Mothers, Wives and Workers:

The Dynamics of White Fertility, Marriage and Women's Labor Supply in the United States

1870 – 1930

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Abstract: The sweeping changes in women's role in the 20th century have their origin in the 1870-1930 period. This was a time when the patterns of women's labor supply and marriage changed profoundly. While fertility kept falling throughout the period, the nuptiality first declined, then, around 1900, picked up again. At the same time, American women were a growing presence on the labor market: first as singles, then, after 1900, increasingly as married women. I develop a model which jointly explains labor market and marriage and fertility behavior during this period. Technological change and the associated increase in single women's labor supply are modeled as the prime force for change: they strengthened women's bargaining position on the marriage market. The pre-marital bargaining between a man and a woman concerns not only the division of (future) family income but also the sources of this income. The bargaining outcome depends on the threat-points of men and women which in turn depend on the wages that men and women earn while single. Men are assumed to derive a disutility from their wives' work and would prefer to see their partners stay at home after marriage. Women, however, draw no disutility from work and focus solely on their overall level of utility. In the model, it is this conflict that leads to a postponement of marriage initially, as the men and women hold out, and then to an increase in married women's labor supply when the men give in. The theoretical findings are further investigated through calibration of the model.

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"*In woman's discovery of her ability to be independent, self-supporting, and self-sufficing, in her wish to work for humanity and not for one man, and in her fear that the appropriating power of a man's love will not be reverence for womanhood, her desire for marriage has lessened. The ideal of marriage is as beautiful as ever, but until she is sure that it can be hers she abides in her friendships and believes that the time will come when all noble women and men will be married. Meanwhile, she waits.*"

Kate Gannett Wells in "Why More Girls Do Not Marry",
North American Review, February 1891

1. Bargaining power and the changing role of women

How to make a living, whether (and when) to marry and how many children to have are three important decisions with lifetime consequences. Around the turn of the century, American women increasingly arrived at substantially different answers to these questions than their mothers and grandmothers had. While the average age at marriage of women was increasing up until the 1890s, it declined thereafter (Haines, 1996; Taeuber and Taeuber, 1958: 153). While the young mothers of the 1870s had as many as 5 births, those who married in the 1920s were firm believers in a two-child family (Hernandes, 1996; David and Sanderson, 1987). While only one in seven women was engaged in "gainful employment" in 1870, one in four was by the 1920s (Hill, 1929: 19). The complex interdependence of the three lifetime questions of work, marriage and fertility, however, calls for a unified explanatory framework in which the women's changing answers can be all analyzed simultaneously. The extant theoretical work either concentrates on post-World War II developments or is ahistorical (Becker, 1981; Greenwood et al., 2003, 2005a, 2005b; Grossbard-Schechtman, 1993; Lundberg and Pollak, 1993, 1996; Manser and Brown, 1980; McElroy, 1990; McElroy and Horney, 1981; Pollak, 1985), yet earlier periods and the historical phenomena connected with them require a thorough explanation, too. The model developed in this paper seeks to achieve just that.

Throughout the 20th century, women have steadily increased their influence in all areas of public life. The seeds of this growing self-assertion were sown between 1870 and 1930. What exactly unleashed women's emancipation has long been a matter of some debate. The argument that changes in the legal status of women such as the married women's property laws of mid-19th century were responsible has met with skepticism (Basch, 1982: 29 – 30; Zeigler, 1996; Roberts, 2006). Goldin (1990: 58) notes that economic progress alone does not guarantee greater gender equality either. Greenwood et al. (2003, 2005a, b) highlight the role of advancing household technology but many of the household gadgets did not come into their own until the second quarter of the 20th century long after many of the emancipatory changes had already begun (Lebergott, 1993; Lomborg, 2001: Figure 37). I make an historical and theoretical argument that starts with technological change affecting the employment of single women. As the opening quote asserts, the labor market experience (and the independently earned income that goes with it) affected young women's expectations regarding marriage. To bring about a broader change in the role of women, however, the mere fact of an independently-earned income was not enough; it also had to be used as a bargaining chip on the marriage market. As the ranks of working single women swelled, their bargaining power increased and, after 1900, both the private (household) and public (labor market) sphere of life slowly began to adjust to the women's views.

2. The mechanism of historical change

With the rise of American industrialization after the Civil War, single women were pushed and pulled into the labor force in ever greater numbers. The changing nature of domestic work, the decline of agriculture and, in some families, poverty were among the push factors (Kessler-Harris, 1981: 57, 70 – 76; Blackwelder, 1997: 12). The pull factors included causes as varied as the division of labor due to new technology, the use of women as strikebreakers – and also, from the women's point of view, the independence that comes with having one's own, earned income.[1] This independence was enhanced for working single women who lived away from their families. Goldin (1990: 53) cites several turn-of-the-century surveys that showed that working single women living away from home usually retained

[1] On the effects of technology on women's employment in various sectors, see Senate Report (1910) Vol. 9, p. 15 – 17. On women as strikebreakers in the cigar industry, see Abbott (1919), pp. 196 – 208. For women as strikebreakers in the printing industry, see, for example, Senate Report (1910), Vol. 9, p. 57.

most of their earnings whereas those who lived at home while working usually remitted most or all of their earnings to their parents. Even then, women enjoyed the benefit of having a greater say over how family finances were distributed (Moehling, 2005).

So strong, in fact, was the desire for independence that many single women had a clear preference for factory work over domestic service even though servants usually received free board and might command a higher pay (Sutherland 1981: 109 – 110).[2] Table 1 illustrates the force of this preference. By 1930, the proportion of single white women working as domestic workers collapsed to between a quarter and a third of what it had been in 1860. Operative employment, on the other hand, was consistently above 30% and only went out of favor after 1910 as new occupations, promising not only higher salaries but also shorter hours and cleaner work environment, emerged. These were professional, clerical and sales jobs.

For women, the relative independence of working single life contrasted with the much stricter routine of married life (Rothman, 1984: 245 – 253).[3] In marriage, women lost many of the legal rights they enjoyed while single (Zeigler, 1996). Peiss (1987) notes that husbands had much greater discretion in spending than wives.[4] There was also a significant difference in how married and single women spent their free time. Single women could and did attend theatres and dances whereas married

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[2] Senate Report (1910), Vol 9. pp. 182 – 183. Part of the difference in wages stemmed from regional differences of relative supply and demand for domestics: in Montana, a "good housekeeper could command $75 to $100" a month (p. 182) compared to "$10 to $14" in New York (p. 180) and compared to a New York factory worker's "$10 to $18 and even $22 a week" in the textile and shoe industry (p. 173). The report also quotes a discussion of this topic in The Revolution, a Boston paper, where, as early as 1870, the problem is repeatedly stated: "The reason girls don't live in private families is because they lose their independence there. They can't go out and buy a spool of thread until their appointed afternoon or evening comes around for it. When mistresses learn to treat their girls as human beings, they can get enough of them." By the 1920's, as American and white immigrant women were increasingly reluctant to take up domestic service, the demand was answered by black women. Due to discrimination and other reasons, domestic service then lost even the small income advantage that it may have had in the late 19th century (Palmer, 1987).

[3] Admittedly, Rothman (1984) relies on evidence that is likely skewed towards middle class women (diaries, letters, literary journal contributions). But using these sources, she documents a growing recognition among women and men that the reality of marriage was far behind the companionate ideal and that women were particularly unhappy with the situation. She quotes a 26-year old Sadie Treat who wrote to her fiancée: "Marriage makes such a difference to me – while with you it's all gain… I must give up more than you." (p. 248)

[4] Regarding the spending discretion, Peiss also quotes (p. 103) an investigator Elsa Herzfield as claiming: "The husband brings his wages to his wife at the end of the week or fortnight. He gives her the whole amount and receives back carfare and 'beer' money; or he gives her as much as 'he feels like' or 'as much as he has left after Saturday night'."

women spent most of their leisure time at home and largely alone or with children, their husbands having gone out with friends (Peiss, 1987: 106; Coontz, 2005: 191 – 193).

This sharp and potentially growing disparity between a woman's single and married life may go some way toward explaining the marked postponement of marriage at the end of the 19th century. Data assembled by Sanderson (1979) and Haines (1996) imply that between 1870 and 1900, the women's mean age at first marriage grew by about 1.5 year.[5] Table 1 shows that, before 1900, the proportion married declined. This development was particularly strong in the metropolitan areas where the proportion married fell by 8 percentage points, or about a fifth, between 1860 and 1880/1900.[6]

The turn of the century, however, marked the nadir of this decline in marriage. The proportion of young women who were married in Table 1 rebounded after 1900 and, by 1930, surpassed the 1860 level. Mean age at marriage declined, falling back to the 1870 level by 1930. A study of three generations of Ohio women indicates that the extra 1.5 years of single life that the late-Victorian women enjoyed compared to their mothers or daughters was probably due to longer courtship and engagement period rather than due to later entry into the marriage market or a higher number of relationships (Koller, 1951).[7]

During this period, the nature of marriage and the public perception of gender roles within marriage were undergoing a substantial transformation (Coontz, 2005: 196 – 215). In the public sphere,

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[5] This estimate relies on the singulate mean age at marriage (SMAM) which stood at 23.85 in 1900. While post-1880 calculations of SMAM in Haines (1996) are based on census data, pre-1880 estimates of Sanderson (1979) are more tentative. In gauging the extent of marriage delay, I rely on Haines' (1996) argument that Sanderson's (1979) estimates are too low in absolute value (compared to what census data would yield if they were available for pre-1880 years) but that they capture the overall trend in SMAM reliably.

[6] Interestingly, the sex ratio (men per 100 women) in the 20-29 year group was actually more favorable to women prior to 1910 and less favorable afterwards. However, overall it fluctuated between a peak of 106.5 (1910) to a trough of 95.3 (1950) for the white population (Table 2 in Haines (1996)). See also Ogburn and Nimkoff (1955:70 – 71).

[7] While Koller (1951) relies on a voluntary questionnaire survey and his sample is limited and biased towards rural population for the oldest generation, he shows, that over 85% of women in each of the three generations considered no more than two serious candidates for marriage and that, in each generation, they had their first date with their (first) future husband at about age 19. Women of older generations reported to have known the men that eventually became their husbands for a much longer period of time.

American courts were increasingly willing to grant women a divorce from cruel husbands.[8] In the private sphere, Koller (1951) reports that, in each successive generation, pre-marital discussions about future family operation (e.g. control of finances, wife's work, number of children etc.) were becoming more frequent. One aspect of the change concerned married women's labor force participation which, as Table 1 illustrates, was on the increase after 1910, particularly in the metropolitan areas.[9]

Inevitably, this process entailed a change in the prevailing attitudes toward a wife's employment. In the 19th century, most women, even if they worked while single, withdrew from employment once they married.[10] Some wives continued to work because their husbands were unable to provide for the family – a signal that a reasonably well-earning husband might not want to send. Because of this social stigma, many wives were discouraged (or prevented by their husbands) from entering the labor market (Goldin, 1990: 133 – 134). The prevailing domestic ideology exalted women primarily as mothers. The Brandeis brief, documenting the negative effects of excessive labor hours on women's fitness for child-bearing in the 1908 *Muller v. Oregon* Supreme Court decision, was motivated precisely by this very specific understanding of a woman's role: namely that women's work must be regulated so that it does not compromise, and interfere with, their future motherhood.[11] As late as the Great Depression, 89 percent of the public believed that married women with husbands present should not work (Kessler-Harris, 2001: 59). Even so, married women were joining the labor force in growing numbers and family life had to adjust.

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[8] For changes in divorce law, see Griswold (2001). Not only physical but mental cruelty also was increasingly viewed as legitimate grounds for divorce.

[9] The participation rates in Table 1 in fact misrepresent the difference between urban and rural areas. Goldin (1990) shows that the 19th century censuses likely underenumerated wives who were supplying unpaid work at a family farm. The omission could be as large as 5 percentage points. See Goldin (1990), Appendix to Ch. 2, pp. 219-227

[10] Baxandall and Gordon (1995), p. 103, cite an 1890 letter of one Knights of Labor leader, concerning the "career future" of one of his female co-workers, Leonora Barry, who was about to marry: "…Sister Barry's days are numbered. You will never, in all probability, rest eyes on her again… She has not yet been called across the dark river but she will soon be buried in the bosom of a Lake that shall wash away all claim that we may have to her…"

[11] See Brandeis and Goldmark (1969). The report had a special section on "Specific Evil Effects on Childbirth and Female Functions" (pp. 36 – 42), and another on "The Effect of Women's Overwork on Future Generations" (pp. 51 – 55). Of the benefit of shorter hours, the report said: "Wherever sufficient time has elapsed since the establishment of the shorter work day, the succeeding generation has shown extraordinary improvement in physique and morals." (p. 57)

An important piece in the puzzle was the changing pattern of marital fertility.[12] Prior to 1900, a between one third and three fifth of the decline in overall fertility was due to falling marriage rate (Sanderson, 1979: 344). Post-1900, however, fertility declined through control exercised inside marriage.[13] It was clearly no longer controlled primarily through the postponement of marriage (as average age at marriage started decreasing). While other factors were likely at play, it seems that the increase in married women's labor force participation and the steep decline in marital fertility are a signs of reallocation of labor from home to the labor market, a result of the changing opportunities for married women.

