through the evolution of two indicators: age at first marriage and the probability to ever marry.

Data on the age at first marriage is only available in the Censuses 1980, 1970, 1960 and 1940 for all ever married persons 14 or over and then in the fertility supplement of the CPS from 1976 until 1995, but restricted to ever married women of a varying age bracket. For this exercise, we focus on the extended age range 35-59. The rationale for that is to maximize the number of observed cohorts, as restricting the sample to women aged 40-59, as in the previous section, would imply loosing all the cohorts born after 1955. In addition, age at observation is no longer as crucial as in the completed fertility case. Indeed, it amounts to assuming that women observed as never married between 35 and 59 will remain unmarried and will be under scrutiny in the probability to ever marry rather than in the age at first marriage.[10]

Figure 3 shows the evolution of age at first marriage in the left panel and that of the probability to ever marry in the right panel. Age at first marriage strikingly follows the dynamics of the baby bust followed by a baby boom, peaking for cohort 1910 at 23 years of age and dropping sharply below 21 for cohort 1935 and reaching 20.5 for the cohort born in 1940 before going back up again. This could capture only tempo effects if women tended to catch up and marry at older ages. But Panel (b) reassures us that this has not been the case. If anything, the probability to ever marry has followed a similar pattern, starting at 92.5% for cohort 1910 and hitting 95% for cohort 1925 and remaining over 93% for the 1935 cohort at the peak of the baby boom, before declining drastically for the subsequent baby bust.

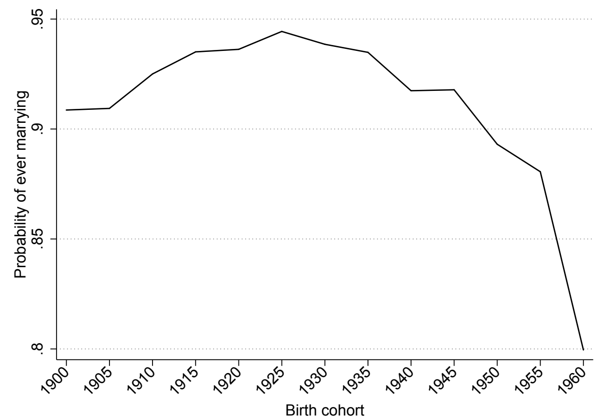
Table 3 shows the OLS estimates of Equation (5) when the dependent variable has been replaced by the age at first marriage. We hence restrict the sample to ever married women only. Results support that the age at first marriage increased for those women who faced stronger volatility during their fertile years. To interpret the magnitude of the change in age at first marriage we consider, as for the interpretation of the estimates of Table 2, the variation in volatility between the cohort born in 1910 and the cohort born in 1935. Considering the estimates in column 5, the decrease in uncertainty between the baby bust and the peak of the baby boom implied a decrease in the age at first marriage of 1.15 years (0.077×14.942). This represents 46% of the 2.5 year variation observed on Figure 3.

Table 4 shows the OLS estimates of Equation (5) using as the dependent variable a dummy variable that indicates whether a woman has ever been married or not. We can see that women facing a higher volatility during their fertile years were also less likely to ever marry. The magnitude is however small. The decrease in uncertainty between the baby bust and the

(2015) find that daily perceived level of stress interferes with menstrual cycle function among women with no known reproductive disorders.

[10]Results remain valid for other age ranges (25-60, 30-60 and 40-60) and are available upon request.

(a) Age at first marriage



(b) Probability of ever marrying

Figure 3: Descriptive statistics for marriage indicators over birth cohorts
Source: US Census 1940-1980 & CPS June supplement 1976-1995

	The dependent variable is age at first marriage				
	(1)	(2)	(3)	(4)	(5)
Volatility	15.203***			17.029***	14.942***
	(1.595)			(1.552)	(1.431)
Cycle		6.251***		4.918***	6.780***
		(1.395)		(1.689)	(1.657)
Trend			0.149	0.443***	0.031
			(0.135)	(0.136)	(0.137)
Education					
Baseline: Up to grade 4					
Up to grade 8					-0.666***
					(0.123)
Up to grade 11					-0.969***
					(0.202)
High school grad					0.153
					(0.213)
Up to 3 years of college					0.876***
					(0.230)
College grad +					2.637***
					(0.219)
Observations	3,473,309	3,473,309	3,473,309	3,473,309	3,473,301
R^2	0.048	0.047	0.047	0.048	0.094

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 3: OLS estimates of the effect of economic uncertainty on age at first marriage

	The dependent variable is the probability of having ever been married				
	(1)	(2)	(3)	(4)	(5)
Volatility	0.356***			-0.260**	-0.209**
	(0.107)			(0.102)	(0.101)
Cycle		-0.433***		-0.626***	-0.637***
		(0.095)		(0.107)	(0.103)
Trend			-0.116***	-0.123***	-0.119***
			(0.008)	(0.008)	(0.008)
Education					
Baseline: Up to grade 4					
Up to grade 8					0.098***
					(0.016)
Up to grade 11					0.114***
					(0.015)
High school grad					0.120***
					(0.015)
Up to 3 years of college					0.111***
					(0.017)
College grad +					0.055***
					(0.016)
Observations	3,705,922	3,705,922	3,705,922	3,705,922	3,705,912
R^2	0.063	0.063	0.064	0.064	0.073

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 4: OLS estimates of the effect of economic uncertainty on the probability of ever marrying

peak of the baby boom is consistent with an increase in the probability of getting married of 1.6 percentage points (0.077×0.209), which could explain a seizable fraction of the observed variation over the period.

Data from the Census allows to perform a similar analysis for a sample of men, though over fewer cohorts. Results are given in Appendix D and are consistent to those of Table 3 concerning the age at first marriage, even though the magnitude of the effect is about three times smaller. In addition, men's probability of ever marrying does not react to levels of economic uncertainty in our sample.

4.3 Heterogeneity analysis

In order to understand whether uncertainty affected some subgroups of individuals rather than others, we look at the heterogeneous effect played by uncertainty on fertility distinguishing individuals by socio-demographic characteristics (education and race), over time (cohorts) and geographic localization (region). The marginal effects of uncertainty on the number of children ever born for different subgroups of individuals are shown in Table 5. We use as controls those of specification (5) from Table 2.

Overall, we see that the effect of uncertainty is quite general and homogeneous, and not driven by a specific group of individuals. This reinforces the results of the previous section. There exists however a few interesting ways in which this effect varies across subgroups.

The education group most affected by uncertainty is the intermediate education group: grade 9 to 11. This is not due to the fact that the period in which economic conditions matter for the fertility of less educated people is earlier in life than that of the more educated (23 years old versus 28), as we will show in Section 5 (Table 8). It may be due instead to the fact that both more and less educated group are more sensitive to business cycle fluctuations. Indeed well educated people are more protected against adverse shocks, while the situation of people without schooling does not improve by a lot even when the economy is booming. Additionally, it could also be due to the fact that both more and less educated have fewer children on average, leaving less room for uncertainty shocks to have a large effect.

