

## Marrying Up: The Role of Sex Ratio in Assortative Matching<sup>†</sup>

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*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 postwar 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 J12, J16, N34)*

Marriage market outcomes are known to have important implications for fertility, education, labor supply, social inequality, and income redistribution (e.g., Raquel Fernandez and Richard 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., Gary S. Becker 1973, 1974, 1981; Francis Bloch and Harl Ryder 2000; Pierre-Andre Chiappori, Bernard Fortin, and Guy Lacroix 2002). 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

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<sup>†</sup> To comment on this article in the online discussion forum, or to view additional materials, visit the article page at <http://www.aeaweb.org/articles.php?doi=10.1257/app.3.3.124>.

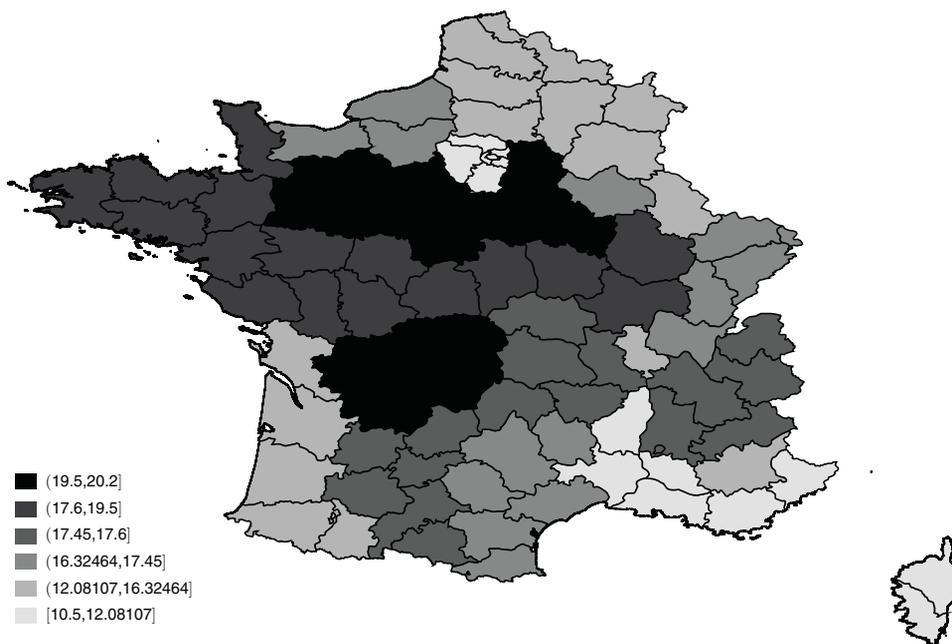


FIGURE 1. THE GEOGRAPHIC VARIATION IN MILITARY MORTALITY RATES

*Notes:* This map shows the geographic variation in the percentage of soldiers killed. A darker color represents a higher mortality rate (see labels for corresponding mortality rate).

scarcity induced by war casualties affected men's 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 percent of French soldiers were reported dead or missing after the war (Michel Huber 1931). WWI 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 18–59 to women aged 15–49 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.<sup>1</sup> Second, military mortality varied substantially across regions, with the percentage of soldiers killed ranging from 10.5 percent to 20.2 percent (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

<sup>1</sup> 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 World War II (WWII).

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 dataset that links nonpublic marriage-level data to French censuses of population and regional data on military mortality. Throughout the paper, we adopt a difference-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 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 postwar 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 20–29 increased by 2.7 percentage points postwar (relative to a prewar average of 39.4 percent). In contrast, fewer men aged 20–29 remained single in regions with higher mortality postwar. 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 postwar 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 postwar in regions with higher mortality. Specifically, in regions where the military mortality was 20 percent compared with regions with 10 percent mortality rates, the proportion of out-of-wedlock births increased by 1.5 percentage points postwar (relative to a prewar average of 6.7 percent 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 Marco H. D. van Leeuwen and Ineke 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 percent 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 postwar 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 nonrandom migration. Overall, we find that the decrease in sex ratio induced by war-related mortality allowed men postwar in regions with higher mortality to marry better than they did prewar. Compared with regions with 10 percent military mortality rates, in regions with 20 percent military mortality rates the probability that a given groom married down postwar decreased by 10 percentage points (from a prewar average of 36.1 percent), and the probability that a given groom married a low-class bride postwar 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 postwar 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.<sup>2</sup> 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 Oliver C. Cox (1940), Richard A. Easterlin (1961), and Marcia Guttentag and Paul F. Secord (1983). A potential problem of these studies, mitigated to a large extent in Josh Angrist (2002), Kerwin Kofi Charles and Ming Ching Luoh (2010), Elizabeth Brainerd (2007), and Jeanne Lafortune (2010), 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. Vijayendra Rao (1993), Shoshana Grossbard-Shechtman (1993), Maristella Botticini (1999), Botticini and Aloysius Siow (2003), and Lena Edlund (2000) suggest that one adjustment is through dowries. Becker (1974, 1981), Theodore C. Bergstrom (1994), Robert J. Willis (1999), and Derek Neal (2004), among others, suggest that a consequence of the imbalance in sex ratio is the emergence of polygamy, including “serial polygamy” (divorce and remarriage) and relationships leading to out-of-wedlock births. Becker (1973, 1981) and Chiappori, Fortin, and Lacroix (2002) 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

<sup>2</sup>For a review of the economics of marriages, see Yoram Weiss (1997). For trends in assortative matching in the United States, see John Pencavel (1998) and Elaina Rose (2001). Other seminal contributions include Claudia Goldin (1990, 2006) and Goldin and Lawrence F. Katz (2002).

