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# Male-biased sex ratios, marriage, and household composition in early twentieth-century Hawai‘i

**Timothy Halliday**[1] | **Sumner La Croix**[1] | **Joseph Price**[2] | **Jacob Van Leeuwen**[3]

[1]Department of Economics, University of Hawai‘i-Mānoa, Honolulu, Hawaii, USA

[2]Department of Economics, Brigham Young University, Provo, Utah, USA

[3]Department of Economics, Texas A&M University, College Station, Texas, USA

**Correspondence**
Sumner La Croix, Department of Economics, University of Hawai‘i-Mānoa, Honolulu, HI, USA.
Email: lacroix@hawaii.edu

**Abstract**

Immigration to Hawai‘i between 1870 and 1930 led to a more than six-fold increase in population and high and rapidly varying sex ratios in the Chinese, Japanese, Korean, Filipino, and Caucasian populations of marriageable age. Using complete populations of the 1910, 1920, and 1930 Territorial Censuses of Hawai‘i, we estimate how male-biased ethnic sex ratios affected choices of second-generation men and women of marriageable age. Econometric results indicate that within-group and extra-group sex ratios impact the likelihood of males and females to marry, to marry a spouse from another ethnic group, to have children, and to live in larger households.

**KEYWORDS**

Hawaii, intermarriage, marriage surplus, sex ratio, territorial census

**JEL CLASSIFICATION**

N37, J12, J15

*... the marriage practice of the members of some racial groups in Hawaii is affected measurably by ... the relative size of the various groups and the sex ratios among the marriageable.*
Romanzo Adams, *Interracial Marriage in Hawaii* (1937, p. 191).

## INTRODUCTION

Between 1870 and 1930, the population of Hawai'i soared, increasing by a factor of six. This surge in population was driven by large-scale migration of male workers and some families from Asia and Europe in response to the rapidly increasing demand for plantation labour in the expanding sugar and pineapple industries. The successive waves of migration led to a complete transformation of the population's ethnic composition as well as high male-biased sex ratios for first-generation Chinese, Japanese, Korean, Filipino, and Caucasian populations. Between 1900 and 1930, sex ratios of first-generation Chinese, Japanese, Korean, Filipino, and Caucasian men and women of marriageable age were often larger than two, that is, there were more than twice as many men as women.

Hawai'i provides a golden opportunity to examine whether high and varying male-biased ethnic sex ratios have different impacts on marriage and household composition in a plantation-based colonial economy than in an industrialised economy, such as the continental United States. Consider the sharp differences between the United States and Hawai'i (La Croix, 2019). From 1898 to 1959, Hawai'i was a US colony, with the federal government retaining ultimate authority over all executive and legislative decisions, including migration to and from the colony. Hawai'i's economy was dominated in the early twentieth century by expanding cultivation of two tropical plantation crops, sugar and pineapple. Large male-biased migrations from Asia were accompanied by smaller mostly male-biased migrations from the continental US, Europe, and the Caribbean. And, most importantly, the marriage market in Hawai'i was isolated from the continental US market by internal migration restrictions applicable to virtually all first-generation Asian migrants in Hawai'i.[1]

Our paper builds on recent work by Weiss and Stecklov (2020) to estimate how two independent measures of female scarcity impacted decisions about both marriage and household composition. We follow Fenske and Gupta (2022) by using the male share of the population of marriageable age as the measure of female scarcity rather than the ratio of males to females in the population of marriageable age. This avoids introducing skewness into measures of female scarcity. Our first measure of female scarcity is an age-specific male share of the population of marriageable age in the individual's ethnic group. This is an important dimension of female scarcity because in virtually all societies, including Hawai'i, males and females from a given ethnic group typically prefer to marry within their own group.[2] Our second measure is the age-specific male share of the population of marriageable age in all other ethnic groups except the individual's own group. In a society with some social space for at least some marriages between spouses from different ethnic groups ('intermarriage'), both males and females facing

[1]Only the small Caucasian population (7.75% of overall population in 1910) had the mobility and resources to participate in the Hawai'i and US marriage markets.

[2]For Hawai'i, see early contributions on intermarriage and cultural attitudes by Adams (1937) and Cheng and Yamamura (1957). In a 1998 survey of the intermarriage literature, Kalmijn (1998, pp. 396–399) finds that preferences for an own-ethnic-group spouse stem from individuals being more attracted to potential spouses with similar cultures and traits, whereas intermarriage is determined both by preferences and opportunities to match with an own-ethnic-group spouse. In a 2013 literature survey, Schwartz (pp. 454–455) emphasises the trend over the twentieth century towards intermarriage and contrasts the perspective of modernization theory ('as societies develop, the basis of success shifts from ascribed characteristics [e.g., social origin, race/ethnicity, religion] to achieved characteristics [e.g., education, experience]') with the perspective of classical assimilation theory (which 'predicts an increase in racial/ethnic intermarriage as the social boundaries between groups blur through the process of assimilation into a common culture').

unfavourable competition within their own ethnic group could initiate searches for spouses in other ethnic groups. Intermarriage became increasingly important in Hawai'i during the colonial period, increasing from 9.1% of marriages among those of marriageable age in 1910 to 19.1% in 1930.

Our data set pools together three complete populations for men and women of marriageable age from the 1910, 1920, and 1930 Territorial Censuses of Hawai'i. We begin our analysis by documenting how critical demographic variables in this rapidly changing multi-ethnic society evolved over the 1910–1930 period. Across eight different ethnic groups, we find substantial variation in within-group and extra-group male shares, ever and current marriage rates, endogamous marriage rates, household size, and the number of children present in a household. Second, we estimate the relationship between first-generation within-group and extra-group measures of female scarcity and decisions by second-generation males and females to marry, enter an endogamous marriage, and marry a substantially older or younger spouse. Third, we estimate how the first-generation within-group male share and first-generation extra-group male share impacted four measures of the composition of second-generation households: (1) whether an individual is household head; (2) number of children present in the household; (3) household size; and (4) whether the individual's or their spouse's mother is part of the household. Finally, we check to see whether our baseline econometric results using first-generation male shares are robust to the use of first- and second-generation male shares.

Our central result is that within-group and extra-group male shares affected marriage decisions and household composition of second-generation males and females in Hawai'i during the 1910–1930 period. Within-group male shares were particularly important for female marriage decisons, but for males only affected the likelihood of endogamous marriage. Large and statistically significant estimates for extra-group male shares add to our understanding of this multi-ethnic marriage market, as they show that males and females took marriage market conditions beyond their ethnic group into account when making their marriage decisions. The size of the foreign-born co-ethnic population of marriageable age also affected these decisions in both the male and female samples, in part because of the different matching opportunities afforded to people in ethnic groups of varying sizes (Choi & Tienda, 2017). Our findings correspond well with the conclusions of the sociologist Romanzo Adams, who observed in 1937 that 'the marriage practice of the members of some racial groups in Hawaii is affected measurably by ... the relative size of the various groups and the sex ratios among the marriageable'.

## REVIEW OF THE LITERATURES ON THE IMPACT OF SEX RATIOS ON MARRIAGE

The within-group sex ratio for the male and female populations of marriageable age plays a central role in Gary Becker's pioneering model of marriage (Becker, 1981). As the within-group sex ratio increases, the increased competition for female spouses mechanically results in a traditional 'marriage squeeze' due to the declining number of women of marriageable age per male of marriageable age (Guttentag & Secord, 1983). An implication of the additional competition among males for more scarce brides is that the female share of the surplus generated by marriage must increase. This increases the bargaining power of potential brides, allowing them to

negotiate more favourable arrangements regarding their household's composition and activities.[3]

In a seminal paper, Angrist (2002) examines how large changes in within-group sex ratios of US immigrants from different ethnic groups affected demographic and economic characteristics of households formed by second-generation males and females between 1910 and 1940. To address issues stemming from confounding between first-generation within-group sex ratios and demographic characteristics of first-generation households, Angrist regresses demographic outcomes from second-generation households on first-generation within-group sex ratios. His econometric estimates suggest:

> that high [within-group] sex ratios in the early twentieth century improved female marriage prospects, reduced female labor force participation, and tilted the balance of household bargaining power toward women more generally. Estimates for families with children also suggest that higher [inside] sex ratios led to increased marital stability and higher income in families with children (p. 999).

Angrist's econometric estimates also show a somewhat counter-intuitive result, that an increase in the within-group sex ratio increased the likelihood that within-group males of marriageable age were ever married or currently married.

Numerous recent papers have exploited spatial variation in sex ratios to estimate whether the impacts reported by Angrist (2002) hold in other locations and time periods. Porter (2016) uses data from the '1982 Chinese Population Census to construct modified provincial sex ratios that reflect the degree to which men tend to marry women from different cohorts' (p. 337). Porter's main findings are that increases in the modified sex ratio increase measures of boys' health, raise the age at which males marry, and lower male consumption of tobacco (p. 369).[4] Charles and Luoh (2010) use a variety of empirical strategies to examine how increases in male incarceration in regional US marriage markets affected women of marriageable age (p. 614). Their findings indicate that 'higher male imprisonment appears to have lowered the likelihood that women marry, modestly reduced the quality of their spouses when they do marry, and shifted the gains from marriage away from women and toward men' (p. 614). Abramitzky et al. (2011) use a difference-in-differences estimator to examine how high male mortality in World War I affected post-war marriage rates and assortative marriage matching in France. In regions with higher male mortality due to the war, female-biased sex ratios impacted marital matching, marriage and divorce rates, and the age gap between brides and grooms (p. 124). Bethmann and

[3]Undertaking empirical tests of Becker's framework on US data, Grossbard-Shechtman (1993) and Grossbard-Shechtman and Neideffer (1997) find that higher sex ratios are associated with less female labour force participation. Another strand of the Becker-inspired literature develops a model of collective labour supply by a married couple, with the distribution of marital surplus dependent on each spouse's bargaining power (Chiappori, 1992; Chiappori et al., 2002). The model shows that an increase in the sex ratio leads to a decrease in female labour supply and an increase in male labour supply. Using US data from the Panel Study of Income Dynamics, Chiappori et al. (2002) find strong evidence for the model's results vis-à-vis female–male labour supplies as well as evidence showing that a higher sex ratio is associated with a larger share of household income allocated to the wife (pp. 59–67). For Hawai'i, see Halliday and La Croix (2013) who, using a sample from IPUMS of Hawai'i census data, show that changes in ethnic sex ratios affected male and female labour force participation.

