

Marriage and Marriage Markets

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This chapter reviews models of marriage, with special emphasis on how the ratio of men to women (the sex ratio) can help explain measurable outcomes such as marriage formation, intra-marriage distribution of consumption goods, labor supply, savings, type of relationship, divorce, and intermarriage. Demographers are the first to have predicted and tested that sex ratios affect marriage formation, one of the pioneers being Louis Henry (1975). Heer and Grossbard-Shechtman (1981) and Guttentag and Secord (1983) have attributed drops in marriage rates and a number of other dramatic changes observed in the late sixties and early seventies to decreases in sex ratio among young adults at that time. Spanier and Glick (1980), Grossbard-Shechtman (1985) and Wilson and Neckerman (1986) have hypothesized that many observed differences between blacks and whites can be explained by the lack of ‘marriageable’ black men.

Economic models that lead to predictions regarding sex ratio effects on other outcomes, including consumption and labor supply were pioneered by Gary Becker (see Section 1). Grossbard’s model is presented in Section 2. The evidence presented in Section 3 indicates that sex ratios do have an impact on labor supply, consumption, savings, and many other outcomes.

1. Marriage markets and sex ratios in Becker’s theory of marriage

The first economic theory of marriage was authored by Gary Becker (1973, 1981) and consists of multiple models. At the micro-level of decision-making, the theory uses rational choice theory and models that had been applied in more conventional applications of economics. Becker’s rational decision-maker is motivated by gains or benefits, including the benefits of specialization between spouses. Even though examples of such benefits given by Becker and others are phrased in terms of a marriage between a man and a woman, the benefits of specialization can also apply to same-sex couples with different skills. Other possible gains from marriage include opportunities to consume jointly and to capture returns to scale.

Becker’s economics of marriage also entails a level of analysis beyond the individual. Here Becker uses at least two types of models: Marshallian partial equilibrium models, and optimal ‘sorting and matching’ models. In the *Treatise on the Family* Becker writes that he uses the phrase ‘marriage market’ metaphorically: it signifies that “the mating of human populations is highly systematic and structured.” (Becker 1981, p. 39). Nevertheless, Becker presents two marriage market models that use the market concept in a more literal sense and that are reminiscent of other applications of market analysis. Both models entail a market equilibrium with an equilibrium marriage rate (the quantity axis) and an equilibrium division of marital output (the price axis). One model assumes that there is only one type of man and one type of woman.. The second Marshallian market equilibrium

¹ I would like to thank the editors for their thoughtful and productive comments. As a result this chapter is a considerably improved version of an earlier working paper.

model has multiple types of men and women participating in separate but inter-related marriage markets. In more modern terminology, this model can be labeled as a “hedonic” market model.² Even though this model was particularly important in his own eyes (Grossbard 2010) Becker dropped it from the *Treatise*, his widely cited book. This hedonic Marshallian model is presented next.

1.1 Becker’s hedonic market model.

Each market is composed of homogeneous women and homogeneous men and establishes an equilibrium price and quantity that depend e.g. on the number of participating men and women and on substitutability between various types of potential spouses.

Figure 1, based on Fig. 2 in Becker (1973), models a market for a particular type of man M_i and a particular type of woman F_j . Following Becker men are on the supply side and women on the demand side. There are $(I - 1)$ other types of men and $(J - 1)$ other types of women. It is assumed that together a (M_i, F_j) couple can produce marital output Z_{ij} . This output is then divided in a part that goes to the man and another that goes to the woman, with $Z_{ij} = m_{ij} + f_{ij}$. It is implicit that a (potential) couple has conflicts on how much each gets access to the marital output. The vertical axis shows m_{ij} , men’s share of the marital output women. If men stay single their output is Z_{i0} and if women stay single their output is Z_{0j} . Women’s demand is downward-sloping: the more output women F_j share with men M_i , i.e. the higher the price of this type of husband, the less women are interested in marrying them rather than remaining single or marrying a man from a substitute type. The most women of this type are willing to ‘pay’ for creating a joint household with this type of man is the output they can produce together Z_{ij} minus what they would produce had they remained single: Z_{0j} . The more they are willing to substitute between this kind of man and the other $(I - 1)$ types of men, the more elastic their demand for men M_i .

Men’s supply is upward-sloping: the larger the share of output they get from this type of woman, the more men M_i are likely to switch from other types of women to marry women F_j . Men’s supply starts at Z_{i0} , their output if they remain single. All individual demands and supplies for these two types are aggregated and an equilibrium male share of marital output (m_{ij}) is obtained at the intersection of demand and supply, namely point e_0 . Given that $Z_{ij} = m_{ij} + f_{ij}$ this equilibrium also implies the equilibrium price of women f_{ij} . At that equilibrium point both men M_i and women F_j are more satisfied being with each other than being in couple with a substitute of type k .

1.2 Becker’s sex ratio analysis

Becker’s marriage market analysis includes comparative statics showing that factors affecting marriage market conditions—including sex ratios-- are expected to influence division of marital output and income.³ This translates into predictions regarding effects of marriage market factors on each spouse’s access to consumer goods.

One of the most important testable implications of Becker’s theory is that sex ratios affect individual consumption. Sex ratios shift aggregate demands and/or supplies in markets for mates.

