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Gender Roles and Technological Progress

Stefania Albanesi and Claudia Olivetti

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Stefania Albanesi† and Claudia Olivetti‡

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Abstract

Until the early decades of the 20th century, women spent more than 60% of their prime-age years either pregnant or nursing. Since then, improved medical knowledge and obstetric practices reduced the time cost associated with women's reproductive role. The introduction of infant formula also reduced women's comparative advantage in infant care, by providing an effective breast milk substitute. Our hypothesis is that these developments enabled married women to increase their participation in the labor force, thus providing the incentive to invest in market skills, potentially narrowing gender earnings differentials. We document these changes and develop a quantitative model that aims to capture their impact. Our results suggest that progress in medical technologies related to motherhood was essential to generate the significant rise in the participation of married women between 1920 and 1960, in particular those with children. By enabling women to reconcile work and motherhood, these medical advancements laid the ground for the revolutionary change in women's economic role.

1 Introduction

The dramatic rise in the labor force participation of married women is one of the most notable economic phenomena of the twentieth century. The trend is particularly prominent for those with young children and has led to a revolutionary change in women's economic role. We examine the contribution of progress in medical technologies related to motherhood to this process and find that these advancements played a critical role.

Our point of departure is that women's maternal role was associated with a considerable time commitment until the early decades of the twentieth century. Consider a typical woman in 1920. Her life expectancy was 55 years at age 10. She married at age 21 and had on average more than 3 children, with her first birth at age 23 and her last at age 33. Her total number of pregnancies was higher than the number of births, given the high fetal mortality rate. In total, she would be pregnant for 34% of the time during her fertile years.

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†Columbia University, NBER, and CEPR. Sa2310@columbia.edu. Corresponding author.

‡Boston University. Olivetti@bu.edu.

Health risks in connection to childbirth were severe. The pre- and post-partum phases, as well as labor, were associated with considerable suffering that could lead to physical disability and, in the extreme, death. One mother died for each 125 living births in 1920. The four main causes of death were septicemia, toxaemia, trauma and hemorrhages. At a rate of 3.6 pregnancies per woman, the compounded risk of death was 2.9% or 1 in 34, a very considerable number. Add to this that, for every maternal death, twenty times as many mothers suffered different degrees of disablement annually (Kerr, 1933). Indeed, infection, toxemia, and trauma were also the main causes of maternal morbidity. The duration of the corresponding disablement ranged between 7 months and 7 years. An additional factor to consider for the early decades of the 20th century is that most infants were breast fed in their first year of life. Women would then be nursing for 33% of the time between age 23 and 33. Since the time required to breast feed one child ranges between 14 and 17 hours per week for the first 12 months, this means that 35% to 43% of women's working time was devoted to nursing for a 40 hour workweek.

Not surprisingly, these biological demands significantly hindered women's ability to participate in the labor force and substantially weakened their incentives to invest in marketable skills. Only 9% of married women were in the labor force in 1920, and only 3% among those with preschool children. Starting in the 1930's there were significant advancements in medical "technologies" related to motherhood. We show that these developments were critical to the rise in married women's labor force participation. We first provide evidence on progress in this area and argue that it reduced the time spent by women in reproductive duties. We then develop a quantitative model that aims to capture their impact.

We consider two dimensions of medical progress. The first corresponds to scientific discoveries that determined a substantial improvement in maternal health and a decline in the time cost associated with pregnancy, childbirth and recovery. Leading examples are the development of bacteriology and the introduction of sulfa drugs and antibiotics that dramatically decreased mortality risk from sepsis, blood banking that reduced the risk from hemorrhages, and standardization of obstetric interventions that brought the incidence of trauma during labor to a minimum. These same advancements also contributed to a fall in stillbirths and miscarriages and the consequent decline in the number of pregnancies for given live births. The second dimension is the development and commercialization of infant formula, which, by providing an effective breast milk substitute, reduced women's comparative advantage in infant feeding and degendered home production. Advancements in both these areas were largely exhausted by the mid 1950's.

We construct measures of this progress using a variety of data sources. For the first component, we derive an index of maternal health based on historical data on births, fetal and maternal deaths. We use this index to proxy the reduction in the time cost associated with pregnancy, childbirth and recovery. For the second component, we posit that the progress in infant feeding technologies is embodied in baby formula and measure it with the time price of Similac, the earliest and most popular modern formula. We collect the data from advertisements in historical newspapers.

The model features overlapping generations of agents who are born single and then marry. When single, they can invest in market skills, which increases their wages in future periods. In addition to consumption and leisure, agents value two home goods. The *general household good* corresponds to activities such as meal preparation, cleaning, and other household chores. *Both* spouses can contribute to the production of this good. The *infant good* represents those activities strictly connected to the existence of infants in the household, that is pregnancy, childbirth and feeding. This home good is only valued in the fecund years of life, and *only* wives can contribute to its production. Two technologies, old and new, can be adopted for the production of each home good. Households must pay to adopt the new technologies, which are less labor intensive than the old. This cost reflects the value of additional market goods required in production. If the new technology is adopted, infant feeding becomes a general household good since both spouses can now take on the task. Households decisions are Pareto efficient and fertility is exogenous. Both the division of labor within the household and gender differences in wages are endogenous. The only exogenous gender asymmetry built into the model is the assumption that only the wives' time is required for the production of infant goods.

Progress in medical technologies that leads to a reduction in the time required from mothers' for infant care is a necessary condition for the rise in labor force participation of married women at all ages in the model. A decline in time cost of pregnancy and the price of infant formula increases the labor force participation of women in the fecund period, which raises investment in market skills when single and reduces their earning differential relative to men. This outcome also reduces women's home hours and increases their participation beyond the fecund years of life.

Our quantitative analysis allows for four exogenous sources of technological progress. The reduction in the time cost of pregnancy, childbirth and recovery, and the introduction and improvement of infant formula have a direct impact on women *only*. The improvement in general household technologies, advocated by Greenwood, Seshadri and Yorugoklu (2005), and the economy-wide increase in real wages affect the opportunity cost of home production for *both* genders. To examine the role of these factors, we calibrate the model to 1920 and we feed in measures of technological progress for the time period between 1920 and 1970 to examine the properties of the transition and to evaluate the impact of each source of progress in isolation. Our results suggests that medical progress is indeed a powerful force. The reduction in the time cost of pregnancy, childbirth and recovery alone can account for the fourfold increase in the labor force participation of married women with children between 1920 and 1960. Progress in home appliances only plays an important role between 1950 and 1970.

Our simulations overpredict the labor force participation rate of married women and the closing of the gender earnings gap. This is not surprising since technological progress is the only force at work in our model. In reality, a variety of offsetting factors were at work. Among those, a very important one until the 1950's was the presence of "marriage bars," consisting in the practice of not hiring married women or dismissing female employees when they married. Marriage bars were prevalent and pervasive in teaching and clerical work, which accounted for half of single women's employment in that period (Goldin, 1991). Cultural forces and preference formation, as emphasized in Fernández, Fogli and Olivetti (2004) and Fernández and Fogli (2005), or statistical discrimination driving gender earnings differentials as in Albanesi and Olivetti (2006), may also have played an important role in slowing down the increase in women's labor force participation.

We are the first to analyze the impact of progress in medical technologies related to motherhood on married women's labor force participation. Our contribution is to isolate and measure sources of technological change that are intrinsically gendered and *directly* affect women, and to quantify their impact. Given that the public health considerations and general scientific discoveries that led to these advancements date as far back as the mid 19th century and largely preceded the rise in married women's participation, they can be considered exogenous. By contrast, the diffusion of modern home appliances largely occurred after World War II and may well have been driven by rising demand from working women. Perhaps more importantly, the new medical technologies generated a tangible effect on women's lives in the late 1920s and early 1930s, the years in which married women's participation started to rise. By making it feasible for women to reconcile work and motherhood these advancements set forth the process of change that revolutionized women's economic role.

The paper is organized as follows. Section 2 documents progress in medical technologies related to motherhood and constructs measures of this progress. Section 3 describes our analytical framework. Section 4 discusses our calibration strategy and presents the results of our quantitative analysis. Section 5 concludes.

2 Progress in medical technologies related to motherhood

This section documents two aspects of technological progress that contributed to reduce the time commitment associated to women's maternal role: the medical advancements that reduced the time cost of pregnancy, childbirth and subsequent recovery, and the introduction and diffusion of 'humanized' infant formula.

2.1 Progress in Maternal Health

The risk of temporary or permanent disability, and potentially death, associated with labor, delivery and post-partum conditions substantially contributed to the cost of women's maternal role, as documented in Loudon (1992) and Leavitt (1986). The four main causes of maternal death were septicemia (40%), toxemia (27%), traumatic accidents of labor (10%) and hemorrhages (10%)[1]. Infection, toxaemia and trauma were also the main causes of maternal morbidity and gave rise to the most debilitating ailments associated with the child bearing process, such as puerperal fever, prolonged labor, vesico-vaginal fistula and other severe forms of perineal lacerations. A variety of complications associated with the puerperium, due to pelvic deformation and lack of strength from poor nutrition, also contributed to imperil the health of the mother, as well as that of the child.

It is hard to comprehensively assess the toll of childbearing on women's health and productivity given the great variety of possible debilitating conditions. Systematic data on the duration and intensity of the disablements are not available even for the most recent years.[2] Yet, a few hospital based studies suggest that certain type of conditions can lead to very persistent disablement. Perineal lacerations are perhaps amongst the most debilitating traumatic consequences of childbirth. Kerr (1933) reports that the duration of complaints ranged from seven months for vesico-vaginal fistula to 3.5 years for perineal lacerations, and up to 7/13 years for incomplete/complete prolapse of the uterus.[3]

We focus on maternal mortality as an index of medical progress in maternal health, given the difficulties in obtaining more comprehensive measures of disablement. As shown in figure 1, there were 60.8 maternal deaths per 10,000 live births in 1915. After a temporary rise due to the 1918 influenza outbreak, the rate of maternal deaths averaged 68 per 10,000 live births in the 1920s. The decline in maternal mortality occurred gradually in the early 1930s and precipitously starting in 1936. The phase of sharply declining maternal mortality rates - from 56.8 deaths per 10,000

[1] Data from U.S. Department of Commerce, Bureau of the Census, Mortality Statistics, 1921. Cause-of-death codes prior to this date do not allow to identify deaths due to traumatic accidents of labor.

[2] The World Health Organization estimates that even today 42 percent of the women who give birth annually experience *at least* mild complications during pregnancy. Despite the large numbers of women who are affected by such morbidity, especially in developing countries, little is known about how to measure it systematically and about the social and economic consequences of different types of morbidities (see Holly, Koblinsky and Mosley, 2000).

[3] This study is based on a sample of 2000 patients seeking treatment between 1928 and 1931 in Glasgow's Royal Samaritan Hospital, a facility devoted exclusively to gynecological cases.

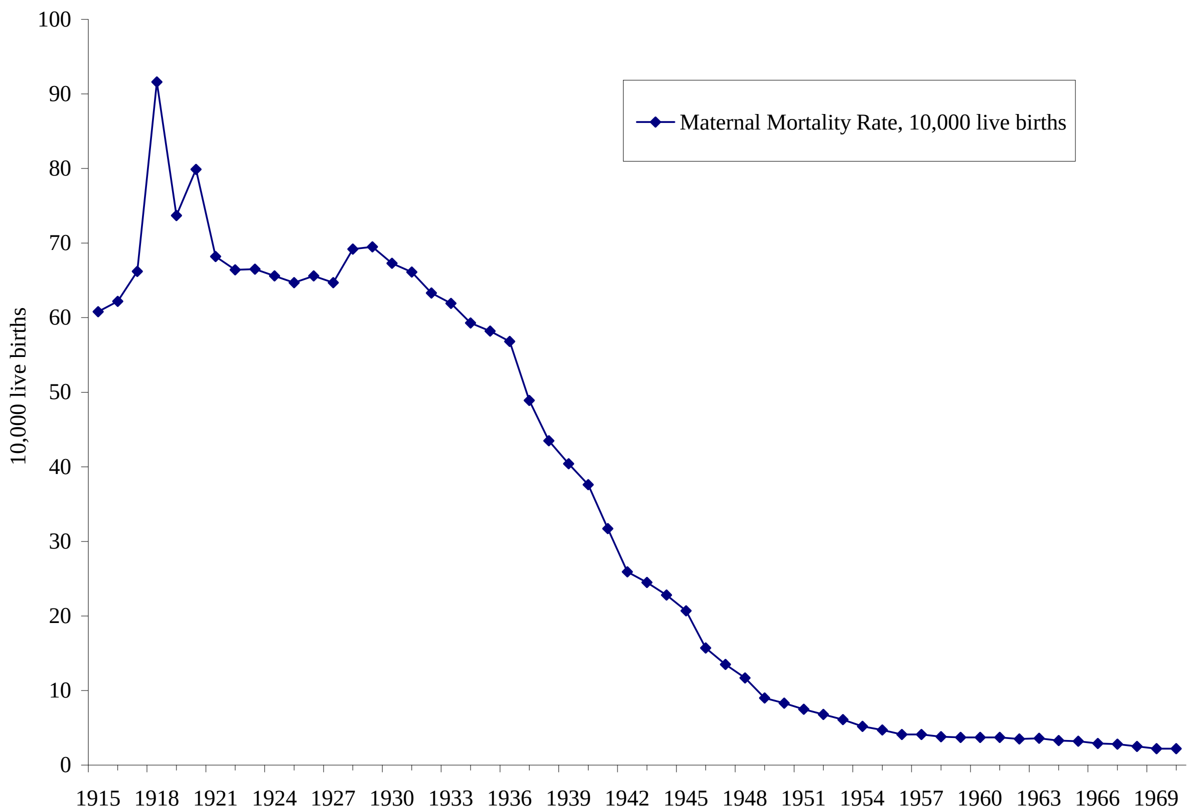

Figure 1: Trends in maternal mortality.

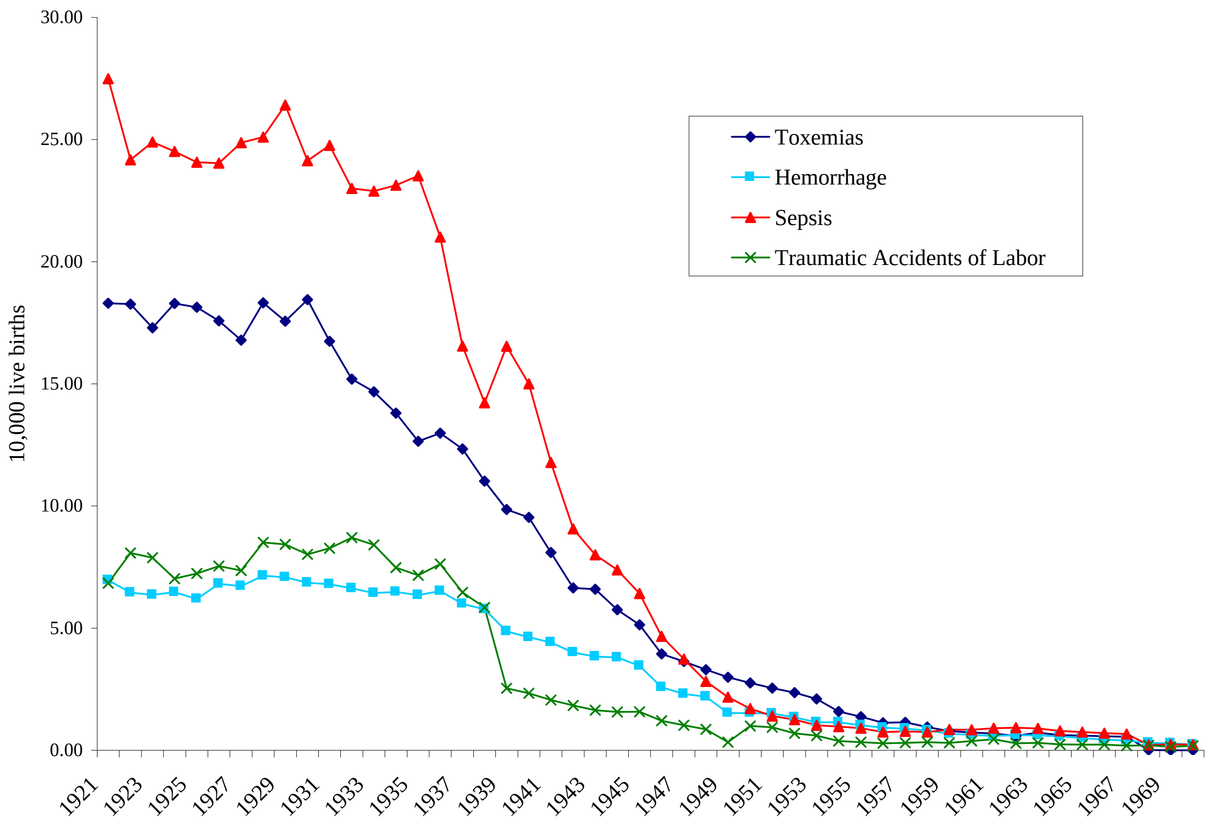

Figure 2: Trends in causes of maternal deaths.

live births in 1936 to 4.7 in 1955, was associated with the surge in the rate of hospital births starting in 1935.[4] As shown in figure 2, the most striking decline occurs for deaths due to sepsis, which drop from 27.5 in 1921 to less than 1 per 10,000 live births in 1955. All other factors of mortality also precipitously decline in the same period. As shown in figure 1, maternal mortality rates continued to decline after 1955, but only gradually, reaching 2 deaths per 10,000 live births in 1970.[5]

What led to these dramatic improvements in maternal health? Table 1 lists the major medical discoveries and innovations connected to pregnancy, labor and parturition between 1800 and 1940, which we discuss in detail in the Appendix.[6] The improvements between 1936 and the mid 1950s can be attributed to the application of the new obstetric practices developed by trial and error in the late 1800s and early 20th century that reduced the incidence of trauma during labor, as well as to the general availability of antibiotics and penicillin to treat infection and sepsis, and of transfusions to replace blood lost in hemorrhages. Improved pre-natal care determined a decline in the incidence of death by toxaemia.