[4]See also Francis (2011) who finds that the increase in male-biased sex ratios in Taiwan after Nationalist soldiers fled to the island in the late 1940s led to an increase in female marriages.

Kvasnicka (2013) use county-level data to examine how '[World War II]-induced shortfalls of men' in postwar Germany contributed to a temporary increase in births out of wedlock.[5]

Grosjean and Khattar (2019) use panels of census data by county for the six Australian colonies spanning 1836–1881 to examine impacts of male-biased sex ratios. They show that higher sex ratios in counties during this period are associated with higher female marriage rates, lower female labour force participation rates, and less female attainment of high-ranking occupations. More surprisingly, they also find that the effects of spatial variation in mid-nineteenth-century sex ratios on household behaviour persisted into the twenty-first century, with conservative cultural norms that evolved in counties with high historic sex ratios leading to less female participation in the labour force and less attainment of high-status occupations.[6,7]

Two recent articles on the influence of sex ratios on marriage decisions develop empirical strategies that influence strategies adopted in this paper.[8] In their study of intermarriage in 669 US regional marriage markets, Choi and Tienda (2017) find that marriage market conditions, such as ethnic sex ratios and relative group size, are typically more important factors underpinning intermarriage than individual factors, such as education or income (p. 313). Their econometric results show that ethnic group size generally has a negative and statistically significant association with male and female intermarriage rates while the within-group sex ratio has a positive but statistically insignificant association on intermarriage rates. Weiss and Stecklov (2020) use data from the 1930 US Census of Population on the six largest emigration countries (England, Germany, Ireland, Italy, Poland, and Russia) to examine the influence of ethnic sex ratios on intermarriage. They specify two distinctly different sex ratio variables: One is the traditional within-group sex ratio for an ethnic group, while the second is an extra-group sex ratio measuring female scarcity in all other ethnic groups (p. 7). Their findings indicate that the impact of gender-biased sex ratios on marriage decisions differs by gender, with males more likely to intermarry when sex ratios are male-biased and females more likely to remain single when sex ratios are female-biased. Estimated coefficients on both sex ratio variables had predicted signs and were statistically significant in at least some regression specifications of marriage decisions. As discussed below, our econometric analysis of marriage decisions and household composition also incorporates two measures of within-group and extra-group female scarcity.

[5]Brainerd (2017) carries out a similar analysis for Russia where male mortality during WWII reduced sex ratios of the population of marriageable age differentially across Russian and Baltic republics. Econometric results reveal that 'male scarcity led to lower rates of marriage and fertility, higher nonmarital births, and reduced bargaining power within marriage for women most affected by war deaths' (p. 229).

[6]In counties with higher sex ratios in the mid-nineteenth century, Australian voters provided less electoral support to the 2017 referendum on same-gender marriage (Baranov et al., 2020).

[7]A large literature examines how couple preferences for at least one male child in contemporary China, India, and Korea have led to high sex ratios and how they have affected crime, marriage, intermarriage, household savings, male education, and marginalisation of 'excess' males. Wei and Zhang (2011) identify channels through which high sex ratios in China increase incentives of households with a son to save to make their son more financially attractive to scarce brides. Horioka and Terada-Hagiwara (2017) examine whether increases in the sex ratio are associated with changes in household savings in Korea and India over the 1975–2010 period, and find a positive effect in Korea and a negative effect in India. Edlund et al. (2013) and South et al. (2014) find that high sex ratios are associated with increased crime in China and India, respectively, while Zhou et al. (2011) find evidence that high sex ratios led to marginalisation of 'excess' males unable to find brides in several East Asian societies.

[8]Other important studies on intermarriage include Adams (1937), Cheng and Yamamura (1957) and Fu and Heaton (1997) on intermarriage in Hawai'i; Furtado (2012) for a cross-country study of intermarriage; and Furtado and Theodoropoulos (2011) for a study of intermarriage and assortative matching by education using recent US data.

## HAWAI'I SEX RATIOS, TERRITORIAL CENSUS DATA, AND DESCRIPTIVE STATISTICS

For this study, we analyse the full-count populations for the 1910, 1920, and 1930 Hawai'i Territorial Censuses provided to the authors by FamilySearch. We use these three territorial censuses because they ask common questions covering several key variables. Each census provides information on the birth places of each resident and their parents, thereby enabling us to identify whether each person in the census is a first- or second-generation immigrant to Hawai'i. All three censuses also provide consistent information on ethnicity of each resident, with specific categories including Puerto Rican, Spanish, Portuguese, Negro, White, Japanese, Korean, Chinese, Filipino, Hawaiian, and part-Hawaiian. Residents with parents from different ethnic groups are categorised as part Hawaiian if one parent is Hawaiian, by the father's ethnicity if both parents are non-white, and by the non-white parent's ethnicity if one parent is white.[9]

Descriptive statistics for men and women of marriageable age from the 1910, 1920, and 1930 full population censuses are provided in Table 1. Residents are categorised as 'second-generation' when at least one parent is foreign born. In each of the three censuses, more than 75% of men of marriageable age (20–38) are either foreign born or second generation, with the percent foreign born falling from 78.0% in 1910 to 54.2% in 1930. The percent of women of marriageable age (18–33) who are either foreign born or second generation ranges from 69.2% in 1910, to 78.7% in 1920, and to 72.7% in 1930, with the percent foreign born falling from 54.0% in 1910 to just 26.7% in 1930.

Women of marriageable age in each of the generational groups and three censuses were much more likely to be married than men, with the differences between female and male marriage rates much larger for foreign born than for Hawai'i born or second-generation. Between the 1910 and 1930 censuses, marriage rates declined by 3.3–6.6 percentage points for Hawai'i-born and second-generation women, by 15.7–17.4 percentage points for Hawai'i-born men, and by 5.5–5.6 percentage points for second-generation men. By contrast, between the 1910 and 1930 censuses, marriage rates declined by less than one percentage point for foreign-born men and women.

Differences between the average ages of married females and married males ('the age gap') are notably high in each of the three censuses (Table 2). For example, in 1920 the average age of husbands exceeded the average age of wives by 6.07 years for Filipinos, 8.34 years for Caucasians, 11.6 years for Koreans, 8.94 years for Japanese, 7.43 years for Portuguese, and 12.73 years for Chinese (Table 2). These differences exceed comparable measures observed in the United States (3.4 years difference in median age of first marriage in 1920), China (2.0–3.1 years difference in mean age of first marriage in 1929–1931), Japan (4.2 years difference in mean age of first marriage in 1920), and Korea (4.5 years difference in median age of first marriage in 1925), the home countries of

[9]In the 1910, 1920, and 1930 censuses, Hawai'i and US enumeration forms ask the same questions with just a few exceptions. For example, the 1930 Hawai'i enumeration form lacks questions on age at first marriage and veteran status that are asked on the US form. Questions on employment and unemployment status also differ across the two forms. All Hawai'i census information used in this study comes from questions also found on US enumeration forms.

**TABLE 1** Summary statistics by gender, age and birth place: 1910, 1920, and 1930 Territorial Censuses of Hawai'i.

| **A. 1910 census** | | | | | | |
|---|---|---|---|---|---|---|
| | **Women, age 18–33** | | | **Men, age 20–38** | | |
| | **Hawai'i born** | **Foreign born bo born** | **Second generation** | **Hawai'i born** | **Foreign born** | **Second generation** |
| Age | 25.00 | 26.76 | 22.49 | 28.38 | 29.68 | 25.36 |
| | (4.57) | (4.19) | (3.80) | (5.42) | (5.35) | (4.58) |
| Currently Married | 0.699 | 0.941 | 0.665 | 0.490 | 0.401 | 0.491 |
| Ever Married | 0.731 | 0.961 | 0.688 | 0.527 | 0.426 | 0.506 |
| Children in Household | 1.69 | 1.59 | 2.38 | 1.35 | 0.77 | 1.78 |
| | (1.85) | (1.67) | (2.20) | (1.76) | (1.39) | (2.08) |
| Mother in Household | 0.229 | 0.032 | 0.276 | 0.294 | 0.106 | 0.342 |
| Family Size | 4.01 | 3.44 | 4.86 | 3.01 | 1.76 | 3.92 |
| | (2.69) | (1.89) | (2.90) | (2.60) | (1.52) | (3.08) |
| *N* | 6302 | 11,033 | 3117 | 8677 | 40,825 | 2819 |
| Percent by gender | 30.81 | 53.95 | 15.24 | 16.58 | 78.0 | 5.39 |
| **B. 1920 census** | | | | | | |
| | **Women, age 18–33** | | | **Men, age 20–38** | | |
| | **Hawai'i born** | **Foreign born** | **Second generation** | **Hawai'i born** | **Foreign born** | **Second generation** |
| Age | 25.07 | 26.17 | 23.62 | 27.80 | 29.32 | 26.53 |
| | (4.47) | (4.14) | (4.39) | (5.53) | (5.50) | (5.15) |
| Currently Married | 0.732 | 0.941 | 0.663 | 0.507 | 0.502 | 0.501 |
| Ever Married | 0.758 | 0.953 | 0.687 | 0.536 | 0.524 | 0.517 |
| Children in Household | 1.86 | 1.70 | 2.47 | 1.30 | 1.01 | 2.04 |
| | (2.00) | (1.60) | (2.29) | (1.85) | (1.51) | (2.27) |
| Mother in Household | 0.190 | 0.055 | 0.262 | 0.237 | 0.124 | 0.327 |
| Family Size | 4.08 | 3.77 | 4.95 | 3.13 | 2.40 | 4.40 |
| | (2.66) | (1.87) | (2.93) | (2.65) | (1.94) | (3.18) |
| *N* | 6276 | 15,234 | 7994 | 8288 | 32,198 | 8018 |
| Percent by gender | 21.27 | 51.63 | 27.09 | 17.09 | 66.38 | 16.53 |

(Continues)