Black women are almost twice as affected by uncertainty as the non-Hispanic White. This is consistent with the findings of Sundstrom (1992) who finds that unemployment rates of Blacks were larger than those of Whites, partly because of a higher discrimination in the labor market especially in unskilled service jobs.[11]

Looking at the heterogeneity over different cohorts, we observe that the effect of uncertainty on fertility is driven by the cohorts born before 1945. Several narratives are consistent with this observation. First, cohorts born after WWII were exposed to a period of decreased aggregate volatility of GDP know as the "Great Moderation" (Stock and Watson 2002). Galì and Gambetti (2009) however points out that the nature of uncertainty changed during the Great Moderation. Other sources of uncertainty, namely the volatility of hours and labor productivity, became more prevalent relative to the volatility in GDP per capita compared to what they were in previous periods. These might well have an impact on fertility decisions and we do not capture their effect with our measure of uncertainty.

A second reason is that uncertainty may have become a less important factor when mechanisms

[11] For the group that is neither Black, White, nor from Hispanic origin, we find a positive effect of uncertainty on fertility. This group represents however only 2% of the sample.

	The dependent variable is children ever born			
	(1)	(2)	(3)	(4)
Education				
Up to grade 4	-5.047***			
	(2.472)			
Grades 5 to 8	-7.401***			
	(1.283)			
Grades 9 to 11	-10.686***			
	(0.986)			
High school grad	-8.122***			
	(0.735)			
3 years of college	-7.037***			
	(0.778)			
College grad & more	-6.543***			
	(0.908)			
Race/Hispanic Origin				
White		-9.014***		
		(0.858)		
Black		-13.959***		
		(1.460)		
Hispanic		-0.754		
		(1.746)		
Other		2.392		
		(1.884)		
Cohort				
1898-1920			-5.648***	
			(1.280)	
1921-1945			-9.486***	
			(0.846)	
1946-1970			-1.979	
			(4.071)	
Region				
New England				-8.254***
				(2.236)
Mid-Atlantic				-13.748***
				(0.862)
East North Central				-11.083***
				(1.729)
West North Central				-7.472***
				(1.492)
South Atlantic				-5.619***
				(1.097)
East South Central				-5.998***
				(1.188)
West South Central				-4.974***
				(0.459)
Mountain				-4.365***
				(0.956)
Pacific				-10.059***
				(1.928)
Observations	3623139	3623139	3623139	3623139
R^2	0.102	0.102	0.105	0.102

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls are those used in Specification (5) from Table 2. In each column, volatility is interacted successively with educational attainment, race, cohort and region of residence. S.E. clustered at the state level in parenthesis. The reported coefficients are marginal effects.

Table 5: Estimated marginal effects of volatility for different subgroups

to cope with economic uncertainty, such as financial developments or safety nets, became more widespread. Finally, another plausible explanation is that the fertility window also became "medically" wider in the present days to overcome for uncertainty shocks in some periods of life.

The most developed areas, Great Lakes and North East, were those in which uncertainty had a larger effect on fertility rates, followed by the Pacific coast. Conversely, the lowest effect happened in the South. This might seem surprising to find such a low effect, in particular in the West South Central region which experienced the natural disaster, known as the Dust Bowl, in the years 1934, 1936 and 1939. One possible reason for the low effect of uncertainty in this region could be due to the migration wave away from the Great Plains that this drought caused.[12] Given that we only observe the state of residence of women when they are 40+, the economic conditions faced during their fertile period might have been those from a different state. This can bias the effect of uncertainty on fertility downwards if migrants moving to less uncertain states tend to have lower fertility than those who did not migrate and remained in the state with higher uncertainty. From the other side, this migration could also bias upwards the effect we find for the Pacific region, as these migrants were mostly moving to California.

4.4 Alternative explanations

As described in Section 2.1, other explanations for the fertility fluctuations have already been proposed in the literature. Here, we show that two of these alternative complement ours. We focus on the effect of infant and maternal mortality and the role of female labor force participation.

The first column of Table 6 replicates the last column of Table 2 that shows our benchmark results on the impact of uncertainty on fertility. Column (2) adds controls for the levels of infant and maternal mortality in the state of residence when women were 21. This follows the work of Albanesi and Olivetti (2014) who find that a decline in maternal mortality tend to increase fertility for women born between 1920 and 1940, while it tends to decrease it for women born between 1941 and 1950 through a rise in women's human capital.[13] We therefore interact maternal mortality with three large cohorts: 1898-1920, 1921-1945 and 1946-1970.

Our results confirm those of Albanesi and Olivetti (2014) as for the negative effect of maternal mortality on fertility for women born prior to 1940 (even 1945 in our analysis). In particular,

[12] See (Hornbeck 2012; Arthi 2018) for an analysis of economic consequences of the Dust Bowl and of the induced outmigration.

[13] Albanesi and Olivetti (2014) use age 15-20 as reference years for mortality rates in order "to alleviate concerns pertaining to joint endogeneity or reverse causation". We use 21 in order to be able to use the earliest cohort that the income data allows us to use: 1898.

we obtain that the sharp decline in maternal mortality of about 45 deaths per 10,000 women observed between the 1898-1920 and the 1921-1945 cohorts can account for an increase of about 0.3 of a child, which is substantial but about four times smaller than Albanesi and Olivetti (2014)'s estimates. The difference may stem from their less demanding specification including only state and cohort fixed effect, but no space time interactions. It may also be due to the inclusion of the macroeconomic controls and in particular economic uncertainty, which we find can account for a large share of the rise in fertility.

Furthermore, we find evidence for the reversal of the effect of maternal mortality for the cohort 1946-1970. Indeed, further drops in maternal mortality rates were associated with larger declines in fertility in that period. This is consistent with the fact that places where maternal mortality was still dropping were arguably the places that started with the highest rates to start with and therefore experienced the largest swings in fertility over the baby boom and busts. The estimated coefficient of 0.01 is consistent with a decline in fertility of only about 0.06 of a child though, which represents just above 10% of their estimated effect. This might be due to the fact that we control for education, which is the mechanism through which Albanesi and Olivetti (2014) claim maternal mortality influences fertility for younger cohorts.

The coefficient on economic uncertainty decreases slightly when we include maternal mortality, but it is still consistent with a variation of about 0.45 of a child.