Table 1: Timeline for Maternal Health

1843	Puerperal fever found contagious. Notion of prevention via hygienic measures introduced.
1852	Methods for vesico-vaginal fistula repair first published. Additional progress in 1914 and 1928.
1861	Findings on preventing post-partum infections in maternity wards first published in Vienna.
1867	First published paper on surgical antisepsis, first clinical application of bacteriological principles.
1879	Pasteur links puerperal fever to streptococcus.
1898	X-ray pelvimetry first used for difficult obstetric cases. Becomes routine in 1930s.
1915	Low cervical cesarean section developed.
1928	Penicillin discovered, becomes widely available at the end of WWII.
1930	American Board of Obstetrics and Gynecology established.
1935	Antibiotic action of sulfonamides discovered.
1936	Hospital blood banks established. Aids with post-partum hemorrhages.

An additional consequence of poor maternal health was the high frequency of stillbirths and miscarriages. Many stillbirths were the outcome of fetal asphyxia in the frequent cases of difficult labor. Both stillbirths and miscarriages were often due to bad health and poor nutrition of the mother, as well as lack of prenatal monitoring (see O'Dowd and Phillipp, 1994). The evolution of fetal mortality rates is similar to that of maternal mortality. Figure 3 plots the time series for fetal deaths starting in 1918.[7] The fetal death rate is stationary around 4% between 1918 and 1930. Between 1931 and 1953 it gradually declines to 2%, and remains at that level thereafter.

[4]Information on maternal mortality by causes is from the U.S. Department of Commerce, Bureau of the Census and U.S. Department of Health, Education and Welfare, several volumes. Maternal mortality rates are from U.S. Census Bureau, Statistical Abstracts of the United States (2003).

[5]The gradual decline continued in the following decades down to a maternal mortality rate of 0.1 per 10,000 live births in 2001.

[6]See also Thomasson and Treber (2004) for an empirical analysis of the consequences of the hospitalization of childbirth on maternal mortality.

[7]Following the WHO standard, fetal deaths are defined as "death prior to the complete extraction or expulsion from its mother of a product of conception, irrespective of the duration of pregnancy." This measure includes both stillbirths and miscarriages and abortions. The stillbirth rate only include fetal deaths in which the period of gestation was 20 weeks or more.

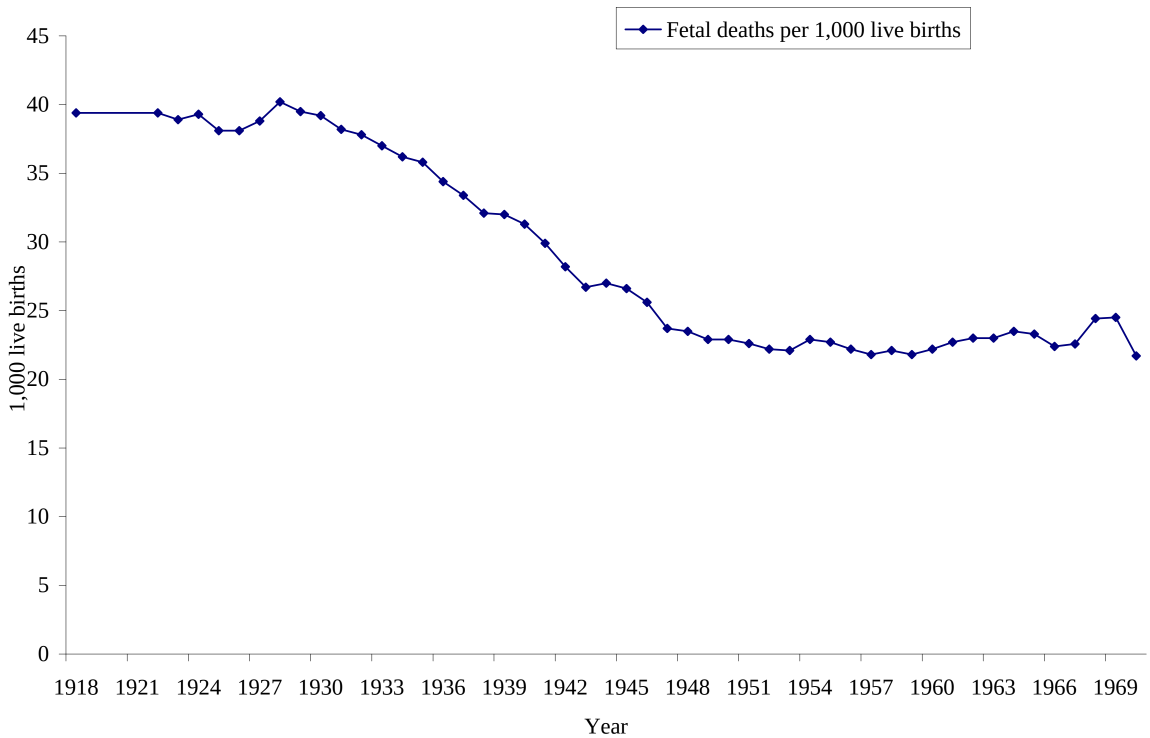

Figure 3: Trends in fetal deaths

This decline is driven by the same medical advancements that result in improved maternal health. Improved obstetric practices, see Table 1, reducing the incidence of difficult labor were a main contributor. The systematic efforts to provide prenatal monitoring beginning in the mid 1920s also played an important role.

2.1.1 Evolution of the Time Cost of Pregnancy, Childbirth and Recovery

The improvements in maternal health arguably led to a decline in the time cost of pregnancy, childbirth and recovery. We construct a measure of maternal mortality risk that compounds the risk of death for each pregnancy over the lifetime number of pregnancies and use it to proxy this decline.

The first step in this process is to derive a correct estimate of the number of pregnancies. Our measure of completed fertility is the Total Fertility Rate (TFR), that is based on live birth registration data.[8] To estimate the corresponding number of pregnancies, we use data on fetal deaths.

The first adjustment we apply corrects for measurement error. As reported in Loudon (1992),

[8] See Jones and Tertilt (2007) for an extensive discussion of lifetime fertility measures.

this was a serious issue in birth registration. There were two potential problems. Since no guidelines were available, children that had died by the time of registration were often registered as stillbirths even if they were born alive. In addition, many births simply went unregistered. We adjust for measurement error using the stillbirth rate, which was equal to approximately 4% in 1920. According to Woodbury (1926), births fell short of their true value by 8.7%, so this adjustment is quite conservative. With this adjustment, our measure of live births is $TFR^* = TFR * (1 + s)$, where s is the rate of stillbirth. We refer to TFR^* as adjusted total fertility.

To calculate the number of pregnancies for given adjusted fertility, we treat the fetal death rate as a measure of the incidence of unsuccessful pregnancies. Denoting with f the probability of a fetal death and using TFR^* as the number of live births, the resulting number of pregnancies amounts to $P^* = TFR^*/(1 - f)$. The resulting adjustment is quite significant. In 1920, while the TFR from registration data was 3.3, the number of pregnancies was equal to 3.6. By 1950, for a TFR of 3.03, the number of pregnancies totaled 3.17.

Our measure of maternal mortality risk is simply given by the product of the probability of death per pregnancy, the maternal mortality rate, by the number of pregnancies P^*. Improvements in fetal and maternal mortality both contribute to the decline of this variable over the period of interest. This variable is plotted in figure 6.

2.2 Progress in Infant Feeding

Until the early decades of the 20th century, cows' milk and hiring a wet nurse were the only two alternatives to mother's milk. In the last decades of the 19th century, both these alternatives were proven inadequate.[9] The new discoveries in physiology, bacteriology and nutritional science in the second half of the 19th century revealed the connection between infant mortality, poor nutrition and tainted milk supplies (Mokyr, 2000). This led to a variety of initiatives to improve public health and develop effective substitutes for mother's milk.

Table 2 lists the main developments in the area of public health.[10] Given the prevalence of diarrhea and dehydration as a major factor in infant mortality, initiatives were targeted to two main concerns: water and sewage treatment, and the quality of milk supplies. The major urban areas were at the forefront of this effort, which was initially local in nature. Various cities introduced milk certification at the end of the 19th century. Progress was slow and uneven. With the link between children's health and environmental conditions firmly established in the public debate, the first federal piece of legislation on the purity of food supplies was finally passed in 1906. By the 1940s most major metropolitan areas had developed water treatment and sewage disposal systems.

[9] After a failed attempt to medicalize the practice of wet nursing in the late 19th century, concerns about transmission of siphylis and other deseases led to its virtual disappearance by the mid-twentieth century. See Golden (1996) for more details.

[10] Sources: http://www.sewerhistory.org/chronos/roots.htm and Wolfe (2001).

Table 2: Timeline in Public Health Initiatives

1838	First chemical analysis of human and cow's milk.
1854	Cholera first demonstrated to spread via water supplies in London.
1892	First US city to treat sewage waters with chlorine.
1893	Bureau of Milk Inspection established in Chicago.
1906	First Federal Pure Food and Drug Act passed by Congress.
1908	First Bureau of Child Hygiene established in New York City.
1912	US Children's Bureau established.
1921	Sheppard-Towner Maternity and Infancy Protection act enacted by Congress.

The first breakthrough in infant nutrition was the realization that cow's milk was a very poor alternative to mother's milk.[11] In 1838, the first chemical analysis showed that cow's milk contains a much higher level of proteins and a lower amount of fat and carbohydrates than human milk. This discovery led to the first generation of cow's milk modifiers, such as Leibig's, Nestle's and Mellin's infant food, developed and introduced commercially between the 1870s and the 1890s. These powdered formulas contained a combination of malt, wheat flour and sugar to be mixed with hot cow's milk and diluted with water. Although better than cow's milk, the resulting infant food was still nutritionally inferior to maternal milk.[12]

Pediatricians strongly opposed these products and discouraged mothers from buying them. Infant feeding studies became the most important sub-field in pediatrics as doctors worked to develop more scientific methodologies for modifying cow's milk. The most successful method was Rotch's "percentage method," the medical gold standard for infant feeding between 1890 and 1915. This formula had several drawbacks. It was still nutritionally inadequate and so complex that it was mostly prepared in milk laboratories and distributed through pediatricians[13].

The most important innovation in infant feeding occurred in the early 1920s when nutrition scientists succeeded in creating a so called 'humanized' infant formula that exactly matched the composition of maternal milk in terms of its fat/proteins/carbohydrates content. The first two formulas with this property, SMA (for "simulated milk adapter") and Similac (for "similar to lactation"), were created in 1919/1920 and are still sold in stores today. These humanized formulas were approved by the medical profession[14] and pediatricians encouraged mothers to use them if they encountered problems breast feeding.

The introduction of effective and easy-to-prepare infant formulas, as well as improvements in baby bottles, induced a dramatic shift from breast- to bottle-feeding between 1920 and the early 1970s. To document this phenomenon, we rely on three sources: the studies by Hirschman and Hendershot (1979) and Hirschman and Butler (1981) for children born between the early 1930s and the early 1970s, and Apple (1987) for the years before 1930.

Figure 4 displays the resulting trend in breast feeding rates. In 1920, the breast feeding rate was 88% and it had declined to less than 25% by the early 1970s. This decline was very dramatic and sudden, and was particularly strong at longer breast feeding durations. While approximately

[11] See Packard and Vernal (1982), Apple (1987) and Schuman (2003) for a more detailed account of the history of infant formula in the United States.

[12] See Table A2 in the appendix.

[13] The formula could also be made at home through a complicated and time and labor intensive process. Newspapers from the time include a very large number of classified ads for nurses specialized in making formula according to Rotch's percentage method.

[14] The name Similac was proposed by Morris Fishbein, the editor of the Journal of the American Medical Association in the 1920s (Schuman, 2003).

50% of newborns were exclusively breast fed at 6 months in 1920, this number had fallen to 3% in 1970. Hirschman and Butler (1981) show that from 1950 to 1970 breast-feeding rates declined both for working and for non-working mothers, although non-working women were more likely to breast feed for more than 3 months. The evidence on trends in the use of commercially prepared formulas is not systematic and is only available since the 1950s. The fraction of 2 to 3 month-old infants fed using commercially prepared formulas increased from 30% in 1955 to 70% in 1970 (Fomon, 2001).

According to all records, the 1970s marked the lowest incidence of breast feeding of the entire 20th century. Breast feeding rates have increased steadily since then, owing to new medical findings on the immunization properties of human milk. In 2004, approximately 63% of mothers breast fed their baby at 1 week. While this rate is comparable to those observed in the 1920s, the duration of breast feeding is now much lower: only 14.2% of babies are exclusively breast fed at 6 months.[15]

As the new medical discoveries increasingly pointed to the importance of mothers' milk for children's development, the introduction of portable breast pumps allowed women to reconcile market work with breast feeding. Although rudimental breast pumps existed since the 16th century, the first successful mechanical pump for humans was created in 1956. The historically high rates of participation of women with young children likely spurred the development of light and efficient portable breast pumps, introduced in 1996.[16]

2.2.1 Price of Similac

We posit that progress in infant feeding technologies is embodied in infant formula and measure it by constructing a series for the time price of infant formula.

We collect the data from advertisements from the Chicago Tribune, the Los Angeles Times and the Washington Post.[17] The historical ads provide information on price, quantity and type of formula in drugstore chains such as Walgreens and Stineway. The price observations refer to items on sale, hence, we interpret them as a lower bound for the price. For each year in the sample and for each city we have monthly observations that we use to construct our yearly series. To derive a measure of the opportunity cost of infant formula, we construct the series for its *time price*. This is obtained by deflating the original price series by hourly wages in manufacturing.[18]

In Figure 5, we report the time price series for the first generation of milk modifiers. Mellin's and Nestle's are in blue and the one for Similac is in red. The first observation on Similac dates to 1935. While there was a large drop in the time price of the first generation of formulas before 1935, we focus on Similac because it was the first commercially available formula to be deemed equivalent to mother's milk and to become popular. In 1975, 52% of infants receiving commercially available milk-based formulas were fed Similac (see Table III in Fomon, 1975.) The formula remains very popular today.[19]

[15] National Immunization Survey, CDC, 2004.

[16] See http://www.slate.com/id/2138639/#ContinueArticle.

[17] This information is available from ProQuest Historical Newspapers Chicago Tribune (1849-1985), Los Angeles Times (1881-1985) and The Washington Post (1877 - 1990). We are grateful to Claudia Goldin for suggesting this data source. The details about the construction of the price series are discussed in the appendix.

[18] Throughout the paper our measures of hourly wages is from Margo (2006a.) Hourly wages and prices are expressed in 1982-1984 U.S. dollars. See appendix for details.

[19] SMA did not achieve great popularity in the U.S, and in 1975 it accounted for less than 12% of the market for commercially prepared formulas (Fomon, 1975). Alternative scientific infant formulas, such as Enfamil, were launched on the market much later, in 1959.

