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# **The Baby Boom, Baby Busts, and Grandmothers<sup>1</sup>**

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## **Abstract**

Studies in family economics and anthropology suggest that grandmothers are a highly valuable source of childcare assistance. As such, availability of grandmothers affects the cost of having children, and hence fertility decisions of young parents. In this paper, we develop a simple model to assess the fertility implications of the fluctuations in both output (as argued by demographers) and grandmother-availability induced child-care costs over the period 1920-1970. Model does a good job of mimicking the bust-boom-bust pattern during this period. When the child-care cost channel is shut down, the model's performance weakens significantly; in particular, it fails to capture the bust in the 1960's altogether.

**JEL Classification Numbers:** J13, J20

**Keywords:** fertility, baby boom, baby bust, female labor-force participation, grandmother availability

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## 1. Introduction

During the 20th century, fertility in the United States, and in many other industrialized nations, has exhibited a series of unprecedented deviations around an otherwise declining trend. The most striking of these deviations is the large upward swing in fertility beginning roughly in the early 1940's and lasting until the early 1960's. This “baby boom” was followed by a sharp downturn after the early 1960's, the “baby bust”, which brought fertility back to trend by the 1980's.

Existing theories of the baby boom and baby bust often attribute these events to fluctuations in productivity that occurred with similar timing - the boom following World War II and the slowdown of the 1970's. Quantitative models appear to lend some support to these theories, but they also suggest that productivity fluctuations are only part the story. Calibrating a model that combines simple versions of the stochastic growth model and the Barro-Becker model of endogenous fertility, Jones and Schoonbroodt (2007) find that deviations in productivity capture about 40 percent of the baby boom. Their model, however, predicts the continuation of the boom well into the 1960's, which is in stark contrast with the data. Greenwood et al. (2005) take into account the fertility implications of deviations in household sector productivity in addition to those in market sector productivity. They argue that the introduction of electricity and associated household appliances reduced the need for labor in the child-rearing process; the implied lower cost of having children must then have led to an increase in fertility, and hence the baby boom. This idea is subsequently quantified in a model that combines elements of the standard overlapping-generations model of population growth and a standard household production model. Although the pattern of fertility generated by their preferred model matches the long-run trend in the U.S. data, the model underestimates the baby boom. An alternative specification of their model provides a better match to the boom, but it also causes the model to underestimate the decline in fertility during the baby bust.

Doepke et al. (2005) propose an alternative theory based on increased demand for female labor during World War II. They argue that women who were old enough to work during the war accumulated valuable market experience, and consequently many of them continued to work

after the war. Younger women who turned adult only after the war and entered the labor market faced competition not only from the men who returned from the war but also from the experienced women of the war generation who were still in the labor force. They argue that this led to less demand for inexperienced young women, who were crowded out of the labor market and chose to have more children instead; and that it is these younger women who account for the bulk of the baby boom. They formalize these ideas in a model of fertility choice along the lines of Galor and Weil (1996) and find that the mechanism can account for a substantial portion of the baby boom and bust event.

A main weakness in most of the papers in this literature is their inability to capture the baby bust occurring in the 1960s: While some models underestimate the baby bust, others fail to capture it altogether, driving fertility the wrong way. In this paper, we argue that incorporating the changes in the availability of extended family members such as aunts and grandmothers and female neighbors and friends for child-rearing that took place during this period into these models can improve their match with the data, particularly in the bust period. The basic idea is that the availability of aunts, grandmothers, and friends (henceforth “grandmother availability” for short) in the home or vicinity should reduce the cost of having kids and hence cause an increase in fertility, other things constant. Since there was a sharp drop in grandmother availability between the late 1950s and the late 1960s after half a century of roughly constant levels (as will be argued in sections 2 and 4), the cost of having kids must have gone up sharply in this period, potentially leading to a bust in fertility.

In order to find out if this hypothesis has any promise confronting the data, at least in a qualitative sense, we use a simple model of fertility along the lines of Yasuoka and Miyake (2009) in which fertility is determined jointly by fluctuations in productivity and child-care costs. The novel aspect of our approach is that we assume that fluctuations in child-care costs are generated by fluctuations in grandmother availability. In particular, following Heckman (1974) and others in the family economics literature, we postulate a negative relationship between the two variables, whereby higher (lower) levels of grandmother availability are associated with lower (higher) levels of child-care costs. After quantifying the model using U.S. data, we find that the pattern of fertility generated by the model matches quite closely that in the data over the

period 1920-1970, thereby replicating the well-known bust-boom-bust pattern, but that there are differences in the levels of the two series.<sup>5</sup> When we shut down the child-care cost channel induced by movements in grandmother availability, the match between the model-generated and actual fertility series worsens considerably and the model fails to capture the baby bust in the 1960's altogether, driving fertility the wrong way. We interpret these findings as evidence that fluctuations in child-care costs induced by movements in availability of grandmothers play a particularly important role in the baby bust event of the 1960's.

The remainder of the paper is organized as follows. In the next section, we first provide empirical evidence concerning trends in grandmother availability for child-care assistance. We also shed some light on the reasons causing the drastic change in the availability of grandmothers that took place during the 10-15 year period following the late 1950's. We then present both theoretical and empirical evidence on the relationship between grandmother availability, child-care costs, female labor force participation, and fertility. In Section 3, we develop the formal model of the relationship between fertility, productivity, child-care costs, and grandmother availability. A series of quantitative experiments are conducted on our theoretical model in Section 4. This section also introduces our formal definition of grandmother availability and explains how we measure it from data. Section 5 presents concluding remarks.

