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Marrying Up: The Role of Sex Ratio in Assortative Matching[1]

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Abstract: We assemble a novel dataset to study the impact of male scarcity on marital assortative matching and other marriage market outcomes using the large shock that WWI caused to the number of French men. Using a difference-in-differences approach, we find that post war in regions with higher mortality rates: men were less likely to marry women of lower social classes; men were more likely and women less likely to marry; out-of-wedlock births increased; divorce rates decreased; and the age gap decreased. These findings are consistent with men improving their position in the marriage market as they become scarcer.

JEL Code: J12, N34

Keywords: Marriage, sex ratio, male scarcity, assortative matching, social classes.

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1. Introduction

Marriage market outcomes are known to have important implications for fertility, education, labor supply, social inequality, and income redistribution (e.g. Fernandez and Rogerson, 2001). One important determinant of marriage market outcomes is the sex ratio, i.e. the ratio of men to women in the population. In particular, a robust prediction of marriage models is that the position of men (women) in the marriage market improves (worsens) with a reduction in the sex ratio (e.g., Becker, 1973, 1974 and 1980, Bloch and Ryder, 2000, Chiappori, Fortin and Lacroix, 2001). In this paper, we investigate how male scarcity due to exceptionally high military mortality during World War I (WWI) changed the relative position of men and women in the French marriage market following the war. Specifically, we analyze how male scarcity induced by war casualties affected men and women's marital status, out-of-wedlock births, and marital assortative matching by social class and by age.

We exploit the regrettable fact that WWI, one of the deadliest conflicts in recent human history, produced an exogenous and unusually large shock to the number of French men. Approximately 16.5% of French soldiers were reported dead or missing after the war (Huber, 1931). The First World War in France provides a particularly useful setting to test the effect of male scarcity on marriage outcomes for the following reasons. First, the ratio of men aged 18 to 59 to women aged 15 to 49 decreased substantially as a result of the military mortality, from 1,087 men per 1,000 women in 1911 to 992 men per 1,000 women in 1921.[5] Second, military mortality varied substantially across regions, with the percentage of soldiers killed ranging from 10.5% to 20.2% (see Figure 1), largely because men served in regiments with others from their regions, and different regiments were sent to battles of different intensities. This variation generated substantial heterogeneity in sex ratios across regions, reaching 864 men per 1,000 women in some regions, which allows us to test the impact of male scarcity on assortative matching and other marriage outcomes. Finally, unlike in many other wars, military mortality was essentially uniform across social classes, meaning that the distribution of social classes in the population remained largely unchanged by the war. This fact rules out the hypothesis that changes in marriage by social class following the war were mechanically driven by changes in the distribution of people across classes.

We use a new data set that links non-public marriage-level data to French censuses of population and regional data on military mortality. Throughout the paper, we adopt a differences-in-differences approach, which examines how marriage outcome patterns changed following the war (first difference) in regions with different levels of military mortality (second difference). We start by using

[5] Since this war was fought in the battlefield, civilian mortality (which is more balanced across genders) was lower than in later major wars such as the Second World War.

census data to analyze the impact of male scarcity on marital status (the proportions of single, divorced and widowed individuals). We find that more women remained single post war in regions with higher mortality. This effect was especially pronounced for women under 29 years old. In regions with 10 percentage point higher military mortality rates, the proportion of single women aged 20 to 29 increased by 2.7 percentage points post war (relative to a pre-war average of 39.4%). In contrast, fewer men aged 20-29 remained single in regions with higher mortality post war. We also find that military mortality had a negative effect on divorce rates for young adults: the proportion of divorcés among men and women aged 20-39 declined post war in regions with higher mortality rates. Finally, as expected, we find a large increase in the proportion of widowed women (especially women aged 30-39) in regions with higher mortality rates. We then analyze the impact of male scarcity on out-of-wedlock births. Such births could reflect men having more partners or men being able to shift the cost of child rearing to single mothers. We find a higher proportion of out-of-wedlock births post war in regions with higher mortality. Specifically, in regions where the military mortality was 20% compared with regions with 10% mortality rates, the proportion of out-of-wedlock births increased by 1.5 percentage points post war (relative to a pre-war average of 6.7% of births).

Next we analyze the impact of male scarcity due to war casualties on assortative matching by social class. From the marriage-level data, which consist of information provided on marriage certificates, we obtain the specific occupations of the brides, grooms, and their parents. Based on those occupations, we assign individuals to one of seven ordered social classes using the Historical International Social Class Scheme (HISCLASS) developed by van Leeuwen and Maas (2005a). This thorough scheme maps occupations to social classes based on several dimensions of the occupations, such as whether they involve supervision of others, the skill level required to perform them, whether they are manual, and the economic sectors into which they fall. The classes in HISCLASS were carefully constructed to categorize individuals according to their life chances and to reflect their social status. We note that while social class is correlated with income, it encompasses several other dimensions that are relevant for marriage. For example, an individual's social class also depends on her level of skill and therefore education, and on the social status and prestige associated with her occupation.

We begin by establishing that there was considerable assortative matching by social class in France before WWI: 44% of men married women of the same social class. We then exploit the exogenous regional variation in military mortality to analyze the effect of a decrease in the male population on assortative matching by social class. First, we use a difference-in-differences approach to test the hypothesis that men married up more post war in regions with higher mortality. Second, we

use an instrumental variable approach to test more directly the causal effect of the sex ratio on assortative matching by social class. Specifically, we use the regional mortality rate as an instrument for the regional sex ratio, which may be endogenous because of factors such as non-random migration. Overall, we find that the decrease in sex ratio induced by war-related mortality allowed men post war in regions with higher mortality to marry better than they used to pre war. Compared with regions with 10% military mortality rates, in regions with 20% military mortality rates the probability that a given groom married down post war decreased by 10 percentage points (from a pre-war average of 36.1%), and the probability that a given groom married a low class bride post war decreased by 17 percentage points.

Finally, we analyze the impact of male scarcity on the age gap between brides and grooms. We note that before the war men married women on average 3.8 years younger. We find that after the war, the age gap narrowed more in regions with higher mortality. This effect is driven mainly by an increase in the age at marriage of women in such regions, with brides marrying on average 10 months older post war in regions with 10 percentage point higher mortality.

Overall, these findings are consistent with the idea that the sex ratio has a strong impact on marriage market outcomes in general and on assortative matching in particular. Our paper contributes to a growing literature on sex ratios and marriage markets. Starting with the seminal work of Becker (1973, 1974), economists have devoted considerable attention to understanding marriage markets.[6] Part of this effort has been to understand the impact of a change in the sex ratio on marriage outcomes such as marriage rates and fertility, though not on assortative matching by social class as in the present paper. Early examples include Cox (1940), Easterlin (1961), Guttentag and Secord (1983). A potential problem of these studies, mitigated to a large extent in Angrist (2002), Charles and Luoh (2010), Brainerd (2007), and Lafortune (2008), is that there may be reverse causality between sex ratios and marriage market outcomes. Our paper uses the exogenous regional variation in military mortality to deal with this potential reverse causality between the sex ratio and the marriage outcomes we consider.

In addition to these articles, other work has pointed out additional adjustments in the marriage market induced by a change in the relative scarcity of men or women. Rao (1993), Grossbard-Shechtman (1993), Botticini (1999), Botticini and Siow (2003) and Edlund (2000) suggest that one adjustment is through dowries. Becker (1974, 1981), Bergstrom (1994), Willis (1999), and Neal (2004), among others, suggest that a consequence of the imbalance in sex ratio is the emergence of polygamy, including “serial polygamy” (divorce and re-marriage) and relationships leading to out-of-

[6] For a review of the economics of marriages, see Weiss (1993).

wedlock births. Becker (1973, 1981), Chiappori et al. (2001) and references therein point out that a possible adjustment is a change in the share of the surplus generated by marriage that is appropriated by each spouse. In this paper, we highlight marrying up as another important adjustment, complementary to the ones mentioned above, when the scarcity of men increases.

Another important issue in the empirical literature of the marriage market is the characterization of individuals' preferences for spouses (e.g., Wong, 2003, Bisin et al., 2004, Choo and Siow, 2006, Ariely, Hitsch and Hortacsu, 2006, Belot and Francesconi, 2006, Fisman et al., 2006, Lee, 2007, Banerjee et al., 2010). Our finding that men marry down less in regions with lower sex ratios is consistent with the hypothesis that assortative matching occurs because in equilibrium individuals cannot marry higher-class people, although they may wish to do so (i.e., they have vertical preferences for social class). This finding is also consistent with horizontal preferences for social class, if the distribution across classes differs sufficiently between genders and individuals prefer to marry up rather than down when they cannot marry someone from their own class. For theories that explicitly model preferences for "marrying up", see Burdett and Coles (1997) and Banerjee et al. (2010).

This paper is organized as follows. In Section 2, we describe the historical context surrounding WWI in France. In Section 3, we present the data. In Sections 4 to 7, we analyze the impact of male scarcity on marital status and out-of-wedlock births, and assortative matching by social class and age at marriage. In Section 8, we draw final conclusions.

2. Historical Context

The First World War, or the Great War, was a global military conflict that lasted from July 1914 until November 1918 and resulted in enormous loss of life. In this section, we present a brief description of the war-related mortality and its implications for the marriage market in France. The most relevant facts for our analysis are that the draft to the French army was nearly universal, the number of casualties was enormous and caused a dramatic decrease in the sex ratio, military mortality was uniform across social classes, and women worked in similar occupations before and after the war.

2.1. Mobilization and mortality during WWI in France: a global phenomenon

During the war, France underwent universal mobilization. Over the war period, about 8 million Frenchmen born between 1867 and 1899 were drafted or voluntarily enrolled in the army (Huber,

1931).[7] To highlight the scope of this mobilization, note that 8.8 million men aged 18 to 51 were registered in the 1911 census, and that the overall French population in 1911 was approximately 33.2 million. Exemptions from the draft were extremely rare. During the war, the French army reviewed all exempt cases and drafted a large proportion of men who were initially exempted, including those who had been injured early in the war.

As a result of this general mobilization and the violence of the conflict, military casualties were enormous. A total of 1.397 million men, or 16.5% of the enrolled soldiers and officers, were reported dead or missing in action at the end of the war. Importantly, military mortality was quite homogenous across military ranks: about 16% of French soldiers and 19% of French officers died or were reported missing. Similarly, mortality across occupations seems to have been quite uniform. Table 1 presents the distribution of fatalities by occupation at age 20 (Panel A) and the distribution of the labor force by occupation from the 1906 and 1921 censuses (Panel B).[8] Although the occupation categories differ slightly between the two tables, the distribution of fatalities by occupation is very similar to that of men in the labor force.[9]

Mortality was uniform across military rank and occupation, but there was substantial heterogeneity in mortality rates across geographical regions and by age. In Section 3.3 we discuss this geographic variation in war mortality and its causes in more detail. Men born between 1892 and 1895 were the most affected, with 27% to 29% mortality rates across France, while men born between 1883 and 1891 experienced mortality rates from 19.2% to 24.1%. Older cohorts of men, aged 40 and above at the beginning of the war, suffered the lowest mortality rates (10% or less). In addition to military casualties, deaths among civilians were high during the period 1914 to 1918, with the peak of mortality being caused by the 1918 Spanish flu epidemic. Among the civilian population, the mortality rate may have been higher for men than women, and the increase in mortality rate was the most striking for individuals aged 15 to 45. This is potentially another exogenous cause of the unbalanced sex ratio in the post-WWI period. Note, however, that deaths from the Spanish flu will not be reflected in our measure of war-related mortality.

[7] About 7.8 million men were drafted and 0.2 million enrolled voluntarily. In addition, 0.5 million foreigners and men from the French colonies joined the French army. All the numbers presented in this subsection are taken from Huber (1931) unless otherwise noted.

[8] Mortality data on soldiers' occupations when drafted are not available. Data on occupation at age 20 were recorded during each individual's military service.

[9] Beyond the numbers in Table 1, anecdotal evidence stresses that many elites and white collar workers perished during the conflict. Four hundred and fifty writers from the "Societe des gens de letters", a writers' organization, 833 former students of the Ecole Polytechnique and 230 from the Ecole Normale, both of which were prestigious universities, were killed during the conflict.

