Mating Competition and Entrepreneurship

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Abstract

We used a natural experiment in Taiwan to test whether mating competition is a major motive for entrepreneurship. After being defeated in Mainland China, more than half million soldiers retreated to Taiwan in 1949. The soldiers were not allowed to get married until the military marriage ban was lifted in 1959. The policy change created a severe marriage squeeze for local men, triggering their animal spirits to engage in entrepreneurial activities. Empirical results show that local men exposed to high sex ratios as a result of the removal of the marriage ban were more likely to become entrepreneurs later on.

Keywords: sex ratios, mating competition, entrepreneurship, Taiwan

JEL code: J10 and L26.

1. INTRODUCTION

Mating is an integral part of human life. Men and women normally adopt an assortative matching mechanism in the mating process with respect to their differences. In the marriage market of contemporary industrial society, women rank men's earning capacity as more important than their appearance, while men attach greater weights to women's physical attractiveness (Buss 1989; Fisman et al., 2006). Realizing wealth is a key sorting variable in the eyes of women, men are motivated to increase their earnings (Cole, Mailath, and Postlewaite, 1992).¹ Becoming an entrepreneur is one way for men to accumulate wealth and edge out opponents in the marriage market competition, because successful entrepreneurs normally earn much more than comparably successful salaried workers (Kirzner, 1973; Levine and Rubinstein, 2013).²

The sociobiology literature has provided some evidence that in a more competitive mating environment, young men are more likely to take risks (Wilson and Daly, 1985; Baker and Maner, 2008). Since risk taking is a key feature of entrepreneurs (Knight, 1921), we hypothesized that mating competition is an important driver of entrepreneurship. To our knowledge the linkage between mating competition and entrepreneurship has not been explored in the entrepreneurship literature. In this paper, we aim to empirically test this hypothesis.

Our paper is related to the large body of literature on entrepreneurship. The literature (Keynes, 1936; Schumpeter, 1942; Kirzner, 1973; Baumol, 1990; Shane and Venkataraman, 2000; Audretsch, 2007; Astebro, et al., 2014) is too broad to be reviewed comprehensively. Here we focus only on animal spirits and entrepreneurship. Animal spirits have been widely recognized as a key driver of entrepreneurship and innovation (Keynes, 1936; Schumpeter, 1942). Facing uncertainty, having a spontaneous optimism is

¹ As shown in Chiappori, Oreffice, and Quintana-Domeque (2012), assortative matching can be multi-dimensional and trade-offs exist between mate attributes. When facing intensified competition in the marriage market, men of course like to improve the quality of their attributes. However, some attributes, such as physical attractiveness, are largely predetermined and hard to change. Consequently, increasing sex ratio imbalance may induce men to improve the more malleable attributes, such as wealth.

² Hamilton (2000) notes that in the US on average self-employed workers do not necessarily earn more than regular salaried workers. Therefore he concludes that some nonpecuniary benefits of self-employment must be important drivers of entrepreneurship. Despite the lower average earnings, some entrepreneurs, such as incorporated ones, earn much more than salaried workers and entrepreneurs' earning distribution have long fatter tails than salaried workers (Levin and Rubinstein, 2013). So entrepreneurship offers a larger option value of earning considerably more than successful salaried workers if the business succeeds. In contrast to the lower earnings in the US, in Taiwan, as shown in Figure 1, both the average and median earnings of employers and self-employed were higher than employees during 1981-2006. Regardless of the difference in average and median earnings, as long as successful entrepreneurs earn much more than ordinary workers, some potential entrepreneurs with spontaneous optimism may be induced to engage in entrepreneurship activities when the opportunity comes.

essential for one to take entrepreneurial activities (Keynes, 1936; Manju and Robinson, 2007). Animal spirits can be influenced by various external factors, such as social network (Nanda and Sorensen, 2010; Lerner and Malmendier, 2013), financing (Kerr and Nanda, 2009), and public policy (Link and Scott, 2012). Despite the burgeoning body of literature, “reviewing the evidence on the roots of entrepreneurship, what surprises us most is how little we really know” (page 65, Astebro, et al., 2014). The literature does not explicitly discuss the role of biological force, such as mating competition, in sparking animal spirits.³ In this paper, we empirically test the impact of mating competition on entrepreneurship.

To test this hypothesis, however, is challenging. In most human societies, sex ratios at marriageable ages are roughly balanced.⁴ Besides, as long as men and women match assortatively, there will be intra-sex mating competitions even if the number of men and women of marriage ages are the same. However, it is difficult to empirically measure the degree of mating competition using sex ratios in such a setting and evaluate its economic impact. Of course, it would be ideal if one could manipulate sex ratios in human populations to artificially create different degrees of mating competition and test the impact on entrepreneurship using randomized control trials (RCTs). It would be unethical, however, not to mention almost impossible, to run this kind of RCT on human beings. This is perhaps one reason why the empirical literature about the impact of mating competition on human economic behavior is still sparse.

In the absence of RCTs, the second best option is to use a natural experiment in the real world, where the variation in sex ratios is caused by exogenous factors that are independent of economic outcomes. In our paper, we used a powerful natural experiment in Taiwan to test our mating competition hypothesis. After being defeated by the Chinese Communist Party in Mainland China, the Chinese Nationalist Party (also known as *Kuomintang*) fled to Taiwan in 1949 with more than one million followers, majority of who were unmarried young soldiers. Such a massive influx of young males from Mainland China created a human-made marriage squeeze for men in Taiwan, which had a

³ One exception is Du and Wei (2011). They developed an overlapping generation model, which predicts that as the ratio of males to females rises—as long as the ratio remains below a threshold—a greater number of men will choose to become entrepreneurs.

⁴ In the human biology literature, the sex ratios at the mating ages are often called operational sex ratios.

population of only about six million people at the time. The sex ratio among the 20–24 age cohort reached as high as 152 men for every 100 women in 1950 (Francis 2011). Moreover, Chiang Kai-shek, the head of the *Kuomintang*, wanted his soldiers to be ready to attack Mainland China at any time instead of settling in Taiwan. So the government imposed a marriage ban on soldiers upon their arrival in Taiwan. The ban was not lifted until 1959. The flood of immigrants from Mainland China and the subsequent marriage regulation and deregulation offer a *natural laboratory* to examine the implications of having too many men in a marriage market for entrepreneurship.

Based on the timing of the imposition and removal of the marriage ban, we imputed operational sex ratios for the marriage-age cohort at the county level over time and directly tested the impact of mating competition on entrepreneurship. Using data from multiple sources, we showed that men who were exposed to high sex ratios as a result of the change in marriage policy were more likely to become entrepreneurs. About 30% of the increase in entrepreneurship can be explained by the rise in operational sex ratios.

In addition to mating competition, we also considered an alternative mechanism that the rise in entrepreneurship may have been driven by the increased labor market competition as a result of the massive influx of male mainland soldiers. Men are inherently more likely to become entrepreneurs than women. When the male mainland soldiers were discharged from the military and joined the labor market, they could have intensified the competition and boosted entrepreneurship in the labor market. It is thus possible that the spike in entrepreneurial activities may have resulted from the labor market competition, instead of the mating competition. Moreover, the mainland soldiers generally had fewer social connections and job opportunities in the private sector than local Taiwanese men, thus making them more likely to take up entrepreneurial activities.

To remedy these concerns, we included the number of men in the labor force at the local level in logarithmic form in all the regressions to directly control for the labor market effect. In addition, in our main analyses, we excluded the mainland Chinese from our sample to focus on the sex ratio effect on the local Taiwanese.⁵ Of course, local

⁵ All the results remain similar when using the full sample, including both native Taiwanese and migrants from mainland China.

