THE IMPACTS OF SEX RATIOS ON MARRIAGE MARKETS IN THE UNITED STATES

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Abstract

Sex ratios, the ratio between the number of males per female in a population, can affect decisions regarding marriage, marriage prospects and outcomes. Sex ratios are a good indicator of the availability of mates in a population and this play an important role when individuals are considering marriage. This paper uses the local marriage market sex ratios in the US (metropolitan areas) to study how the availability of individuals from the different sex affects decisions towards marriage and the selection of mates. The empirical results suggests that high sex ratios (more males than females) reduces the number of single females in a population, increases the number of single males and have a negative effect on the age differential between couples. Also, individual outcomes such as schooling and income level are much more related to individual and regional characteristics than to sex ratios. Sex ratios also appear to have little or no effect on the mating process, I observe that individuals tend to marry others with similar educational levels despite of the different availability of mates in a region.

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1 INTRODUCTION

The study of marriage and its socioeconomic effects was kept out of the academic debate for a long time (Cigno, 1991). Becker (1981) shows that in pre-industrial and traditional societies marriage was a family choice rather than an individual decision, the power of the individual to choose its mate was minimum and the process involved much more the family interests than the person's. In modern societies, however, the influence of the family in the marriage decision process declined and the individual, who is getting married, became the center of the selecting process. In this sense, marriage became an important variable of analysis to social scientists due to its significant impacts to the life of individuals and society. One question that emerges from this debate is how actors select their mates and what are the consequences of this selection.

One of the most important factor affecting the decision to marry and the mating process is the availability of mates. Sex ratios, defined as the number of males per females in a population, are a good indicator of the availability of mates and can have important consequences on socioeconomic outcomes. Changes in sex ratio can affect the rates of marriage, since the existence or the lack of mates will anticipate or postpone a marital decision. Also, we can expect males in such regions with higher sex ratios to invest more in their human capital in order to become more attractive to possible mates.

It is a well known fact in demography that sex ratio at birth is around 1.05, that is 105 males per 100 females, and as individuals grow older this number tends to get closer to 100 due to the differential mortality between sexes. In a few countries we observe extreme variations in this number, but for the United States the number has been pretty stable over time. Sex ratio can have an effect on marriage markets for fast growing populations since males tend to marry younger females. The older cohort of males will have a larger pool of females to choose from whereas the females will face a much smaller pool of possible mates (Bergstrom & Lam, 1988). Another source of changes in sex ratios that might affect marriage patterns is due to internal migration. Some regions can attract or repulse individuals of a specific sex given the characteristics and necessities of the job market or any other regional particularity.

In this paper, I analyze the impacts of regional sex ratio differences on marital patterns, marital outcomes and the mating process in the United States. I exploit how the availability of mates affects decisions related to the first marriage. I assume that individuals will only search for mates in the area where they reside and that individuals prefer, following Becker and Cigno, to marry someone with similar characteristics, in my case the level of education.

In this paper, I use data from the 1980 and 1990 Census (5% state) IPUMS files. The data are limited to individuals who reside in the Metropolitan Areas of the United States (see map in the appendix). The IPUMS provide individual information on socioeconomic and demographic characteristics and permit us to match spouses and/or patterns using the household identification number as the key variable.

I extract individuals residing in the metropolitan areas that were married with the spouse present or not present. Males selected were between 20 to 32 years of age and females 18 to 30 years of age. The age difference between the two groups is to account for the observed difference in age at marriage of spouses widely discussed in the literature. Since I do not have information whether the union is a first marriage or not, I select young adults assuming that those would have a higher chance to be entering the first union and therefore being more affected by the sex ratio.

Spouses were grouped in 5 different educational groups: less than high school, high school diploma, less than college, college and more than college. The sex ratios were estimated for each one of the metropolitan areas using all individuals in the same group selected before.

The paper uses three methodological approaches to study the effects of sex ratios on the marriage market. The first approach is a graphical description of the marital patterns according to regional sex ratios. I use scatter-plots of the percentage of single individuals in the region and the sex ratio to observe how the availability of mates affects the decision towards marriage. Also, I analyze graphically how spouse age differences vary across regions in relation to their sex ratios. We expect that sex ratios affect when individuals marry and with which group they marry.

