
DISCUSSION PAPER SERIES



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**THE INSTITUTE OF ECONOMIC RESEARCH
KOREA UNIVERSITY**

**「WORLD WAR II, MISSING MEN,
AND OUT-OF-WEDLOCK CHILDBEARING」**

Michaek Kvasnicka and Dirk Bethmann

Discussion Paper No. 07-30 (October 2007)



The Institute of Economic Research Korea University
Anam-dong, Sungbuk-ku,
Seoul, 136-701, Korea
Tel: (82-2) 3290-1632 Fax: (82-2) 928-4948

WORLD WAR II, MISSING MEN, AND OUT-OF-WEDLOCK CHILDBEARING

Michael Kvasnicka*[‡]
Humboldt University Berlin

Dirk Bethmann^{†‡}
Korea University

October 1, 2007

Abstract

Based on county-level census data for the German state of Bavaria in 1939 and 1946, we use World War II as a natural experiment to study the effects of sex ratio changes on out-of-wedlock fertility. Our findings show that war-induced shortfalls of men to women significantly increased the nonmarital fertility ratio at mid century, a result that proves robust to the use of alternative sex ratio definitions, post-war measures of fertility, and estimation samples. The magnitude of this increase furthermore appears to depend on the future marriage market prospects that women at the time could expect to face in the not-too-distant future. We find the positive effect on the nonmarital fertility ratio of a decline in the sex ratio to be strongly attenuated by the magnitude of county-level shares of prisoners of war. Unlike military casualties and soldiers missing in action, prisoners of war had a sizeable positive probability of returning home from the war. Both current marriage market conditions, therefore, and foreseeable improvements in the future marriage market prospects of women appear to have influenced fertility behavior in the immediate aftermath of World War II.

Keywords: World War II, Sex Ratios, Out-Of-Wedlock Births.

JEL Classification: J12, J13, N34.

*Contact author: Michael Kvasnicka, Institute for Economic Theory II, Department of Economics, Humboldt University Berlin, Spandauer Str. 1, 10099 Berlin, Germany; email: kvasnicka@wiwi.hu-berlin.de.

[†]Korea University, Department of Economics, Anam-dong, Sungbuk-gu, Seoul 136-701, Republic of Korea (South Korea); email: dirk@korea.ac.kr.

[‡]This paper has benefited from useful comments by Silke Anger, Joshua Angrist, David Autor, Ronald Bachmann, Sebastian Braun, Michael C. Burda, Donald Cox, Ju-Hyun Pyun, Albrecht Ritschl, Martin Spieß, Harald Uhlig, Axel Werwatz, and participants of the 2007 Australasian Meeting of the Econometric Society, a seminar of the Berlin Network of Labor Market Research (BeNA), and the 2007 annual conference of the Collaborative Research Center 649 on 'Economic Risk'. Burcu Erdogan, Katja Hanewald, and Arda Özcan have provided valuable research assistance. Financial support by the Fritz Thyssen Stiftung, the Brain Korea 21 Program, and the Collaborative Research Center 649 is gratefully acknowledged. All remaining errors are our own.

1 Introduction

Sex ratios, commonly defined as the numbers of men per women in a geographic region or population of interest, may affect a wide range of social, demographic, and economic outcomes in societies. Foremost, as direct measures of marriage market tightness, sex ratios are likely to have immediate effects on marriage rates. Moreover, and more generally, sex ratios may influence the relative bargaining strengths of women and men in the marriage market, as the relative abundance of a sex is inversely related to its potential mating opportunities, that is its outside options. Sex ratio changes may therefore affect both intra-household resource allocation between spouses as well as the labor force participation of married women. Finally, and in part through their effects on marriage rates, sex ratio changes may influence modes of fertility (marital vs nonmarital) by affecting the respective propensities of women and men to engage in nonmarital sex and to bear and rear their children out of wedlock. An excess supply of women, for instance, increases the outside mating opportunities available to men and raises intra-female competition. Such marriage market conditions should make it easier for men to seek (potentially reproductive) nonmarital sex and more difficult for women to secure long-term male commitment in the form of marriage as a precondition for engaging in a sexual relationship.

While a growing body of literature has explored quantitatively the consequences of sex ratio imbalances for marriage rates and female labor force participation, the relationship between sex ratios and out-of-wedlock childbearing still remains comparatively underresearched. Furthermore, existing empirical studies on the effects of sex ratios on nonmarital fertility may be susceptible to the problem of omitted variable bias and reverse causality. For sex ratios at regional level and changes in them over time are rarely exogenous, mostly because of sex-biased migration. A potential way to mitigate this identification problem is to focus on events, such as wars or immigration episodes, that lead to exogenous sex ratio changes (see, for example, Acemoglu, Autor, and Lyle, 2004, and Angrist, 2002). Germany in the second half of the 1940s provides a fruitful area for research in this respect. Not only did World War II (WWII) lead to a serious shortage of prime-aged men in Germany that caused women in their prime fertility years (20-40) to outnumber men in the same age bracket by a factor of 10 to 6 in the first post-war census in 1946. The 1940s also saw the largest proportional surge in out-of-wedlock childbearing in 20th-century Germany. The share of nonmarital births in total births rose from 7.6% in 1938 to 16.4% in 1946 (the latter figure refers to West Germany only). Important for identification, pre- to post-war sex ratio changes exhibited considerable geographical variation, as regions were differentially affected by WWII in terms of military losses, missing military personnel (soldiers missing in action, m.i.a.), and prisoners of war (pows). Both for analytical reasons and for the scale of nonmarital fertility encountered in the aftermath of WWII, therefore, does Germany at mid-century represent a particularly interesting historical episode for the study of the effects of imbalanced sex ratios on out-of-wedlock childbearing.

Based on a unique dataset, we use WWII as a natural experiment to study the effects of sex ratio changes between 1939 and 1946 on the prevalence of out-of-wedlock childbearing in the south German state (Land) of Bavaria. Our focus on Bavaria, the second most populous and largest German state in territory after the war, is inspired by the unmatched wealth and quality of population and fertility data available for the late 1930s and 1940s. Unlike most other German states founded after WWII, post-war Bavaria was neither a new administrative creation, nor severely altered in territory from its historical confines. Because of this continuity, statistical records for Bavaria in the immediate pre- and post-WWII period excel those available for other German states both in scope and quality. To disentangle the effects of war-induced sex ratio changes from confounding aggregate influences on out-of-wedlock fertility, such as regime change, the weakening of social norms and morals, and general economic hardship, our identification strategy exploits regional variations in sex ratio changes at county level. Specifically, we run panel regressions with fixed county effects that control for common shifts across regions in reproductive behavior. Our findings show that shortfalls of men to women in a county significantly increased the share of non-marital births, that is the nonmarital fertility ratio, a result that proves robust across different sex ratio specifications, post-war measures of fertility, and estimation samples. We furthermore find the effect of a decline in the sex ratio to depend on the nature and permanency of the male shortfall in a county, i.e. on the marriage market prospects that women at the time could expect to face in the near future. Military casualties and soldiers recorded as missing in action had a respectively zero and near zero probability of ever returning home. Pows, in contrast, had a decidedly positive chance to do so (and most indeed did come back, although some only late). Counties with a higher fraction of pows among their missing men after the war hence had a predictable greater chance to witness a rise in the sex ratio in the not-too-distant future, i.e. an improvement in the marriage market conditions for women. We find these differences across counties to attenuate (reduce the positive) effect of war-induced declines in the sex ratio on the prevalence of nonmarital fertility. This result may be of importance beyond the particular historical episode considered in the analysis. For it points to the possibility that also in other applications, the contemporaneous effects of sex ratio imbalances on outcomes of interest may be moderated by anticipated future changes in marriage market conditions. To the best of our knowledge, this eventuality has been disregarded entirely in the empirical economics literature on the effects of sex ratios.

The paper is organized as follows. The next section provides the theoretical and historical background and discusses the existing literature. Section 3 describes the data used in the empirical analysis. Our identification strategy, the main regression results, and various robustness checks are presented in Section 4. Section 5 summarizes the main findings and concludes.

2 Background

This background section consists of three parts. The first (Section 2.1) surveys theoretical arguments why sex ratios may affect marriage patterns and modes of fertility. The second (Section 2.2) reviews the scant empirical literature on the link between sex ratio imbalances and out-of-wedlock childbearing. And the third (Section 2.3) provides a detailed overview of the demographic consequences of WWII for Bavaria. The latter documents, among other things, the magnitude of the male shortfall induced by WWII in Bavaria and explores its main constituent parts (prisoners of war, military deaths, and soldiers missing in action). It also provides some time-series evidence on the evolution of the out-of-wedlock fertility ratio in Bavaria over the last century and discusses the large inflow of refugees into the state after the war in terms of its timing, size, and final allocation, as well as the stationing of allied (US) occupation troops.

2.1 Theoretical Considerations

Men seek women, and women seek men for companionship, sex, reproduction, and marriage. Throughout history, mating and marriage markets, as well as sexual behavior, have been strictly regulated by societies. None of them, however, has arguably ever been completely shielded from the laws of supply and demand. Although explicit prices are rarely observed, implicit prices do exist on the marriage market, and they can be expected to vary as market conditions change, i.e. as the relative abundance of the two sexes or the sex ratio is altered. In Beckerian theories of marriage and family formation (Becker, 1991), sex ratios are therefore seen as a key factor that influences the division of bargaining power between women and men, affecting potentially a wide variety of family-related outcomes, such as marriage propensities, the division between spouses of the gains from marriage, marital instability, and female labor force participation (the study by Chiappori, Fortin, and Lacroix (2001) is a prominent recent example).

Social scientists Guttentag and Secord (1983) were among the first to apply this reasoning to modes of fertility, that is to the respective relative prevalences of marital and non-marital childbearing. If men are relatively abundant, Guttentag and Secord argue, that is if the sex ratio is high, women have greater bargaining power vis-à-vis men, which enables them to trade sex which men desire for marriage and two-parent child care, that is for male commitment and financial transfers. If the sex ratio is low, in contrast, women are in a weaker position to demand and ultimately secure such male commitment and high levels of paternal support in the rearing of offspring. Women that want to maintain a relationship in such a situation may find themselves more pressured to succumb to male demands for uncommitted sex, and women that get pregnant (wanted or unwanted) may run a greater risk of being abandoned by their partners. Numerous subsequent studies, but most notably the work by Wilson (1987), have further promoted and made prominent, both within and outside economics, this potential causal pathway between sex ratios and observed fertility behavior. Before we discuss a complementary casual pathway, we will

briefly elaborate on why women and men may pursue different objectives on the mating market, as is implicitly assumed in the above line of reasoning, and document how economists have incorporated this argument in theoretical models of out-of-wedlock childbearing.