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., Linda Y. Wong 2003; Alberto Bisin, Giorgio Topa, and Thierry Verdier 2004; Eugene Choo and Siow 2006; Günter J. Hitsch, Ali Hortaçsu, and Dan Ariely 2010; Michèle Belot and Marco Francesconi 2006; Raymond Fisman et al. 2006; Soohyung Lee 2007; Abhijit Banerjee et al. 2009). 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 Ken Burdett and Melvyn G. Coles (1997) and Banerjee et al. (2009).

This paper is organized as follows. In Section I, we describe the historical context surrounding WWI in France. In Section II, we present the data. In Sections III–V, 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 VI, we draw final conclusions.

## I. Historical Context

The WWI, 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.

### *A. 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).<sup>3</sup> To highlight the scope of this mobilization, note that 8.8 million men aged 18–51 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.

<sup>3</sup>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.

TABLE 1—DISTRIBUTION ACROSS OCCUPATIONS

Occupation	Percent of fatalities			
<i>Panel A. Distribution of fatalities by occupation at age 20 (in percent)</i>				
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			
	1906		1921	
Occupation	Males	Females	Males	Females
<i>Panel B. Distribution of the labor force by occupation (in percent)</i>				
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
Percent of the pop. in the labor force	68.2	39.0	71.2	42.6

*Note:* Panel B applies to 1906 territory for both years.

*Source:* Huber (1931)

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 percent 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 percent of French soldiers and 19 percent 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).<sup>4</sup> 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.<sup>5</sup>

Mortality was uniform across military rank and occupation, but there was substantial heterogeneity in mortality rates across geographical regions and by age. In Section IIC, 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

<sup>4</sup>Mortality data on soldiers' occupations when drafted are not available. Data on occupation at age 20 were recorded during each individual's military service.

<sup>5</sup>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 lettres," a writers' organization, 833 former students of the École Polytechnique, and 230 from the École Normale, both of which were prestigious universities, were killed during the conflict.

27 percent to 29 percent mortality rates across France, while men born between 1883 and 1891 experienced mortality rates from 19.2 percent to 24.1 percent. Older cohorts of men, aged 40 and above at the beginning of the war, suffered the lowest mortality rates (10 percent or less). In addition to military casualties, deaths among civilians were high during the period 1914–1918, 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 15–45. 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.

### B. Marriage Market in France

The nineteenth century and the beginning of the twentieth century in France were characterized by a stable celibacy rate of 10 percent to 13.5 percent, and a high marriage rate (Jacques Dupâquier 1988). The average marriage rate of the 1908–1913 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 percent of marriages) both before and after the war (Martine 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 (André 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 1900–1950 and highlights how the war disturbed women's marriage patterns. For women born in the period 1891–1895, the distribution of marriages is literally cut in half with the 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 men for every 1,000 women. If we restrict to the population of marriageable age (18–59 years old for men and 15–49 years old for women),<sup>6</sup> the sex ratio decreased from 1,087 men per 1,000 women in 1911 to 992 men per

<sup>6</sup>These are the age groups defined by the French census as marriageable age. Fifteen and 18 years old were the minimum legal ages for marriage for women and men, respectively.

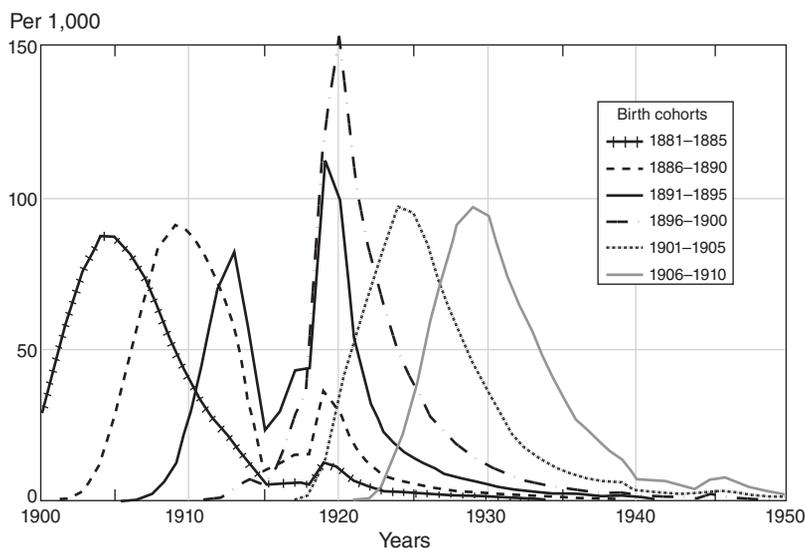


FIGURE 2. NUMBER OF FIRST MARRIAGES PER 1,000 WOMEN BY BIRTH COHORTS AND YEARS

Source: Henry (1966).

1,000 women in 1921, reaching 864 in some regions with high mortality rates.<sup>7</sup> If we focus on singles, widows, and divorcés who were 30 years old or younger but of marriageable age, there were approximately 2 men for every 3 women.

### C. WWI and the French Labor Market

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 men to their civilian jobs. Female labor force participation increased during the war, but returned to its prewar level after the war ended. Specifically, Table 1 shows that female labor force participation was 39.0 percent in 1906 and 42.6 percent by 1921; by 1926 it had fallen to 37.2 percent.<sup>8</sup>

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 percent and 95 percent 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).

<sup>7</sup> Authors' calculation from French census data.

<sup>8</sup> 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 percent (Laura Lee 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 reopen their doors in 1919, women's positions were limited, their wages lagged behind men's wages, and the occupations that were exclusively reserved to males before the war again became unavailable to women (Downs 1995; Sylvie Schweitzer 2002). Women who were not working before the war returned to their homes once the war was over (Jean-Jacques 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 prewar averages differ from the postwar 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 rehire, 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 percent by 1921. Table 1 shows that, as in the case of women, 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 percent, only a bit higher than its 1906 level of 68.2 percent.