² Rao (1993) is possibly the first to have used the term ‘hedonic’ to describe this kind of multi-market Demand and Supply model of marriage. Siow (2007) also used the term. Some have called this Becker model a matching model (e.g. Abramitzky et al. 2011; Chiappori and Salanie 2016).

³ What Becker calls “marriage market factors”, i.e. the factors influencing equilibrium in marriage markets and therefore intra-household distribution of goods, appear as EEP in McElroy (1990) and as distribution factors in Chiappori (1997).

Therefore they can have an impact on the implicit price of wives and husbands. This follows from Becker's hedonic market model presented above as well as from his simpler marriage market model with only one type of man and one type of woman (Becker 1973, 1981). The more men there are relative to the number of women, i.e. the higher the sex ratio, the more competition there will be among men and the higher women's price. In terms of Figure 1, more men implies that the supply of men moves from S_0 to S_1 , men's equilibrium access to the marital output decreases from e_0 to e_1 and the share of marital output and individual consumption obtained by women increases accordingly.⁴ The opposite is the case when there is relative oversupply of women: in that case women's assignable consumption or leisure will go down whereas men's will increase. Becker (1973, 1981) specifically mentions a potential application of this theory to consumption and leisure: "available information on the amounts spent on husband's and wife's clothing or on their leisure could be related to sex ratios..."

In the hedonic model with different types of men and women who are either substitutes or complements, changes in sex ratio in one marriage market can also affect prices, and access to marital output, in other marriage markets. A higher aggregate sex ratio in the economy does not necessarily translate into a higher sex ratio in each (M_i, F_j) marriage market. For example, there may be an oversupply of men at the national level, but not in a particular sub-market (let us say, the college-educated).

Becker's predictions regarding sex ratio effects on consumption and leisure consist of a few sentences. He does not expand on how inter-temporal consumption, including savings, will be affected. Likewise, Becker's theory does not lead to clear predictions regarding sex ratio effects on labor supply. According to Becker higher sex ratios will lead to more leisure for married women, but since to him leisure includes both 'personal time' and 'time in household production', it does not necessarily follow that more leisure means less work in the labor force. Becker does not recognize that what is produced in the joint household, what he calls Z_{ij} , is also a function of the value of time of both members of the household.⁵ If members of the family firm have different opinions or interests as to how their resources, including their own time, should be allocated to production inside or outside the home, how are conflicts resolved in the household?

In the U.S. and many other countries under 'coverture' the right to manage the household's resources was given to the husband who also controlled the wife's earnings if she worked outside the home (see Geddes et al. 2012). In many mostly agricultural African countries it is still the case that women are not allowed to own land, which gives men much allocative decision-making power. Under such often called 'patriarchal' regimes do higher sex ratios translate into as much extra consumption and leisure for the wife as is the case in more egalitarian household production systems? These and other questions can potentially be addressed by the Grossbard models of marriage presented next.

2. Sex ratios and marriage markets as markets for Work-In-Household

Grossbard (1976) went beyond its main focus, an economic analysis of polygyny, in that it offered the first economic model recognizing the possibility of in-marriage conflict regarding who does the household production and how those who work at household production get compensated for it.

⁴ According to the simple model, division of output in a representative marriage is not clearly determined when there are equal numbers of men and women. Some other Beckerian marriage market models also lead to similar predictions regarding sex ratio effects on individual access to marital output.

⁵ Like Becker's marriage models, models of intra-marriage allocation that came after Becker, such as bargaining models or consensus models (e.g. McElroy and Horney 1981, Apps and Rees 1997, Chiappori 1997), ignored potential conflicts of interest between those who work at household production and those who only enjoy such consumption.

While it contains many of the same elements as Becker's marriage market models of marriage, it models each wife and husband as a separate agent making decisions regarding both production and consumption.⁶ The model's parallels with labor economics facilitate the formulation of predictions regarding sex ratio effects on labor supply (see Section 2.1). In labor economics firms and workers are typically considered as separate agents all along—before, during, and after employment. Firms and workers often have conflicts regarding amount of work and compensation for that work. Even if there is a match between a worker and a firm and employment occurs, the diverging interests that drive them may lead to conflict. Firms are often concerned about low worker productivity due to possible principal-agent problems.

Similarly, in Grossbard (1976) spouses are separate agents who may have conflicting interests regarding household production. It gives examples related to the production of food and children. In the USA today a major goal of marriage is to produce children. Consider a father who wants to delegate childrearing responsibilities to his wife and thinks his child needs more time with her mother than the wife is willing to spend. This creates a principal-agent problem. Most economists of the family only recognize such problems in case of divorce, when children are under the custody of one parent (e.g. by Weiss and Willis 1985). It follows from Grossbard (1976) that this problem is not limited to divorced parents. In marriage husbands and wives may have conflicts regarding any jointly consumed marital household-produced output, including happiness from joint children, with individual spouses typically preferring to get more output and of better quality but often willing to devote fewer of their own resources and efforts into the production process. Furthermore, production-related conflicts may occur regarding marital output that only benefits one spouse but that is produced by the other.