To summarize, women's answers to the three big questions of work, marriage and childbearing changed significantly between 1870 and 1930. This transformation, I argue, started and ended in the labor market and it changed family life in the process. For a variety of reasons, the gap between the employment and lifestyle opportunities of single versus married women was widening in the late 19th century. As wage earners, young single women could enjoy a certain level of independence and freedom which they lost upon marriage. These perquisites of single life increased the opportunity cost of marriage as well as the young women's threat point in bargaining with men on the marriage market. Some previously acceptable matches became unacceptable as a result and the marriage rate declined. The turnaround in the marriage rate around 1900 suggests that men eventually acquiesced to the growing bargaining power of women who thus won a greater say in the distribution of family resources and in the allocation of their own time between market and household. These changes made marriage more attractive again, the age at marriage declined and the marriage rate rebounded. Fertility was affected first by the postponement of marriage, then by the increased labor supply of women.

[12] The following analysis omits out-of-wedlock fertility. While accurate information of the rate of out-of-wedlock births is hard to find, Taeuber and Taeuber (1958) put it at 4% (p. 266) for the period 1938 – 1950. If, in the previous decades, the rate was similar in value, it is unlikely that it would influence the analysis much.

[13] Note that early 20th century was a time when information on methods of contraception proliferated, providing the means, if not the motivation, for the birth control. See Coontz (200), p. 197

In the model below, I put this mechanism on a more formal footing. The calibration exercise that follows and the related simulations show that the model is able to capture the main observed trends in labor force participation, marital behavior and fertility in US history. The main points of divergence between the historical reality and the results of simulation arise in marital behavior. The simulations produce the swing in marriage rate for a wide array of parameters but the actual rate of marriage is overestimated and is sensitive to the value of the discount factor, δ.

3. The model

The model is based on the search-theoretical guidelines of Mortensen (1988) and on Nash-bargaining models of Manser and Brown (1980) and McElroy and Horney (1981) but it is not a dynamic general equilibrium model, as seen, for example, in Greenwood et al. (2003). The long-term changes in marital and labor decisions are analyzed in terms of comparative statics as the model is solved separately for each generation of young marriage-seeking men and women.

Time is split into discrete periods. Within each period, each unmarried individual must make a decision whether to work during the current period (having a time endowment of 1 each period), whether to marry during the period and, if so, what the characteristics of the newly formed family will be (i.e. number of children, wife's labor supply etc., see Figure 1).

The utility function takes the following form:

Men	Women
$U = \pi\sqrt{n} + c_M - \rho(\theta_M)l$	$U = \sigma\sqrt{n} + c_F$
subject to $c_M \leq (1-\alpha-\beta n)(w_M - R)$	subject to $c_F \leq \alpha(w_M - R) + w_F l$ or $c_F \leq C$

In this quasi-linear utility function, c_M and c_F stand for man's and woman's consumption; n represents the number of children a person has; α is the fraction of a husband's wages consumed by a wife and l represents a wife's labor supply.[14] Before marriage, workers – both men and women – are assumed to live in their own household which costs a constant R ("rent") to maintain every period.[15] If a woman does not work while single, she is assumed to live in with her parents, pay no rent and receive a stipend C. The parameters π and σ are utility weights which determine how a person values children relative to consumption. Since generally $\sigma \neq \pi$, men and women can differ in their subjective evaluations of the two sources of utility. The parameter $\rho(\theta_M)$ in the man's function is a measure of his disutility from his wife's labor supply, l, and it depends positively on the man's personal productivity parameter, θ_M. A non-zero labor supply on the wife's part brings the husband a disutility that is greater the more productive he is.[16] Finally, the consumption good can be purchased at unit price for wages. The quasi-linear functional form has the convenient property that it treats children (n) as a normal (household public) good, but since each child claims a fraction β of a father's income, it also allows for a negative relationship between income and fertility which is the historically observed relationship.

The matching mechanism ('dating') can be viewed as a simplified version of a partner search as described in Mortensen (1988).[17] Adults are indexed by a productivity level (denoted θ_M for men, θ_F for women), cumulatively distributed according to $F(\Theta_i)$ over $\Theta = [\underline{\theta}, \overline{\theta}]$. Together with a production function, the productivity parameter determines each person's wage. Assume that men's production function is $f = A\theta_M l_M$ and wage $w_M(\theta_M) = A\theta_M$ where A is a technological parameter. For women, assume $g = B\theta_F l$ and $w_F(\theta_F) = B\theta_F$, with parameter B describing technology. Men and women are identical *ex ante* but when a pair meets they observe each other's labor force status, productivity and utility parameters. Upon mutual observation, the man may or may not formulate a marriage proposal (described in section 3.3) which the woman may or may not accept (as described in section 3.2 and

[14] Since the model allows the possibility that married women do not supply any labor and thus earn no wages, αw_M is the monetary transfer from their husband that is their sole source of consumption. See Combs (2006), pp. 70 – 71, for a brief description of how such a monetary transfer worked in the late 19th century. For a more recent period, see Woolley (2003).
[15] Thus, there are economies of scale in marriage, as two separate households are reduced to one. See Greenwood et al. (2005b) for a similar argument.
[16] For simplicity, the model takes $\rho(\theta_M)=\rho\theta_M$ where $\rho < 1$ is a constant.
[17] A similar matching mechanism is employed by Greenwood et al. (2003) and Greenwood and Guner (2005b).

3.4). Once married, men and women stop searching. I assume there is no divorce.[18] Both men and women expect their next-period wage to be the same as their current-period wage – not so much because they have myopic expectations but rather because their decisions regarding marriage are viewed as life-cycle decisions.

3.1. The Woman's Dilemma: Evaluating a Marriage Proposal

The model is solved by backward induction. Denote a woman's lifetime utility V and her one-period utility v_s if she is single and v_m if married. Depending on her labor force status, a woman enjoys $v_s = w_F - R$ or $v_s = C$ while single. If she accepts a marriage proposal, (n, α, l), she enjoys $v_m = \alpha(w_M - R) + w_F l + \sigma\sqrt{n}$ of utility every subsequent period of her life. If she rejects, she will start a new relationship and face the same decisions next period. Thus, assuming a discount factor $\delta < 1$, a marriage proposal will only be accepted as long as $v_s + \delta V \le v_s + \delta \frac{v_m}{1-\delta}$ which simplifies to $V \le \frac{v_m}{1-\delta}$.

Note that prior to meeting her date each period, all that a single woman knows is that the man she meets may or may not propose to her. Let us assume, then, that there is a set Θ_r such that every man of productivity $\theta_M \in \Theta_r$ is willing and able to present a proposal that is worth accepting. A proportion $r = \int_{\theta_M \in \Theta_r} dF(\theta_M)$ is a fraction of all the men who are "marriageable bachelors". Then, a woman's lifetime utility depends on the probability of her meeting such a man:

$$V = (1-r)(v_s + \delta V) + r v_s + \frac{\delta}{1-\delta} \int_{\theta_M \in \Theta_r} v_m(\theta_M) dF(\theta_M) = (1-r)(v_s + \delta V) + r v_s + \frac{\delta}{1-\delta} E_r v_m \qquad \text{(Eq. 1)}$$

where $E_r v_m$ denotes an expectation of marital utility across the acceptable marriage proposals. Therefore, a proposal that a single woman finds acceptable is such that

[18] Divorce was rather rare between 1870 and 1930. According to Hernandez (1996), there were 1.5 divorces per thousand married women in 1870. By 1930, the divorce rate grew to 8 per thousand married women – considerably lower than the peak 22.8 divorces per thousand married women in 1979.

$$\frac{1-\delta}{1-(1-r)\delta}v_s + \frac{\delta}{1-(1-r)\delta}E_r v_m \le v_m \qquad \text{(Eq. 2)}$$

The proportion r of eligible bachelors then consists of those men who can formulate a proposal that satisfies this inequality. But note that each individual man must take the left-hand side of the inequality as given; one man can influence neither r, nor $E_r v_m$, nor v_s. Thus, from the man's perspective, each woman has some given fixed reservation utility which his proposal must match or better, if it is to be accepted. Since men have the power to make a take-it-or-leave-it offer, they will exactly match such reservation utility when they propose.

This also means that, from the woman's point of view, v_m is independent of θ_M and $E_r v_m = r v_m$.[19] Using this result and simplifying the inequality yields $v_s \le v_m$, or more specifically, $\max(w_F - R; C) \le \alpha(w_M - R) + w_F l + \sigma\sqrt{n}$. Thus, every woman accepts any proposal that promises her at least as high a per-period utility as she is currently enjoying while single. This result is expected considering that the bargaining rule employed in the model is, according to Manser's and Brown's (1980) typology, a dictatorial one. In a dictatorial setup, one of the bargaining parties gets to make a take-it-or-leave-it offer to the other party. The result is that such offer will exactly match the other party's reservation utility, or threat point.[20]

3.2. Optimal proposal

Since a man has the initiative in proposing, his aim is to come up with a vector (n^*, α^*, l^*) that would be utility-maximizing for him yet still acceptable to his partner. His optimization problem can be summarized thus:

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[19] Note, however, that the woman's utility can potentially come from two sources: consumption and children. While the prospective husband's productivity, θ_M, does not influence the overall level of a woman's utility (or "marital satisfaction"), v_m, it has an impact on the sources of utility. A high- θ_M husband will supply his wife with higher consumption c but will propose to have fewer children (n) whereas a low- θ_M man will do the opposite. Thus, a marriage to a less productive man does not condemn a woman to a "less happy" marriage, rather, the "happiness" will come from a non-consumption source.

[20] An alternative is symmetric bargaining where the couple solves some Nash objective function in which the prospective utilities of both partners are treated symmetrically. See Manser and Brown (1980), pp. 36 – 41.

$$\max_{n,\alpha,l} \pi\sqrt{n} + (1-\alpha-\beta n)(w_M - R) - \rho\theta_M l$$

subject to:

$\max(w_F - R, C) \le \alpha(w_M - R) + w_F l + \sigma\sqrt{n}$ (woman's reservations utility constraint – WRUC)

$l + tn \le 1$ (wife's time constraint – WTC)[21]

$l \ge 0$ (non-negative labor supply condition – NLSC)

This yields the necessary first order conditions (FOC):

n: $$\frac{\pi}{2\sqrt{n}} - \beta(w_M - R) - \lambda t - \mu\left[-\frac{\sigma}{2\sqrt{n}}\right] = 0 \quad \text{(Eq. 3)}$$

α: $$-(w_M - R) - \mu[-(w_M - R)] = 0 \quad \text{(Eq. 4)}$$

l: $$-\rho\theta_M - \lambda - \mu(-w_F) + \nu = 0 \quad \text{(Eq. 5)}$$

Together with the constraints, the first-order conditions form a system of six equations with six unknowns (three optimization variables and three shadow prices-lagrangean multipliers). The solution of this constrained optimization is such that WRUC is always binding ($\mu = 1$). Thus, women's level of utility does not change with marriage. It also means that women never reject such a proposal because waiting for next period would not be advantageous to them in any way. However, this result connects a woman's pre-marriage economic position with the determination of intra-household resource distribution. If the wages earned by single women increase, it will have an important effect on how much they will consume as wives. With regard to the other two constraints, corner solutions are possible, depending on wages.

What is of primary interest is precisely how the optimal proposal – the vector (n^*, α^*, l^*) – responds to changes in male and female wages, w_M and w_F. This is summarized in Table 2 and in Figure 2 which is drawn in a w_F–w_M space. The optimization constraints delineate three regions which affect the nature of the optimal solution. In Region 1, wives do not supply market labor (the NLSC

[21] Each child claims a fixed fraction t of a woman's time. It is assumed that $t > \beta$.

constraint binds) and fertility (n^*) is high as women spend all their time rearing children (WTC binds). In Region 2, the fertility transition gets under way (WTC is relaxed) but married women's employment is zero (NLSC still binds). Eventually, in Region 3, fertility decline is in full swing and married women gradually appear on the labor market (NLSC is relaxed and WTC becomes binding again as women split all their time between child-rearing and labor supply).

When most men and women earn relatively low wages, most matches will at first fall into Region 1. As wages keep increasing due to technological change, more matches will occur in Regions 2 and 3. How many matches fall into Region 2 and how many into Region 3 depends both on the absolute levels of male and female wages and also on the relative wages of women and men. Because the proportion of matches falling into any one region will differ from generation to generation due to technological change, the resulting marriages will also differ from generation to generation.