## II. Data

We use data from several sources, including a nonpublic marriage-level dataset, prewar and postwar 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.

### A. The TRA Dataset

Our marriage-level data are from the TRA dataset, 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 École des hautes études en sciences sociales, aims at analyzing social and geographical mobility in France in the nineteenth and twentieth centuries. Dupâquier (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.<sup>9</sup> 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 (Jean-Pierre 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. Dupâquier (2004) points out two potential biases in the TRA dataset. The aristocracy might be underrepresented, and foreign males who came to France after 1832 are not included in the sample.<sup>10</sup>

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.<sup>11</sup> 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 the war.

### B. *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 (ICPSR) (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 the percentage of men/women single, divorced, and widowed. We use the Vital Statistics for France to obtain the département-level percentage of out-of-wedlock births for 1911 and 1921.

We also link the year and département of each marriage in the TRA dataset 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

<sup>9</sup>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.

<sup>10</sup>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 dataset was collected (i.e., 1803–1986), farmers seem to be overrepresented 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 dataset constructed with all of the 6,000 TRA families (source: e-mail conversation with Jean-Pierre Pélissier 2008).

<sup>11</sup>Occupations are missing for about 5 percent of the grooms and 12 percent of the brides, and for over 40 percent of their parents.

as the ratio of the number of males aged 18–59 to the number of females aged 15–49, 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.

### *C. 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 (Philippe 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 (nine départements), we allocate a weighted average of the mortality 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 percent in Seine-et-Oise to 20.2 percent in Seine-et-Marne. The mean mortality rate computed over the 87 départements is 16.8 percent; the median is 17.5 percent. Départements marked in darker shades have higher mortality rates. Départements marked in full white correspond to a mortality rate of 11.9 percent or lower and départements marked in the darkest shade correspond to a mortality rate of 19.6 percent 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 battlefield to complement the troops of the northeastern regions where most of the fighting was taking place (Boulanger 2001; Jules Maurin 1992).<sup>12</sup> 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 battlefield, but the mixing was imperfect and some regional differences in mortality persisted.

### **III. 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 postwar 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

<sup>12</sup>For example, soldiers from Bretagne were sent to the Parisian region, while soldiers from the Parisian region went further east.

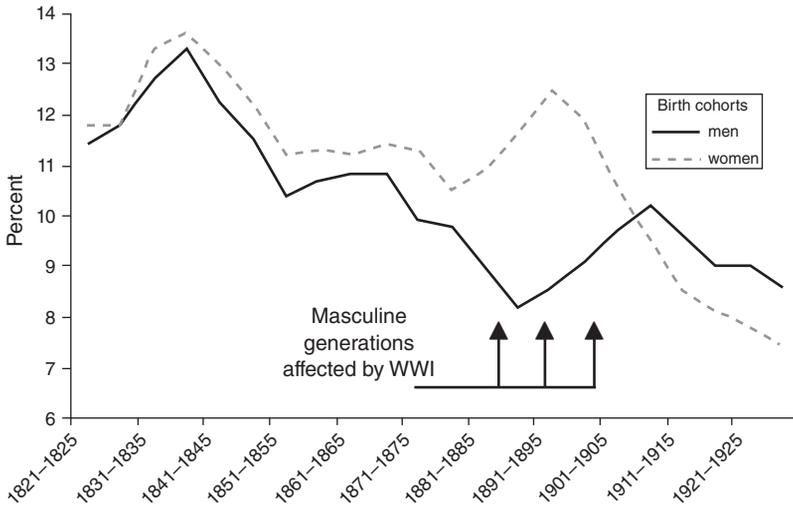


FIGURE 3. PERCENTAGE OF SINGLES AT AGE 50 BY BIRTH COHORT

Source: Roussel (1975).

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 département-level data from the 1911 and 1921 censuses and apply a difference-in-differences approach. Specifically, we estimate

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

where  $Y_{dt}$  is the percentage of men (or women) of a particular marital status (single, divorced, or widowed) in département  $d$  at time  $t$ ;  $\delta_d$  is a département dummy that captures time-invariant département-level factors, such as local traditions related to marriage;  $PW_t$  is a postwar 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 postwar 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 percent instead of 10 percent, the proportion of single women aged 20–29 was 2.7 percentage points higher postwar (relative to a prewar average of 39.4 percent). Among men, we find that fewer of those aged 20–29 remained single in départements with higher mortality postwar.<sup>13</sup> These findings suggest that when men are in relative shortage, they are more likely to marry.

<sup>13</sup>Curiously, there was an increase in the proportion of single males aged 40–49 in regions with high mortality postwar.

TABLE 2—THE IMPACT OF MALE SCARCITY ON MARITAL STATUS BY AGE GROUP AND GENDER

Dependent variable	Single males	Single females	Divorced males	Divorced females	Widowed males	Widowed females
Age group:						
15–19	0.010 (0.006)	0.109* (0.043)				
20–29	–0.312*** (0.108)	0.270** (0.095)	–0.004** (0.002)	–0.006 (0.004)	0.003 (0.003)	0.053* (0.030)
30–39	0.044 (0.084)	0.037 (0.047)	–0.013 (0.008)	–0.013* (0.007)	–0.001 (0.008)	0.245*** (0.050)
40–49	0.119** (0.047)	0.065** (0.033)	0.003 (0.007)	–0.007 (0.006)	0.002 (0.013)	0.138*** (0.032)

Notes: Coefficient presented is on the interaction between postwar and military mortality. 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 postwar dummy and département dummies. The number of observations in each regression is 174. Standard errors are presented in parentheses.