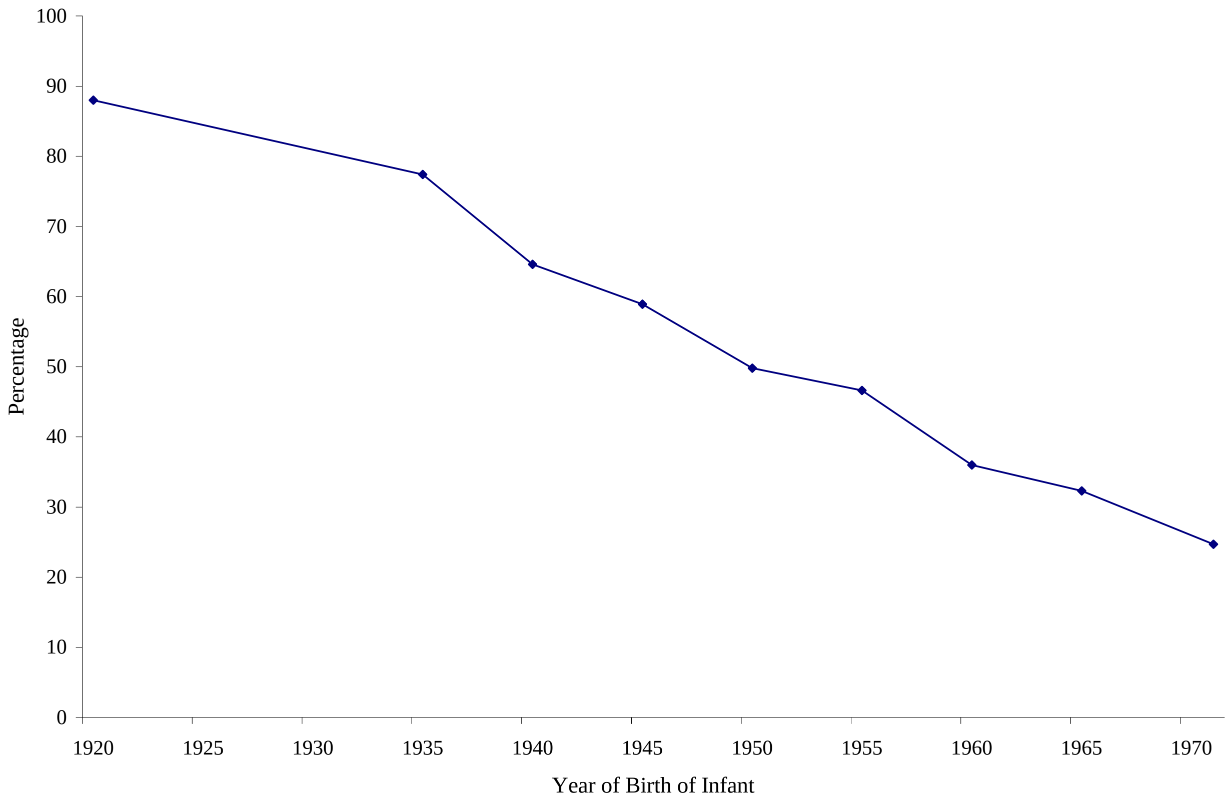

Figure 4: Trends in breast-feeding

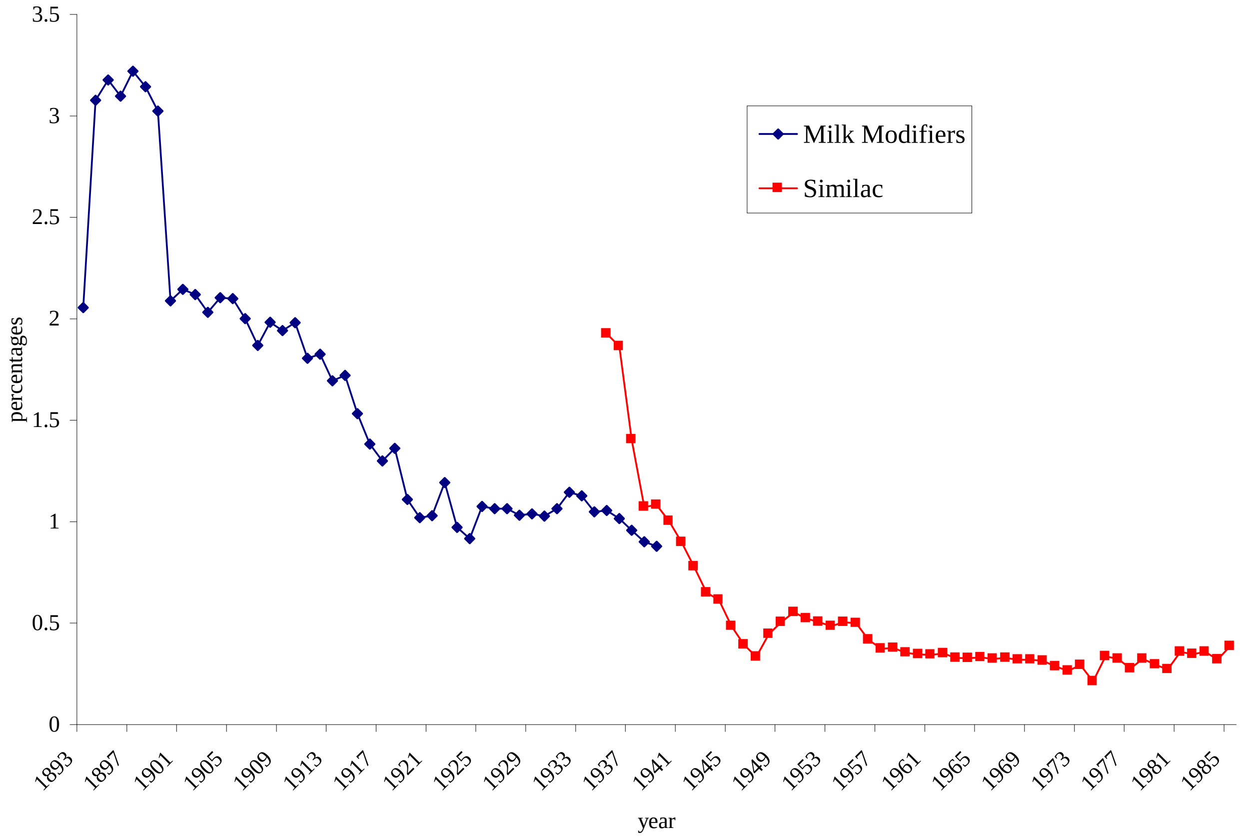

Figure 5: Time price of Infant Formula

The time price should be interpreted as follows. The value of 2 for 1935 means that the cost of 1 liquid ounce of Similac corresponds to 2% of the hourly wage in manufacturing in that year. Given that 4 liquid ounces are needed for the typical feeding, the opportunity cost of one feeding was approximately 5 minutes of work. This time price declined by an average of 5.1% per year between 1935 and 1970. The decline in the time price of formula parallels the decline in its monetary cost. In 1920, the cost of bottle-feeding a baby boy of median weight during his first year of life ranged between 39 and 48 percent of disposable income. By year 1970 this cost had fallen to approximately 2 percent of personal disposable income.[20]

3 Model

We assume the economy is populated by overlapping generations of agents who live for three periods, r, with $r = 0, 1, 2$. Each generation comprises a continuum of agents who differ in their productivity in market production, ξ, and by gender. Cohorts and the overall population are split equally by gender and the distribution of market productivity is the same across genders. In

[20]These calculations take into account the fact that the amount of formula needed varies by weight and the number of feedings varies by age. See Data Appendix for details.

the first age of their life, all agents are single. In the second period of life, they all marry to an agent of different gender and with the same productivity and remain married in the third period. In each model period, t, a new generation of single agents is born, and total population size is constant.

Agents value private consumption, c, and leisure, l, in all periods. Individual preferences can be represented by the following lifetime utility function:

$$\sum_{r=0,1,2}\left(\prod_{s=0}^{r}\beta_s\right)u\left(c_r,l_r\right),$$

where

$$u\left(c,l\right)=\frac{c^{1-\sigma}}{1-\sigma}+v\left(l\right),$$

and $v\left(l\right)$ represents the sub-utility from leisure:

$$v\left(l\right)=\psi_0\frac{l^{1-\psi}}{1-\psi},$$

with $\sigma,\psi_0,\psi\geq 0$. The parameters $\beta_r\in(0,1)$ represent the discount factor from age r to age $r-1$. with $\beta_0=1$. We allow for differential discount factors to accommodate ages of different duration.

Leisure is defined as:

$$l=T-h-p\bar{n},$$

where T is the individual time endowment, $p\in[0,1]$ denotes labor force participation, $\bar{n}$ corresponds to the fixed number of work hours an employed individual works on the market, and h denotes home hours.

Home hours are applied to the production of two home goods. The *general household good*, G, corresponds to activities such as meal preparation, cleaning, helping children with homework, vacation planning, yard work and other activities. This good must be produced at all ages of life. In the first period of marriage and only in that period, households must also produce the *infant good*, I, which corresponds to activities deriving from the existence of infants in the household, such as pregnancy, childbirth and feeding. Hence, the first period of marriage can be interpreted as the fecund period of life.

The next section describes in detail the production technology for each home good.

3.1 Home Production

For each good, both time and market goods are inputs in production. The key assumption is that women and men can equally contribute to the production of general household goods. Instead, *only* the wife's time is used as an input in the production of infant goods. This asymmetry is clearly extreme, since the husbands' contribution to the production of infant goods is necessary, at least at conception. However, it provides a simple and realistic way of modelling women's comparative advantage in the production of infant goods, based on the fact that *only* women can give birth and breast feed.

The ratio of home hours to market goods in home production depends on technology. There are two technologies for the production of each home good, *old* and *new*. The new technologies are less time intensive than the old. The old technologies are free, while there is a fixed cost to adopt the new technologies expressed as a time price. This cost corresponds to the monetary value of the market goods associated with the new technologies translated into units of time. The time price of the new technologies can change over time. A decline in this price reflects technological progress embodied in the market goods used in production. Households choose which technology to adopt for each home good in each period of their life.

3.1.1 Infant Goods

The infant goods are produced exclusively using the wife's time. Their level of production is denoted with I and does not vary with the technology, which only influences the time intensity of production. Let h^{fI} denotes the time required by the wife to produce I. Under the old technology:

$$I = \min\left\{\nu_I \rho_I, h^{fI}(0)\right\}, \tag{1}$$

where $h^{fI}(0) = \rho_I \nu_I > 0$. Under the new technology:

$$I = \rho_1 \min\left\{\nu_I, h^{fI}(1)\right\}, \tag{2}$$

with $h^{fI}(1) = \nu_I > 0$. The parameter $\rho_I > 1$ measure the reduction in time intensity associated with the new technology, with $h^{fI}(0) = \rho_I \nu_I > h^{fI}(1) = \nu_I$. The quantity $\rho_I \nu_I$ under the new technology can be interpreted as the quantity of market goods associated with production, such as infant formula. The old technology is free and we denote the price of the new technology with q^I.

A few words of interpretation are in order here. The total time devoted by wives to infant good production represents the sum of feeding time plus the time associated with pregnancy, childbirth and recovery. This is based on the notion that the physical cost of pregnancy reduces a woman's ability to perform market work. The parameter ν_I measures this cost in equivalent time units. Based on the evidence on progress in medicine and obstetrics, most households were just confronted with "best" practices for behavior during pregnancy, childbirth and recovery, while they chose how to feed their child. Correspondingly, we treat the time cost of pregnancy, childbirth and recovery, ν_I, as a parameter, and we model bottle feeding as a choice.

To incorporate the effects of the reduction in the physical cost of pregnancy over time reflecting progress in medical knowledge and obstetric practices, as well as changes in fertility, we will allow ν_I to vary over time with the measure of maternal mortality risk constructed in section 2. We posit that breast feeding is the *only* feeding method under the old technology, while under the new technology infants are fed formula with a bottle. Adoption of the new technology allows infant feeding, which under the old technology can solely be produced by the mother, to become a general household good that could be produced by both spouses. After all, there is no difference between bottle feeding an infant and general household goods, such as helping children with homework or meal preparation, in terms of comparative advantage by gender. Hence, under the new I technology, the mother's time required for infant feeding drops to zero, a saving that corresponds in percentage terms to $(\rho_I - 1)$. On the other hand, the time required for general good production rises by the amount $\nu_I(\rho_I - 1)$, the time devoted to breast feeding. Implicit in this treatment is the assumption that the time required for infant feeding does not depend on the method. Even under the new technology, the asymmetry in the spouses' contribution to infant good production remains since mothers still have to bear the physical cost of pregnancy ν_I.

We now describe the production technology for general household goods.

3.1.2 General Household Goods

Our model for general household good production is similar to Greenwood, Seshadri, and Yorugoklu (2005).

Let $H\left(\tau^G\right)$ denote the contribution of home hours to production under technology $\tau^G = 0, 1$, where τ^G denotes whether the old ($\tau^G = 0$) or the new ($\tau^G = 1$) technology is used. The production function for *singles* and *old married households* is:

$$\begin{aligned} G &= \min\left\{\rho_G \nu_G, H(0)\right\}, \\ G &= \rho_G \min\left\{\nu_G, H(1)\right\}. \end{aligned} \tag{3}$$

The parameter $\rho_G > 1$ denotes the time savings associated with the new G technology, so that the new technology requires fewer home hours, that is $H(0) = \rho_G \nu_G > H(1) = \nu_G$. The quantity $\rho_G \nu_G$ under the new technology can be interpreted as the quantity of market goods associated with the production of the general household good. We denote with q^G the time price of the new home durables technology, which reflects the market value of the market goods associated with the new G technology, such as home appliances, groceries etc. The old technology is free.

For married households, spouses contribute to the production of G according to:

$$H = \left[0.5\left(h^{fG}\right)^{\zeta} + 0.5\left(h^{m}\right)^{\zeta}\right]^{1/\zeta}, \tag{4}$$

where the parameter ζ determines the substitutability of husbands' and wives' home hours in the production process. The spouses' contribution is symmetric, irrespective of the technology used.

For *young married households*, we incorporate the complementarity between infant and general household good production by letting the time requirement H vary with the technology adopted for producing the infant good, as described above. Specifically:

$$\begin{aligned} G\left(\tau^I\right) &= \min\left\{\rho_G \nu_G, H\left(0, \tau^I\right)\right\}, \\ G\left(\tau^I\right) &= \rho_G \min\left\{\nu_G, H\left(1, \tau^I\right)\right\}, \end{aligned} \tag{5}$$

where $H\left(0, \tau^I\right) = \rho_G \nu_G + \tau^I \nu_I (\rho_I - 1)$ and $H\left(1, \tau^I\right) = \nu_G + \tau^I \nu_I (\rho_I - 1)$, and $\nu_I (\rho_I - 1)$ is the time required for infant feeding, an activity that becomes a general household good if the new I technology is adopted.[21]

We now describe the agents' optimization problems at each age in life.

3.2 Single Agents' Problem

Agents are born with no wealth and cannot borrow against future income. At age 0, they are single. They decide on whether to participate in the labor force in that period, on whether to acquire market skills, on how to produce the home good G and on how much to save. The acquisition of market skills has a time cost of $\gamma > 0$ and affects their labor market productivity at ages $r = 1, 2$, as follows:

$$\xi^j = \xi\left(1 + \varepsilon e^j\right), \tag{6}$$

[21] This is an analytically tractable way to model this complementarity, given our technological assumption. Of course, since the choice of technology does not affect the level of production or utility directly, many other strategies would be equivalent.

where the parameter ε represents the returns to skills and $e^j = 0$ when no skills are acquired and $e^j = 1$ otherwise.

A single individual's problem is:

$$\Pi_0^j(\xi) = \max_{a_1^j \geq 0, p, e \in \{0,1\}, \tau^G} u\left(c, T - e\gamma - h\left(\tau^G\right) - p\bar{n}\right) + \beta_1 \Pi_1^j\left(a_1^j, e; \xi\right), \tag{Problem S}$$

subject to (6), (3) and:

$$c + a_1^j \leq w\left(\xi p - \tau^G q^G\right),$$

for $j = f, m$. Here, $\Pi_1^j\left(a_1^j, e; \xi\right)$ denotes the maximized present discounted value of individual lifetime utility at the beginning of period 1, which will be derived below. The variable w denotes economy-wide real wages in efficiency units of labor and may change over time, due to improvements in the market production technology.[22]

3.3 Household Problem

We model married individuals according to Chiappori's (1988, 1997) *collective labor supply* approach. Under this paradigm, household decisions are Pareto efficient. Households choose a sequence of private consumption, participation, and home hours for each spouse, as well as technologies for the production of the home goods, subject to an intertemporal budget constraint and to the technological and feasibility constraints.[23]

We first describe the optimal choice of home hours in each period, taking as given the production technology. This step amounts to solving the following cost minimization problem:

$$C\left(\bar{H}, \bar{h}^{fI}\right) = \min_{h^m \in \left[0, \bar{h}\right], h^{fG} \in \left[0, \bar{h} - h^{fI}\right]} \xi\left(1 + \varepsilon e^f\right) h^f + \xi\left(1 + \varepsilon e^m\right) h^m$$

subject to

$$h^f = h^{fI} + h^{fG},$$

$$\left[0.5\left(h^m\right)^\zeta + 0.5\left(h^{fG}\right)^\zeta\right]^{1/\zeta} \geq \bar{H},$$

$$h^{fI} \geq \bar{h}^{fI},$$

for some $\bar{H} = H\left(\tau^G, \tau^I\right)$ and $\bar{h}^{fI} = h^{fI}\left(\tau^I\right)$.