In the context of conventional firms the worker experiences an opportunity cost and the employer enjoys some benefits leading her to be willing to pay the worker. If the wage is sufficiently high the worker will do the job. To facilitate the application of labor market analysis to marital firms Grossbard (1976) and Grossbard-Shechtman (1984) defined the concept of 'Work-in-Household' (WIHO), a service that is of benefit to one spouse (let us say the wife) while it involves an opportunity cost on the part of the spouse supplying the service (let us say the husband).⁷ Multiple markets for various types of WIHO-workers differentiated by education, ethnicity, age, etc. set WIHO prices where demand and supply intersect. These prices, similar to equilibrium wages in labor markets, guide coordination and sorting, help resolve conflicts of interest, and thus contribute to cooperation and productivity in the household. For example the conflict between a husband/father who wants more mothering for his child than his wife wants to supply may be resolved by a transfer of income from the father to the mother. Thus the father may be "paying" the mother to do more household production than she had originally intended.

Allocative efficiency is reached if quantity demanded equals quantity supplied at the market price. This holds for both labor markets and marriage markets defined as markets for WIHO. Contracts between workers and employers can help resolve principal-agent problems and possible conflicts regarding compensation for work in household production benefiting the spouse (WIHO). Marriage institutions regulate (often informal) labor contracts between spouses, in a manner similar to how employment institutions regulate labor contracts between workers and employers (see Grossbard-Shechtman and Lemennicier 1999), except that prices are more difficult to identify and measure.

⁶ For more details see Grossbard-Shechtman (1993) and Grossbard (2015).

⁷ What is now called WIHO was called 'wife labor' in Grossbard (1976) and 'spousal labor' in Grossbard-Shechtman (1984).

Another difference between commercial firms and marriage firms is that in the case of conventional firms the distinction between the worker and the firm is clear, but in marriages that is not always clear: both spouses can possibly hire each other as household production workers.

In principle, this analysis could be gender-neutral. However, in traditional societies, relative to men, women are more likely to be the principal suppliers of WIHO. Korea is one of the traditional societies where women do considerably more household production than men. Given that work at household production involves a loss of utility it is not surprising that Bethmann and Rudolf (2016) found that in Korea marriage made men happier than women. To the extent that WIHO workers could get rewarded for their work in the form of more marital consumption, the Korean gender gap in marital happiness suggests that women may not be fully satisfied with the rewards they obtain for the WIHO that they supply. Bethmann and Rudolf also found that the gender gap is more pronounced in older couples, which suggests that relatively to their counterparts in younger couples women in older couples tend to be underpaid for their WIHO. Younger women may have higher higher bargaining power in their marriage markets and their marriages: their better labor market opportunities may have led to higher prices for WIHO.

In some societies men are not permitted to cook (for instance in Maiduguri, Nigeria, in the 1970s) and cooking is hard work, making the parallels between labor and WIHO more transparent than they are in a contemporary Western country. It is also less of a stretch to conceive of a price of WIHO in a cultural context where men are expected to provide food ingredients, lodging and clothing to their wives who would otherwise not have access to such necessities. Furthermore, anthropological descriptions of conflicts of interest that often arose between a husband and wife (wives) or between the wives working for the same husband (Cohen 1971) facilitate the application of the WIHO concept.

The value of using markets for WIHO to model marriage and derive testable implications is not limited to such traditional societies but also helps understand egalitarian heterosexual couples (Amuedo-Dorantes et al. 2011) or same-sex ones (see Grossbard and Jepsen 2008). Markets for WIHO are affected by all the factors mentioned in Becker's theory of marriage, including sex ratios.

2.1 Sex ratio effects on labor supply

A major prediction developed in Grossbard-Shechtman (1984) and Grossbard (2015) but not found in Becker's marriage models is that sex ratios will affect individual labor supply outside the home. Becker's marriage markets are markets for brides or grooms and in his theory higher sex ratios imply a higher price for brides which they can translate into more personal consumption goods and leisure. However, he did not analyze allocation of time between three time uses: leisure, work in household production and work for an outside employer.⁸ In contrast, Grossbard-Shechtman (1984) conceives of marriage markets as markets for WIHO and derives that labor supply is an inverse function of the price of WIHO. In the case of female heterosexual WIHO workers living in a society following traditional gender roles higher sex ratios imply a higher price for their WIHO and a lower price for male WIHO. I assume that WIHO workers respond to prices and have an upward-sloping supply. Other motivations may be present, such as love, devotion, feelings of guilt or duty, but they are not expected to neutralize the role of prices. Therefore, if women get paid better for their WIHO due to higher sex ratios they are less likely to participate in the labor force, whereas if sex ratios are lower male WIHO-workers will be less likely to work outside the home.

⁸ Gronau (1977) did consider these three time uses but he completely ignored the supply side of household production. He only included demand for such production.

2.2 Other predicted sex ratio effects

Grossbard (2015, Chapter 11) also analyzes how sex ratios may affect individual savings of men and women in different positions in life (single, married, or post-marriage). It integrates sex ratios into an overlapping-generations model based on Grossbard and Pereira (2010) that assumes a traditional gender-based division of labor and WIHO workers who get paid by their spouse for their work in household production. Prior to marriage young single men save in order to be able to afford women's WIHO as priced in marriage markets. In contrast, young women who hope to marry don't need to save much as men, as they anticipate that after marriage they will not only earn their income from work in the labor force but they will also get paid for their WIHO. After marriage the opposite is the case: married women who obtain an income from their husband may need to save to prepare themselves against the risk of losing that income, whereas for married men the prospect of marital disruption entails a higher net income (after intra-marriage transfers are taken into account) and less need for precautionary savings. These gender differentials depend on the price of WIHO. The higher that price due, for instance, to a higher sex ratio, the higher the savings rate among young single men (or their families) preparing for marriage, but the more married men may experience a financial relief in case of marital disruption, hence a lower savings rate among married men. In contrast, a higher sex ratio leading to higher pay for women's WIHO is predicted to lead to lower savings among single women and higher savings among married women. The net effect of sex ratios on aggregate savings rates will depend on the relative size of these four effects on young single men, young single women, older married men and older married women.