Both Doepke, Hazan, and Maoz (2015) and Bellou and Cardia (2014) suggest that changes in female labor force participation is an important determinant for understanding fertility swings. Column (3) of Table 6 therefore includes controls for the average female labor force participation in the state of residence during fertile years. Specifically we use Censuses from 1920 to 1990 and ACS from 2000 to 2005 to compute the labor force participation rates of women aged 21 to 35, residing in a given state and born in a given year as follows:

$$FLFP_{isb} = \delta_0 + \Delta_s \times \Psi_b + \delta_1 a_i + \delta_2 a_i^2 + \epsilon_{isb},$$

where $FLFP$ is a dummy variable taking value 1 when a woman i participates to the labor market, Δ and Ψ are the fixed effects for the state of residence s and the year of birth b respectively and a denotes the age at survey. For each birth year, women are not observed at all ages between 21 and 35. Ideally, we would like to include age at survey fixed effects to fully account for any time invariant differences in female labor force participation across ages. Given that we only have decennial observations, we only observe female labor force participation for at most 2 ages for a given birth year. Therefore, instead of age at survey fixed effects, we include a second order polynomial in age and predict female labor force participation assuming that all women are of age 28.

Figure 4 shows the variation in aggregate female labor force participation during fertile years by birth year. We can see that there were fluctuations ranging from 32 to 38% for the cohorts born before 1940 and a very clear rise in labor force participation for women born after WWII from around 40% to around 75% in less than 20 birth years.

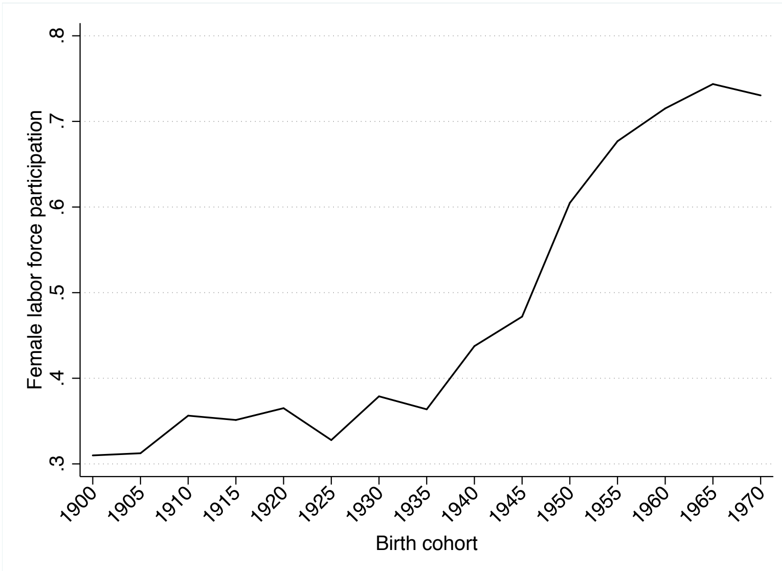


Figure 4: Female labor force participation during fertile years over birth cohorts

Column (3) of Table 6 shows that female labor force participation is significantly and negatively associated to fertility. This is in line with gender biased technological change providing a better labor opportunities for women, thus increasing the opportunity cost of having children (Feyrer, Sacerdote, and Stern 2008). In terms of magnitude, female labor force participation was of 35% for the 1910 cohort, 36% for that of 1935 and 72% for the 1960 cohort. Whether to interpret the coefficients of $FLFP$ in Table 6 (Columns 3 and 4) as causal is subject to discussion. Indeed it could well be that economic uncertainty affects female LFP, or that there is a reverse causality problem if fertility affects female LFP, as shown in Bloom et al. (2009). Still, we find that the change in female LFP can only account for a change of 0.005 of a child between cohorts 1910 and 1935. The relevance of female LFP for fertility however appears in the most recent bust period when the doubling of the female LFP rate mirrors a 0.21 decrease in fertility between cohorts 1935 and 1960. Fernández (2013) and Fogli and Veldkamp (2011) both insist on the rise in female LFP as being primarily the result of increased participation of mothers of young children, made possible by a higher compatibility between a working and parental life.

The swings in female labor force participation before the 1940 cohort were not likely to be large enough in magnitude to have a major role in explaining the difference in fertility between cohorts 1910 and 1935. On the contrary, the drastic rise of female labor force participation for the cohorts born after 1935 could well explain the decline in fertility between cohorts 1935 and 1960.

	The dependent variable is children ever born			
	(1)	(2)	(3)	(4)
Volatility	-8.068***	-6.063***	-7.728***	-5.757***
	(0.730)	(0.659)	(0.714)	(0.647)
Cycle	-0.008*	-0.008	-0.010**	-0.011**
	(0.005)	(0.005)	(0.005)	(0.006)
Trend	-0.144***	-0.130***	-0.104**	-0.101**
	(0.040)	(0.041)	(0.042)	(0.042)
Education				
Baseline: Up to grade 4				
Up to grade 8	-0.323***	-0.323***	-0.323***	-0.323***
	(0.114)	(0.114)	(0.114)	(0.114)
Up to grade 11	-0.633***	-0.633***	-0.634***	-0.634***
	(0.148)	(0.148)	(0.148)	(0.148)
High school grad	-1.093***	-1.093***	-1.093***	-1.093***
	(0.161)	(0.161)	(0.161)	(0.162)
Up to 3 years of college	-1.227***	-1.227***	-1.228***	-1.228***
	(0.174)	(0.174)	(0.175)	(0.175)
College grad +	-1.538***	-1.538***	-1.538***	-1.538***
	(0.173)	(0.173)	(0.173)	(0.173)
Infant mortality		-0.000		-0.001
		(0.002)		(0.002)
Maternal mortality (baseline cohort [1898-1920])		-0.006***		-0.005***
		(0.001)		(0.001)
Maternal mortality × cohort [1921-1945]		-0.007***		-0.007***
		(0.002)		(0.002)
Maternal mortality × cohort [1946-1970]		0.010***		0.009***
		(0.003)		(0.003)
Female labor force participation			-0.589***	-0.544***
			(0.140)	(0.146)
Observations	3623139	3623139	3623139	3623139
R^2	0.100	0.101	0.101	0.101

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 6: OLS estimates of the effect of economic uncertainty on fertility with alternative hypothesis

5 Robustness

Here, we perform five robustness analysis. First, we show that the effect of uncertainty on fertility is not likely to be affected by an issue of selective migration from high to low uncertainty states. Second, we show that our results are not sensitive to the choice of the age range during which economic conditions affect fertility (21-35). Third, we repeat the analysis using different cohort sizes. Fourth, we also show that the results remain if, instead of using income growth volatility, we use the deviation from the BGP to measure uncertainty. Finally, we address the concern related to the statistical power coming from the large number of observations with respect to the parsimonious number of explanatory variables.