The first order necessary conditions for h^{fG} and h^m for interior solutions are:

$$\frac{\xi\left(1 + \varepsilon e^f\right)}{\left(h^{fG}\right)^{\zeta - 1}} = \frac{\xi\left(1 + \varepsilon e^m\right)}{\left(h^m\right)^{\zeta - 1}}, \tag{7}$$

[22] We assume that progress in market technology is not gender biased and that the distribution of individual productivities, which is symmetric across genders, remains constant over time. For an analysis of skill bias technological change and its effects on female participation and fertility, see Galor and Weil (1996).

[23] The Pareto problem can be decentralized by allowing each spouses to individually choose labor force participation and private consumption in each period. Households then jointly choose a rule for sharing household wealth, savings, the allocation of home hours and the technologies for producing the home goods. The fact that saving is a joint household decision implies that individual problems are static. Moreover, the household is implicitely assumed to have commitment in the joint choices.

$$\left[0.5\left(h^m\right)^\zeta + 0.5\left(h^{fG}\right)^\zeta\right]^{1/\zeta} = \bar{H},$$

$$h^{fI} = \bar{h}^{fI}.$$

We will denote with $h^j\left(\tau^G, \tau^I\right)$ for $j = f, m$ the policy functions for the cost minimization problem. By (7), if $e^f = e^m$, then, the solution is $h^{fG} = h^m$. If instead $e^f \leq e^m$, then, the only solution has $h^{fG} > h^m$. Hence, the symmetry in the spousal allocation of home hours devoted to the production of G depends on the opportunity cost of home hours, that is potential wages, for each spouse.

Let Z_t denote total household expenditures net of total household income in period t:

$$\begin{aligned} Z\left(\tau^G, \tau^I; q^G, q^I, w\right) &= \sum_{j=f,m}\left[c^j + \xi^j l^j\right] + w\left[C\left(H\left(\tau^G\right), h^{fI}\left(\tau^I\right)\right) + q^G\tau^G + q^I\tau^I\right] \\ &\quad - Tw\sum_{j=f,m}\xi^j. \end{aligned}$$

Substituting in the expressions for the cost of production of the two public goods, we obtain:

$$Z\left(\tau^G, \tau^I; q^G, q^I, w\right) = \sum_{j=f,m} c^j + w\left(q^G\tau^G + q^I\tau^I\right) - w\sum_{j=f,m}\xi^j p^j \bar{n},$$

where w corresponds to the contemporaneous value of economy-wide real wages. Hence, the household's intertemporal budget constraint is given by:

$$Z_1\left(\tau_1^G, \tau_1^I; q_1^G, q_1^I, w_1\right) + \frac{Z_2\left(\tau_2^G, \tau_2^I; q_2^G, q_2^I, w_2\right)}{1 + R_2} \leq a_1, \tag{8}$$

where a_1 is household wealth at the beginning of age 1[24]. The households initial wealth a_1 is given by the sum of the spouses' wealth at the beginning of age 1, $a_1 = \left(a_1^f + a_1^m\right)(1 + R_1)$, where the values of a_1^j solve the spouses' individual optimization problem when single.

The households' Pareto problem is given by:

$$\max_{\tau_1^I, \left\{c_r^j, p_r^j, \tau_r^G\right\}_{r=1,2, j=f,m}} \sum_{r=1,2}\beta_2^{r-1}\sum_{j=f,m}\lambda_j u\left(c_r^j, T - h_r^j\left(\tau_r^G, \tau_r^I\right) - p_r^j\bar{n}\right)$$

subject to (8) and (3), (1)-(2), (6), with $e_r^j = 0$ for $r = 1, 2$, $h_2^{fI} = 0$ and $h_2^f = h_2^{fG}$ and where λ_j $j = f, m$ denote the spouses' Pareto weights.

The first order necessary conditions for the household problem are:

$$\lambda_j u_{c,1}^j - \mu = 0, \text{ for } j = f, m, \tag{9}$$

$$\lambda_j \beta_2 u_{c,2}^j - \mu\left(1 + R_2\right) = 0, \text{ for } j = f, m, \tag{10}$$

$$\lambda_j u_{l,1}^j - \mu w_1 e^j = 0, \text{ for } j = f, m, \tag{11}$$

$$\lambda_j \beta_2 u_{l,2}^j - \mu\left(1 + R_2\right) w_2 e^j = 0, \text{ for } j = f, m, \tag{12}$$

[24] Here, the home goods are not marketable, so their production level does not enter in the household budget constraint. See Chiappori (1997) for a discussion.

for given values of τ_r^G and τ_1^I, as well as the intertemporal budget constraint (8). Here, μ is the multiplier on the intertemporal budget constraint.

The intertemporal pattern of consumption is independent from the distribution of the Pareto weights or the choice of technology and labor force participation patterns over time. Instead, the higher the Pareto weight of a spouse, the higher the optimal level of consumption and leisure. It follows that p_r^j is decreasing in λ^j ceteris paribus, so that wives will participate more if their Pareto weight is lower.

The Euler equation for the individual saving choice at age 0 is:

$$-u'\left(p_0^j\xi - a_1^j, T - \gamma e_0^j - p_0^j\bar{n}\right) + \beta_1\Pi_{1,a}^j\left(a_1^j, e; \xi\right)\begin{cases} \leq 0, \\ = 0 \text{ for } a_1^j > 0. \end{cases} \tag{13}$$

The envelope condition for this problem is:

$$\Pi_{1,a}^j\left(a_1^j, e; \xi\right) = \frac{\mu}{\lambda_j}, \text{ for } j = f, m. \tag{14}$$

Intuitively, a spouse with a higher Pareto weight will obtain a larger share of resources when married and finds it optimal to bring lower wealth levels into the marriage, other things equal.

Here, as previously noted, $\Pi_1^j\left(a_1^j, e; \xi\right)$ is the maximized present discounted value of lifetime utility at the beginning of period 1. Given that this corresponds to the individual value function for the household's optimization problem, it is possible to incorporate the agent's problem when single into the household problem, to simplify the derivation of lifetime consumption, home hours and participation paths. We describe this strategy of solving the household problem in detail in the Model Appendix.

3.4 Market Production and Equilibrium

A continuum of identical, perfectly competitive firms in each period produce an undifferentiated output using labor only, and then convert it into consumption goods and goods used in the production of general household and infant goods.

The representative firm produces the undifferentiated output, Y, according to the production function:

$$Y \leq \Xi N, \tag{15}$$

where the variable Y denotes per capita production of the undifferentiated good and N is per capita (average) labor input in efficiency units, given by:

$$N = \int_i p(i)\,\xi_i\,(1 + e_i)\,d\Gamma(i), \tag{16}$$

where i indexes individuals in the population. Here, Ξ corresponds to average labor productivity. Ξ may grow over time to reflect technological advancements in market production. Y can be transformed into home durables, D, commodities used in the production of infant goods K, and private consumption goods, C, according to the technology:

$$\gamma^G D + \gamma^I K + C \leq Y. \tag{17}$$

Given that all technologies are constant returns to scale and that the production sector is competitive, $w = \Xi$ in equilibrium, so that wages will grow one to one with market productivity. In addition, competitive pricing pins down the equilibrium values of q^l as a function of the technological marginal rates of transformation γ^l, for $l = G, I$.

We describe the representative firm's problem and the derivation of the equilibrium in the Model Appendix.

4 Quantitative Analysis

We calibrate parameters to match the equilibrium of our model to a variety of data statistics in 1920. We then simulate the transition between 1920 and 1970 predicted by the model, by feeding in measures of technological progress in general and infant good technologies, as well as the rise in economywide real wages over this period. Finally, we run several experiments to gauge the contribution of the introduction of each source of technological progress in isolation.

4.1 Calibration

We set $\lambda_f = \lambda_m = 0.5$ so that spouses have equal bargaining power. We fix $\sigma = 1$ and $\psi = 1$, so that utility is logarithmic in private and public consumption. This implies that wealth and substitution effects of changing new technology prices and aggregate wages exactly cancel. We interpret the single period as covering ages 15-22, and the second period as covering ages 23-35. We consider the last period as corresponding to ages 36-60. We set the yearly interest rate at 5%, and fix $\beta_1 = \exp(-0.05 * 7)$ and $\beta_2 = \exp(-0.05 * 13)$, with $R_r = 1/\beta_r - 1$ for $r = 1, 2$.

We calibrate the remaining parameters to match certain data statistics of interest in 1920.

We parameterize the G technology as follows. Given our assumption that spouses have a symmetric role in the production of G, we set $\zeta = 0.9$, which corresponds to an elasticity of substitution between husbands' and wives' home hours in the production of G equal to 10. We set the parameters ρ_G and ν_G based on the assumption that all households in which the wife participates in the labor force adopt the new technologies in 1920. Using the value of home hours of married women, conditional on participation in the labor force, and of married men in 1920, this delivers:

$$\begin{aligned}
\rho_G \nu_G &= \left[0.5 * \left(\frac{4}{112} \right)^{\zeta} + 0.5 \left(\frac{51}{112} \right)^{\zeta} \right]^{1/\zeta} = 0.2346, \\
\nu_G &= \left[0.5 * \left(\frac{4}{112} \right)^{\zeta} + 0.5 \left(\frac{25}{112} \right)^{\zeta} \right]^{1/\zeta} = 0.1256,
\end{aligned}$$

which implies $\rho^G = 1.87$.[25]

For the infant good technology, recall that the parameter ν_I corresponds to the time cost of pregnancy, childbirth and recovery as a fraction of the time endowment, while the parameter ρ_I corresponds to the time saving associated with bottle feeding relative to breast-feeding.

We use our estimate for the number of pregnancies, P^*, based on the calculations described in Section 2 to obtain a value for ν_I, under the assumption that for each pregnancy, women

[25] Data sources on home hours are reported in the data appendix.

experience 4.5 unproductive months. Then, as a fraction of their time endowment during the young married period, this component of the cost is equal to:

$$\nu_I\,(1920) = \frac{P^*_{1920} * (4.5/12)}{35-23}.$$

To compute the time cost associated with infant feeding, we use infant feeding charts from the National Association of Pediatrics, according to which the average time required to breast-feed one child for the first 12 months ranges between 14 and 17.30 hours per week. Given the adjusted completed fertility rate, TFR^*, the fraction of the time endowment that women spent nursing is $\frac{TFR^*_{1920}*(17/112)}{35-23}$. The total time commitment then adds to:

$$\rho_I\,(1920) = \frac{\nu_I\,(1920) + TFR^*_{1920} * (17/112)\,/\,(35-23)}{\nu_I\,(1920)}.$$

Based on $TFR^*_{1920} = 3.4$ and $P^* = 3.6$, this implies $\nu_I = 0.1141$ and $\rho_I = 1.35$.

Agents in our model need to know the evolution of economy-wide wages, w, and new home technology prices, q^I and q^G, to solve their decision problems. To compute the equilibrium in 1920, we assume that agents forecast future values of new technology prices and wages based on their expectation for the rate of growth of each of these variables. We then take this expectation to correspond to the average annual rate of change of the data counterparts of these variables over the time period 1920-1970. As discussed in Section 2, we adopt the notion that technological progress in the infant good is embodied in the market goods used in its production under the new technology and will be reflected in their time price. So we take the time price of the new I technology, q^I, to correspond to the time price of Similac. Since this series starts in 1935 we extrapolate it back to 1920 using the average yearly price change between 1935 and 1970 which is equal to 5.08%.

Similarly, we posit that technological progress in general household goods is embodied in home durables and we use their time price to proxy such progress. We take q^G, the time price of the new general household technology in the model, to correspond to the real value of the quality-adjusted Divisia price index for eight appliances built by Gordon (1990), rescaled by the real hourly wage in manufacturing. This price series is available only since 1947. We extrapolate it back to 1920 applying to home durables the methodology developed by Cummins and Violante (2002).[26] The average yearly rate of decline in this variable is 4.6%.

We calibrate the relative price of the new home technologies, the ratio q^I/q^G, using information on the monetary cost of formula and on historical prices for home appliances. We assume that a household who adopts the new G technology purchases a refrigerator, a washer and a vacuum cleaner and that the appliances need to be replaced every 5 years. Thus, a household must replace them twice in the young married period. The replacement cost corresponds to their price in the year of replacement, computed using the series for the price of home durables. Similarly, we convert the cost of feeding one child with infant formula to 1920 dollars. The ratio of the cost of feeding one child with infant formula and the cost of buying the three major home appliances in 1920 is 0.084. We then multiply this ratio by the adjusted total fertility rate in 1920, which is equal to 3.4. This delivers: $q^I/q^G = 0.3$.

We assume the distribution of ξ is log-normal, with mean $\bar{\xi}$ and standard deviation σ_ξ. This leaves six remaining parameters: q^G, ε, γ, ψ_0, $\bar{\xi}$ and σ_ξ. which we calibrate to match the value in

[26] Details about the construction of the price series for home durables are in the appendix.

1920 of the following population statistics: home hours of married women who participate in the labor force, home hours of married women who do not participate in the labor force, home hours of men, the average rate of adoption of new general household technologies, the average rate of bottle feeding, and labor force participation of married women by cohort as a ratio to the labor force participation of men. Specifically, our target for the labor force participation of old married women in our model is the labor force participation rate in 1920 of white married women born between 1866 and 1885 over the labor force participation of men in 1920. Our target for the labor force participation of young married women in our model corresponds to the participation rate in 1920 of white married women born between 1886 and 1895 over the labor force participation of men in 1920. We select the parameterization that minimizes the sum of squares of the distance of the values predicted by our model for those parameters and the corresponding data statistic. The population statistics and the corresponding model values are listed in Table 3. The calibrated parameters are reported in Table 4.

Table 3: Calibration Targets

Population Statistic	Value in 1920	Model Value
Home hours of married women who do not participate in the labor force	51	49
Home hours of married women who participate in the labor force	25	22
Male home hours	4	7
Average adoption of new general household technology	7%	8%
Average adoption of bottle feeding technology	15%	15%
Labor force participation of young married women	9%	9%
Labor force participation of old married women	6.5%	6.5%

The data on labor force participation of married women by cohort in 1920 is reported in Goldin (1990). The 1920 targets for home hours by gender and employment status of wives are described in the Data Appendix. In order to obtain the targets in model units, we simply divide the statistics for home hours per week by 112, the non-sleeping hours per week. We obtain: $T = 1$, $\bar{n} = 0.36$, $h_G^f = 0.456$ for wives who do not participate in the labor force, $h^f = 0.223$ for wives who participate, and finally $h^m = 0.0357$ for husbands. The target value of 15% for the adoption rate of the new infant feeding technology is based on the fact that, as discussed in Section 2.2, approximately 85% of infants were breast-fed in 1920. The target value of 7% for the adoption rate of new general household goods technologies is based on an average of the percentage of households with washing machines, refrigerators and vacuum cleaners, from Bowden and Offer (1994).

Table 4: Calibrated Parameters

σ, ψ	1	q^G	1.6
ζ	0.9	q^I/q^G	0.27
ν_G, ρ_G	0.126, 1.87	ε	0.25
ν_I, ρ_I	0.114, 1.35	γ	0.08
β_1, β_2	0.74, 0.41	ψ_0	1.54
$\bar{\xi}$	3.6	σ_ξ	0.7

4.2 Equilibrium at 1920 Prices

We now discuss the main cross-sectional properties of the equilibrium in 1920.

All men participate in the labor force and invest in market skills, and all single women participate in the labor force. All single men adopt the new general household goods technology, while only a fraction of single women do. Male home hours are highest when single. Labor force participation of married women and investment in market skills are increasing in productivity and decreasing in age, though for married women, their participation is higher when old than when young. Home hours devoted to the production of G goods are highest for young married women, followed by old married women and by single women. Home hours of women are decreasing in productivity and female and male home hours in a given cohort converge as productivity increases. This is due to the fact that adoption of new home goods technologies is increasing in productivity. The adoption of new home goods technologies is necessary for married women to participate in market work, as participation of the wife occurs only for households that have adopted both new technologies.