Some relationships involve less commitment than marriage. For some purposes it is better to model markets for relationships involving cohabitation but not necessarily marriage. Whether couples are married or not can be viewed as an element of the price of WIHO defined in a broader sense (Heer and Grossbard-Shechtman 1981; Grossbard-Shechtman 1993). In a market for WIHO defined more broadly, an element of the price of WIHO is the commitment that the employer of WIHO is willing to make to the WIHO worker. Under traditional gender roles this implies that the higher the price of women's WIHO, the more men will be willing to make the marriage commitment. This also applies to men performing WIHO who are likely to prefer being married to the women they work for in household production. We mostly hear of 'househusbands' and married 'stay-home dads'. Men who specialize in household production may not be as common among cohabiting couples, but this topic has not been systematically investigated.

Since higher sex ratios are associated with higher prices for female WIHO workers, it follows that when sex ratios are higher, women will be more likely to be married rather than to cohabit out-of-marriage. If men and women differ in their preferences for divorce, sex ratios may also affect divorce rates: with higher sex ratios, women are more likely to get their divorce-related preferences fulfilled, and men less so.

Sex ratios may also affect the likelihood that a woman is a lone mother in the sense that her child is born in a single mother household. Ekert-Jaffe and Grossbard (2008) show that there would be fewer lone mothers where sex ratios are higher and, presumably, women get 'paid' better for doing the WIHO of raising the child of her male partner.

Hedonic marriage markets for spouses with different characteristics coexist side by side. The higher a person's price in a marriage market, the more that person is likely to get his or her first choice of partner. In the context of traditional gender roles, heterosexual relationships and coexisting ethnic or religious groups, the higher the sex ratio in the market for women with given characteristics, the more these women are likely to get their first choice of partner. More generally, individual WIHO-workers of given ethnicity or religion who prefer to marry inside their group are

more likely to find a mate with that characteristic if their “price” is higher, and one of the reasons that price may be higher is due to fluctuations in sex ratio. In some cases intermarriage with a partner from a higher status group may be the preferred state, and the higher the price of the WIHO worker, the more that individual is likely to marry up (see Grossbard-Shechtman 1993).

Heer and Grossbard-Shechtman (1981) also used this marriage market model to explain why lower sex ratios would lead women to study more at universities: the more they expect to participate in the labor force the more they are likely to obtain an education that will raise their future earnings. Low sex ratios may also lead women to have fewer children. Furthermore, Heer and Grossbard-Shechtman (1981) postulated that women faced with low sex ratios in marriage markets would be more likely to join feminist organizations: the lack of well-paid WIHO jobs that had been available to previous generations of women may have been one reason that women from low-sex ratio generations protested male-dominated norms, rules and institutions. Grossbard (1980) predicted that where sex ratios are lower it is more likely that polygyny (husbands marrying multiple wives) will be allowed. Otherwise, in societies where women have few options other than domestic production and reproduction, unmarried women or their relatives may put political pressure on those supporting the institution of compulsory monogamy and thereby making it difficult for some women to have their own children. Grossbard (1980) also presents a rationale that helps explain why some societies have polyandry, an institution allowing marriages with multiple husbands (usually brothers married to the same woman). These are early examples of ‘institutional economics of marriage.’

2.3. Compensating differentials in marriage

The more others have a demand for WIHO workers with particular characteristics, the higher their price in marriage. In turn, this will affect all the outcomes discussed above: education, labor supply, type of relationship, intermarriage, etc. Furthermore, characteristics of those who employ WIHO will also affect the price of WIHO in a manner reminiscent of compensating differentials in labor markets. In the commercial sector, firms or industries with less desirable characteristics have to pay more for the same workers relative to what more desirable employers have to pay. Likewise, *ceteris paribus* the less attractive the characteristics of those employing WIHO the more they have to pay for WIHO. To the extent that women are doing the WIHO then compensating differentials are what men with less desirable characteristics have to pay beyond what the more attractive men are paying. For men doing WIHO compensating differentials will be expressed in extra pay for their WIHO when married to less desirable women. The idea of compensating differentials in marriage has many testable implications, including implications for labor supply, time spent doing WIHO, marriage versus cohabitation, ethnic intermarriage, and number of wives in a polygynous society.

Examples of testable predictions regarding women’s labor supply, assuming that women do the WIHO, are that women who are young relative to their husbands are likely to work less in the labor force. This assumes that youth is at a premium and therefore young women may get a higher WIHO price than women older than their husbands(see Grossbard-Shechtman 1984). Likewise, if being thin is considered an advantage in markets for WIHO it follows that individuals who are thin relative to their spouses are likely to obtain a higher price for their WIHO and therefore to supply less labor to the labor force (Grossbard 2015).

Spouses who benefit from WIHO will be expected to pay more for WIHO if they are relatively old, uneducated, belonging to ethnic groups with lower status, or otherwise ‘less desirable’. Therefore the presence of compensating differentials in marriage is predicted to lead to fewer hours of WIHO performed by the WIHO workers in the marriage if incomes are held constant.