There is ample evidence for the existence of marked differences in the respective mating market behavior of women and men. In particular, it has been found that men more than women tend to aspire to multiple partners, casual sex, and uncommitted partnerships (see, for instance, Buss, 2002). Several factors may account for these differences. As men more than women may add to their offspring quantity through promiscuous mating (Trivers, 1972), they face a higher opportunity cost of marriage in terms of reproductive potential foregone. They can also more easily or at lower cost desert both partner and (unborn) child, hence evade costly commitment and parenting, if the continuation of a partnership or pregnancy is unwanted. As children are a public good to their parents (e.g. Smith, 1977, Weiss and Willis, 1985), men may hence more easily free-ride on the parental investment of their female partners. And they may be more inclined to do so, when the costs associated with such behavior in terms of stigma or subsequent search for a new partner are low, as is likely to be the case in a low sex ratio environment. Pregnant women also tend to be more dependent on outside support than soon-to-be-fathers, and out-of-wedlock motherhood, at least traditionally, tends to carry more of a social stigma than unwed fatherhood. As suggested in Guttentag and Secord (1983), therefore, women and men are likely to make different use of enhanced bargaining power when faced with a favorable mating environment, i.e. the effects of sex ratio changes on marriage market and fertility outcomes can be expected to differ depending on which sex finds itself in excess demand or supply. In particular, a fall in the sex ratio, i.e. a decline in the relative abundance of men, should cause mating and reproductive behavior in society to assume more the kind favored by men, resulting in a greater prevalence of casual and uncommitted sex and a rise in out-of-wedlock childbearing (Wilson, 2002).

These differences in constraints and opportunities faced by women and men have inspired economic research on various aspects of marriage and nonmarital fertility. With respect to the former, a recent study has shown them to be sufficient determinants of individual mating behavior to derive a microeconomic foundation for the institution of marriage (Bethmann and Kvasnicka, 2007). And as to nonmarital fertility, prominent economic models of out-of-wedlock childbearing rely heavily on them. Willis (1999), for example, derives a general equilibrium model in which low sex ratios cause some men to forgo marriage in order to father as many children as possible out of wedlock with different women who subsequently raise their children with little paternal support. Akerlof, Yellen, and Katz (1996) also emphasize the role of sex differences in the preference for partnership commitment and inter-, as well as intra-sexual competition. In their analysis of the trend increase in out-of-wedlock childbearing observed in the US and other major countries since the late 1960s, they argue that the introduction of the contraceptive

pill and the legalization of abortion has led to increased intra-female competition between women willing and women not willing to adopt these new technologies. As men, which are assumed to be interested in uncommitted and non-reproductive sex, favored women who adopted these contraceptive methods over women that did not, women who refused their use were put at a competitive disadvantage. For the latter, these technological advancements hence led to a de facto reduction in the sex ratio of men to women that were willing to commit (get married) in the event of pregnancy. As a result of the consequent deterioration in the bargaining power of women, the study concludes, men could demand more successfully uncommitted sex from women that previously would not have succumbed to such demands.

A complementary potential causal pathway by which sex ratio declines may increase out-of-wedlock childbearing are induced changes in the magnitude of economic resources available to women. The drafting of men during WWII may have well drawn many women permanently into the labor force in Germany, as was the case in the US (see, for example, Acemoglu, Autor, and Lyle, 2004). If indeed so, then among those women that experienced an increase in their own sources of income, the prospects of unwed motherhood with potentially little, or at least more uncertain paternal support might have become somewhat less worrisome and costly to women. As a result, more women might have engaged in potentially reproductive sex outside marriage. And among those women that did get pregnant, even if unwanted, a larger share than hitherto the case might have decided to bear and rear their children out-of-wedlock. This line of reasoning can be found, for example, in the work of Willis (1999), who investigates the potential causes of out-of-wedlock childbearing and its trend increase over time. According to the author, low sex ratios and an increased command by females of independent sources of income (including government transfers) may have combined forces, inducing men to forgo marriage in greater numbers and causing unwed women to willingly bear and rear their children out of wedlock more frequently.

Both of these pathways, and potentially others still, might have been at work in post-war Germany. If so, they are likely to have joined forces, complementing and reinforcing each other, for each ultimately originates from a decline in the sex ratio, and each by and of itself predicts a rise in the out-of-wedlock birth ratio. The respective quantitative importance of each of these pathways might, of course, be quite different. In the present study, we will not investigate these individual channels. Our empirical analysis of the relationship between changes in sex ratios and observed fertility behavior at mid century will be exclusively reduced form in kind, leaving an investigation of these different causal pathways to complementary future research.

2.2 Previous Research

Early thoughts on the sex ratio can be traced back as far as Charles Darwin and his work on the descent of man (Darwin, 1874). First empirical studies on the potential link between sex ratios and marriage rates appeared in the 1930s and 1940s (Groves and Ogburn, 1928; Cox, 1940), but it was not until Gary Becker's

seminal work on a theory of marriage in the early 1970s that empirical studies began to research in greater numbers the effects of sex ratios on marriage market outcomes and modes of fertility. As the following literature review illustrates, however, empirical studies on the link between sex ratios and out-of-wedlock fertility are still scant and furthermore largely descriptive in nature. They are also predominantly for the U.S and strongly focused on racial differences in fertility behavior, as out-of-wedlock birth have tended to be much more prevalent among blacks than whites in the last decades. To the best of our knowledge, no empirical studies exist that investigate the effects of WWII-induced sex ratio changes on the prevalence of nonmarital fertility.

Correlating sex ratios among black and white Americans with the respective marriage rates and out-of-wedlock birth ratios of both racial groups across states in the US for 1970, Guttentag and Secord (1983) find the proportion of births that were out-of-wedlock among both racial groups to decrease in their respective sex ratios at state level, an effect that proved stronger for blacks than for whites. Academic interest in the link between sex ratios and nonmarital fertility was further stimulated by the prominent works of Wilson and Neckermann (1986) and Wilson (1987), who hypothesized that low female marriage rates and high rates of out-of-wedlock fertility in inner cities among black women in the US could be explained by the lack of marriageable black men. They attributed this shortfall to both their low numbers (because of high rates of incarceration and violent deaths) and their average weak earnings potential (because of high unemployment), but produced only descriptive statistics to support their claim. Similarly, Fossett and Kiecolt (1990), in a study on rural areas in Louisiana also find the sex ratio among African Americans to be inversely correlated with the risk of a black child being born out-of-wedlock. South and Lloyd (1992a/1992b) and Fossett and Kiecolt (1993) come to similar conclusions for U.S. metropolitan areas in 1980, based on cross-section regression analysis using census (Public Use Microdata Samples, PUMS) and vital statistics data (National Center for Health Statistics data files).

None of the studies reviewed above is based on a quasi-experimental design. As argued in the introduction, a potential problem is therefore that confounding factors may affect the relationship between sex ratios and measures of out-of-wedlock fertility. Across regions, sex ratios vary predominantly as a result of endogenous sex-biased migration. If the latter is driven by factors that by themselves are conducive to higher rates of nonmarital fertility, such as a generally greater prevalence of liberal attitudes among female migrants to metropolitan areas, then any causality inferred from correlations observed between sex ratios and out-of-wedlock fertility may be spurious. War-induced variations in regional sex ratio changes, as caused by WWII in Bavaria, may provide a natural experiment that can overcome these potential problems in the study of the effects of sex ratio imbalances on nonmarital fertility levels.

2.3 World War II, Missing Men, and Out-Of-Wedlock Fertility in Bavaria

On the 8th of May 1945, Germany surrendered unconditionally. After six years of war, it was both impoverished and devastated. The victorious allied forces occupied Germany and assumed complete control of its social, political, and economic life. Soon, however, they began to foster the economic and political reconstruction of defeated Germany. German government, in particular, was to be restored, at least in the West, along decentralized, federalist lines that would provide a counterweight to any future tendency of centralizing totalitarianism. One of the first states (Länder) to be founded after the war was Bavaria (28.9.1945). As the second most populous and largest state in territory after the war, Bavaria accounted for slightly more than half the resident population of the American occupation zone in 1946.¹ Subdivided into five districts (Regierungsbezirke) and 168 counties (Kreise), Bavaria was not a new administrative creation, unlike the majority of German states created after the war. Moreover, apart from the loss of the Rhinepfalz exclave to the newly formed state of Rhineland-Palatinate in the West, Bavaria remained firmly within its historic boundaries (for details see Table A.2 in the appendix).

Despite a significant military and civilian death toll, estimated at a fifth of a million in 1946, and the continuing absence of nearly half a million military personnel either held in war captivity or recorded as missing in action (June 1947 estimate), its population had increased by roughly 1.75 million, or 24.9%, from 7.04 million in 1939 to 8.79 million in 1946. This net increase is mainly attributable to the influx of large numbers of refugees and displaced persons. Totalling 1.67 million at the time of the 1946 census, refugees arrived in particular from the Sudetenland (Czechoslovakia) and Silesia (Poland). In addition, 0.42 million people, which had been resident in the later territory of the four occupation zones and Berlin in September 1939, moved to Bavaria by 1946, most of which had been evacuated from their homes. The population changes induced by WWII have thus been truly tremendous both in their scale and in their scope.

Most military casualties, pows, and missing military personnel were prime-aged men, which had a profound impact on age-specific sex ratios in Bavaria. As shown in Figure 1, the relative number of men per women in 1946 starts to fall significantly and abruptly from age nineteen and reaches a minimum in the low- to mid-twenties of the age distribution. Although the sex ratio slowly recovers thereafter, it remains significantly depressed up to the age of about forty-five. WWII, therefore, led to a dramatic shortage of prime-aged men in Bavaria, particularly among the 20 to 40 age cohort. This unprecedented female marriage squeeze implied that for every third women of prime marriageable age (20-40) in Bavaria there simply wasn't a potential husband and hence any prospect to wed at the time. The second but more moderate dip observable in the 1946 sex ratio at ages 47-68 reflects the military losses incurred during World War I (WWI). These age cohorts correspond to the 19-40 years olds in 1918.

¹The American occupation zone included the German states (Länder) of Bavaria, Hesse, Wuerttemberg-Baden, the cities of Bremen and Bremerhaven in the north of Germany, and one sector of Berlin.