The female/male earnings ratio in the model depends on the relative investment in skills across genders. Investment in market skills is lower for the older cohorts of women in the model, leading to a lower female/male earnings ratio for the old relative to the young. This cohort effect stems from the fact that the old married cohort faces higher prices for the new home technologies and lower real wages. This leads to lower adoption rates at both ages of marriage and, therefore, lower participation of women when married, and lower investment in market skills when single. This property of the model is consistent with empirical evidence for the US that average gender wage differentials are increasing with age and higher for older cohorts.[27]

The model predicts higher home hours for men with working wives relative to the data. This is due to the fact that more married women who participate in the labor force in the model have invested in market skills than in data. Since they have the same wage as their husbands, the allocation of home hours is symmetric in those households in the old period.

4.3 Transition

Our model features four exogenous sources of technological change. The first is the reduction in the time cost of pregnancy, childbirth and recovery driven by improved medical knowledge and obstetric practices leading to lower maternal mortality rates, as well as by changes in fertility. The second is the introduction of infant formula and its improvement over time, reflected in the decline of its the time price. These factors have a direct impact on women only. Third, the improvement in general household technologies as reflected in the decline in the time price of new home appliances. Lastly, the increase in economy wide labor productivity, due to technological progress in market good production, reflected in the increasing average real wage. The third and fourth factor influence the opportunity cost of home production for both genders.

To evaluate the role of these factors, we feed measures of these variables into the model to examine the properties of the transition between 1920 and 1970. For market productivity, we use

[27] In the data, there isn't a substantial difference in average years of formal schooling across genders for the period, though the statistic is slightly lower for women. Median years of school completed by people 25 and over are equal to 8.6 for men and 8.7 for women in 1940. See Table A1 - http://www.census.gov/population/www/socdemo/educ-attn.html. In our interpretation, investment in market skills in the model does not precisely correspond to formal schooling, but to effort exerted in early labor market experiences that may influence future carrier paths and earning potential.

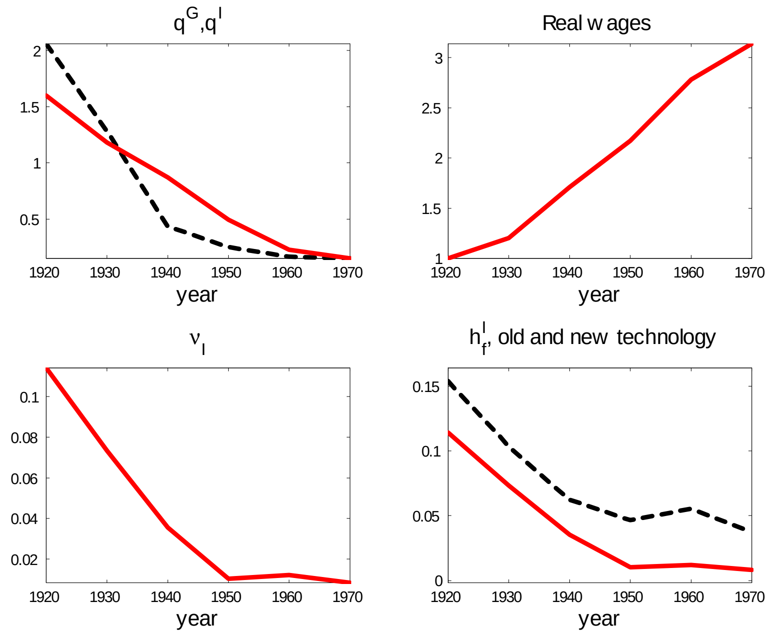

Figure 6: Forces of technological progress in the model.

real wages. For the new general household technology, we use Gordon's Divisia price index as described in Section 4.1. For the new infant good technology, we use the time price of Similac. Finally, we use the index of maternal death risk as a proxy for the decline in the time cost of pregnancy, childbirth and recovery, as discussed in section 2. We set:

$$\nu_I(t) = M\tilde{M}_t * \nu_I(1920),$$

$$\rho_I(t) = 1 + \frac{TFR_t^* * (17/112)}{(33-23)\,\nu_I(t)},$$

where $M\tilde{M}_t = MatMort_t / MatMort_{1920}$, and $MatMort_t$ is the maternal mortality rate at time t. The index of technological progress then corresponds to the variable $M\tilde{M}_t$.

Figure 6 plots the transitional forces at work in our model over the period of interest. Consistent with our calibration strategy, we assume that agents forecast the change in new technology prices and real wages over their lifetime using the yearly average change over the period of interest. Our results for the transition are displayed in figure 7, where the solid red lines correspond to data and the dashed black lines correspond to model predictions.

The model over predicts the rise in the labor force participation of young married women and in the adoption of the new infant good technology. By 1970, 83% of all young married women participate in the labor force when young (dashed-line in panel 5), and 90% of young married households adopt the new infant good technology (panel 1), whereas in the data only 47% of young married women participate and the formula feeding rate is 75%.[28] This outcome is due to

[28] We compute period averages by cohort in the model simulations. This is required since the young married period lasts 11 years, the old married period lasts 27 years, which is longer than the 10 year time interval we adopt for our simulations. Hence, when we compute the transition, 1/11 agents that were young in 1920 will still be

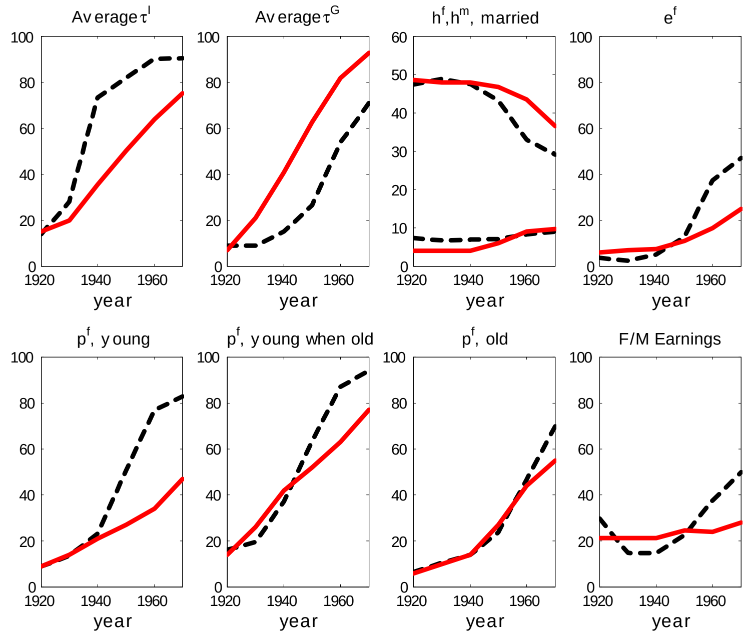

Figure 7: Model transition.

the fact that the decline in q^I is very rapid between 1920 and 1950. The adoption of the new G technology is slightly slower than in the data. The slow adoption of the new general household technologies in the model reflects that fact that until 1940 there is no significant reduction in its time price.

The ability to invest in market skills amplifies the effect of the new home technologies on women's labor force participation and accelerates the transition in the model. We plot the fraction of married women that have invested in market skills in each year in panel 4. In 1920, this fraction is equal to 3%, it then declines to 1% in 1930, reflecting the higher fertility rates in that cohort, and it takes off in 1940 rising to 45% in 1970. We interpret this variable broadly, reflecting not only years of formal education but also additional time invested in their careers that workers can only pursue early in their employment history. This implies that there is no single summary measure of this variable that we can use to compare the model's prediction with the data along this dimension. In figure 7, we compare women's investment in market skills in the model with the percentage of white women graduating from college by cohort.[29] The college graduation rate

young in 1930. Similarly, 7/27 agents that were old married in 1920 will still be old married in 1940, 10/27 will still be old married in 1930. To take this into account in the transition, we treat 1920 as if everybody is a new single agent, a new young married agent and a new old agent, consistent with our calibration. In 1930 we compute all the decisions for the new single, young married and old married agents. The population statistics on the young married and old married that we report for 1930 reflect the fact that 10/11 young marrieds in 1930 are new young marrieds and 1/11 young marrieds made their decisions in 1920 and behave accordingly. Similarly for the old married agents and for all successive years.

This treatment is consistent with the maintained assumption that at each stage in life agents make all their decision at the beginning of the period based on the current prices/wages and expected future prices.

[29]Source: U.S. Bureau of the Census, Current Population Reports, Series P-20, Educational Attainment in the United States.

is 6% in 1920 and rise to 25% in 1970. Interestingly, the take off for women's college graduation rates in the data occurs in 1940, as predicted by our model.

We report the female/male ratio of average labor earnings in panel 8 (dashed line) and we compare it to the ratio of wage income for the white married population from the Census. The model predicts a value of 30% for 1920, higher than its empirical counterpart equal to 21%. The earnings ratio drops in the model in 1930 and 1940, to 15%. This is mainly a compositional effect, due to the entry of unskilled married women in the labor force in that time period, which determines a decline of average wage income of women, conditional on participation. The earnings ratio rises steadily from 1950 onward in the model, reaching 50% in 1970, whereas in the data it is only 28% at the same date.

Labor force participation of married women increases with age in the model, consistent with the data. This can be seen from panels 5 and 6, where the dashed-dotted line corresponds to the labor force participation rate of young married women when old. The value predicted by our model is quite close to the data until 1940 after which it rises at a faster rate. This outcome is driven by the acceleration in women's investment in market skills in 1940, which is more intense in the model than in the data, as well as by the fast adoption of new infant good technologies in 1930.

The rates of participation for old married women is very close to the data. In all years, young married women (dashed line in panel 5) exhibit higher participation rates than old married women (panel 7). This cohort effect, which is also present in the data, is due to the fact that old married women face lower lifetime earnings due to rising real wages and higher new home technology prices. This reduces their incentive to invest in market skills and their opportunity cost of home production relative to men.

Finally, home hours of married women decline significantly, while male home hours increase over time. This outcome is mostly driven by the rising rates of women's investment in market skills at all ages, which induces greater symmetry in the household allocation of home hours. Total leisure for married men then decreases substantially relative to total leisure of married women who participate in the labor force. Home and market work for participating married women, excluding the time devoted to the production of infant goods, totals to 65 hours in 1920, and falls to 54 hours in 1970. For married men, total work amounts to 48 hours in 1920 and rises to 53 hours in 1970 in the model.

This prediction is consistent with empirical evidence for the US, on the decline in leisure time for men married to women who participate in the labor force *relative* to their wives. This phenomenon is discussed by Knowles (2005), who focusses on the time period 1965-2003. For our period of interest, it is not possible to measure home hours of husbands conditional on the participation status of their wife. However, the downward trend in married men's leisure relative to their wife is clearly present. Knowles (2005) argues that the decline in married men's relative leisure is due to an increase of wives' bargaining power within the household. In our model, this outcome stems from the fact that women's lower comparative advantage in home production increases wives' earning potential on the labor market and induces a more equal distribution of home hours.

4.3.1 Discussion

How do we interpret the fact that the model largely overpredicts the labor force participation of young married women and the rate of adoption of new infant good technologies relative to the data? The evolution of household technologies and labor productivity is the only force that influences female labor force participation and gender earnings differentials in the model, while other factors may also play a role and dampen the effect of improving technologies in practice.

One very important factor which we abstract from is the presence of "marriage bars" for women until the 1950's. Marriage bars consisted in the practice of not hiring married women or dismissing female employees when they married. Marriage bars were prevalent in teaching and clerical work, which accounted for approximately 50% of single women's employment between 1920 and 1950. Goldin (1991) extensively documents the pervasiveness of these practices for different school districts and for firms hiring office workers. The probability of not retaining single female worker upon marriage ranged between 47.5% to 58.4% for school districts between 1928 and 1942, and between 25% and 46% for firms hiring office workers between 1931 and 1940. The probability of not hiring a married woman ranged between 62% and 78% for school districts and between 39% and 61% for firms hiring office workers over the same periods.

Conditional on employment, differences in wages across genders are purely driven by differences in investment in market skills in our model. We do not allow for statistical or taste based discrimination. Yet, even in current years approximately 10% of the gender differences in earnings cannot be accounted for by observable differences in characteristics that are related to productivity (O'Neill, 2000). Albanesi and Olivetti (2006) argue that this unexplained gender earnings differential could be due to statistical discrimination. Gender discrimination would greatly reduce women's incentive to invest in market skills and participate in the labor force in our model.[30]

Cultural factors may also have played an important role in slowing down the increase in women's labor force participation. Fernández and Fogli (2005) document the strong role of country of origin, a proxy for cultural differences in attitudes with respect to women's work, in second-generation American women's labor force participation behavior. Based on survey evidence reported in Fogli and Veldkamp (2007) and Fernández (2007), only 20% of respondents believed that a married woman should work in the period between 1935 and 1945. By 1970, this number went up to 55%, a very significant rise to a level that still suggests a significant cultural barrier to women's employment.[31]

We also assume that the distribution of bargaining power in the household is exogenous, constant over time and equal across spouses. Empirical evidence[32] suggests that the distribution of bargaining power across spouses depends on relative wages. Based on this, the assumption that spouses have symmetric bargaining power in the 1920's seems unrealistic since married women had lower earning potential. Institutional factors, such as divorce laws, lack of political representation and marriage bars in the labor market may also have contributed to reduce women's bargaining power in the household. The gradual lifting of these constraints over the course of the twentieth century can be represented as an increase of the wives' Pareto weight in the household problem in the context of our model.[33] Knowles (2005) argues that the reduction in female/male earnings differential indeed increased the bargaining power of women and led to a decline in gender differ-

[30] Numerical experiments suggest that differential returns to work or skill investment by gender do not significantly affect the transition. This is due to the fact that the conventional measures of these gender differentials do not vary much over this time period.

[31] Fogli and Veldkamp (2007) and Fernández (2007) point to uncertainty about the effect of mother's work on the welfare of young children as an important determinant of these attitudes.

[32] See Browning, Bourguignon, Chiappori, and Lechene (1994) and Mazzocco (2007).

[33] Doepke and Tertilt (2007) argue that the rise in returns to education at the beginning of the twentieth century increased women's importance in the household and spurred a process of equalization in their economic and social rights.

entials in home hours. In our model, a rising Pareto weight for married women would lead to a slower increase in their participation, since this is inversely related to their Pareto weight in the household problem.

Lastly, we assume that the only cost associated to the adoption of new infant good technology is the monetary cost and that infant formula was readily available in all locations after its commercial introduction. In practice, there could be additional learning costs associated with the use of infant formula that slow down its diffusion in the population or uncertainty about the effectiveness of formula as a substitute for mother's milk. For example, formula was initially not available in all locations. In the 1920s and early 1930s, diffusion of knowledge on infant formula mainly occurred via women giving birth in hospitals. For this period, the rate of hospital birth can in fact be considered an upper bound on the possible rate of diffusion of infant formula. In addition, as discussed in Section 2, in the early 1970s, new scientific discoveries regarding the positive effect of mother's milk on the immune status of the baby and on the child's resistance to infections brought about a resurgence in breast feeding. The inclusion of additional adoption costs for infant formula, as well as constraints on diffusion, would dampen the adoption rate of infant formula in the model and slow down the rise in married women's labor force participation.[34]

4.4 Experiments

We now run several experiments to isolate the role of each source of technological progress in isolation. The experiments are summarized in Table 5.[35]

Table 5: Experiments

Experiment 1	q^I and q^G constant
Experiment 2	q^G constant
Experiment 3	Constant q^G and ν_I
Experiment 4	q^I and ν_I constant
Experiment 5	Constant ν_I

We report the behavior of all variables in Table 6 and selected results from the experiments in figures 8-11. In all figures, the dashed lines correspond to the transition in the full model, the dash-dotted line correspond to the transition in the experiment, while the solid lines correspond to the data.

Experiment 1 fixes q^I and q^G to their value in 1920, so that the only dynamic force is the decline in ν_I. Results are displayed in figure 8. There is no increase in the adoption of new infant and general household technologies over the entire period in this experiment. Changes in the labor force participation of young married women exclusively reflect changes in the time cost of pregnancy. Despite this, labor force participation for young married women rises as much as in the data between 1920 and 1950. The reduction in the time cost of pregnancy, childbirth and

[34] The new discoveries on the immunization properties of mother's milk could be modelled as a negative shock to the productivity of the new infant good technology. That is, adopting the new technology, would still save time but deliver a lower quantity of infant good. If preferences were defined over the quantity of infant goods, this would lead, other things equal, to higher breast feeding rates.

[35] We do not conduct and experiment with constant real wages, since due our logarithmic specification for preferences, substitution and wealth effects associated with a generalized rise in the level of real wages exactly cancel. This implies that the transition with constant real wages is exactly the same as with rising real wages. In all the experiments, real wages are held constant.