Taiwanese men might also be driven into self-employed jobs as mainland veterans grabbed a greater share of the limited formal jobs in Chiang Kai-shek's government. However, the temporal pattern of entrepreneurial activities moved more in tandem with the timing of the imposition and removal of the marriage ban than with several waves of soldier discharges, suggesting that the rise in entrepreneurship was mainly driven by the mating competition rather than the labor market competition.

Finally, it is possible that having excess men in the labor market may have crowded out job opportunities for women, inducing more women to become entrepreneurs in regions with high sex ratios. However, we found that women's entrepreneurship activities are much less correlated with the degree of marriage market competition than men.

Our paper contributes to a new literature on the biological roots of entrepreneurship. Based on twins' data in the UK and US, Nicolaou and Shane (2009 and 2010) show some entrepreneurial behaviors are inheritable. One key difference is that our paper focuses on the evolutionary biological (sexual selection) driver of entrepreneurship, while theirs highlight the genetic component to entrepreneurial behavior.

Our paper is also closely related to the emerging body of literature on the economic impact of sex ratio imbalance (Angrist, 2002; Chiappori, Fortin, and Lacroix, 2002; Lafortune, 2003; Abramitzky, Delavande, and Vasconcelos, 2011; Wei and Zhang, 2011a; Wei, Zhang and Liu, 2012; Bethmann and Kvasnicka, 2013; Edlund et al., 2013). However, none of these papers directly examine the impact of sex ratios on entrepreneurship, which is a focus of this paper. One exception is Wei and Zhang (2011b), which show that in areas with more skewed sex ratios in the pre-marital cohort, Chinese parents with sons are more likely to engage in risky jobs and set up businesses. Our paper differs from theirs in one key aspect. Their paper focuses on the parental response to sex ratio imbalance among their children's cohort, while our paper examines the long-term impact on entrepreneurship on men who themselves are exposed to marriage squeezes.

The rest of this paper is arranged as follows. Section 2 describes the historical background and the procedures for imputing operational sex ratios. Section 3 establishes the fact that sex ratios matter to marriage market outcomes and being an entrepreneur was associated with a higher likelihood of getting married. In other words, women did regard

entrepreneurship as a desirable trait in the marriage market. In Section 4, we unravel evidence to show that in regions with higher operational sex ratios, men were more likely to engage in entrepreneurial activities. Section 5 concludes.

2. HISTORICAL BACKGROUND AND DATA

Historical Background

In Mainland China, immediately after the end of World War II, the Chinese Nationalist Party and the Chinese Communist Party fought a civil war between 1945 and 1949. The former was defeated and retreated to Taiwan with a great number of followers, including soldiers and civilians. Various studies have suggested that the number of civil war immigrants to Taiwan ranged between 0.6 and 1.25 million, while Taiwan's local population was only 6 million (Barclay 1954; Jacoby 1967; Ho 1978; Chen and Yeh 1982; Liu 1986; Lin 2002). Among the immigrants, the number of soldiers, who were mostly single males in their early 20s, is estimated to have exceeded half a million. It is thus not surprising that the composition of the immigrants was highly male-biased. Francis (2011) suggested that among the immigrants, men outnumbered women by a factor of 4 to 1, which led to a significant and sudden rise in Taiwan's sex ratio among those of marriage ages.

So as to be ready to counterattack Mainland China, the soldiers of the Chinese Nationalist Party were not allowed to get married in the 1950s (Lin 2002). In 1952, the marriage ban was formally written into a law called the Military Marriage Ordinance (MMO).⁶ The MMO forbade most active military personnel from getting married, except for military officers and technician sergeants. However, in August 1959, the ban was relaxed for most soldiers, except for male soldiers younger than 25, female soldiers younger than 20, and all soldiers who had served fewer than three years.⁷ This relaxation essentially made the MMO nonbinding for most immigrant soldiers, who either were already older than 25 or had served more than three years by 1959. This meant that they could finally get married, roughly 10 years after their arrival in Taiwan.

⁶ The ban was de facto effective even before the law was enacted.

⁷ In 1974, the MMO was further relaxed to include only soldiers currently involved in combat and students in military academies. It was completely repealed in 2005.

In the mid-1950s, the *Kuomintang* began to conscript young Taiwanese men to replace aging immigrant soldiers. In principle, conscripted Taiwanese men were also subject to the marriage ban. However, unlike their immigrant counterparts, Taiwanese soldiers generally served only for two or three years and remained socially connected to others outside the military. So the ban was less binding on them.

Imputing Operational Sex Ratios

In Taiwan, the official population data are collected through a civilian household registration system. However, prior to 1969, the number of active military personnel was treated as a state secret and excluded from the civilian registration system, unless they got married (Lin 2002). In November 1968, this exclusion was changed by an executive order that required all military personnel to be registered in the civilian system. This means that until 1969, immigrant soldiers did not show up in official population data. Consequently, the raw sex ratio calculated from official population data prior to 1969 is underestimated.

To correct the bias of the raw sex ratio, in this paper we imputed operational sex ratios that better reflect the intensity of competition in the marriage market. We excluded immigrant soldiers in the calculation of operational sex ratios before 1960 because they were effectively subject to the MMO. However, the Taiwanese soldiers were still included in the operational sex ratio, because of their short duration of service and strong social ties, even though they were also subject to the MMO. In this paper, we adopted the imputation method proposed by Chang (2012). The details of the imputation procedure are provided in the appendix.

Table 1 presents the imputed male population in shaded areas and the percentage difference between the imputed and official male population in parentheses by five-year cohorts. In 1960, the official source reported 380,765 men aged 30–34. However, as shown in the table, 85,764 male soldiers, or 22.5 percent of the official number, were omitted. For the cohort 35–39, 61,897 men (18.5 percent of the reported male cohort size) were excluded. For the cohort 20–49 as a whole, the official statistics missed 191,358 men, accounting for 11 percent of the total male cohort population, a sizable omission.

Figure 2 plots the imputed sex ratios for three cohorts, 20–29, 30–39, and 40–49, from 1954 to 1970. The three cohorts follow different patterns. Cohort 20–29 had the lowest sex ratio. When the marriage ban was lifted in 1959, most mainland immigrants were already older than 30. Thus cohort 20–29 was mainly composed of the local population. The sex ratio for the age group 30–39 exhibits a bell curve, reaching its peak value, over 1.4, in 1959. Afterward, it declined as the soldiers aged and were reclassified into the older bracket of 40–49. Consequently, the sex ratio for cohort 40–49 witnessed a steady increase in this period. Since the sex ratio imbalance was particularly high among age group 30–49, it was difficult for the mainland male soldiers in this cohort to find wives of the same age after the MMO was lifted in 1959. As a result, they had to seek younger women, which in turn created a squeeze for men in their 20s. Therefore, if we used only the number of men and women aged 20–29 to compute sex ratios, the true degree of marriage competition would be underestimated. In view of this concern, we opted to compute the operational sex ratio over a wide age range.

Sex Ratios and Marriage Outcomes

Figure 3 illustrates the imputed operational male-to-female sex ratio (interchangeably, we also called it the prime-age sex ratio) for cohort 15–49 and women's marriage rate in Taiwan. It is apparent from the figure that the sex ratio started at a low level (slightly above 1) in the late 1940s, suggesting that the naturally occurring sex ratios were quite normal at that time. The ratio rose, peaked in the late 1950s, and remained at a plateau for more than a decade. At its peak, the operational sex ratio was as high as 1.18, which means that there were roughly six men competing for every five women of marriageable ages. Inevitably, one-sixth of men mathematically could not find a wife. As the immigrant soldiers aged, they were phased out from the calculation of the operational sex ratio. Accordingly, the sex ratio declined steadily from 1970 and did not fall to a normal level until the 1980s, when the entire immigrant cohort exceeded the age of 60. Not surprisingly, the female marriage rate mirrors the patterns of operational sex ratios, as shown by the dotted line in Figure 3. As the sex ratios went up or down, so did women's marriage prospects, which confirms that the imputed operational sex ratios represent a good measure of the terms of trade in the marriage market. The finding is

consistent with Tsai (2011) that higher sex ratios bring about a larger likelihood of marriage for women.