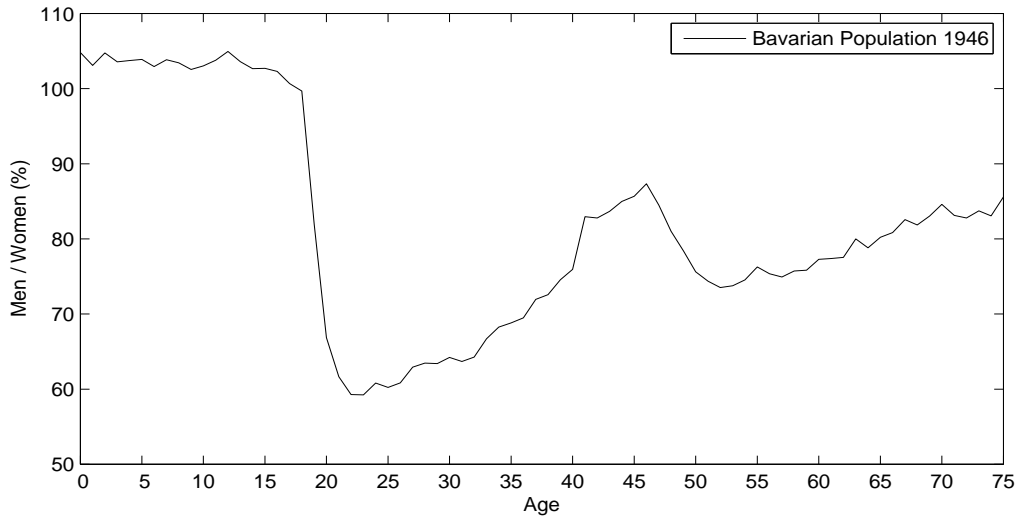


FIG. 1: Post World War II sex ratios by age in Bavaria, October 1946 census.

Both world wars also led to sharp albeit temporary increases in the share of out-of-wedlock births in Bavaria. As documented in Figure 2, the fraction of nonmarital births started to rise well in the course of both military conflicts, peaked in their immediate aftermaths, and leveled off rapidly thereafter. In magnitude, however, the change (absolute and relative) induced by WWII far exceeded that of its predecessor. Between 1939 and 1946, the share of nonmarital births in Bavaria more than doubled from 10.0% to 21.5%. In historical perspective, the magnitude of nonmarital fertility encountered after WWII is truly exceptional. At no time in the first half of the 20th century, nor in the fifty years that followed did nonmarital fertility ever again assume such heights. After a long and steady decline in the prosperous 1950s and 1960s, and a subsequent first gradual, then strong trend increase from the late 1970s onwards, it was only in 2004 that the nonmarital fertility ratio in Bavaria again reached a comparable magnitude. Over time, the evolution of the nonmarital fertility ratio closely tracks that of the total number of nonmarital births. Increases or declines in the ratio were therefore not just driven by changes in marital fertility. The final stages of WWII and its immediate aftermath, in particular, were characterized by a dramatic hike in the total number of out-of-wedlock births that closely parallels the rise in the nonmarital fertility ratio at the time. At the end of WWI, in contrast, the nonmarital fertility ratio peaked already well before the total number of out-of-wedlock births reached its post-war local maximum. The rise in the ratio in the final stages of WWI must therefore have been in large part driven by declines in marital fertility levels. As the latter picked up after the war, the nonmarital fertility ratio declined, although the number of births out-of-wedlock continued to rise. A greater backlog of marital births during WWI is generally held accountable for this post-war baby boom. This pattern stands in stark contrast to the situation encountered after WWII. This time, no major backlog in marital births existed, as soldiers had ample opportunity to procreate during the war, at least in its first half, because of frequent and generous

furlough granted by the military authorities (see, for example, Mühle, 1947).

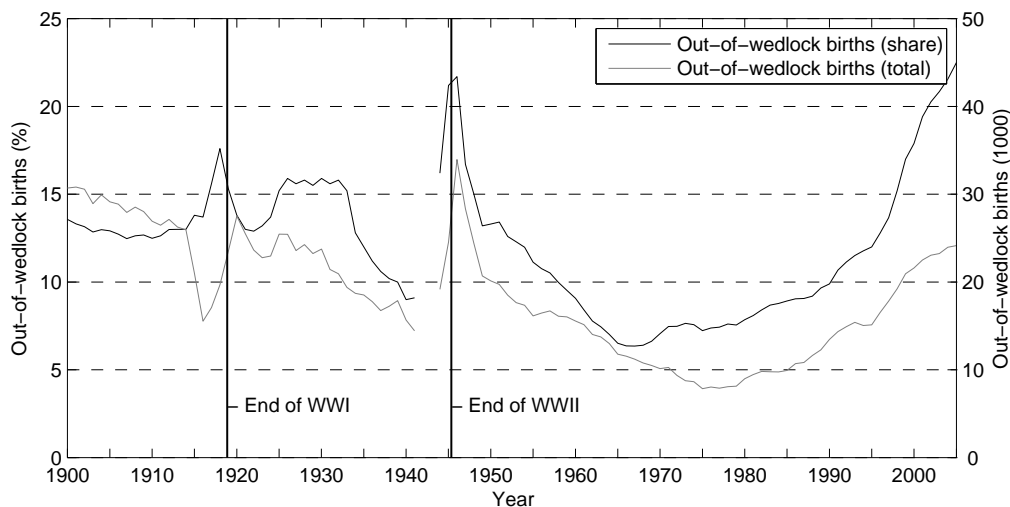


FIG. 2: Out-of-wedlock births in Bavaria (share and total), 1900-2005.

Although on a far less dramatic scale, the interwar years too witnessed significant changes in out-of-wedlock fertility. After having returned to its pre-war level in the early 1920s, the share of nonmarital births first rose against the backlog of political and economic instability that came to characterize the mid-1920s to early 1930s, and then experienced a long and steady decline from 1933 until the outbreak of WWII. Improvements in economic conditions, marriage-promoting policies under the National Socialist regime, and a decline in the share of younger age cohorts among the fertile population, i.e. of groups traditionally more prone to nonmarital fertility, have been suggested to underlie this trend decline.²

The dramatic surge in nonmarital fertility after WWII had far-reaching social repercussions. It caused great concern among German policy makers at the time and fueled public debates on the worrisome decline of moral sentiment. Inspired by the need to cushion the likely adverse effects of nonmarital birth status for kids born out-of-wedlock, a special provision was included in the later West German Constitution, i.e. the Basic Law, that mandates their equal treatment before the law.³ In practice, however, children born out of wedlock and their parents continued to face various forms of discrimination and legal obstacles, as traditional family values resurged in backlash to the post-war turmoil and perceived moral decay (see Buske, 2004 for a detailed account).

2.3.1 Prisoners of War, Military Casualties, and Missing Military Personnel

Military casualties, prisoners of war, and missing military personnel account for most of the severe post-war sex ratio imbalance in Bavaria. According to the 1947 Statistical Yearbook of Bavaria, 169,960

²From 1933 onwards, newly married couples could apply to the state for special loans at low interest. For each child subsequently born, 25% of the loan was waived. In Bavaria, 16.8% of all couples marrying in 1933 received such a loan, a figure that rose to 33.5% in 1939 (see Pupeter, 1942).

³See Article 6, Section 5 of the Basic Law of the Federal Republic of Germany which came into effect in May 1949.

military casualties were recorded between September 1939 and December 1946. The first count of pows and missing military personnel in Bavaria was carried out only in June 1947, two full years after the war had ended (its main findings are summarized in Swoboda, 1948). Although 6 months after the first post-war census, the numbers recorded in this registration differ only marginally from the situation encountered in October 1946. For 99.3% of the military personnel recorded as missing in June 1947, the last sign of life had been received already prior to January 1 1946.⁴ Furthermore, only 33,000 pows returned between the end of October 1946 and June 1947 (Wronski, 1948).

At the time of the June 1947 count, 445,827 members of the Wehrmacht were recorded to be still either in war captivity or missing. Pows accounted for slightly less than half the total number (212,494 or 47.7%), being mostly detained in the Soviet Union (49.4%), in France (25.1%), and in England (10.0%). 99.9% of pows and missing military personnel were male, predominantly of prime age. These two groups of missing men accounted for a significant share of the 1946 male census count in Bavaria. In the 20-40 age bracket, their total would have increased the respective male census figure by no less than 35.6%. After June 1947, pows and missing military personnel remained slow to return. By June 1948, i.e. one full year later, only 80,923 pows had come back, that is less than two out of five captives recorded in the 1947 registration. Among missing military personnel, the rate of return was truly miniscule (1002 or 0.4% of the respective June 1947 count), which made this group contribute only 1.2.% of all repatriates. In sum therefore, the respective numbers of military casualties, pows, and missing military personnel reported in these sources provide not only a very accurate representation of the respective sizes of these groups at the time of the October 1946 census, but also continued to do so for an extended period after this first post-war census in Germany.

Changing drafting regulations and erratic swings in military fortunes, frequent redeployments of troops to different theaters of combat, and last but not least the scale and totality of losses incurred by the German armed forces during WWII left little room for systematic differences across soldiers in terms of risks of subsequent death, war captivity, or ending as missing in action. Indeed, drafting regulations for the Wehrmacht knew both few exemptions and few rules for differential assignments of soldiers. Moreover, in the course of WWII, drafting procedures became increasingly strict and more encompassing, as ever larger numbers of dead soldiers had to be replaced from a pool of potential recruits that was shrinking considerably in size. In a last effort to protract the inevitable military defeat, even the very young and the old (aged 16 to 60) were drafted in the so-called Volkssturm from September 1944. The greatest number of casualties were incurred by the Wehrmacht in 1944 and in the spring of 1945. According to the military historian Rüdiger Overmans (Overmans, 1999), both years saw 62.9% of all German military

⁴The distribution of the dates that last signs of life had been received from soldiers recorded as missing in the June 1947 registration provides strong support for the finding of Overmans (1999, p.238) that the final phase of WWII was by far the most costly in terms of German military losses. The period between January 1 1944 and 8 May 1945 accounted for 76.2% of all recorded missing personnel in the June 1947 registration.

losses incurred during the war, with the five months from December 1944 to April 1945 alone accounting for more than ten times as many dead soldiers than the entire first one and a half years of WWII (approx. 1.5 million vs. 130,000).

2.3.2 Refugees

The second major population change in Bavaria induced by WWII stems from the large inflow of refugees which caused a sizeable net increase in the state's population. This section documents this inflow and reviews its size, timing and composition, as well as the determinants of the final allocation of refugees across different regions in Bavaria.

Refugees accounted for 19.0% of the October 1946 Bavarian population.⁵ Of these 1.67 million refugees, 53% had fled or were expelled from the Sudetenland and 26% from Silesia. As shown in Figure 3, age-specific sex ratios among refugees exhibited the same general pattern as those for the Bavarian population excluding refugees. The shortage of men among younger age cohorts, however, is somewhat less pronounced among refugees. As suggested in Haerendel (1994, p. 23), this difference can be explained by the sizeable presence among refugees of discharged pows that had been unable to return to their homes in the east when released from captivity. Refugees came in two main flows to Bavaria. The first inflow started to set in before the war had ended in early 1945 and lasted until December 1945. It consisted mainly of Germans to the east of the Oder-Neisse line that were fleeing from the advancing Soviet troops. Of the 513,000 refugees that had arrived in Bavaria by December 1945, the great majority settled no further than in the immediate border districts of Niederbayern-Oberpfalz (39.8%) and Oberfranken-Niederfranken (31.8%) in the north-east of Bavaria. The second and larger inflow began in January 1946 and ended in December of the same year, the so-called ordered expulsion of Germans from the Sudetenland, which had been decided at the Potsdam Conference in July/August 1945. In the course of 1946, more than 786,000 refugees were brought to Bavaria in organized rail transports, accompanied by another 176,000 individuals who arrived on foot.⁶ The latter consisted mostly of discharged pows, as already noted, and men which had at first been held back by the Czechoslovakian authorities.