Many aspects of the history of the American family at the turn of the 19th and 20th centuries are captured in the optimal proposal. A marriage proposal in Region 1 involves a high optimal n^* that is independent of male and female wage. In Region 2, optimal n^* is lower than that in Region 1 and it also declines in male wage. More productive men demand fewer children because the utility from children exhibits diminishing returns, yet each child costs a given proportion of the man's wage, β. Moreover, for married couples in Region 3, the woman's wage also enters the denominator of n^*, because in Region 3 a married woman's labor supply is positive and the negative effect of diminishing utility is reinforced by the positive time cost of children, t, that women incur.

Married women supply no labor to the market in Regions 1 and 2. Thus, even if a woman works while single, she drops out of the labor market once she marries. Here the model realistically captures what was a frequent practice in the turn-of-the-century urban America (Goldin 1990: Table 2.6). Note that in Region 2, she would have spare time to work, since the WTC is not binding. It is the disutility that her husband gets from her employment that prevents her from earning an independent income. The Region 3 matches, however, are those where the woman's wage, w_F, is so high that the man’s opposition becomes “too expensive” and so starts proposing positive l. Note that an increase in w_F reduces n^* and increases l^*: thus in Region 3, married women’s labor supply increases with wage.

The fraction α^* of man’s income is a reflection of both a woman’s consumption prior to marriage and of the family’s fertility. Before marriage, consumption is women’s only source of utility. Once married, women obtain the same level of utility (see section 3.1) but now from two sources: consumption and children. This means that a woman’s consumption declines in marriage and that children are substituted. The degree of substitution will depend on the productivity of the husband. If a woman is married to a high-productivity man, the couple will have fewer children but the man will supply his wife with a high consumption while if the husband has low-productivity, consumption will be lower and n^* higher.

As time goes on, technological change effects a transformation both on the marriage market and on the labor market. It increases wages and thus shifts the distributions of both male and female wages. As a result, the proportion of matches that place to Regions 2 and 3 will increase from generation to generation and if such matches also lead to marriage, marital fertility will decline and more women will remain in the workforce after marriage (in Region 3).

3.3. Why do single women go to work?

In deciding whether to go to work or not, a single woman considers the costs and benefits of either alternative. Her labor force status and her wage are important because they directly influence how much of the family’s resources she will claim in marriage but it also makes her less attractive as a marriage partner relative to non-working or lower-earning women. Thus, by entering the labor force, a woman increases her lifetime consumption and utility but jeopardizes her chances of marriage (since men can adopt a waiting strategy). The costs and benefits of not working are the reverse of that; there is the certainty of proposal but low consumption throughout life.

A woman’s lifetime utility is denoted V:

$$V = \max\left\{C + \frac{\delta}{1-\delta}C; (1-r)\left(w_F - R + \delta V\right) + r\left[w_F - R + \frac{\delta}{1-\delta}(w_F - R)\right]\right\} \quad \text{(Eq. 6)}$$

The first term, $C + \frac{\delta}{1-\delta}C = \frac{C}{1-\delta}$, denotes her lifetime utility if she does not work (i.e. she marries at the end of the current period). The second term denotes the lifetime utility if she does work in the current period. The fraction *r* represents the probability that she will marry in the current period if she chooses to work, that is, the fraction of men who will propose to the working woman because they do not find it optimal to wait (see section 3.1.). It is not difficult to show that the problem has a simple solution where

$$V = \max\left\{\frac{C}{1-\delta}; \frac{w_F - R}{1-\delta}\right\} \quad \text{(Eq. 7)}$$

Therefore, any woman will work if her wage is high enough to ensure her higher utility (net of rent) than what her family can provide her on a stipend. Thus, for the female wages, it must hold that $w_F(\theta_F) \geq R + C$ which implies that working women are those for whom $\theta_F \geq \theta_{F\min} = \frac{R+C}{B}$. If technology increases female wages (across the whole distribution) faster than the family stipend and rent increase, more and more single women will go to work and *p*, the proportion of working single women, will rise:

$$p = \int_{\frac{R+C}{B}}^{\bar{\theta}} dF(\theta_F) = 1 - F\left(\frac{R+C}{B}\right) \quad \text{(Eq. 8)}$$

3.4. To propose or not to propose?

From the man's point of view, the alternative to making a proposal is to wait until the next period and hope for a better match. Denote a man's utility from marrying a working woman $U = U_W\left(w_M(\theta_M), w_F(\theta_F)\right)$ and his utility from marrying a non-working woman $U = U_N\left(w_M(\theta_M), C\right)$. Marriage with a non-working woman brings men higher utility than marriage with a working woman

($U_N > U_W$) and marriage with lower-earning (low-θ_F) woman is preferable to men over a marriage with a high-earning (high-θ_F) woman because women with lower pre-marital consumption will accept a lower α, ceteris paribus. Non-working women therefore always get a proposal while working women receive a proposal depending on how likely the man is to meet a better match in the e next period:

$$U_W(w_M(\theta_M), w_F(\theta_F)) \leq\geq \delta EU \qquad \text{(Eq. 9)}$$

Expected utility must obviously take into account all potential alternatives that may arise in next period's matching. A man might meet a non-working woman, or a low-earning woman he might be willing to marry, or a high-earning woman, he would prefer to pass and wait once more. Expressed mathematically,

$$\begin{aligned} EU &= F\left(\frac{R+C}{B}\right)U_N(w_M(\theta_M), C) + \int_{\theta_{F\min}}^{\theta_F*} U_W(w_M(\theta_M), w_F(\theta_F))dF(\theta_F) + \delta EU\big(1 - F(\theta_F*)\big) = \\ &= \frac{1}{1-\delta+\delta F(\theta_F*)}\left[F\left(\frac{R+C}{B}\right)U_N(w_M(\theta_M), C) + \int_{\theta_{F\min}}^{\theta_F*} U_W(w_M(\theta_M), w_F(\theta_F))dF(\theta_F)\right] \end{aligned} \qquad \text{(Eq. 10)}$$

The value of the expected utility hinges critically on θ_F*, which is the highest level of female productivity that a man is willing to accept in his spouse. Since $U_W\big(w_M(\theta_M), w_F(\theta_F)\big)$ decreases monotonically in θ_F, the cut-off point θ_F* is unique for every man so that if a woman has $\theta_F \leq \theta_F*$, he will propose to her; otherwise, he will wait. If a man meets a woman such that $\theta_F = \theta_F*$, he will be indifferent between proposing to her and waiting:

$$U_W(w_M(\theta_M), w_F(\theta_F*)) = \delta EU\big(w_M(\theta_M), w_F(\theta_F*)\big) \qquad \text{(Eq. 11)}$$

Because men differ in their own productivity, this cut-off point will be a function of θ_M, $\theta_F* = \theta_F*(\theta_M)$. Notice that the threshold function $\theta_F* = \theta_F*(\theta_M)$ can be turned into $w_F* = w_F*(w_M)$ by a simple positive monotonic transformation.[22] At any given time, only a fraction

[22] Given the productivity functions, $w_F* = B\theta_F*\left(\frac{w_M}{A}\right) = w_F*(w_M)$.

of matches will result in marriage, those where the pair's wages (w_F, w_M) are below $w_F*(w_M)$. Thus, $w_F*(w_M)$ is a proposal boundary, examples of which are drawn in Figure 3.

The shape of these boundaries is determined by the properties of utility functions in Regions 1-3. Some of these properties are summarized in the Appendix. A more intuitive explanation of the hump shape of the proposal boundary in Region 3, emerges from Figure 4. In this figure, four utilities are plotted against θ_F on the horizontal axis. The utilities differ by θ_M in such a way that $\theta_{M1} < \theta_{M2} < R + \frac{(\pi+\sigma)\sqrt{t}}{2\beta} < \theta_{M3} < \theta_{M4}$, meaning that the two men with θ_{M1} and θ_{M2} will find all their dates either in Region 1 or in Region 3 (depending on the productivity of the woman they meet) whereas the two men with θ_{M3} and θ_{M4} will find all their matches in Regions 2 or 3. The crucial point is how the derivatives of the utility function are affected as one crosses from one region to the next. The transition from Region 1 to Region 3 is one where all three choice variables – n, α and l – change continuously and so does utility. In the transition from Region 2 to Region 3, however, only n changes continuously while l and α jump (l jumps from 0 to $1 - tn > 0$ which effects a discontinuous change in α). For that reason, the utility surface is not smooth (differentiable) along the line $w_F = \rho\theta_M = \frac{\rho}{A} w_M$. This, in turn, is a consequence of the relaxation of the women's time constraint (WTC) in Region 2: women have free time on their hands in Region 2 because their husbands do not let them work even though they have too few children to use up all their time endowment. Thus, a move from Region 2 to Region 3 entails a discontinuous reallocation of this unused time to labor which affects the slope of the utility function. It is the constraints and their binding or relaxed state what produces the unusual shape of the proposal boundary.

The size of the hump, however, depends on other parameters, such as δ, and it need not appear at all. However, it is not a product of the distribution of productivity among men and women (i.e. $F(\theta_M)$ or $F(\theta_F)$) and it is not specific to the particular functional form of the utility function, used in the model.

From a historical perspective, however, the hump is not as unusual as it may seem. The eventual increase in married women's labor supply comes, as the calibration exercise will show, precisely from those matches that occur below this inverted-U-shaped boundary which has its peak somewhere in the middle range of male wages. In this, the model reflects the historical fact that the arrival of married women into the office or even the factory in large numbers was to a great degree a middle-class phenomenon where previously 'non-employed' wives converted their free time into labor supply.

3.5. Labor market meets marriage market

The overall marriage rate (MR) equals

$$MR = \int_{\underline{\theta}}^{\overline{\theta}} F\big(\theta_F * (\theta_M)\big) f(\theta_M) d\theta_M \qquad \text{(Eq. 12)}$$

Changes in the marriage rate will depend on how the matches that are formed as part of the random dating stand relative to the proposal boundary (see Figure 3). Both male and female wages are affected by technological change (parameters A and B) but so is the proposal boundary. Generally speaking, an increase in male productivity increases male wages and male utility from marriage, ceteris paribus, while an increase in female productivity raises female wages and single women's labor supply and has a negative effect on men's utility from marriage. More specifically, a rise in A increases θ_F* for every level of θ_M while a rise in B decreases θ_F* for every level of θ_M. For the marriage rate to exhibit the swing that was observed historically, we need to show that, prior to 1900, the technological effects working through women's labor market were stronger than the effects on the male labor market but that the situation changed after 1900.

4. Quantitative analysis

In this section I calibrate the model presented in section 3 to examine its plausibility in explaining the social and economic changes in women's lives at the turn of the 20th century. I focus on four series: (1) single women's labor supply, *p*, (2) marital fertility[23], *n*, (3) the marriage rate, *MR*, and (4) the behavior of married women's labor supply, *l*. Additionally, the variable *α*, the share of husband's income transferred to his wife, can gives some insight into (5) the manner in which household resources were divided and how this division changed through time. Moreover, given that households in the model differ in *n*, *l* and *α* depending on which region they are formed in, I analyze regions 1 or 2 or 3 separately. The households of Region 1 represent traditional families, poor but fertile. Region 2 families resemble the households of well-to-do husbands and stay-at-home wives. Region 3 comprises those in the middle – the "middle class" where wives work and the division of resources is more favorable to the wife. This is necessarily a crude, stylized split but, as Table 2 documents, the solutions to the optimization problems differ from region to region not only in actual values but also in functional form, so the portrayal of the three regions as giving rise to three distinct manners of household operation finds some support here.

4.1. Parameters and inputs

The parameter values are summarized in Table 4. They were selected with an eye to fitting the model with the observed marriage, fertility and labor market behaviors. The parameters *π* and *σ* are the men's and women's weights on children relative to consumption. The high values for *π* = 195 and *σ* = 65 are not unrealistic: to convince a man to have only one child instead of four would require a compensation of $195 dollars of consumption which, depending on the year, could be anywhere between 20% and 50% of that man's average annual income. Women's valuation of children is lower than that of men, which reflects the fact that 19th century women were exposed to a number of sources of "disutility" associated with childbearing such as high risk of death or infection during pregnancy

[23] Strictly speaking, the variable *n*, being a subject to pre-marital bargaining, represents the desired number of children rather than marital fertility. For that reason, for each marriage cohort, the simulated *n* is compared with the number of children that survived to age 20 rather than with the actual number of births. However, I use the term "marital fertility" as a short hand for *n* in the following section.

and birth, a disproportionate share of child care etc. Men, on the other hand, were more in the position of "pure consumers" when it came to the enjoyment of their children's company (Peiss, 1987: 103).