Owing to such a large backlog of male soldiers in the marriage market, average marriage age for men increased from 22.3 years old in 1955 to 27.3 in 1970, while women's average marriage age rose by only one year. As shown in Figure 4, the gender gap in marriage age had widened since the mid-1950s, reaching its climax (5.3 years) in 1970. The enlarging marriage age gap reflects increasing competition among men seeking wives.

The co-movement of operational sex ratios and marriage age gap in Figure 4 is only suggestive. Some individual characteristics also matter to marriage age. To address this concern, we regressed the spousal age gap on sex ratios at age 20 by controlling for a set of personal characteristic variables and the estimates are reported in Table 2. The dependent variable "spouse age gap" is defined as the difference between husband's and wife's ages. Column (1) in Panel A is based on Taiwan 1990 Population Census. We restricted our sample to household heads and their spouses because the census lists each household member's relationship to the household head, while the spousal relationship for other married family members cannot be identified. Column (2) uses the Survey of Health and Living Status of the Middle-Aged and the Elderly in Taiwan in 1996 and 2003. Sex, ethnicity, education, a full set of birth year fixed effects, and a dummy indicating sample 2003 (only for column 2) are included as regressors. The sex ratio variable is highly significant and positive in both panels. A standard deviation increase in sex ratios, about 0.1, would widen marriage age gap by about 0.4 years, roughly 10% of the observed spouse age gap. The impact is economically sizable. In panel B, we examined the sex ratio effect on the probability of ever being married by the survey time for women. In column (1), we used both the 1980 and 1990 Census but restrict to women aged at least 25 in accordance with the use of sex ratios at age 20. In column (2), the sample consists of female elderly. While the mean probabilities are both very high in the two samples, the sex ratio effects are still both positive and significant. Specifically, one standard deviation increase in the sex ratio leads to an increase in the probability by 1.58 and 0.65 percentage points in these two samples respectively.

Definitions of Entrepreneurship

The main data sources used in our analysis are population censuses and the Survey of Health and Living Status of the Middle-aged and the Elderly in Taiwan. It is important to clarify how entrepreneurship is defined in the two datasets.

1. Population Census

Since 1949 when the *Kuomintang* retreated to Taiwan, population censuses have been conducted there in 1956, 1966, 1980, 1990, 2000, and 2010. The censuses generally collected information on sex, birth date, marital status, education, and employment status. The censuses also gathered information on who holds a job and whether one is an employer, a self-employed, or a salaried worker. All information is evaluated on the day of the census. An electronic format of individual level census data was not available until 1980. So for our main estimation of the sex ratio effect on entrepreneurship, we used individual data from the 1980 and 1990 censuses and added a sample dummy for the 1990 wave.

The entrepreneurship variable is defined as one if a person was an employer at the time of the census and zero if being a worker, self-employed or unemployed. This definition has one major drawback. Some people might have tried to be entrepreneurs, failed, and ended up working for others or taking early retirement. Thus, they would be classified as non-entrepreneurs in the population census. Such a definition may underestimate the degree of entrepreneurship during early life. To remedy this concern, we also used an alternative dataset—the longitudinal Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan for 1996 and 2003.

2. Survey of Health and Living Status of the Middle-Aged and the Elderly in Taiwan

The Survey of Health and Living Status of the Middle-Aged and the Elderly in Taiwan (shortened as “the elderly survey”) is a longitudinal survey conducted by the Bureau of Health Promotion under the Department of Health in Taiwan. We used two samples drawn in 1996 and 2003. The two samples include cohorts born during 1931–

1945 and 1946–1953 respectively. Accordingly, they reached age 20 during 1951–1973. In our regression analyses, we combined the two samples and added a sample dummy.

One advantage of this elderly survey is that it contains lifetime employment history. This information is based on a series of employment questions. For each job that a respondent had ever taken, the survey asked the respondent to indicate the owner of the business. One option was that the owner was oneself or the spouse. Unfortunately, the survey did not further separate the two cases. We thus defined the entrepreneurship variable as one if the respondent or the spouse had ever worked as a business owner or had been self-employed in nonagricultural sectors and as zero if the respondent had never worked or had worked only as an employee. It would have been ideal to define the entrepreneurship variable by including only business owners in the same way as in the census. However, the elderly survey did not distinguish business owners from the self-employed in nonagricultural sectors.

This definition on entrepreneurial history based on the elderly survey is broader than the definition on employer status in the census in two aspects. First it includes both employers and self-employed. Second, it encompasses all the entrepreneurial effort, even failed ones. This broader definition likely overestimates the prevalence of entrepreneurship than the definition based on employer status. Despite the caveat, it is the only dataset available that includes detailed employment history. Please bear this shortcoming in mind when reading the results based on the elderly data. One advantage of using both the narrow and broad definitions in our analyses is that they offer a lower and upper bound of estimates.

3. ENTREPRENEURSHIP AS A DESIRABLE TRAIT IN THE MARRIAGE MARKET

Are Entrepreneurs Wealthier?

By comparing earnings between workers and self-employed entrepreneurs in the US, Hamilton (2000) found that despite much higher risks, self-employed entrepreneurs earn less than paid employees. If entrepreneurship does not bring more wealth, then men do not have much incentive to become entrepreneurs when facing marriage market squeeze. To test if Hamilton's finding also holds in Taiwan or not, we plotted the average

and median earnings of employers, self-employed, and workers based on Taiwan Family Income and Expenditure Survey from 1981 to 2006 in Panel A and Panel B of Figure 1. The relative gap between employer and employee income has been rather constant throughout the period. The self-employed also earned more than employees most of the time. In general, employers and self-employed in Taiwan come with an income premium compared to paid workers.

Marriage Outcomes for Entrepreneurs and Workers

It has been widely documented that wealth is an important status variable in the marriage market (Buss 1989). Because entrepreneurs, on average, were wealthier than workers in Taiwan (successful ones were much richer), we expected successful male entrepreneurs to be more appealing to mating partners than ordinary male workers in Taiwan. Ideally, we should test this out using data at the time that the marriage ban was lifted. However, historical information back then was very sketchy. As a second best, we used the Taiwan Population Census in 1980 and 1990 to check for the footprint evidence left in the contemporaneous relationship between current marital status and entrepreneurship.

In this subsection, we first compared the marriage rates for entrepreneurs and non-entrepreneurs who aged 20-59 by origin, gender, and education level between Taiwanese and mainland immigrants in Table 3 using 1980 and 1990 censuses. The patterns changed little from 1980 to 1990, offering some assurance of using later census data to infer the entrepreneurship decisions around the time of marriage ban removal. Given the same education level, male entrepreneurs were more likely to get married than non-entrepreneurs. A Taiwanese man's chance of getting married would increase from 0.66 to 0.89 in 1980 (or 0.64 to 0.90 in 1990) if he changed his status from a non-entrepreneur to an entrepreneur, while the gain was even larger for an immigrant man (from 0.53 to 0.79 in 1980 or from 0.51 to 0.81 in 1990). In a word, the marriage rate among lowly educated male entrepreneurs, particularly among Taiwanese men, was significantly higher than non-entrepreneurs in both 1980 and 1990.

However, the association between entrepreneurship and marriage likelihood was more subdued for women. A comparison of Panel A for Taiwanese and Panel B for

mainlanders reveals that local Taiwanese enjoyed a higher marriage rate than immigrants given the same education level and entrepreneurship status. The marriage rate gap between the Taiwanese and immigrants was more pronounced for men than for women. Interestingly, the most highly educated group did not have the highest marriage rate. In specific, the marriage rate among illiterate entrepreneurs in both 1980 and 1990 was 0.92, higher than that among those with a college education (0.84 in 1980 and 0.88 in 1990). There are two possible explanations. First, there was a rise in both education and age at first marriage over time in Taiwan, making the younger cohorts tend to have higher education but lower marriage rates than the older cohorts. Second, successful entrepreneurship could to some extent have offset the disadvantage of low education in the marriage market.