TABLE 1 (Continued)

| C. 1930 census | | | | | | |
|---|---|---|---|---|---|---|
| | Women, age 18–33 | | | Men, age 20–38 | | |
| | Hawai'i born | Foreign born | Second generation | Hawai'i born | Foreign born | Second generation |
| Age | 25.06 | 27.99 | 23.79 | 26.53 | 27.73 | 26.64 |
| | (4.55) | (3.76) | (4.39) | (5.22) | (5.12) | (5.11) |
| Currently Married | 0.666 | 0.935 | 0.602 | 0.330 | 0.400 | 0.435 |
| Ever Married | 0.699 | 0.952 | 0.622 | 0.353 | 0.418 | 0.451 |
| Children in Household | 2.09 | 2.87 | 2.56 | 0.958 | 0.663 | 2.00 |
| | (2.18) | (1.89) | (2.17) | (1.77) | (1.45) | (2.13) |
| Mother in Household | 0.221 | 0.073 | 0.336 | 0.163 | 0.069 | 0.367 |
| Family Size | 4.45 | 5.06 | 5.30 | 2.59 | 2.00 | 4.59 |
| | (3.04) | (2.23) | (3.02) | (2.62) | (1.94) | (3.20) |
| *N* | 9848 | 9597 | 16,542 | 20,735 | 46,258 | 18,402 |
| Percent by gender | 27.39 | 26.69 | 46.01 | 24.28 | 54.17 | 21.55 |

*Note*: Hawai'i-born is defined as the person and their parents were born in Hawai'i. Second-generation is defined as the person was born in Hawai'i but at least one parent was born outside of Hawai'i. Currently Married, Ever Married, and Mother in Household are binary variables.
*Source*: 1910, 1920, and 1930 Territorial Censuses of Hawai'i.

most immigrants to Hawai'i.[10] Because of the larger than usual differences in male–female marriage ages, we increased the age range for men of marriageable age from 20–35 years to 20–38 years.

Table 3 shows that most marriages observed among those of marriageable age in 1910%–90.9%, 1920%–86.7%, and 1930%–81% were endogamous, that is, a marriage to a person of the same ethnicity. One explanation for the high rates of endogamy is that, excluding native Hawaiians, the male share of the marriageable-age population for all ethnic groups was relatively high, with relatively fewer females available to males searching for brides. Thus, brides from scarce ethnic groups were easily matched with men from the same ethnic group. Native Hawaiians, the group with the lowest male share and the highest relative supply of women, also had one of the highest rates of exogamy among females. If a Caucasian, Portuguese, Japanese or Chinese male married a woman of another ethnicity, it was usually a Native Hawaiian woman. The share of endogamous marriages declined between 1910 and 1930, registering at just 81% of all marriages in 1930. Puerto Rican, Japanese and Caucasian men and women had the highest rates of exogamy in 1930.

[10]China: Lee & Wang, 1999, tabs. 5.1 and 5.4; United States: Carter et al., 2006, vol. 1, Series Ae481–482; Korea: Kwon et al., 1975, tab. III.3; Japan: National Institute of Population and Social Security Research, 2020, tab. 6.

**TABLE 2** Average age gap between husband and wife: By ethnic group and territorial census.

| | Wife | | Husband | | Age Gap | |
|---|---|---|---|---|---|---|
| **Ethnic group** | **Age** | ***N*** | **Age** | ***N*** | **ΔAge** | ***N*** |
| *1910 census* | | | | | | |
| Korean | - | 0 | 31.00 | 3 | - | - |
| Chinese | 26.40 | 63 | 37.59 | 266 | 11.64 | 329 |
| Japanese | 22.33 | 3 | 30.24 | 110 | 9.64 | 113 |
| Filipino | 24.00 | 1 | 31.00 | 5 | 9.17 | 6 |
| Portuguese | 24.06 | 63 | 31.99 | 479 | 7.25 | 542 |
| Puerto Rican | 23.75 | 4 | 27.20 | 15 | 5.74 | 19 |
| Caucasian | 30.14 | 7 | 34.75 | 53 | 8.42 | 60 |
| *1920 census* | | | | | | |
| Korean | 20.33 | 3 | 35.48 | 27 | 11.60 | 30 |
| Chinese | 27.87 | 132 | 40.99 | 424 | 12.73 | 556 |
| Japanese | 22.83 | 191 | 33.24 | 903 | 8.94 | 1094 |
| Filipino | 26.67 | 3 | 28.87 | 85 | 6.07 | 88 |
| Portuguese | 27.25 | 124 | 37.62 | 365 | 7.43 | 489 |
| Puerto Rican | 23.33 | 3 | 28.95 | 57 | 7.23 | 60 |
| Caucasian | 27.54 | 26 | 35.92 | 163 | 8.34 | 189 |
| *1930 census* | | | | | | |
| Korean | 26.80 | 10 | 37.84 | 57 | 12.66 | 67 |
| Chinese | 29.12 | 155 | 43.87 | 238 | 10.67 | 393 |
| Japanese | 28.58 | 545 | 35.10 | 2319 | 7.76 | 2864 |
| Filipino | 25.80 | 5 | 31.32 | 323 | 7.25 | 328 |
| Portuguese | 29.65 | 96 | 32.82 | 111 | 4.77 | 207 |
| Puerto Rican | 29.00 | 17 | 36.33 | 180 | 10.32 | 197 |
| Caucasian | 27.64 | 77 | 33.14 | 100 | 4.79 | 177 |

*Note*: Sample is restricted to married couples with at least one second-generation spouse, a husband between ages 20 and 38, and a wife between ages 18 and 33. Sample observations (*N*) are higher for husbands than wives since there are more non-Hawaiian men than non-Hawaiian women who are married in our sample.
*Source*: 1910, 1920, and 1930 Territorial Censuses of Hawaii.

## DOCUMENTING CHANGES IN ETHNIC POPULATIONS AND MALE SHARES, 1872–1930

Hawai'i had been isolated from the rest of the world for more than 350 years when a British exploratory expedition arrived in Hawai'i in 1778. Exposure to western diseases took a heavy toll on an isolated population with little immunity, and Hawai'i's indigenous population fell from 400,000–500,000 people in 1778 to 130,000 people in 1831–1832 and then to just 39,500 people in 1896. Without a labour force to work their fields and buy their products, Hawaiian chiefs reorganised their economic system to facilitate investment by foreign firms in large-scale sugar (and later pineapple) plantations, and importation of foreign supplies of labour to work

**TABLE 3** Endogamous marriages among foreign-born and second-generation men and women of marriageable age: 1910, 1920, and 1930 Territorial Censuses of Hawai'i.

| | Women, age 18–33 | | | Men, age 20–38 | | |
|---|---|---|---|---|---|---|
| Ethnicity | Married native Hawaiian | Endogamous marriage | Married other foreign stock | Married native Hawaiian | Endogamous marriage | Married other foreign stock |
| *A. 1910 census* | | | | | | |
| Hawaiian | 91.30 | 91.30 | 8.70 | 98.42 | 98.42 | 1.58 |
| Korean | 0.00 | 99.17 | 0.83 | 7.63 | 89.31 | 3.05 |
| Chinese | 6.33 | 64.00 | 29.67 | 36.96 | 53.29 | 9.75 |
| Japanese | 0.08 | 98.52 | 1.40 | 1.98 | 97.95 | 0.06 |
| Filipino | 2.44 | 96.75 | 0.81 | 7.94 | 90.48 | 1.59 |
| Portuguese | 4.69 | 69.00 | 26.31 | 25.77 | 70.74 | 3.49 |
| Puerto Rican | 3.31 | 92.63 | 4.05 | 3.92 | 94.21 | 1.87 |
| Caucasian | 9.43 | 73.36 | 17.21 | 27.54 | 66.56 | 5.90 |
| Total by gender | 1.30 | 90.21 | 8.49 | 6.93 | 91.51 | 1.57 |
| Total male and female | | | | 4.12 | 90.86 | 5.02 |
| *B. 1920 census* | | | | | | |
| Hawaiian | 87.00 | 87.00 | 13.00 | 97.67 | 97.67 | 2.33 |
| Korean | 1.10 | 97.81 | 1.10 | 20.00 | 78.36 | 1.64 |
| Chinese | 8.39 | 61.69 | 29.92 | 15.46 | 72.16 | 12.38 |
| Japanese | 1.68 | 90.37 | 7.95 | 8.25 | 89.81 | 1.94 |
| Filipino | 0.49 | 98.39 | 1.11 | 12.11 | 85.41 | 2.48 |
| Portuguese | 4.05 | 72.67 | 23.28 | 12.00 | 82.16 | 5.84 |
| Puerto Rican | 4.14 | 77.62 | 18.25 | 27.10 | 70.26 | 2.64 |
| Caucasian | 10.20 | 74.05 | 15.74 | 29.15 | 67.63 | 3.22 |
| Total by gender | 2.26 | 86.01 | 11.72 | 9.44 | 87.41 | 3.14 |
| Total male and female | | | | 5.67 | 86.68 | 7.65 |
| *C. 1930 census* | | | | | | |
| Hawaiian | 92.19 | 92.19 | 7.81 | 97.77 | 97.77 | 2.23 |
| Korean | 3.10 | 83.98 | 12.92 | 23.13 | 70.07 | 6.80 |
| Chinese | 8.12 | 77.34 | 14.54 | 5.56 | 85.31 | 9.14 |
| Japanese | 5.51 | 68.92 | 25.58 | 23.96 | 67.89 | 8.15 |

**TABLE 3** (Continued)

| Ethnicity | Women, age 18–33 | | | Men, age 20–38 | | |
|---|---|---|---|---|---|---|
| | Married native Hawaiian | Endogamous marriage | Married other foreign stock | Married native Hawaiian | Endogamous marriage | Married other foreign stock |
| Filipino | 0.38 | 98.05 | 1.58 | 17.40 | 81.24 | 1.36 |
| Portuguese | 4.33 | 82.35 | 13.32 | 5.72 | 88.61 | 5.67 |
| Puerto Rican | 2.72 | 54.49 | 42.79 | 28.45 | 65.36 | 6.19 |
| Caucasian | 21.69 | 66.12 | 12.18 | 26.11 | 67.93 | 94.04 |
| Total by gender | 3.93 | 80.04 | 16.04 | 13.02 | 81.95 | 5.04 |
| Total male and female | | | | 8.27 | 80.95 | 10.78 |

*Source*: 1910, 1920, 1930 Territorial Censuses of Hawai'i.

the fields (La Croix, 2019: chs. 5–6). Hawai'i passed legislation in 1850 to allow indentured foreign labour on 3-5-year contracts to work on sugar plantations. Over 3900 Chinese male indentured labourers came to Hawai'i between 1852 and 1876.