5.1 Selective migration

The first concern regards whether we measure the relevant economic conditions when using the state of residence at the age of survey (40 to 59). Some individuals though may have lived some of their fertile years in a different state. In particular, migrants could be moving away from states where uncertainty was high to other states where they faced lower levels of uncertainty. If those who migrate to less uncertain states are those who have higher fertility, then the negative coefficient on uncertainty might be due to selection and not to a causal relationship running from uncertainty on fertility.

In the period we examine, several important waves of migration occurred. We already mentioned the migrants escaping the central plains in the aftermaths of the environmental disaster known as the Dust Bowl. In addition, there was a large continuous flow of African American migrating out of the Southern states, mainly towards three regions: the North East, the Great Lakes area and California.[14] Boustan, Kahn, and Rhode (2012) use natural disasters of the early twentieth century to document that out-migration has been a means for populations to mitigate the effect of adverse shocks. Migration therefore has the potential of biasing downward our estimates.

We address this concern using information on the state of birth for the cohorts born before 1950.[15] We define migrants as individuals who reside in a state that is not the one in which they were born. This measure probably underestimates migration as it disregards any movement out and back to the state of birth. We first look at how economic conditions (either in the state of residence or in the state of birth) affect the probability of cross-state migration. In our sample, 45% of women had migrated according to that definition. The two first columns of Table 7 show the result as we find that none of the economic conditions seem to have any

[14] Boustan (2016) analyses the characteristics, determinants and consequences of the Great Migration.

[15] Unfortunately, we only have access to this information in the Census, not in the CPS. Therefore we can run this robustness only on the subsample of women born before 1950.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Probability to migrate		Number of children ever born				
			All		Movers		Stayers
	State of residence	State of birth	State of residence	State of birth	State of residence	State of birth	
Volatility	-0.064	-0.275	-6.202***	-5.865***	-6.430***	-5.964***	-5.319***
	(0.086)	(0.177)	(0.559)	(0.586)	(0.674)	(0.237)	(0.744)
Cycle	-0.001	-0.001	-0.017***	-0.013***	-0.013***	-0.024***	-0.016**
	(0.001)	(0.001)	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)
Trend	-0.006	0.027	-1.741***	-1.715***	-1.670***	-1.827***	-1.748***
	(0.025)	(0.044)	(0.191)	(0.188)	(0.221)	(0.722)	(0.201)
Observations	3189407	3189407	3189407	3189407	1963587	1225820	1225820
R^2	0.158	0.080	0.077	0.074	0.075	0.083	0.080

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Two first columns present a linear probability model where the dependent variable is a dummy that equals one if state of residence is different from state of birth, zero otherwise. The dependent variable is number of children ever born for all remaining columns. Controls are those used in Specification (5) from Table 2. Fixed effects for state (of residence or birth accordingly) times cohort. S.E. clustered at the relevant state level in parenthesis.

Table 7: Selection into migration

significant impact on the probability to migrate.

Another way to discard that our results are driven by selective migration is to look separately at movers and stayers, which we do in the remaining five columns of Table 7. In column (3), we replicate specification (5) of Table 2 on the subsample of cohorts born before 1950. Column (4) repeats the exercise using economic conditions in the state of residence. Columns (5) and (6) replicated (3) and (4) restricting the attention to movers (live in a different state than their state of birth), while column (7) looks only at stayers (live in the state they were born in). The negative effect of volatility on fertility is robust across all these specifications. The magnitude is barely affected. If anything, conditions in the state of residence seem to affect fertility more and movers are more affected than stayers. This goes in the direction of a downward bias in our estimates inasmuch as cross-state migration seem to have been used as an instrument to smooth adverse shocks.

5.2 Age groups

In the benchmark regression model, we use 21-35 as the age range over which economic conditions should affect fertility. One could question this choice. Moreover, one could also argue that the relevant age range varies across individuals of different education groups. For instance, uneducated women tend to have children earlier in life. Therefore, economic conditions relevant for fertility could well be those between 16 and 30 rather than between 21 and 35.

	HS dropout		HS graduate		Some college or more	
	16-30	21-35	16-30	21-35	16-30	21-35
Volatility	-4.045***	-5.759***	-2.930***	-9.860***	-4.486***	-6.498***
	(1.217)	(1.133)	(0.917)	(0.889)	(1.356)	(1.225)
Cycle	-1.782**	-0.009	-1.857***	-0.010	0.494	-0.002
	(0.829)	(0.009)	(0.763)	(0.008)	(1.109)	(0.010)
Trend	-0.373	-0.253	-0.279***	-0.267***	-0.050	-0.058
	(0.280)	(0.242)	(0.072)	(0.067)	(0.062)	(0.054)
Observations	1021724	1044073	1402703	1409511	1164874	1169555
R^2	0.053	0.052	0.070	0.071	0.073	0.073

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls are those used in Specification (5) from Table 2. S.E. clustered at the state level in parenthesis.

Table 8: OLS estimates for different age ranges and levels of education

In Table 8, we show the effect of economic conditions on fertility for three education groups comparing in each case two different age ranges: 16-30 and 21-35 and using specification (5) in Table 2. The first striking point to notice is that volatility is the only variable that is consistently significant across levels of education and age ranges. Second, in terms of magnitude, the volatility of the period 21-35 has an effect that is roughly twice as big with respect to that on the 16-30 period, although the correlation between the two measures is 0.9. We do not find that the relevant age range comes earlier in life for less educated women. One possible reason is that people may catch up after an uncertainty shock early in life. On the other hand, because uncertainty shocks are hard to anticipate, fertility adjustments to those that occur later in life are less likely. Another possible reason is that controlling for education shuts down the channel running from uncertainty to fertility through educational choice. Uncertainty early in life is more likely to affect educational attainment, which would imply a smaller residual effect once controlled for education.

5.3 Cohort size

Identification relies on within state and cohort variation, here we explore the sensitivity of the results to the choice of the cohort size.

In Table 9, we explore the sensitivity of the results to the choice of the cohort size. The identification relies on the inclusion of fixed effects that capture the influence of state-specific slow-moving factor. The notion of slow moving is captured by the size of the cohort for which we include fixed effects. In the baseline, we use cohorts aggregating five years of birth. The risk is twofold: there may remain some state-specific factors affecting fertility that co-move with economic uncertainty within the five-year periods; on the other hand, because local eco-

	(1) 3-year cohorts	(2) 5-year cohorts	(3) 7-year cohorts	(4) 10-year cohorts	(5) No fixed effects
Volatility	-5.557***	-8.068***	-9.034***	-11.604***	-9.292***
	(0.837)	(0.730)	(0.623)	(0.628)	(1.214)
Cycle	0.013	-0.008*	0.023***	0.008***	0.034*
	(0.009)	(0.005)	(0.005)	(0.003)	(0.017)
Trend	-0.106	-0.144***	-0.172***	-0.190***	-0.197***
	(0.069)	(0.040)	(0.026)	(0.030)	(0.017)
Cohort × state FE	YES	YES	YES	YES	NO
Observations	3623139	3623139	3623139	3623139	3623139
R^2	0.102	0.100	0.099	0.098	0.073

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All columns include controls for education and age at survey dummies.