Parameters ρ and δ are important because they have a direct bearing on the marriage market and the married women's labor supply. Their specific values have been chosen to obtain the best possible fit between the simulation results and the actual historical developments. ρ is a measure of a man's disutility from wife's work and determines the slope of the border between Regions 2 and 3 in Figure 2. Setting it at 0.462 implies that for a man who earns, say, \$500 a year in 1900 (approximate nominal annual income of a non-farm employee around 1900), the difference between having a non-working wife and one who works full-time is equivalent to about \$150 worth of consumption. The subjective discount factor δ is crucial for determining the proposal boundary because it is instrumental in evaluating the alternative to marriage – the expected utility from future potential match. Annualized, δ usually takes values between 0.947 (Cooley and Prescott, 1995) to 0.98 (Greenwood et al. 2005b). Given that the wage rates entering the calibration are annual earnings when multiplied by each individual's labor supply, one period of time in my model is set at one year. I set the discount factor $\delta = 0.96$, which is in line with, for example, the value used in Kydland and Prescott (1982). It implies an annual interest rate of 4.1% which is close to the historical values for yields on US government bonds during the period (Historical Statistics of the United States: Millenial Edition, 2006: Table Cj 1192).

The productivity and technological parameters are set so that the resulting annual earnings correspond to those observed in the US economy from 1870 to 1930 in 1930 prices. I also seek to realistically capture the relationship between male and female earnings. Goldin (1990: Table 3.1) shows that throughout the period in question (1870 – 1930), the ratio of female-male wages moved between 0.55 and 0.58 and so the productivity and technological parameters – particularly regarding women's wages – are also set with a view to this fact. The wage trends from which these parameters are derived come from the Historical Statistics of the USA.

The child-rearing parameters are β, the fraction of a man's income spent per child, and t, the fraction of a woman's time spent per child. These are set at 0.065 and 0.25. This means that, on average, a child claims about 6.5% of a father's wages net of rent and about 25% of a mother's time.

The exact value of C, a non-working single woman's stipend, is hard to establish historically. It is likely that its size varied in proportion to the wealth of each woman's parental family. In the model, C is assumed constant for all women but growing over time. The value of C is important because a woman's premarital utility is decisive in determining α, the share of husband's income that must be transferred to her as consumption. In the premarital bargaining, if C were too low, then α could become negative, which would be unrealistic because all of a woman's utility would then derive from her children and she would have negative consumption. I also assume that the stipend grew at a slower rate than real wages: if it grew at the same (or higher) rate, then the proportion of single women in the labor force could never increase because the same (or higher) fraction of low productivity women would find it preferable to stay out of employment. In this way, C is allowed to grow from about $125 in 1870 to about $255 in 1930 in current prices.[24] Considering that C is defined as a stipend that a single woman can use purely for consumption ("pin money"), these values are equivalent to between $2 and $5 per week of personal consumption (in nominal value) between 1870 and 1930. For comparison, a dressmaker in 1870 would make about $12 per week and a seamstress about $9 at current prices.[25] By 1930, a woman clerk could earn about $22 per week and a manufacturing employee about $17 (Goldin, 1990: Table 3.2A). Based on these considerations, the values of C seem plausible.

Similarly, the value of R, "rent", is hard to pin down because the living arrangements of single women took many forms, from living in private families to sharing a room in an organized boarding house. Some information on rents is available from the Historical Statistics of the United States but a

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[24] In real 1930 dollars, it grows from $160 to about $255.

[25] Senate Report (1910, Vol. 9, Table F, p. 263

consistent series stretching the whole period from 1870 to 1930 is hard to reconstruct. In calibrating my model, I let the rent variable, *R*, grow at the same real rate as men's wages. This implies that the weekly housing costs faced by the single working women grew, in nominal terms, from $1.13 in 1870 to about $3.54 in 1930. These numbers are slightly on the low end but not too far from actual values. The 1910 Senate report states, for example, that the "average weekly cost of living" of women employed in department stores and factories ranged somewhere between $3.18 and $4.24, nominally (Senate Report 1910 (5): 53). These average weekly costs comprised food, shelter, heat, light and laundry and were calculated from data reported by relatively high-earning women (such as store assistants) in large cities. The overall average for all employed single women is therefore likely to have been somewhat lower. Moreover, if food and laundry is subtracted from these figures to arrive at actual costs of household operation (shelter, heat and light), we would probably get quite close to the $1.46 per week, implied by the calibration setup for 1910.

4.2. Simulation results and comparison

The simulation uses Matlab 7 to generate 5000 male and 5000 female productivity levels from the log-normal distribution. Men and women, indexed by θ_M and θ_F, are then randomly matched in each decade from 1870 to 1930. Figure 5 shows the successive matches for four selected years. The sequence of the graphs illustrates how the growth of wages slowly moves the bulk of the matches out of Region 1 and into Regions 2 and 3. At the same time, the proposal boundary shifts, separating those matches that end in marriage from relationships that end in a break-up. The hump in the proposal boundary is relatively slight at first but becomes eventually prominent. It is responsible for the swing in marriage rate: in the first three decades of the simulated history, the cloud of matches shifts faster than the proposal boundary and that is why the marriage rate declines.

Table 5 compares the model-generated series with the actual historical series. The single women's labor force participation is reproduced relatively well by the model. It is driven by the growth in women's wages, w_F, relative to the stipend C and rent R. Simulated marital fertility is close to its historical values in 1870 and 1920 although it falls somewhat more slowly than the historical series. The marriage rate shows a swing at a time when it historically occurred. The married women's labor force participation is overestimated but it replicates the historical experience in that it stays relatively low until about 1900 after which time it explodes.

The biggest mismatch occurs in the year 1930 which produces very high marriage rate, an excessively high married women's labor supply and a very low number of children. The last two are closely connected, since married women in the model allocate their time between child care and labor supply. To see what kind of change in parameters would be required to bring the 1930 model-generated results more in line with historical reality, I ran another simulation using the same model and same parameter values as the benchmark results in Table 5 – except for a one-time change in β between 1920 and 1930 from 0.065 to 0.033. The results presented in Table 6 and the changed 1930 results are highlighted. In terms of marital fertility and marriage rate they represent a better fit than the 1930 values in Table 5. The married women's labor supply is significantly reduced, too – to 39.6% – which is considerably lower than 62% in Table 5.

The question is whether halving of β during the 1920s is defensible as historically realistic. The parameter β denotes the proportion of a husband's income (net of rent) claimed by each child. A move from 0.065 to 0.033 therefore implies that by 1930, the average child cost only 3.3% of the father's income whereas it cost 6.5% in 1920. Note that costs of household operation are already captured by the variable R, so the fraction of income consumed by a child should be viewed as expenditures tied directly to the child's needs, such as children's clothing etc. Sufficiently detailed data are hard to find but Lebergott (1993: 91, 148) shows that the fraction of American families' overall spending on clothing declined in the 1920s. Moreover, within this declining share a growing portion was spent on women's clothing. This implies that the fraction spent specifically on children's clothing was probably declining even faster. If Moehling (2005: 427) is correct in arguing that clothing expenditures usually represent “a sizeable fraction of a total private consumption”, then there seems to be some evidence that a decline in β is not entirely unrealistic.

These aggregate results hide a considerable amount of variation between the three solution regions (see Figure 2). Results of calibration by region are displayed in Table 7. This table illustrates that most of the changes in the marriage behavior are taking place in Region 3. Although the marriage rate is consistently increasing in this region, it starts from zero. The three regions are distinct in terms of the desired number of children, n, as predicted by the model. Region 1 has the highest and maximum possible fertility, $1/t$, or 4 children. Marital fertility in Region 2 starts at the lowest level of the three regions but falls most slowly. The greatest movement in marital fertility occurs in Region 3, where according to the solutions in Table 2 both male and female wage act to reduce it. In both Regions 2 and 3, the eventual level of childbearing is about 2 children per family, which corresponds well with historical trends.

The third column of Table 7, denoted α, shows the average fraction of a family’s income that is spent on wife’s consumption. This fraction increases in Regions 1 and 2, reflecting the growing bargaining power of women on the marriage market. As more and more women work before marriage and as their wages grow, men must adjust their marriage proposals accordingly. So α increases. It is lower in absolute terms in Region 2 than in Region 1 because the men in the Region 2 couples are more productive. Thus, α is calculated from a higher (male) income. In Region 3, the situation is more complicated since wives work ($l > 0$). It can even become negative, if the wife is the more productive spouse ($\theta_F > \theta_M$). The variable ‘share’ therefore refers to the fraction of total financial resources of a family that are controlled by a working wife, including her own earnings ($w_F l$). The reason why the share declines before it increases is again is that the composition of couples with working wives changes from 1890 to 1930. In 1890, the working wives come from those couples in Region 3 where the husbands have a low productivity θ_M (see Figure 5, Graph “1890”). Their earnings therefore represent a large fraction of the family’s income. As the pool of couples with working wives grows in size to include marriages with high-θ_M husbands, the average share declines. But the underlying growth in women's bargaining power operates even for Region 3 couples and ultimately the share of family budget controlled by the wife increases in Region 3 also.

4.3. Sensitivity analysis

To see how much my results depend on particular parameter values, I ran the same simulation exercise changing each of the relevant parameters by about ± 20% from the parameter value of the benchmark case (see Table 4). Such variation is large enough to produce changes in the simulation results, allowing for a sensitivity analysis. The results are summarized in Figures 6-9.

Figure 6 shows that single women's labor force participation is, for the most part, immune to changes in parameter values. This is because it depends exclusively on female wages, the value of stipend, C, and the value of rent, R. Married women's labor force participation in Figure 9 displays greater variance. The kink in married women's labor supply is robust with respect to variation in parameters although the overall level of labor supply is strongly affected by those parameters that influence marriage and fertility: δ, ρ, π and σ. This is not surprising. In the model, we solve for married women's labor supply as the residual of the time endowment after children are taken care of ($l = 1 - tn$). This is why a high π, for example, through its positive effect on the number of children, dampens the married women's labor supply. Higher δ means that fewer marriages occur in Region 3, ceteris paribus, because the prospect of waiting is more enticing compared to a specification where δ is lower. Fewer marriages in Region 3 means in turn that the working wives of Region 3 make up a smaller proportion of all wives which thus reduces aggregate married women's labor supply. Overall, however, whatever the parameter change, the change in married women's labor supply is decidedly higher after 1900 than before this date. The kink is robust in this respect although the actual values of married women's labor force participation are overestimated.

Figures7 and 8 focus on marital behavior and fertility. The swing in marriage rate is heavily influenced by specific parameter values although it does not disappear even for very high levels of δ. Thus, the swing in marriage rate is a persistent feature of the calibrated model. The fact that δ has considerable influence is also documented in the fact that an increase from 0.9 to 0.99 makes the swing much deeper and shifts the minimum age at marriage into later years. The parameter ρ has a similar effect, deepening the marriage swing when ρ is higher and dampening it when it is lower. That these two parameters are crucial should come as no surprise: one of them, δ, determines how valuable postponement of marriage is relative to marrying the present match; the other, ρ, affects a man's disutility from his potential wife's work which makes marriage to a working woman less likely and initial downturn of marriage steeper. At any rate, the swing in marriage rate seems quite robust with respect to parameter changes.

The number of children is mostly affected by the parameters that directly affect n (see Table 2): π, σ, β and t. The changes in overall marital fertility occur in the direction one would expect. The higher the utility weights of children, π and σ, the higher the marital fertility. The higher the real and temporal costs of children, β and t, the lower the marital fertility. Other parameters, such as ρ and δ, influence marital fertility primarily through their effect on marriage.

5. Conclusions

The life of American women changed considerably during the six or seven decades following the Civil War and young women's ability to earn independent income was an important cause of the changes. Although many families perceived their young daughter's employment as a temporary expedient intended only to improve the financial standing of the family, the labor market activity in fact had deep effects on the young women's expectations regarding their future professional and family life. Inevitably, such expectations began to have an impact on the workings of the marriage market. As the number of working single women increased, their new outlook on marriage and work ultimately reshaped many areas of life such as fertility, household management and married women's labor supply.

The theoretical model and the calibration show how interdependent the personal and professional decisions are in one's life. They also highlight that growing individual bargaining power of women, while crucial, is considerably more effective when reinforced by the strength in numbers. Individual power affects how resources are divided inside an individual family but it was the growing proportion of working single women that eventually led to a turnaround in the marriage rate. The scope of change is all the more impressive considering that the marriage market was structured (both historically and in the model) in such a way that it was men who decided when to propose marriage, to whom and on what terms.

This is not to deny that other forces were also at work. A revolution in household technology was getting under way after 1900, shortening the housewife's workday and reducing the workload. This strengthened the wives' case that outside employment was something to seriously consider (Greenwood et al., 2005). Technological change, however, only created an opportunity; it was up to women to seize it, sometimes in opposition not only to their husbands but also to various social critics who confused liberation with "too much independence" (Lebergott, 1993). It is also undeniable that some changes in women's standing in the economy and in the family were a result of the political movements of the day. But it is equally undeniable that these political changes were just as much an outgrowth of what was happening "on the ground" in individual families.