Because we did not control for individual factors other than education in Table 3, the evidence of the positive relationship between entrepreneurship and marriage for men shown in the table is just suggestive. Next, we ran regressions at the individual level to control for these factors. In the sample, the operational sex ratio for the sample at age 20 averages at 1.10, which is higher than the naturally occurring ratio. Using the sample, we regressed men's and women's marital status on their entrepreneurial status, by controlling for a set of personal characteristics, such as age, education, birthplace, and a full set of county fixed effects.

Table 4 reports the regression results for local Taiwanese and immigrants from mainland China. In Panel A for local Taiwanese, the coefficient for the employer status variable in the regression on men is 0.154, highly significant at the one percent level, meaning that the probability of getting married for an employer is 15-percentage-point higher than a non-employer. By comparison, the coefficient is almost zero (0.007) and statistically insignificant in the regression on women. Education also mattered with marriage prospects. Educated men were more likely to get married than illiterate men. However, for local women, those with elementary education had the highest marriage rate, whereas those with a high school or college degree had a lower likelihood of marriage.

The results for the mainland immigrants as shown in Panel B are similar. For a male immigrant, an entrepreneur's marriage status was 20.7 percentage points higher

than workers, or 39 percent of the mean (0.207/0.529). The impact was larger for male immigrants than for local men, probably reflecting the fact that the immigrants faced a more competitive marriage market than local men. Education also mattered more dearly to an immigrant with respect to marriage. A man from mainland China with more than 12 years of schooling was 40 percent more likely to get married than an illiterate man. A college or higher education brought a local man 14.4 percent more likelihood of getting married compared with an illiterate local man. Apparently, being an employer and having more years of education were correlated with better marriage prospects, particularly if they were male migrants from mainland China. However, we cannot draw a causal inference based on the regression results due to data limitation.

In sum, employers generally earn more than paid workers and have better marriage prospect. In the wake of excess men in the marriage market, men have to compete harder. Becoming entrepreneur is one way to improve their earnings opportunities.

4. STATISTICAL EVIDENCE

OLS Analysis at the Individual Level

We regressed entrepreneurship on local sex ratios using the census data and the elderly survey data. In the subsequent analysis, we used only the restricted sample of native Taiwanese.⁸ In so doing, we did not need to worry about the impact of confounding factors specific to mainland Chinese veterans on their employment status. In addition, we controlled for personal characteristics in the analysis. Furthermore, the two-wave census data helped address the mortality selection problem. Due to a higher mortality rate, old people, especially men, were less likely to be observed in the census year of 1980 or 1990 than young people. So the observed prevalence of entrepreneurship in old age might have diverged from the actual situation prior to 1959 when they were still young, creating a measurement error. We ameliorated the problem by including birth year fixed effects in a panel regression as long as the age-specific mortality rate was rather stable across time. Specifically, we used the following equation:

⁸ The results based on the whole sample are similar. They are available upon request.

$$y_{ijt} = \beta_0 + \beta_1 SR_{jt} + \beta_2 Malepop_{jt} + \beta_3 X_{ij} + \beta_4 D_j + \beta_5 W + \varepsilon_{ij}, \quad (1)$$

where y_{ijt} refers to the employment status (one for being an employer in 1980 or 1990 and zero if otherwise) for a native Taiwanese man or woman i in county j born in year t ; SR_{jt} is the imputed sex ratio at the county level when the individual aged 20. We did not have residence information when individuals were aged 20, so we used their current residence as a proxy.

Higher sex ratios mean more males in the labor market than females. Because men are inherently more likely to become entrepreneurs than women, the effect of sex ratio imbalance on entrepreneurship may be a simple statistical artifact of a great supply of men in the labor market. To address this concern, we included a working-age male population (20–64) in logarithmic form ($Malepop_{jt}$) in all the following regressions.

To control for human capital, another widely viewed pinnacle of the “Taiwan Miracle” of rapid economic growth (Lucas 1993; Stiglitz 1996), we included a set of dummy variables for educational levels (elementary school, junior high school, senior high school, college, and postgraduate) in X_{ij} . In addition, X_{ij} includes marital status and a full set of single birth year dummy. A set of county-fixed effects (D_j) are also included to control for county-specific factors, such as the presence of a military base, industrial structures, or a resource endowment. In order to reflect the systematic policy change, we included a 10-year cohort dummy indicating cohorts 1940–1949. A dummy variable indicating wave 1990 was added to capture some potential systematic differences between two waves of census.

Panel A in Table 5 displays the coefficient for sex ratio at age 20 in regressions on men and women using a subsample of native Taiwanese in the 1980 and 1990 population censuses. It is highly significant in both regressions. The coefficient is greater in the regression on men than in that on women. The effect is economically significant—an increase of 0.1 in the operational sex ratio boosts the total percentage of men who become entrepreneurs by 1.22 percentage points. Given that only about 4 percent of men were reported to be entrepreneurs in the 1980 and 1990 censuses, such an increase in sex ratios accounts for 29 percent ($0.1 \times 0.122 / 0.042 \times 100$) of total number of employers.

Interestingly, the sex ratio variable is also significant in the regressions for women, though the magnitude is much smaller (by a factor of 4) than for men. After women were married to small-business owners, some of the women got involved in the business and were naturally counted as entrepreneurs in the census. According to the 1990 census, the probability of an employer's wife being counted as an employer is about ten times of the chance for an employee's wife. However, there is very little evidence that male entrepreneurs prefer to marry a female entrepreneur in the first place. On average, men place a greater weight on physical attributes than on income in their dating preferences, while women value their mating partners' income more dearly (Hitsch, Ali Hortaçsu, and Dan Ariely, 2010). Thus the observed high percentage of entrepreneurship among the wives of employers may have little to do with mating competition prior to marriage. This is perhaps the main reason why we also found a positive, yet weaker, association between sex ratios and female entrepreneurship.

The census data suffer from a major limitation, as they asked the employment status at the time of the survey but did not inquire about employment history. Some people might have tried to be entrepreneurs, failed, and ended up working for others or taking early retirement. Thus, they would be classified as non-entrepreneurs in the population census. To further explore the effect of this on entrepreneurial effort, we used an alternative dataset—the longitudinal Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan for 1996 and 2003. The survey contained detailed information on employment history.

We reported the regression results for male and female elderly in Panel B of Table 5. The coefficient for the sex ratio variable in the male regression is 0.709, larger than that observed in Panel A.⁹ Men had a higher likelihood of involvement in entrepreneurial activities if they resided in a county with more-skewed sex ratios. An increase of 0.1 in the operational sex ratio could explain 22 percent ($0.1 \times 0.709 / 0.32$) of total entrepreneurial effort. In contrast to the male regressions, the sex ratio variable in female regressions is insignificant, as shown in Columns (2) in Panel B.

⁹ In elderly survey, the entrepreneurship variable includes both employers and self-employed as these two are indistinguishable. This is another reason why the coefficient for the sex ratio variable is large in Panel B than in Panel A.

Alternative Sex Ratios

So far we have used the sex ratio for a wide cohort 15–49 when one was at age 20. When hundreds of thousands of mainland male soldiers flooded the marriage market after the MMO removal, many of them were already in their 30s or 40s. So they had to look for younger wives. The age gap of first marriage exceeded more than five years by 1970. Therefore, the ratio of men to women in the same age cohort 15–49 may not accurately reflect the actual supply and demand situation in the marriage market. As a robustness check, we repeated the regressions in Table 5 with an alternative sex ratio — the ratio of men aged 20–49 to women 15–44 years old. As shown in Table 6, the results held.