Table 9: OLS estimates using different cohort sizes and no fixed effects

nomic conditions might be autocorrelated or have persistent effect, using fixed effects at very disaggregated level in time could remove some meaningful correlation between fertility and uncertainty. To explore this issue, we make the cohort size vary from three to ten years of birth. As expected, the coefficients tend to be smaller the smaller the size of the cohort for which we include fixed effects. Column (5) confirms that our results do not rely on the inclusion of the fixed effects.

5.4 Alternative measure of economic conditions

As alternative measures of economic conditions, we use the mean and standard deviation of $\mu_{s,t}$, the deviation from the trend in Equation (1), over 15 years:

$$\text{cycle}'_{s,t} = E(\mu_{s,t})|_{t\in[t-7,t+7]} = \frac{1}{15}\sum_{i=t-7}^{t+7}\mu_{s,i}, \tag{6}$$

$$\text{volatility}'_{s,t} = \sigma(\mu_{s,t})|_{t\in[t-7,t+7]} = \sqrt{\frac{1}{15}\sum_{i=t-7}^{t+7}(\mu_{s,i}-\bar{\mu}_{s,t})^2}. \tag{7}$$

Figure 5 shows the alternative measures for the cyclical component and the volatility of the economic conditions, respectively $\text{cycle}'_{\text{CA},1978}$ and $\text{volatility}'_{\text{CA},1978}$ (Equations 6 and 7). As in Figure 5, we illustrate the variables for the state of California and the cohort born in 1950. First we obtain the "deviation from the trend" by taking the difference between "income per capita" and "trend". We then compute its mean and standard deviation for the years 1971 to

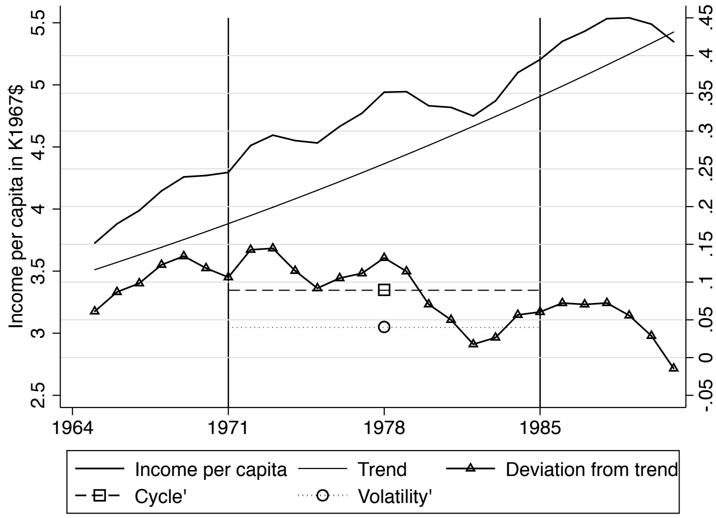


Figure 5: Income per capita, trend, and alternative measures of cycle and volatility for California and reference year 1978.

1985 in order to get our alternative measures of cyclicality.

In Table 10, we show the OLS estimates of Equation (5) using the mean and standard deviation of the growth rate in income per capita over fertile years as measures of cycle and volatility respectively (Equations 6 and 7). Results are consistent with those shown in Table 2. The magnitudes of the coefficients are however different. The difference between average volatility for the cohort born in 1910 and that for the cohort born in 1935 equals 0.123. This gives a variation in the number of children ever born between 0.17 and 0.23 for the lowest point of the baby-bust and the peak of the baby-boom. Results are therefore more conservative with this measure.

One possible reason is that when we measure volatility using deviation from the BGP, we obtain larger fluctuations than using the more "local" method based on growth rates. In particular, it induces a higher volatility measure during the 1960s and the end of the 1970s, which we do not find using the baseline measure. Fertility however remains stable during that period, biasing downward the coefficient.

	The dependent variable is children ever born					
	(1)	(2)	(3)	(4)	(5)	(6)
Volatility	-1.893***			-1.924***	-1.937***	-1.416***
	(0.212)			(0.219)	(0.234)	(0.211)
Cycle		0.093		-0.207	-0.078	0.175
		(0.191)		(0.170)	(0.169)	(0.221)
Trend			-0.154***	-0.180***	-0.132***	-0.111***
			(0.038)	(0.040)	(0.041)	(0.039)
Education						
Baseline: Up to grade 4						
Up to grade 8					-0.323***	-0.323***
					(0.114)	(0.114)
Up to grade 11					-0.633***	-0.633***
					(0.148)	(0.148)
High school grad					-1.093***	-1.093***
					(0.161)	(0.162)
Up to 3 years of college					-1.227***	-1.227***
					(0.175)	(0.175)
College grad +					-1.538***	-1.538***
					(0.174)	(0.173)
Infant mortality						-0.001
						(0.002)
Maternal mortality						
cohort [1898-1920]						-0.005***
						(0.001)
cohort [1921-1945]						-0.018***
						(0.003)
cohort [1946-1970]						0.004
						(0.002)
Observations	3623139	3623139	3623139	3623139	3623139	3623139
Adj. R^2	0.065	0.065	0.065	0.065	0.100	0.100

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 10: Effect of economic uncertainty on fertility, using deviation from BGP as the uncertainty measure

5.5 Aggregating and subsampling

Another possible concern is that the significance of the coefficients might be driven by the large number of observations compared to the limited amount of variation in the explanatory variables. Indeed, they vary at the state of residence (max 50) and year of birth (72) levels, which yields a maximum of 3600 different values for the explanatory variables, while the sample contains roughly 1000 times as many observations. In order to address this issue, we perform two checks.

First, we collapse the sample using the means of the variables of interest in cells defined by state of residence, year of birth and educational attainment. The rationale to break down by educational attainment although there is no variation in the explanatory variables across educational categories is that it is the main individual level characteristics which we control for and the effect of education on fertility may well be non-linear. We therefore prefer to have means by educational attainment and control for these categories rather than have more aggregate means and control for a flexible function of average educational attainment in the cell. The sample is reduced drastically as it nows contains 19056 observations. Table 11 shows that the results are not affected.

Second, we draw twenty random 5% subsamples of the main sample and run specification (5) from Table 2 on each of the subsamples. We show the coefficients for volatility and their confidence interval in Figure 6. The red indicates zero while the gray line shows where the coefficient in the baseline regression stands. All coefficients are negative, only three are not significant at the 95% confidence level. In comparison, the coefficient on the trend is never significant and that on the cycle only once.