Viewed from a broader perspective, the changes of the 1870 – 1930 period set the stage for further reforms in the 20th century and therefore marked a crucial turning point in women's history. It was then that they began to present an ever stronger case for a right to vote, for legislative protection in the work place and for an equal access to education – which are all the hallmarks of full citizenship.

Appendix

Theorem 1. Assume that c.d.f. $F(\theta_F)$ is continuous and differentiable. The threshold function $\theta_F{*} = \theta_F{*}(\theta_M)$ *is continuous over* $\Theta = [\underline{\theta}, \overline{\theta}]$ *and differentiable at all points except where* $w_F(\theta_F{*}) = \rho\theta_M = \frac{\rho}{A} w_M(\theta_M)$ *and* $w_M(\theta_M) \geq R + \frac{(\pi+\sigma)\sqrt{t}}{2\beta}$.

Moreover, $\forall \theta_M ; \theta_F{*}(\theta_M) > \theta_{F\min} = \frac{R+C}{B}$.

Proof.

Continuity: Note that $U_W(\theta_M, \theta_F)$ is a continuous function as can be verified by plugging the solutions from Table 2 into the utility function. Similarly,

$$EU(\theta_M, \overline{\theta}_F) = \frac{1}{1-\delta+\delta F(\overline{\theta}_F)}\left[F\left(\frac{R+C}{B}\right) U_N(w_M(\theta_M), C) + \int_{\theta_{F\min}}^{\overline{\theta}_F} U_W(w_M(\theta_M), w_F(\theta_F)) dF(\theta_F)\right]$$ is

continuous because it is a linear combination of continuous functions. By implication, $G(\theta_M, \overline{\theta}_F) = U_W(\theta_M, \overline{\theta}_F) - \delta EU(\theta_M, \overline{\theta}_F)$ is continuous. Note that the proposal boundary $\theta_F{*}(\theta_M)$ is defined for such (θ_M, $\theta_F{*}$) that $G(\theta_M, \theta_F{*}) = 0$.

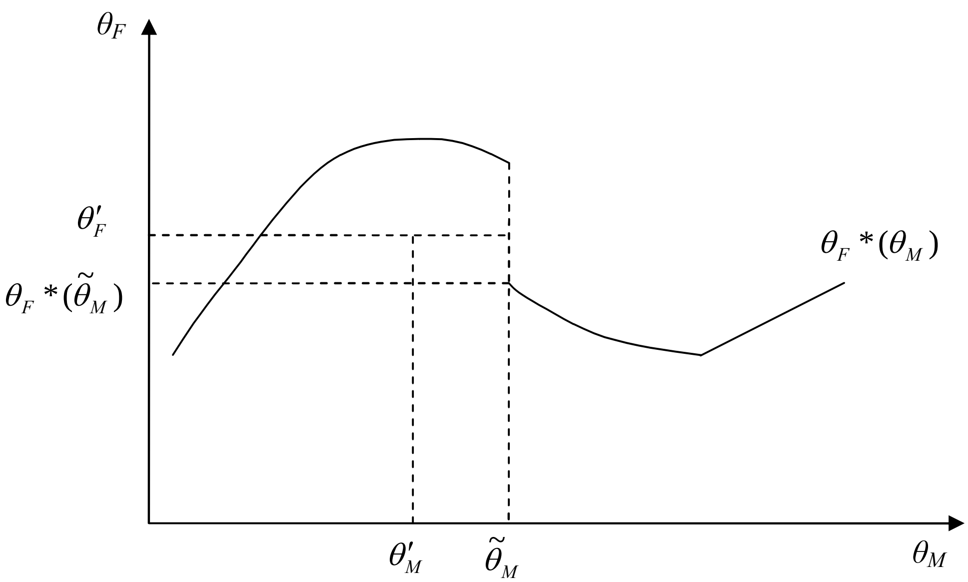
Now, suppose $\theta_F{*}(\theta_M)$ is discontinuous at some point $\tilde{\theta}_M$. Specifically, without loss of generality, assume that the discontinuity is such that $\exists \gamma > 0, \varepsilon > 0 \forall \theta_M \in [\tilde{\theta}_M - \varepsilon, \tilde{\theta}_M) \Rightarrow \left|\theta_F{*}(\theta_M) - \theta_F{*}(\tilde{\theta}_M)\right| > \gamma$ (see Figure A1).

The discontinuity of the proposal boundary at $\tilde{\theta}_M$ implies that $\forall \gamma > 0 \exists \theta'_F \neq \theta_F{*}(\tilde{\theta}_M)$ such that $\left|\theta'_F - \theta_F{*}(\theta_M)\right| < \gamma$ and $G(\tilde{\theta}_M, \theta'_F) \neq 0$ (which is just another way of stating that $(\tilde{\theta}_M, \theta'_F)$ does not lie on the proposal boundary). The value of the function *G* must either be strictly positive or strictly negative at $(\tilde{\theta}_M, \theta'_F)$.

Assume, without loss of generality, that $G\left(\tilde{\theta}_M, \theta'_F\right) < 0$. Now, notice that

$\forall \varepsilon > 0 \forall \theta'_M \in \left[\tilde{\theta}_M - \varepsilon, \tilde{\theta}_M\right] \Rightarrow G(\theta'_M, \theta'_F) > 0$ since all such points (θ'_M, θ'_F) lie below the proposal boundary. But in that case, $G\left(\theta_M, \overline{\theta}_F\right)$ is discontinuous at $(\tilde{\theta}_M, \theta'_F)$ because $\exists \eta > 0, \varepsilon > 0 \forall \theta'_M \in [\tilde{\theta}_M - \varepsilon, \tilde{\theta}_M) \Rightarrow \left|G(\theta'_M, \theta'_F) - G(\tilde{\theta}_M, \theta'_F)\right| > \eta$. That is a contradiction. QED.

Figure A1 – Discontinuous proposal boundary in a $\theta_M - \theta_F$ space



Differentiability: Totally differentiate the condition $U_W(\theta_M, \theta_F*) - \delta EU(\theta_M, \theta_F*) = 0$ to obtain

$$\frac{d\theta_F*}{d\theta_M} = \frac{\delta \frac{\partial EU}{\partial \theta_M} - \frac{\partial U_W}{\partial \theta_M}}{\frac{\partial U_W}{\partial \theta_F*} - \delta \frac{\partial EU}{\partial \theta_F*}}$$

. It is easy to verify that, given the solutions in Table 2 to the optimization problem in section 3.2, all four of these partial derivatives exist and are finite at all points except that the derivatives $\frac{\partial EU}{\partial \theta_M}$, $\frac{\partial U_W}{\partial \theta_M}$ and $\frac{\partial U_W}{\partial \theta_F*}$ do not exist at (θ_M, θ_F) such that

$w_F(\theta_F*) = \rho\theta_M = \frac{\rho}{A} w_M(\theta_M)$ and $w_M(\theta_M) \geq R + \frac{(\pi + \sigma)\sqrt{t}}{2\beta}$. Consequently,

$$\frac{d\theta_F*}{d\theta_M}=\frac{A}{B}\frac{\delta F\left(\frac{R+C}{B}\right)\frac{\partial U_N}{\partial\theta_M}+\delta\int_{\frac{R+C}{B}}^{\theta_F*}\frac{\partial U_W(\theta_M,\theta_F)}{\partial\theta_M}f(\theta_F)d\theta_F-\left[1-\delta+\delta F(\theta_{F*})\right]\frac{\partial U_W(\theta_M,\theta_F*)}{\partial\theta_M}}{\left[1-\delta+\delta F(\theta_{F*})\right]\frac{1}{B}\frac{\partial U_W}{\partial\theta_F*}}$$

does not exist at such points either. QED.

*Lower bound on θ_F **: This part of the theorem states that every man, no matter how low his θ_M, will be willing to propose to at least some working women. No man will propose to non-working women only.

This part is also proven by contradiction. Suppose $\theta_F*(\theta_M)\le\theta_{F\min}=\frac{R+C}{B}$. Then

$EU(\theta_M,\theta_F)=F(\theta_F*)U_N(\theta_M,C)+\left[1-F(\theta_F*)\right]\delta EU(\theta_M,\theta_F)=\frac{F(\theta_F*)}{1-\delta+\delta F(\theta_F*)}U_N(\theta_M,C)$. But for $\theta_F*(\theta_M)$, it must also hold that $U_W(\theta_M,\theta_F*)-\delta EU(\theta_M,\theta_F*)=0$ which, however, in this particular case simplifies to $U_N(\theta_M,C)-\frac{\delta F(\theta_F*)}{1-\delta+\delta F(\theta_F*)}U_N(\theta_M,C)\ne 0$. Thus $\theta_F*(\theta_M)\le\theta_{F\min}=\frac{R+C}{B}$ cannot be the proposal boundary. QED.

Theorem 2. Assume that c.d.f. $F(\theta_F)$ is continuous and differentiable.

Then, provided $t>\beta$ and $1>\rho>0$

(a) for θ_M such that $w_M(\theta_M)<R+\frac{(\pi+\sigma)\sqrt{t}}{2\beta}$, $\theta_F*(\theta_M)$ is increasing in θ_M;

(b) for $\left[\theta_M,\theta_F*(\theta_M)\right]$ such that $\left[w_M(\theta_M),w_F(\theta_F*)\right]\in$ Region 2 and $w_F(\theta_F*)\ne\rho\theta_M=\frac{\rho}{A}w_M(\theta_M)$, $\theta_F*(\theta_M)$ is increasing in θ_M.

Proof. (a) By Theorem 1, $\theta_F*(\theta_M)$ is differentiable for θ_M such that $w_M(\theta_M) < R + \frac{(\pi+\sigma)\sqrt{t}}{2\beta}$. Using the formula for $\frac{d\theta_F*}{d\theta_M}$ (see above) and plugging in the expressions for the individual utility partial derivatives, one obtains $\frac{d\theta_F*}{d\theta_M} > \frac{A}{B}\frac{(1-\delta)}{[1-\delta+\delta F(\theta_F*)]}\frac{\left(1-\frac{\rho}{A}l*-\beta n*\right)}{(1-l*)} > 0$. QED

(b) Again, by Theorem 1, $\theta_F*(\theta_M)$ is differentiable for $[\theta_M, \theta_F*(\theta_M)]$ such that $[w_M(\theta_M), w_F(\theta_F*)] \in$ Region 2 and $w_F(\theta_F*) \neq \rho\theta_M = \frac{\rho}{A}w_M(\theta_M)$. Using the formula for $\frac{d\theta_F*}{d\theta_M}$ (see above) and plugging in the expressions for the individual utility partials yields

$\frac{d\theta_F*}{d\theta_M} = \frac{A}{B}\frac{1-\delta}{1-\delta+\delta F(\theta_F*)}(1-\beta n*) > 0$. QED

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Figure 1 - Sequence of decision-making during each period