2.2. Marriage market in France

The 19th century and the beginning of the 20th century in France were characterized by a stable celibacy rate of 10% to 13.5%, and a high marriage rate (Dupaquier, 1988). The average marriage rate of the 1908 to 1913 period (the annual number of new spouses per 10,000 inhabitants) was 158, putting France at a high rank among European nations. Divorce was a rare phenomenon (around 4-6% of marriages), both before and after the war (Segalen, 1981).

After the onset of the war, the total annual number of marriages diminished sharply, reaching its lowest value in 1915 (75,200 marriages compared with 247,900 in 1913). After 1915, the marriage rate started to increase again, though at a slow pace, as enlisted men were regularly granted leave to return home to marry. By 1919, the marriage rate exceeded its 1913 value. More than 2 million marriages took place in the 4 years following the end of the war (Armengaud, 1965). While the marriage rate increased everywhere after the war, there was heterogeneity by region, with higher marriage rates on the Atlantic coast and in the industrial regions of Paris and Northern France (Huber, 1931).

Figure 2 shows the total number of first marriages for women by cohort for the period 1900 to 1950 and highlights how the war disturbed women's marriage patterns. For women born in 1891 to 1895, the distribution of marriages is literally cut in half with a first part of the distribution before the conflict and the second part concentrated in a few years after the war. To some extent, the cohort of women born in 1886-1890 experienced a similar effect. For women born in 1896-1900, the distribution of marriages is characterized by a large and narrow peak after the war.

In addition to the above changes in the marriage outcomes, the war had a huge impact on the marriage market through the gender composition of the population. While in 1911 the sex ratio was 997 men for every 1,000 women, by 1921 it had fallen to 909 for every 1,000. If we restrict to the population of marriageable age (18 to 59 years old for men and 15 to 49 years old for women[10]), the sex ratio decreased from 1,087 men per 1,000 women in 1911 to 992 men per 1,000 women in 1921, reaching 864 in some regions with high mortality rates.[11] If we focus on singles, widows and divorcés who were 30 or younger but of marriageable age, there were approximately 2 men for every 3 women.

2.3. WWI and the French labor market

[10] These are the age groups defined by the French census as marriageable age. 15 and 18 years old were the minimum legal ages for marriage for women and men respectively.
[11] Authors' calculation from French census data.

We next discuss the French labor market around the war, and provide historical evidence that the changes in the female labor market that occurred during the war were reversed upon the end of the war with the return of the men to their civilian jobs. Female labor force participation increased during the war, but returned to its pre-war level after the war ended. Specifically, Table 1 shows that female labor force participation in 1911 was at 39.0% and returned to 42.6% by 1921; by 1926 it had fallen further to 37.2%.[12]

In the spring of 1915, the military industries started to hire women to replace the men who were drafted. However, most of the women hired were not new workers; between 80 and 95% of the women who worked in the metalworking industry during the war worked before the war in textiles, clothing or services. Despite their new jobs, women typically did not receive new training by their employers. Instead, firms invested in the mechanization of the workplace and women were typically assigned repetitive tasks that required only limited skills (Downs, 1995). When men returned at the end of the war, women were massively laid off (Downs, 1995). In addition, when the firms and factories later started to re-open their doors in 1919, women's positions were limited, their wages lagged behind men's and the occupations that were exclusively reserved to males before the war became again unavailable to women (Downs, 1995, Schweitzer, 2002). Women who were not working before the war returned to their homes once the war was over (Becker, 1999); most of those who used to work before the war returned to their old jobs (Downs, 1995). Table 1 presents the distribution of women across various sectors before and after the war. While some of the pre-war averages differ from the post-war averages, the differences are small in magnitude, which provides further evidence that there were no substantial changes in female occupations due to the war.

Meanwhile, drafted men were absent from their jobs until the demobilization, which began in November 1918. Unlike in England, the demobilization was not organized around the professional activity of the drafted. Rather, it was organized by age, with older men being discharged earlier. By October 1919, 4.5 million men had been discharged (Huber, 1931). To ease their return to economic activity, the government passed a law in November 1918 stating that all administrations and public and private firms had to re-hire, wherever possible, the men they had employed before the war. After a short period of high male unemployment at the end of the war, normal economic activity picked up in 1919 and the unemployment rate fell to 1.4% by 1921. Table 1 shows that, as in the case of women,

[12] Female unemployment increased in 1914 due to the closure of firms and factories at the onset of the war, but decreased in the spring of 1915 because of the demand of the war industry. At the same time, female labor force participation increased. Though there was no census during the war, female labor force participation is estimated to have reached a peak of 46% (Down, 1995).

the distribution of male workers by sector did not change substantially between 1906 and 1921. In 1921, the male labor force participation was 71.2%, only a bit higher than its 1906 level of 68.2%.

3. Data

We use data from several sources, including a non-public marriage-level data set, pre and post-war French censuses of population, and geographical data on the number of French war casualties. Because most of these data are unique and have not been used before, this section presents and discusses them in some detail. Appendix Table A1 presents the summary statistics of the dependent variables used in the analyses.

3.1. The TRA data set

Our marriage-level data are from the TRA data set, which is the result of a survey, "l'enquête des 3,000 familles", that collected data on the descendants of 3,000 couples who got married between 1803 and 1832 in mainland France. This project, undertaken by the Ecole des Hautes Etudes en Sciences Sociales, aims at analyzing social and geographical mobility in France in the 19th and 20th centuries. Dupaquier (2004) presents in detail the sampling design and logistics of the data collection. We briefly summarize these below.

The 3,000 families selected between 1803 and 1832 were representative of the French population at the time (one family per 10,000 inhabitants) living in mainland France. Data on birth, marriage and death certificates were collected. Geographical quotas were used to ensure geographical representativeness: the number of couples sampled per département was proportional to its population from the 1806 census.[13] Then, in each département, a random sample of couples was drawn among those whose names started with the letters "TRA," such as Trarieux, Trabit, etc… The letters TRA were chosen to allow names from various local dialects to be represented in the sample, as well as to ensure representativeness of all the social classes (Pélissier et al., 2005). Specifically, names starting with the letters TRA are believed to cut across all social classes in France. Obviously there are other ways to randomize to ensure representativeness, but selecting TRA names is a particularly practical way to do so since documents in archives are typically organized by name. The descendants of the TRA families and their spouses were followed until 1986. To avoid exponential growth of the sample size over time, the descendants of women (who lost their TRA name upon marriage) are not included in the sample. Dupaquier (2004) points out two potential biases in the TRA data set. The aristocracy

[13] Départements are administrative units similar to counties. In the period 1870-1914, France had 87 départements. After WWI, the number increased to 90 because territories from Alsace-Lorraine lost in the 1870s were recovered.

might be under-represented, and foreign males who came to France after 1832 are not included in the sample.[14]

We obtain access to data from marriage certificates in two periods around WWI: 1909-1914 and 1918-1928. These data contain information on the year and département of marriage, ages and occupations of both spouses, occupations of their parents, and whether their parents were still alive.[15] In addition, we know whether the marriage took place in a rural area. We have observations on 1,688 marriages before the war and 4,509 after it.

3.2. The French censuses and Vital Statistics

The French census data for the years 1906, 1911 and 1921 are available from Inter-university Consortium for Political and Social Research (2007). The 1926 census data are available from archives at the library of the National Institute for Statistics and Economic Studies (INSEE). We use the 1911 and 1921 censuses to construct département-level variables on marital status such as percentage of men/women single, divorced and widowed. We use the Vital Statistics for France to obtain the departement-level percentage of out-of-wedlock births for 1911 and 1921.

We also link the year and département of each marriage in the TRA data set to département-level information available from the censuses. In particular, we construct for 1911, 1921, and 1926 the sex ratio in each département, which we define as the ratio of the number of males aged 18 to 59 to the number of females aged 15 to 49, the age groups defined by the French census as marriageable age. The average sex ratio was 1.12 in 1911 and 1.02 in 1921, when it ranged from 0.86 to 1.23.

3.3. The military mortality data

Huber (1931) provides the proportion of soldiers reported dead and missing by the military region in which they were enlisted. During WWI, continental France was separated into 22 military regions (Boulanger, 2001). We link marriages to regional mortality data based on the départements in which the marriages occurred. For départements that fall entirely within a military region (78 départements), we allocate the mortality rate of their military region. For each département that falls into more than one military region (9 départements), we allocate a weighted average of the mortality

[14] Nobles may sometimes be classified under the letter D (because they are called “de Tra” rather than “Tra”). Some nobles might thus have escaped the original design. In addition, while the proportion of farmers is correct when considering the period over which the overall TRA data set was collected (i.e. 1803-1986), farmers seem to be over-represented in the resulting sample for the period 1970-1986. This may raise some selectivity issues. To deal with this, the descendants of 3,000 additional “TRA” couples who married between 1803 and 1832 have been followed. The sample we use is based on the data set constructed with all of the 6,000 TRA families (source: email conversation with Jean-Pierre Pélissier).

[15] Occupations are missing for about 5% of the grooms and 12% of the brides, and for over 40% of their parents.

rates of the military regions into which it falls. We use as weights the proportions of the 1911 population of the département in each of its constituent military regions. Military mortality therefore varies at the département level.

Figure 1 shows the geographical variation in military mortality rate. This mortality rate ranges from 10.5% in Seine-et-Oise to 20.2%% in Seine-et-Marne. The mean mortality rate computed over the 87 départements is 16.8%; the median is 17.5%. Départements marked in darker red have higher mortality rates. Départements marked in full white correspond to a mortality rate of 11.9% or lower and départements marked in the darkest red correspond to a mortality rate of 19.6% or higher.

Several factors contribute to the regional heterogeneity in military mortality rate. In addition to the natural randomness associated with war casualties, during the first two years of the war men residing in the same military region were typically sent to the same war zone. This was because soldiers either served in their military regions of residence, or were sent together to the battlefront to complement the troops of the northeastern regions where most of the fighting was taking place (Boulanger, 2001; Maurin, 1992).[16] The heterogeneity in military mortality during these years may thus be explained by the fact that men from different départements participated in battles of different violence levels. Military mortality in 1914 and 1915 constitutes about 49 percent of the total military deaths during WWI: 23 percent of the overall war casualties occurred in 1914, and 26 percent in 1915 (Becker, 1999). From 1916, men from different military regions were more mixed together at the battlefront, but the mixing was imperfect and some regional differences in mortality persisted.

4. The impact of male scarcity on marital status and out-of-wedlock births

A direct consequence of the unbalanced sex ratio following the war was that many women remained single in the post-war period. Figure 3 emphasizes the large increase in female celibacy rates as measured by the percentage of singles at age 50 by birth cohort. It also shows a large decrease in male celibacy rates for men in cohorts affected by the war, suggesting that some men who would otherwise have remained single got married.

We now use regional heterogeneity in mortality to analyze in more detail the impact of military mortality on marital status three years after the war. We use departement-level data from the 1911 and 1921 censuses and apply a difference-in-differences approach. Specifically, we estimate:

$$Y_{dt} = \delta_d + \lambda PW_t + \alpha M_d \times PW_t + \varepsilon_{dt}, \qquad (1)$$

[16] For example, soldiers from Bretagne were sent to the Parisian region, while soldiers from the Parisian region went further east.

where Y_{dt} is the percentage of men (or women) of a particular marital status (single, divorced or widowed) in département *d* at time *t*, δ_d is a département dummy that captures time-invariant département-level factors such as local traditions related to marriage, PW_t is a post-war dummy that equals one if the observation Y_{dt} comes from the 1921 census and zero otherwise, and M_d is the military mortality rate in département *d*. The coefficient on $M_d \times PW_t$ is therefore the coefficient of interest. Table 2 presents the estimates of the coefficients on $M_d \times PW_t$ by gender and age group.

The results indicate that more women remained single post war in départements with higher mortality rates, and that this effect was larger for women less than 29 years old. In départements where the military mortality was 20% instead of 10%, the proportion of single women aged 20 to 29 was 2.7 percentage points higher post war (relative to a pre-war average of 39.4%). Among men, we find that fewer of those aged 20-29 remained single in départements with higher mortality post war.[17] These findings suggest that when men are in relative shortage, they are more likely to marry.