In 1876 a reciprocity treaty between the Kingdom of Hawai'i and the United States was implemented that allowed sugar produced in Hawai'i to enter the United States duty free. The treaty induced a more than eighteen-fold expansion in sugar production between 1874 and 1898, and created demand from Hawai'i sugar plantations for tens of thousands of new workers (La Croix, 2019: ch. 6). Between 1876 and 1898, planters and the Hawai'i government cooperated to facilitate immigration from China, Japan, and Portugal to work in sugar fields and associated processing factories and industries. This immigration transformed Hawai'i's population, with the overall population increasing by 270% and the percent foreign born increasing from 8.0% to 61.7% between 1872 and 1900.

Conflicts between foreign investors and Hawai'i's government over government spending priorities and proposed changes in Hawai'i's constitution led to a coup d'etat by a small group of mostly Caucasian settlers (assisted by US Marines) and the overthrow of the Hawaiian monarchy in January 1893. Two consecutive treaties of annexation between the new Hawai'i government and the United States failed by large margins to gain the required two-thirds vote in the US Senate. In spring 1898, US military operations in the Philippines during the Spanish-American War raised the strategic value of Hawai'i, and the United States annexed Hawai'i by a joint resolution of Congress on 7 July 1898.

Until the 1898 annexation, the vast majority of males of marriageable age in Hawai'i were unmarried. Most of the unmarried men were migrants who did not intend to marry and settle in Hawai'i but rather were focused on accumulating wealth to enhance their economic and social prospects when they returned to their home countries. The US annexation changed their decision-making calculus, in part because federal legislation passed in 1900 voided all

existing and future indentured labour contracts in Hawai'i.[11] Beechert (1985) and Liou (2015) show that plantation wages in Hawai'i increased after the Organic Act's ban on penal labour contracts became effective. For single male workers, the combination of a more stable government and higher wages increased the benefits of settling permanently in Hawai'i and starting a family.

Annexation also increased demand for plantation labour. Operating under an increasingly protective US tariff umbrella, Hawai'i's sugar and pineapple industries expanded massively after 1900, and they recruited and brought to Hawai'i new immigrants from Europe, Asia, and the Caribbean. Between 1900 and 1930, Hawai'i's population increased by 240%, primarily due to immigration. Immigrants comprised 61.7% of the population in 1900; most were young males from Japan and China recruited by sugar plantations to work in fields and factories.[12] Migrants had also come from Portugal to work as plantation workers and foremen (*lunas*) and from the United States and Europe to work at skilled jobs and management positions. Labour unrest among Japanese workers prompted sugar plantations to diversify their workforce by recruiting workers from newly annexed Puerto Rico and the Philippines as well as Korea, Canada, Great Britain, Germany, Portugal, and Spain. The result was a sweeping transformation of both the size and ethnic composition of Hawai'i's population during the first three decades of US colonial rule, with a rapid increase in immigrants and a rapid decrease in the percentage of the population that was native Hawaiian. By 1930, first-generation immigrants comprised 18.6% and the second-generation 37.5% of the total population.

Changes in US immigration law, the political environment in countries sending immigrants, and expansion of sugar production in Hawai'i changed the gender composition of immigrants to Hawai'i. This led to large changes in the male share of the population of immigrants of marriageable age (Table 4). We briefly review changes in male shares within and across major ethnic groups and consider factors underlying the changes.

## Chinese male shares

The Chinese immigrant within-group male share was 0.87 in 1910 before declining to 0.54 in 1920 and 0.53 in 1930. Strict application of the US government's Chinese Exclusion Act to Hawai'i after annexation in 1898 virtually ended immigration of male labourers.

## Filipino male shares

The Hawaiian Sugar Planters' Association (HSPA) recruited more than 120,000 Filipinos to Hawai'i between 1906 and 1930, transforming the ethnic composition of the plantation workforce from more than 60% Japanese in 1900 to more than 70% Filipino in 1930. The switch to Filipino workers was due primarily to a near complete ban on immigration from all other Asian countries imposed by the Immigration Act of 1924 and the status of Filipinos as US nationals

[11]The Organic Act. An Act to Provide a Government for the Territory of Hawaii. Act of April 30, 1900, C 339, 31 Stat 141. Section 10 voided labour contracts that hold persons in 'service for a definite term'.

[12]See La Croix and Fishback (2000) for an in-depth discussion of the ethnic composition of the plantation workforce.

**TABLE 4** Ethnicity distribution and within-group male share: Hawai'i born, foreign born and second generation of marriageable age.

| | Percent of each population | | | Within-group male share | | |
|---|---|---|---|---|---|---|
| **Ethnicity** | **1910** | **1920** | **1930** | **1910** | **1920** | **1930** |
| *Born in Hawai'i—At least third generation population* | | | | | | |
| Native Hawaiian | 97.39 | 82.00 | 91.18 | 0.55 | 0.49 | 0.59 |
| Caucasian (US) | 2.61 | 18.00 | 8.82 | 0.64 | 0.63 | 0.84 |
| *Foreign-born population* | | | | | | |
| Korean | 5.17 | 2.66 | 0.70 | 0.93 | 0.66 | 0.26 |
| Chinese | 9.24 | 2.17 | 1.10 | 0.87 | 0.54 | 0.53 |
| Japanese | 71.46 | 21.60 | 16.24 | 0.73 | 0.52 | 0.46 |
| Filipino | 2.21 | 27.37 | 61.70 | 0.88 | 0.86 | 0.90 |
| Portuguese | 5.32 | 1.70 | 0.65 | 0.56 | 0.51 | 0.49 |
| Puerto Rican | 3.55 | 2.23 | 0.81 | 0.63 | 0.58 | 0.59 |
| Caucasian (European) | 1.19 | 2.69 | 2.11 | 0.69 | 0.68 | 0.70 |
| Caucasian (US) | 1.87 | 9.58 | 16.70 | 0.61 | 0.61 | 0.78 |
| *Second-generation population—Born in Hawai'i with at least one foreign-born parent* | | | | | | |
| Korean | 0.02 | 0.11 | 1.02 | 0.00[a] | 0.65 | 0.49 |
| Chinese | 29.08 | 21.73 | 18.92 | 0.55 | 0.54 | 0.55 |
| Japanese | 5.53 | 19.33 | 45.16 | 0.44 | 0.48 | 0.49 |
| Filipino | 0.17 | 0.25 | 0.38 | 0.35 | 0.53 | 0.50 |
| Portuguese | 48.45 | 32.14 | 18.48 | 0.47 | 0.48 | 0.48 |
| Puerto Rican | 0.10 | 0.51 | 3.29 | 0.35 | 0.43 | 0.47 |
| Caucasian (European) | 10.99 | 13.91 | 9.11 | 0.57 | 0.58 | 0.75 |
| Caucasian (US) | 5.66 | 12.03 | 3.64 | 0.47 | 0.45 | 0.46 |

[a]In 1910, there were one second-generation Korean female and zero second-generation Korean males of marriageable age.
*Source*: 1910, 1920, and 1930 Territorial Censuses of Hawai'i.

until the passage of the Tydings-McDuffie Act in 1934.[13] Most Filipino workers planned to return home after saving money in Hawai'i, were generally not accompanied by their families, and did not summon picture brides.[14] This led to an extremely high male share of Filipino migrants of marriageable age in the 1910 Territorial Census (0.88) that persisted into the 1920 Census (0.86) and 1930 Census (0.90).

[13]1924 Immigration Act. An act to limit the immigration of aliens into the United States, and for other purposes. H.R. 7995; Pub.L. 68–139; 43 Stat. The Tydings–McDuffie Act, also known as the Philippine Independence Act, Pub.L. 73–127, 48 Stat. 456, was enacted March 24, 1934 and ended the status of Filipinos as US nationals.

[14]From 1909 to 1926, the Hawaiian Sugar Planters'Association paid passage to Hawaii for Filipino workers and their families, and from 1915 to 1926 also paid return passage for workers and families if the worker had completed a three-year employment contract. Starting in 1926 the Association discontinued paying passage to Hawaii while it continued to pay return passage for workers and families (Wentworth, 1941, pp. 30–32).

## Portuguese male shares

The male share of Portuguese immigrants, considered by other ethnic groups in Hawai'i as distinct from Caucasian or White, fell from 0.56 in 1910 and 0.51 in 1920 to 0.49 in 1930.[15] The relatively low initial male shares occurred because most Portuguese male labourers came to Hawai'i with their families.

## US Caucasian male shares

The US Caucasian immigrant male share was stable initially, registering at 0.61 in 1910 and 1920, but then rose to 0.78 in 1930. The male immigrant imbalance was due in part to the establishment of the federal and territorial governments in Hawai'i as well as construction on new US military bases, in particular Pearl Harbour and Schofield Barracks.[16]

## Japanese male shares

The Japanese immigrant male share was very high in 1910 (0.73) before declining to 0.52 in 1920 and 0.46 in 1930 (Table 4). The main factor behind the decline was the Gentlemen's Agreement of 1907–1908, which ended the emigration of male Japanese workers to Hawai'i. The end of prime-age male emigration was followed by the *Yobiyose Jidai* ('Summoned Era') immigration rules. Between 1908 and 1924 the US and Japanese governments allowed close relatives and 'picture brides' (*shashin hanayome*) to join the roughly 50,000 Japanese males working in Hawai'i in 1907 (Ichioka, 1988). Over the entire *Yobiyose Jidai* period, 26,506 men above working age, 30,633 women, and 5138 children came to Hawai'i from Japan.

## Korean male shares

The male share for immigrant Koreans was extremely high in 1910 (0.93), but fell to 0.66 in 1920 and to 0.26 in 1930.[17] One reason for the sharp decline was that after Japan's annexation of Korea in 1910, the colonial government ended emigration of male workers to stop losses to its colonial labour force. A second reason was that the US government and the Japanese-run government in Korea allowed single Korean workers living in Hawai'i to bring picture brides to Hawai'i. Immigration of picture brides from both Japan and Korea ended in 1924 when the United States imposed its comprehensive ban on immigration from Asia.