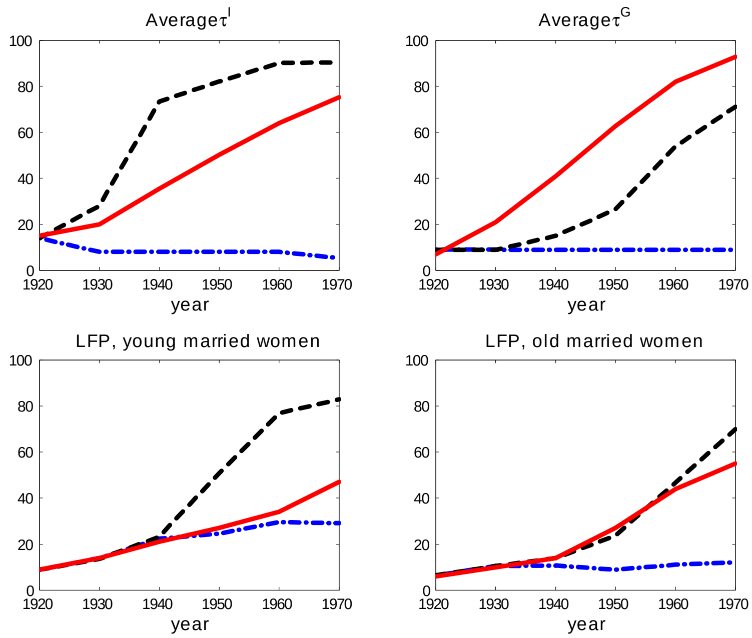

Figure 8: Experiment 1

recovery *alone* can account for the rise in the participation of married women in the fecund period of life over these years. Labor force participation of old married women does not increase beyond 1940. Table 6 also shows that there is no reduction in female home hours and no increase in the investment in market skills.

It is a feature of the model that single women's investment in markets skills is strongly linked to the expectation of being in the workforce in the old married period. This stems from the fact that this period is the longest in the agents' lifetime in the model, and returns to investment in market skills are mostly reaped in those years. On the other hand, adoption of the new infant good technology in the young married period also encourages investment in market skills. This mechanism generates a strong complementarity between adoption of the new infant good technology, investment in market skills and work in the old married period for women, which emerges in all the experiments. Investment in market skills also leads to a more symmetric household allocation of home hours, because it eliminates gender differentials in earnings. Hence, women's participation in the old married period is associated with a relatively high female/male earnings ratio.

In experiment 2, q^G is held constant so that there is no improvement in the general household technology and the transition is exclusively driven by the decline in ν_I and q^I. Results are displayed in figure 9. Not surprisingly, the average τ^G remains at 1920 levels for the entire time period, however, τ^I is unchanged relative to the full transition. Married women's labor force participation rises less than in the data and in the full model between 1950 and 1970, while it's virtually unaffected between 1920 and 1950. This suggests that improvements in general household technologies play a strong role in the later time period. In the early period, rising female participation rates are mostly driven by young married women entering the labor force as ν_I declines and households adopt the new infant good technology, and this pattern is mostly

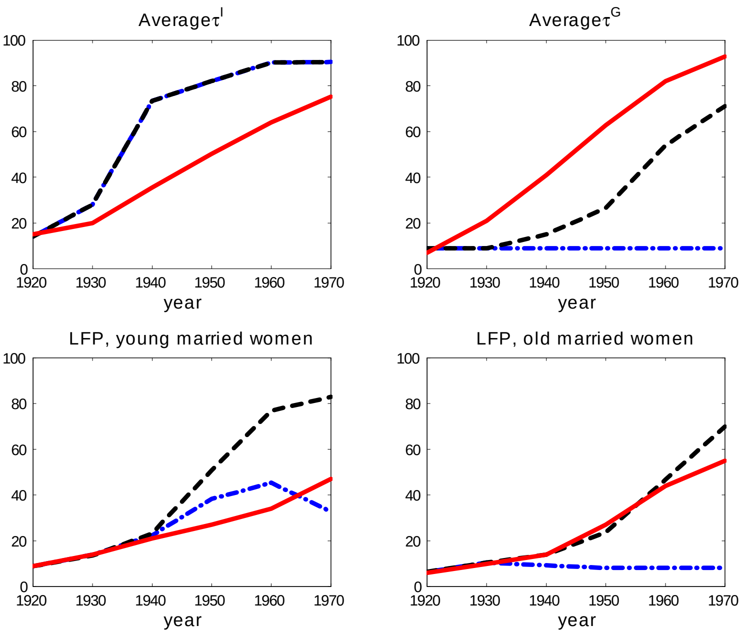

Figure 9: Experiment 2

unaffected by the constant value of q^G. The high value of q^G has a direct negative effect on participation of old married women. This discourages investment in market skills and indirectly also affects young married women's participation in the labor force between 1950 and 1970, despite the high rates of adoption of new infant good technologies.

We report the results for experiment 3 in Table 6. This experiment isolates the effect of a decline in q^I since both ν_I and q^G are constant. Labor force participation of young married women rises from 9% in 1920 to 20% in 1970. This suggests that the declining cost of infant formula alone can account for only a small fraction of the rise in participation of young married women, and the decline in the time cost of pregnancy, childbirth and recovery instead has a much stronger impact over those years.

Experiment 4 isolates the effect of the decline in q^G. The results are displayed in figure 10. With q^I and ν_I constant, τ^I is also constant. The labor force participation of young married women is lower than in the full transition and much lower than in the data between 1920 and 1950. Absent any decline in q^I or ν_I, young married women's labor force participation is 9% lower than in the data in 1930, 13% lower in 1940, 3% lower in 1950. This suggests that in the model the rise in the labor force participation of young married women is strongly driven by progress in medical technologies. By contrast, old married women's labor force participation and the adoption of new general household technologies are virtually unaffected with respect to the model with all sources of technological progress. As reported in Table 6, investment in market skills is lower in 1960 and 1970, which depresses the F/M earnings ratio for that period.

Results for experiment 5, in which ν_I is kept constant at the 1920 level are reported in figure 11. The transition is only driven by the decline in price of the new infant and general household technologies in this experiment. The lack of progress in medical technologies mostly effects the participation of young married women, which is approximately 10% lower in all years relative to

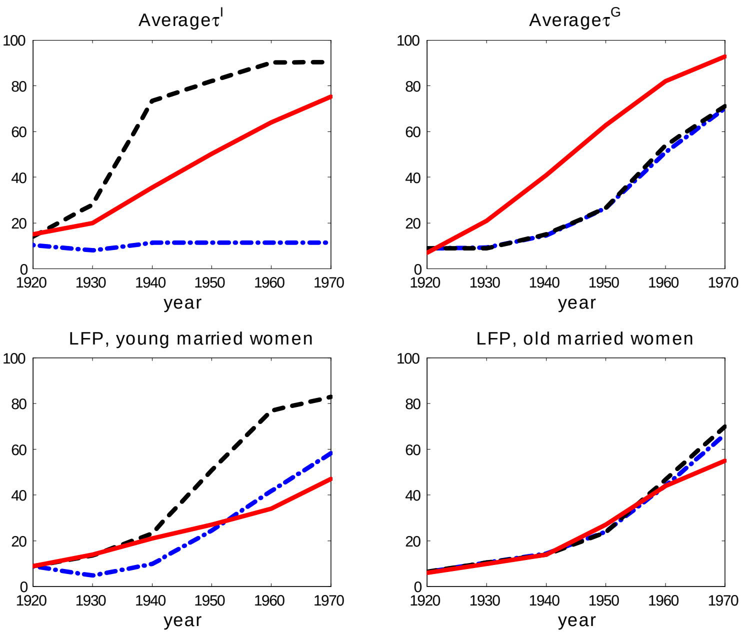

Figure 10: Experiment 4

the full version of the model and approximately 5% lower than in the data in 1930 and 1940. Once again, the decline in the time cost of pregnancy emerges as the essential factor for the rise in participation of young married women before 1950.

We also conducted an experiment to evaluate the role of fertility, by allowing all sources of progress and fixing fertility at the 1920 level. The transition is virtually unchanged relative to the full model. This suggests that high fertility is not in itself detrimental to rising participation of married women if the time cost of pregnancy is declining and households can adopt the new home technologies.

Summing up, the reduction in the time cost of pregnancy, childbirth and recovery appears to be the most important force behind the rise in the participation of married women with children between 1920 and 1960. Its impact is stronger than the decline in the price of infant formula over that period. Improvements in medical technologies alone can fully account for the rise in the participation of young married women between 1920 and 1950. Improvements in general household technologies mostly affect labor force participation of young and old married women between 1950 and 1970. The ability to adopt *both* the new infant good technology and the new general household technology are essential for the rise in labor force participation of old married women between 1950 and 1970.

5 Concluding Remarks

Our results suggest that the advancements in medical technologies that reduced the time cost of pregnancy, childbirth and recovery were essential for the rise in labor force participation of young married women with children between 1920 and 1960, while infant formula played a smaller role over that time period. The introduction and improvement in home appliances accounts for a

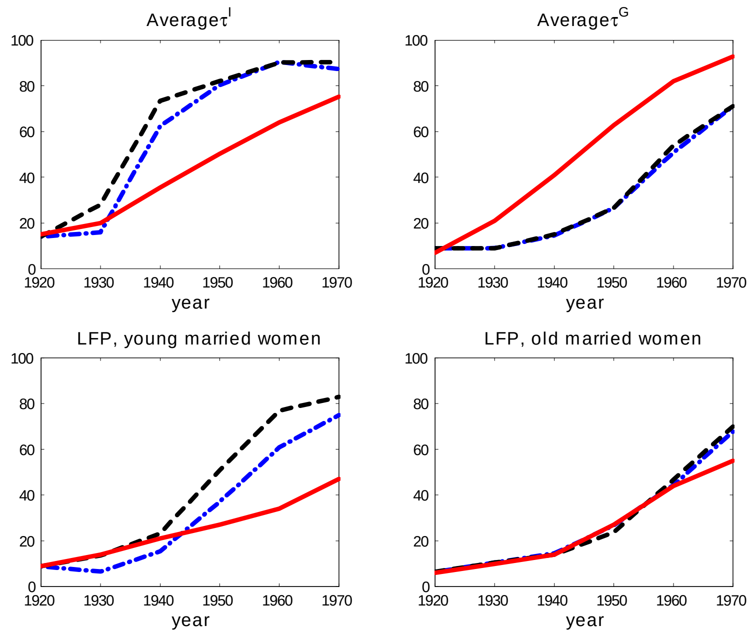

Figure 11: Experiment 5

significant fraction of the rise in female labor force participation between 1950 and 1970.

We concentrate on the years before 1970 since we are interested in medical advancements that occurred (and plateaued) before then. As discussed in the literature, after 1970 additional factors such as the availability of oral contraception and the change in divorce laws played a role in explaining the increase in women's investment in education, labor force participation and wages. Goldin and Katz (2002) show that the availability of oral contraceptives starting in the late 1960's contributed to the increase in the number of college graduated women into professional programs and to the decline in the age at first marriage. Bailey (2006) shows that legal access to the pill before age 21 significantly reduced the likelihood of having a first birth before age 22 and increased the number of women in the paid labor force.

We focus on the time intensive nature of the commitments associated with motherhood. An additional factor to consider is that for professional women the career clock and the biological clock almost exactly coincide. This is a recent phenomenon, connected to the shift from "jobs to careers" in women's work choices which was, as argued by Goldin (2006), in part induced by the availability of oral contraceptives. This concurrence may account for the high drop out rates of highly educated women, as well as for their under-representation in executive positions in many professions. Albanesi and Olivetti (2007) argue that the greater cost associated with career investment for women may explain the differences in the level and structure of compensation by gender for top executives.

One important property of our model is that, by considering medical advancements related to motherhood, it can reproduce the contemporaneous rise in fertility[36] *and* in labor force participation of married women with young children that took place in the US in the late 1930s. Our current analysis, however, abstracts from fertility decisions. A version of our model with fertility

[36] See Greenwood, Seshadri and Vanderbroucke (2005).

choice has the potential to endogenously generate the rise in fertility, as well as account for the dynamics of labor force participation. While this is beyond the scope of this paper, we plan to explore the role of fertility decisions in future work.

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6 Model Appendix

6.1 Household Problem

Given that individuals are born without any initial wealth, they will all participate in the labor force when single. Then, we can write a unified intertemporal budget constraint, valued in terms of age 1 consumption goods, given by:

$$Z_1 + \frac{Z_2}{1+R_2} \leq \left[2\xi - \sum_{j=f,m} \left(c_0^j - w_0 \xi p_0^j\right)\right](1+R_1). \tag{18}$$

The households' unified Pareto problem is:

$$\max_{e_0^j, \tau_1^I, \left\{c_r^j, p_r^j, \tau_r^{G(j)}\right\}_{r=0,1,2, j=f,m}} 0.5 \sum_{j=f,m} u\left(c_0^j, T - e_0^j \gamma - h_0^j\left(\tau_0^G, \tau_0^I\right) - p_0^j \bar{n}\right) + g_0\left(G_0^j\left(\tau_0^{Gj}\right)\right)$$

$$+\beta_1 \left[\sum_{r=1,2} \beta_2^{r-1} \sum_{j=f,m} \lambda_j u\left(c_r^j, T - h_r^j\left(\tau_r^G, \tau_r^I\right) - p_r^j \bar{n}\right) + g_1\left(G_1\left(\tau_1^G\right), I_1\left(\tau_1^I\right)\right) + \beta_2 g_2\left(G_2\left(\tau_2^G\right)\right)\right]$$

subject to (18) and (3), (1)-(2), (6), $h_2^{fI} = 0$ and $h_2^f = h_2^{fG}$. Here, the Pareto weights over age 0 utility are symmetric, consistent with the fact that agents choose the age 0 allocation individually.

Combining (9) and (13):

$$c_0^j = c_1^j \left[\beta_1 (1+R_1) \frac{\lambda^j}{0.5}\right]^{-1/\sigma}, \text{ for } j = f, m. \tag{19}$$

Similarly, combining (9) and (10):

$$c_2^j = c_1^j \left[\beta_2 (1+R_2)\right]^{1/\sigma}, \text{ for } j = f, m. \tag{20}$$

Using (9) for f and m :

$$c_1^m = c_1^f \left(\frac{\lambda_m}{\lambda_f}\right)^{1/\sigma}. \tag{21}$$

Equations (18)-(21), jointly with (9), give rise to a system of six equations in the six unknowns c_r^j for $j = f, m$ and $r = 0, 1, 2$.

6.2 Market Production and Equilibrium

The problem for the representative firm is given by:

$$\max_{d,k,c} \Xi y - wN$$

subject to (15) and (17), where w is corresponds to economy wide labor productivity in the current period. Hence, in equilibrium, w will be equal to Ξ at each date.

The resource constraint is:

$$\begin{aligned} 0 \quad = \quad & \sum_{r=1,2} n(r) \left(q^G \int_j \tau_r^G(j)\, d_r^{\tau_r^G(j)} dj \right) + q^I n(r) \int_j \tau_1^I(j)\, k^{\tau_1^I(j)} dj \\ & + \sum_{r=1,2} n(r)\, C_r + \frac{1}{3} a_1' + \int_i \left(a_0'(i) + \xi (1+e_i)\, p(i) \right) di - Y - \sum_{r=1,2} n(r)\, a_r (1+R), \end{aligned}$$

where j indexes households in the population, $n(r)$ denotes the fraction of agents of age r in the population and:

$$\begin{aligned} C_r &= \int_i \left(s_r(i) + \xi(i)(1+e_i)\, p_r(i) \right) di, \\ Y &= \sum_{r=0,1,2} n(r) \int_i p_r(i) * \xi(i)(1+e_i)\, di, \end{aligned}$$

where i indexes individuals in the population and capital letters denote aggregate values.

Integrating budget constraints over all households in the population:

$$A(1+R) + \int_i \xi p(i)\, di = C + q^G \int_j \tau^G(j)\, dj + q^I \int_j \tau^I(j)\, k^{I^{\tau^I}}(j)\, dj - A',$$

where i indexes all living individuals and j all living households.

Since $Y = \int p(i) * \xi(i)\, di = \int_j \tau^G(j)\, d^{\tau^G}(j)\, dj + \int_j \tau^I(j)\, k^{\tau^I}(j)\, dj + C + A' - A(1+R)$ from the resource constraint, then:

$$\int_j \tau^G(j)\, d^{\tau^G}(j)\, dj + \int_j \tau^I(j)\, k^{\tau^I}(j)\, dj = q^G \int_j \tau^G(j)\, dj + q^I \int_j \tau^I(j)(j)\, dj, \tag{22}$$

where market clearing requires $\int_j \tau^I(j)\, k^{\tau^I}(j)\, dj = K$ and $\int_j \tau^G(j)\, d^{\tau^G}(j)\, dj = D$. Then, under competitive pricing, (22) pins down the equilibrium values of q^l as a function of the technological marginal rates of transformation γ^l, for $l = G, I$.