At the same time, mortality seems to have had a negative impact on divorce rates. Specifically, Table 2 shows that the proportion of divorcés among both men aged 20-39 and women aged 20-39 declined post war in départements with higher mortality. For instance, in the 30-39 age group, the proportion of divorcés of either gender declined post war by 0.13 percentage points in a département with 20% mortality relative to in one with 10% mortality (relative to a pre-war average of 0.5% for men and 0.7% for women). This finding seems to stand in contrast to South and Trent (1988), who found the sex ratio to be negatively correlated with the divorce rate for a large sample of developed and developing nations, and to Guttentag and Secord (1983), who argue that in societies with a low sex ratio men are less committed to existing marital relationships and more apt to divorce when they do marry. Our results may be partly due to the fact that some of the marriages that would have ended in divorce were more likely to be dissolved by the death of the husband in places with higher mortality. Another explanation may be that, despite their better position, men may have been less likely to ask for a divorce after the hardship of the war, especially in places where mortality was high.

Finally, as expected, we find a large negative impact of military mortality on the proportion of widowed women. The effect is the largest for women aged 30-39: in départements where the military mortality was 20% instead of 10%, the proportion of widowed women aged 20 to 29 was 2.5 percentage points higher post war (relative to a pre-war average of 1.0%).

[17] Curiously, there was an increase in the proportion of single males aged 40-49 in regions with high mortality post war.

Another adjustment in the marriage market that has been proposed in the literature as a response to an imbalance in the sex ratio is the emergence of polygamy and relationships leading to out-of-wedlock births (Becker 1974, 1981, Bergstrom 1994, Willis 1999, Neal 2004). We next investigate the impact of male scarcity on out-of-wedlock births in France after the first WWI. We estimate a specification similar to equation (1) where the dependent variable is the département-level percentage of births that were out-of-wedlock from the Vital Statistics for the years 1911 and 1921. The coefficient on mortality interacted with post-war is 0.148 and statistically significant at the 1% level (regression not presented). This implies that the proportion of births that were out-of-wedlock was 1.5 percentage points higher (relative to a pre-war average of 6.7%) post war in a département with mortality of 20% than in one with mortality of 10%. Out-of-wedlock births may be an indicator of polygamy or a sign that men were able to have children without having to invest in them.

5. The impact of male scarcity on assortative matching by social class

A robust prediction of marriage models is that the position of men in the marriage market improves with a reduction in the ratio of men to women in the population. For example, in Becker's (1973, 1974 and 1981) frictionless model of the marriage market, an increase in men's scarcity leads the average man to appropriate more of the surplus generated by his marriage. More recently, Chiappori, Fortin and Lacroix (2001) presented a model of household bargaining and the distribution of resources inside the family. In their model, a reduction in the sex ratio increases men's bargaining power both within the household and in the marriage market.[18] Burdett and Coles (1997) and Bloch and Ryder (2000) consider a marriage market with search frictions and heterogeneous agents. In their set-up, there is assortative matching by class endogenously defined in the marriage market. A reduction in the male population implies that men of a given class marry women of higher classes than they did before the decrease in the male population.

In this section, we use our marriage-level data to evaluate whether men were able to marry better in places with more male scarcity following WWI. We first describe how we allocate individuals into social classes. Then we test whether there was assortative matching by social class before the war. Finally, we use difference-in-differences and instrumental variables approaches to evaluate the impact of male scarcity on assortative matching by social class.

[18] Hoppe, Moldovanu and Sela (2009) is another recent theoretical paper that discusses the effect of the sex ratio on assortative matching. Iyigun and Walsh (2007) provide a model in which an asymmetry in the sex ratio in the marriage market produces gender differences in premarital investments and consumption.

5.1. Assigning social classes based on the Historical International Social Class Scheme

We use the marriage certificate data on the specific occupations of the bride and groom (or their parents) to allocate each to a social class. To do this, we first match each of over a thousand occupations present in our data set to a 5-digit code from the Historical International Standard Classification of Occupations (HISCO) using a mapping available on the History of Work Information System website (http://historyofwork.iisg.nl/).

HISCO is a detailed coding system, containing about 1,600 distinct occupations, designed to facilitate the comparison of historical international data. It is based on the 1968 International Standard Classification of Occupations (ISCO68), and customized for historical data (van Leeuwen et al., 2002). HISCO allocates each occupation to one of 7 sectors: (1) Professional, (2) Technical and Related Workers Administrative and Managerial Workers, (3) Clerical and Related Workers, (4) Sales Workers, (5) Service Workers, (6) Agricultural, Animal Husbandry and Forest Workers, Fishermen and Hunters and (7) Production and Related Workers, Transport Equipment Operators and Laborers. Each of these sectors is itself divided into smaller sub-sectors. For example, codes of the type 6-xx.xx correspond to the agricultural sector. Codes of the type 6-2x.xx refer to agricultural workers. This last group includes codes of the type 6-22.xx for field crop and vegetable farm workers and these, in turn, contain more specific occupational categories such as wheat farm workers (coded as 6-22.30) (van Leeuwen and Maas, 2005a).

To map occupational codes into social classes, we use the Historical International Social Class Scheme (HISCLASS) developed by van Leeuwen and Maas (2005a). The HISCLASS system is ideal for our purposes because it allocates each of the 1,600 HISCO occupations into one of 12 social classes, where a "social class" is defined by van Leeuwen and Maas (2005a) as "*a set of persons with the same life chances*." The mapping of occupations into social classes takes into account various dimensions of social status including whether the occupation is manual, the skill level required to perform it, and the degree to which the occupation involves supervision of others. This mapping is the result of a combination of the views of expert historians and the classifications given in the 1965 Dictionary of Occupational Titles (DOT). Expert historians were independently asked to classify HISCO occupations into social classes; DOT classifications are based on observations in plants and businesses that assign grades along these dimensions to over 10,000 occupation categories in US. In cases where the DOT and the experts disagreed, the experts' opinions were taken. To increase the sample size in each class, in this paper we use the version of HISCLASS condensed into the following **7 social classes** (class 1 being the highest, and class 7 being the lowest):

Class 1: Higher managers and professionals

Class 2: Lower managers and professionals, clerical and sales personnel

Class 3: Foremen and skilled workers

Class 4: Farmers and fishermen

Class 5: Lower-skilled workers

Class 6: Unskilled workers

Class 7: Lower-skilled and unskilled farm workers

This 7-class classification has been used in other works, and in particular in works using the TRA data set, to study social mobility and endogamy (Pélissier et al., 2005, Holt, 2005, Bull, 2005, Schumacher and Lorenzetti, 2005, Arrizabalaga, 2005, Lanzinger, 2005, Dribe and Lundh, 2005, Van de Putte et al., 2005, Bras and Kok, 2005, van Leeuwen and Maas, 2005b, 2005c). Appendix Table A3 provides examples of occupations for each of the classes for men and women.

We allocate individuals into classes based on their *own* occupations. One concern is that 34% of the brides in our data set do not have occupations, and therefore are excluded from our analysis based on own occupation. Another potential concern with using occupations as a measure of social class to compare assortative matching by class before and after the war is that the war may have induced individuals to change their occupations such that they would be allocated to different classes after the war. However, as discussed in Section 2.3, female labor force participation and occupations changed very little after the war compared with pre-war. Among men, mortality seemed similar across occupations. Finally, a third potential issue is that male scarcity may have changed the average age at which women married (see Section 6), which in turn may affect occupation at marriage. However, brides post war married on average less than a month older than their pre-war counterparts and only 10 months older post war in départements with 10 percentage point higher mortality, which is unlikely to significantly affect their social classes as measured by occupations. In any case, we control for the ages of brides and grooms in our regressions, which allows us to capture the effect of the sex ratio on social class that goes beyond its effect on age.

We additionally use two other approaches to allocate brides and grooms into classes. The first is to allocate brides and grooms to classes using the occupations of their fathers. This approach avoids the drawbacks of using own occupation, but fathers' occupations are missing from our data for 43.4% of brides' fathers and 47.7% of grooms' fathers, and may not be missing at random (e.g., fathers from lower social class may die younger). Moreover, class based on own occupation and class based on father's occupation measure different aspects of class if individuals value their spouse's class and their spouse's father's class differently. Finally, because of intergenerational mobility, the classes, or "life chances", of fathers are an imperfect measure of those of their children. Indeed, the pre-war correlation

between class based on father's occupation and class based on own occupation is only 0.44 for grooms and 0.30 for brides.

Our second alternative approach "predicts" brides' classes using the pre-war relationship between the occupation-based classes of the brides and background characteristics that may affect their life chances, such as the classes of their parents and whether they live in a rural area. We predict the classes of the grooms similarly (see Appendix Table A4 for the imputation regressions).[19] This method is not affected by changes in average age at marriage or changes in occupations driven by war mortality, and allows us to use marriages where the bride has no occupation or where the father's occupation is missing.[20] This imputation procedure, however, has two main drawbacks: it may introduce measurement error in our dependent variables, and it relies on the assumption that the relationship between our predictors and the class of the bride is the same for brides with and without occupations.

In Appendix Table A1, we present the distribution of brides and grooms when classified into the 7 classes based on their own occupations and on those of their fathers.

5.2. Pre-war assortative matching by social class

Before analyzing the impact of military mortality on assortative matching by social class, we study how strong matching by class was before the war. Specifically, we use pre-war data to test whether people marry those of similar class as opposed to randomly. We do so by examining the distribution of social distance, defined as the class of the bride minus the class of the groom, among pre-war marriages. When people marry within class, the social distance is zero.

To implement this test, we compare the realized distribution of social distance with the distribution we would expect under the null hypothesis that pre-war grooms married randomly. Using a bootstrapping method, we construct 95% bootstrap confidence intervals for the distribution of social distance under the null hypothesis of random matching. Specifically, denote the number of pre-war marriages in our sample by N. From the distribution of groom classes, we draw N grooms randomly with replacement; from the distribution of bride classes we draw N brides randomly with replacement.

[19] In practice, we apply the following procedure. First, we regress bride class on: father's class dummies including dummies for fathers' class is missing for various reasons; mother's class dummies including dummies for mother's class is missing for various reasons; rural; interaction of rural with the father's class and mother's class dummies; city size dummies. Denote the predicted values $\hat{bride}$. We do the same to predict groom's class. Denote the predicted values $\hat{groom}$. Second, we define our dependent variables (see Section 5.3) using $\hat{bride}$ and $\hat{groom}$ for all brides and all grooms (including those with and without occupations).

[20] If parents' classes are not missing at random, a missing parent's class may contain some information on the life chances of the child. We therefore include a dummy for a parent's class being missing and avoid the necessity to drop such observations.

We match the list of grooms with the list of brides, and derive the distribution of social distances for this simulated set of marriages. We repeat this process 1000 times and construct the 95 percent confidence interval. The *observed* points in Figure 4 show the actual distribution of pre-war social distance for the marriages in our sample. Panel A presents social distance based on own class; Panel B presents social distance based on father's class. In both cases, the observed distribution lies on the border of or outside the confidence interval for most social distances. In the case of own class, for instance, for brides and grooms of the same class, the observed proportion is nearly twice as large as the upper boundary of the confidence interval. For the other social distances between -4 and +4, the observed proportions lie close to or below the lower bounds of the confidence intervals. For the extreme social distances, the observed proportions are approximately zero.

Overall, the figure clearly rejects the null hypothesis of random matching for classes based on own or father's occupation. Grooms in the pre-war period were much more likely to marry brides of their own social class than chance would dictate, and were much less likely to marry brides who were socially distant from them. Note that 44% (45%) of men married women of the same social class defined using own (father's) occupation, and 69% (70%) of men married a spouse whose social class was within one class away.[21]

5.3. Male scarcity and assortative matching by social class

In this section, we test the hypothesis that men married better post war, i.e., married on average women of higher social classes compared with pre-war, in départements with higher mortality. We estimate difference-in-differences regressions where military mortality is the "treatment." Specifically, we estimate:

$$Y_{idt} = \delta_d + \lambda PW_t + \alpha M_d \times PW_t + \gamma Z_{idt} + \varepsilon_{idt}, \qquad (2)$$

where i is a marriage, d is a département, and t is the year of the wedding. We use three alternative dependent variables Y: (1) the difference between the class of the bride and the class of the groom (a lower value means the man married up more); (2) a dummy for whether the groom married a bride of

[21] There are at least two reasons why perfect assortative matching by social class may not occur even in environments where social class is important for marriage decision. The first is that the distribution of classes may be different across genders. For example, if there are many more men than women in class 1, then all the excess males in class 1 either remain single or they will marry women from other classes. Second, even if the distribution of classes is similar across gender, there are other characteristics, such as physical attractiveness or personality, that affect the marriage decision and that are not captured by social class.

lower class than his (married down); and (3) a dummy for whether a groom married a low-class bride (defined as being a bride of class 5, 6 or 7).[22] [23]

As before, δ_d is a département dummy that captures time-invariant département-level factors such as local traditions related to marriage and class distribution, PW_t is a post-war dummy variable that equals one if the wedding took place after the war and zero otherwise, M_d is the mortality rate due to the war in military département *d*, and Z_{idt} are individual-level controls such as groom class dummies, age and whether the marriage took place in a rural area.[24] We cluster standard errors at the département level.