[15]Our analysis combines the census categories of 'Spanish' and 'White' into a 'Caucasian' category.

[16]The 1910, 1920, and 1930 territorial census samples for Hawai'i used in this study do not include active-duty US military personnel based in Hawai'i.

[17]Patterson, 2000, p. 80 estimated that between 600 and 1000 picture brides came to Hawai'i from Korea from November 1910 to 1924.

# ESTIMATING THE EFFECTS OF MALE-BIASED SEX RATIOS ON HOUSEHOLD COMPOSITION

## Substitution, income, and selection effects

Increases in the within-group sex ratio affect male and female propensities to marry via two main channels: mechanical increases in competition among males for within-group brides as the number of potential brides per male decreases and increases in bargaining power of within-group women of marriageable age (Becker, 1981).[18] Increases in competition raise the likelihood that within-group females marry as competition causes within-group males to offer a larger share of the surplus expected to be attained from marriage to potential brides. The larger share of marriage surplus provides incentives for within-group women to marry who otherwise would have chosen to remain single. By contrast, the effect of an increase in the within-group sex ratio on the likelihood that a within-group male will marry is less clear. Holding the supply of brides constant, the mechanical increase in competition decreases the male marriage rate, as there are fewer brides available per male of marriageable age, that is, the classic marriage squeeze (Guttentag & Secord, 1983). However, as males offer a larger share of the marriage surplus to potential brides, this provides incentives for more within-group women to marry, thereby increasing the within-group male marriage rate. Whether the supply effect dominates the mechanical competition effect partly depends on the share of the marriageable-age within-group female population who would otherwise remain single and could potentially enter the marriage market in response to better marriage offers from within-group men.

How does this analysis change when within-group males and females have the social space to marry outside their ethnic group, that is, when social norms do not lead to severe isolation of such couples from their families and societies? We follow the social science literature in assuming that both men and women prefer to marry a co-ethnic spouse but that men respond to an increase in the within-group sex ratio by broadening their search for a spouse to extra-group women. This provides access to a larger supply of potential brides for a given offer of additional marriage surplus (Kalmijn, 1998; Qian & Lichter, 2007; Schwartz, 2013). While this option increases within-group male intermarriages, the additional supply of brides from other ethnic groups may or may not be sufficiently large to offset the negative effect of mechanical competition on within-group male marriage rates. By contrast, an increase in the within-group sex ratio still increases within-group female marriage rates, albeit to a smaller extent. The positive effect is smaller when intermarriage is an option for within-group men because their offers of a larger share of the surplus from marriage attract both within-group and extra-group women to the marriage market.

Was there sufficient 'social space' in Hawai'i for second-generation males and females to marry outside their ethnic groups in the early twentieth century? Intermarriage has a long history in Hawaii, with marriages between Hawaiian women and American and British Caucasian men dating back to the late eighteenth century and marriages between Hawaiian women and Chinese men happening more frequently in the last two decades of the nineteenth century (Adams, 1937). These early intermarriages were due in part to liberal Hawaiian marriage customs as well as the isolation of American and British Caucasians from their more racially

[18]This analysis ignores incentives by within-group males to invest in additional human capital to make themselves more attractive grooms. Such investment could draw more within-group females into the marriage market. See Furtado (2012) and Lafortune (2013).

**FIGURE 1** Emmeline Agatha Marie Kailimoku Afong Magoon (1858–1946, seated in dark dress) was the eldest child of Chun Afong and Julia Fayerweather Afong. Posed in formal fashion are children Catherine, Makia, husband John Alfred Magoon, children Eaton, Allie and Lani. They married in 1887. The photograph is from the 1890s. Caption and photo are taken from Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Emmeline_Afong_Magoon_and_family_(PP-67-1-010).jpg Last access on 11 January 2024.

restrictive home countries. This legacy meant that Japanese, Korean, Filipino, Puerto Ricans, Caucasians, and Portuguese immigrants who arrived in the 1886-to-1930 period were immediately exposed to intermarried couples and their ethnically-mixed children who were reasonably well integrated into Hawai'i's society (Figure 1). Several ethnic groups shared a common religion, the Roman Catholic faith, and this facilitated intermarriage between Filipinos, Portuguese, Puerto Ricans, Spanish, and some American Caucasians. Migration in the early twentieth century from rural plantations to more ethnically diverse urban areas also facilitated social contact with people from other ethnic groups.

For some groups, there was less social space for intermarriage. Japan's annexation of Korea in 1910 led to hostility between Japanese and Koreans in Hawai'i, and effectively prevented any intermarriage between the two groups. The US government's willingness to allow Korean and Japanese migrants to sponsor immigration of picture brides between 1907 and 1924 also reduced the likelihood of intermarriage by first-generation Korean and Japanese men.

How would an increase in the extra-group sex ratio influence the likelihood of a within-group male or female entering an endogamous marriage? For within-group men, the increase in the extra-group sex ratio represents an increase in competition from extra-group men for

both within-group and extra-group women. This should reduce within-group male intermarriages as more extra-group women choose grooms within their own ethnic group, and reduce within-group male endogamous marriages as some within-group females choose extra-group marriages in response to offers of additional marriage surplus from extra-group males. A countervailing effect is that the offers of an increased share of marriage surplus could increase the supply of within-group females in the marriage market enough to increase the likelihood of endogamous marriage. For within-group females, the analysis is similar: Additional competition from extra-group males and offers of a higher share of marriage surplus should increase within-group female intermarriages but have an indeterminate effect on endogamous marriages. Thus, our expectation is that male and female responses to changes in within-group and extra-group male shares could diverge in both direction and magnitude.

How might an increase in the within-group sex ratio affect the gap in age between bride and groom for within-group males and within-group females?[19] Consider within-group females first. We assume that women prefer to marry men who are closer in age to them (Casterline et al., 1986; Kurzban & Weeden, 2005; Laslett, 1977). As the within-group sex ratio increases, the mechanical increase in competition from within-group men ('the marriage squeeze') for fewer within-group brides allows women of marriageable age to choose grooms who are closer to their age. However, the increase in competition also raises a bride's share of marriage surplus, and this advantages older males with higher wealth and incomes. They have the resources to offer a larger share of the marriage surplus to younger women, more of whom will then be induced to marry due to the extra benefits from marriage. Thus, the net effect of an increase in within-group sex ratios on the marriage age gap in the within-group female sample is indeterminate. For the within-group male sample, we assume that men prefer to marry younger women. As the within-group sex ratio increases, the increase in competition raises a bride's share of marriage surplus, and this advantages older males with higher wealth and incomes than younger males, and should increase the marriage age gap.

An increase in the extra-group sex ratio yields slightly different effects for the marriage age gap in the within-group male sample. As extra-group females select younger extra-group grooms in response to the new competition, older extra-group males find themselves without brides and expand their search to other ethnic groups. Mechanical competition for within-group females from older extra-group males raises the marriage age gap for within-group females while income effects from the increased female share of marriage surplus could reinforce age selection effects.

We also estimate regressions for four household composition variables—mother in household, living with own children, household size, and individual is head of household. Sex ratios affect these variables indirectly via their effect on marriage rates and the female share of household surplus. Consider how an increase in the within-group sex ratio that increases the within-group female marriage rate could affect household composition. When spouses in the additional marriages are living in extended family households, marriage can trigger changes in household structure. Some newlyweds move from households with larger extended families and set up their own smaller households, thereby decreasing average family size. Leaving an extended family household also reduces the likelihood of a mother or mother-in-law in the new household. Additionally, marriage typically is followed by a newly married couple becoming parents, which obviously increases the likelihood of living with your own children. We caution that the size of these effects is bounded by the magnitude of the increase in the female marriage rate

[19]Age gap regressions are estimated using samples of married men and married women of marriageable age.

triggered by the increase in the within-group sex ratio. Large effects are more likely to occur if the increase in the within-group sex ratio generates a substantial increase in the within-group female marriage rate.

The increase in the within-group sex ratio also triggers a second set of effects that stem from the increase in the female share of marriage surplus. One way for a married women to have a higher share of the marriage surplus is for her husband to accommodate more fully his wife's preferences regarding household structure. We note that female preferences may be difficult to identify and that the task is complicated by selection effects in the marriage market that are triggered by the change in the within-group sex ratio. A main implication is that we cannot make clear predictions regarding how changes in the within-group sex ratio will affect the four household structure variables.

## Econometric framework

We propose a simple estimation strategy inspired by Angrist (2002) in which we exploit within-ethnicity variation in the share of males of marriageable age to estimate the effects of skewed sex ratios on key marital and demographic outcomes. Identification hinges on two factors. First, the inclusion of ethnicity fixed effects adjusts for all confounders at the ethnicity level. Second, for all estimations, we employ second-generation outcomes and first-generations male shares to address concerns regarding reverse causality. Because first-generation migrants are potential spouses for second-generation residents, their presence can affect marriage decisions and household composition choices by second-generation males and females of marriageable age.[20] Variation in within-ethnic group first-generation male shares by and large was related to changes in the migration policies of the US government and national governments of countries sending migrants to Hawai'i that were unrelated to conditions in the Hawai'i marriage market. Consider that changes in US migration policies towards Japanese and Chinese migrants were due to racial animus, that changes in Japanese policies towards Korean emigration were due to the colonial government in Korea desiring to limit losses to its workforce, and that the US annexation of Hawaii in 1898 raised the level plantation wages in Hawaii, thereby reducing incentives for immigrant workers to return home. While national policies towards male immigration were plausibly unrelated to Hawaii marriage markets, an exception was the Japanese and US policies towards female migration from Japan and Korea, as until 1924 they allowed emigration of 'picture' brides who were joining single Korean and Japanese male workers (as discussed above).

We estimate the following model, with individuals denoted with the subscript $i$, ages with $a$, ethnicities with $j$, and census years with $t$. For a given outcome $y_{iajt}$ from a second-generation individual of marriageable age, we estimate the following model:

$$y_{iajt} = \alpha_1 \text{WithinGroupShare}_{ajt} + \alpha_2 \text{ExtraGroupShare}_{ajt} + \beta \ln \text{ForeignBorn}_{jt} + \vartheta_1 M_i + \vartheta_2 F_i + \gamma_t + \delta_j + \theta_a + \varepsilon_{iajt}. \quad (1)$$

[20]We note that studies prior to Angrist (2002) regressed same-generation household characteristics on same generation within-group sex ratios.