## **2. Theoretical and Empirical Evidence**

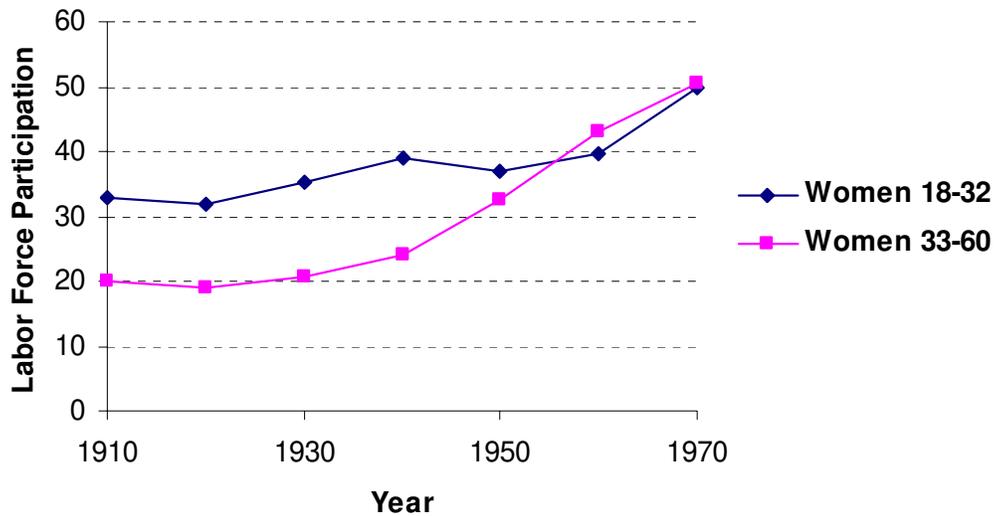
### **2.1. Changes in Grandmother Availability**

We hypothesize that (i) grandmothers will be less likely to offer help in child-rearing if they are working or looking for work themselves, and (ii) mothers will be more likely to need child-care assistance if they are working or looking for work themselves. In order to get a quantitative measure of grandmother availability for child-care assistance over time, we utilize Census data from the Integrated Public Use Microdata Series (IPUMS) of the Minnesota Population Center. This data set provides information on labor force participation rates of women for various age

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<sup>5</sup> The difference in levels should not be surprising since the model is not constructed and simulated so as to match the data quantitatively, but rather to provide a sense of the potential contribution of the fluctuations in grandmother availability to the baby boom and bust event.

groups on a decennial basis. Figure 1 displays the evolution of the labor force participation rates of young-age (18-32 years) and old-age (33-60 years) females between 1910 and 1970.



*Figure 1: Labor Force Participation by Young (18-32) and Old (33-60) Women in the United States (includes women of all races and marital statuses)*

The figure indicates that between 1910-1970 (i) labor force participation rates for both young and old-age females increased almost steadily, with roughly equal growth rates until the 1940's and (ii) the labor force participation rate of older women (33-60) grew more rapidly than that of younger women (18-32) beginning in the 1940's. Therefore, the symmetric evolution of the labor force participation of younger and older women goes through a breakdown around 1940.<sup>6</sup> If we assume that the young-age women represent potential mothers and the old-age women represent potential grandmothers in the population, these two observations suggest a simultaneous increase in the need for non-parental child-care (potential moms are more likely to be working) and a decrease in the availability of such care (potential grandmothers are more likely to be working) over time. Therefore, non-parental child-care provided by grandmothers becomes increasingly scarce during this period. Moreover, the increase in the scarcity of such care accelerates in the 1950's. In the absence of other forms of child-care, such as those provided in

<sup>6</sup>Doepke et al. (2005) also point to this fact. They argue that the surge in labor market participation of older women in the 1950's was due in large part to a long-term effect of WWII. In particular, they argue that the women who worked during the war accumulated valuable labor market experience, and consequently many of them continued to work after the war.

formal markets, the decline in grandmother availability must have worked to increase the cost of having kids between 1910 and 1970, particularly after the early 1950's.

## **2.2. Formal Child-care Availability before the 1970's**

In our analysis, we focus on the period before 1970. The scarce evidence suggests that the size of the (formal) child-care industry was quite small up until the early 1970's. For example, Low and Spindler (1968) find in their survey that in 1965, for 10.5 million mothers with children 0-17 years of age, licensed day care facilities were available for only 475,000 children. They also report that 80 percent of children were cared for either by themselves, or by their immediate or extended family (mother, father, or other relative). Ruderman (1968) reports similar findings concerning the forms of child-care available during that period. Kamerman (1983), on the other hand, provides evidence to the effect that the child-care industry grew rapidly beginning in the early-to-mid 1970s. An important factor contributing to this change appears to have been the government programs (such as workfare legislations and child-care tax credits) initiated in the early 1970's under the Nixon administration. Since these programs subsidize market-provided child care, but not that provided by unpaid relatives, they change the relative price of market and nonmarket provided care (Klerman and Leibowitz, 1990). This change coupled with the fact that labor force participation by women has also been growing seems to have been an important force behind the rapid growth of the child care industry observed in the 1970's.

## **2.3. Child-care Availability, Grandmothers, and Employment Decisions**

Previous research shows that child care costs have a significant effect on the employment decisions of women. Low and Spindler (1968) report that the younger the children the less likely was a mother to be working a full year rather than part year. Ruderman (1968), Bowen and Finegan (1969), and Gronau (1973) find that only younger children (under 3) exert an important retarding effect on women's work effort. These findings might be explained by the fact that child-care costs are the highest for this group of children (See, for example, Del Boca et. al., 2005).

Child care costs also affect the fertility decisions of women. Blau and Robins (1989, 1990) provide evidence that fertility is negatively related to the price of child care. Connelly (1992) finds that fertility and employment decisions are intertwined and that higher child care costs discourage employment.