One may also ask whether the age interval of 15–49 years old is too broad, considering most men in their 40s were already married. To address this concern, we defined the third sex ratio measure as the ratio of men 20–39 years old to women 15–34 years old and repeated the previous regressions. We also reported the results in Table 6 and the main findings are robust to this alternative sex ratio variable.

Heterogeneous Effects

We first looked at the relation between entrepreneurship and sex ratios at different ages. We have used the sex ratio at age 20 in the previous analyses. Since most men at 20 were not married yet, sex ratios at age 20 largely capture the pre-martial motive. By age 30, more than two-thirds of men were married, according to the 1980 population census. Thus, sex ratios at age 20 should matter more to entrepreneurship than sex ratios at 30 if the main motive for entrepreneurship is for mating and marriage.

We repeated the regressions in Table 6 by varying the sex ratio at ages from 20 to 30. Figure 5 plots the estimated coefficient for the sex ratio variable and the corresponding 95 percent confidence intervals. In both panels, based on elderly survey and population censuses, the coefficient on sex ratio was initially positive and significant at the pre-martial age. But the effect declined with age. By age 30, the coefficient became statistically indifferent from zero.

The impact of the marriage market squeeze on entrepreneurship may also differ by education level. To explore the heterogeneous impact of education, Table 7 expands

Panel B of Table 5 by including two additional terms, the interactions of sex ratio at 20 with a dummy indicating 1–12 years of education and a dummy indicating more than 12 years of schooling. Those who are illiterate comprise the base group.

The coefficient for the sex ratio variable in the regression on men remained positive and highly significant. The interaction term of the sex ratio variable and the dummy for 1–12 years of schooling was 0.11, significant at a 1 percent level. The less-educated people were generally poorer than the more educated ones. According to the prediction of the status model outlined in the literature review, they might have had greater incentives than the college graduates to become entrepreneurs so as to get rich. However, being entrepreneurs requires some basic literacy and math skills. It is an enormous challenge for an illiterate man to successfully operate a business even if he has a strong drive. This is probably why those with a basic education were most responsive to changing sex ratios.

The interaction of sex ratio with the dummy indicating high education (with 13 years of schooling and above) is insignificant. There are at least two explanations. The first is that the highly educated people normally held better-paid white-collar jobs. This meant they were largely insulated from the marriage market competition. In addition, their opportunity cost of becoming entrepreneurs was higher than those with only basic education. Overall, we found that as the marriage market tightened, local Taiwanese men with a basic education were more likely to become entrepreneurs than those who were illiterate and college educated. Rising sex ratios intensified the drive of local men with basic education to become entrepreneurs.

2SLS Analysis at the Individual Level

Although the sex ratio imbalance was largely driven by the exogenous shock of the influx of mainland Chinese soldiers, the resultant subsequent marriage ban, and the lift of the ban, people may still have some concerns about the endogeneity of the sex ratio variable for several reasons.

First, sex ratios may have coincided with some local business opportunities, which were attractive to entrepreneurs but not controlled in the regressions. When the *Kuomintang* retreated to Taiwan, they set up their military bases mainly for the strategic

purpose of defense. Although the military bases were not aimed at promoting local economic growth, their presence might have provided some local job opportunities. Considering that local sex ratios were highly correlated with the presence of military bases, it is possible that sex ratios to some extent represented local economic opportunities. Including county-fixed effects in regressions could, to a large degree, control for (though hardly eliminate) the unobserved, location-specific factors related to growth potentials.

Second, if men in counties with skewed sex ratios could easily marry women in counties with more normal sex ratios, then the operational sex ratio at the county level was not a good measure of the actual local marriage market tightness. Such a measurement error could have clouded a precise estimation of the true impact. To ameliorate that concern, in all of the regressions, we also checked the robustness of the results by replacing sex ratios at the county level with ones at the more aggregate regional level (results are not reported here). In theory, the incidence of cross-regional marriage must have been lower than that across counties, because a region encompasses multiple counties. Our results remained largely the same when we used regional sex ratios. Moreover, if marriage-induced migration was numerous, the sex ratios among native Taiwanese should have departed from parity. The largely balanced sex ratios inferred from the Taiwan Population Censuses in 1956 and 1966 and shown in Figure 6 largely dismiss the migration story.

Despite our efforts, other endogeneity problems might still have been plaguing our efforts. We applied an instrument variable approach as a robustness check. As implied in Figure 6, the degree of sex ratio imbalance was largely associated with the number of Chinese men from the mainland. The initial spatial distribution of mainland Chinese or military bases was mainly determined by political or military concerns. After the marriage ban was lifted in 1959, the number of excess men in a county was highly proportional to the number of mainland Chinese men. Therefore, we used the interactions of the initial number of mainland Chinese men with a dummy variable indicating the birth cohorts of 1940-1949 who were born at least a decade before the lift of the marriage ban to predict the operational sex ratios.

We report the first-stage estimation results in Table 8. Columns (1) and (3) are for the census data in 1980 and 1990, while Columns (2) and (4) are for the elderly survey. In all the regressions, the instrument is positive and statistically significant.

Table 9 shows the two-stage least square regression (2SLS) estimations. The coefficient for the sex ratio variable is significant in both regressions on men based on census data (Columns 1) and the elderly survey (Column 2). Its magnitudes are 61% and 163% larger than the corresponding OLS estimates in Table 5, respectively. With respect to the regressions on women, the coefficient for sex ratio based on the census data is 67% greater than in the OLS regressions in Table 5. The 2SLS results are broadly consistent with our story that higher sex ratios stimulate men's entrepreneurship.

Potential Alternative Explanations

Some confounding factors, such as migration, can also explain the relationship between sex ratios and entrepreneurship. For instance, an area with dynamic private sector development may be a more attractive migration destination for men than women. As more men migrate to the place, local sex ratios naturally would become more skewed.

If the migration story holds true, then a higher sex ratio simply reflects the job opportunities in favor of men. However, we would expect to see that native Taiwanese men also migrated to the high sex ratio regions to seek better job opportunities, creating a high sex ratio between Taiwanese men and women. We tested this out by plotting the sex ratios of native Taiwanese at the county level drawn from the *Taiwan Population Census Reports* of 1956 and 1966 in Panel A of Figure 6. The sex ratio values center around one. The balanced sex ratio among native Taiwanese across counties refutes the migration story.

In short, the observed local sex ratio imbalance was mainly driven by the uneven spatial distribution of mainland Chinese immigrants in Taiwan, not by the domestic migration patterns of native Taiwanese in pursuit of better business opportunities. To native Taiwanese, the local sex ratio imbalance caused by the influx of mainland Chinese was largely an exogenous shock. In our quantitative analyses, we exclusively investigated how the exogenous marriage market shock affected *native Taiwanese* men and women's entrepreneurial behavior.

Although we found a positive association between operational sex ratios and the prevalence of entrepreneurship across regions, the impact may not solely stem from mating competition. We discussed four possible channels. First, there might have been a labor market effect as a result of the entry of veterans into the society. A large number of veterans entering the job market could have depressed wage rates and induced more people to become entrepreneurs. If the timing of the massive demobilization coincided with relaxation of the marriage ban, then it's not possible to determine if the effect came from the labor market competition or from marriage market competition. In the 1950s the number of veterans was treated as a state secret. Lin (2003) made a great effort to uncover the number of soldiers discharged from active service by year. Although the compiled statistics included in his paper are incomplete, they still offer some hints about the trend of demobilization in the first two decades after the KMT retreated to Taiwan. His data showed that there were two peaks, 1958–1959 and 1969–1970, which are markedly different from the bell-shaped curve for the growth rate of the number of registered companies (Chang and Zhang, 2012).