Table 3 shows the estimation results of equation (2) when we use own occupation to allocate individuals into classes. The regressions suggest that, compared with pre-war, men were more likely to marry better after the war in regions with higher mortality rates; the coefficients on mortality interacted with the post-war dummy are negative and statistically significant at conventional levels in all the specifications. For example, in the regressions predicting whether the groom married down (column 2), the coefficient on military mortality interacted with the post-war dummy is -0.010. This magnitude can be interpreted as follows. Consider two regions that were identical pre war, but one of which had 20% mortality, and the other of which had only 10% mortality. Then post war the probability that a given groom married down would be 10 percentage points lower in the high mortality region than in the low mortality region (relative to a pre-war average of marrying down equal to 36.1%). Similarly, the coefficient in the regression predicting whether the groom married a low bride class (column 3) is -0.017, suggesting that in départements where the military mortality was 20%, the probability that a given groom married a low class bride post war decreased by 17 percentage points compared with départements with 10% military mortality rates.[25]

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[22] Note that our regressions include only men who actually married, so we face a sample selection issue. Although this means we are unable to test the model's prediction that low class women will be more likely to remain single when men are scarcer, it does not affect our testing of the prediction that men will marry up more when men are scarcer.

[23] Appendix Table A2 presents the pre and post-war marriage matrices of brides and grooms from each social class.

[24] The groom's age is used as stated on the marriage certificate if it falls within the range 10-89. Otherwise it is constructed as the difference between the year of marriage and date of birth if this falls in the same range. If neither age nor date of birth yields a sensible age, groom's age is taken as missing. Bride's age is constructed similarly. The dummy for rural is defined at the marriage level according to the administrative status of the place of marriage, which may take the values *chef lieu de département*, *chef lieu d'arrondissement*, *chef-lieu de canton* and *rural*. We consider the category *rural* to indicate a rural marriage, and the other three categories to indicate urban marriages.

[25] The estimations do not take into account the proportion of injured by military regions, since no such data are available. A potential concern is that men who were severely injured might have had poorer marriage opportunities, which may affect our results. After the war, 920,000 of the survivors were eligible to receive a pension from the state because of their disability (Corvisier, 1992). As a simple exercise, consider the limit case in which all those receiving a pension were unable to get married. Military mortality totaled 1,227,796 men, so the sum of mortality plus injured is 2,147,796. Treating all

Panel A of Figure 4 shows that in the pre-war period the most common marriages were those within the same class or those where the bride was one class lower than the groom. To better understand the changes in patterns of assortative matching, we also investigated an alternative dependent variable that tested whether men were more likely to marry strictly above their own class in places with higher mortality (marry "strictly up"). We found the coefficient to be very small and imprecisely estimated. This suggests that men's higher likelihood of marrying better post war in départements with high mortality occurred mainly through men being less likely to marry strictly down (and less likely to marry a low class bride) rather than through men being more likely to marry strictly up.[26]

We expect the impact of male scarcity on men's ability to marry better (in terms of social class) after the war to be higher on average for middle and low-class men than for men from the highest social classes. This is because men from higher social classes were already marrying on average women of high classes, leaving less room for improvement. Performing the same regressions as (1) but excluding men of classes 1 and 2, we find (columns 4-6 of Table 3) that indeed the coefficients are larger in magnitude than those based on the full sample.

In columns 1-3 of Table 4, we present the main results when we define class based on father's occupation. The coefficients of mortality interacted with the post-war dummy are small and insignificant. This could be a result of the small sample size due to occupation being missing for many fathers. However, it could also be that individuals may value their spouse's class and their spouse father's class differently. In this sense, it may be that father's-occupation-based class is a much less important margin of adjustment in the marriage market than own-occupation-based class following a decrease in the male population. Columns 4-6 of Table 4 shows the results with imputed classes, where we use pre-war data to impute brides' and grooms' classes based on their parents' occupations, whether parents' occupations are missing, and other background information.[27] The coefficients of interest are negative and are precisely estimated (though smaller in magnitude than those of Table 3) when the dependent variables are class difference and marrying down, which suggests again that men married better after the war in départements with higher mortality rates.

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these men as military deaths implies we should scale our coefficients by (1,227,796 / 2,147,796), which is equal to 0.57. Hence, under this extreme assumption, the coefficients would decrease in magnitude by 43%.

[26] We also ran the regressions separately for rural and urban samples; the results were not significantly different in rural and urban areas.

[27] Note here a groom is considered to marry down if the bride's class is lower than 0.5 worse than the groom's class, and brides are defined as "low class" if their imputed class is 4.2 or worse. This cutoff yields approximately the same proportion of low class brides as the cutoff of 5 when classes are defined using own occupation.

We now test the effect of the sex ratio on assortative matching by class directly by instrumenting the potentially endogenous département-level sex ratio with département military mortality rates. As pointed out in the literature (e.g., Angrist, 2002, Kerwin and Luoh, 2005), the analysis of the impact of the sex ratio on the marriage market may suffer from omitted variable bias and possibly reverse causality. For example, a low sex ratio may indicate strong male out-migration. If migrants are selected positively or negatively according to unobservable variables that are relevant for marriage outcomes (e.g., groom's ability or health), the random error term in a simple OLS regression of marriage outcomes on the sex ratio may be correlated with the sex ratio.[28]

In our context, we use military mortality as an instrument for the sex ratio because it exhibits exogenous geographical variation that affects the sex ratio, under the assumption that mortality does not have a direct effect on marriage by social class.[29]

In the first stage, we regress the sex ratio on military mortality interacted with post war and on the same controls used in the second stage. The second stage of our IV specification is:

$$Y_{idt} = \delta_d + \lambda PW_t + \alpha SR_{td} + \gamma Z_{idt} + \varepsilon_{idt}, \qquad (3)$$

where *i* is a marriage, *d* is a département, and *t* is the year of the wedding. The dependent variable *Y* is defined as before. The independent variable of interest is the département-level sex ratio SR_{td}, which is instrumented with military mortality interacted with post war.[30] We cluster the standard errors at the département level.

[28] Take for example the case of health as an omitted variable that is correlated with the sex ratio because of migration. We expect good health to improve the groom's position in the marriage market. The direction of the omitted variable bias thus depends on the sign of the covariance between the sex ratio and good health. In the regressions using the difference between the class of the bride and the class of the groom, we therefore expect a downward bias in the coefficient associated with the sex ratio if migrants are more likely to be in good health than non-migrants, and an upward bias if migrants are more likely to be in poor health.

[29] While we cannot test this exclusion restriction, Appendix Table A5 suggests that mortality is not correlated with pre-war marriage by social class for own or father's class. As an additional test, we use pre-war data to estimate difference-in-differences "placebo" regressions, in which we falsely assume that the war took place between 1911 and 1912. We expect this placebo treatment to have no effect on marriage patterns. The coefficients associated with mortality rate interacted with the post-1911 dummy are statistically indistinguishable from zero in the specifications using own or father's class (one exception is for low class bride when we use own class where the coefficient is statistically significant at 10%). This suggests that the results presented in Table 3 are not driven by changes in marriage patterns that occurred before the war. However, note that Table A5 suggests that mortality itself is significant in the results where classes are assigned based on imputations; we thus do not present IV results for those.

[30] The sex ratio is not measured at the time of the wedding, but rather at the census year closest to the wedding. Marriages in the period 1909 to 1914 use the 1911 sex ratio, marriages in the period 1918 to 1923 use the 1921 sex ratio, and marriages in the period 1924 to 1928 use the 1926 sex ratio.

Columns 1 to 3 of Table 6 show the results when we use own occupation to allocate individuals into classes. The results suggest that men were more likely to marry women of better social classes after the war in départements with lower sex ratios.[31] The coefficient associated with the instrumented sex ratio is statistically significant at conventional levels for all the dependent variables. The IV regression predicting class difference (column 1) suggests that a decrease in the sex ratio from 10 men for every 10 women to 9 men for every 10 women would improve the expected class of bride married by a given groom by 0.42 from an average class difference of 0.21. The coefficients of columns 2 and 3 imply that a decrease in the sex ratio from 10 men for every 10 women to 9 men for every 10 women would decrease the probability a given groom married down by 20 percentage points and decrease the probability of marrying a low class bride by 35 percentage points. We run similar regressions when classes are allocated based on father's occupation (columns 3 to 6 of Table 6). As in the difference-in-differences specifications, the coefficients associated with the sex ratio are small and imprecisely estimated when we use father's occupation.

In Appendix Table A6 we present the results of equation (3) estimated by OLS. The coefficient associated with the sex ratio has the right sign but is much smaller in magnitude than in the IV estimation. This could suggest that endogeneity of the sex ratio is important. The difference between the IV and the OLS estimates is consistent with migrants being positively selected (e.g., healthier men being more likely to migrate).

Overall, our results show that the increase in male scarcity in post-WWI France enabled men to improve their position in the marriage market and marry women from higher social classes when compared with pre-war standards. Although our results do not allow us to fully understand the precise mechanisms behind this social ascension of men, they are consistent with the idea that, on average, men prefer women of higher class, i.e. that men have vertical preferences. Thus, one possible explanation for the assortative matching by social class that we observe at the beginning of the 20th century in France is that, although men preferred to marry higher class women, in equilibrium they were unable to do so. Note, however, that men marrying up as a result of male scarcity is also consistent with horizontal preferences for social class, provided that the distribution of classes across gender is sufficiently different and individuals prefer to marry up rather than down when marrying horizontally is not possible.

[31] Our results are robust to using a sex ratio defined as the ratio of the number of males aged 15 to 49 to the number of females aged 15 to 49, and the ratio of the number of males aged 15 to 39 to the number of females aged 15 to 39, though the coefficient of the instrumented sex ratio is less precisely estimated for class difference in the latter case.

6. The impact of male scarcity on spousal age gap and age at marriage

We next analyze the effects of military mortality on assortative matching by age, namely the spousal age gap and age at marriage. To identify the effect of the war above and beyond its effect on class, we control for the classes of the bride and the groom, just as we control for the ages of the bride and groom in our analysis of the effect of the war on social class. We focus on first marriages (84% of our observations) and follow the same difference-in-differences empirical strategy as in Section 5.3. We estimate a regression similar to (2) where the dependent variables are (i) the difference between the age of the bride and the age of the groom, (ii) the age of the groom, and (iii) the age of the bride.

Before the war, the average groom was 3.8 years older than his bride, 33% of the grooms married brides who were 0 to 3 years younger than themselves, and the average age of brides at first marriage was 23.9. Table 7 shows the impact of male scarcity on the age gap and age at marriage. In column 1, the coefficient associated with mortality interacted with post-war is positive and statistically significant, suggesting that the age gap between brides and grooms narrowed in regions with higher mortality post war. To illustrate the magnitude of this effect, consider two regions where grooms were the same amount older than their brides on average pre war. Suppose one region suffered 10% mortality, and the other suffered 20% mortality. Then, *ceteris paribus*, post war the average age gap between brides and their grooms would be 11 months narrower in the high mortality region than in the low mortality region. Columns 2 and 3 show no significant differences in the average age of grooms post war in regions of different mortality rates, but an increase in the average age of brides in regions with higher mortality. For example, brides married 10 months later in départements with 10 percentage point higher mortality rates. Overall, these results show that in départements with higher mortality rates the age gap between the groom and the bride decreased relative to in low-mortality départements because women tended to marry at an older age, while men did not delay their marriages.[32]

The fact that women married at an older age in départements with higher mortality is consistent with several plausible explanations. It may have taken more time for women to find a match due to male scarcity, so they ended up getting married at a later age. Alternatively, it could be that men preferred to marry slightly older women than they married before the war and were able to do so after the war.