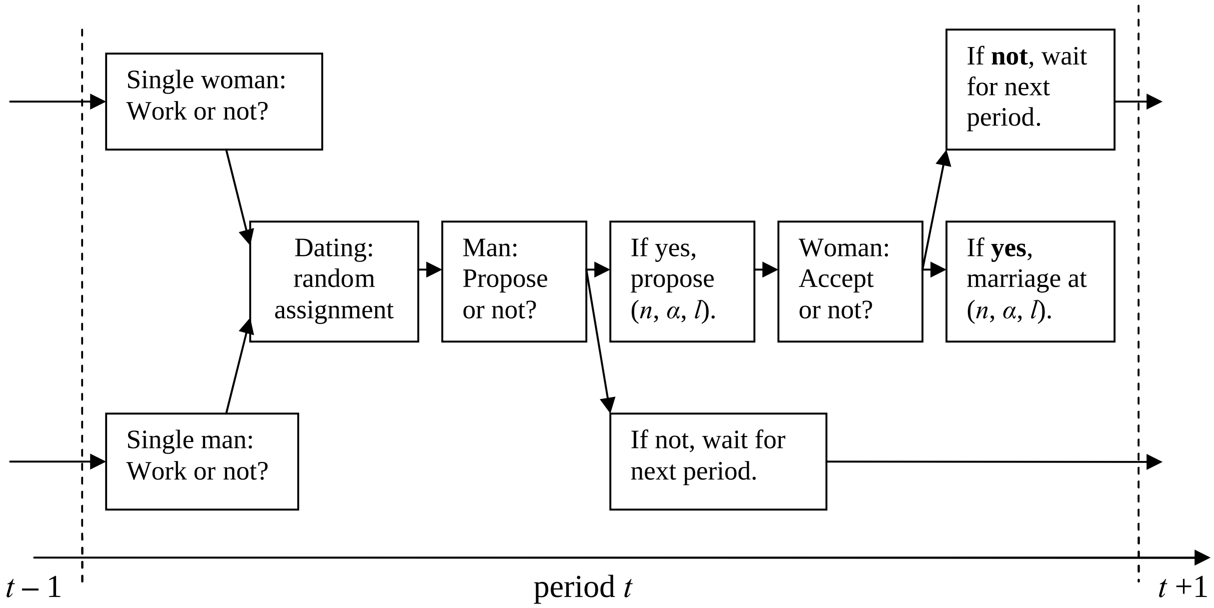
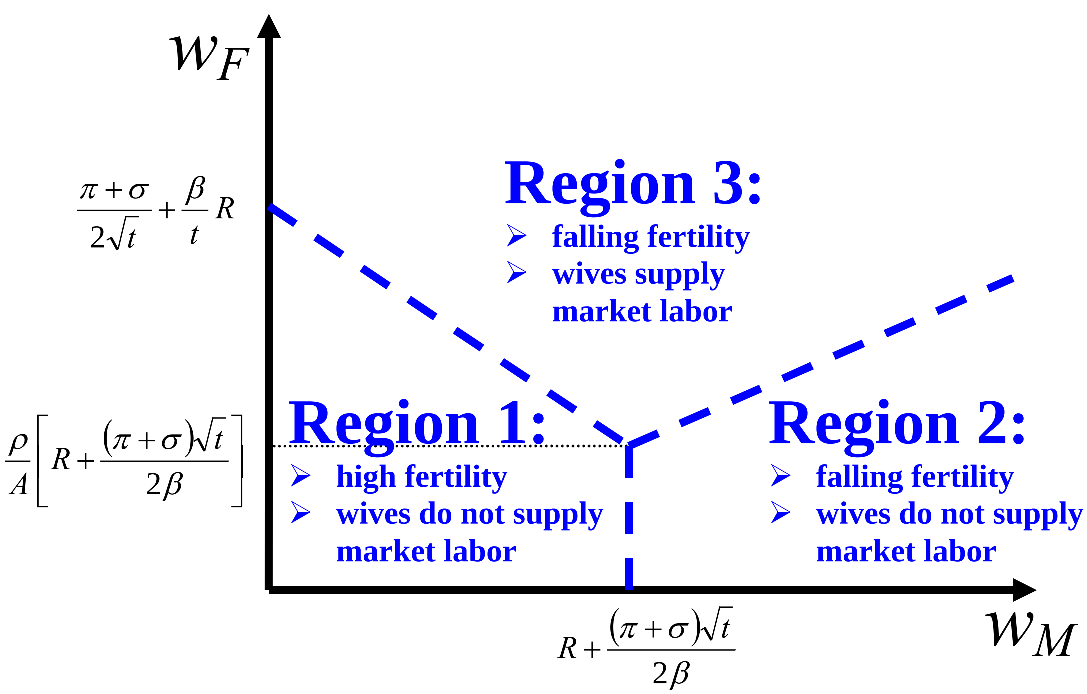
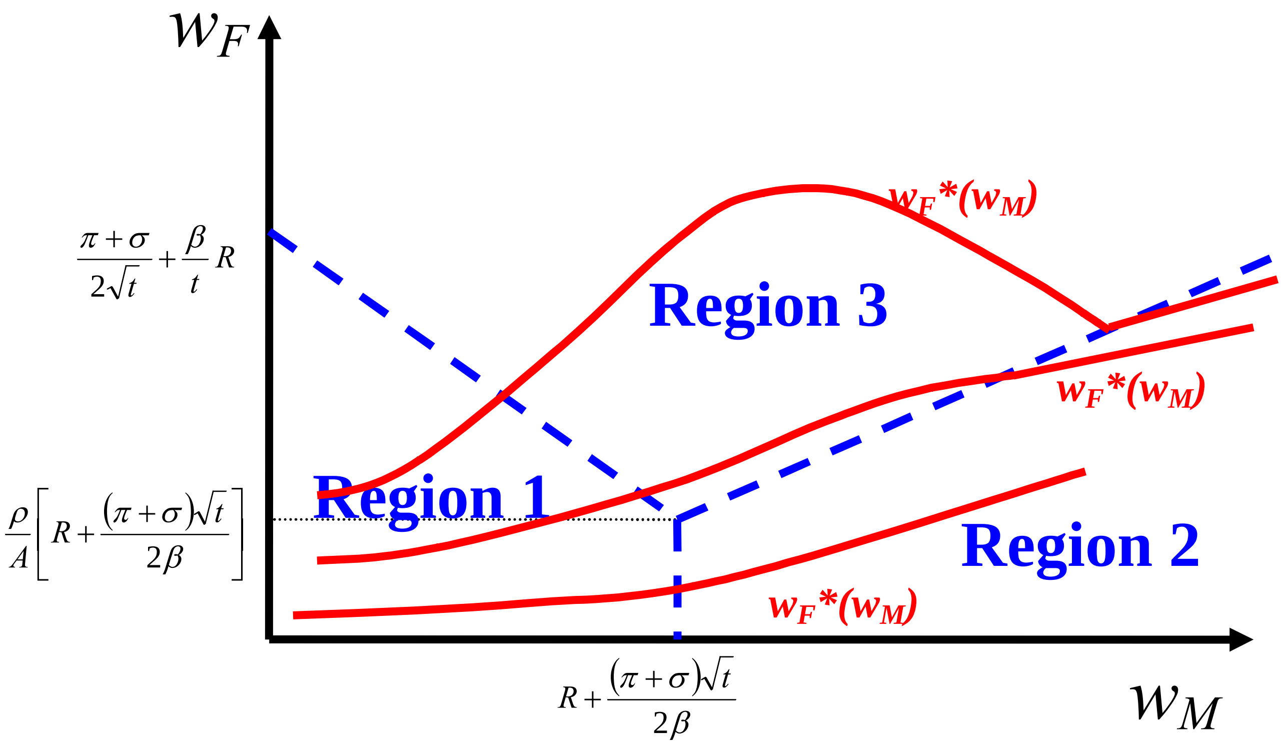


Figure 2 – Optimal proposals in a $w_M - w_F$ space



Note: Man's proposal will vary depending on the region in which a match occurs. The region borders are determined by optimization constraints. For their formal expression, as well as for closed-form solutions for the optimization problem, see Table 2.

Figure 3 – Proposals boundaries in a $w_M - w_F$ space



Note: The proposal boundaries determine the marriage rate. Matches which lie below the boundary mature into marriages; otherwise they end in a break-up. Their position and shape depend on model parameters, primarily on the values of δ and ρ. For discussion of the proposal boundary, see section 3.4. For formal treatment of their shape, see Theorem 1 and the

Figure 4 – Men's utility at different levels of θ_M and θ_F

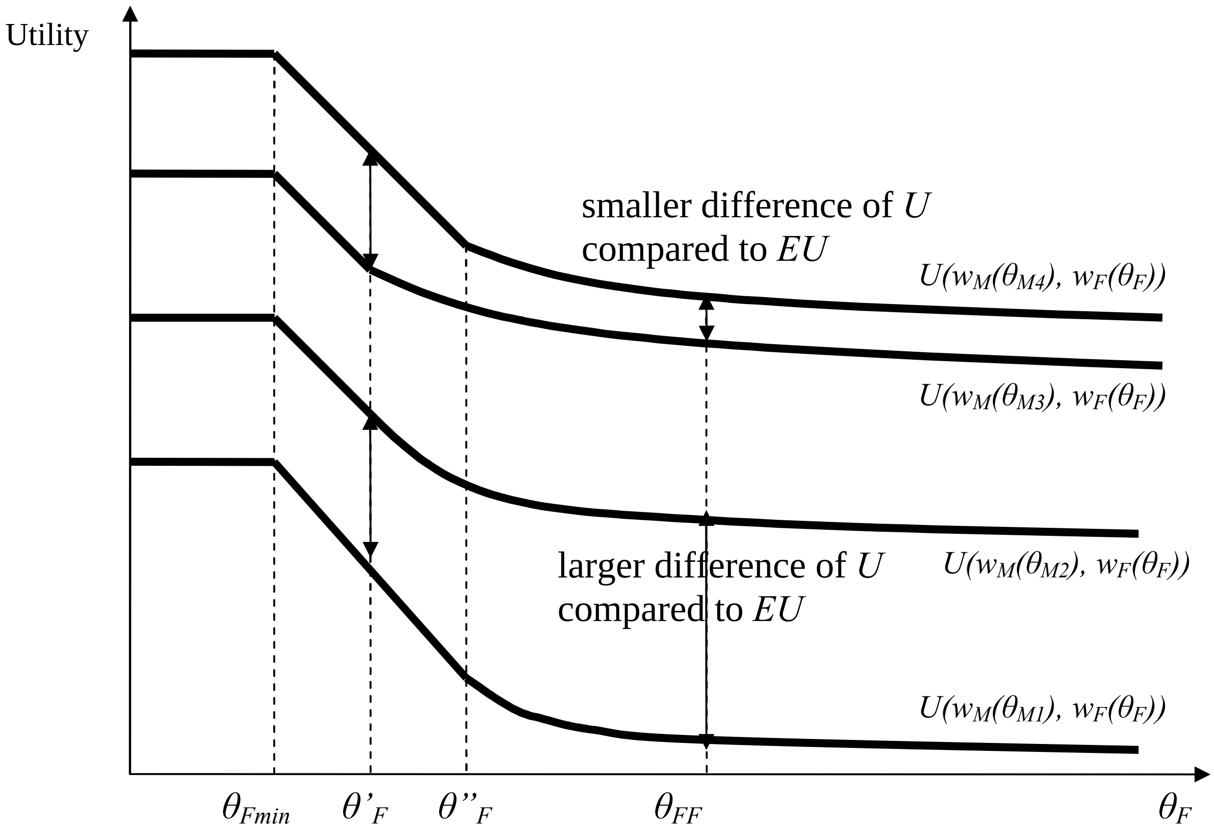
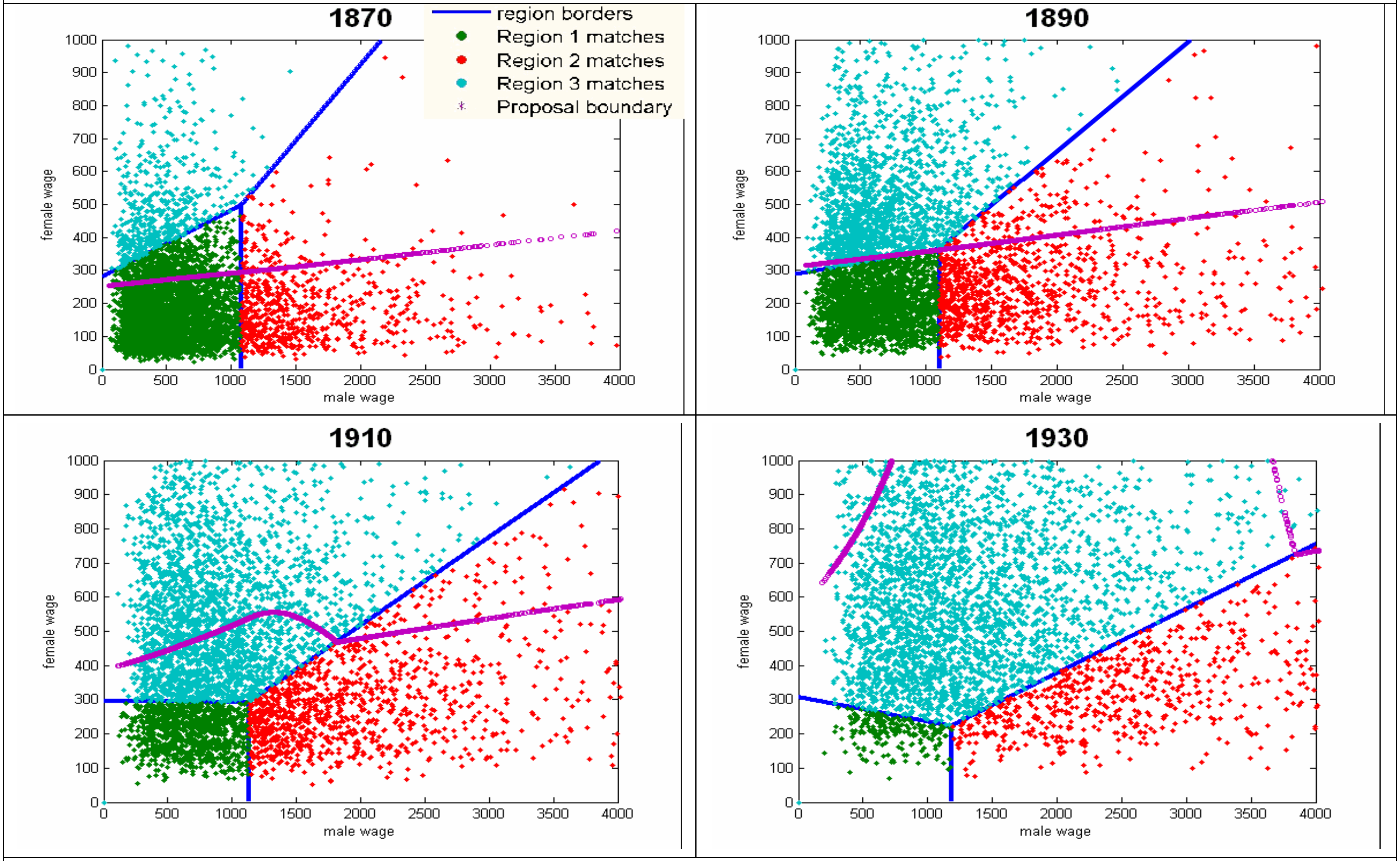


Figure 5 – Matches and proposal boundaries 1870 – 1930



Note: Graphs depict the gradual movement of the 'cloud of matches' out of Regions 1 and 2 and into Region 3. At first, the cloud shifts faster than the proposal boundary and the marriage rate falls but after 1900, this process is reversed and the marriage rate increases.