As for the effect of education on the likelihood of cohabitation versus marriage, in a context of women as WIHO workers preferring a marriage contract, Grossbard-Shechtman (1993) predicted that more educated women are more likely to be married than those with less education. This would be the result of their higher productivity at marital production benefiting the spouse. The predicted effect of men's education is ambiguous when women are the main WIHO workers: on the one hand more educated men are more desirable mates and will be able to get away with paying a lower price for women's WIHO (thus being less willing to make commitments) but to the extent that jointly consumed goods are produced in marriage and these goods are normal goods, educated men may end up paying more for more high quality WIHO (see Grossbard-Shechtman 2003).

3. Evidence on sex ratio effects

3.1 Measuring sex ratios

The most reliable tests on how sex ratios affect a variety of outcomes are natural experiments such as exogenous differences in sex ratio across birth cohorts or as a result of wars killing disproportionate numbers of men. In contrast, tests for sex ratio effects across geographical units are problematic due to the possibility of reverse causality. For example, the inverse association between sex ratio and women's labor supply in studies based on cross-city variation such as Grossbard-Shechtman and Neideffer (1997) or Chiappori et al. (2002) may indicate that women migrated to cities with more job opportunities for women. Since people can't change their year of birth examining the behavior of successive cohorts with varying sex ratios is a better way of testing for the consequences of sex ratio fluctuations. Sex ratios vary by birth cohort to the extent that parents control their children's gender via sex-specific abortions or infanticide. The development of new technologies to ascertain a foetus' gender have led to increases in sex-specific abortions, especially in countries with strong preferences for sons such as China and India.

Sex ratios may also vary by birth cohort even if equal amounts of boys and girls are born in consecutive cohorts because (1) on average, women marry men who are generally somewhat older and the age difference does not fluctuate much, and (2) the number of births fluctuates from one birth cohort to the next. In all the countries that have experienced a spectacular baby boom after World War II (WW II) sex ratios have changed over time. For example, in the early 1950s in the US there were more marriageable men than women—sex ratios higher than 1—as a result of declining numbers of births following the 1929 Depression. Conversely, in the mid-1960s, when the first baby-boomers started dating, baby-boom women were in oversupply as birth cohorts born right before them were relatively small and sex ratios were lower than 1. Heer and Grossbard-Shechtman (1981) calculated that in the USA in 1956 the sex ratio was balanced but 9 years later, in 1965, there were 11 missing men for every 100 women ages 17 to 24, reflecting the onset of an earlier baby-boom after the New Deal became effective.

Grossbard-Shechtman and Neuman (2003) calculated sex ratios from US Census data for 5-year age groups using a two year age difference at marriage and measuring sex ratios at ages 20-24 or 25-29 for the period 1916 to 1980. This sex ratio varied between .87 for the women born in 1946-1950 (and men born in 1944-1948, a period of rapid baby-boom) and 1.07 for the women born in 1971-1975 (and men born in 1969-1973, a period of declining fertility). In other words, there were about 13 missing men for every 100 post WW II baby-boom women observed in the 1970 Census,

whereas there were 7 surplus men for women born in 1971 to 1975 and observed in the 2000 Census. These fluctuations due to an almost constant spousal age gap and large fluctuations in number of births are more dramatic than those observed in China since the onset of the one-child policy that led to higher sex ratios due to gender-specific abortions, infanticide and adoptions abroad.

In China the one-child policy was instituted in 1979. Between 1988 and 2004 the sex ratio for young adults aged 16 to 25 rose from 1.02 to 1.06, not accounting for a gender differential in age at marriage (Edlund et al. 2013). Edlund et al (2013) also use the 2000 Census of China to calculate a cohort-based sex ratio in an urban sample aged 18 to 45, assuming a two-year spousal age gap. Ratios were calculated for each city covered in their sample This sex ratio based on only one Census year and a wide range of ages varied between 0.851 and 1.899, clearly indicating internal gender-specific migration.

Sex ratios also vary across ethnic, racial and religious groups. For example, a number of studies have compared sex ratios among blacks and whites in the USA (e.g. Wilson and Neckerman 1986, Brien 1997). However, when geographical variation in sex ratio is used to explain outcomes such as marriage rates or intra-household allocation there is always the possibility of spurious correlation rather than causal mechanisms. To circumvent this problem Charles and Luoh (2010) used incarceration of men as an exogenous determinant of sex ratios in marriage markets. Their study compares blacks and whites in various age groups in various counties and regions of the USA.

Next, evidence on sex ratio effects is reported in the order predictions were presented in the previous sections.

3.2 Evidence on Consumption

Becker (1973, 1981 p.42) suggested that researchers may want to use information on what is now called ‘assignable consumption’, such as spending on husband’s and wife’s clothing, to test whether more of the household’s consumption benefits the wife when sex ratios are higher in marriage markets. In the same paragraph he had also suggested to use such data to test for the effect of men’s and women’s incomes and wages on the individual consumption of each member of a couple, a suggestion followed by Manser and Brown (1980) and McElroy and Horney (1981). They found that “his” wage and income and “her” wage and income typically had different effects on assignable consumption of husband and wife, with own income affecting own consumption more than spouse’s income. Later studies that have confirmed this finding include Thomas (1990), Brown (2009), Browning et al. (1994), and Wong (2015). Examples of such assignable consumption items are tobacco and alcohol consumed more by men and investments in children’s human capital which tend to be higher on women’s spending preferences.