[32] We also again ran specifications where we use mortality M_d alone instead of département dummies (results not shown). The coefficients of interest, the ones associated with mortality interacted with post-war, are essentially unchanged in these specification. However, we note that mortality itself is statistically significant (and negative), suggesting a correlation between mortality and pre-war age gap. One possible explanation is that younger men were more likely to be drafted and that therefore mortality was higher in départements with a younger age structure. The main specifications with department dummies absorb such differences across départements.

7. Conclusions

A robust prediction of marriage models is that the position of men (women) in the marriage market improves (worsens) with a reduction in the ratio of men to women in the population. This paper uses an exogenous negative shock to the male population generated by WWI mortality in France to analyze empirically the impact of male scarcity on several outcomes of the marriage market. Overall, we find that the decrease in the proportion of men in the population due to war-related mortality increased the proportion of men who married and allowed them to marry women of higher social class. Men experienced "social ascension", marrying women from classes that would have been inaccessible before the war. We find that post war in regions with higher mortality, women were less likely to marry and they married at an older age, leading to a decrease in the age gap between brides and grooms. We also show that post war in regions more affected by military mortality, there were more out-of-wedlock births and fewer divorces.

This paper illustrates a potential consequence of brutal wars such as WWI: the change in marriage patterns, along with an increase in social mobility and out-of-wedlock births. Despite the fact that these results were obtained in the specific context of post-WWI France, they may shed light on the consequences of current imbalances in the sex ratio (a relative scarcity of women) in South Asia.

Finally, one may wonder whether the war induced a transitional or permanent change in social mobility and social integration. This question is left for future research. On this specific front, an obstacle to overcome is the occurrence of WWII, which may hinder the analysis of the long-term implications of WWI on social mobility. Another natural extension is to examine the effect of military mortality on marrying up in other countries that participated in WWI. Such a study could shed light on differences in social mobility across countries.

References

Angrist, Joshua. 2002. "How Do Sex Ratios Affect Marriage and Labor Markets: Evidence from America's Second Generation." *Quarterly Journal of Economics*, 117: 997-1038.

Ariely, Dan, Guenter Hitsch, and Ali Hortacsu. 2006. "What Makes You Click? Mate Preferences and Matching Outcomes in Online Dating." Working Paper.

Armengaud, André. 1965. *La Population Francaise au 20e Siecle*. Paris: Presses universitaires de France.

Arrizabalaga, Marie-Pierr. 2005. "Pyrenean Marriage Strategies in the Nineteenth Century: The French Basque Case." *International Review of Social History*, Supplement 50.

Banerjee, Abhijit, Esther Duflo, Maitreesh Ghatak and Jeanne Lafortune. 2009. "Marry for what? Caste and Mate Selection in Modern India." Working Paper.

Battagliola, Françoise. *Histoire du travail des femmes*, Paris, La Découverte, Collection Repères, 2004.

Becker, Gary. 1973. "A Theory of Marriage: Part I,." *Journal of Political Economy*, 81: 813–46.

Becker, Gary. 1974. "A Theory of Marriage: Part II." *Journal of Political Economy*, 82: S11–S26.

Becker, Gary. 1981. *A Treatise on the Family*. Cambridge, MA: Harvard University Press.

Becker, Jean-Jacques. 1999 "Les deux guerres mondiales et leurs conséquences" in Jean-Pierre Bardet and Jacques Dupaquier (Eds) *Histoires des Populations de L'Europe, Les temps Uncertains 1914-1998*. Fayard, France.

Belot, Michele and Marco Francesconi. 2006. "Can Anyone be 'The' One? Evidence on Mate Selection from Speed Dating." IZA Discussion Papers 2377, Institute for the Study of Labor (IZA).

Bergstrom, Ted. 1994. "On the Economics of Polygyny." University of California Working Paper.

Bisin, Alberto, Giorgio Topa, and Thierry Verdier. 2004. "Religious Intermarriage and Socialization in the United States." *Journal of Political Economy*, 112: 615–664.

Bloch, Francis, and Harl Ryder. 2000. "Two-Sided Search, Marriages, and Matchmakers." *International Economic Review*, 41: 93-116.

Blossfeld, Hans-Peter, and Andreas Timm. 2003. *Who Marries Whom? Educational Systems as Marriage Markets in Modern Societies*. Amsterdam: Kluwer Academic.

Botticini, Maristella. 1999. "A Loveless Economy? Intergenerational Altruism and the Marriage Market in a Tuscan Town,1415-1436." *Journal of Economic History*, 59: 104-121.

Botticini, Maristella and Aloysius Siow. 2003. "Why Dowries?" *American Economic Review*, 93: 1385-1398.

Boulanger, Philipe. 2001. *LA FRANCE DEVANT LA CONSCRIPTION - Géographie Historique D'une Institution Républicaine 1914 - 1922*. Economica, Paris.

Bozon, Michel and François Héran. 1987. "La découverte du conjoint: I. Evolution et morphologie des scènes de rencontre." *Population*, 42(6): 943-985.

Brainerd, Elizabeth. 2007. "Uncounted Costs of World War II: The Effect of Changing Sex Ratios on Marriage and Fertility of Russian Women."

Bras, Hilde and Jan Kok. 2005 “"They Live in Indifference Together": Marriage Mobility in Zeeland, The Netherlands, 1796-1922.” *International Review of Social History*, Supplement 50.

Bull, Hans Henrik. 2005. “Deciding Whom to Marry in a Rural Two-Class Society: Social Homogamy and Constraints in the Marriage Market in Rendalen, Norway 1750-1900.” *International Review of Social History*, Supplement 50.

Burdett, Ken and Melvyn G. Coles. 1997. “Marriage and Class.” *The Quarterly Journal of Economics*, 112: 141–168.

Chiappori, Pierre-Andre, Bernard Fortin, and Guy Lacroix. 2001. “Marriage Market, Divorce Legislation, and Household Labor Supply.” *Journal of Political Economy*, 110: 37-72.

Charles Kerwin and Ming Luoh. 2005. “Male Incarceration, the Marriage Market and Female Outcomes.” *The Review of Economics and Statistics*, 92(3): 614-627.

Choo, Eugene and Aloysius Siow. 2006. “Who Marries Whom and Why.” *Journal of Political Economy*, Vol. 114, No. 1: 175-201.

Corvisier, André. 1992. “Le peuple français en guerre,” in André Corvisier (Ed) *Histoire militaire de la France de 1871 à 1940*. Presse Universitaire de France, Paris.

Cox, Oliver C. 1940. “Sex Ratio and Marital Status among Negroes.” *American Sociological Review*, 6: 937-947.

Diamond, Peter. 1982. "Wage Determination and Efficiency in Search Equilibrium." *Review of Economic Studies*, 49: 1217-1227.

Downs, Laura Lee. 1995. *Manufacturing Inequality: Gender Division in the French and British Metalworking Industries, 1914-1939*. Cornell University Press, NY.

Dupaquier, Jacques. 1988. *Histoire de la Population Francaise*, 1re éd. Paris: Presses universitaires de France.

Dupaquier, Jacques. 2004. “L’Enquête des 3000 Familles.” *Annales de démographie* historique, 107: 7-18.

Dribe, Martin and Christer Lundh. 2005. “Finding the Right Partner: Rural Homogamy in Nineteenth-Century Sweden.” *International Review of Social History*, Supplement 50.

Easterlin, Richard A. 1961. “The American Baby Boom in Historical Perspective.” *American Economic Review*, 51: 1-60.

Edlund, Lena. 2000. “Marriage Squeeze Interpretation of Dowry Inflation: A Comment.” *Journal of Political Economy*, 108: 1327-1333.

Fernandez, Raquel and Richard Rogerson. 2001. “Sorting and Long-Run Inequality.” *The Quarterly Journal of Economics*, 116: 1305–1341.

Fisman, Raymond, Sheena S. Iyengar, Emir Kamenica, and Itamar Simonson. 2006. “Gender Differences in Mate Selections: Evidence from a Speed Dating Experiment.” *Quarterly Journal of Economics*, 121: 673–679.

Girard, Alain. 1974. *Le choix du conjoint*. Presse Universitaire de France, Paris.

Goldin, Claudia. 1990. *Understanding the Gender Gap: An Economic History of American Women*, University of Chicago Press.

Goldin, Claudia and Lawrence Katz. 2002. "The Power of the Pill: Oral Contraceptives and Women's Career and Marriage Decisions," *Journal of Political Economy*, 110: 730-70.

Goldin Claudia. 2006. "The 'Quiet Revolution' That Transformed Women's Employment, Education, and Family," *American Economic Review* (Ely Lecture), 96: 1-21.

Grossbard-Shechtman, Shoshana. 1993. *On the Economics of Marriage.* Boulder, CO: Westview Press.

Guttentag, Marcia, and Paul F. Secord. 1983. *Too Many Women? The Sex Ratio Question.* Beverly Hills, CA: Sage Publications.

Holt, Katherine. 2005. "Marriage Choices in a Plantation Society: Bahia, Brazil." *International Review of Social History*, Supplement 50.

Hoppe, Heidrun, Benny Moldovanu, and Aner Sela. 2009. "The Theory of Assortative Matching Based on Costly Signals." *Review of Economic Studies*.

Hout, Michael. 1982. "The Association Between Husbands' and Wives' Occupations in Two-Earner Families." *American Journal of Sociology*, 88: 397-409.

Huber, Michel. 1931. *La Population de la France Pendant la Guerre.* Paris: Presses Universitaires de France.

Huston, Ted and George Levinger. 1978. "Interpersonal Attraction and Relationship." *Annual Review of Psychology*, 29:115-56.

Inter-university Consortium for Political and Social Research. DEMOGRAPHIC, SOCIAL, EDUCATIONAL AND ECONOMIC DATA FOR FRANCE, 1833-1925 [Computer file]. ICPSR07529-v2. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producer and distributor], 2007-02-16.

Iyigun, Murat, and Randall Walsh. 2007. "Building the Family Nest: Pre-Marital Investments, Marriage Markets and Spousal Allocations." *Review of Economic Studies*, 74: 507-35.

Kalmijn, M. 1998. "Intermarriage and Homogamy: Causes, Patterns and Trends." *Annual Review of Sociology*, 24: 395-421.

Lafortune, Jeanne. 2008. "Making Yourself Attractive: Pre-Marital Investments and the Returns to Education in the Marriage Market." Working Paper.

Lanzinger, Margareth. 2005. "Homogamy in a Society Oriented to Stability: A Micro Study of a South Tyrolean Market Town, 1700-1900." *International Review of Social History*, Supplement 50.

Lee, Soohyung. 2007. "Determinants and Consequences of Marital Sorting: Evidence From a Korean Matchmaking Service." Stanford Working Paper.

Mare, Robert D. 1991. "Five Decades of Educational Assortative Mating." *American Sociological Review*, 56: 15-32.

Matouschek Niko and Imran Rasul. 2008. "The Economics of the Marriage Contract: Theories and Evidence." *Journal of Law and Economics*, 51: 59-110.

Maurin, Jules. 1992. "Les combattants face à l'épreuve de 1914-1918," in André Corvisier (Ed) *Histoire militaire de la France de 1871 à 1940*. Presse Universitaire de France, Paris.

McPherson, Miller, Lynn Smith-Lovin, and James Cook. 2001. "Birds of a Feather: Homophily in Social Networks." *Annual Review of Sociology*, 27: 415-44.

Mortensen, Dale. 1982. “The Matching Process as a Noncooperative Bargaining Game,” in *The Economics of Information and Uncertainty*, John J. McCall, ed. Chicago: University of Chicago Press.

Neal, Derek. 2004. “The Relationship between Marriage Market Prospects and Never-Married Motherhood.” *The Journal of Human Resources*, Vol. 39, No. 4: 938-957.