Refugees were allocated by the Bavarian authorities to different counties almost exclusively on the basis of free housing capacity (cf. Haerendel, 1994, p. 39; Bauer, 1982, p. 27-28). The latter, in turn, was largely determined by the extent of housing stock destroyed during the war. Given the scale of their destruction, intake capacities of metropolitan areas were generally quite low compared to those of rural areas. Major cities, being especially hard hit, were even often completely closed off by the authorities.⁷

⁵The 1946 census defined refugees as persons of German mother tongue who had been resident outside the territory of the four occupation zones and Berlin on the 1st of September 1939.

⁶Monthly arrival rates of refugees in 1946 peaked in June and declined rapidly thereafter. Less than 20,000 refugees arrived in the last 2 months of 1946, i.e. after the October census (Bayerisches Staatsministerium des Innern, 1947, p. 12).

⁷Of the September 1939 housing stock, 74.7% had been totally destroyed in Würzburg, 49.3% in Nuremberg, 37.9% in Aschaffenburg, 33.7% in Schweinfurt, 33.2% in Munich, and 24.0% in Augsburg (Bayerisches Statistisches Landesamt, 1948).

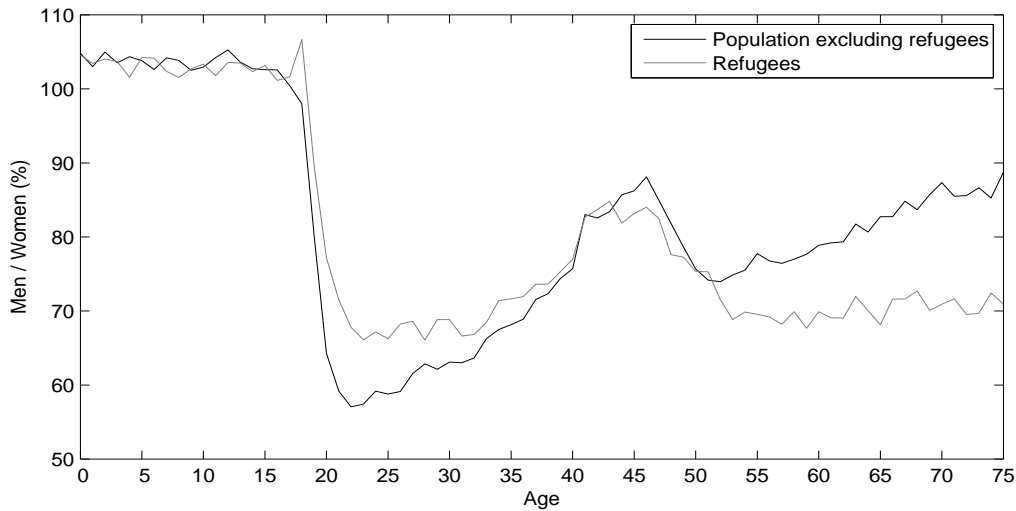


FIG. 3: Age-specific sex ratios of population and refugees, October 1946 census.

The majority of refugees, as a consequence, was allocated to the countryside. Three quarters of all refugees at the time of the 1946 census were in fact located in municipalities with less than 5,000 inhabitants.

Once allocated, refugees remained severely restricted in their subsequent ability to change residence. Already in February 1946, a general ban on cross-county migration had been imposed by the Bavarian state commissioner for refugees (Bayerische Staatskanzlei, 1946, p. 2). Although first exceptions were introduced from August 1946, significant administrative barriers remained in force, in particular, the requirement to obtain official approval for residence changes from the district authorities (Bauer, 1982, p. 207). The continuing shortage of housing space and lack of transport facilities furthermore proved to be major and persistent obstacles to cross-county mobility. General freedom of movement within Bavaria was reintroduced only in May 1949 (Bayerisches Staatsministerium des Innern, 1949, p. 1), and remaining restrictions on migration to regions particularly precarious in their housing situation lifted altogether only as late as June 1950 (Allied High Commission, 1950, p. 414). The initial allocation of refugees across counties, as a consequence, proved to be very persistent for an extended period of time.

Summarizing the above, Germans in the East not only fled or were expelled wholesale in the final stages and immediate aftermath of WWII, i.e. irrespective of their economic status, sex, or age, but were allocated across counties by the Bavarian authorities with little more in mind than the immediate necessity to accommodate them. Moreover, refugees remained severely circumscribed in their subsequent freedom of movement. These features are very important for analytical reasons, because they leave little room for factors related to these population displacements that could potentially confound the relationship at county level between sex ratio changes induced by these refugee flows and the prevalence of out-of-wedlock fertility. This is a clear advantage over studies that have investigated the effects of immigration induced sex ratio changes in peace times, for immigration flows are usually endogenous not only with respect to

their underlying causes, but also in terms of their composition and ultimate destination.

2.3.3 Occupation troops

Apart from refugees that flood into Bavaria after the war, and soldiers still missing (losses, pows, soldiers m.i.a.), the stationing of allied occupation troops constitutes the third major population change induced by WWII. Detailed data on US military occupation forces, i.e. their regional distribution and troop strengths in Bavarian counties, are not available for the early years of the occupation, which precludes statistical analyzes of their quantitative importance for post-war county-level differences in the prevalence of nonmarital fertility in Bavaria.⁸ Like all personnel of the allied forces stationed in Germany, they had also been exempted from (not included in) the 1946 census count. US soldiers in Bavaria, although numerous on VE-day (victory in Europe), however, accounted for but a fraction of the war-induced male shortfall at the time births in 1947 and 1948 were sired, a result of the massive redeployment of troops from Europe that set in as soon as hostilities had ceased.⁹ Authorized troop strength of the US military in Bavaria on 30 June 1947, for instance, amounted to only 117,000, or one fifth of the 600,000 German soldiers dead, imprisoned or missing in action at this time.¹⁰ In no way, therefore, did US troops compensate for the massive shortfall among German men at the time that children born in 1947/1948 were sired.

A ban on nonfraternization notwithstanding, US soldiers had however frequent and often intimate contact with German women.¹¹ Contemporary statistics on the number of (out-of-wedlock) children fathered by American soldiers, dubbed by Germans at the time as *Besatzungskinder* or occupation children, are however non-existent. For fear of negative publicity and to prevent paternity and child support suits filed against US soldiers, American military government had explicitly prohibited state youth and welfare offices within their zone of occupation to sample such data (see Fehrenbach, 2005, p. 69).¹² Unrestrained sexual activity of US soldiers in the early post-war years was a primary concern to area command because of its adverse effects on German public opinion, growing concerns at the homefront about the conduct of US troops stationed abroad, and the dramatic spread of sexually transmitted diseases.

⁸Records at the Military History Office (MHO) at the headquarter of the United States Army in Europe (USARUER) in Heidelberg, Germany do not contain information on the strength and distribution of US troops in Bavaria. Station Lists for Germany for 1945-1949, held at the US National Archives in Maryland, also lack regional statistics on unit strength.

⁹Between 12 May 1945 and 30 June 1946, 3,044,985 soldiers, or 99.2% of theater strength on VE-day were redeployed from Europe (most of whom were not replaced by new troops), the majority to the US for demobilization (Frederiksen, 1953 p 46).

¹⁰Figure provided by courtesy of Bruce Siemon, chief historian at USAREUR headquarters.

¹¹The directive on nonfraternization was issued a day after first allied troops entered German territory on 11 September 1944. Inspired by security concerns and the perception of collective German war guilt, it forbade allied military personnel to engage in any inter-personal contacts with the civilian German population. Although terminated as an official occupation policy on 1 October 1945, marriages with Germans remained prohibited until December 1946 and general contact with the civilian population continued to be discouraged officially. For an in-depth account of the evolution and effectiveness of the nonfraternization policy, see Frederiksen (1953), pp.129-139.

¹²The first official count by German authorities was carried out as late as 30 April 1955 and lacked detailed regional statistics. For Bavaria as whole, it attributed 8.4% (5.9%) of all kids born out-of-wedlock in 1947 (1948) to members of the US occupation forces (Schmidt, 1955).

Technically, the non-inclusion of (in the majority male) US occupation personnel from our county-level count of men introduces measurement error into our sex ratio variable. The latter, however, will only cause a bias in our estimates (apart from reducing their precision), if it is systematically correlated across counties with our census-based sex ratio measure. This is highly unlikely. For the stationing of (predominantly male) US troops in post-war Bavarian counties was determined by altogether different factors than the war-induced county-level shortfalls among German men. The regional stationing and strength of US troops in 1946-1948, i.e. the years relevant for births recorded in 1947/1948, was dictated entirely by post-war administrative and security considerations on part of the US army command. County-level shortfalls among German men, in contrast, i.e. military casualties, pows, and missing military personnel, were mostly incurred outside Bavaria and during combat in the course of WWII. The need to house US military personnel in the early occupation could have had the potential to introduce some correlation between the number of troops stationed in a county and the size of war-induced male shortfalls among the resident German population. But the nonfraternization ban in force from September 1944 explicitly forbid the billeting of US troops with Germans (see, for example, Goedde, 1999), a proscription that was stringently enforced by US area command. For these reasons, we believe it rather unlikely that the measurement error in our county-level sex ratio variable will cause some bias in our regression estimates.

3 Data

No electronic dataset exists for Bavaria (and indeed neither for Germany, nor for any other German state) that contains regional population and fertility information, let alone individual-level data, for the immediate pre- and post-WWII period. To carry out this study, we collected and then processed all county-level information used in the empirical analysis from original statistical series published in the late 1930s and second half of the 1940s, obtained from various national and state archives, statistical offices, and libraries. The various sources used in the generation of this unique dataset together with our sampling strategy are described in Section 3.1. Section 3.2 documents and discusses the individual variables created from this raw data that are subsequently used in our regression analysis, and Section 3.3 presents some summary statistics for our final estimation sample.