Figure 6 - Single women's labor supply and variation in parameters

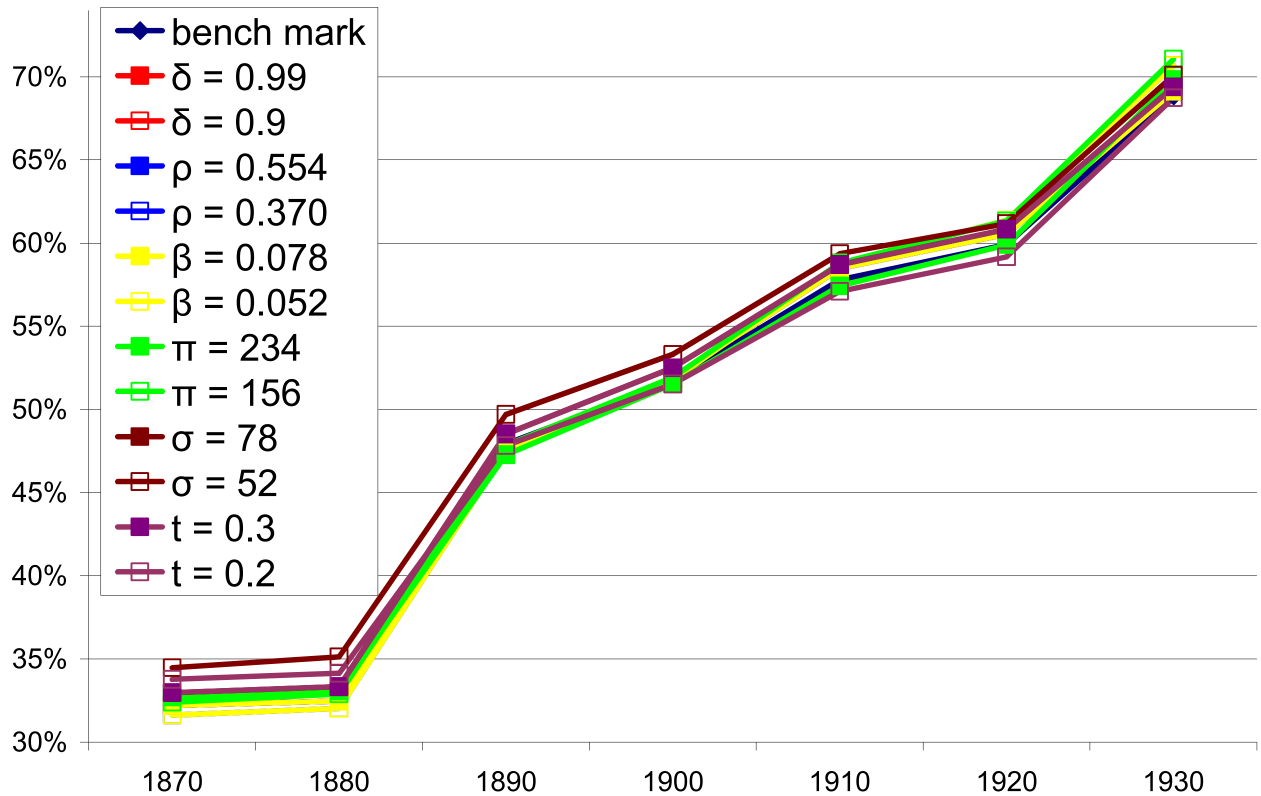


Figure 7 - Marriage rate and variation in parameters

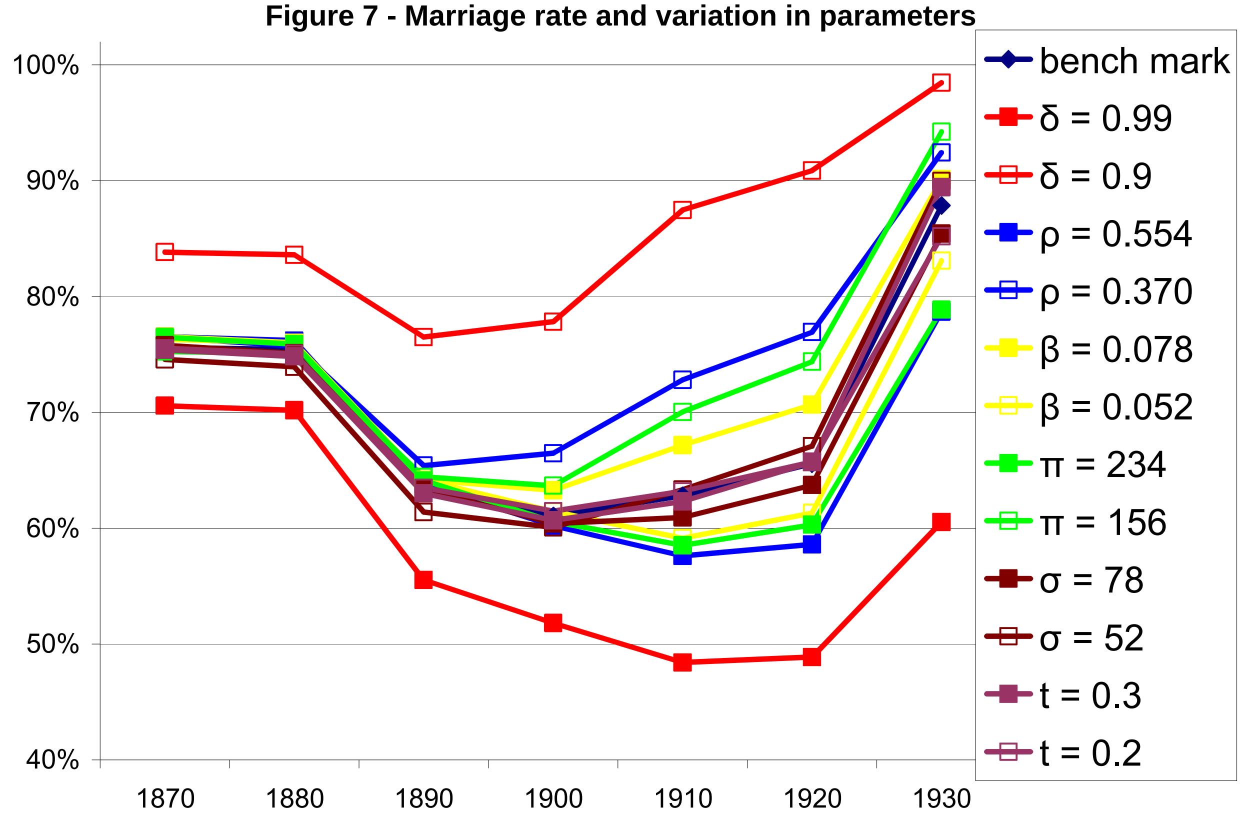


Figure 8 - Marital fertility and variation in parameters

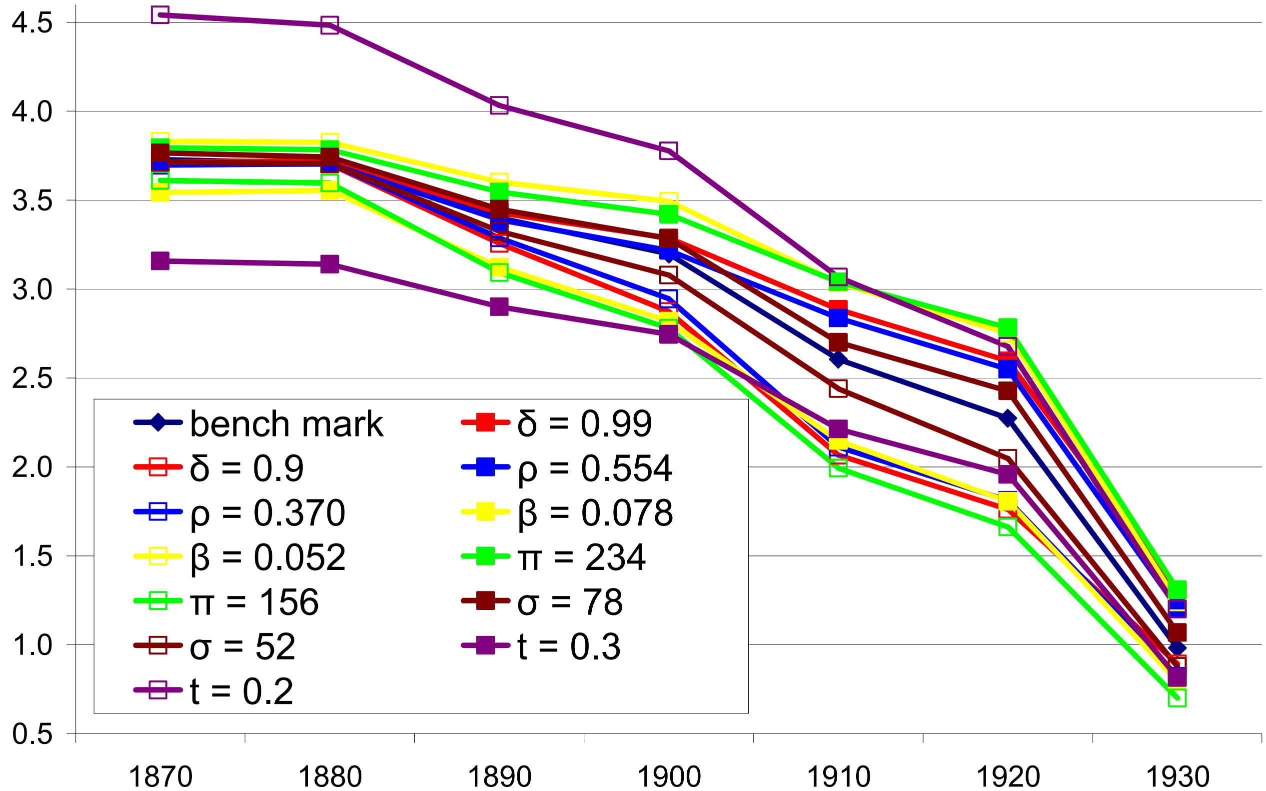
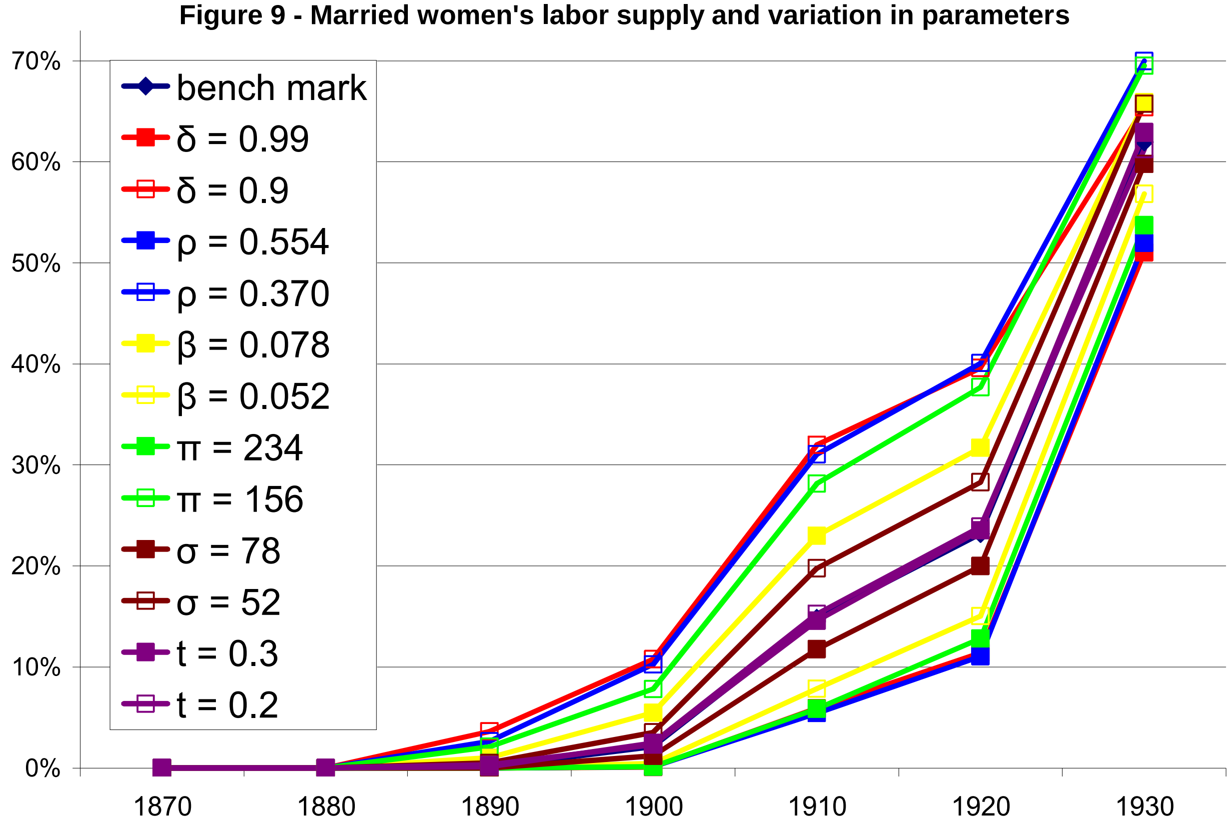