\*\*\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

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 postwar in départements with higher mortality. For instance, in the 30–39 age group, the proportion of divorcés of either gender declined postwar by 0.13 percentage points in a département with 20 percent mortality relative to one with 10 percent mortality (relative to a prewar average of 0.5 percent for men and 0.7 percent for women). This finding seems to stand in contrast to Scott J. South and Katherine 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. It is, however, consistent with the results of Charles and Luoh (2010), who find that in the United States a higher incarceration rate, which reduces the number of males in the marriage market, is associated with a lower incidence of divorce among women. One potential explanation for women being less likely to be divorced in places with higher mortality is that women were more likely to stay single and less likely to ever marry (and therefore divorce) in those places. Another potential and complementary explanation is that more of the marriages that would have ended in divorce were dissolved by the death of the husband in places with higher mortality. As for men, the lower proportion of divorcés in regions with higher mortality may reflect the fact that men who divorced remarried quickly in places where they were scarcer. Additionally, under male scarcity, men may be more likely to find better matches, which are more stable and less likely to dissolve. We also cannot rule out the possibility that, contrary to common wisdom and 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 percent instead of 10 percent, the proportion of widowed women aged 20–29 was 2.5 percentage points higher postwar (relative to a prewar average of 1.0 percent).

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 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 postwar is 0.148 and statistically significant at the 1 percent 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 prewar average of 6.7 percent) postwar in a département with mortality of 20 percent than in one with mortality of 10 percent. 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.

#### IV. 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, 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 (2002) 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.<sup>14</sup> 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.

<sup>14</sup> Heidrun C. Hoppe, Benny Moldovanu, and Aner Sela (2009) is another recent theoretical paper that discusses the effect of the sex ratio on assortative matching. Murat Iyigun and Randall P. 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.

### A. 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 1,000 occupations present in our dataset 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 and 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, Maas, and Andrew Miles 2002). HISCO allocates each occupation to one of seven sectors: professional; technical and related workers, administrative and managerial workers; clerical and related workers; sales workers; service workers; agricultural, animal husbandry and forest workers; fishermen, and hunters; and production and related workers, transport equipment operators and laborers. Each of these sectors is 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 the United States. 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 seven **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 dataset, to study social mobility and endogamy (Pélissier et al. 2005; Katherine Holt 2005; Hans Henrik Bull 2005; Reto Schumacher and Luigi Lorenzetti 2005; Marie-Pierre Arrizabalaga 2005; Margareth Lanzinger 2005; Martin Dribe and Christer Lundh 2005; Bart Van de Putte et al. 2005; Hilde Bras and Jan Kok 2005; van Leeuwen and Maas 2005b, 2005c). Appendix Table A2 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 percent of the brides in our dataset 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 IC, female labor force participation and occupations changed very little after the war compared with prewar. 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 V), which in turn may affect occupation at marriage. However, brides postwar married on average less than a month older than their prewar counterparts and only 10 months older postwar 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 percent of brides' fathers and 47.7 percent of grooms' fathers, and may not be missing at random (e.g., fathers from lower social classes 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 prewar 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 prewar 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 A3 for the imputation regressions).<sup>15</sup> This method is not affected by

<sup>15</sup> In practice, we apply the following procedure. First, we regress bride class on: father's class dummies including dummies for father's 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; and city size dummies. Denote the predicted values *bride*. We do the same to predict groom's class. Denote the predicted

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.<sup>16</sup> 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 seven classes based on their own occupations and on those of their fathers.

### B. Prewar 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 prewar 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 prewar 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 prewar grooms married randomly. Using a bootstrapping method, we construct 95 percent bootstrap confidence intervals for the distribution of social distance under the null hypothesis of random matching. Specifically, denote the number of prewar 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. 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 1,000 times and construct the 95 percent confidence interval. The *observed* points in Figure 4 show the actual distribution of prewar 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.

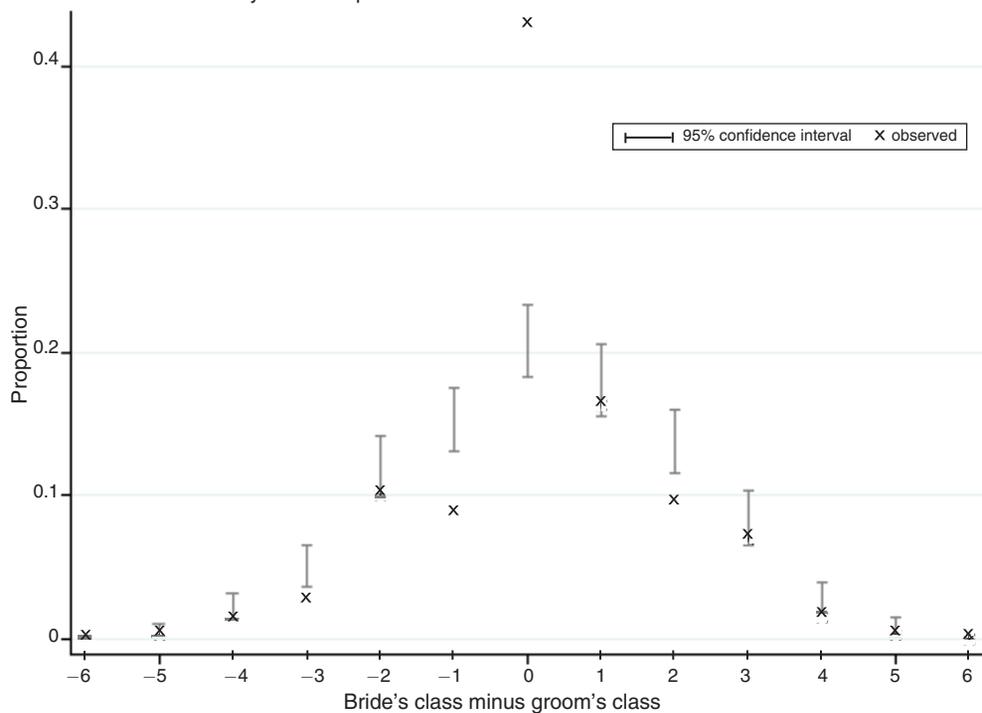
Overall, the figure clearly rejects the null hypothesis of random matching for classes based on own or father's occupation. Grooms in the prewar period were much more likely to marry brides of their own social class than chance would