Pélissier, Jean-Pierre, Danièle Rébaudo, Marco H.D. van Leeuwen, and Ineke Maas. 2005. “Migration and Endogamy According to Social Class: France, 1803-1986.” *International Review of Social History*, Supplement 50.

Pencavel, John. 1998. “Assortative Mating by Schooling and the Work Behavior of Wives and Husbands.” *American Economic Review*, 88: 326-329.

Pissarides, Christopher. 1990. *Equilibrium Unemployment Theory*. Oxford: Blackwell.

Rao, Vijayendra. 1993. “The Rising Price of Husbands: A Hedonic Analysis of Dowry Increases in Rural India.” *Journal of Political Economy*, 101: 666–77.

Rose, Elaina,. 2001. “Marriage and Assortative Mating: How Have the Patterns Changed?” University of Washington Working Paper.

Rose, Elaina,. 2005. “Education and Hypergamy, and the “Success Gap” University of Washington Working Paper.

Schumacher, Reto and Luigi Lorenzetti. 2005. ““We have no proletariat”: Social Stratification and Occupational Homogamy in Industrial Switzerland. Winterthur 1909/10-1928.” *International Review of Social History*, Supplement 50.

Segalen, Martin. 1981. *Sociologie de la famille*. Armand Colin, Paris.

Schweitzer Sylvie. 2002. *Les Femmes ont toujours travaillé. Histoire du travail des femmes aux XIXe et XXe siècle.* Odile Jacob : Paris.

South, Scott J., and Katherine Trent. 1988. "Sex ratios and women's roles: A cross-national analysis. *American Journal of Sociology* 93: 1096-1115.

Van de Putte, Bart, Michel Oris, Muriel Neven, and Koen Matthijs. 2005. “Migration, Occupational Identity and Societal Openness in Nineteenth-Century Belgium.” *International Review of Social History*, Supplement 50.

van Leeuwen, Marco H.D., Ineke Maas and Andrew Miles. 2002. *HISCO: Historical International Standard Classification of Occupations*. Leuven: Leuven University Press.

van Leeuwen, Marco H.D., and Ineke Maas. 2005a. “A short note on HISCLASS.” Working Paper available at http://historyofwork.iisg.nl/docs/hisclass-brief.doc.

van Leeuwen, Marco H.D., and Ineke Maas. 2005b. “Total and Relative Endogamy by Social Origin: A First International Comparison of Changes in Marriage Choices during the Nineteenth Century.” *International Review of Social History*, Supplement 50.

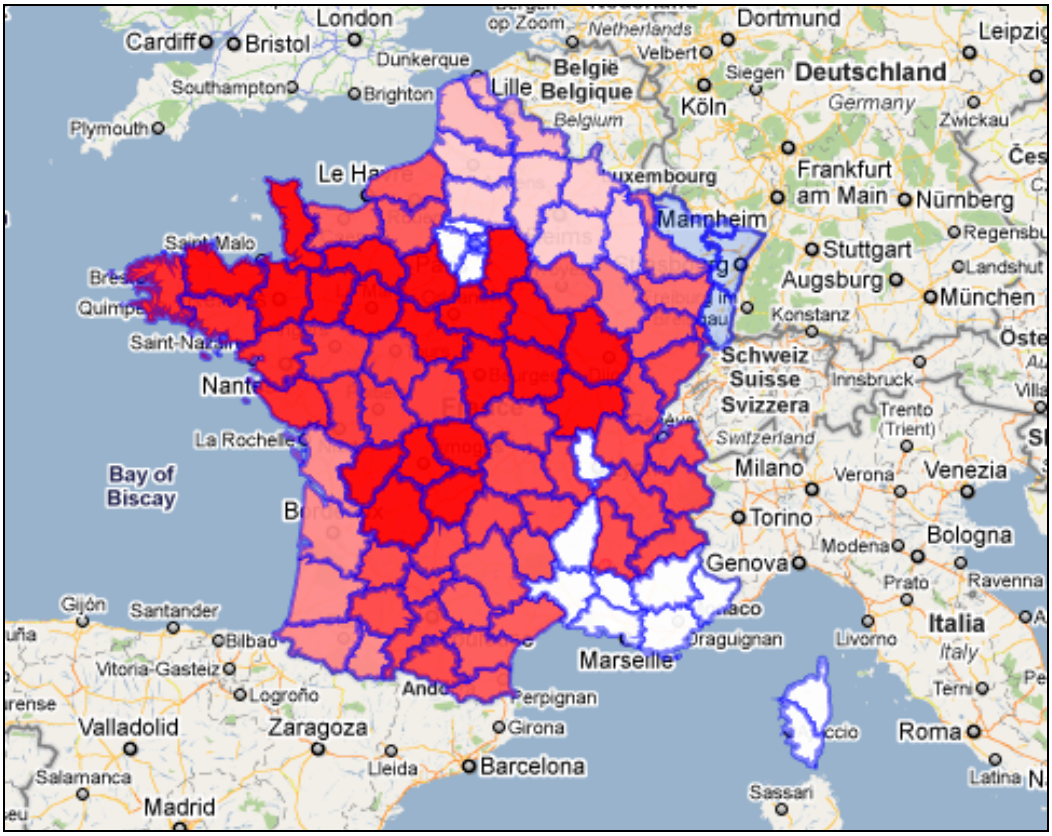
van Leeuwen, Marco H.D., and Ineke Maas. 2005c. “Endogamy and Social Class in History: An Overview.” *International Review of Social History*, Supplement 50.

Weiss, Yoram. 1993. “The Formation and Dissolution of Families: Why Marry? Who Marries Whom? And What Happens Upon Divorce,” in *The Handbook of Population and Family Economics*, Mark R. Rosenzweig and Oded Stark, ed. Amsterdam: North Holland.

Willis, Robert J. 1999. “A Theory of Out-of-Wedlock Childbearing.” *The Journal of Political Economy*, Vol. 107, No. 6, Part 2: S33-S64.

Wong, Linda Y., 2003. “Structural Estimation of Marriage Models.” *Journal of Labor Economics*, 21: 699–727.

Figure 1: The geographic variation in military mortality rates



This map shows the geographic variation in the percentage of soldiers killed. Totally white corresponds to a mortality rate of 11.9%, the 10th percentile; totally red corresponds to a mortality rate of 19.6%, the 90th percentile.

Figure 2: Number of first marriages per 1,000 women by birth cohorts and years

Source: Henry (1966)

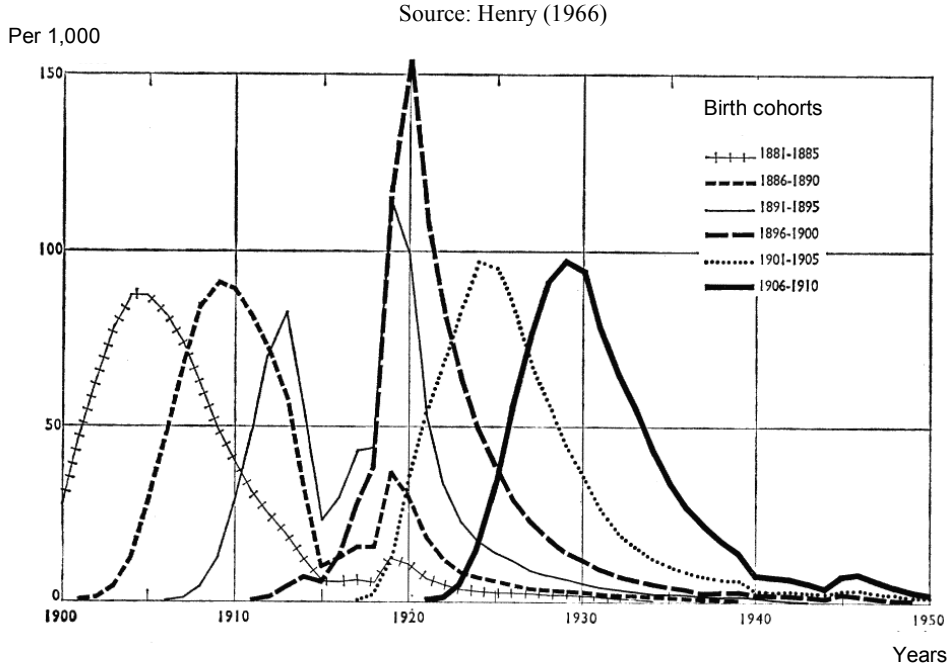


Figure 3: Percentage of singles at age 50 by birth cohort

Source: Roussel (1971)

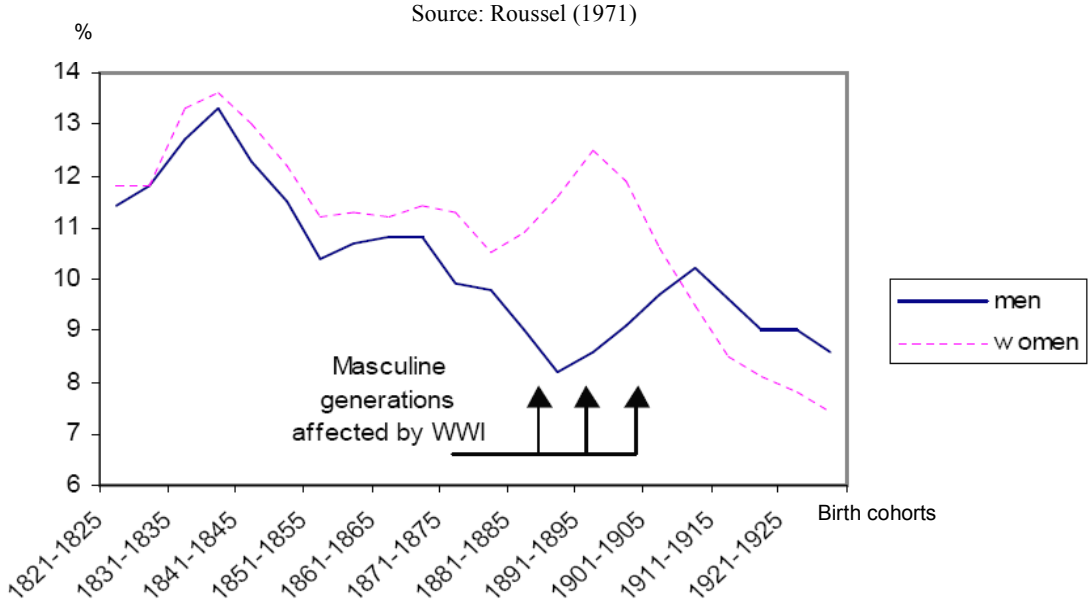
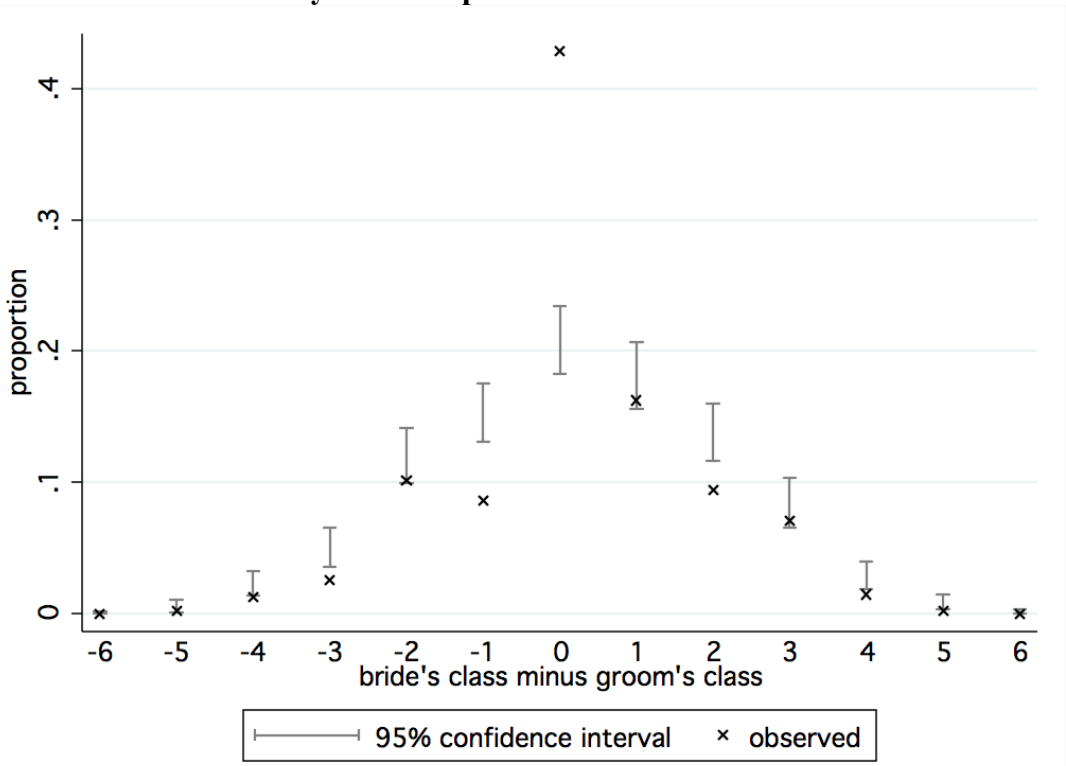


Figure 4: Pre-WWI matching was assortative

Panel A: Class defined by own occupation



Panel B: Class defined by father's occupation

Note: The null hypothesis is that grooms match randomly from the population of brides.