Figure 9 - Married women's labor supply and variation in parameters



			1860	1870	1880	1890	1900	1910	1920	1930
	Table 1: Marriage and labor market characteristics of white women aged 20-24 (%)									
	Proportion married	Non-metro area	53.35	51.97	50.23		48.87	50.15	53.94	54.21
		Metro area	**42.52**	**39.69**	**34.35**		**34.58**	**39.56**	**42.99**	**42.68**
	Labor force participation		**1860**	**1870**	**1880**	**1890**	**1900**	**1910**	**1920**	**1930**
	Married women	Non-metro area	5.09	1.60	1.73		1.98	5.62	4.69	8.00
		Metro area	**3.77**	**2.55**	**3.29**		**2.42**	**5.41**	**8.81**	**15.06**
	Single women	Non-metro area	32.46	26.94	31.39		39.91	49.76	51.01	53.48
		Metro area	**55.03**	**56.62**	**57.09**		**64.13**	**73.06**	**79.98**	**79.14**
	Proportions employed as:		**Married women**							
			1860	**1870**	**1880**	**1890**	**1900**	**1910**	**1920**	**1930**
Occupations	Professional, clerical and sales	Non-metro area	3.42	13.55	13.27		13.60	12.08	28.37	46.83
		Metro area	**11.92**	**2.85**	**6.77**		**14.19**	**14.87**	**37.53**	**57.93**
	Craftswomen and operatives	Non-metro area	21.55	36.46	28.62		39.23	16.51	27.26	32.63
		Metro area	**54.77**	**71.49**	**76.10**		**58.83**	**50.27**	**46.66**	**29.70**
	Service workers	Non-metro area	59.30	34.14	27.98		22.60	11.28	12.90	11.05
		Metro area	**28.54**	**24.21**	**13.53**		**16.20**	**24.07**	**8.72**	**9.03**
	Other	Non-metro area	15.74	15.85	30.13		24.57	60.13	31.47	9.50
		Metro area	**4.77**	**1.45**	**3.60**		**10.78**	**10.79**	**7.09**	**3.35**
	Proportions employed as:		**Single women**							
			1860	**1870**	**1880**	**1890**	**1900**	**1910**	**1920**	**1930**
Occupations	Professional, clerical and sales	Non-metro area	15.50	18.25	21.76		35.40	48.89	63.58	60.02
		Metro area	**7.06**	**5.71**	**12.19**		**28.49**	**40.00**	**62.21**	**65.94**
	Craftswomen and operatives	Non-metro area	24.44	23.76	25.40		22.96	16.65	13.43	15.10
		Metro area	**37.62**	**37.92**	**44.14**		**37.18**	**36.91**	**25.54**	**19.19**
	Service workers	Non-metro area	54.41	52.26	45.08		34.68	23.55	14.68	16.41
		Metro area	**54.12**	**51.59**	**40.52**		**32.16**	**20.52**	**9.65**	**12.30**
	Other	Non-metro area	5.65	5.72	7.75		6.95	10.92	8.31	8.48
		Metro area	**1.21**	**4.78**	**3.16**		**2.17**	**2.57**	**2.60**	**2.58**

Source: IPUMS. The 20-24 age group is selected because many single women started their employment at this age, moreover, between 1870 and 1930, the average age at marriage mostly oscillated between 22 and 25 years of age. White women have been selected for analysis here because other groups, such as blacks and Native Americans are represented in relatively low numbers in IPUMS samples which makes any computations of averages and proportions less reliable.

Table 2: Solution to the constrained optimization – optimal proposal				
	Binding constraints	$n*$	$\alpha*$	$l*$
Region 1 $w_M < R + \frac{(\pi+\sigma)\sqrt{t}}{2\beta}; w_F < \frac{\pi+\sigma}{2\sqrt{t}} - \frac{\beta}{t}(w_M - R) + \frac{\rho}{A} w_M$	WTC, NLSC	$\frac{1}{t}$	$\frac{\max(C; w_F - R)}{w_M - R} - \frac{\sigma}{(w_M - R)\sqrt{t}}$	0
Region 2: $w_F \leq \rho\theta_M = \frac{\rho}{A} w_M; w_M \geq R + \frac{(\pi+\sigma)\sqrt{t}}{2\beta}$	NLSC	$\left[\frac{\pi+\sigma}{2\beta(w_M - R)}\right]^2$	$\frac{\max(C; w_F - R)}{w_M - R} - \frac{\sigma(\pi+\sigma)}{2\beta(w_M - R)^2}$	0
Region 3 $w_F \geq \frac{\pi+\sigma}{2\sqrt{t}} - \frac{\beta}{t}(w_M - R) + \frac{\rho}{A} w_M; w_F > \rho\theta_M = \frac{\rho}{A} w_M$	WTC	$\left[\frac{\pi+\sigma}{2\beta(w_M - R) + 2t(w_F - \rho\theta_M)}\right]^2$	$\frac{\max(C; w_F - R)}{w_M - R} - \frac{w_F l*}{w_M - R} - \frac{\sigma\sqrt{n*}}{w_M - R}$	$1 - tn*$
Note: Optimal proposals differ by region. Desired number of children, *n*, is highest in Region 1 but otherwise decreases in male (Region 2) and female (Region 3) wages. Married women do not work in Regions 1 and 2 because they are prevented either by full-time child care (Region 1) or by their husbands disutility from wife's work (Region 2).				

Table 3: Derivatives of the indirect utility function with respect male and female productivity			
	Region 1	Region 2	Region 3
$\frac{\partial U_W}{\partial \theta_F}$	$-B$	$-B$	$-B(1-l*)$
$\frac{\partial U_N}{\partial \theta_F}$	0	0	$Bl*$
$\frac{\partial U_W}{\partial \theta_M}$	$A\left(1-\frac{\beta}{t}\right)$	$A(1-\beta n_2*) = A\left[1-\beta\left(\frac{\pi+\sigma}{2\beta(w_M - R)}\right)^2\right]$	$A\left(1-\frac{\rho}{A}l* - \beta n_3*\right)$
$\frac{\partial U_N}{\partial \theta_M}$	$A\left(1-\frac{\beta}{t}\right)$	$A(1-\beta n_2*) = A\left[1-\beta\left(\frac{\pi+\sigma}{2\beta(w_M - R)}\right)^2\right]$	$A\left(1-\frac{\rho}{A}l* - \beta n_3*\right)$
Note: The derivatives are calculated using the optimal solutions from Table 2. The expression 'None' in the left-most column reflects the fact that the family stipend *C* is assumed to be sufficiently low that all women who match in Region 3 are working while single.			

Table 4: Parameters and their values		
Parameter	*Description*	*Value*
π	relative weight of children in the utility functions of men	195
σ	relative weight of children in the utility function of women	65
ρ	strength of husband's dislike of his wife's employment	0.462
β	fraction of income spent on children	0.065
t	time spent by a mother per child	0.25
δ	discount factor	0.96

Table 5: Simulation results versus Historical trends								
	Single women's labor force participation		Marriage rate		Desired number of children		Married women's labor force participation	
	historical	**model**	historical	**model**	historical	**model**	historical	**model**
1870	34.4%	**31.9%**	49.37%	**75.9%**	3.742	**3.718**	1.8%	**0.0%**
1880	39.0%	**32.2%**	46.41%	**75.5%**	3.257	**3.708**	2.0%	**0.0%**
1890		**47.5%**		**63.6%**	2.879	**3.374**		**0.1%**
1900	50.2%	**51.6%**	43.64%	**61.0%**	2.695	**3.176**	2.1%	**1.9%**
1910	60.8%	**58.2%**	45.62%	**62.9%**	2.599	**2.585**	5.5%	**15.0%**
1920	66.4%	**60.5%**	48.70%	**65.4%**	2.331	**2.247**	6.4%	**23.9%**
1930	69.0%	**69.5%**	47.86%	**87.7%**	2.131	**0.965**	11.5%	**62.7%**

Note: Results of simulation were obtained using parameters values as specified n Table 4. For historical values, the sources are: IPUMS for single and married women's labor force participation and for marriage rate. They pertain to white women aged 20-24. Desired number of children is derived from marital fertility in Hernandez (1996: 318) and the mortality statistics from Historical Statistics of United States and pertains to the number of children born to a given cohort of women that survived to age 20.

Table 6: Simulation results versus Historical trends								
	Single women's labor force participation		Marriage rate		Desired number of children		Married women's labor force participation	
	historical	**model**	historical	**model**	historical	**model**	historical	**model**
1870	34.4%	**32.7%**	49.37%	**75.8%**	3.742	**3.707**	1.8%	**0.0%**
1880	39.0%	**33.1%**	46.41%	**75.3%**	3.257	**3.700**	2.0%	**0.0%**
1890		**47.3%**		**63.4%**	2.879	**3.400**		**0.1%**
1900	50.2%	**51.5%**	43.64%	**60.9%**	2.695	**3.195**	2.1%	**1.9%**
1910	60.8%	**57.4%**	45.62%	**62.7%**	2.599	**2.610**	5.5%	**14.2%**
1920	66.4%	**59.9%**	48.70%	**65.2%**	2.331	**2.291**	6.4%	**23.1%**
1930	69.0%	**69.8%**	47.86%	**68.6%**	2.131	**2.073**	11.5%	**39.6%**

Note: Results of simulation were obtained using parameters values as specified n Table 4 except for a one-time change in β from 0.065 in 1920 to 0.033 in 1930. For historical values, the sources are the same as in Table 5.

Table 7 - Simulation results by regions

Region 1	Single women's labor force participation	Marriage rate	α	Marital fertility	Married women's labor force participation
1870	22.5%	85.0%	10.5%	4.000	0.0%
1880	22.9%	85.0%	10.5%	4.000	0.0%
1890	12.2%	98.6%	14.9%	4.000	0.0%
1900	3.2%	98.3%	15.6%	4.000	0.0%
1910	0.0%	97.9%	18.2%	4.000	0.0%
1920	0.0%	96.0%	20.0%	4.000	0.0%
1930	0.0%	95.0%	24.7%	4.000	0.0%
Region 2	Single women's labor force participation	Marriage rate	α	Marital fertility	Married women's labor force participation
1870	31.4%	83.6%	4.8%	2.218	0.0%
1880	28.1%	84.4%	4.7%	2.210	0.0%
1890	37.3%	85.5%	6.8%	1.966	0.0%
1900	37.3%	88.0%	7.4%	1.830	0.0%
1910	32.4%	91.4%	8.1%	1.595	0.0%
1920	29.0%	93.5%	8.3%	1.430	0.0%
1930	25.2%	96.6%	8.8%	0.913	0.0%
Region 3	Single women's labor force participation	Marriage rate	share	Marital fertility	Married women's labor force participation
1870	100.0%	0.0%	NA	NA	NA
1880	100.0%	0.0%	NA	NA	NA
1890	100.0%	3.5%	27.4%	3.848	3.8%
1900	99.6%	15.1%	19.2%	3.260	18.5%
1910	89.0%	39.0%	17.2%	2.296	42.6%
1920	86.2%	48.2%	17.2%	1.936	51.6%
1930	80.7%	85.7%	23.1%	0.844	78.9%

Note: Simulation results were obtained using parameter values as specified in Table 4. Variable *α* refers to the share of husband's income transferred to a non-working wife. Variable 'share' refers to the fraction of total financial resources of a family that are controlled by a working wife.