**TABLE 5** OLS regressions: Marriage decisions by women of marriageable age.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Variables** | **Ever Married** | **Currently Married** | **Endogamous Marriage** | **Age Gap** |
| ExtraGroupShare | 0.765*** | 0.749*** | −2.246*** | 24.06*** |
| | (0.210) | (0.204) | (0.343) | (4.121) |
| WithinGroupShare | 0.015 | −0.001 | −0.323*** | 3.344*** |
| | (0.056) | (0.059) | (0.066) | (0.755) |
| ln (Foreign born) | 0.029** | 0.027* | −0.018 | −0.166 |
| | (0.0136) | (0.014) | (0.017) | (0.202) |
| Observations | 27,661 | 27,661 | 27,661 | 16,142 |
| *R*-squared | 0.287 | 0.254 | 0.145 | 0.058 |

*Note*: *,**, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

The variables WithinGroupShare$_{ajt}$ and ExtraGroupShare$_{ajt}$ are our primary variables of interest and denote the share of males in the population within some neighbourhood of individual *i*'s age. We compute these both within and outside of the individual's ethnic group.[21] This specification builds on Weiss and Stecklov (2020) who pioneered the use of both measures. The variable, ForeignBorn$_{jt}$, is the first-generation population of marriageable age of ethnic group *j* in census year *t*. The variables $M_i$ and $F_i$, are binary variables showing type of mixed parentage (foreign-born mother-only [$M_i$] or foreign-born father-only [$F_i$]).[22] Finally, we include fixed effects for ethnicity, age, and census year, and cluster all standard errors at the age, ethnicity, and census year levels. Identification of regression estimates stems from the assumption that changes in immigration flows are primarily driven by changes in the migration policies of the US government and national governments of countries sending migrants to Hawai'i. Seven of the eight dependent variables in our regressions are either count variables (Number of Children in Household, Family Size) or binary variables (Currently Married, Ever Married, Endogamous Marriage, Mother in Household, Head of Household). Our baseline specification is the linear probability model and thus we estimate all regressions with OLS. As a check to this specification, we also estimate a logistic specification for the five binary outcome variables and a Poisson specification for the two count outcome variables.

We construct age-specific extra-group and within-group male shares for males and females of marriageable age. If men and women were to only marry someone their exact same age, then we would construct the male shares by dividing the total number of men by the total number of individuals that age. We expand this exact age matching measure to account for the fact that men prefer to marry younger brides but tend to seek out brides who are relatively close to their age. Thus, we construct our male share measure in a way that allows the potential wives for each male to be up to 5 years younger or 2 years older. Similarly, we allow the potential husbands for females to be up to 5 years older or 2 years younger. The age-specific male shares offer the advantage that they may be less prone to measurement error as they are more representative of the marriage

[21]We follow Fenske and Gupta (2022) in replacing the traditional measure of female scarcity in the marriage market—the within-group sex ratio—with the percent of males in the relevant population. This creates a less skewed independent variable.

[22]Individuals are characterised as second-generation if they have one or two foreign-born parents.

markets corresponding to the individual. They also deliver more within-ethnic group variation. Porter (2016) refers to this type of construction as a 'modified weighted availability ratio'.

## Marriage regressions

Using the sample of women of marriageable age (18–35), Table 5 reports OLS estimates from pooled regressions on Ever Married, Currently Married, Endogamous Marriage, and Age Gap variables. OLS estimates for WithinGroupShare are small, vary in sign, and are statistically insignificant in the Currently Married and Ever Married regressions.[23] Estimates for ExtraGroupShare from the Ever Married and Currently Married regressions are positive and statistically significant at the 1% level. They indicate that ethnic marriage markets were closely enough linked that intensified competition for brides among extra-group men increased the likelihood that within-group women married. Estimates for ln(Foreign Born) are positive, small in magnitude and statistically significant at the 10% level (columns 1 and 2).

Results from the Endogamous Marriage regression (column 3) reveal negative, statistically significant estimated coefficients on Within-Group Share and Extra-Group Share. The negative coefficient on Extra-Group Share (−2.25) is consistent with the idea that when there is additional competition from extra-group males for within-group brides, this will induce some substitution from remaining single to intermarriage and from an endogamous marriage to intermarriage. The negative (and much smaller) estimated coefficient on WithinGroupShare (−0.32) is unexpected, as intensified mechanical competition between within-group males for within-group brides is consistent with more not fewer endogamous marriages as the within-group bride's share of marriage surplus increases. The larger effect on endogamous marriage rates from a one percentage point increase in ExtraGroupShare relative to the same increase in WithinGroupShare is likely to be partly due to the larger combined size of the marriage-age male population in other ethnic groups relative to the individual's own group. The estimate for ln(Foreign Born) is negative and statistically insignificant at the 10% level.[24]

Results from the Age Gap regression (column 4) reveal large, positive and statistically significant estimated coefficients for both WithinGroupShare (3.34) and ExtraGroupShare (24.06). A one-percentage point (0.01) increase in the within-group share yields a 0.034 year increase in Age Gap whereas the same increase in the extra-group share yields a 0.24 year increase in Age Gap. Both positive estimates could be generated by the additional supply of brides induced to enter the marriage market by offers of higher shares of marriage surplus. Older males from both groups are more likely to have sufficient resources to accommodate a higher share of marriage surplus for their spouse and this selection effect is consistent with an increase in the age gap at marriage.

Table 6 reports estimates for the same set of pooled OLS regressions, this time using the sample of men of marriageable age (20–38). In the Ever Married and Currently Married regressions (columns 1 and 2), estimated coefficients on WithinGroupShare are positive, small, and statistically insignificant. These results provide some support for the proposition that the negative effect on the likelihood of marriage for within-group males from an increase in mechanical competition

[23]Logit estimates of WithinGroupShare differ from LPM estimates. They are positive and statistically significant at least at the 10% level in both regressions (Table A1, columns 1 and 2). The logit estimates indicate that as competion between within-group males for brides intensifies, within-group women become more likely to marry.

[24]In the logit specification (Table A1, column 3), the estimated coefficient for ln (Foreign Born) remains negative but is statistically significant at the 10% level.

**TABLE 6** OLS regressions: Marriage decisions by men of marriageable age.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Variables** | **Ever Married** | **Currently Married** | **Endogamous Marriage** | **Age Gap** |
| ExtraGroupShare | 0.925*** | 0.963*** | −0.924*** | 8.592*** |
| | (0.260) | (0.270) | (0.279) | (1.910) |
| WithinGroupShare | 0.025 | 0.027 | −0.116** | 0.391 |
| | (0.053) | (0.056) | (0.059) | (0.582) |
| ln (Foreign born) | −0.016 | −0.012 | −0.033** | −0.095 |
| | (0.016) | (0.016) | (0.015) | (0.152) |
| Observations | 29,247 | 29,247 | 29,247 | 12,012 |
| *R*-squared | 0.342 | 0.318 | 0.226 | 0.093 |

*Note*: *,**, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

for brides is roughly offset by the increase in supply of within-group and extra-groups brides induced by the higher shares of marriage surplus provided to brides in the more competitive marriage market. Our findings are consistent with results reported by Angrist (2002) who finds that more skewed within-group sex ratios are positively associated with currently being married in his study of second-generation male marriages in the 1910–1940 US censuses.

Estimates for ExtraGroupShare are positive, large, and statistically significant at the 1% level in the Currently Married and Ever Married regressions (columns 1 and 2). In the Ever Married regression (column 1), a one percentage point increase (0.01) in ExtraGroupShare increases the likelihood of marriage by almost one percentage point (0.0093). The large size of this effect is surprising given the negative impact on the likelihood of within-group men marrying due to the increase in mechanical competition from extra-group males. The increase in competition for within-group brides should also increase supply of women in the marriage market; a large net positive effect could occur if the competition effect is small relative to the supply effect. A small competition effect could occur if within-group women viewed extra-group men as relatively poor substitutes for within-group men while the supply effect of additional brides to the marriage market could be large if extra-group men offered large increases in marriage surplus to attract a (hard-to-get) within-group bride. As expected, estimates for ln(Foreign Born) are negative albeit, statistically insignificant (columns 1 and 2).[25]

In the Endogamous Marriage regressions (Table 6, column 3), estimated coefficients on WithinGroupShare and ExtraGroupShare are negative and statistically significant at least at the 5% level. Both results provide support for the proposition that additional within-group and extra-group competition for within-group brides provide incentives to within-group males to search more intensively for a match with an extra-group bride.[26] Estimates for

[25]In the logit specifications (Table A2, columns 1 and 2), the estimated coefficients for ln(Foreign Born) remain negative but becomes statistically significant at the 1% level (column 1) and the 5% level (column 2).

[26]Recent studies of exogamous marriages by economists have focused on factors other than sex ratios to explain the likelihood of exogamous marriages. Furtado & Theodoropoulos, 2011, p. 1257 'find that matching on education rather than ethnicity is more important for natives than for the foreign born and for the foreign born who arrived as young children rather than for those who arrived as teenagers'. Unfortunately, we cannot test this hypothesis, as our data sets with the full-count 1910, 1920, and 1930 territorial censuses of Hawai'i do not contain census data on an individual's education.

**TABLE 7** OLS regressions: Household decisions by women of marriageable age.

| Variables | (1) Children in Household | (2) Mother in Household | (3) Family Size | (4) Individual is Head of Household |
|---|---|---|---|---|
| ExtraGroupShare | 0.928 | −0.869*** | 0.429 | −0.081 |
| | (1.220) | (0.168) | (1.462) | (0.061) |
| WithinGroupShare | 0.324 | −0.054 | −0.304 | 0.008 |
| | (0.277) | (0.0430) | (0.330) | (0.018) |
| ln(Foreign born) | −0.216*** | −0.035*** | −0.343*** | 0.009*** |
| | (0.0778) | (0.0101) | (0.0891) | (0.004) |
| Observations | 26,457 | 26,457 | 27,653 | 27,661 |
| *R*-squared | 0.089 | 0.149 | 0.053 | 0.010 |

*Note*: *,**, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

ExtraGroupShare (−0.92) are much larger in magnitude than those for WithinGroupShare (−0.12), an effect that could be partly due to the much larger combined size of the male population of marriageable age in other ethnic groups relative to a male's own group.