Table 1: Distribution across occupations

Panel A: Distribution of fatalities by occupation at age 20 (in %)

Occupation	% of fatalities
Agriculture	41.5
Industry/Alimentation/Construction/Transportation	35.7
Sales	9.5
Liberal professions	2.4
Civil servant	1.3
Domestic	4.2
Clergy	0.2
Without profession	0.5
Others	4.6
Total	100.0

Panel B: Distribution of the labor force by occupation (in %)

	1906		1921	
Occupation	males	females	males	females
Fishing	0.6	0.1	0.6	0
Agriculture and forestry	43.8	43.2	39.9	45.9
Industry and transportation	37.9	32.7	41.8	28.7
Sales	10.4	10.1	10.4	11.7
Liberal professions	2.4	2.5	2.3	3.4
Public service	3.5	1.3	4.2	2.3
Domestic	1.4	10.1	0.8	8
% of the pop. in the labor force	68.2	39.0	71.2	42.6

The source of both panels is Huber (1931). Panel B applies to 1906 territory for both years.

Table 2: The impact of male scarcity on marital status by age group and gender

Coefficient presented is on the interaction between post war and military mortality							
Dependent variable:		single males	single females	divorced males	divorced females	widowed males	widowed females
age group:	15-19	0.010	0.109*				
		(0.006)	(0.043)				
	20-29	-0.312***	0.270**	-0.004**	-0.006	0.003	0.053*
		(0.108)	(0.095)	(0.002)	(0.004)	(0.003)	(0.030)
	30-39	0.044	0.037	-0.013	-0.013*	-0.001	0.245***
		(0.084)	(0.047)	(0.008)	(0.007)	(0.008)	(0.050)
	40-49	0.119**	0.065**	0.003	-0.007	0.002	0.138***
		(0.047)	(0.033)	(0.007)	(0.006)	(0.013)	(0.032)

Notes: Coefficients are from OLS regressions run separately for each age group and gender. The dependent variable in each regression is the percentage of the gender in the given age group with the stated marital status, in either 1911 or 1921. All regressions include a post war dummy and departement dummies. The number of observations in each regression is 174. Standard errors are presented in parentheses. Asterisks denote significance at: * 10%, ** 5%, *** 1%.

Table 3: Impact of male scarcity on assortative matching by class (OLS)
Classes defined by own occupation

	All classes of groom			Excluding grooms of class 1 and 2		
Dependent variable:	class difference	married down	low class bride	class difference	married down	low class bride
% of Soldiers Killed * Post War	-0.020*	-0.010**	-0.017***	-0.035***	-0.017***	-0.023***
	(0.010)	(0.004)	(0.005)	(0.013)	(0.004)	(0.006)
Post War	0.196	0.092	0.223***	0.491**	0.240***	0.338***
	(0.146)	(0.065)	(0.066)	(0.187)	(0.060)	(0.082)
Rural	0.190**	0.032	-0.034	0.191**	0.032	-0.036
	(0.085)	(0.029)	(0.030)	(0.091)	(0.029)	(0.033)
Bride's Age (/100)	-0.582	0.087	-0.095	-0.923*	-0.164	-0.084
	(0.473)	(0.160)	(0.142)	(0.488)	(0.185)	(0.188)
Groom's Age (/100)	0.355	-0.166	0.134	0.430	0.033	0.048
	(0.377)	(0.138)	(0.127)	(0.364)	(0.130)	(0.151)
Groom Class Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Departement Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.387	0.271	0.232	0.357	0.240	0.261
Observations	3117	2994	3117	2432	2309	2432

Notes: The first three columns are for the full sample of grooms; the second three columns exclude grooms of classes 1 and 2. The dependent variable in the first and fourth columns is the class of the bride minus the class of the groom (thus a greater class difference indicates the groom married a lower class of bride); the dependent variable in the second and fifth columns is a dummy variable for whether the groom married a bride of lower class than himself; the dependent variable in the third and sixth columns is a dummy for the bride being of low class (5, 6 or 7). Classes are defined using own occupation. Standard errors, clustered at the departement level, are presented in parentheses. Asterisks denote significance at: * 10%, ** 5%, *** 1%.

Table 4: Impact of male scarcity on assortative matching by class (OLS)
Alternative definitions of class

	Classes defined by father's occupation			Classes imputed using background characteristics		
Dependent variable:	class difference	married down	low class bride	class difference	married down	low class bride
% of Soldiers Killed * Post War	0.009	-0.002	-0.005	-0.006**	-0.006**	-0.002
	(0.016)	(0.005)	(0.005)	(0.002)	(0.002)	(0.003)
Post War	-0.174	0.006	0.062	0.088***	0.108***	0.033
	(0.239)	(0.073)	(0.080)	(0.030)	(0.035)	(0.036)
Rural	0.153	0.016	-0.098***	0.301***	0.209***	0.397***
	(0.098)	(0.030)	(0.030)	(0.023)	(0.019)	(0.026)
Bride's Age (/100)	-2.458**	-0.110	-0.580**	0.362	0.359**	0.096
	(1.049)	(0.223)	(0.255)	(0.286)	(0.158)	(0.117)
Groom's Age (/100)	-0.331	-0.476*	-0.514**	0.035	0.134	-0.023
	(0.951)	(0.268)	(0.226)	(0.115)	(0.086)	(0.091)
Groom Class Dummies	Yes	Yes	Yes			
Groom Half-Class Dummies				Yes	Yes	Yes
Departement Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.355	0.282	0.218	0.461	0.244	0.433
Observations	1966	1882	1966	5832	5832	5832

Notes: All regressions are for the full sample of grooms. The first three columns define class by father's occupation; the second three columns impute class from background characteristics including parents' classes. The dependent variable in the first and fourth columns is the class of the bride minus the class of the groom (thus a greater class difference indicates the groom married a lower class of bride); the dependent variable in the second and fifth columns is a dummy variable for whether the groom married a bride of lower class than himself; the dependent variable in the third and sixth columns is a dummy for the bride being of low class (5, 6 or 7). Standard errors, clustered at the departement level, are presented in parentheses. Asterisks denote significance at: * 10%, ** 5%, *** 1%.

Table 5: Impact of male scarcity on assortative matching by class (IV)

	Class defined by own occupation			Class defined by father's occupation		
Panel A: Stage 2 regressions						
Dependent variable:	class difference	married down	low class bride	class difference	married down	low class bride
Sex Ratio (men/women)	4.220*	2.022**	3.475***	-2.292	0.632	1.361
	(2.157)	(0.863)	(1.017)	(4.070)	(1.166)	(1.295)
Post War	0.245	0.116*	0.263***	-0.224	0.021	0.092
	(0.160)	(0.065)	(0.071)	(0.331)	(0.094)	(0.103)
Rural	0.197**	0.036	-0.028	0.152	0.016	-0.098***
	(0.085)	(0.030)	(0.031)	(0.093)	(0.029)	(0.030)
Bride's Age (/100)	-0.497	0.126	-0.026	-2.523**	-0.091	-0.542**
	(0.450)	(0.141)	(0.149)	(1.011)	(0.225)	(0.236)
Groom's Age (/100)	0.372	-0.156	0.149	-0.441	-0.447*	-0.449*
	(0.358)	(0.131)	(0.124)	(0.957)	(0.257)	(0.242)
Groom Class Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Departement Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.383	0.263	0.214	0.353	0.283	0.215
Observations	3117	2994	3117	1966	1882	1966
Panel B: Stage 1 regressions						
Dependent variable: Sex Ratio						
% of Soldiers Killed * Post War	-0.005***	-0.005***	-0.005***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Controls as in Stage 2	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.890	0.887	0.890	0.893	0.894	0.893

Notes: Panel A shows the second stage of the IV regressions, where marriage outcomes are regressed on the instrumented sex ratio and controls; Panel B shows the first stage, where the sex ratio is regressed on military mortality interacted with post war, and controls.
The first three columns define class by own occupation; the second three columns define class by father's occupation. The dependent variable in the first and fourth columns is the class of the bride minus the class of the groom (thus a greater class difference indicates the groom married a lower class of bride); the dependent variable in the second and fifth columns is a dummy variable for whether the groom married a bride of lower class than himself; the dependent variable in the third and sixth columns is a dummy for the bride being of low class (5, 6 or 7). The sex ratio is defined as men aged 18-59 divided by women aged 15-49 in the departement and census period. Standard errors, clustered at the departement level, are presented in parentheses. Asterisks denote significance at: * 10%, ** 5%, *** 1%.

Table 6: Impact of male scarcity on assortative matching by age (OLS)

Dependent variable:	age difference	groom's age	bride's age
% of Soldiers Killed * Post War	0.092**	0.019	0.083**
	(0.036)	(0.038)	(0.038)
Post War	-0.626	-0.931*	-1.164*
	(0.536)	(0.519)	(0.615)
Rural	-0.325**	0.331	-0.340*
	(0.125)	(0.215)	(0.184)
Groom Class Dummies	Yes	Yes	No
Bride Class Dummies	Yes	No	Yes
Departement Dummies	Yes	Yes	Yes
R-Squared	0.063	0.062	0.064
Observations	4868	5205	5287

Notes: The dependent variable in the first column is the age of the bride minus the age of the groom; the dependent variables in the second and third columns are the age of the groom and the age of the bride. Classes dummies include categories for no occupation and missing occupation/class. Standard errors, clustered at the departement level, are presented in parentheses. Asterisks denote significance at: * 10%,

Appendix

Table A1: Summary statistics

	Pre war		Post war	
	Mean	Standard deviation	Mean	Standard deviation
Departement-level variables				
Military mortality			16.8	2.6
Sex ratio	1.12	0.09	1.01	0.07
Marital status variables				
% single males aged 15-19	99.8%	0.1%	99.5%	0.2%
% single males aged 20-29	68.4%	7.1%	62.8%	7.4%
% single males aged 30-39	19.7%	5.2%	20.5%	5.0%
% single males aged 40-49	12.0%	3.1%	11.9%	3.1%
% single females aged 15-19	93.3%	2.9%	94.3%	2.3%
% single females aged 20-29	39.4%	8.2%	45.5%	7.7%
% single females aged 30-39	14.6%	3.7%	15.7%	4.2%
% single females aged 40-49	11.3%	3.0%	11.5%	2.9%
% divorced males aged 20-29	0.1%	0.1%	0.1%	0.1%
% divorced males aged 30-39	0.5%	0.3%	0.7%	0.4%
% divorced males aged 40-49	0.7%	0.4%	0.9%	0.5%
% divorced females aged 20-29	0.3%	0.2%	0.4%	0.2%
% divorced females aged 30-39	0.7%	0.4%	0.9%	0.5%
% divorced females aged 40-49	0.7%	0.5%	0.9%	0.5%
% widowed males aged 20-29	0.3%	0.1%	0.3%	0.1%
% widowed males aged 30-39	1.7%	0.3%	1.7%	0.3%
% widowed males aged 40-49	4.1%	0.6%	4.0%	0.5%
% widowed females aged 20-29	1.0%	0.2%	2.7%	0.8%
% widowed females aged 30-39	4.1%	0.7%	9.9%	1.5%
% widowed females aged 40-49	10.8%	1.7%	11.6%	1.6%
% of births out-of-wedlock	6.7%	3.5%	7.4%	2.9%
Marriage-level variables				
Classes defined by own occupation				
Class difference	0.21	1.55	0.24	1.53
Married down	0.36		0.35	
Low class bride	0.44		0.40	
Classes defined by father's occupation				
Class difference	0.07	1.69	0.04	1.59
Married down	0.31		0.29	
Low class bride	0.26		0.27	
Classes imputed from background characteristics				
Class difference	0.36	0.60	0.35	0.57
Married down	0.78		0.79	
Low class bride	0.42		0.41	
Age variables				
Age difference	-3.8	4.9	-3.1	4.5
Bride's age	23.9	5.6	23.9	5.7
Groom's age	27.5	5.3	26.8	6.0

Class distribution	Pre war		Post war	
	Brides	Grooms	Brides	Grooms
Class defined by own occupation				
1	1.1%	5.5%	2.0%	7.2%
2	9.6%	17.9%	17.6%	20.4%
3	30.6%	24.3%	22.3%	24.4%
4	14.9%	23.0%	17.7%	22.5%
5	33.3%	20.1%	30.6%	16.9%
6	6.4%	5.4%	6.9%	5.5%
7	4.1%	4.0%	3.0%	3.3%
Class defined by father's occupation				
1	7.1%	8.7%	7.2%	7.5%
2	13.4%	13.5%	14.3%	13.8%
3	16.6%	14.2%	14.5%	17.0%
4	36.9%	39.5%	37.0%	36.6%
5	13.7%	12.7%	14.7%	13.6%
6	6.2%	6.8%	8.2%	7.3%
7	6.2%	4.6%	4.2%	4.2%

Notes: Post war values of the departement-level variables are for 1921.