7 Data Appendix

7.1 Demographics

Data on total fertility rate and number of live births are from Hauser (1976). Data for median age at first marriage correspond to Series A 158-159 in Historical Statistics of the United States (1975). Data for median age at first birth are obtained by using information on first births by age of mother from the National Center of Health Statistics (http://www.cdc.gov/nchs/data/statab/t991x02.pdf). We use information on number of women in each age group (Series A 119-134, Historical Statistics of the United States, 1975) in order to obtain the median age at first birth in 1920. We take the statistic for median age at last birth from Glick (1977, Table 1.)

7.2 Wages and Prices

7.2.1 Prices

Nominal prices are deflated by using the U.S. Bureau of Labor Statistics All Urban Consumers Price Index (CPI-U) with base 1982-1984. This index is an average of prices for all items in the CPI and across all major U.S. cities. We deflate monthly and yearly data by using the corresponding (monthly or early) CPI-U.

7.2.2 Real Wages

The historical real wage series that is most commonly used in the literature is the series discussed in Hanes (1996). However, the series starts in 1923 and has a break during WWII (1941 to 1946). Given that we focus on the 1920-1970 period, we use real hourly wages in manufacturing (or full-time year-round workers) from Margo (2006a.) This series is available for every year between 1909 and 1995. The two series move very closely although for every year, real wages in Hanes' series are larger than in Margo's.

7.2.3 Wage Rates by Gender

We use the 1920-1948 series on hourly wages of production workers in manufacturing by gender from Margo (2006b.) This series is based on *aggregate payroll* data collected by the National Industrial Conference Board (NICB.) Unfortunately, information on wage rates by gender is not readily available after 1948. Hence we use data from the Handbook of Labor Statistics, 1970, Table 109 (Number and Average Straight-Time Hourly Earnings of Production Workers in Selected Manufacturing Industries, 1967-69) to compute the male and female hourly wage in 1968. Unfortunately these data are only available for selected industries. Therefore, we scale the wages upwards to match (1967-69 average of) series Ba4361 (the aggregate hourly wages based on the NICB sample.) We use simple linear interpolation to fill in the missing data between 1948 and 1968.

7.2.4 Female/Male Earnings Ratios

Data on the female/male earnings ratio are from Goldin (1990, Table 3.1). This is the standard series used in the literature and it provides information on the gender gap for full-time year-round workers. We also use Census data to construct a measure of the average gender earnings ratio for the overall population. In this case we use the IPUMS Census 1% samples from 1940 to 1970 (for

1970, we use the 1% State sample). Our sample includes white men and women, aged 16 through 64, living in non-farm households. We further restrict the sample to observations with group quarters status equal 1, "Households under 1970 definition." We use the information on wage and salary income (INCWAGE). For all years N/A code (999999) is treated as missing data. Since the information on income in the 1940 and 1950 Censuses is only available for sample-line persons the statistics by gender are obtained as weighted averages using sample-line weights (SLWT). For 1960 and 1970 sample-line weights coincide with person weights (PERWT).

7.3 Trends in Labor Force Participation of Married Women

7.3.1 By Age and Cohort

We construct cohort and time series measures of labor force participation (LFP) of married women using comparable 1890 to 1980 LFP data constructed by Goldin (1990, Table 2.2). The data are disaggregated into five age groups: 15-24, 25-34, 35-44, 45-54, 55-64. Since data are not available for 1910 we obtain LFP by age for this decade by linear interpolation of the appropriate statistics between 1890 and 1920.

Based on these data we compute the LFP statistics used in section 4.1, 4.3 and 4.4, as follows. The 1920 calibration target for LFP of "young" (age 23 to 35) married women corresponds to the LFP of women born in 1886-1895 (that is, married women age 25-34 in 1920). The 1920 target for LFP of "old" (age 36 to 60) married women is obtained by averaging LFP statistics for the 35-64 age group across three cohorts: 1856-1865, 1866-1875 and 1876-1885. The time series data for LFP of old married women used in Figure 7-11 and in Table 6 is obtained by averaging (with the appropriate population weight obtained from Haines and Sutch (2006)) LFP of married women aged 35-44, 45-54 and 55-64 in each decade. The corresponding data points for LFP of young married women correspond to LFP of women aged 25-34 in 1920, 1930, ..., 1970.

7.3.2 By Number of Children

We use 1920 to 1970 IPUMS Census data to compute LFP by number of children. Our sample inclusion rules are the same as in section 7.2.4.

We count individuals whose imputed labor status is "employed" or "unemployed" (variable EMPSTAT, codes 1 and 2) as participating in the labor force (see IPUMS documentation for information on consistency of this variable across time and comparability to other measures of participation.) Because employment status information is not available in 1920, we use occupation data for that year instead. Using the 1950-standardized variable (OCC1950), we count all individuals with an "occupational response" (codes 0 through 970) as participating in the labor force. Observations with a "non-occupational response," unknown occupation or no data are, therefore, counted as non-participants. We report LFP by presence of children within various age categories, as well as for women with no children. These statistics are obtained by using information on the total number of children living in the household (variable NCHILD), the total number of children less than 5 years old (NCHLT5) and on the age of the youngest child (variable YNGCH). Averages are weighted using person weights (variable PERWT). Table A1 presents the data on LFP by presence of children for married and never married white women age 23 to 35.

Table A1: Female LFP by marital status and presence of children (percentages)

	Married		Never Married	
	no children	children ≤12	no children	children ≤12
1920	15	4	80	63
1930	27	6	83	62
1940	38	10	86	61
1950	54	14	86	62
1960	66	22	86	63
1970	74	32	86	64
1920-1950	262	242	9	-1
1920-1960	342	443	8	0
1950-1970	37	129	-1	2
1960-1970	12	44	0.3	1

Based on IPUMS data. LFP based on EMPSTAT (code = 1-2) in years 1930 to 1970. LFP based on OCC1950 (code = 0-970) in 1920. Children variables based on NCHILD, NCHLT5, and YNGCH. Restricted to GQ=1, weights=PERWT. Age 25-35.

7.4 Home Hours

The "1920" value for married men's home hours is from Table 11.1 in Robinson (1985.) According to this source, men only spent 4 hours per week in family care activities. A reported in Vanek (1973), housewives spent 51 hours per week attending to household chores. For employed married women, defined as working for pay more than 15 hours per week, Vanek (1973, page 194) reports 26.8 hours per weeks for rural employed women and 23.6 hours per week for urban employed women. Following Ramey and Francis (2006) we take the average of these two statistics (25 hours per week). The numbers that we use for home hours are consensus estimates. Vanek (1973) reports information from a compilation of time-use studies conducted by the Bureau of Nutrition and the Bureau of Home Economics between 1924 and 1928. In all these studies home hours by housewives range from 50 hours per week to 60 hours per week. The few studies that report home hours for men show that men spent on average between 3 and 5 hours per week in home activities. See also Ramey and Francis (2006) and Bryant (1996).

7.5 Progress in Maternal Health

We can identify three phases in the history of childbirth in the US.[37] Until 1850s, only women were admitted in the birthroom and deliveries were assisted exclusively by midwives. Between 1850 and 1935, physicians gradually entered the birthroom. After 1935, births rapidly shifted to the hospital. While rates of maternal mortality only declined substantially starting in the last phase, the changes to the birthing process that led to this outcome began in the second part of the 19th century. In the first phase, midwives, despite their extensive experience, did not have sufficient medical knowledge to deal with the potential complications associated with parturition and physicians were not trained to deal with women's health. In the late 18th century, affluent families in the North-East started to invite male physicians to assist with deliveries. Physicians used drugs to alleviate pain during labor and hasten delivery, and often resorted to bloodletting

[37] See Loudon (1992) and Leavitt (1986) for further details.

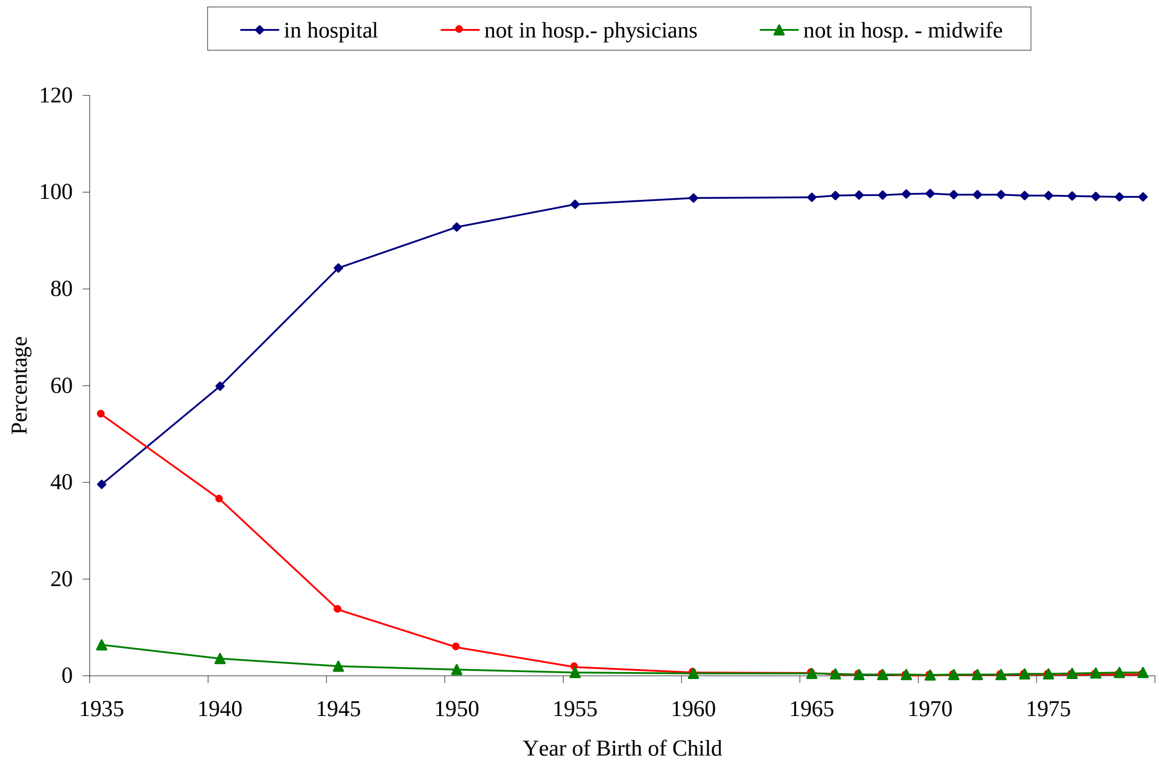

Figure 12: Percentage of live births in hospital by place of delivery and type of attendant.

and forceps. This practice steadily grew in the second half of the 19th century. In 1900, 50% of all births were assisted by midwives and the rest by physicians.

The presence of formally trained physicians was instrumental in preventing maternal and neonatal deaths in many instances. However, the initial lack of experience and the practice of avoiding visual examination of female patients undermined their ability to intervene effectively during parturition. Experimentation and excessive operative interventions, such as aggressive use of forceps, were common. In addition, physicians' exposure to other patients with communicable diseases actually increased the risk and incidence of post-partum infections before germ theory was widely accepted and antibiotics were available.

Even if initially the intervention of physicians did not contribute to a substantial reduction in maternal mortality, it led to the introduction of new procedures that laid the ground for an improvement in obstetric practices that substantially reduced the risk of maternal disability and death during the first half of the twentieth century. The most notable developments were surgical procedures to correct perineal lacerations, and the adoption of new hygiene standards following the discoveries in bacteriology of the late 1800s.

The perceived iatrogenic nature of women's birthing and post-partum conditions in the early part of the 20th century led to the move from home to hospital. This shift was part of a broader effort in the medical profession to standardize and monitor obstetric practices. While until the mid 1920s, only poor women gave birth in hospitals, starting in the 1930s, with the advent of electronic imaging and advanced neonatal therapies that could only be administered in a hospital setting, wealthy women also started giving birth in hospitals. As shown in Figure 12, 36.9% of all births took place in hospitals in 1935. By 1955, 94.4% of all births took place in hospitals.

7.6 Physical and Monetary Cost of Breast Feeding

Our estimates of the total time and monetary cost of breast feeding are based on information from the National Association of Pediatrics (http://www.med.umich.edu/1libr/pa/pa_formula_hhg.htm). According to this source, the number of feedings per day varies by the infant's age. That is, an infant should be fed 6 to 8 formula feedings per day for the first month, 5 to 6 formula feedings per day from 1 to 3 months, 4 to 5 formula feedings per day from 3 to 7 months, 3 to 4 formula feedings per day from 7 to 12 months. The number of daily feedings decreases with the age of the child as solid food is introduced in the later period.

7.6.1 Physical Cost

Based on accounts from pediatric journals, it is reasonable to assume that the time spent for each feeding (time for the actual feeding and cleaning up) ranges from 20 to 30 minutes. Combining this information with the number of daily feedings by age, we can obtain rough estimates of the average weekly time cost of feeding an infant. We find that a mother would spend 700 to 900 hours breast feeding a baby during his first 12 months of life. This calculation implies that she would spend on average 13.6 to 17.3 hours per week in this activity.

7.6.2 Monetary Cost

According to the National Association of Pediatrics, the amount of formula needed for a baby varies by the infant's weight. Newborns usually start with 1 ounce per feeding, by 7 days they can take 3 ounces per feeding. The amount of formula that most babies take per feeding (in ounces) can be calculated by dividing the baby's weight (in pounds) in half. We use this information as well as the 2000 Infant Growth Charts from the Center for Disease Control of the National Center of Health Statistics (available at: http://www.cdc.gov/growthcharts/) to obtain our estimates of the average daily intake of infant formula (in liquid ounces) for a baby of median weight during the first 12 months of his life. The average daily cost of exclusively breast feeding an infant is then obtained by multiplying the resulting average daily quantity of formula by the price of a 'ready-to-feed' liquid ounce of Similac.

We use the 2000 CDC Infant Growth Chart since it is based on a representative sample of formula- and breast-fed infants. Also available are the 1977 Growth Charts that are based on a study conducted in Ohio from 1929 to 1975. The babies in this study were primarily fed formula or a combination of breast milk and formula and often started solids before 4 months. Since the mode of infant feeding influences the pattern of infant growth we think that the 2000 CDC Growth Char provides a better approximation for the weight growth of (exclusively breast fed) infants in 1920.

7.7 Infant Formula

Table A2 reports differences in the composition of different types of milk and of first and second generation infant formulas. Data on human and cow milk are from Packard and Vernal (1982, page 140). Data for Nestle are from Apple (1987). Data on the more contemporary formula are from Hambraeus (1977). Entries are percentages of grams of fat\proteins\carbohydrates per 1,000 grams of milk/formula. We use the composition of SMA for the 1920s as a proxi for Similac's. We think that this is a reasonable assumption since, as shown in the last two columns of the table, the two formulas are nutritionally equivalent in 1977. In the 1970s, nutritional scientists realized that it was wrong to design the formula to exactly match human milk. As a consequence there was a drastic change in the composition of these formulas relative to those created in the 1920s. No further path breaking discovery has occurred ever since. Similac products currently in stores are nutritionally equivalent to those sold in 1977.

Table A2: Percentage composition of different types of milk

	Human Milk	Cow's Milk	Nestle 1929	SMA 1920s	SMA 1977	Similac\Enfamil 1977
Proteins	0.9%	3.4%	2.3%	0.9%	1.5%	1.5%
Fat	4.4%	3.6%	2.3%	4.6%	3.5%	3.6%
Carbs	6.6%	4.8%	5.7%	6.5%	7%	6.8%

7.7.1 Humanized Infant Formula: Similac

The infant formula that became known as Similac was developed in the early 1920s by two Boston based scientists, Alfred W. Bosworth, a milk chemist, and Henry Bodwidtch, a pediatrician. The formula, marketed by the Moores and Ross Milk Company in 1924, was initially sold only through physicians, who would place their own label on the plain cans. By 1926, it was commercialized under the name Similac (see Schuman, 2003.)

As discussed in Section 2, we measure technological progress embedded in infant formula based on a time series for the real price of Similac constructed from historical ads from the Chicago Tribune, the Los Angeles Times and the Washington Post. For each year between the mid 1930s and the mid 1980s we have monthly information on price, quantity and type (powder, concentrated liquid, ready-to-feed) of Similac products on sale in drugstore chains in these three cities.