Using both cohort-based and cross-sectional data from mainland China, Maria Porter (2016) found that when sex ratios are higher men consume less tobacco and alcohol.

3.3 Evidence on leisure and savings.

Sex ratio effects on leisure were recently tested in Taiwan by Chang et al. (2016). They defined total work time as employment, commuting, and housework and compared three cohorts while also using cross-sectional data. As expected from theory they found that the higher the sex ratio, the more leisure women had.

Sex ratio effects on savings have recently been tested by Wei and Zhang (2011): they investigated recent changes in China's household savings as a function of China's increasingly high sex ratio. The sex ratio at birth in China climbed from 1.06 in 1980 to 1.27 in 2007, implying men outnumbering women at age 25 or below by at least 30 million. They found that increases in sex ratios account for about half of the observed increase in Chinese household savings in recent years. Horioka and Terada-Hagiwara (2016) estimated how household savings varied with sex ratios in India and Korea using long-term time series data for the 1975–2010 period. They found that the pre-marital sex ratio (unadjusted for differentials in age at marriage) had a negative impact on savings in India, where the bride's side tends to pay substantial dowries to the groom's side at marriage, but a positive impact in Korea, where, as in China, the groom's side has to bear a disproportionate share of marriage-related expenses including purchasing a house or condominium for the newlywed couple.

With Qingyuan Du, Wei also provided cross-country macro evidence based on data for 159 countries for the years 1990-2010 (Du and Wei 2013). They found that the more sex ratios diverge from 1 either positively or negatively the higher the savings rates..

Wei and Zhang (2011) and Du and Wei (2013) interpret their findings as evidence of a competitive savings motive: when there is an excess number of men in the marriage market, young men (or their parents) will compete more to find a wife and therefore save more. The conclusion of Wei and co-authors is similar to that derived independently by Grossbard and Pereira (2010) who also assume competitive marriage markets. However, Wei, Zhang and Du only consider prices paid before marriage, and mostly by parents, whereas Grossbard and Pereira model prices for work in household production paid during the marriage that are expected prices from the point of view of singles and their parents preparing for marriage.

3.4 Sex ratios and labor supply

From 1960 to 1975, the labor force participation rates of married women aged 20-24 rose dramatically from 31.7 percent to 57.0 percent in the labor force. This coincided with the entry of the first baby-boom women, born after WW II, into marriage and labor markets. This is consistent with marriage market analysis: first baby-boom women participated in marriage markets with extremely low sex ratios (13 missing men for every 100 women in the very first 5-year cohort born after WW II) and low sex ratios push women in the labor force. By the late 1970s and early 1980s, later baby-boomers with more balanced sex ratios entered labor and marriage markets as the number of babies born in the U.S. stopped booming after 1960. This coincided with the end of the big surge in young women's employment. By the 1990s the time series on labor force participation was long enough to enable rigorous time series analysis tying women's labor supply to cohort-based changes in sex ratio. Using data for 1965-1990 and controlling for other factors that changed over time, Grossbard-Shechtman and Granger (1998) showed that early baby-boom women experienced more rapid growth in labor supply than women born earlier or later. This was precisely the cohort with the lowest sex ratio.

It also followed from sex ratio analysis that by the time that the small cohorts born in the early 1970s (around the passage of *Roe vs. Wade*) would reach adulthood a possible reversal would occur in young women's rate of participation in the labor force and that it would decrease rather than

increase as there would be a surplus of men and sex ratios would be larger than 1 (Grossbard-Shechtman 1985).

Grossbard and Amuedo-Dorantes (2007) analyzed employment data over the period 1965-2005 for women aged 25 to 44 born between 1926 and 1980 and found that cohorts of women with lower sex ratios had experienced above-average labor force participation, whereas cohorts of women with higher sex ratios—such as women born during the baby-bust after 1961--had experienced below-average labor force participation. An increase in the sex ratio of .10 was found to have the same effect on young women's labor force participation rate as two more years of schooling.

Sex ratio analysis also helps explain recent trends in labor force participation in the U.S.A. Consider the labor participation rate for all women ages 30 to 54 in three recent five-year periods--2000 to 2005, 2005 to 2010, and 2010 to 2015—depicted by the dark grey line in Figure 2. It can be seen that from 2000 to 2015 that participation rate dropped from above 77% to slightly under 75%, but the drop was not continuous: there was a slight rise in participation in the period 2005 to 2010, which includes the beginning of the big recession. During this whole period this age group included women born in 1961-1965, the first baby-bust 5-year cohort born after fertility stopped booming in 1960. At their prime age for dating these first baby-bust women benefited from a high sex ratio that stood at 1.03, i.e. there was a surplus of 3 men for every 100 women two years younger (Grossbard-Shechtman and Neuman 2003). This was considerably higher than the sex ratio of 0.97 characterizing the marriage market for women born in the preceding cohort (1956-1960), the end-of-baby-boom women. Replacement of end-of-baby-boom women by women born in the first baby-bust thus implies an increase in sex ratio from .97 to 1.03 or a switch from a shortage of 3 men to a shortage of 3 women. This large drop in sex ratio helps explain some recent decreases in labor force participation, as shown in Figure 2.