	The dependent variable is children ever born					
	(1)	(2)	(3)	(4)	(5)	(6)
Volatility	-5.258***			-6.180***	-7.897***	-5.919***
	(0.770)			(0.688)	(0.762)	(0.694)
Cycle		0.002		0.007*	-0.006	-0.004
		(0.004)		(0.004)	(0.004)	(0.005)
Trend			-0.412***	-0.440***	-0.127***	-0.122**
			(0.053)	(0.053)	(0.047)	(0.049)
Education						
Baseline: Up to grade 4						
Up to grade 8					-0.322***	-0.320***
					(0.116)	(0.115)
Up to grade 11					-0.632***	-0.631***
					(0.150)	(0.150)
High school grad					-1.093***	-1.093***
					(0.164)	(0.164)
Up to 3 years of college					-1.228***	-1.230***
					(0.178)	(0.177)
College grad +					-1.539***	-1.540***
					(0.176)	(0.176)
Infant mortality						-0.001
						(0.002)
cohort [1898-1920]						-0.007***
						(0.001)
cohort [1921-1945]						-0.014***
						(0.003)
cohort [1946-1970]						0.004
						(0.002)
Observations	19056	19056	19056	19056	19056	19056
R^2	0.444	0.443	0.445	0.446	0.686	0.687

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 11: OLS estimates using collapsed sample

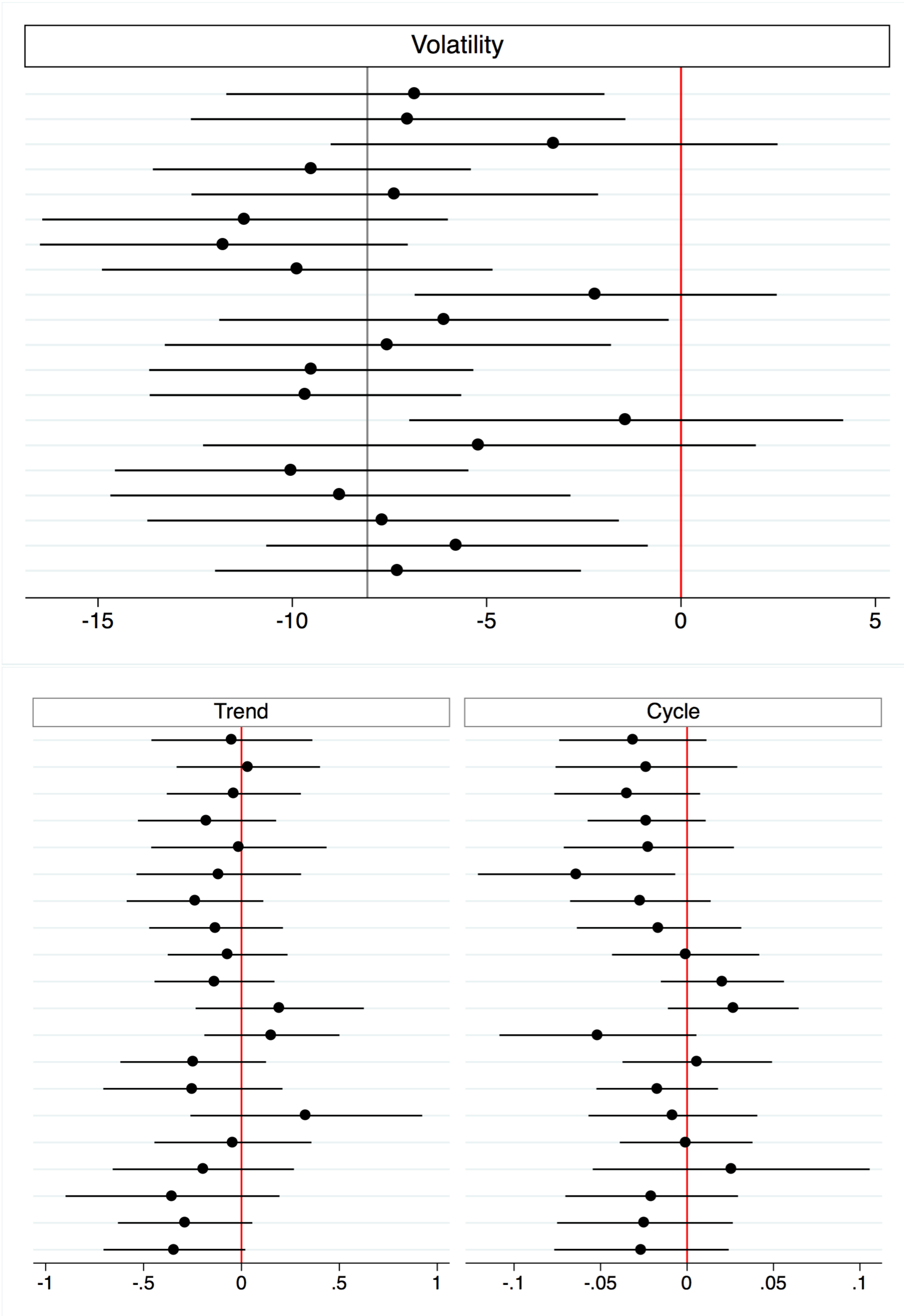


Figure 6: Coefficient on volatility, cycle and trend, using 20 random 5% subsamples

6 Conclusion

The factors that led to the baby boom experienced by the cohorts born between 1925 and 1945 are still widely discussed today. Among these reasons are the rise of electro domestic supplies, the lower risk of maternal death, WWII and the Great Depression leading to changes in the female labor supply composition.

We show that periods of high uncertainty during a woman's fertile years can negatively affect her fertility. This contributes to the understanding of the bust in fertility for those women who were of reproductive age during the Great Depression and WWII. Reducing economic uncertainty might then be an objective to pursue for governments of countries where fertility is below its replacement level.

However, the link between economic uncertainty and fertility has become insignificant for cohorts born after 1945. We argue that this is due to the increasing availability of instruments to insure against uncertainty shocks, such as financial development, the welfare state or even the increased fertility window made possible by medical progress. We therefore hypothesize that the Great Recession will not have demographic consequences comparable to those generated by the Great Depression, at least in developed economies.