3.1 Data Sources and Sampling Strategy

The empirical analysis is based on aggregate county-level data for the civilian population in Bavaria in the immediate forefront and aftermath of WWII. The data covers 156 counties and has been compiled from printed publications of the Bavarian Statistical Office (Bayerisches Statistisches Landesamt), which continued to operate almost uninterrupted for the period under investigation, and the Statistical Office of the Reich (Statistisches Reichsamt).¹³ The data set reflects the county-level structure and territorial

¹³A detailed tabulation of the various statistical publications used is provided in Table (A.1) in the appendix.

organization of Bavaria on the day of the first post-war census, i.e. the 29th of October 1946. Of the 168 counties at this time, 12 had been subject to territorial changes after the May 1939 census, i.e. our pre-war sampling point, and were hence excluded from the estimation sample.¹⁴ A timeline summarizing our data sampling strategy is represented graphically in Figure 4.

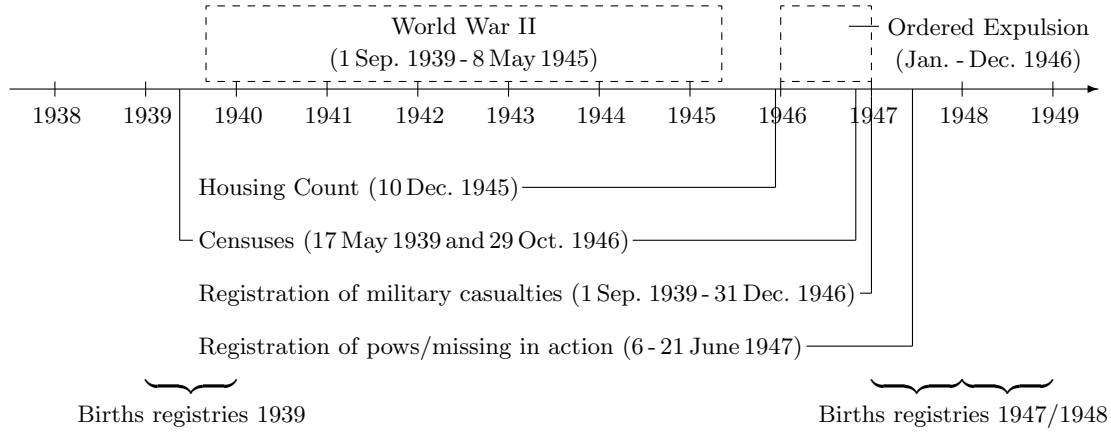


FIG. 4: Timeline of data sampling strategy.

Censuses carried out on May 17 1939 and October 29 1946 - the latter under the auspices of the allied occupation forces in Germany - are our primary sources of information on the levels and characteristics of county populations in Bavaria in the forefront and aftermath of WWII. Stock measures sampled from the two censuses include the sizes of county populations (total, by age cohorts and sex), the numbers of refugees (1946 census only) and catholics in counties, and county-level population densities. From an analytical perspective, the timing of the two censuses is of great advantage. The May 1939 census took place in the vicinity of WWII, but well before its actual outbreak in September. The October 1946 census, in turn, as already noted, is well timed for a first stock-taking of the main population changes induced by the war. As documented in Sections 2.3.1 and 2.3.2, organized expulsions of Germans from the Sudetenland had climaxed already in June 1946, leveled off rapidly thereafter, and were terminated altogether in December of the same year. Missing military personnel, in turn, was hardly located in the years following the census, and prisoners of war were returning at but a slow pace. Administrative restrictions imposed by the German authorities furthermore made internal cross-county movements of civilians difficult if not impossible for 1946 and most of 1947. This restriction of endogenous migration flows is important. It implies that the October 1946 census figures continued to provide a quite accurate characterization of the regional population distribution in Bavaria for an extended period of time after October 1946.

In addition to the two censuses, a number of statistical sources are used for various county-level

¹⁴A list of these omitted counties together with a description of their respective border changes can be found in Table (A.2) in the appendix.

information (for detailed references, see Table A.1 in the appendix). Data on the number of military casualties recorded between September 1939 and December 1946 and the percent of the 1939 housing stock destroyed by December 1945 are sampled from special counts of the Bavarian Statistical Office. Numbers of prisoners of war and military personnel missing in action are obtained from their first official post-war registration in June 1947, which was initiated by the Allied Council of Ministers and carried out by the Bavarian Statistical Office. Finally, annual births statistics (total, marital, and nonmarital) for counties are taken from (place-of-residence) county birth registries for the years 1939 (pre-war period) and 1947 as well as 1948 (post-war period). Births recorded in 1939, by definition, must have been sired no later than April 1939 and hence well before the outbreak of WWII in September. There is no evidence to suggest that fertility in 1939, i.e. its magnitude and modes, was already affected by (potential expectations of imminent) war. Total annual births in Bavaria, rather than exhibiting a pre-war boom, actually grew somewhat less between 1938 and 1939 (6.4%) than between 1937 and 1938 (7.0%), the 1939 nonmarital fertility ratio remained virtually identical to that of 1938 (10.2% vs. 10.0%), and the number of births recorded between September and December 1939, i.e. the first four months of WWII, showed hardly any change from that recorded during the same months in 1938 (a plus of only 1.3%).¹⁵ As to the aftermath of WWII, we consider births in 1947 rather than births in 1946 to construct our post-war measures of county-level fertility. This choice is primarily motivated by the fact that the majority of refugees arrived only in the spring and summer of 1946, but also has the additional advantage in that births in 1947 were significantly less likely than births in the first two years of the occupation to be result of coercive as opposed to consensual sex of German women with members of the allied forces. New borns in 1947 must have been mothered and fathered no later than March or April 1947 and therefore at a maximum of six months after the census to be included in our post-war fertility count. Children born in early 1947, however, were sired in the spring of 1946 and hence still at a time when refugees kept arriving in great numbers. As a robustness check, therefore, we also consider births in 1948 in our empirical analysis.

3.2 Variables used in the Analysis

Non-marital Fertility Ratio: Our endogenous variable of interest, i.e. the nonmarital fertility ratio, is defined as the number of out-of-wedlock births divided by the total number of births in a given year and county. It hence represents a measure of the relative prevalence of different modes of fertility (marital vs. nonmarital). As the nonmarital fertility ratio captures the average odds of women in a county that do give birth to bear their children out-of-wedlock, it implicitly controls by design for potential county-level differences that may affect total fertility levels (the sum of marital and nonmarital births).

¹⁵Marriages, however, did grow significantly stronger from 1938 to 1939 than from 1937 to 1938 (18.1% vs. 5.4%). But two-thirds of this increase (11.9 percentage points) or almost the entire difference to the previous year's growth rate are attributable to the first four months of WWII, i.e. September to December 1939.

Sex Ratio / Male Shortfall: Depending on actual mating patterns and the types of outcome of interest, different sex ratio definitions may be preferable as the relevant measure of the respective abundances of women and men on the mating and marriage market. With information on only the total number of births in a year and county, a broad rather than a narrow sex ratio measure (in terms of age brackets considered) is required for our empirical analysis. In our baseline specification, we define the sex ratio as the number of men aged 20-50 relative to the number of women aged 14-40 times one hundred. The sex-specific age brackets used in this definition correspond to the respective prime fertility years of women and men at the time. The choice of a broad sex ratio measure, like the one employed, has a number of intrinsic advantages over alternative, more restricted sex ratios definitions.¹⁶ First, age differences between couples or eligible partners may be very dispersed, even though mean differences in age are very modest. Figure A.1 in the appendix, which plots age differences between spouses at marriage in Bavaria in 1939, suggests that such age dispersion is indeed significant in our data. Constructing our sex ratio based on narrow age ranges would therefore carry the risk of neglecting significant intra-sexual competition for potential partners across adjacent age cohorts. Second, even if women and men were seeking eligible partners from a narrow age range, this may well change if the sex ratio changes significantly. As Bavaria did experience a dramatic shortfall of prime-aged men in the aftermath of WWII, the choice of a broad sex ratio measure that is robust to such changes is once again to be preferred methodologically.¹⁷ Last but not least, broad sex ratio measures have been found to perform well empirically in analyses of marriage and fertility behavior, often outperforming alternative measures based on narrower age ranges for the type of reasons just reviewed (see Fossett and Kiecolt, 1991).

Alternative (and more direct) measures of the male shortfall induced by WWII that are used in parts of the regression analysis include the respective county-level magnitudes of military deaths, prisoners of war, and missing military personnel. Military deaths, by definition, constitute certain and permanent missings of men. Return probabilities of missing military personnel were hardly any better, as argued in Section 2.3.1, whereas prisoners of war had significant positive chances of return after the war. Women (and men) in Bavaria in the immediate aftermath of WWII might have adjusted their mating behavior in line with these differential odds of future improvements (worsening) in their respective marriage and mating market prospects. The respective relative sizes of these three groups of missing men, therefore, could have influenced the effect that county-level declines in sex ratios had on the nonmarital fertility ratio. In particular, we would expect the relative size of the group of prisoners of war to exert a moderating influence on any rise in the nonmarital fertility ratio that is induced by a given decline in the sex ratio.

¹⁶For an in-depth methodological review of the sex ratio in empirical applications, see Fossett and Kiecolt (1991).

¹⁷Age differences at marriage between spouses were indeed much more dispersed in 1947 than in 1939. The share of husbands ten or more years older than their wives at marriage, for instance, was almost three times as large in 1947 than in 1939 (12.4% vs. 4.5%), and that of husbands six years younger or older one fifth higher (36.4% vs. 29.3%). For more details, see Kellerer, 1948).

Confounding Factors: Apart from the sex ratio, i.e. our explanatory variable of primary interest, we also control for a number of potentially confounding factors. Variables included for this purpose in our regression analysis measure the extent and scope of war effects on the levels and composition of county populations, their social cohesion and average standards of living, as well as county-level infrastructure. A population density measure controls for potential differences in fertility behavior stemming from either scale effects in the mating function or population-size related differences in the relative strictness and social sanctioning of norms related to sexual behavior and procreation. A variable for the share of catholics in the population also serves the purpose of proxying for moral standards and social cohesion at county level. Furthermore, we control for the percentage of housing stock destroyed during the war and the population share of refugees in a county. While the former proxies for the degree of physical destruction counties have experienced, the latter represents a measure of both the economic situation of (often significant) parts of the population and the extent of potential disruption imposed on counties, economically and socially, by the arrival of huge numbers of refugees. As both of these latter variables, by definition, measure post-war quantities only, they will be redefined in the regression analyses to measure respectively the share of the September 1939 housing stock that is still intact and the share of non-refugees in county populations.