In the Age Gap regression (Table 6, column 4), the estimated coefficient on WithinGroupShare is positive and statistically insignificant whereas the estimated coefficient on ExtraGroupShare is positive, much larger than the coefficient on WithinGroupShare, and statistically significant at the 1% level. This result could be due to additional competition from extra-group men for brides that increases the women's share of marriage surplus. This facilitates marriages by older men who have sufficient resources to gain from entering into marriage despite receiving smaller shares of the marriage surplus.

## Household composition regressions

Table 7 reports estimates of the relationship between within-group and extra-group male shares and four household composition variables for women of marriageable age in the three pooled Hawai'i censuses. In the Children in Household regression (column 1), the estimated coefficients on WithinGroupShare (0.32) and ExtraGroupShare (0.93) are positive and statistically insignificant. The increased presence of children in these households occurs alongside an increase in the likelihood of female marriages in the Ever Married regression when WithinGroupShare and ExtraGroupShare increase (Table 5, column 1).[27] The presence of more children in a household is likely to be a direct effect of the higher female marriage rate and subsequent decisions by the additional married households to have children.

In the Mother in Household regression (Table 7, column 2), the estimated coefficient on WithinGroupShare is negative and statistically insignificant while the estimated coefficient on ExtraGroupShare is also negative, much larger than corresponding WithinGroupShare coefficient, and statistically significant at the 1% level. One possible explanation for the negative relationship is that the additional extra-group and within-group competition between males for brides, a result of the higher male shares, provides potential brides with more bargaining power. One way to exercise this power is to ask that potential grooms make additional

[27]Very few children were born out of wedlock in Hawai'i during this period.

**TABLE 8** OLS regressions: Household decisions by men of marriageable age.

| Variables | (1) Children in Household | (2) Mother in Household | (3) Family Size | (4) Individual is Head of Household |
|---|---|---|---|---|
| ExtraGroupShare | −0.324 | −1.134*** | 2.312 | 0.714*** |
| | (0.818) | (0.349) | (1.604) | (0.233) |
| WithinGroupShare | −0.503** | −0.269*** | −1.640*** | 0.052 |
| | (0.219) | (0.060) | (0.328) | (0.051) |
| ln(Foreign born) | −0.456*** | −0.062*** | −0.741*** | −0.022 |
| | (0.060) | (0.021) | (0.093) | (0.016) |
| Observations | 26,212 | 26,212 | 29,239 | 29,247 |
| *R*-squared | 0.125 | 0.107 | 0.127 | 0.267 |

*Note*: *,**, and *** indicate statistical significance at the 10, 5, and 1 percent levels.

accommodation for potential brides' preferences to establish independent households, that is, not to live with their mother-in-law.

Within-group and extra-group male shares have little effect on family size or who heads the household. In the Family Size regressions (Table 7, column 3), the estimated coefficients on WithinGroupShare (−0.30) and ExtraGroupShare (0.43) are statistically insignificant. Likewise, in the Individual is Head of Household regression (column 4), the estimated coefficients on WithinGroupShare and ExtraGroupShare are small and statistically insignificant.

We note that in three of the four regressions with the women of marriageable age sample reported in Table 7, the factor that most strongly predicts the four measures of household composition is ln(Foreign born). Similar results are obtained in regressions with the men of marriageable age sample (Table 8). These results stand in sharp contrast to findings for the 1910–1940 US marriage market reported in Angrist (2002), who observes that sex ratios rather than the relative sizes of first-generation co-ethnic populations were a stronger predictor of the same four measures of household composition. One potential explanation is that members of smaller groups in Hawaii had more contact with members of other groups compared to members of larger groups and that more contact tends to reduce social distance between groups (Choi & Tienda, 2017, pp. 3–4).

Table 8 reports estimates of the relationship between within-group and extra-group male shares and four household composition variables for men of marriageable age in the three pooled Hawai'i censuses. In the Children in Household, Mother in Household, and Family Size regressions (columns 1, 2, 3), all but one estimated coefficient—ExtraGroupShare in the Family Size regression)—for WithinGroupShare and ExtraGroupShare are negative. These results are consistent with males in a more competitive marriage market (induced by the higher extra-group and within-group male shares) making more accommodations to potential brides' preferences. Accommodations are necessary because increased competition among a group of males for brides increases the women's share of the marriage surplus. We find it somewhat surprising that the effects of increases in extra-group and within-group male share are stronger in regressions using the sample of men of marriageable age (Table 8) than in regressions using the sample of women of marriageable age (Table 7).

In the Individual is Head of Household regression (Table 8, column 4), the estimated coefficient on WithinGroupShare is positive, small, and statistically insignificant, whereas the

estimated coefficient on ExtraGroupShare is positive and statistically significant. The Extra-Group Share relationship could be driven by the additional male marriages and intermarriages driven by increases in ExtraGroupShare (Table 6). We conjecture that the marriage bargains underlying these additional marriages, particularly in the case of intermarriages, could involve setting up an independent household to meet bride preferences and to avoid cultural clashes with non-co-ethnic relatives.

We reran the OLS regressions reported in Tables 5–8 with corresponding logit and poisson estimators and report these results in Tables A1–A4. The results are broadly consistent with those reported in Tables 5–8, with discrepancies noted in footnotes 23, 24, and 25. The main differences are in the estimated coefficients on WithinGroupShare in the Ever Married and Currently Married regressions. The OLS coefficients (Table 5, columns 1 and 2) vary in sign and are statistically insignificant whereas the logit coefficients (Table A1, columns 1 and 2) are both positive and statistically significant at the 1% level in the Ever Married regression and at the 10% level in the Currently Married regression.

## CONCLUSION

We find that changes in female scarcity in Hawai'i impacted marriage choices and household composition of males and females of marriageable age. In the marriage regressions on the female sample (Table 5), we find that a larger within-group male share is associated with a higher likelihood that a within-group female marries and matches with an older husband. In the marriage regressions on the male sample (Table 6), we find that a larger within-group male share is not associated with changes in the likelihood of being married or the age gap with one's spouse but does result in these men being more likely to match with a spouse outside of their group.

We also build on work by Weiss and Stecklov (2020) and augment our empirical analysis of marriage choice and household composition by including a measure of the male share among first-generation individuals of marriageable age from all other ethnic groups. In the marriage regressions on the female sample (Table 5), we find that a larger extra-group male share is associated with a higher likelihood that a within-group female marries, matches with a husband outside of her ethnic group, and marries a much older husband. We find very similar patterns in the marriage regressions on the male sample: A larger extra-group male share is associated with a higher likelihood that a within-group male marries, matches with a wife outside of his ethnic group, and has a larger gap in age with his wife. These results nicely illustrate that female scarcity in other ethnic groups is relevant to males and females in a given ethnic group once a society allows social space for intermarriage to occur frequently. This transition happened in Hawai'i during our sample period, as intermarriage increased from 9.1% of total marriages among the population of marriageable age in 1910 to 19.0% in 1930 (Table 3).

We also examine the relationship between female scarcity and household composition variables. Regression results on the female sample (Table 7) indicate both larger extra-group and within-group male shares are associated with a lower likelihood that women have a mother or mother-in-law living in their household but does not substantially affect number of children in household, family size, or likelihood of being the household head. Regression results on the male sample (Table 8) are very different, as they indicate that a larger within-group male share is associated with a lower likelihood of children in the household and mother or mother-in-law living in the household as well as a smaller family size. In addition, they also show that a larger

extra-group males share is associated with a lower likelihood of children in the household and mother or mother-in-law living in the household as well as a higher likelihood that the male is head of household. For both males and females, we expect changes in household composition to be driven by changes in marriage rates, and in both the male and female samples, increases in extra-group male share generate large increases in marriage rates. We caution that more work is needed to specify more completely the paths via which variations in within-group and extra-group female scarcity affect household composition.

The size of the foreign-born co-ethnic population of marriageable age also had a large impact on men's marital choices and household composition for men and women. Our results parallel those reported in Choi and Tienda (2017), who find that relative group sizes affected intermarriage rates in the United States during the 2008–2011 period. There are a variety of channels via which relative group size could affect marital choices and household composition, and more research with Hawai'i census data on ethnic composition of neighbourhoods and plantation housing could be productive in illuminating the sources of this relationship.

Our central conclusion, that in the early twentieth century female scarcity had significant impacts on marriage and household composition in Hawai'i, differs in some specifics but generally parallels results reported by Angrist (2002) for the same period for the continental United States. The successive waves of immigration that transformed the composition of the Hawai'i population in the late nineteenth and early twentieth centuries provide a broad canvas for investigating whether an extension of the scope of female scarcity to multiple ethnic groups improves our understanding of marriage outcomes and household composition. Our conclusion is that the Hawai'i case provides a clear illustration of the principle that marriage market constraints are a powerful influence on marital decisions and household composition in all human societies, yet also vividly shows that the specific social, economic, and political context is critically important in shaping outcomes.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ORCID

*Sumner La Croix* https://orcid.org/0000-0003-4690-6927

## REFERENCES

Abramitzky, R., Delavande, A. & Vasconcelos, L. (2011) Marrying up: the role of sex ratio in assortative matching. *American Economic Journal: Applied Economics*, 3, 124–157.

Adams, R. (1937) *Interracial marriage in Hawaii: a study of the mutually conditioned processes of acculturation and amalgamation*. New York: Macmillan Co.

Angrist, J. (2002) How do sex ratios affect marriage and labor markets? Evidence from America's second generation. *Quarterly Journal of Economics*, 117, 997–1038.

Baranov, V., De Haas, R. & Grosjean, P. (2020) Queens of the desert: convictism and marital attitudes across Australia. *American Economic Asssociation Papers and Proceedings*, 110, 457–462.

Becker, G.S. (1981) *A treatise on the family*. Cambridge: Harvard University Press.

Beechert, E. (1985) *Working in Hawaii, a labor history*. Honolulu: University of Hawai'i Press.

Bethmann, D. & Kvasnicka, M. (2013) World War II, missing men, and out-of-wedlock childbearing. *Economic Journal*, 123, 162–194.

Brainerd, E. (2017) Uncounted costs of World War II: the effect of changing sex ratios on marriage and fertility of Russian women. *Review of Economics and Statistics*, 99, 229–242.