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values *grôom*. Second, we define our dependent variables (see Section IVC) using *brîde* and *grôom* for all brides and all grooms (including those with and without occupations).

<sup>16</sup>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.

Panel A. Class defined by own occupation



Panel B. Class defined by father's occupation

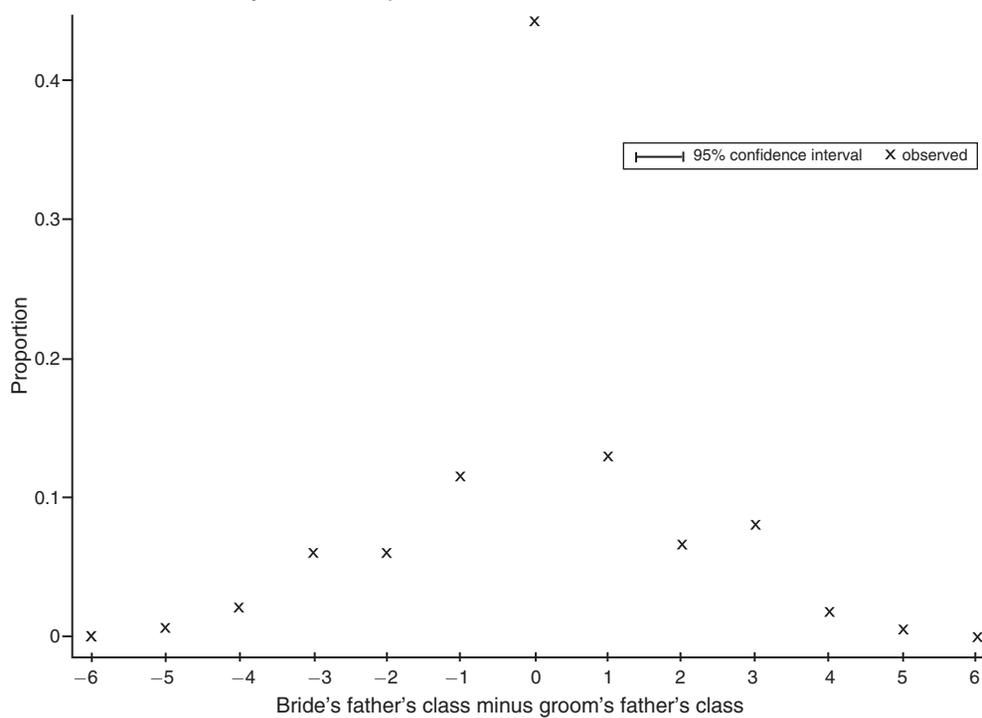


FIGURE 4. PRE-WWI MATCHING WAS ASSORTATIVE

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

dictate, and were much less likely to marry brides who were socially distant from them. Note that 44 percent (45 percent) of men married women of the same social class defined using own (father's) occupation, and 69 percent (70 percent) of men married a spouse whose social class was within one class away.<sup>17</sup>

### C. Male Scarcity and Assortative Matching by Social Class

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

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

where  $i$  is a marriage,  $d$  is a département, and  $t$  is the year of the wedding. We use three alternative dependent variables  $Y$ : the difference between the class of the bride and the class of the groom (a lower value means the man married up more); a dummy for whether the groom married a bride of lower class than his (married down); and a dummy for whether a groom married a low-class bride (defined as being a bride of class 5, 6, or 7).<sup>18 19</sup>

As before,  $\delta_d$  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 postwar 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.<sup>20</sup> 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 prewar, men were more likely to marry better after the war in regions with higher mortality rates; the coefficients on mortality interacted with the postwar dummy

<sup>17</sup>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.

<sup>18</sup>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.

<sup>19</sup>Appendix Table A4 presents the prewar and postwar marriage matrices of brides and grooms from each social class.

<sup>20</sup>The groom's age is used as stated on the marriage certificate if it falls within the range of 10–89 years old. 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.

TABLE 3—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY CLASS (OLS)  
(Classes defined by own occupation)

Dependent variable	All classes of groom			Excluding grooms of class 1 and 2		
	Class difference	Married down	Low-class bride	Class difference	Married down	Low-class bride
Percent of soldiers killed × postwar	−0.020* (0.010)	−0.010** (0.004)	−0.017*** (0.005)	−0.035*** (0.013)	−0.017*** (0.004)	−0.023*** (0.006)
Postwar	0.196 (0.146)	0.092 (0.065)	0.223*** (0.066)	0.491** (0.187)	0.240*** (0.060)	0.338*** (0.082)
Rural	0.190** (0.085)	0.032 (0.029)	−0.034 (0.030)	0.191** (0.091)	0.032 (0.029)	−0.036 (0.033)
Bride's age (/100)	−0.582 (0.473)	0.087 (0.160)	−0.095 (0.142)	−0.923* (0.488)	−0.164 (0.185)	−0.084 (0.188)
Groom's Age (/100)	0.355 (0.377)	−0.166 (0.138)	0.134 (0.127)	0.430 (0.364)	0.033 (0.130)	0.048 (0.151)
Groom class dummies	Yes	Yes	Yes	Yes	Yes	Yes
Département dummies	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.387	0.271	0.232	0.357	0.240	0.261
Observations	3,117	2,994	3,117	2,432	2,309	2,432

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 département level, are presented in parentheses.