3.3 Summary Statistics

Summary statistics for our final estimation sample are provided in Table 1. As can be seen, all variables exhibit great dispersion across counties in both 1939 and 1946 (1947/1948) and marked changes in their average levels from the pre- to the post-war period. The latter applies in particular to our county-level measures of nonmarital fertility and the relative abundance of the two sexes. Of the 156 counties in our estimation sample, only two experienced a decline in the nonmarital fertility ratio between 1939 and 1947, and none an increase in sex ratio between 1939 and 1946. The average nonmarital fertility ratio in our estimation sample increased by two thirds from 9.4% in 1939 to 16.1% in 1947 and then levelled somewhat off to 14.4% in 1948. Our sex ratio measure, in turn, declined by one fourth from 105 men per 100 women in 1939 to as little as 76.5. Military casualties and soldiers missing in action each account for about one-third of the total number of soldiers still absent at the time of the 1946 census, prisoners of war for somewhat more than one fourth. The respective sizes of these three groups of “missing” men in their summary total also vary significantly across counties, e.g. for military casualties from 19.5% to as much as 45.6%. Refugees, in turn, on average account for 21.3% of county populations, and again their share varies greatly across counties, ranging from as little as 3.8% to 33.4%. This great dispersion reflects the already documented disproportionate allocation of refugees by the authorities to the country side because of its better opportunities to house and feed the large number of new arrivals (see Section 2.3.2). The dramatic inflow of refugees accounts also for the marked increase in average county-level population

density between 1939 and 1946. In several dimensions, therefore, did WWII lead to profound changes in county populations, their sizes, and composition.

TABLE 1: SUMMARY STATISTICS ON BAVARIAN COUNTIES, PRE- AND POST-WWII

	Year	Mean	Sd	Min	Max
Nonmarital fertility ratio (nonmarital births / total births) (%)	1939	9.4	3.8	1.9	24.4
	1947	16.1	3.8	7.0	25.6
	1948	14.4	3.9	4.6	24.8
Sex ratio (men 20-50 / women 14-40) (%)	1939	105.0	8.1	86.9	137.7
	1946	76.5	6.6	63.0	102.7
Population density (population/km ²)	1939	327.3	649.9	35.6	3,442.1
	1946	373.3	686.4	52.5	3,511.6
Catholics share (%)	1939	74.4	31.2	3.2	99.4
	1946	71.5	24.0	12.9	95.6
War deaths / total missings (%)	1946	26.6	4.0	19.5	45.6
Pows / total missings (%)	1946	34.9	2.5	26.1	40.3
Soldiers m.i.a. / total missings (%)	1946	38.5	2.6	28.2	44.1
Refugee share (%)	1946	21.3	5.8	3.8	33.4
September 1939 housing stock destroyed (%)	1945	4.2	9.3	0.0	74.7
Number of counties: 156 (150)					

NOTE: Total missings are the sum of war deaths, pows, and soldiers missing in action. As six counties lack information on the number of war deaths recorded as of December 1945, the respective three entries in the table are derived from 150 counties only.

4 Statistical Model and Results

4.1 Identification Strategy and Statistical Model

The dramatic hike in out-of-wedlock childbearing in Bavaria after WWII may have been caused by a number of factors, of which the significant war-induced fall in the sex ratio is but one potential contributor. Regime change, moral decay, and general economic hardship, in particular, may underlie much of the observed surge in nonmarital fertility after the war. To disentangle the impact of these aggregate confounding influences on out-of-wedlock fertility from the effects of war-induced sex ratio changes, our identification strategy exploits regional variations in sex ratio changes at county level in Bavaria between 1939 and 1946. Specifically, we run panel regressions with fixed county effects that control for common shifts in nonmarital fertility levels across time t (pre-war, respectively post-war period) and counties i :

$$y_{it} = \theta_t + \delta S_{it} + x'_{it}\beta + \alpha_i + u_{it}, \quad (\text{A})$$

where y_{it} is our measure of the prevalence of non-marital fertility in a county (the nonmarital fertility ratio). θ_t is an indicator variable that takes the value one for post-WWII observations and zero otherwise. It hence controls for influences on nonmarital fertility between our two sampling points that are common to all counties, such as the regime change in Germany. S_{it} is our county-level sex ratio measure, which

in the baseline specification denotes the ratio of men aged 20-50 to women aged 14-40. The vector x_{it} , in turn, contains a number of variables on time-variant county characteristics to capture effects of potentially confounding influences, α_i is a fixed county effect, and u_{it} an error term with the usual ideal properties. Fixed county effects control for time-invariant observable and unobservable characteristics of counties that may influence levels of fertility and its particular modes, including regional differences in morals, age structures, and features related to reproductive behavior more generally, such as persistent differences in mating and marriage patterns. All variables, except our post-war indicator, are specified in logs to ease the interpretation of estimated coefficients. Our underlying identification strategy is represented graphically in Figure 5. It plots changes in the out-of-wedlock birth ratio in counties between 1939 and 1947 against changes in the sex ratio between 1939 and 1946. As is evident, and foreshadowing our regression results, a strong negative relationship exists between pre-to-post-war changes in sex ratios and non-marital fertility ratios at county level.

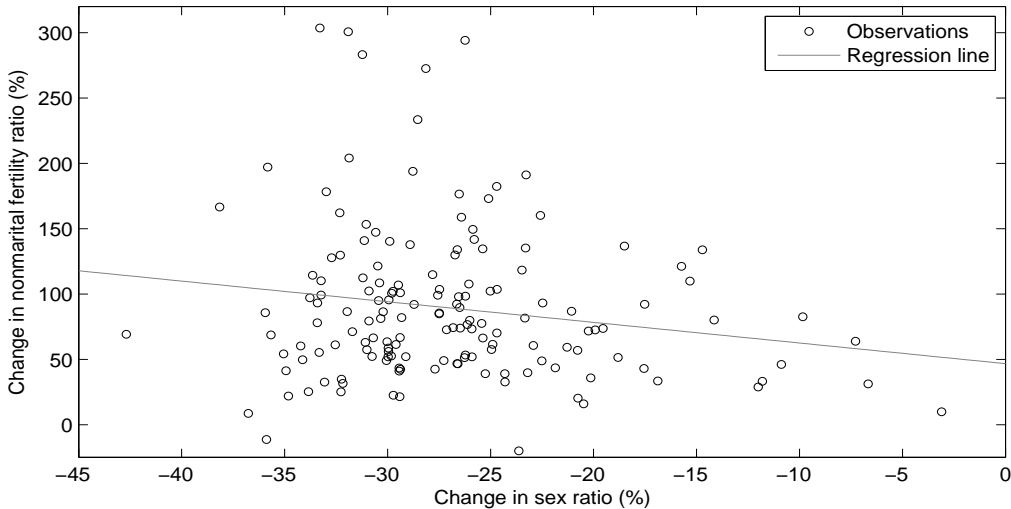


FIG. 5: Pre- to post-war percentage changes in sex ratios and nonmarital fertility ratios in Bavarian counties.

4.2 Results

4.2.1 Total Male Shortfall At County Level

In our baseline specification, we estimate five models that increasingly control for potentially confounding influences along different dimensions. In the most parsimonious specification, we regress the nonmarital fertility ratio only on a post-war indicator and our sex ratio measure. Model 2 extends this setup by including a variable for the share of non-refugees in the population of a county. Further covariates are added consecutively in Models 3 to 5. These include, in order of their addition, the share of the 1939 civilian housing stock that is still intact after the war, the population density of a county, and the share of catholics in a county population. As discussed in Section 3.2, these variables are used to control for

local differences in economic stress and population disruption caused by refugee-induced net population increases, the immediate physical effects of the war on county infrastructure and living conditions, potential scale effects in regional mating markets, and the relative strictness and social sanction of norms related to sexual behavior and nonmarital procreation. The results of these regressions are summarized in Table 2.

TABLE 2: FIXED-EFFECTS ESTIMATES FOR 1939/1947 NONMARITAL FERTILITY RATIO (in logs)

	Model A.1	Model A.2	Model A.3	Model A.4	Model A.5
Post-war indicator	0.42*** (0.09)	0.55*** (0.09)	0.68*** (0.11)	0.71*** (0.12)	0.71*** (0.12)
Sex ratio (men 20-50/women 14-40)	-0.56** (0.28)	-1.27*** (0.32)	-1.10*** (0.33)	-1.07*** (0.33)	-1.07*** (0.33)
Share non-refugees in population		1.48*** (0.37)	1.72*** (0.38)	1.50*** (0.51)	1.49*** (0.51)
Share 1939 housing stock intact			0.36* (0.18)	0.51* (0.29)	0.51* (0.29)
Population density				-0.23 (0.35)	-0.23 (0.35)
Share catholics in population					0.06 (0.06)
Constant	0.15 (1.28)	-3.36** (1.50)	-6.91*** (2.34)	-5.64* (3.03)	-5.85* (3.04)
Observations	312	312	312	312	312

NOTE: All variables are in logs. ***,**,* denote statistical significance at the 10%, 5%, and 1% level. Standard errors in parentheses.

The findings in Table 2 confirm that Bavarian counties have on average experienced a marked increase in their relative nonmarital fertility levels between 1939 and 1947. First and foremost, however, changes in the nonmarital fertility ratio at county level appear to have been strongly influenced by the magnitude of war-induced shortfalls in the relative numbers of men. Indeed, in all five models does the sex ratio exert a highly significant and strong negative effect on the nonmarital fertility ratio (that is, a decline in the sex ratio at county level increases the nonmarital fertility ratio). As argued in Section 2.1, a decline in the sex ratio reduces the mating opportunities available to women, their marriage prospects, and hence bargaining power vis-à-vis men. Our finding is consistent with this prediction. As a consequence of the unfavorable shifts in sex ratios at county level induced by WWII, women appear to have consented in greater numbers to male demands for nonmarital sex and to the prospects (of potentially unwanted) out-of-wedlock childbearing. As to the other explanatory variables, the nonmarital fertility ratio decreases in the county-level population share of refugees and in the share of the local civilian housing destroyed during the war. Both variables are highly correlated, as noted, because refugees after the war were allocated by the authorities to different counties largely on the basis of housing capacity available to accommodate them. Their estimated coefficients are hence likely to evince the same lower proclivity among refugees to procreate out-of-wedlock. Finally, neither our population density measure nor our measure of the religious cohesion of counties, as measured by the share of catholics in the population, exert a statistically significant effect on the nonmarital fertility ratio.

TABLE 3: FIXED-EFFECTS ESTIMATES FOR 1939/1948 NONMARITAL FERTILITY RATIO (in logs)

	Model A.1	Model A.2	Model A.3	Model A.4	Model A.5
Post-war indicator	0.36*** (0.08)	0.48*** (0.08)	0.60*** (0.10)	0.63*** (0.11)	0.63*** (0.11)
Sex ratio (men 20-50 / women 14-40)	-0.36 (0.24)	-1.02*** (0.28)	-0.86*** (0.29)	-0.83*** (0.29)	-0.83*** (0.29)
Share non-refugees in population		1.36*** (0.32)	1.59*** (0.34)	1.40*** (0.45)	1.40*** (0.45)
Share 1939 housing stock intact			0.35* (0.16)	0.47* (0.25)	0.47* (0.25)
Population density				-0.19 (0.30)	-0.20 (0.30)
Share catholics in population					0.04 (0.05)
Constant	-0.77 (1.13)	-3.98*** (1.32)	-7.37*** (2.05)	-6.30** (2.66)	-6.44** (2.67)
Observations	312	312	312	312	312

NOTE: All variables are in logs. ***,** denote statistical significance at the 10%, 5%, and 1% level. Standard errors in parentheses.