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A Comparison with NBER recessions

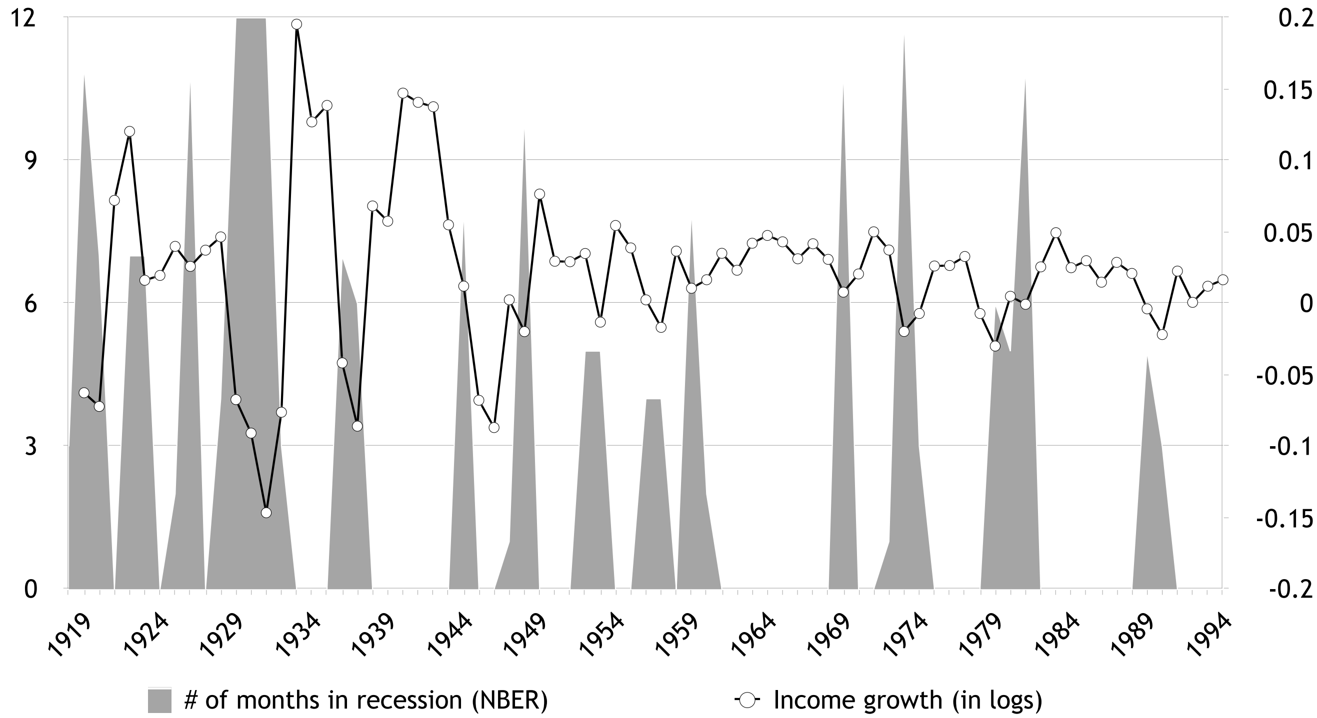
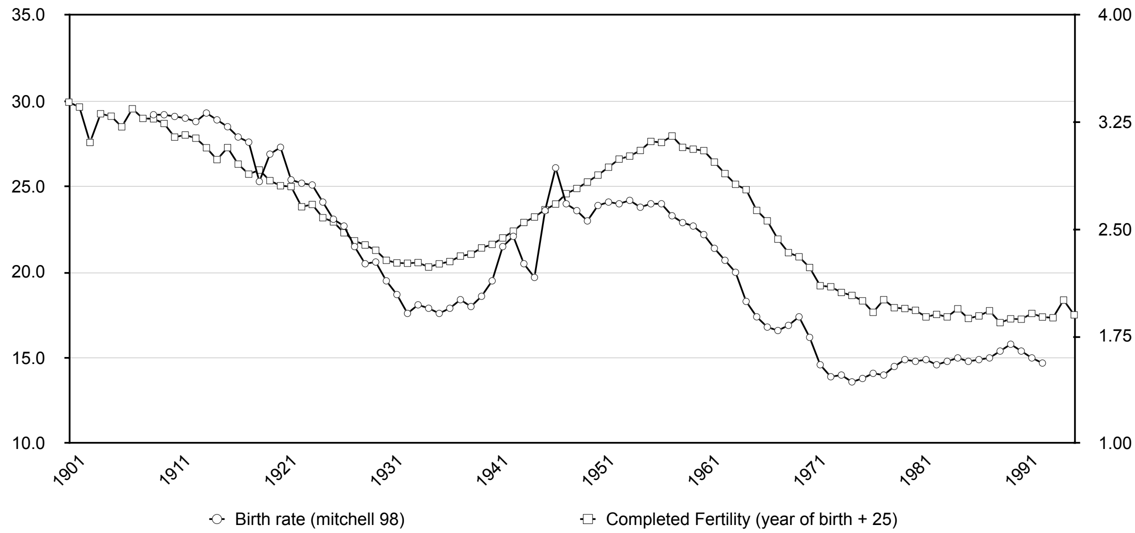


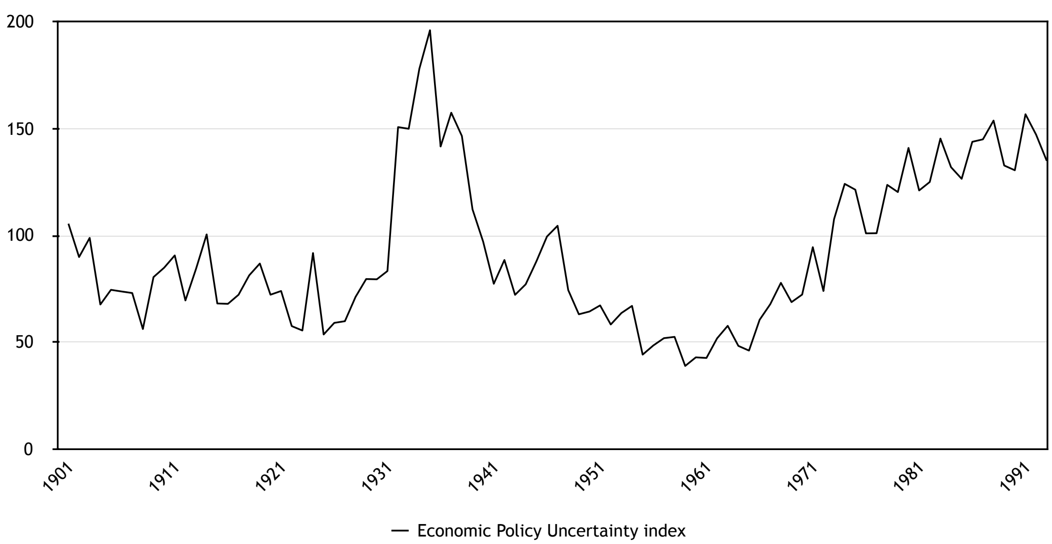
Figure 7: NBER recessions and income per capita growth over time, for the United States
Source: www.nber.org & the Bureau of Economic Analysis

B News-Based Historical Economic Policy Uncertainty

Figure 8 relates fertility to another variable that that captures uncertainty over time. This is the News-Based Historical Economic Policy Uncertainty (EPU) (Baker, Bloom, and Davis 2016). We do not use this variable in the empirical analysis because it is not available at the state-level. Comparing Figures 8b and 1c, we see that both show that high levels of uncertainty at the national level between 1930 and 1940, which correspond to the fertile years for the women born between 1900 and 1925. Figure 1c shows an increase in policy uncertainty, which we do not see from our proxy for economic uncertainty (ie. the standard deviation of growth rates).