\*\*\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

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 postwar dummy is  $-0.010$ . This magnitude can be interpreted as follows. Consider two regions that were identical prewar, but one of which had 20 percent mortality, and the other of which had only 10 percent mortality. Then postwar 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 prewar average of marrying down equal to 36.1 percent). Similarly, the coefficient in the regression predicting whether the groom married a low-class bride (column 3) is  $-0.017$ , suggesting that in départements where the military mortality was 20 percent, the probability that a given groom married a low-class bride postwar decreased by 17 percentage points compared with départements with 10 percent military mortality rates.<sup>21</sup>

<sup>21</sup> 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 (André 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 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 percent.

Panel A of Figure 4 shows that in the prewar 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 postwar 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.<sup>22</sup>

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 postwar 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’s 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 show the results with imputed classes, where we use prewar data to impute brides’ and grooms’ classes based on their parents’ occupations, whether parents’ occupations are missing, and other background information.<sup>23</sup> 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.

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; Charles and Luoh 2010), 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

<sup>22</sup>We also ran the regressions separately for rural and urban samples. The results were not significantly different in rural and urban areas.

<sup>23</sup>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 five when classes are defined using own occupation.

TABLE 4—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY CLASS (OLS)  
(Alternative definitions of class)

Dependent variable	Classes defined by father's occupation			Classes imputed using background characteristics		
	Class difference	Married down	Low-class bride	Class difference	Married down	Low-class bride
Percent of soldiers killed × postwar	0.009 (0.016)	-0.002 (0.005)	-0.005 (0.005)	-0.006** (0.002)	-0.006** (0.002)	-0.002 (0.003)
Postwar	-0.174 (0.239)	0.006 (0.073)	0.062 (0.080)	0.088*** (0.030)	0.108*** (0.035)	0.033 (0.036)
Rural	0.153 (0.098)	0.016 (0.030)	-0.098*** (0.030)	0.301*** (0.023)	0.209*** (0.019)	0.397*** (0.026)
Bride's age (/100)	-2.458** (1.049)	-0.110 (0.223)	-0.580** (0.255)	0.362 (0.286)	0.359** (0.158)	0.096 (0.117)
Groom's age (/100)	-0.331 (0.951)	-0.476* (0.268)	-0.514** (0.226)	0.035 (0.115)	0.134 (0.086)	-0.023 (0.091)
Groom class dummies	Yes	Yes	Yes			
Groom half-class dummies				Yes	Yes	Yes
Département dummies	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.355	0.282	0.218	0.461	0.244	0.433
Observations	1,966	1,882	1,966	5,832	5,832	5,832

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 département level, are presented in parentheses.

\*\*\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

term in a simple OLS regression of marriage outcomes on the sex ratio may be correlated with the sex ratio.<sup>24</sup>

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.<sup>25</sup>

<sup>24</sup>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 nonmigrants, and an upward bias if migrants are more likely to be in poor health.

<sup>25</sup>While we cannot test this exclusion restriction, Appendix Table A5 suggests that mortality is not correlated with prewar marriage by social class for own or father's class. As an additional test, we use prewar 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 percent). 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.

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

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

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  $SR_{idt}$ , which is instrumented with military mortality interacted with postwar.<sup>26</sup> We cluster the standard errors at the département level.

Columns 1–3 of Table 5 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.<sup>27</sup> 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 4–6 of Table 5). 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 prewar 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 twentieth century in France is that, although men preferred to marry higher class women, in equilibrium they were unable to do so. Note, however, that

<sup>26</sup> 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 1909–1914 use the 1911 sex ratio, marriages in the period 1918–1923 use the 1921 sex ratio, and marriages in the period 1924–1928 use the 1926 sex ratio.

<sup>27</sup> Our results are robust to using a sex ratio defined as the ratio of the number of males aged 15–49 to the number of females aged 15–49, and the ratio of the number of males aged 15–39 to the number of females aged 15–39, though the coefficient of the instrumented sex ratio is less precisely estimated for class difference in the latter case.

TABLE 5—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY CLASS (IV)

Dependent variable	Class defined by own occupation			Class defined by father's occupation		
	Class difference	Married down	Low-class bride	Class difference	Married down	Low-class bride
<i>Panel A. Stage 2 regressions</i>						
Sex ratio (men/women)	4.220* (2.157)	2.022** (0.863)	3.475*** (1.017)	-2.292 (4.070)	0.632 (1.166)	1.361 (1.295)
Postwar	0.245 (0.160)	0.116* (0.065)	0.263*** (0.071)	-0.224 (0.331)	0.021 (0.094)	0.092 (0.103)
Rural	0.197** (0.085)	0.036 (0.030)	-0.028 (0.031)	0.152 (0.093)	0.016 (0.029)	-0.098*** (0.030)
Bride's age (/100)	-0.497 (0.450)	0.126 (0.141)	-0.026 (0.149)	-2.523** (1.011)	-0.091 (0.225)	-0.542** (0.236)
Groom's age (/100)	0.372 (0.358)	-0.156 (0.131)	0.149 (0.124)	-0.441 (0.957)	-0.447* (0.257)	-0.449* (0.242)
Groom class dummies	Yes	Yes	Yes	Yes	Yes	Yes
Département dummies	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.383	0.263	0.214	0.353	0.283	0.215
Observations	3,117	2,994	3,117	1,966	1,882	1,966
<i>Panel B. Stage 1 regressions</i>						
Dependent variable: Sex ratio						
Percent of soldiers killed	-0.005***	-0.005***	-0.005***	-0.004***	-0.004***	-0.004***
× postwar	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Controls as in stage 2	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	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 postwar, 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 département and census period. Standard errors, clustered at the département level, are presented in parentheses.