In the absence of a formal child care market, other arrangements for child care become important in determining the fertility and employment decisions of young women. Low and Spindler (1968) report that 80 percent of children of working mothers were cared for by themselves or by their immediate or extended family and that the most frequent type of child care used was by a relative other than the father, and that a substantial fraction of that care was provided by grandparents (presumably grandmothers). They also report that the lowest level of dissatisfaction for care provided by people other than themselves was about care provided by other adult relatives such as the grandmothers. Rodes (1975) reports a similar finding concerning care provided by adult relatives. Consistent with this body of work, Mason and Kuhlthau (1992) find in their sample of working mothers that about one-third name relatives such as the grandmother rather than the child's father as the ideal caregiver for children under age three. There is also evidence that the presence of the grandmother in the household is associated with higher likelihoods of being in the labor market (Van Gameren and Ooms, 2009), and earlier returns to work among working women with preschool-aged children, especially those with young preschoolers (Klerman and Leibowitz, 1990). Among those returning to work before their infant was three months old, more than half the women used a relative to care for their child (Leibowitz et al., 1992). They also report that having one's own mother nearby has a large impact on the types of child care chosen for very young. However, later decisions about type of provider are independent of the availability of the grandmother.

#### **2.4. Arguments from Anthropology**

The evidence coming from studies in anthropology confirms the effect of grandmothers on fertility decisions of young women. These studies are mainly motivated by the observation that a major difference between human beings and other mammals is that female members of human societies live long beyond their reproductive capacity. This is evidenced in the comparison of

reproductive and postmenopausal life spans of human species with other primates. Although different primates have reproductive phases of same lengths during their life time, female human species have exceptionally long postmenopausal life spans (Schultz, 1969).

A proposed explanation for this phenomenon, Grandmothering Hypothesis, suggests that post-reproductive component of life for females is favored by natural selection due to positive effects of grandmothering on the fitness of the offspring (Hawkes et al., 1998). This effect has likely emerged as human societies were shifting from simple to hard-to-handle food, giving an opportunity to vigorous elder females for helping their daughters and increasing the representation of their vigor in descendant generations (Hawkes, 2004).

Using individual-based multi-generational data sets from pre-modern (18th and 19th centuries) populations of Finland and Canada, Lahdenpera et al. (2004) study the fitness benefits of post-reproductive lifespan for females. They find that the presence of a grandmother increases the number of grandchildren and reduces interbirth intervals for the grandchildren. In addition to this, grandchildren have significantly higher survival probabilities if their grandmother is alive at their birth.

### **3. The Model**

In this section, we lay out a model of the response of fertility to movements in Total Factor Productivity (TFP) and grandmother availability. The model we use is based on Yasuoka and Miyake (2009). We add two new components to the basic model: Productivity shocks and child-care cost shocks, where the latter is assumed to be induced by changes in grandmother availability. In each period, the shocks are realized and the representative household decides how much to consume, how many children to have, and how much to invest in each child's education given her income.<sup>7</sup> Income is determined by the household's human capital level and the realization of the productivity shock. The household's human capital, in turn, depends on her

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<sup>7</sup> Note that since the shocks are realized before the household decision process, our model is in fact a deterministic one. Therefore, the word “shock” should not be interpreted literally.

parents' human capital and on her level of education (chosen by her parents in the previous period)

The household's problem can be formulated as follows. In each period, the household solves the utility maximization problem:

$$\max_{c_t, n_t, e_t} \alpha \ln(n_t h_{t+1}) + (1 - \alpha) \ln(c_t)$$

subject to:

$$p_t n_t + e_t n_t + c_t = s_t h_t \quad (1)$$

$$h_{t+1} = e_t^\beta h_t^{1-\beta} \quad (2)$$

$$h_0 \text{ fixed,}$$

where  $s_t$  is the productivity shock,  $p_t$  is the child-care cost,  $c_t$  is consumption,  $n_t$  is the number of children,  $e_t$  is the level of education per child,  $h_t$  is human capital in period  $t$  and  $\alpha$  and  $\beta$  are between 0 and 1. The maximization takes place after the realization of  $s_t$  and  $p_t$ . Equation (1) is the budget constraint and equation (2) is the law of motion for human capital across generations.<sup>8</sup>

There are two types of costs associated with having children and, for simplicity, both costs are assumed to be in terms of goods. The first cost,  $p_t$  is associated with producing children and is best interpreted as representing child-related costs that begin around birth and continue during the early preschool years of a child. The key assumption we make is that if a grandmother is around to help with looking after children, then this cost is reduced for parents. We model this effect by letting  $p_t$  be a decreasing function of grandmother availability,  $G_t$  that is, we let

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<sup>8</sup> The constraint set in this problem is not convex because of the term  $e_t n_t$ . Despite this fact, a sufficient condition for the problem to be well-defined is that  $\alpha > \alpha\beta$ , which is satisfied in our setup since  $\beta < 1$ . Please see Jones et al. (2011) for details.

$$p_t = f(G_t), \quad (3)$$

where  $f(.) > 0$  and  $f'(.) < 0$ .<sup>9</sup> The second cost of having children is associated with educating them. In particular, parents can increase the quality of a given child (i.e. the human capital in the following period) by spending resources: At a cost of  $e_t$ , the human capital of a child can be increased from  $h_t$  to  $h_{t+1}$  according to equation (2). We assume that this cost is independent of grandmother availability.

The solution for the optimization problem stated above yields the following optimal allocations:

$$c_t = (1 - \alpha)s_t h_t, \quad (4)$$

$$e_t = \frac{\beta p_t}{1 - \beta}, \quad (5)$$

$$n_t = \frac{\alpha(1 - \beta)s_t h_t}{p_t}. \quad (6)$$

The key variable of interest is the fertility rate,  $n_t$ , given by equation (6). This is the model quantity that we will identify with the Total Fertility Rate (TFR) in the data in the next section. Note that  $n_t$  increases with the realized level of income,  $s_t h_t$ , and decreases with the cost of producing children,  $p_t$ .<sup>10</sup> Moreover, the law of motion for human capital implies that  $h_t$  depends on the initial level of human capital and the past realizations of the cost of producing children in the following way:

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<sup>9</sup> In Yasuoka and Miyake (2009)'s theoretical model, the price of child-care is determined endogenously by supply and demand in a formal market for child-care services.