Moreover, the veterans' squeeze on local jobs may not have been as high as the numbers suggest. Lin (2003) estimated that in 1953, 80,000 soldiers were discharged. Among them, more than 30,000 were disabled or had severe health problems. They were discharged and treated in the 1950s, and many of them ended up in nursing homes. To avoid social unrest and disruptions to local labor markets, the government actively sought funding from the United States through bilateral aid and implemented a few large public projects to employ the able veterans. These public projects included the cross-Taiwan highways and the eastern Taiwan development program. During 1955–1958, nearly 40,000 veterans worked on these public projects. Because it was mainly the veterans who were mobilized to work on these public projects, their impact on the local job market was minimal. After the projects were finished, the government settled a significant number of veterans in a few counties, in particular Hwa-Lien and Tai-Dong. Because these two counties were remote and poor at the time, a massive influx of young veterans might have created a huge pressure on the local labor market, making self-employment the only viable option. To check this possibility, we excluded the two counties in the sample and repeated all the regressions. All the findings carried through. In addition, in some

regression analyses, we included male prime-age population (log) to control for the labor market effect. Above all, we found that marriage market squeeze is indeed a major driver behind men's competitive economic behavior independent of the labor market competition.

When the *Kuomintang* army fled to Taiwan, it brought with it a significant amount of treasures. Areas with higher sex ratios frequently happened to have military bases. As a result, those areas likely received more financial transfers from the government or even bilateral military aid from the United States. As the military spent the money, it stimulated local businesses and created jobs. We argue that our analyses already controlled for this effect, if any. The spatial distribution of military bases and government institutions barely changed from the 1950s to the early 1980s. In addition, most of the military and government reform did not occur until Chiang Kai-shek passed away in 1975. Because our analysis primarily focuses on the period before that, the number of military and government institutions in a region could be largely treated as fixed. Technically, the influence of these institutions on the local economy could have been largely controlled for by the inclusion of county-fixed effects in all regressions. Moreover, their presence alone could not explain the bell-shaped temporal pattern of the extensive firm growth.

As the soldiers who retreated from mainland China aged and retired from the military, they needed to find jobs in the civilian sector. Given their limited education and working experience, they might have had difficulty finding formal jobs and were forced to become self-employed or start small businesses in local areas. In other words, they had no choice but to become entrepreneurs, which had nothing to do with mating competition. However, even if veterans ended up as entrepreneurs in a larger proportion for reasons unrelated to sex ratio imbalances, the overall effect would be rather muted because of their small size as a group; that is, mainland Chinese accounted for only 14 percent of the total prime-age population. Moreover, we dropped mainland Chinese from the sample in our main analyses.

Finally, the fear of a possible invasion by the Chinese Communist Party (CCP) may have inhibited people in Taiwan from becoming entrepreneurs in the 1950s, especially after the massacre of landlords and capitalists in mainland China. However, the

possibility of a CCP invasion was greatly diminished by the Great Famine that occurred in mainland China during 1959–1961, at about the same time that the marriage ban on soldiers was lifted in Taiwan. Therefore, one may argue that the two effects cannot be separated. If this were true, the effect of the lowered invasion fear should have had a similar impact across ages and sexes. Yet, we find the effect varied by gender and age. Moreover, the CCP invasion hypothesis cannot explain the decrease in entrepreneurship in the 1970s when the invasion threat from mainland China faded.

5. Conclusions

From a Darwinian perspective, the struggle for reproduction is critical for any species, including human beings (Darwin, 1871). Failure to find a mate is not just an unhappy outcome for many people; it also means one cannot pass on one's genes. Because wealth is a crucial status indicator in the human marriage market, men tend to intensify their effort to pursue wealth when the terms of trade favor women. Because being an entrepreneur is perhaps a readily available way for one to get rich, we hypothesize that increasing the ratio of males to females stimulate men's animal spirits and induces them to initiate entrepreneurial activities, despite the inherently high risk.

The unintended marriage market squeeze that originated from the *Kuomintang* army's retreat to Taiwan provided us with a natural experiment to directly test this hypothesis. Using different datasets, we reached the same finding: local Taiwanese men who were exposed to the change in marriage policy on soldiers displayed a higher percentage of entrepreneurship later on. The removal of marriage ban sparked Taiwanese men's entrepreneurship.

Our paper demonstrates that some aspects of human economic behavior might have a biological root as advocated by Cox (2007) and Frank (2011). Fusing a biological perspective with economic analysis can shed new insight on human economic behaviors, such as entrepreneurship. Keynes (1936) regard "animal spirits" — the spontaneous urge to action under uncertainty — as a key driver of entrepreneurship. However, Keynes did not specify where the animal spirits come from. Our paper offers some evidence that mating competition may have something to do with "animal spirits," which are ingredients of entrepreneurship.

APPENDIX (FOR ONLINE POSTING): IMPUTATION PROCEDURES

To impute the prime-age (1549) sex ratio in the marriage market, we used two policies. The first policy is the executive order in November 1968 that required all military personnel to register in the civilian household registration system. Due to this order, the immigrant soldiers appeared in the registration system for the first time since 1949. We exploited the change in the number of men between mid-1968 and mid-1970 to backwardly impute the number of male immigrant soldiers in each year with adjustment for mortality. Because the number of female immigrant soldiers was negligible, we did not impute for them. Chang (2012) showed that there was no unusual, discernible change in the number of registered women over 1968–1970. The second policy is the lift of the marriage ban in 1959 as described in the historical background section. Because the male immigrant soldiers were not allowed to get married before the lift, we only added the post-1959 imputed numbers of male immigrant soldiers into the calculations of the prime-age sex ratios.

Since the mid-1950s, the local Taiwanese men have had to serve in the military for two or three years in their early twenties (20–24). Their registrations during their service were excluded from the civilian system until 1965. Because their service was short and their mortality rate was low, we used a linear projection method to impute their numbers for 1954–1965. On the other hand, we assumed that Taiwanese young men could still compete in the marriage market even when they served in the military, because they only served for a short period and usually remained socially connected. Francis (2011) made the same assumption. The following describes the imputation procedures for male immigrant soldiers and male Taiwanese soldiers in more detail. The method was originally proposed by Chang (2012).

Immigrant Soldiers

Step 1. Calculate the difference in male populations between 1968–1969 and 1969–1970.

Because we used mid-year population data, the increase in male population between 1968 and 1969 represents the increase between mid-1968 and mid-1969. Likewise, the increase between 1969 and 1970 represents the increase between mid-1969 and mid-1970. We assumed these two differences mainly resulted from the registration of

the immigrant soldiers that started in November 1968. We also assumed their registration had been completed by mid-1970.

As an example, to impute the number of missing immigrant soldiers of age 30–34 in 1960, we used the male population of age 38–42 in 1968, 39–43 in 1969, and 40–44 in 1970. For 1965–1969, we aggregated the data in five-year age groups. Hence, we broke them down into single ages using the distribution of single ages we had observed from other years.

Step 2. Calculate the average male age-specific death rates.

We adjusted the two differences in Step 1 with age-specific death rates for men. We acquired the death rates from the Department of Household Registration under the Ministry of Interior. The death rates are also in five-year-age groups. Without further information, we had to use the average death rates across years. For example, we calculated the average death rate of the group 30–34, 35–39, and 40–44 from 1960 to 1969 in order to adjust the difference between 1969 and 1970 by the following formula:

$$\frac{\Delta^{1969-1970}}{(1-M)^{10}},$$

where $\Delta^{1969-1970}$ is the difference between 1969 and 1970 and M is the average death rate.

Note that the death rates are civilian death rates. We assumed that the death rates for the immigrant soldiers were similar to the civilian death rates, because there was no combat in Taiwan over this period.

Step 3. Add the imputed immigrant soldiers to the original male populations.