Table A2: Assortative matching by class

Panel A: Pre war

bride's class: / groom's class:	1	2	3	4	5	6	7	total
1	3	8	6	0	5	0	0	22
	13.6%	36.4%	27.3%	0.0%	22.7%	0.0%	0.0%	100%
2	2	36	60	4	45	6	2	155
	1.3%	23.2%	38.7%	2.6%	29.0%	3.9%	1.3%	100%
3	3	28	112	7	69	13	3	235
	1.3%	11.9%	47.7%	3.0%	29.4%	5.5%	1.3%	100%
4	0	2	19	122	57	1	9	210
	0.0%	1.0%	9.1%	58.1%	27.1%	0.5%	4.3%	100%
5	1	13	72	7	99	21	9	222
	0.5%	5.9%	32.4%	3.2%	44.6%	9.5%	4.1%	100%
6	1	3	9	2	24	18	1	58
	1.7%	5.2%	15.5%	3.5%	41.4%	31.0%	1.7%	100%
7	0	1	8	2	17	2	16	46
	0.0%	2.2%	17.4%	4.4%	37.0%	4.4%	34.8%	100%
total	10	91	286	144	316	61	40	948
	1.1%	9.6%	30.2%	15.2%	33.3%	6.4%	4.2%	100%

Panel B: Post war

bride's class: / groom's class:	1	2	3	4	5	6	7	total
1	16	38	11	2	14	3	0	84
	19.1%	45.2%	13.1%	2.4%	16.7%	3.6%	0.0%	100%
2	10	185	125	13	98	10	5	446
	2.2%	41.5%	28.0%	2.9%	22.0%	2.2%	1.1%	100%
3	12	101	197	29	183	51	7	580
	2.1%	17.4%	34.0%	5.0%	31.6%	8.8%	1.2%	100%
4	1	14	46	330	116	4	12	523
	0.2%	2.7%	8.8%	63.1%	22.2%	0.8%	2.3%	100%
5	5	48	96	22	208	32	13	424
	1.2%	11.3%	22.6%	5.2%	49.1%	7.6%	3.1%	100%
6	1	11	22	5	49	53	5	146
	0.7%	7.5%	15.1%	3.4%	33.6%	36.3%	3.4%	100%
7	0	1	9	14	28	4	27	83
	0.0%	1.2%	10.8%	16.9%	33.7%	4.8%	32.5%	100%
total	45	398	506	415	696	157	69	2286
	2.0%	17.4%	22.1%	18.2%	30.5%	6.9%	3.0%	100%

Notes: Classes are defined by own occupation. This table presents the number and percentage of grooms in each class pre and post war who married brides of each class.

Table A3. Examples of common occupations within each class

Class	Women	Men
1	Accountant, professor	Accountant, engineer
2	Store employee, bank employee	Railway company employee, store employee
3	Seamstress, cook	Mechanic, constructor
4	Farmer, winegrower	Farmer, winegrower
5	Domestic, linen maid	Driver, domestic
6	Factory worker, worker	Factory worker, worker
7	Day laborer, farm worker	Day laborer, farm worker

Table A4: Class imputation regressions

Dependent variable: class defined by own occupation	brides		grooms	
	coefficient	standard error	coefficient	standard error
Father's Class Dummies				
Class 1	-0.866*	0.478	-1.022***	0.250
Class 2	-0.474*	0.252	-0.880***	0.198
Class 3	-0.091	0.209	-0.378*	0.196
Class 4	0.108	0.239	0.132	0.211
Class 5	0.261	0.226	0.574***	0.205
Class 6	0.314	0.236	0.226	0.240
Class 7	0.337	0.526	1.873***	0.526
Father is Dead	0.095	0.176	-0.082	0.156
Father has no Occupation	0.388	0.467	-0.218	0.427
Mother's Class Dummies				
Class 1	-0.615	0.592	0.022	0.338
Class 2	-0.890***	0.287	-0.107	0.277
Class 3	-1.007***	0.259	-0.048	0.362
Class 4	0.157	0.294	-0.066	0.245
Class 5	0.003	0.179	0.552***	0.165
Class 6	0.303	0.258	0.534**	0.247
Class 7	-0.952	1.329	0.267	0.384
Mother is Dead	0.044	0.164	0.117	0.134
Mother has no Occupation	-0.222	0.183	0.108	0.138
Rural	0.688**	0.308	0.860***	0.236
Rural * Father's Class Dummies				
Class 1	-0.162	0.705	-0.260	0.415
Class 2	-0.397	0.595	-0.331	0.394
Class 3	-0.400	0.397	-0.574*	0.338
Class 4	-0.215	0.358	-0.498*	0.289
Class 5	-0.366	0.400	0.180	0.347
Class 6	-0.383	0.795	-0.241	0.576
Class 7	-0.183	0.607	-1.290**	0.601
Father is Dead	-0.274	0.317	-0.273	0.254
Father has no Occupation	0.547	0.813	-0.814	0.912
Rural * Mother's Class Dummies				
Class 1	0.973	1.158	-0.954*	0.539
Class 2	0.625	0.625	-0.212	0.603
Class 3	1.041**	0.502	-0.111	0.550
Class 4	-0.516	0.371	0.088	0.299
Class 5	0.082	0.279	-0.489**	0.241
Class 6	0.511	0.541	-0.914	0.566
Class 7	1.687	1.368		
Mother is Dead	-0.213	0.279	-0.169	0.211
Mother has no Occupation	-0.400	0.339	-0.549**	0.227
City Size Dummies				
Paris	-0.369**	0.147	-0.284**	0.118
Big City	-0.089	0.195	-0.323**	0.153
Medium-Sized City	0.112	0.159	0.000	0.126
Observations	973		1,596	

Notes: This table presents the OLS regressions used to impute the classes of the brides and grooms from background characteristics. Pre-war marriages only are used. The dependent variable in each case is class defined by own occupation. Asterisks denote significance at: * 10%, ** 5%, *** 1%.

Table A5: Impact of male scarcity on assortative matching by class (OLS, no regional fixed effects)

	Class defined by own occupation			Class defined by father's occupation			Class imputed from background characteristics		
Dependent variable:	class difference	married down	low class bride	class difference	married down	low class bride	class difference	married down	low class bride
% of Soldiers Killed * Post War	-0.018*	-0.007	-0.014***	0.005	-0.003	-0.006	-0.006**	-0.006**	-0.003
	(0.011)	(0.005)	(0.005)	(0.016)	(0.005)	(0.005)	(0.002)	(0.002)	(0.003)
% of Soldiers Killed	0.025	0.005	0.002	0.014	0.002	0.002	0.021**	0.013***	0.016***
	(0.018)	(0.008)	(0.010)	(0.015)	(0.005)	(0.005)	(0.008)	(0.004)	(0.005)
Post War	0.195	0.069	0.196***	-0.093	0.019	0.081	0.099***	0.105***	0.038
	(0.152)	(0.065)	(0.073)	(0.249)	(0.071)	(0.080)	(0.030)	(0.033)	(0.036)
Rural	0.378***	0.099***	0.064	0.161*	0.020	-0.085***	0.341***	0.223***	0.424***
	(0.094)	(0.037)	(0.044)	(0.090)	(0.026)	(0.030)	(0.035)	(0.025)	(0.032)
Bride's Age (/100)	-0.428	0.167	0.027	-2.366**	-0.159	-0.544**	0.376	0.378**	0.113
	(0.416)	(0.149)	(0.164)	(0.953)	(0.214)	(0.235)	(0.259)	(0.144)	(0.124)
Groom's Age (/100)	0.115	-0.246*	-0.001	-0.587	-0.410	-0.622**	-0.010	0.127	-0.042
	(0.358)	(0.133)	(0.148)	(0.910)	(0.272)	(0.238)	(0.105)	(0.085)	(0.096)
Groom Class Dummies	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Groom Half-Class Dummies	No	No	No	No	No	No	Yes	Yes	Yes
R-Squared	0.344	0.197	0.116	0.322	0.229	0.154	0.429	0.222	0.397
Observations	3117	2994	3117	1966	1882	1966	5832	5832	5832

Notes: Classes are defined by own occupation in the first three columns, by father's occupation in the second three columns, and are imputed from background characteristics including parents' classes in the last three columns. The dependent variable in the first of each set of three columns is the class of the bride minus the class of the groom (thus a greater class difference indicates the groom married a lower class of bride); the dependent variable in the second is a dummy variable for whether the groom married a bride of lower class than himself; the dependent variable in the third is a dummy for the bride being of low class (5, 6 or 7). Standard errors, clustered at the departement level, are presented in parentheses. Asterisks denote significance at: * 10%, ** 5%, *** 1%.

Table A6: Impact of male scarcity on assortative matching by class (OLS equivalent of IV)

	Class defined by own occupation			Class defined by father's occupation		
Dependent variable:	class difference	married down	low class bride	class difference	married down	low class bride
Sex Ratio (males/females)	0.742	0.430	0.962***	0.411	0.534*	0.363
	(0.842)	(0.301)	(0.322)	(1.100)	(0.292)	(0.439)
Post War	-0.040	-0.013	0.058	-0.004	0.011	0.008
	(0.105)	(0.032)	(0.038)	(0.100)	(0.028)	(0.040)
Rural	0.202**	0.041	-0.025	0.142	0.010	-0.094***
	(0.084)	(0.029)	(0.030)	(0.098)	(0.029)	(0.029)
Bride's Age (/100)	-0.533	0.089	-0.084	-1.958**	-0.007	-0.491**
	(0.451)	(0.154)	(0.138)	(0.942)	(0.201)	(0.221)
Groom's Age (/100)	0.229	-0.189	0.102	-0.602	-0.616**	-0.536**
	(0.364)	(0.133)	(0.127)	(0.895)	(0.274)	(0.215)
Groom Class Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Groom Half-Class Dummies	No	No	No	No	No	No
Departement Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.388	0.271	0.227	0.361	0.286	0.218
Observations	3193	3066	3193	2103	2009	2103

Notes: This table presents results from equation (3) run as OLS regressions. Classes are defined by own occupation in the first three columns, and by father's occupation in the second three columns. The dependent variable in the first of each set of three columns is the class of the bride minus the class of the groom (thus a greater class difference indicates the groom married a lower class of bride); the dependent variable in the second is a dummy variable for whether the groom married a bride of lower class than himself; the dependent variable in the third is a dummy for the bride being of low class (5, 6 or 7). Standard errors, clustered at the departement level, are presented in parentheses. Asterisks denote significance at: * 10%, ** 5%, *** 1%.