<sup>10</sup> Assuming that fertility is increasing in income might seem strange in the face of the fact that most studies find a negative relationship between the two variables; especially if one is trying to understand the secular decline in fertility rates in industrialized countries since the early 1800's. Since our focus is on the period between 1910 and 1970, however, we do not view this as a serious problem for our analysis. This is because the coefficient of correlation between the two annual series for TFR and TFP for the years 1917 to 1968 is 0.35, which suggests that the U.S. TFR is procyclical during this period. Please see also Jones and Schoonbroodt (2007) on this point, who find that the coefficient of correlation between the annual series of the deviations of the two variables from their respective trends is 0.67 for the same period.

$$h_t = h_{t-1}(p^{t-1}) = \left(\frac{\beta p_{t-1}}{1-\beta}\right)^{\beta(1-\beta)^0} \dots \left(\frac{\beta p_0}{1-\beta}\right)^{\beta(1-\beta)^{t-1}} h_o^{(1-\beta)^t}, \quad (7)$$

where  $p^{t-1} = (p_{t-1}, p_{t-2}, \dots, p_0)$  is the history of child-care costs up to and including period  $t-1$ .

Taking account of this, equation (6) can be rewritten as

$$n_t = \frac{\alpha(1-\beta)s_t h_t(p^{t-1})}{p_t}. \quad (8)$$

Therefore, both current and past realizations of  $p$  influence  $n_t$ , but they do so in a different way. Specifically, while high values of current  $p$  reduce  $n_t$ , high values of past  $p$ 's increase it. It is easy to see why a high  $p_t$  should reduce  $n_t$ : The high cost of having kids discourages parents from having too many. To see why high values of past  $p$ 's increase  $n_t$  on the other hand, consider the following thought exercise: Suppose that  $p_{t-1}$  is high. In this case, the high cost of producing kids discourages parents from having kids in period  $t-1$ , causing  $n_{t-1}$  to go down (equation 6). The reduction in the number of kids then relaxes period  $t-1$  parents' budget constraint and allows them to spend more on each child's education, increasing  $e_{t-1}$  (equation 5). Increased child education in period  $t-1$  produces higher human capital adults (i.e. parents) in period  $t$ , causing  $h_t$  to go up (equation 2). This, in turn, allows period  $t$  parents to earn more income. Since children are normal goods, the increase in income leads to an increase in number of children in this period, that is, a higher  $n_t$  (equation 6). This result can be interpreted as a Beckerian quantity-quality trade-off.

#### 4. Quantification

In this section, we perform a number of simple quantitative experiments on the model developed in the previous section. Our ultimate goal is to find out whether including grandmother availability in an otherwise standard model of fertility choice can improve the ability of the model to account for the data during the baby boom and bust episode. Consistent with this goal,

we first calculate the actual magnitudes of deviations from the trends of TFP and child-rearing costs for every decade from the 1910's to the 1960's, and then feed these into the model to obtain model results for fertility rates. Next, we compare the fertility series generated by the model with the actual time series of fertility rates. Finally, in order to highlight the significance of child-rearing costs for fertility, we consider a version of the model in which shocks to child-rearing costs are completely shut down, and compare the results with that of the full-fledged model. While performing these exercises, we also briefly describe the main features of the relevant variables in the data, namely, TFP, TFR, and availability of child-care assistance provided by grandmothers.

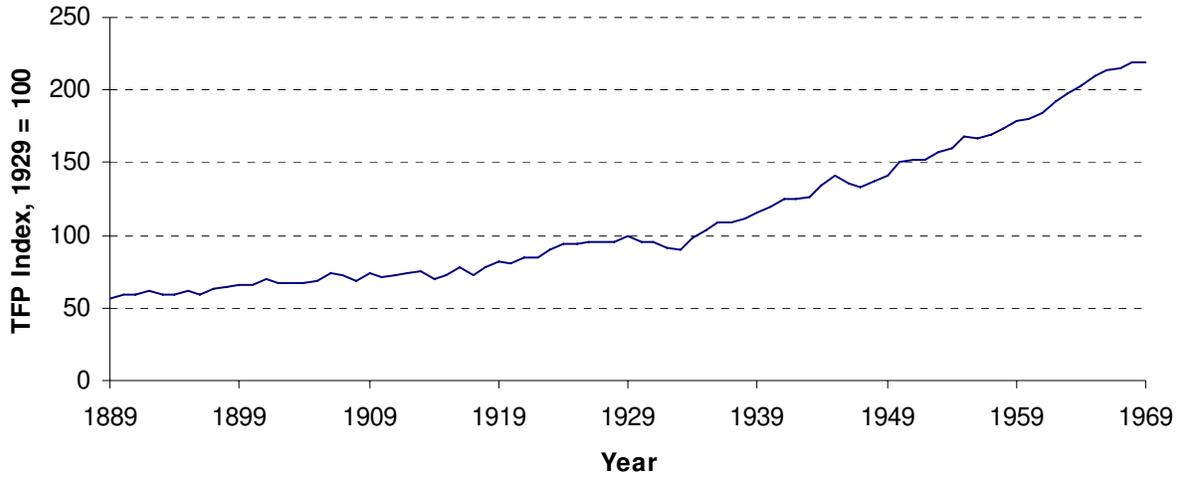
#### 4.1 Model with both TFP and Child-rearing Cost Shocks

A critical choice here is the length of a period. Like Greenwood et al. (2005) and Jones and Schoonbroodt (2007), we assume that a period is 10 years. In addition, we must specify the parameters of the model to fully characterize the decision rules. Throughout, we set  $\alpha = 1/2$  and  $\beta = 1/2$ .<sup>11</sup> Finally, we normalize the initial levels of human capital and child-rearing costs to 1, that is, we set  $h_0 = p_0 = 1$ .