\*\*\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

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.

## V. 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 percent of our observations) and follow the same difference-in-differences empirical strategy as in Section IVC. We estimate a regression similar to (2) where the dependent variables

TABLE 6—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY AGE (OLS)

Dependent variable	Age difference	Groom's age	Bride's age
Percent of soldiers killed $\times$ postwar	0.092** (0.036)	0.019 (0.038)	0.083** (0.038)
Postwar	-0.626 (0.536)	-0.931* (0.519)	-1.164* (0.615)
Rural	-0.325** (0.125)	0.331 (0.215)	-0.340* (0.184)
Groom class dummies	Yes	Yes	No
Bride class dummies	Yes	No	Yes
Département dummies	Yes	Yes	Yes
$R^2$	0.063	0.062	0.064
Observations	4,868	5,205	5,287

*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 département level, are presented in parentheses.

\*\*\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

are the difference between the age of the bride and the age of the groom, the age of the groom, and the age of the bride.

Before the war, the average groom was 3.8 years older than his bride, 33 percent of the grooms married brides who were 0–3 years younger than themselves, and the average age of brides at first marriage was 23.9. Table 6 shows the impact of male scarcity on the age gap and age at marriage. In column 1, the coefficient associated with mortality interacted with postwar is positive and statistically significant, suggesting that the age gap between brides and grooms narrowed in regions with higher mortality postwar. To illustrate the magnitude of this effect, consider two regions where grooms were the same amount older than their brides, on average, prewar. Suppose one region suffered 10 percent mortality and the other suffered 20 percent mortality. Then, *ceteris paribus*, postwar 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 postwar 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.<sup>28</sup>

<sup>28</sup>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 postwar, are essentially unchanged in these specifications. However, we note that mortality itself is statistically significant (and negative), suggesting a correlation between mortality and prewar 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.

The fact that women married at an older age in départements with higher mortality is consistent with several plausible explanations. Because women in such regions had more difficulty finding spouses, they may have taken longer to find matches, and thus ended up marrying at older ages. Alternatively, this may be a consequence of men preferring to marry slightly older women than they married before the war and were able to do so after the war.

## VI. 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 postwar 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 postwar 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.

## APPENDIX

TABLE A1—SUMMARY STATISTICS

	Prewar		Postwar	
	Mean	Standard deviation	Mean	Standard deviation
Département-level variables				
Military mortality			16.8	2.6
Sex ratio	1.12	0.09	1.01	0.07
Marital status variables				
Percent single males aged 15–19	99.8	0.1	99.5	0.2
Percent single males aged 20–29	68.4	7.1	62.8	7.4
Percent single males aged 30–39	19.7	5.2	20.5	5.0
Percent single males aged 40–49	12.0	3.1	11.9	3.1
Percent single females aged 15–19	93.3	2.9	94.3	2.3
Percent single females aged 20–29	39.4	8.2	45.5	7.7
Percent single females aged 30–39	14.6	3.7	15.7	4.2
Percent single females aged 40–49	11.3	3.0	11.5	2.9
Percent divorced males aged 20–29	0.1	0.1	0.1	0.1
Percent divorced males aged 30–39	0.5	0.3	0.7	0.4
Percent divorced males aged 40–49	0.7	0.4	0.9	0.5
Percent divorced females aged 20–29	0.3	0.2	0.4	0.2
Percent divorced females aged 30–39	0.7	0.4	0.9	0.5
Percent divorced females aged 40–49	0.7	0.5	0.9	0.5
Percent widowed males aged 20–29	0.3	0.1	0.3	0.1
Percent widowed males aged 30–39	1.7	0.3	1.7	0.3
Percent widowed males aged 40–49	4.1	0.6	4.0	0.5
Percent widowed females aged 20–29	1.0	0.2	2.7	0.8
Percent widowed females aged 30–39	4.1	0.7	9.9	1.5
Percent widowed females aged 40–49	10.8	1.7	11.6	1.6
Percent 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

(Continued)

TABLE A1—SUMMARY STATISTICS (Continued)

Class distribution	Prewar		Postwar	
	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

Note: Postwar values of the département-level variables are for 1921.

TABLE A2—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 A3—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

(Continued)

TABLE A3—CLASS IMPUTATION REGRESSIONS (*Continued*)

Dependent variable: Class defined by own occupation	Brides		Grooms	
	Coefficient	Standard error	Coefficient	Standard error
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. Prewar marriages only are used. The dependent variable in each case is class defined by own occupation.

\*\*\*Significant at the 1 percent level.