As the last step, we added the adjusted differences to the original male population in 1960. For the immigrant soldiers, we imputed for the group of age 30–34 from 1960–1964, the group of age 35–39, 40–44, and 45–49 from 1960–1969. When we imputed backwardly, these age groups are the age-year cells that were affected.

Taiwanese Soldiers

To impute the Taiwanese soldiers, we simply fitted a linear projection between 1954 and 1965 for the age group 20–24. Taiwanese soldiers mostly serve in their early

twenties for two to three years, so they did not affect other age groups. Meanwhile, numbers of men and women of this age group run parallel to each other except for the period 1955–1964 and the women population appears to be linear over this period. Therefore, it was reasonable to assume that the male population should also have been linear, had the Taiwanese soldiers not been excluded.

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Table 1 Imputed Male Population by Age Cohort from 1954 to 1970

Year	15–19	20–24		25–29	30–34		35–39		40–44		45–49	
1954	452,424	387,094		336,057	294,732		245,574		224,156		177,689	
1955	455,418	396,936	(6.7)	341,429	300,044		248,523		230,274		184,169	
1956	468,884	406,779	(18.5)	350,438	311,901		264,965		240,760		194,533	
1957	487,289	416,621	(26.0)	356,309	329,198		287,066		251,431		211,113	
1958	494,518	426,463	(28.4)	350,018	345,002		301,533		255,260		225,535	
1959	498,951	436,306	(30.9)	362,910	363,701		317,093		261,565		239,345	
1960	490,216	446,148	(39.5)	393,591	466,529	(22.5)	396,107	(18.5)	269,496	(−0.80)	269,300	(7.8)
1961	475,628	455,991	(46.2)	412,713	469,778	(19.0)	406,041	(16.3)	301,936	(5.0)	274,106	(6.6)
1962	475,454	465,833	(48.1)	422,474	462,839	(14.2)	413,905	(14.3)	336,750	(10.0)	270,158	(3.7)
1963	493,054	475,675	(50.2)	432,372	455,109	(10.1)	433,127	(14.5)	368,297	(15.0)	274,407	(4.4)
1964	526,901	485,518	(51.6)	441,571	448,827	(6.9)	464,309	(16.9)	390,376	(17.0)	272,546	(1.6)
1965	584,158	495,360		460,627	427,486		501,664	(20.2)	413,127	(17.1)	277,026	(−0.80)
1966	658,998	481,063		473,282	429,673		504,293	(17.1)	424,626	(15.0)	309,178	(4.7)
1967	732,117	481,603		481,418	432,331		496,657	(13.3)	436,577	(13.7)	344,216	(10.3)
1968	785,175	496,798		487,740	438,150		483,944	(9.3)	457,538	(13.3)	373,787	(14.2)
1969	832,331	523,284		490,685	445,886		472,995	(4.0)	478,013	(5.6)	389,586	(8.0)
1970	872,038	574,687		481,767	456,059		461,030		501,243		403,240	

Note: Modified based on Table A1 in Chang (2013). The shaded figures are imputed male population. Those figures in the adjacent parentheses refer to the percentage differences compared with the original male population in the same cohort.

Table 2 Sex Ratio Effect on Spousal Age Gap and Probability of Ever Being Married for Women

Panel A: Spousal Age Gap		
	(1) 1990 Census [mean age gap=4.06]	(2) Elderly Survey [mean age gap=4.37]
Sex ratio at 20	4.132*** (0.647)	3.774** (1.511)
R ²	0.195	0.127
Observations	2,893,143	3,744
Sample composition	Household heads	Elderly
Panel B: Probability of Ever Being Married for Women		
	(1) 1980 & 1990 Census [mean probability=0.91]	(2) Elderly Survey [mean probability =0.985]
Sex ratio at 20	0.158** (0.062)	0.065* (0.031)
R ²	0.183	0.036
Observations	7,704,788	1,914
Sample composition	Women of Age>=25	Female elderly

Sources: Population Census in 1980 and 1990, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan). Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan, 1996 and 2003, Bureau of Health Promotion, Department of Health, R.O.C (Taiwan).

Notes: spousal age gap in panel A is the husband's age minus the wife's age. In the 1990 population census, information on spousal age gap is only available for house heads. Note that such information is not available in the 1980 population census. Dependent variable in panel B is a dummy indicating if a woman is currently married or has ever being married before. Sex ratio is men per women at the county level when a person was aged 20. Sample used in column (1) in panel B consists of women who were aged at least 25 in the survey year. All regressions additionally include sex (only panel A), ethnicity, education, a full set of single birth year dummies and county dummies, and a dummy indicating sample 1990 (only panel B) and sample 2003 (only panel A). Robust standard errors clustered at county at parentheses. ***, **, and * indicates significant at 1%, 5% and 10%.

Table 3 Marriage Rate for Men and Women (20-59) by Education and Employer Status

	Entrepreneurs				Non-entrepreneurs			
	Men		Women		Men		Women	
	1980	1990	1980	1990	1980	1990	1980	1990
Panel A: Taiwanese								
Illiterate	0.92	0.92	0.79	0.75	0.81	0.78	0.87	0.85
Elementary	0.93	0.94	0.83	0.80	0.79	0.84	0.87	0.88
High School	0.86	0.88	0.75	0.75	0.53	0.57	0.60	0.68
College & Above	0.84	0.88	0.71	0.72	0.48	0.51	0.45	0.45
Total	0.89	0.90	0.79	0.76	0.66	0.64	0.77	0.74
Panel B: Mainland Chinese								
Illiterate	0.75	0.74	0.82	0.72	0.42	0.56	0.89	0.83
Elementary	0.81	0.89	0.87	0.78	0.52	0.65	0.92	0.87
High School	0.77	0.78	0.76	0.66	0.55	0.46	0.65	0.62
College & Above	0.80	0.83	0.71	0.68	0.55	0.53	0.45	0.48
Total	0.79	0.81	0.78	0.69	0.53	0.51	0.73	0.65

Source: 1980 & 1990 Population Census. Entrepreneurs refer to those listed as employers in the questionnaire and non-entrepreneurs include anyone else.

Table 4 Are Employers More Likely to Be Married?

Panel A: Taiwanese		
	(1) Men [mean= 0.661]	(2) Women [mean= 0.753]
Employer	0.154*** (0.004)	0.007 (0.009)
Elementary school	0.205*** (0.006)	0.115*** (0.009)
High school	0.189*** (0.009)	-0.016 (0.020)
College and above	0.144*** (0.015)	-0.204*** (0.036)
Observations	8,904,877	8,227,173
Panel B: Mainlanders		
	(1) Men [mean= 0.529]	(2) Women [mean= 0.684]
Employer	0.207*** (0.010)	0.044*** (0.009)
Elementary school	0.160*** (0.008)	0.113*** (0.010)
High school	0.323*** (0.011)	0.0005 (0.0251)
College and above	0.400*** (0.015)	-0.117** (0.045)
Observations	1,408,749	1,324,833

Source: Taiwan 1980, 1990 Population Census, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan).

Notes: The sample includes men and women of age 20-59. The dependent variable is a dummy variable that indicates being married if the value is 1. *Employer* is a dummy variable that indicates being an employer. The reference education group has no education. High school includes both junior and senior high school. Both regressions include age, a full set of county dummies and a dummy indicating the 1990 census. Robust standard errors clustered at the county level are in parentheses. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

Table 5 OLS Estimates of Prime-Age Sex Ratio Effect on Entrepreneurship

Panel A: Population census		
	(1)	(2)
	Men	Women
	[Mean=0.042]	[Mean=0.008]
Sex ratio at 20	0.122***	0.030**
	(0.042)	(0.011)
R ²	0.04	0.008
Observations	10,161,593	9,382,437
Panel B: Elderly survey		
	(1)	(2)
	Men	Women
	[Mean=0.32]	[Mean=0.21]
Sex ratio at 20	0.709***	0.153
	(0.197)	(0.164)
R ²	0.08	0.074
Observations	1,840	1,837

Sources: In panel A: Population Census in 1980 and 1990, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan). In panel B: Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan, 1996 and 2003, Bureau of Health Promotion, Department of Health, R.O.C (Taiwan).