It can be seen that whenever the high-sex-ratio first baby-bust cohort replaced the low-sex-ratio end-of-baby-boom women the labor force participation fell faster than average for the whole age group. More specifically, the dark grey line indicates that from 2000 to 2005 participation for all women 30-54 dropped by one percentage point, from 77% to 76%, but that of women then aged 40 to 44 shown on the black line dropped faster: from almost 80% to almost 78%. In 2000 the women aged 40 to 44 were low-sex-ratio end-of-baby-boom women; by 2005 they had been replaced by first high-sex ratio baby-busters. The relatively rapid drop in female labor force participation thus coincides with the replacement of the last baby-boom cohort by the first baby-bust cohort. From 2005 to 2010 the same cohort replacement occurred for women ages 45 to 49 and is associated with a slight drop in labor force participation (the lightest grey line), in contrast to the increase in participation experienced by all women aged 30 to 54 as the U.S entered a recession. The contrast between the high sex ratio baby-bust cohort and the preceding low sex ratio baby-boom cohort is starkest for the transition from 2010 to 2015: in 2015 the high-sex-ratio first baby-bust women were aged 50-54 and had a labor force participation more than 2 percentage points lower than that of their low-sex-ratio predecessors at the same age.

This analysis leads to some predictions: soon the first baby-bust women will retire and will be replaced by millennials in the age group 30 to 54. Millennials are characterized by balanced sex ratios and so far millennial women have demonstrated their commitment to the labor force by increasing their participation during the recession years. It is therefore to be expected that from the sex ratio point of view the labor force participation of women aged 30 to 54 will increase as high-sex-ratio

first baby-bust women are being replaced by millennials who experienced sex ratios close to one when actively participating in marriage markets (see Grossbard 2016).

Comparing blacks and whites in various age groups in various counties and US regions Charles and Luoh found that poorer marriage prospects due to higher incarceration rates drove women to participate more in the labor force. Angrist's study based on sex ratio variation due to varying flows of male and female immigrants found a large negative effect of sex ratios on female labor force participation.

3.5 More sex ratio effects.

It follows from the analysis in the previous section that when sex ratios are higher and gender roles are traditional a higher sex ratio will be associated with relatively more marriage and fewer odds of non-marital cohabitation. This helps explain why the very low sex ratio cohort born after WWII in the US experienced rapid increases in non-marital cohabitation (Heer and Grossbard-Shechtman 1981, Guttentag and Secord 1983). Ekert-Jaffe and Grossbard (2008) found that the cohort of women born right after WWII and characterized by low sex ratios in 12 Western countries, were considerably more likely to become lone mothers. Using the Fragile Families study and cross-city variation in sex ratio, Mincy et al. (2005) found a positive association between sex ratio and the odds of a stronger commitment between parents. In particular, the higher the sex ratio, the higher were the odds of marriage versus other co-parentships not involving parental co-residence. They found that an increase of 10 percent in sex ratio, say from 1 to 1.1--which amounts to the addition of ten surplus men per hundred women--increases these women's odds of marriage by 14.1 percent.

Sex ratios also help explain differences in marriage rates between blacks and whites. Brien (1997) found that racial differences in the timing of marriage were related to state level differences in sex ratios, more so than to local level sex ratio differences. Charles and Luoh (2010) found that lower sex ratios in marriage markets defined by race, age, and location that were due to higher incarceration rates were associated with a lower likelihood that women marry, a higher likelihood that women marry down in terms of their education level, and a lower likelihood of marrying up. Angrist's (2002) comparison of various immigrant groups that had experienced exogenous changes in sex ratio found that high sex ratios had a large positive effect on the likelihood of female marriage and slight positive effects on the marriage rates of second-generation men.

As for the effect of sex ratios on the probability of ethnic intermarriage Chiswick and Houseworth (2011) found that in the USA the more members of the other gender from the same region of origin are available in a particular location, the less it is likely that an individual will intermarry, which indicates a preference for marrying people from the same origin.

Furthermore, low sex ratios have been linked to large increases in women's college attendance and to the onset of the feminist revolution, following the entry of the first post WW II baby-boomers--lowest sex-ratio generation--into marriage markets in the late 1960s and 1970s (Heer and Grossbard-Shechtman 1981;Grossbard-Shechtman 1993). Cohort changes are exogenous, and so are changes in incarceration. Consequently, Charles and Luoh's finding of a positive association between incarceration rate and fraction of women with any college training is consistent with a negative association between cohort-based sex ratio and women's education.

Evidence from China also indicates that sex ratios affect human capital accumulation. More specifically Porter (2016) showed that when sex ratios are higher sons are healthier. The causality

may be as follows: when sex ratios are higher married women have higher bargaining power relative to that of husbands; with more bargaining power mothers control relatively more of the household's resources and they prefer to invest more in their sons' health capital. A study based on Taiwanese data also documented that sex ratios and human capital investments in children were positively related (Francis 2011).⁹

Edlund et al. (2013) found that for cities and cohorts with higher sex ratios women are less likely to obtain an education. Given that they are also less likely to be employed in the labor force this reduced human capital accumulation may be a consequence of lower expected and actual employment.