Next, we must obtain the realizations of the shocks to TFP and child-rearing costs for all decades beginning with 1910-1919 and ending with 1960-1969. To this end, we first use the TFP data as laid out in Kendrick (1961) and Kendrick (1973). This data series is available at annual frequencies and is shown in Figure 2 over the period 1889 to 1969.

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<sup>11</sup> The quantitative results are not sensitive to the choice of  $\alpha$ . The choice of  $\beta$ , however, can affect the results to some degree. Studies by Solon (1992) and Zimmerman (1992) suggest that the inter-generational income correlation (corresponding roughly to  $1 - \beta$  in our model) is at least 0.4 for individuals and around 0.5 for families.



*Figure 2: Total Factor Productivity, 1889-1969*

The main features of this data series are:

- A general upward trend,
- An downward trend during the 1920's and 1930's, and
- A return to trend following World War II.

We use this data series to obtain the realizations of the TFP shocks for the period 1910-1970. In particular, we first define

$$s_t = \frac{A_t}{\bar{A}_t} \quad (9)$$

where  $A_t$  denotes the realization of TFP in period  $t$  and  $\bar{A}_t$  denotes the value predicted by the trend of TFP in period  $t$ . Thus,  $s_t$  takes the value of 1 if there is no shock, that is, when  $A_t = \bar{A}_t$ . Depending on the nature of the shocks, which can be positive or negative, the value of  $s_t$  moves around 1. Note that while  $A_t$  comes directly from Kendrick's data,  $\bar{A}_t$  must be calculated. To do this, we fit an exponential trend to the TFP series. We finally use equation (9)

to compute  $s_t$  decade by decade, beginning with 1910 to 1919. The estimated series for  $s_t$  is given by [0.935, 0.966, 0.905, 0.987, 1.026, 1.079].

Obtaining the series for the child-rearing costs,  $p_t$ , is slightly more involved. We do this in a number of steps. First, recall that we argued in the previous sections that child-rearing costs are negatively related to grandmother availability. Here, we specify this relation as

$$p_t = f(G_t) = \bar{p} + \varepsilon(G_t) \quad (10)$$

where  $\bar{p}$  is the constant long-run level of the child-care cost, which is without loss of insight set equal to  $p_o$  (which is equal to 1 by assumption), and  $\varepsilon(G_t)$  is the shock to this cost induced by movements in grandmother availability. Therefore, we assume that changes in the cost of child-care come only from changes in the availability of grandmothers for child-rearing.<sup>12</sup> Just like the value of  $s_t$ , the value of  $p_t$  moves around 1: While an above-trend value of  $G_t$  decreases  $p_t$  (in which case  $\varepsilon(G_t) < 0$ ), a below-trend value of  $G_t$  increases it (in which case  $\varepsilon(G_t) > 0$ ).

In order to determine whether  $\varepsilon(G_t)$  is positive or negative, we must first obtain a quantitative measure of grandmother availability,  $G_t$ . Unfortunately, grandmother availability is not a routinely reported statistic. We must therefore construct it ourselves. Our approach to constructing such a measure is based on two premises:

- Grandmothers will be more likely to offer child-care assistance if they are not working or looking for work, and
- Mothers will be more likely to need child-care assistance if they are working or looking for work.

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<sup>12</sup> There might of course be other factors impacting the cost of child-care. However, this way of modeling allows us to isolate the effects on fertility of fluctuations in grandmother availability.

Consistent with these premises, we use labor force participation data for younger and older women (representing potential mothers and potential grandmothers, respectively) from IPUMS for the decades 1910 to 1970 to construct our statistic.<sup>13</sup> In particular, we compute

$$G_t = \frac{(\text{Women who *are not* in the labor force and are aged between 33 - 60})_t}{(\text{Women who *are* in the labor force and are aged between 18 - 32})_t}$$

for  $t=1910-1919, \dots, 1960-1969$ . Here, the numerator is used as a proxy for the *supply* of child-care and the denominator as a proxy for the *demand* for child-care. As such, this statistic can be interpreted as an “effective supply” or “availability” of child-care assistance provided by grandmothers in the present context.<sup>14</sup> Note that by construction this measure takes into account child-care assistance provided not only by extended family members such as aunts and grandmothers, but potentially also that provided by female neighbors or friends. Figure 3 shows the time path for this series. Observe that the availability of child-care assistance is essentially constant between 1910 and 1960, with a sharp decline thereafter. As we will see shortly, this change likely has important implications for trends in fertility.

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<sup>13</sup> Note that since IPUMS dataset is based on Census surveys, the data are available only every 10 years. Also, since this dataset comes from a stratified sample, the data are weighted using the appropriate weighting scheme. See Ruggles et al. (2004) for details.

<sup>14</sup> Our quantitative results are robust to various specifications of the age brackets: We have also checked appropriate combinations of (20-32), (18-35), (20-35) age brackets for younger women and (36-60), (40-60), (40-65) for older women.