Since there are very few observations on ready-to-feed formula we only use information on the price of powder and concentrated liquid Similac. These products did not differ in terms of their chemical composition. The only differences between powder and liquid formula were (and still are) related to the proportion of water that needs to be added in order to obtain one ready-to-feed liquid ounce of formula and in the differential amount of time required to effectively mix powder or concentrated liquid with water. Since this difference is negligible, we consider the two products as equivalent in terms of their quality. In order to average their prices, we express them in the same unit of measure (that is, one ready-to-feed liquid ounce of formula) using the following conversion rules. According to the instructions reported on the current Similac labels, 25.6 ounces of powder can make approximately 196 fluid ounces of formula whereas 13 ounces of concentrated liquid Similac can make 26 fluid ounces of formula. Therefore, the price of one unit (i.e. one liquid

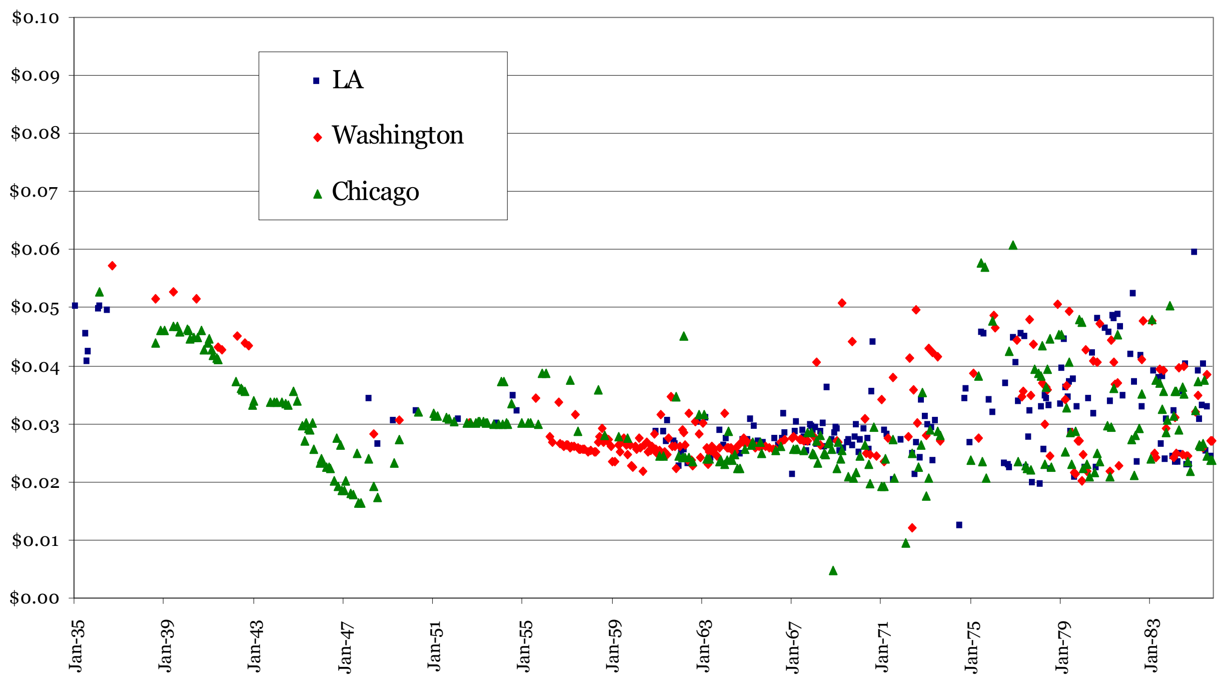

Figure 13: Average Monthly Price of Similac

ounce) of formula in real terms is obtained by dividing the (real) price of the can by the quantity of formula (in liquid ounces) that can be obtained by using the content of the can.

Figure 11 shows the monthly city-level data for the unit price of Similac thus obtained. Interestingly, there is little price variation across cities before 1970. As shown in the figure, we do not have information for each month/year. If the information for one year is missing we interpolate prices across the two adjacent years. There is no record on the price of Similac in the Los Angeles Times from July 1936 to March 1948 and in the Washington Post from October 1942 to May 1948. Hence, for some of the early years our series is based on the price of Similac for the Chicago area alone. For some years we also have information on the regular (non sale) price of the product. However, this information is very limited and cannot be used to obtain a consistent price series. Nonetheless, it is interesting to note that a 16 ounces can was often referred to as the '$1.25 Similac' and not by its weight. This seems to suggest that the non-sale price of the product was $1.25 for a long time (from 1935 to the late 1940s/early 1950s). Over time we find more and more ads of the '$1.25 Similac' at discount prices suggesting that the price of the formula was closer to its sale price in the early 1950s than it was in the mid 1930s. It follows that we are probably underestimating the decline in the price of Similac over this period.

Over time the nutritional content of Similac has improved with the introduction of iron-fortified formulas in 1959 and of the ready-to-feed version of the product in the 1970s. Since we are using sale prices we actually have very few observations for these improved products. Hence we have excluded them from our calculations. We also have data for Enfamil, a formula that became available in the late 1950s/early 1960s. However, data on Enfamil are only available since 1961, hence we have excluded these observations from our analysis. However, nothing would change if we were to include them in our calculations.

7.7.2 Milk Modifiers: Nestle's and Mellin's

We have also extended the price series backward by collecting the prices of the first-generation of milk-based formulas (Mellin's and Nestle's) that were commercially introduced in the late 19th century. These formulas were milk modifiers, that is, they were mixed in given proportions to cow milk. The information collected from the ads, however, did not include quantities only prices. We obtain estimates for the quantities of these products by using a variety of sources - figures from Apple (1987) and historical ads, labels and bottles sold on Ebay.[38] Below we describe our procedures for computing the sizes of Mellin's and Nestle's products. Since the powdered formulas had to be mixed with milk (and water) in given proportions we add to our calculations the price of cow milk. To this aim we use the series of retail price of "delivered" fluid milk (series 195 from the Statistical Abstract of the United States: Bicentennial Edition). The price reported in this series is an order of magnitude higher than the one reported in the wholesale price series from the NBER. However, the retail price is reasonable when compared with a more recent series on the retail price of milk sold in stores (and not 'delivered' milk) available from the University of Wisconsin Dairy Marketing and Risk Management Program (http://future.aae.wisc.edu/data/monthly_values/by_area/307?tab=prices&grid=true) for the period 1980-1997. Below we report the calculations that we used to obtain the price of one liquid ounce of 'ready to feed' formula.

Nestle's Sizes: Nestle's infant food came in different sizes:

1. The size sold for $0.5 at regular price would correspond to 1lb of powder formula. We find this information from historical ads on Ebay.
2. The "hospital size" can of powder Nestle's weighted 4.5lb. This information is reported in Figure 3.3, Apple (1987).

There seem to be also additional, unknown, sizes of the Nestle's cans. Since we do not have this information we drop these price observations from our sample. Size and type may have changed in the 1920s. Therefore, non-hospital size packages sold at a regular price of more than $0.5 (essentially all non-hospital packages after about 1919) are excluded from the series.

Conversion factor: We use the following calculations in order to obtain the price of one liquid ounce of 'ready to feed' formula: 6 table spoons + 20 oz of cow's milk + 15 oz water = 38oz of liquid (where 2 table spoons are equal to 1 liquid oz). This information is taken from page 12 in the August 1929 issue of the Journal of the American Economic Association. The calculation above assumes that 1 table spoon of powder is equal to 9 gr of powder, based on current package descriptions (where, generally, 1 scoop = 9 gr, approximately). The conversion factor that we use

[38] See http://americanhistory.si.edu/collections/object.cfm?key=35&objkey=110 for an example.

to go from table spoons to liquid oz is as follows: 1oz = 28.35 grams = 3.15 tbsp = 0.53 servings of 6 tbsp.

Mellin's Sizes: There were only two sizes of Mellin's – small and large bottles. The large bottle had a net weight of 10oz (Figure 5.6, Apple (1987)), an approximate volume of 16oz (authors communication with ebay seller), and approximate dimension of 6" to 6 $\frac{3}{4}$" height and 3" diameter. The small bottle's approximate dimensions are 5 $\frac{1}{2}$" height and 2 $\frac{1}{2}$" diameter (authors communication with ebay seller). Based on dimensions, we can estimate that the small bottle should contain 60% to 64% as much formula as the large bottle. If we use 60%, it's net weight is 6oz and it's volume is 9.6oz.

Type: Data for Mellin's do not report whether the product was sold in powdered or liquid form. The mixing directions for Mellin's formula call for use of "level tablespoons." Combined with information on types of formula generally available in the relevant time period, we assume that Mellin sold only powder formula.

Conversion factor: We use the following calculations in order to obtain the price of 1 liquid oz of 'ready to feed' formula (assuming that the large size corresponds to a 16oz bottle and the small one corresponds to a 9.6oz bottle): 6tbsp + 16oz cow's milk + 12oz water = 31oz of liquid. This information is taken from Figure 5.4 in Apple (1987). Since 6tbsp = 3 oz, by volume this implies that 1oz of powder = 31/3 liquid oz of usable ready to use formula.

7.7.3 Additional Information on Breast Feeding Practices

Our data on changes in breast-feeding practices for children born between the early 1930s and the early 1970s are from the 1965 National Fertility Study and the 1973 National Survey of Family Growth (Cycle I) conducted by the National Center of Health Statistics (as reported in Hirschman and Hendershot (1979) and Hirschman and Butler (1981).) The evidence on breast- and bottle-feeding rates before 1930 is based on a series of studies conducted by the Children Bureau for different geographical areas during the period 1917-1919 (see Apple, 1987, Table 9.1). The evidence on trends in the use of commercially prepared formulas is mainly based on the Ross Mother's Survey that was conducted by Ross Laboratories in Ohio, the current producer of Similac, from 1955 to the late 1980s.[39]

The data from Hirschman and Hendershot (1979) and Hirschman and Butler (1981) are based on retrospective surveys. This might pose problems related to the precision of the information especially for older cohorts of women. However, the numbers that we report are consistent with evidence from hospital discharge records and, at least to our knowledge, represents the most accurate description of trends in breast feeding over this period. The sporadic evidence from alternative records (hospital discharge records and the Ross Mother's survey,) although not extensive, consistently shows that by the early 1970s less than 25% of newborn babies were breast fed (at hospital discharge or at 1 week.)

The study by Hirschman and Hendershot (1979) also present interesting evidence on how breast feeding rates vary with indicators of social status over this period. They show that, for all cohorts, college educated women are more likely to breast feed than women with lower levels of educational attainment. However, statistically significant differentials in breast feeding incidence by education do not extend to the duration of breast feeding. The relation between the incidence of breast feeding and education has changed over time. For births occurring in 1950 or earlier, the

[39] See Martinez and Nalezienski (1979).

variation in breast feeding rates by education was small. In the late 1950s, a U-shape relationship emerged, with breast feeding more likely among women with the least or most years of education. By the 1970s, breast feeding was least common among women with the lowest levels of education, a pattern that persists to the year 2000.

7.8 Household Appliances

We use Gordon's quality-adjusted Divisia price index for household appliances (Gordon, 1990) rescaled by real wages as a measure of the time price of new general household technologies. This price series is available from 1947 to 1984. In order to obtain a series starting in 1920 we extrapolate the quality-adjusted price index backward by applying to home durables the procedure developed by Cummins and Violante (2002) to construct a quality-adjusted post-1984 price index for the capital goods that make up equipment and software. Their procedure is based on the assumption that the speed of technological change for these goods can be measured as the difference between the growth rate of constant-quality consumption and the growth rate of the good's quality-adjusted price index. Since NIPA data on household durables are not disaggregated by type of appliance we cannot perform the full-fledged adjustment proposed in Violante and Cummins but simply apply the relevant part of their procedure to our aggregate series for household appliances. In our application we use the NIPA price index for kitchen and other household appliances (NIPA Table 2.5.4, row 30) and Gordon's Divisia price index for eight household appliances. Both series are available for the period 1947-1984. Following Cummins and Violante we use the pairs of price indexes over the entire period to estimate an econometric model of Gordon's quality adjusted price index (in logs) as function of a time trend, the current value of the NIPA price index (in logs) and the growth rate of lagged GDP (from NIPA.) The estimated quality bias implicit in the NIPA series is the coefficient on the NIPA log price. We then extrapolate the Gordon's quality-adjusted price index backward by using the NIPA price series for the pre-1947 period and our estimate of the quality bias. In our exercise we use the Gordon's quality-adjusted price index that does not include further 'adjustments' for energy efficiency or repair costs since these changes occurred post 1970.

We estimate a quality-adjustment of -3.04% per year between the two series over the 1947-1984 period. The first available year for the NIPA series is 1929. The NIPA price index for kitchen and household appliances increased by 0.98% per year between 1929 and 1947. By combining this information with the estimated quality adjustment we obtain an (estimated) exponential decline in the quality-adjusted price index for household durables of 2.06% (0.98%-3.04%) per year between 1947 and 1929. Since we need to obtain a price series starting in 1920 we extrapolate this adjusted price index backward by assuming that the rate of NIPA price change between 1920 and 1929 is the same as the one observed between 1929 and 1947.

The appliance prices that we use for our calibration are as follows. From Cowan (1983) and General Electric Catalogues, the cheapest model or refrigerators sold at $450 dollars in 1924, whereas the latest model Frigidaire refrigerator sold for 714$ in 1922. The price of the most recent model of Maytag electric washing machine was 165$ in 1922. The first information of the price of a vacuum cleaner dates to 1947 when the most recent Hoover model sold for 249.50$. To estimate q^I/q^G in section 4.1, for each appliance, we convert the first available price to 1920 dollars and we deflate it back to 1920 using the average rate of growth for the time price of home durables.

Table 6: Transition and experiments

year	LFP of Young Married Women						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	9%	9%	9%	9%	9%	9%	9%
1930	14%	14%	14%	14%	7%	5%	7%
1940	21%	23%	22%	22%	11%	10%	15%
1950	27%	51%	25%	38%	18%	24%	37%
1960	34%	77%	30%	45%	23%	42%	61%
1970	47%	83%	29%	33%	20%	58%	75%

year	LFP of Young Married Women when "Old"						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	14%	16%	16%	16%	16%	16%	16%
1930	26%	20%	14%	11%	11%	20%	21%
1940	42%	37%	11%	10%	11%	37%	42%
1950	52%	63%	15%	10%	10%	64%	64%
1960	63%	87%	16%	10%	10%	82%	82%
1970	77%	94%	14%	10%	10%	91%	93%

year	LFP of Old Married Women						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	6%	7%	7%	7%	7%	7%	7%
1930	10%	11%	11%	11%	11%	11%	11%
1940	14%	14%	11%	9%	9%	14%	15%
1950	27%	24%	9%	8%	9%	24%	27%
1960	44%	47%	11%	8%	13%	44%	44%
1970	55%	70%	12%	8%	8%	66%	68%

year	Women's Investment in Market Skills						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	6	4%	4%	4%	4%	4%	4%
1930	7	2%	2%	2%	2%	2%	2%
1940	8	5%	1%	1%	1%	5%	5%
1950	11	13%	4%	4%	4%	14%	11%
1960	17	37%	4%	4%	7%	20%	20%
1970	25	47%	2%	2%	4%	36%	51%

year	Adoption of new infant good technology						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	15	14%	14%	14%	10%	10%	14%
1930	20	28%	8%	28%	28%	8%	16%
1940	36	73%	8%	73%	69%	11%	62%
1950	50	82%	8%	82%	82%	11%	80%
1960	64	90%	8%	90%	90%	11%	90%
1970	75	90%	5%	90%	90%	11%	87%

year	Adoption of new general household technology						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	7	9%	9%	9%	9%	9%	9%
1930	21	9%	9%	9%	9%	9%	9%
1940	41	15%	9%	9%	9%	15%	15%
1950	63	27%	9%	9%	9%	27%	27%
1960	82	54%	9%	9%	9%	51%	51%
1970	93	71%	9%	9%	9%	70%	71%

year	Married Women's Home Hours						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	49	47	47	47	47	47	47
1930	48	49	48	49	49	48	48
1940	48	48	49	49	47	46	46
1950	47	43	49	48	48	43	44
1960	44	33	49	47	46	41	39
1970	37	29	49	47	33	29	29

year	Men's Home Hours						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	4	7	7	7	7	7	7
1930	4	7	7	7	7	7	7
1940	4	7	7	7	7	7	7
1950	6	7	7	7	7	8	7
1960	9	8	7	7	8	8	7
1970	10	9	7	7	7	9	9

year	F/M Earnings						
year	Data	Model	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
1920	21%	30%	30%	30%	30%	30%	30%
1930	21%	15%	25%	15%	15%	22%	19%
1940	21%	15%	16%	11%	11%	35%	19%
1950	25%	23%	14%	16%	11%	32%	21%
1960	24%	38%	13%	17%	13%	30%	31%
1970	28%	50%	13%	12%	13%	42%	47%