Notes: The dependent variable in panel A is a dummy variable indicating an employer. The dependent variable in panel B is a dummy variable indicating whether one or one's spouse has ever been an employer or self-employed in nonagricultural sectors. Sex ratio is measured at the county level. Only Taiwanese people are included. In both panels, all regressions additionally include a full set of single birth year dummies and county dummies, a dummy variable indicating birth cohorts 1940-1949 who aged 20 in 1960–1969, ethnicity (only panel B), birth country (only panel A), education, marital status and log of prime-age males at the county level. Robust standard errors clustered at the county level are reported in parentheses. ***, **, * denotes significant at 1percent, 5 percent and 10 percent.

Table 6 OLS Estimates Using Alternative Sex Ratios

	(1) Men	(2) Women
Alternative sex ratio at 20	Panel A: Population Census	
Men 20-49/ Women 15-44	0.110** (0.041)	0.028** (0.011)
Men 20-39/ Women 15-34	0.071* (0.034)	0.016* (0.008)
	Panel B: Elderly Survey	
Men 20-49/ Women 15-44	0.706*** (0.193)	0.128 (0.182)
Men 20-39/ Women 15-34	0.537*** (0.141)	0.111 (0.120)

Sources: In panel A: Population Census in 1980 and 1990, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan). In panel B: Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan, 1996 and 2003, Bureau of Health Promotion, Department of Health, R.O.C (Taiwan). Notes: The dependent variable in panel A is a dummy variable indicating an employer. The dependent variable in panel B is a dummy variable indicating whether one or one's spouse has ever been an employer or self-employed in nonagricultural sectors. Sex ratios are measured at county level. Only Taiwanese people are included. All estimates are from separate regressions. In both panels, all regressions additionally include log of prime-age male population at county, a full set of single birth year dummies and county dummies, a dummy variable indicating birth cohort 1940-1949 who aged 20 in 1960-1969, ethnicity (only panel B), birth country (only panel A), a dummy indicating wave 1990 (only Panel A), a dummy indicating wave 2003 (only Panel B), education and marital status. Robust standard errors clustered at the county level are reported in parentheses. ***, **, * denotes significant at 1%, 5% and 10%.

Table 7 Heterogeneous Sex Ratio Effects on Entrepreneurship by Education

	(1) Men	(2) Women
Sex ratio at 20	0.675*** (0.201)	0.111 (0.182)
Sex ratio at 20×(Edu=1-12 yrs)	0.112*** (0.030)	0.085*** (0.026)
Sex ratio at 20×(Edu≥13 yrs)	0.037 (0.042)	-0.020 (0.042)
R ²	0.071	0.072
Observations	1,840	1,837

Sources: Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan, 1996 and 2003, Bureau of Health Promotion, Department of Health, R.O.C (Taiwan).

Notes: The reference group is 0 year of education. Sex ratio is interacted with two education level dummies indicating 1–12 years of education and 13 + years of education respectively. The dependent variable is a dummy variable indicating whether one or one's spouse has ever been an employer or self-employed in nonagricultural sectors. Sex ratio is measured at the county level. Only Taiwanese people are included. All regressions additionally include a full set of single birth year dummies and county dummies, a dummy variable indicating birth cohort 1940–1949 who aged 20 in 1960–1969, ethnicity, marital status and log of prime-age males at the county level. Robust standard errors clustered at the county level are reported in parentheses. ***, **, * denotes significant at 1 percent, 5 percent and 10 percent.

Table 8 First Stage Estimation Results

	(1)	(2)	(3)	(4)
	Men	Men	Women	Women
log mainland Chinese men $\times$ cohort 1940-1949	0.062***	0.033***	0.064***	0.019***
	(0.006)	(0.004)	(0.006)	(0.004)
Dataset used	Census	Elderly	Census	Elderly
R ²	0.75	0.78	0.75	0.76
Observations	10,161,593	1,840	9,382,437	1,837

Sources: Regressions (1) and (3) are based on Population Census, 1980 and 1990, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan). Regressions (2) and (4) are based on Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan, 1996 and 2003, Bureau of Health Promotion, Department of Health, R.O.C (Taiwan).

Notes: The dependent variable is sex ratio at age 20. County-level numbers of mainland Chinese men are based on the 1956 population census. Only Taiwanese people are included. All regressions additionally include the same set of controls as in the OLS regressions. Robust standard errors clustered at the county level are reported in parentheses. ***, **, * denotes significant at 1 percent, 5 percent and 10 percent.

Table 9 2SLS Estimates of Prime-Age Sex Ratio Effect on Entrepreneurship

	(1)	(2)	(3)	(4)
	Men	Men	Women	Women
Sex ratio at 20	0.196*** (0.039)	1.863*** (0.309)	0.050*** (0.001)	-0.883 (1.53)
Dataset used	Census	Elderly	Census	Elderly
R ²	0.040	0.066	0.008	0.061
Observations	10,161,593	1,840	9,382,437	1,837
Endogeneity test				
p-value	0.003	0.006	0.001	0.461

Sources: Regressions (1) and (3) are based on *Population Census*, 1980 and 1990, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan). Regressions (2) and (4) are based on *Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan*, 1996 and 2003, Bureau of Health Promotion, Department of Health, R.O.C (Taiwan).

Notes: The dependent variable in regressions (1) and (3) is a dummy variable indicating an employer. The dependent variable in regressions (2) and (4) is a dummy variable indicating whether one or one's spouse has ever been an employer or self-employed in nonagricultural sectors. Sex ratio is measured at the county level. Only Taiwanese people are included. Other controls are the same as in the OLS regressions. Robust standard errors clustered at the county level are reported in parentheses. ***, **, * denotes significant at 1 percent, 5 percent and 10 percent respectively.

Figure 1 Average Income of Employers, the Self-employed and the Employees
Panel A: Average Income

Panel B: Median Income

Notes: Farmers are excluded. The vertical axis is in logarithm.
 Sources: Taiwan Income and Expenditure Survey 1981-2006.

Figure 2 Imputed Sex Ratio by Cohort

Sources: Sex ratios are derived from the authors' own calculation.

Figure 3 Prime-Age Sex Ratio and Women Marriage Rate

Sources: Prime-age sex ratio is derived from the authors' own calculation; women marriage rates are from various *Taiwan Demographic Fact Books* published by the Ministry of Interior, Taiwan. See <http://eng.stat.gov.tw/ct.asp?xItem=25763&CtNode=5347&mp=5>. Notes: Prime-age sex ratio is defined as the number of men per women for ages 15–49; marriage rate is the percentage of married women among all women who are at least 15 years old.

Figure 4 Age of First Marriage in Taiwan: 1950–1990

Sources: The age of first marriage during 1975–1990 (solid line) is from the Department of Household Registration, Ministry of Interior, Executive Yuan, Taiwan. Data retrieved at http://www.ris.gov.tw/zh_TW/346. The age of first marriage for women during 1950–1974 (dash line) is imputed using the 1980 population census. The age of first marriage for men during 1950–1974 (dash line) is imputed using Survey of Health and Living Status of the Middle Aged and the Elderly in Taiwan.

Figure 5 Estimates of the Sex Ratio Effect for Men across Ages

Sources: authors' own calculation.

Notes: solid lines are the estimate of coefficient. Dash lines are the 95 percent confidence interval.

Figure 6 Sex Ratio of Native Taiwanese and Mainland Chinese in 1956 and 1966

Sources: 1956 and 1966 Taiwan Population Census, Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan)
 Notes: sex ratio includes both the civilian and institutionalized populations.