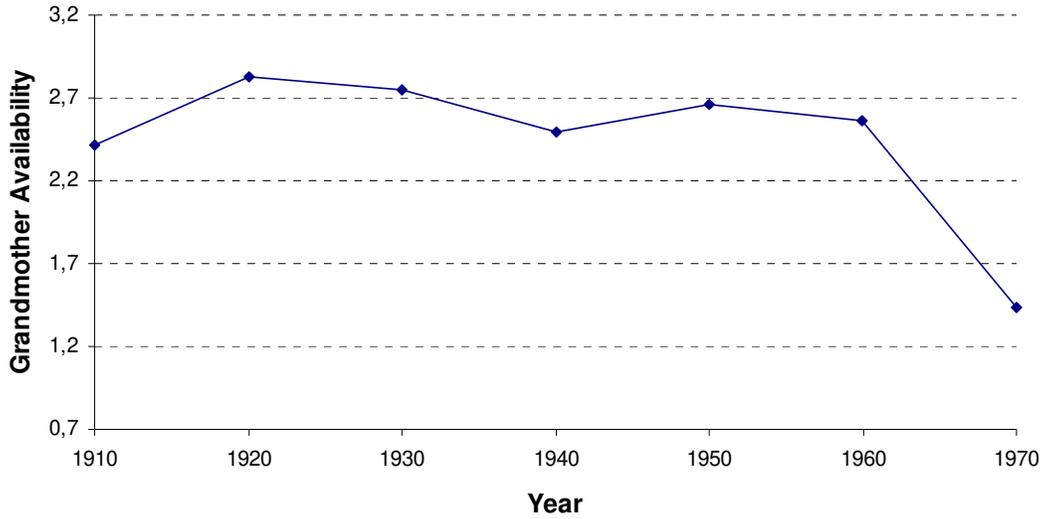


Figure 3: Grandmother Availability

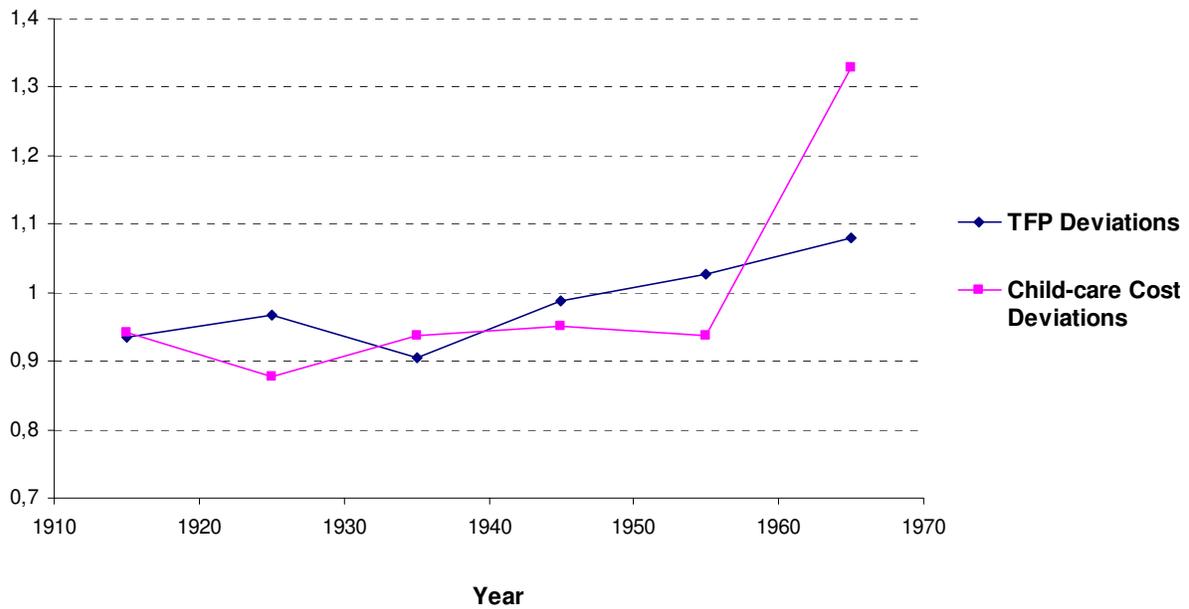
Having developed the grandmother availability statistic, we are ready to define  $\varepsilon(G_t)$  which was first introduced in equation (10). First, using the fact that  $G_t$  is roughly constant during most the period between 1910 and 1970, we take the average of the values for 1910-1970 in order to obtain the “trend” value of  $G_t$  for the period.<sup>15</sup> Let  $\bar{G}$  denote this trend value. We can then define

$$\varepsilon(G_t) = \frac{\bar{G}}{G_t} - 1 \quad (11)$$

Observe that  $\varepsilon(G_t) > 0$  when  $G_t < \bar{G}$  and  $\varepsilon(G_t) < 0$  when  $G_t > \bar{G}$ . We finally use equation (11) in conjunction with equation (10) to compute  $p_t$  decade by decade, beginning with 1910 to 1919. The estimated series for  $p_t$  is given by  $p = [0.941, 0.878, 0.937, 0.952, 0.938, 1.329]$ .

The following figure shows the deviations of  $s_t$  and  $p_t$  from their respective trends.

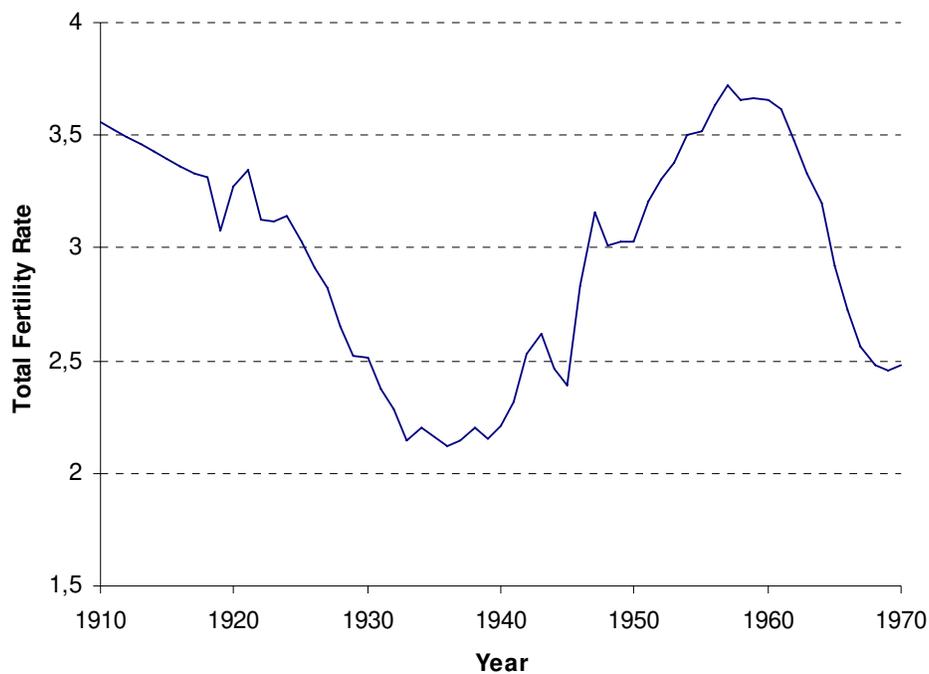
<sup>15</sup> Other ways of obtaining the trend for the period (such as fitting a polynomial trend to the series) do not affect the qualitative results of our analysis.