Edlund et al. have also tied sex ratios to crime rates, in particular crimes performed by young men. Using data for 30 Chinese provinces in the period 1988 to 2004 they found that men in cohorts faced with a higher sex ratio at birth were more likely to engage in crime. Their results were sensitive to the inclusion of a province time trend, suggesting that their findings may be partially driven by migration of men to certain cities that also have higher crime rates. In that case they would not be capturing sex ratio effects. To the extent that sex ratios are really associated positively with crime it may indicate that young unmarried men engage in crime as a means of obtaining the funds to attract the relatively scarce brides. However, in the USA it has been documented that men born in the early 1970s, a period of rapidly dropping fertility and therefore high sex ratios in marriage markets when this cohort started dating, have experienced a drop in crime rate (Donohue and Levitt 2001). Increased competition among men for relatively scarce women due to high sex ratios may thus be related to crime rates in different ways in different cultures. When in a better bargaining position in marriage markets women may incentivize men towards a reduction in their criminal activities (which is consistent with US findings) rather than encourage men to accumulate more assets by illegal means (which is consistent with Chinese findings).

Heer and Grossbard-Shechtman (1981) linked rapidly shrinking sex ratios in the USA to big drops in fertility, thus indicating that sex ratios and fertility moved in the same direction. However, Francis (2011) documented that as sex ratios rose in Taiwan the total number of children in a family decreased, in apparent contradiction with the interpretation of time trends in the USA. It could be that these diverging results for the USA and Taiwan are due to the larger proportion of married mothers in Taiwan. With higher sex ratios married women in Taiwan may have been more able to actualize their preferences for small families. In contrast, as sex ratios dropped dramatically in the USA in the late 1960s and 1970s women opted out of the "first marriage; then children" mode and without pressure for extra fertility on the part of men overall fertility dropped with sex ratios.

Conclusion

Analytical tools, such as those that economists routinely apply to understand the determinants of more traditional outcomes, can help us understand how marriage markets affect personal access to consumption goods, individual savings, leisure time, and labor supply. The same tools also throw

⁹ Francis (2011) constructed sex ratio measures using the number of men aged 15–39, excluding mainlanders in the military, divided by the number of women aged 15–39, then multiplied by 100. He did not include mainlanders enlisted in the Taiwanese military because the government did not permit them to marry. He defined the sex ratio at the regional level based on five standard geographic regions for the period 1950 to 1984.

light on choice of living arrangements, including choice between marriage and other forms of cohabitation and co-parenting, and investments in own and children's human capital.

This chapter has centered on one particular variable reflecting marriage market conditions: the sex ratio, or ratio of men to women. By affecting demand and supply in marriage markets, sex ratios can have an impact on numerous outcomes including consumption, labor supply, savings and crime. Evidence on sex ratio effects was reported, with an emphasis on studies that establish causality. There is widespread evidence for many parts of the world that sex ratios have important effects on savings, labor supply and consumption and a variety of other outcomes. Sex ratios may also have an impact on the macro economy that has not yet been studied.

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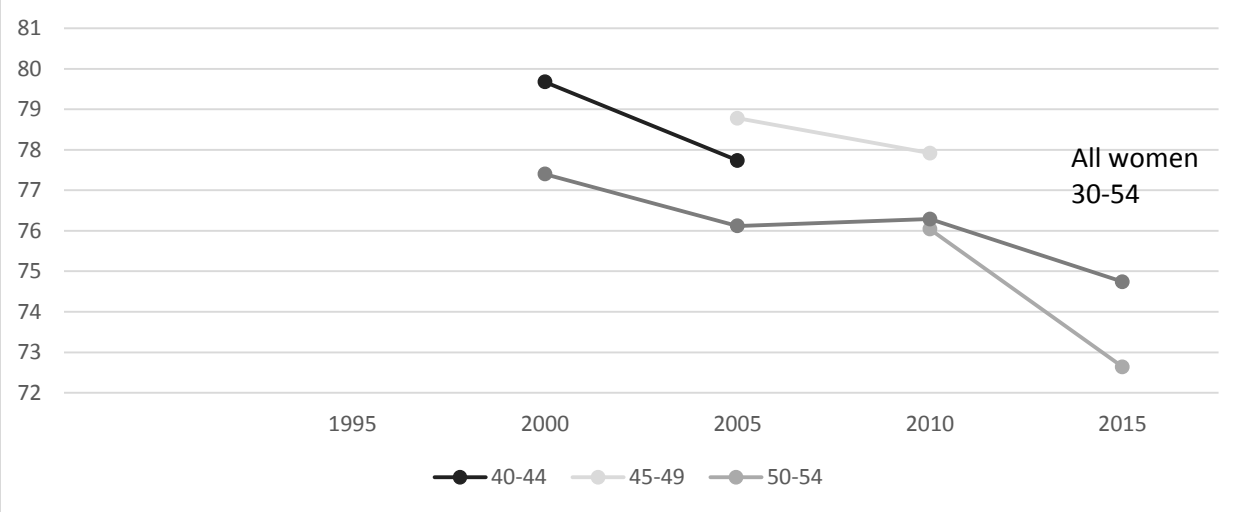
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Figure 1: use power point Figure 1

Figure 2. Women's labor force participation, all women ages 30-54 (dark grey) and high-sex-ratio first baby-bust cohort, 2000-2015.



Note First baby-bust cohort was born in years 1961-1965. It was aged 40-44 in 2005, 45 to 49 in 2010, and 50 to 54 in 2015.