The second approach examines how sex ratio affects marital outcomes as discussed above. I estimate OLS model having as dependent variables personal income and as explanatory variable the sex ratio, in this case controlling for regional characteristics. I also do a similar bivariate analysis, but on differences between the two censuses rather than on levels, using a simple fixed-effect model. According to the theoretical framework, I expect that males in areas with high sex ratio will have higher incomes because they had to invest more in their personal characteristics in order to be more attractive to the existent pool of females.

The third approach uses log-linear models to study how sex ratios affect the marriage patterns. This model uses a transition matrix as a measurement instrument and this matrix shows how males and females mate according to their personal characteristics, in our case the educational level.

The main diagonal represents the homogamy in the marriage market, individuals with similar levels of education getting married. To the right of the main diagonal I observe individuals marrying up, that is, the mate has better individual attributes than the observed person does. And to the left of the main diagonal, I observe individuals marrying down, since they are mating with others with worse personal attributes.

The log-linear model identifies the associations between spouse's levels of education independent of the marginal distributions of spouse's educational levels. In other words, the model express the logarithmic of the cell frequency in a contingency table expanded to allow for all possible interactions in the table. The advantage of this model is that it permits tests of independence between the combination of variables, and controls for marginal effects.

The paper attempted to discuss the patterns of marriage formation in the metropolitan areas of the United States and how sex ratios can affect marital rates and mating selection. The idea of studying marriage markets and couple formation is traditional in economics and sociology. To my knowledge, however, little attention has been paid to how the availability of mates affects the selection process. So far the literature has focused on how sex ratio affects the number of married and single individuals, spouses' age differentials and labor market outcomes. The contribution of this paper is twofold: it analyzes the impact of sex ratio on the mating process and it studies metropolitan areas in the US, whereas previous work focused on the whole country and/or states.

Impacts of the sex ratio on marriage markets were estimated using a variety of approaches. A graphical analysis showed that fluctuations in sex ratios are correlated to the percentage of single people in a particular area and also affects spouse's age differentials. In my estimates, the impacts for females seem to be stronger than for males. The results are similar to others discussed in the literature. These impacts, however, need to be better studied. I believe that a better specification of the model (controlling for other factors, fixed-effect model) might provide more realistic estimates and better insights to the problem.

The mating process, investigated using a log-linear model, showed strong evidence of homogamy in the marriage market despite variations in sex ratios. Males and females tend to marry persons with similar personal attributes. I did not find strong evidence that marriage squeeze affects the way individuals select their mates. I speculate that men and women postpone the decision to marry in order to meet a more desirable mate, or decide to co-reside before marrying, before making a final decision if they want to marry or not with the other individual. I intend to test this last hypothesis before the presentation of the paper.

Several questions remained unanswered and they are possible topics for future research. The first one is the construction of a better estimate of mates availability that takes into consideration the educational composition of each region. Second, expand the analysis to all US counties and/or municipalities and perform the study over a longer period of time to better understand the problem. And last, study the impacts of mating on the household decision making process.

The paper is structured in 6 sections including this brief introduction. The following section presents and discusses the analytical framework and, briefly, reviews the theoretical and empirical literature. The third section presents the data used in the paper and some descriptive statistics and presents the areas of analysis. The fourth section describes the basic methodology and the estimated models. The empirical results are presented and discussed in the fifth section. And, the sixth section concludes the paper and presents some ideas for further research.

2 ANTECEDENTS

2.1 General Theories of Marriage

The development and the study of marriage (and marriage markets theories) stay outside the mainstream economic theory and other fields of study because during most of the part of history the marriage was a decision made mainly by the parents than by the self interested parts (Cigno, 1991). From the moment where individuals started to have more power to make their own decisions about marriage, the economic and sociological theories and models became appropriate to study this aspect of life.

Cigno (1991) presents in a simple form the basic models of mating. In the first model, he assumes the marriage market as a cooperative game model, where persons set a matrix of preferences and search their possible mates according to this matrix. In a simple

example, one can imagine the world formed by **m** men (m1, m2, m3) and **w** (w1, w2, w3) women and each one has a set of preferences of marriage with the opposite sex (Cigno, 1991).