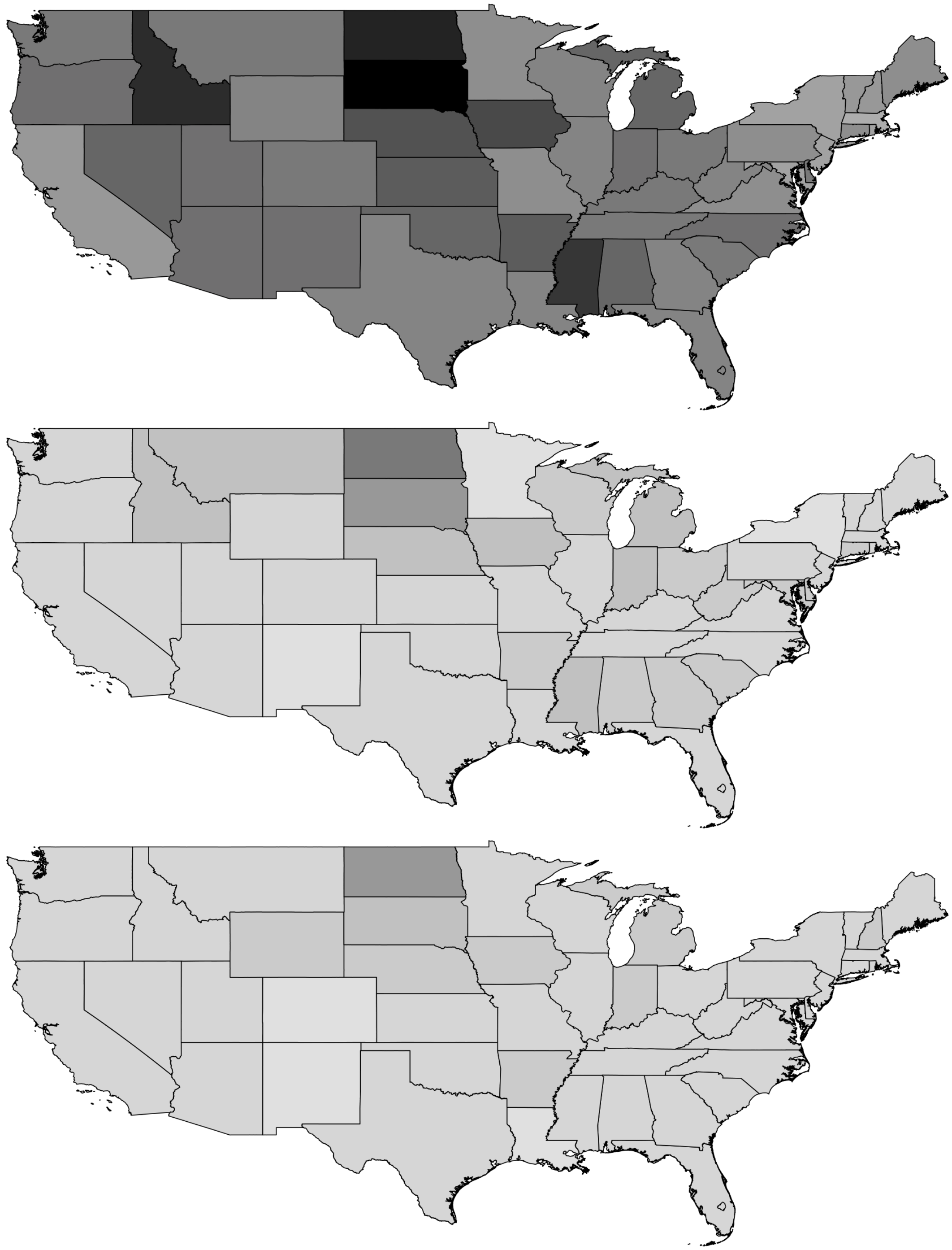
(a) Completed fertility and crude birth rate in the US
Source: US Census 1940-1990 & CPS June supplement 1990-2010 for completed fertility
Mitchell (1998) for crude birth rates



(b) Economic Policy Uncertainty index
Source: `http://www.policyuncertainty.com/us_historical.html`

Figure 8: Uncertainty and fertility over time in the United States.

C Geographical and time variation of uncertainty



Note: We use bins of size 0.01 ranging from 0.01 (lightest gray) to 0.24 (darkest gray).

Figure 9: Standard deviation of income growth, by state, for 1935 (top), 1960 (middle) and 1985 (bottom)

D Age at first marriage and probability of ever marrying – men

Tables 12 and 13 replicate the results of Tables 3 and 4 for the sample of men only.

	The dependent variable is age at first marriage				
	(1)	(2)	(3)	(4)	(5)
Volatility	3.535***			2.311***	4.189***
	(0.888)			(0.800)	(0.927)
Cycle		6.044***		5.667***	3.025***
		(0.715)		(0.699)	(0.823)
Trend			-0.135***	-0.048	-0.670***
			(0.050)	(0.054)	(0.080)
Education					
Baseline: Up to grade 4					
Up to grade 8					-0.253***
					(0.085)
Up to grade 11					-0.334***
					(0.115)
High school grad					0.197*
					(0.116)
Up to 3 years of college					0.631***
					(0.120)
College grad +					1.553***
					(0.118)
Observations	5,115,879	5,115,879	5,115,879	5,115,879	4,770,951
R^2	0.161	0.161	0.161	0.161	0.170

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 12: OLS estimates of the effect of economic uncertainty on age at first marriage

	The dependent variable is ever marrying				
	(1)	(2)	(3)	(4)	(5)
Volatility	-0.065			-0.101*	-0.121**
	(0.045)			(0.052)	(0.051)
Cycle		-0.017		-0.012	0.004
		(0.046)		(0.048)	(0.051)
Trend			-0.016**	-0.019***	-0.034***
			(0.006)	(0.007)	(0.007)
Education					
Baseline: Up to grade 4					
Up to grade 8					0.077***
					(0.006)
Up to grade 11					0.103***
					(0.007)
High school grad					0.105***
					(0.007)
Up to 3 years of college					0.106***
					(0.007)
College grad +					0.091***
					(0.008)
Observations	4,245,973	4,245,973	4,245,973	4,245,973	4136072
R^2	0.026	0.026	0.026	0.026	0.027

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. State-cohort and age at survey fixed effects in all specifications. S.E. clustered at the state level in parenthesis.

Table 13: OLS estimates of the effect of economic uncertainty on the probability of ever marrying