By the spring/summer of 1946, refugees still kept pouring into Bavaria in great numbers. As a consequence, not every individual among these newcomers counted in the October 1946 census from which we construct our sex ratio measure had already arrived in time to potentially participate in the procreation of children that were born in early 1947, i.e. the year we sample our post-war fertility data in counties. Rerunning our regressions as a robustness check, using births in 1948 instead of 1947 to construct our post-war nonmarital fertility ratio, however, leads to qualitatively unchanged results. As can be seen from the respective regression outputs in Table 3, the estimated coefficients of our sex ratio measure, while declining in absolute size, are again negative throughout and highly statistically significant in all models except the first. Our main finding, therefore, is firmly corroborated. War-induced declines in sex ratios appear to have increased county-level nonmarital fertility at the expense of childbearing in wedlock.

With data on only the annual number of births (total, marital, and nonmarital) in Bavarian counties before and after the war, we argued in Section 3.2 for the use of a broad sex-ratio measure that includes all women and men in their primary years of fertility. In the empirical analysis so far we considered the relative numbers of men aged 20-50 to that of women aged 14-40 as of the respective sampling dates of the last pre- and first post census. To check for the robustness of our results to the use of alternative - yet still fairly broad given our aggregate fertility data - sex ratio measures, we constructed a number of such measures and ran separate regressions equivalent to Model 5 in Tables 2 and 3.¹⁸ As to men, we continue to consider only those aged 20 or older in our alternative sex ratio definitions, as it was only from this lower age threshold that war-induced shortfalls of men became marked in the 1946 age

¹⁸Sex-specific population figures in the 1939 and 1946 censuses were published by age brackets only that furthermore differ in width between the two censuses. Age brackets in the 1946 census are broader and hence constitute a binding constraint on the kind of sex ratio measures that can be constructed in a consistent way for both sampling years. Separate population figures in the 1946 census are published for cohorts aged 14-19, 20-24, 25-29, 30-39, 40-49, 50-59, and 60-64.

distribution (see Figure 1). Among women, in turn, we maintain age 14 as a lower bound. This threshold roughly coincides with the average age at which women become fertile. As noted in Section 3.2, the choice of a lower minimum age for women than for men is also inspired by the fact that in the immediate vicinity of WWII, women tended to marry in far greater numbers than men already in their teenage years (see Figure A.2 in the appendix). As is evident from the main regression output in Table 4, all sex ratio variables exert a sizeable negative and statistically significant effect on the county-level nonmarital fertility ratio (the 3rd row of the table replicates our earlier regression results). Our main finding therefore of a negative relationship between the magnitude of male shortfalls and the prevalence of out-of-wedlock fertility at county level proves robust to the use of alternative sex ratio definitions.

TABLE 4: FIXED-EFFECTS ESTIMATES FOR 1939/1947('48) NONMARITAL FERTILITY RATIO (in logs)

Sex ratio measure	Δ mean sex ratio (in %)	Estimated sex ratio coefficient	
	1939 – 1946	1939 – 1947	1939 – 1948
Men 20-40 / women 14-30	-41.1	-1.07 *** (0.26)	-0.86 *** (0.23)
Men 20-40 / women 14-40	-37.5	-0.74 *** (0.26)	-0.59 ** (0.23)
Men 20-50 / women 14-40	-27.2	-1.07 *** (0.33)	-0.83 *** (0.29)
Men 20-50 / women 14-50	-27.4	-0.78 ** (0.34)	-0.62 ** (0.29)
Observations		312	312

NOTE: The tabulated coefficients were estimated from separate regressions of Model A.5 for different sex ratio measures and post-war sampling years of fertility data. Endogenous and explanatory variables are specified in logs. ***,** denote statistical significance at the 10%, 5%, and 1% level. Standard errors in parentheses.

We furthermore checked for the robustness of our results with respect to changes in the underlying estimation sample. In particular, we excluded those counties most hard hit in terms of local destruction by the war as measured by our housing stock variable (>20% of 1939 housing stock destroyed). Excluding these respectively seven counties, which as may be expected coincide with the most populous counties in pre-war Bavaria (e.g. Munich, Nuremberg, or Augsburg), did not qualitatively affect our result of an estimated negative effect of county-level sex ratios on the ratio of nonmarital to marital births. In quantitative terms, however, our estimated sex ratio coefficients declined somewhat (for births measured in 1939/1947 to -.86, and for births measured in 1939/1948 to -.65).

4.2.2 Expected Permanency of Male Shortfall at County Level (pows, m.i.a, deaths)

Across counties, war-induced shortfalls of men varied not only in size but also in composition, i.e. in the respective contributions of military deaths, prisoners of war, and missing military personnel to the summary total of men "missing" in a county after the war (see Table 1). As discussed in Section 2.3.1, these three groups of men differed markedly in their subsequent probabilities of return: zero for the first group of soldiers, chances of return were positive but minuscule for the second, and large (at least in cumulative terms) for the third. As the permanency of male shortfalls is inversely related to the marriage

market prospects that women at the time could expect to face in the future, it is likely that women and men in the early post-war years have figured in these differential rates of return when deciding on their respective mating, marriage, and reproductive behavior. If male shortfalls in a county were largely accounted for by military deaths or soldiers recorded as missing in action, women had *ceteris paribus* less reason to save themselves and hope for marriage in the near future, i.e. to refrain from (potentially reproductive) nonmarital sex, than if the bulk of "missing" men was accounted for by prisoners of war. If this conjecture is true, we would expect the post-war nonmarital fertility ratio to be less strongly affected by a decline in the sex ratio, the greater is relative size of prisoners of war in a county.

To test this hypothesis, we estimate a modified version of our regression equation (A), where we interact the log of the sex ratio with respectively the share (z_{it}^1) of prisoners of war in the 1939 county figure of men aged 20-50 and with the share (z_{it}^2) of soldiers missing in action in the same population, i.e.:

$$y_{it} = \theta_t + (\delta_0 + \delta_1 z_{it}^1 + \delta_2 z_{it}^2) S_{it} + x'_{it} \beta + \alpha_i + u_{it}. \quad (\text{B})$$

If our conjecture is correct, a larger presence of prisoners of war in a county should attenuate (make less positive) the effect of a decline in the sex ratio on the out-of-wedlock birth ratio, i.e. δ_1 should be positive and statistically significant. If soldiers missing in action are no different in their effect on the nonmarital fertility ratio in a county from soldiers that have died, we should furthermore find δ_2 to be statistically insignificant and close to zero in magnitude. The main regression output is provided in Table 5. Models A in the first and third columns reproduce for convenience the main regression output from our most elaborate specifications (Models 5) in Tables 2 and 3. Models B include the two interaction terms, as specified in equation (B). As is evident, the results provide clear support for both conjectures. A larger prevalence of prisoners of war in a county attenuates the positive effect on the nonmarital fertility ratio of a decline in the sex ratio, whereas a larger share of soldiers missing in action exerts no significant effect, neither statistically nor in terms of magnitude of the estimated coefficient.

Differences across counties in the likely permanency of male shortfalls (expected rates of return of men) encountered after WWII therefore appear to have had a sizeable effect on county-level fertility behavior. This finding may be of general importance beyond the particular historical episode analyzed in the current application. In the economics literature on sex ratio effects, only the relationship between current sex ratio imbalances and current economic, social, and demographic outcomes is generally investigated. If our findings do generalize to other applications, however, that is if future marriage market conditions differ also in other settings across regions or groups of individuals in ways that can be anticipated so as to influence current behavior, then such a restriction in focus on exclusively contemporaneous relationships between sex ratios and outcomes of interest may prove to be inadequate.

TABLE 5: FIXED-EFFECTS ESTIMATES FOR 1939/1947('48) NONMARITAL FERTILITY RATIO (in logs) ACCOUNTING FOR NATURE OF MALE SHORTFALL

	1947		1948	
	Model A.5	Model B.5	Model A.5	Model B.5
Post-war indicator	0.71*** (0.12)	0.42*** (0.13)	0.63*** (0.11)	0.40*** (0.12)
Sex ratio (men 20-50 / women 14-40)	-1.07*** (0.33)	-0.87*** (0.32)	-0.83*** (0.29)	-0.67** (0.29)
Sex ratio \times (Pows / 1939 men 20-50)		0.66* (0.35)		0.55* (0.31)
Sex ratio \times ((Soldiers mia) / 1939 men 20-50)		0.07 (0.37)		0.02 (0.33)
+ Population density				
Share non-refugees in population				
Share September 1939 housing stock intact	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>yes</i>
Share catholics in population				
Constant				
Observations	312	312	312	312

NOTE: All variables are in logs. ***,** denote statistical significance at the 10%, 5%, and 1% level. Standard errors in parentheses.

4.3 Discussion

Our results suggest a strong positive effect of declines in the relative number of men on the nonmarital fertility ratio. Being reduced-form, however, our analysis does not provide information on the particular causal pathways underlying this effect. As argued in Section 2.1, sex ratio changes may affect modes of fertility through a number of channels. In Germany at mid century, several such channels may have operated in tandem.

War-induced declines in the sex ratio increased potential mating opportunities for men but reduced them for women, which should have increased male bargaining power vis-à-vis women on the mating and marriage market. As in the model of Akerlof, Yellen, and Katz (1996), intra-female competition may have intensified as a result and intra-male competition may have lessened, making it easier for men to demand uncommitted sex. It could also have made it less costly for men to desert their female partners in the event of pregnancy, as the dramatic scarcity of men in the aftermath of WWII is likely to have reduced the potential cost of unwed fatherhood and female desertion in terms of future male mating market chances.

The drafting of men during WWII may also have drawn many women permanently into the labor force, as has been the case in the US (see, for example, Acemoglu, Autor, and Lyle, 2004). If indeed so, then among those women that experienced an increase in their own sources of income, the prospects of unwed motherhood with potentially little, or at least more uncertain paternal support might have become somewhat less worrisome. A greater number of women might hence have engaged in potentially reproductive sex outside marriage. And among those that became pregnant, a larger share than hitherto

might have decided to bear and rear their children out-of-wedlock. This explanation, as noted, is closely related to the line of argument developed in the study of Willis (1999) on out-of-wedlock childbearing and its underlying determinants.