*Figure 4: Total Factor Productivity and Child-care Cost: Deviations from Trend*

The final step in our experiment is to compare the model-generated fertility series versus the actual time series of fertility rates. To do this, we first obtain model results for fertility rates decade by decade by feeding the realizations of  $s_t$  and  $p_t$  into the model. Next, in order to obtain the actual time series of fertility rates, we use Total Fertility Rate (TFR) data from Natality Statistics Analysis from National Center for Health Statistics.<sup>16</sup> This data series is available at annual frequencies, beginning with 1917. We complement this series by another time series prepared by Haines (1994). Since Haines uses Census data, the time series is available only every 10 years. Figure 5 shows our TFR series over the period 1910 to 1970.

<sup>16</sup> We thank Alice Schoonbroodt for providing this time series to us.



*Figure 5: Total Fertility Rate, 1910-1970*

The main features of this data series are:<sup>17</sup>

- A downward trend until the mid 1930's,
- An upward trend between the late 1930's and late 1950's, and
- A downward trend after the late 1950's.

In order to make model and data quantities comparable, we then calculate the decade averages of the TFRs beginning with 1910 to 1919 and ending with 1960 to 1969. Figure 6 plots the fertility time series generated by our model and those observed in the data, where the fertility level of the first decade is normalized to 1 for both series. As can be seen in the figure, the model is quite successful in predicting the general pattern in fertility, except for the first decade. In particular, the model predicts a baby boom beginning around the mid-1930's and lasting until the mid-1950's, and a baby bust beginning around the mid-1950's, just like in the data. The model also

<sup>17</sup> The exact timing of these events depends on how exactly one looks at the data. For example, while Greenwood et al. (2005) start the baby boom in 1936, Jones and Schoonbroodt (2007) start it a few years later. Readers are referred to these two papers for a detailed description of this data series.

predicts an early baby bust between the 1920's and 1930's. Overall, the model is quite successful in capturing the main features of the bust-boom-bust event that took place in the United States around the middle of the 20th century.

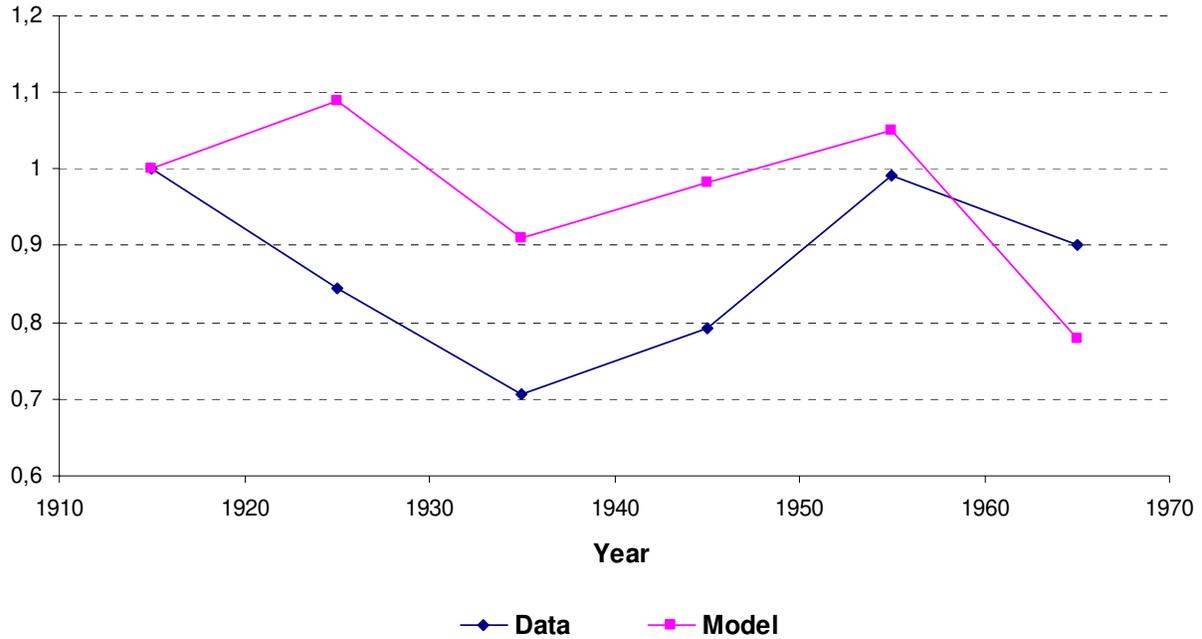
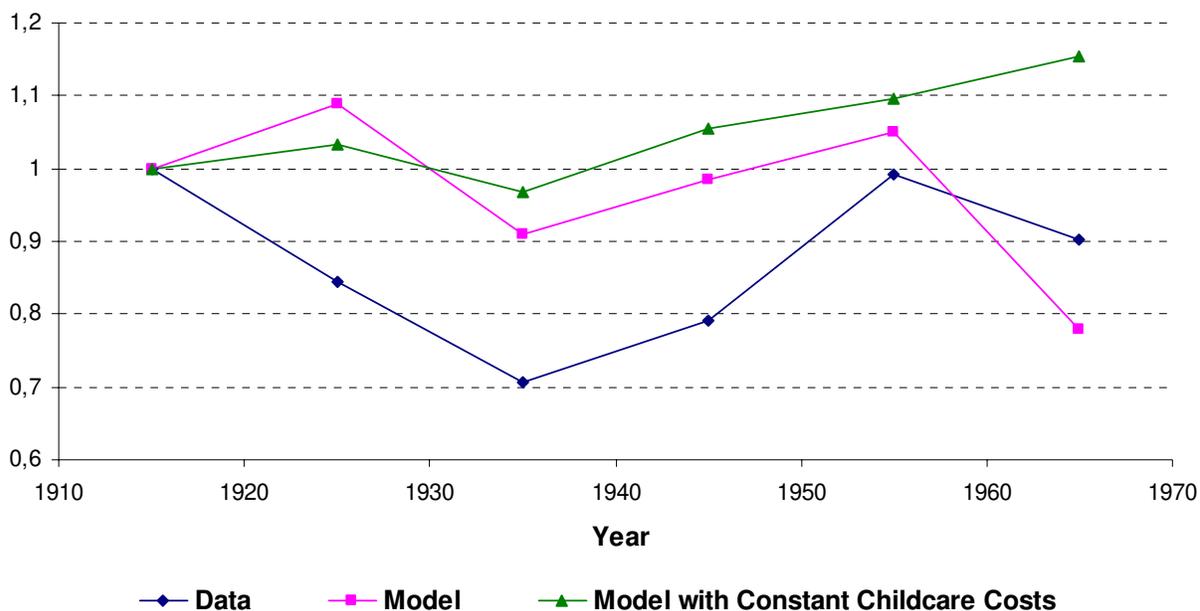