Carter, S.B., Garner, S.S., Haines, M.R., Olmstead, A.L., Sutch, R. & Wright, G. (Eds.). (2006) *Historical statistics of the United States: earliest times to the present, Millennial Edition*, Vol. II. New York: Cambridge University Press.

Casterline, J.B., Williams, L. & McDonald, P. (1986) The age difference between spouses: variations among developing countries. *Population Studies*, 40, 353–374.

Charles, K.K. & Luoh, M.C. (2010) Male incarceration, the marriage market, and female outcomes. *Review of Economics and Statistics*, 92, 614–627.

Cheng, C.K. & Yamamura, D.S. (1957) Interracial marriage and divorce in Hawaii. *Social Forces*, 37, 77–84.

Chiappori, P.-A. (1992) Collective labor supply and welfare. *Journal of Political Economy*, 100, 437–467.

Chiappori, P.-A., Fortin, B. & Lacroix, G. (2002) Marriage market, divorce legislation, and household labor supply. *Journal of Political Economy*, 110, 37–72.

Choi, K.H. & Tienda, M. (2017) Marriage-market constraints and mate-selection behavior: racial, ethnic, and gender differences in intermarriage. *Journal of Marriage and Family*, 79, 301–317.

Edlund, L., Li, H., Yi, J. & Zhang, J. (2013) Sex ratios and crime: evidence from China. *Review of Economics and Statistics of Political Economy*, 110, 37–72.

Fenske, J. & Gupta, B. (2022) Conflict and gender norms: evidence from India. Paper presented at the World Economic History Congress, Paris, France, on July 27, 2022.

Francis, A.M. (2011) Sex ratios and the red dragon: using the Chinese Communist Revolution to explore the effect of the sex ratio on women and children in Taiwan. *Journal of Population Economics*, 24, 813–837.

Fu, X. & Heaton, T.B. (1997) *Interracial marriage in Hawaii: 1983–1994*. Lewiston, New York: Edwin Mellen Press.

Furtado, D. (2012) Human capital and interethnic marriage decisions. *Economic Inquiry*, 50, 82–93.

Furtado, D. & Theodoropoulos, N. (2011) Interethnic marriage: a choice between ethnic and educational similarities. *Journal of Population Economics*, 24, 1257–1279.

Grosjean, P. & Khattar, R. (2019) It's raining men! Hallelujah? The long-run consequences of male-biased sex ratios. *Review of Economic Studies*, 86, 723–754.

Grossbard-Shechtman, S. (1993) *On the economics of marriage: a theory of marriage, labor, and divorce*. Boulder, Colorado: Westview Press.

Grossbard-Shechtman, S. & Neideffer, M. (1997) Women's hours of work and marriage market imbalances. In: Persson, I. & Jonung, C. (Eds.) *Economics of the family and family policies*. New York: Routledge.

Guttentag, M. & Secord, P.F. (1983) *Too many women? The sex ratio question*. Beverley Hills, CA: Sage Publications.

Halliday, T. & La Croix, S. (2013) Sons, daughters, and labor supply in early twentieth-century Hawai'i. Department of Economics, University of Hawai'i Working Paper, No. 13-18.

Horioka, C.Y. & Terada-Hagiwara, A. (2017) The impact of pre-marital sex ratios on household saving in two Asian countries: the competitive saving motive revisited. *Review of Economics of the Household*, 15, 739–757.

Ichioka, Y. (1988) *The Issei: the world of the first generation Japanese immigrant, 1885–1924*. New York: Free Press.

Kalmijn, M. (1998) Intermarriage and homogamy: causes, patterns, trends. *Annual Review of Sociology*, 24, 395–421.

Kurzban, R. & Weeden, J. (2005) HurryDate: mate preferences in action. *Evolution and Human Behavior*, 26, 227–244.

Kwon, T.H., Lee, H.Y., Chang, Y. & Yu, E.-Y. (1975) *The population of Korea*. C.C.R.E.D. Series. Seoul: Population and Development Studies Center, Seoul National University.

La Croix, S. (2019) *Hawai'i: eight hundred years of political and economic change*. Chicago and London: University of Chicago Press.

La Croix, S. & Fishback, P. (2000) Migration, labor market dynamics, and wage differentials in Hawaii's sugar industry. *Advances in Agricultural Economic History*, 1, 31–72.

Lafortune, J. (2013) Making yourself attractive: pre-marital investments and the returns to education in the marriage market. *American Economic Journal: Applied Economics*, 5(2), 151–178.

Laslett, P. (1977) Characteristics of the western family considered over time. *Journal of Family History*, 2(2), 89–116.

Lee, J.Z. & Wang, F. (1999) *One quarter of humanity: Malthusian mythology and Chinese realities, 1700–2000*. Cambridge: Harvard University Press.

Liou, W. (2015) Effects of annexation on labor in Hawaii. In: Liou, W. (Ed.) *Three essays in labor economics*. Unpublished doctoral dissertation. Mānoa: University of Hawai'i.

National Institute of Population and Social Security Research. (2020) Selected demographic indicators of Japan. http://www.ipss.go.jp/p-info/e/S_D_I/Indip.html [Accessed 17 July, 2020].

Patterson, W. (2000) *The Ilse: first-generation Korean immigrants in Hawai'i, 1903–1973*. Honolulu: University of Hawai'i Press & University of Hawai'i Center for Korean Studies.

Porter, M. (2016) How do sex ratios in China influence marriage decisions? *Review of Economics of the Household*, 14, 337–371.

Qian, Z. & Lichter, D. (2007) Social boundaries and marital assimilation: interpreting trends in racial and ethnic intermarriage. *American Sociological Review*, 72(1), 68–94.

Schwartz, C. (2013) Trends and variations in assortative mating: causes and consequences. *Annual Review of Sociology*, 39, 451–470.

South, S.J., Trent, K. & Bose, S. (2014) Skewed sex ratios and criminal victimization in India. *Demography*, 51, 1019–1040.

Wei, S.-J. & Zhang, X. (2011) Competitive saving motive: evidence from rising sex ratios and savings rates in China. *Journal of Political Economy*, 119, 511–564.

Weiss, I. & Stecklov, G. (2020) Assimilation and ethnic marriage squeeze in early 20th century America: a gender perspective. *Demographic Research*, 42, 99–132.

Wentworth, E.C. (1941) Filipino Plantation Workers in Hawaii: A Study of Incomes, Expenditures and Living Standards of Filipino Families on an Hawaiian Sugar Plantation. Studies of the Pacific, No., 7. San Francisco: American Council, Institute of Pacific Relations.

Zhou, X.D., Wang, X.L., Li, L. & Hesketh, T. (2011) The very high sex ratio in rural China: impact on the psychosocial wellbeing of unmarried men. *Social Science & Medicine*, 73, 1422–1427.

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## APPENDIX A: LOGIT AND POISSON REGRESSION RESULTS

**TABLE A1** Logit regressions: Marriage decisions by women of marriageable age.

| | (1) | (2) | (3) |
|---|---|---|---|
| **Variables** | **Ever Married** | **Currently Married** | **Endogamous Marriage** |
| ExtraGroupShare | 0.779*** | 0.746*** | −2.216*** |
| | (0.201) | (0.193) | (0.354) |
| WithinGroupShare | 0.167*** | 0.104* | −0.283*** |
| | (0.057) | (0.059) | (0.055) |
| ln (Foreign born) | 0.016 | 0.0158 | −0.027* |
| | (0.013) | (0.0129) | (0.016) |
| Observations | 27,661 | 27,661 | 27,661 |
| Pseudo *R*-squared | 0.239 | 0.205 | 0.122 |

*Note*: Robust standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

**TABLE A2** Logit regressions: Marriage decisions by men of marriageable age.

| | (1) | (2) | (3) |
|---|---|---|---|
| **Variables** | **Ever Married** | **Currently Married** | **Endogamous Marriage** |
| ExtraGroupShare | 0.712*** | 0.723*** | −1.034*** |
| | (0.230) | (0.246) | (0.235) |
| WithinGroupShare | 0.011 | −0.004 | −0.173*** |
| | (0.040) | (0.045) | (0.046) |
| ln(Foreign born) | −0.029*** | −0.025** | −0.042*** |
| | (0.011) | (0.011) | (0.012) |
| Observations | 29,247 | 29,247 | 29,247 |
| Pseudo *R*-squared | 0.284 | 0.264 | 0.197 |

*Note*: Robust standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

**TABLE A3** Logit and poisson regressions: Household decisions by women of marriageable age.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Variables** | **Children in Household** | **Mother in Household** | **Family Size** | **Individual is Head of Household** |
| ExtraGroupShare | 0.837 | −0.764*** | 0.247 | −0.028 |
| | (1.284) | (0.189) | (1.521) | (0.062) |
| WithinGroupShare | 0.104 | −0.105** | −0.371 | 0.012 |
| | (0.271) | (0.0476) | (0.318) | (0.015) |
| ln(Foreign born) | −0.247** | −0.0366*** | −0.364*** | −0.007 |
| | (0.102) | (0.0110) | (0.107) | (0.004) |
| Observations | 26,457 | 26,457 | 27,653 | 27,661 |
| Pseudo *R*-squared | 0.040 | 0.124 | 0.019 | 0.038 |
| Estimator | Poisson | Logit | Poisson | Logit |

*Note*: Robust standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

**TABLE A4** Logit and poisson regressions: Household decisions by men of marriageable age.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Variables** | **Children in Household** | **Mother in Household** | **Family Size** | **Individual is Head of Household** |
| ExtraGroupShare | −1.550* | −0.762** | 2.182 | 0.385* |
| | (0.823) | (0.319) | (1.484) | (0.203) |
| WithinGroupShare | −1.075*** | −0.254*** | −1.982*** | −0.009 |
| | (0.244) | (0.0573) | (0.337) | (0.040) |
| ln(Foreign born) | −0.747*** | −0.0845*** | −0.999*** | −0.031* |
| | (0.0986) | (0.0231) | (0.131) | (0.012) |
| Observations | 26,212 | 26,212 | 29,239 | 29,247 |
| Pseudo *R*-squared | 0.080 | 0.088 | 0.064 | 0.218 |
| Estimator | Poisson | Logit | Poisson | Logit |

*Note*: Robust standard errors in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.