Both of these pathways, and yet others still, might have been at work in post-war Germany. If so, they are likely to have joined forces, complementing and reinforcing each other, for each ultimately originates from a decline in the sex ratio, and each by and of itself predicts a rise in the out-of-wedlock birth ratio. While their respective contributions to observed changes in fertility behavior at mid century remain yet to be determined, our analysis has produced evidence that the net effect of war-induced sex ratio declines has been a significant increase in the out-of-wedlock birth ratio. Complementary research could fruitfully analyze these different pathways, in particular their respective quantitative importance for observed fertility behavior in the aftermath of WWII. Research on belligerent countries other than Germany, in turn, is required to assess the external validity of our findings.

5 Conclusion

Lacking a quasi-experimental design, existing studies on the effects of sex ratio imbalances on nonmarital fertility are potentially susceptible to the problems of omitted variable bias and reverse causality. Using WWII as a natural experiment, we studied the effects of sex ratio changes between 1939 and 1946 on the prevalence of out-of-wedlock childbearing in the south German state of Bavaria. Exploiting for identification cross-county variations in war-induced male shortfalls resulting from war deaths, missing military personnel, and prisoners of war, our findings provide strong evidence that war-induced county-level shortfalls in the relative number of men have significantly increased the prevalence of out-of-wedlock childbearing in the aftermath of WWII. Robust to the use of various sex ratio specifications, alternative post-war measures of county-level nonmarital fertility, as well as different estimation samples, our findings are broadly consistent with theories that stress the importance of sex ratios for the relative bargaining power of women and men on the mating and marriage market.

A further important finding of this study on Bavaria at mid century is that the effect of a decline in the sex ratio at county level appears to depend in magnitude on the nature and hence permanency of the male shortfall encountered in a county. The relative prevalence of prisoners of war among county-level male shortfalls attenuated the positive effect of a decline in the sex ratio. Unlike soldiers that have died in combat or that were missing in action after the war, prisoners of war had a significant positive chance to return home. Counties with a larger relative population of prisoners of war in the immediate aftermath of WWII could therefore expect to see a greater future improvement in the marriage market conditions faced by women. This finding may be of general importance for studies investigating the effects of sex ratio imbalances on economic, social, and demographic outcomes. For if future changes in marriage market

conditions differ also in other settings across regions and groups of individuals in important ways that can be anticipated, then a restriction in focus, as has hitherto been the case in empirical studies on the effects of sex ratios, on exclusively current measures of sex ratios may be inadequate.

A Appendix

A.1 Data Sources

The county-level data set has been constructed from statistical publications of the Bavarian Statistical Office and the annual series *Statistics of the German Empire*. A detailed list of the various publications used - organized by variable and sampling year - is provided in Table A.1.

TABLE A.1: DATA SOURCES FOR INDIVIDUAL VARIABLES USED IN THE EMPIRICAL ANALYSIS

	Pre-WWII		Post-WWII		
	1939	1945	1946	1947	1948
Births	BSL (1940)			BSL (1949)	BSL (1949)
Population	SDR (1942a)		BSL (1948c)		
Area (km ²)	SDR (1942a)		BSL (1948c)		
Refugees			BSL (1948b)		
Military casualties			BSL (1948a)		
Prisoners of war				Swo (1948)	
Soldiers m.i.a.				Swo (1948)	
Catholics	SDR (1942b)		BSL (1948c)		
Housing stock		BSL (1948a)			
Observations	156	150	156	156	156

NOTE: BSL = Bayerisches Statistisches Landesamt (Bavarian Statistical Office), SDR = Statistik des Deutschen Reiches (Statistics of the German Empire).

BSL (1940): *Zeitschrift des Bayerischen Statistischen Landesamts*, vol. 72(3/4).

BSL (1948a): *Statistisches Jahrbuch für Bayern 1947. Kreisanhang*, Statistisches Jahrbuch für Bayern, vol. 23, 369-409.

BSL (1948b): “Die Flüchtlinge in Bayern. Ergebnisse einer Sonderauszählung aus der Volks- und Berufszählung vom 29. Oktober 1946”, *Beiträge zur Statistik Bayerns*, vol. 142.

BSL (1948c): “Die Volks- und Berufszählung am 29. Oktober 1946 in Bayern. Teil I Volkszählung”, *Beiträge zur Statistik Bayerns*, vol. 145, Datenanhang.

BSL (1949): *Zeitschrift des Bayerischen Statistischen Landesamts*, vol. 81, 114-139.

SDR (1942a): “Volkszählung. Die Bevölkerung des Deutschen Reiches nach den Ergebnissen der Volkszählung 1939. Heft 1. Stand, Entwicklung und Siedlungsweise der Bevölkerung des Deutschen Reiches. Tabellenteil”, *Statistik des Deutschen Reiches*, vol. 552(1), 88-108.

SDR (1942b): “Volkszählung. Die Bevölkerung des Deutschen Reiches nach den Ergebnissen der Volkszählung 1939. Heft 3. Die Bevölkerung des Deutschen Reiches nach der Religionszugehörigkeit. Tabellenteil”, *Statistik des Deutschen Reiches*, vol. 552(3), 36-40.

Swo (1948): see Swoboda (1948) in the references.

A.3 Estimation Sample

The data set has been constructed based of the county-level structure and territorial organization of Bavaria on the 29th of October 1946, i.e. the day of the first post war census. Of the 168 Bavarian counties at the time, 12 had been subject to territorial changes, either in the inter-war period or in the immediate aftermath of WWII. These counties were omitted from the final estimation sample. A list of these counties, together with a description of their respective territorial changes, is provided in Table A.2 below. Although Bavaria had remained largely within its historical boundaries after the war, it did lose parts of its territory to adjacent states (Länder) or neighboring countries. For completeness, these losses are briefly documented. They comprise the loss of the Bavarian Rheinpfalz district to the newly created state of Rhineland-Palatinate (founded on 30 August 1946), the return of three entire counties (Bergreichenstein, Markt Eisenstein, and Prachatitz) to Czechoslovakia, and the assignment of the county of Lindau to the French occupation zone.

TABLE A.2: COUNTIES EXCLUDED FROM ESTIMATION SAMPLE BECAUSE OF CHANGES IN TERRITORY

Affected county	Territorial change	
Sonthofen	loss to	Austria
Waldmünchen	loss to	Czechoslovakia
Mellrichstadt	gain from	county Meiningen (state of Thuringia)
Burglengenfeld	exchange with	county Parsberg
Parsberg	exchange with	county Burglengenfeld
Bad Neustadt an der Saale	loss to	county Brückenau
Brückenau	gain from	county Bad Neustadt an der Saale
Kulmbach	loss to	county Kulmbach city
Kulmbach city	gain from	county Kulmbach
Gemünden	loss to	county Hammelburg
Karlstadt	loss to	county Hammelburg
Hammelburg	gain from	counties Gemünden and Karlstadt
Number of counties = 12		

A.4 Age at Marriage and Marital Status by Age

As shown in Figure A.1, age differences between men and women at marriage in 1939, although modest on average, were very dispersed and indeed large in magnitude for a significant fraction of marriages. As noted in the text, this dispersion increased markedly after WWII (see footnote 18 for further details).

Women also tended to marry in greater numbers than men already in their teenage years, both before and after the war (Figure A.3). However, the share of women (men) married in the age group 20-30 declined (increased) significantly pre- to post-war, a finding consistent with expectations given the dramatic decline in the sex ratio in Bavaria at mid century.

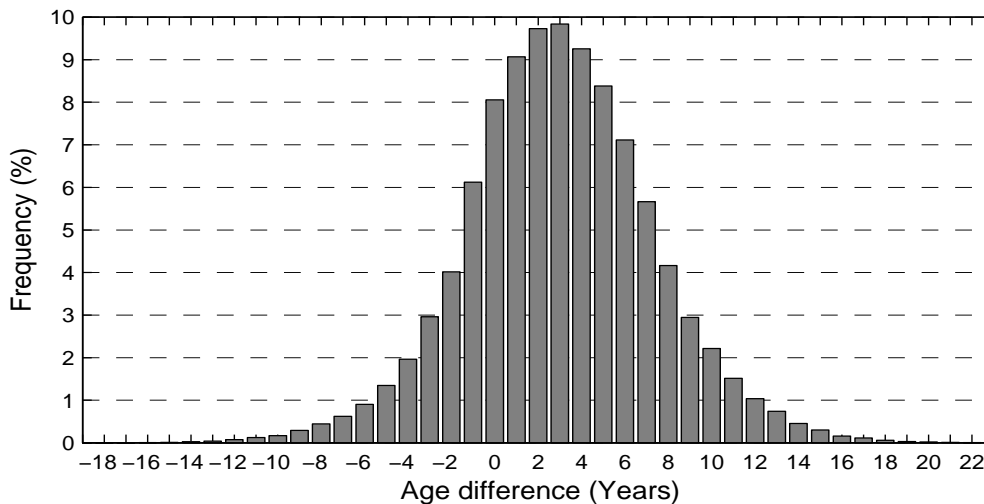


FIG. A.1: Age differences between men and women marrying in Bavaria in 1939.

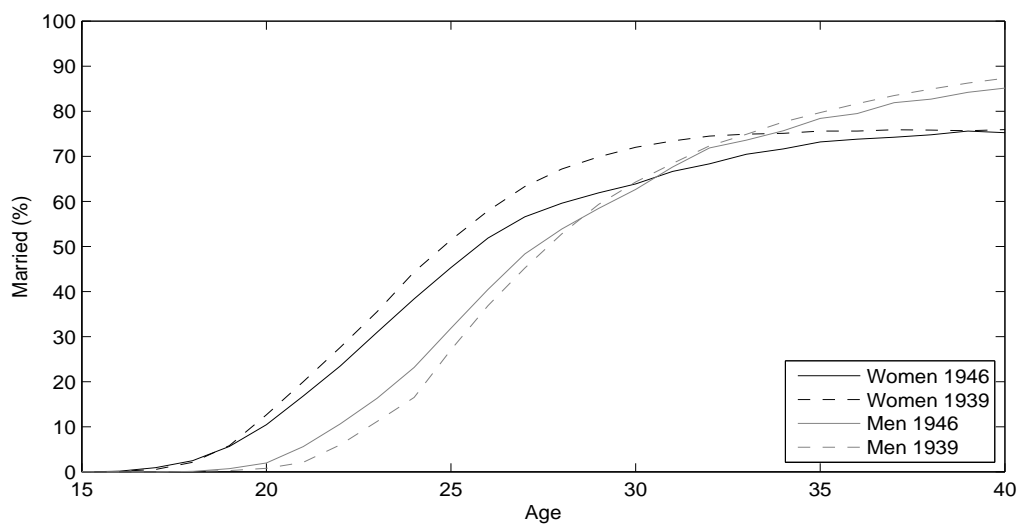


FIG. A.2: Marital status of women and men in Bavaria by age in 1939 and 1946.

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