Figure 6: Total Fertility Rate, Model versus Data

#### 4.1 Model with only TFP Shocks

In order to highlight the importance of child-rearing costs (and hence grandmother availability) for fertility, we now consider a baseline version of our model in which these costs are assumed to be constant over time. Specifically, we ignore the volatility in child-rearing costs by setting  $p = 1$  for all decades (that is, we set  $\varepsilon(G_t) = 0$  for all  $t$ ). Therefore, in this version of the model, movements in fertility rates arise solely as a result of shocks to TFP. This version of the model is also interesting because it most closely corresponds to that in Jones and Schoonbroodt (2007). Figure 7 displays the pattern of fertility rates predicted by each of the two models as well as those observed in the data.



*Figure 7: Total Fertility Rate, Both Models versus Data*

As can be seen from the figure, overall the version of the model with varying child-rearing costs tracks more closely the fertility movements observed in the data than the version of the model with constant child-rearing costs. In particular, the figure shows that failing to take into account the fluctuations in child-rearing costs causes the gap between model-generated fertility rates and actual fertility rates to widen during the first baby bust that took place between the 1920's and 1930's as well as during the baby boom that took place between the 1930's and 1950's. The major difference between these two models arises, however, when we move from the 1950's to 1960's, that is, during the second baby bust. Contrary to what's in the data, the version of the model with constant child-rearing costs predicts an increase in fertility rates during this period. When grandmother availability-induced movements in child-rearing costs are taken into account, however, the model predicts a decline in the fertility rate in this decade, as observed in the data. This finding suggests that the increase in child-rearing costs that took place during this period was large enough to reverse the positive effect on fertility coming from TFP shocks.

Our simple quantitative analysis suggests, therefore, that taking into account the temporal changes that took place in child-rearing costs induced by changes in the availability of aunts,

grandmothers, and other adult women such as neighbors and friends can improve the ability of an otherwise standard model of fertility to account for the data, particularly during the baby bust that occurred in the 1960's.

## **Conclusion**

In this paper, we have developed a simple theory that links the baby boom and busts of the 20th century to fluctuations in productivity and child-rearing costs faced by young women making fertility decisions.

Since there was a take-off in productivity in the 1940's and child-rearing costs were relatively low, our theory predicts a baby boom during this period. Likewise, the slowdown in the growth of productivity coupled with unusually high child-rearing costs faced by young women in the 1960's generates a baby bust. Our theory also predicts an earlier baby bust that took place between the 1920's and 1930's, just as observed in the data. Our quantitative experiments demonstrate that child-rearing costs are important in accounting for the bust-boom-bust event: The pattern of fertility generated by the version of the model with constant child-rearing costs provides a significantly worse match with the actual time series of fertility rates than that generated by the version of the model that features variable child-rearing costs. The main weakness of the former version of the model is that it fails to predict a baby bust in the 1960's, driving fertility the wrong way.

The novelty of our approach is that we link the cost of child-care to the extent of the availability of extended family members such as grandmothers and aunts (and also female neighbors and friends), an insight borrowed from the literatures on family economics and anthropology. Since formal sources of child-care were severely limited until the 1970's, focusing on such informal care is not only reasonable but also indispensable. We show that such care was relatively abundant during the baby boom, making it easier for young women to have children. Following the surge in the labor force participation of older women in the 1940's, such informal child-care became increasingly scarce since older women now had less time to look after grandchildren. The scarcity of such care reached unusually high levels in the 1960's when the rapid growth in

the labor force participation of older women was matched with an equally strong growth in the labor force participation of younger women, causing a baby bust.

Overall, our analysis suggests that the asymmetric evolution of the labor force participation of young-age and old-age women after the 1940's and the associated changes in the availability of informal child-care assistance provided by close family members such as aunts and grandmothers play an important role in accounting for the baby boom and bust periods of the 20th century.

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