\*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

TABLE A4—ASSORTATIVE MATCHING BY CLASS

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

(Continued)

TABLE A4—ASSORTATIVE MATCHING BY CLASS (Continued)

	Bride's class							Total
	1	2	3	4	5	6	7	
<i>Panel B. Postwar</i>								
Groom's class								
1	16 19.1%	38 45.2%	11 13.1%	2 2.4%	14 16.7%	3 3.6%	0 0.0%	84 100%
2	10 2.2%	185 41.5%	125 28.0%	13 2.9%	98 22.0%	10 2.2%	5 1.1%	446 100%
3	12 2.1%	101 17.4%	197 34.0%	29 5.0%	183 31.6%	51 8.8%	7 1.2%	580 100%
4	1 0.2%	14 2.7%	46 8.8%	330 63.1%	116 22.2%	4 0.8%	12 2.3%	523 100%
5	5 1.2%	48 11.3%	96 22.6%	22 5.2%	208 49.1%	32 7.6%	13 3.1%	424 100%
6	1 0.7%	11 7.5%	22 15.1%	5 3.4%	49 33.6%	53 36.3%	5 3.4%	146 100%
7	0 0.0%	1 1.2%	9 10.8%	14 16.9%	28 33.7%	4 4.8%	27 32.5%	83 100%
Total	45 2.0%	398 17.4%	506 22.1%	415 18.2%	696 30.5%	157 6.9%	69 3.0%	2,286 100%

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

TABLE A5—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY CLASS (OLS, No Regional Fixed Effects)

Dependent variable	Class defined by own occupation			Class defined by father's occupation		
	Class difference	Married down	Low-class bride	Class difference	Married down	Low-class bride
<i>Panel A</i>						
Percent of soldiers killed × postwar	-0.018* (0.011)	-0.007 (0.005)	-0.014*** (0.005)	0.005 (0.016)	-0.003 (0.005)	-0.006 (0.005)
Percent of soldiers killed	0.025 (0.018)	0.005 (0.008)	0.002 (0.010)	0.014 (0.015)	0.002 (0.005)	0.002 (0.005)
Postwar	0.195 (0.152)	0.069 (0.065)	0.196*** (0.073)	-0.093 (0.249)	0.019 (0.071)	0.081 (0.080)
Rural	0.378*** (0.094)	0.099*** (0.037)	0.064 (0.044)	0.161* (0.090)	0.020 (0.026)	-0.085*** (0.030)
Bride's age (/100)	-0.428 (0.416)	0.167 (0.149)	0.027 (0.164)	-2.366** (0.953)	-0.159 (0.214)	-0.544** (0.235)
Groom's age (/100)	0.115 (0.358)	-0.246* (0.133)	-0.001 (0.148)	-0.587 (0.910)	-0.410 (0.272)	-0.622** (0.238)
Groom class dummies	Yes	Yes	Yes	Yes	Yes	Yes
Groom half-class dummies	No	No	No	No	No	No
R <sup>2</sup>	0.344	0.197	0.116	0.322	0.229	0.154
Observations	3,117	2,994	3,117	1,966	1,882	1,966

(Continued)

TABLE A5—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY CLASS  
(OLS, *No Regional Fixed Effects*) (Continued)

Dependent variable	Class imputed from background characteristics		
	Class difference	Married down	Low-class bride
<i>Panel B</i>			
Percent of soldiers killed × postwar	−0.006** (0.002)	−0.006** (0.002)	−0.003 (0.003)
Percent of soldiers killed	0.021** (0.008)	0.013*** (0.004)	0.016*** (0.005)
Postwar	0.099*** (0.030)	0.105*** (0.033)	0.038 (0.036)
Rural	0.341*** (0.035)	0.223*** (0.025)	0.424*** (0.032)
Bride's age (/100)	0.376 (0.259)	0.378** (0.144)	0.113 (0.124)
Groom's age (/100)	−0.010 (0.105)	0.127 (0.085)	−0.042 (0.096)
Groom class dummies	No	No	No
Groom half-class dummies	Yes	Yes	Yes
R <sup>2</sup>	0.429	0.222	0.397
Observations	5,832	5,832	5,832

*Notes:* Classes are defined by own occupation in the first three columns of panel A, by father's occupation in the second three columns of panel A, and are imputed from background characteristics including parents' classes in the last three columns of panel B. 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 département level, are presented in parentheses.

\*\*\*Significant at the 1 percent level. \*\*Significant at the 5 percent level.

\*Significant at the 10 percent level.

TABLE A6—IMPACT OF MALE SCARCITY ON ASSORTATIVE MATCHING BY CLASS (*OLS equivalent of IV*)

Dependent variable	Class defined by own occupation			Class defined by father's occupation		
	Class difference	Married down	Low-class bride	Class difference	Married down	Low-class bride
Sex ratio (males/females)	0.742 (0.842)	0.430 (0.301)	0.962*** (0.322)	0.411 (1.100)	0.534* (0.292)	0.363 (0.439)
Postwar	−0.040 (0.105)	−0.013 (0.032)	0.058 (0.038)	−0.004 (0.100)	0.011 (0.028)	0.008 (0.040)
Rural	0.202** (0.084)	0.041 (0.029)	−0.025 (0.030)	0.142 (0.098)	0.010 (0.029)	−0.094*** (0.029)
Bride's age (/100)	−0.533 (0.451)	0.089 (0.154)	−0.084 (0.138)	−1.958** (0.942)	−0.007 (0.201)	−0.491** (0.221)
Groom's age (/100)	0.229 (0.364)	−0.189 (0.133)	0.102 (0.127)	−0.602 (0.895)	−0.616** (0.274)	−0.536** (0.215)
Groom class dummies	Yes	Yes	Yes	Yes	Yes	Yes
Groom half-class dummies	No	No	No	No	No	No
Département dummies	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.388	0.271	0.227	0.361	0.286	0.218
Observations	3,193	3,066	3,193	2,103	2,009	2,103

*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 département level, are presented in parentheses. \*\*\*Significant at the 1 percent level. \*\*Significant at the 5 percent level. \*Significant at the 10 percent level.

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1. Ran Abramitzky, , Adeline Delavande, , Luis Vasconcelos. 2011. Marrying Up: The Role of Sex Ratio in Assortative MatchingMarrying Up: The Role of Sex Ratio in Assortative Matching. *American Economic Journal: Applied Economics* **3**:3, 124-157. [[Abstract](#)] [[View PDF article](#)] [[PDF with links](#)]