As defined by Cigno (1991), the best situation for all individuals would happen when males mate with their preferable female and vice-versa. In this point, no one can be in a better situation and any change of partners will make at least one individual worse off than before (this point is defined by the matrix main diagonal where m1 marries w1, and so on).

However, this model assumes that only one particular characteristic of the opposite sex will be observed in the mating process. Cigno (1991), therefore, extrapolates its model to assume a variety of characteristics in the mating process. When assuming that other factors influence the process of choice, the equilibrium of the model is reached when individuals maximize the product of their union, that is, all the pros and cons of union formation will be considerate and the best one will be chosen. In this sense, marriage is expected to reduce the difference between individuals and not to turn them larger.

Becker (1981) suggests that a mating of likes and dislikes happen when the product generated by the union is maximized. The union has a positive mating when individual with similar characteristics married and it is a negative mating when persons with different characteristics mate.

In addition to that, Becker (1981) develops a model to explain the economic decision of the marriage. According to the author, individuals take into account basically three factors before getting married: the benefits of that particular union, the costs of divorce and the availability of partners. In a general form, according to the economic model of marriage proposed by Becker, individuals will get married when the gains of being

married are larger than the gains of remaining single (this computation will consider both the benefits and costs of the mating).

2.2 Empirical Evidence

The level of homogamy (or not) in marriage markets has been focus of research for many societies. The main objective of those papers is to analyze the trends in homogamy in different marriage markets (normally, different countries); possible factors that could affect this pattern of marriage and possible outcomes of the mating process.

Lewis & Oppenheimer (2000) based on the National Longitudinal Survey of Health estimated a hazard model to verify how the educational composition of local marriage markets affect both educational and assortative mating and the relationship between education and the timing of marriage. The main result of the authors is that educational concentration influences educational sorting. That is, in less educationally concentrated areas, individuals are more likely to marry with someone with different educational level than in areas where education is highly concentrated. In addition to that, the chance of a worst marriage for females in less educated areas are worst than the chance observed for males, and older women worsens the chance of a "good mating" for women.

Pullum and Peri (1999) examine the homogamy in the marriage market of Montevideo (Uruguay). The authors discussed the roles of personal attributes in the mating process. They found that education and religion have an important feature in the homogamy process. The other major finding is that the social area, the region where individuals spend most of their time and have higher chance to meet partners, is an important dimension of the marriage choice.

Poppel and others (2001) perform a different approach. Their main interest is the age homogamy in the Netherlands marriage market over a long period of time. The authors

find that there is a narrowing of the age gap in the country, and that in recent years it is more likely to marry someone closer in age than ever before. However, they point out that the data does not allow them to investigate what factors are behind the observed trends in age of marriage.

Qian (1997) studies the marriage pattern in the United States in 1980 and 1990. The author shows how inter-marriage (racial and educational) changed in the US over this short period of time, and how marriage between the white population and racial minorities changes according to the level of education of the possible mate. The main conclusion of the study is that inter racial marriage is easier to occur when individuals have different levels of education, in this sense according to Qian (1997), persons (males or females) are changing economic power (measure by the educational level) for social status (measure by the partner race).

2.3 Sex Ratio and the Marriage Markets

The papers discussed above emphasize the homogamy in different marriage markets and/or some specific characteristic of the marriage market (normally education) affects the mating process. However, none of the studies discuss the possible impacts of different sex ratios on marital patterns and marital outcomes.

The following anecdote, named the swimming pool model, may help to understand the effects of sex ratios on marital outcomes and to clarify our main hypothesis. Suppose that we have a collection of swimming pools spread over a region and in each one of them there is a number of males and females with different characteristics. An individual in one swimming pool can only search for a mate in the same place; he/she cannot migrate to the next swimming pool searching for a possible better mate. We also assume that each individual carries a sign showing information on how many years of schooling each one

has, and this is the only information known by prospective mates. The sex ratio in each swimming pool is defined by a number of reasons: size of the pool, quality of the water, provision of food and beverages. In this model, however, we assume that these variables also affect the decision towards marriage e.g. when to marry and with whom to marry, but they all will be absorbed by the observed sex ratios.

Given this scenario each individual, male and female, will search the best possible mate in that pool of mates. In pools where the sex ratio is too high, more males than females, we expect women having more bargain power because they are more desirable than males. Thus, they can wait longer to choose a better mate and males will have to invest more on their qualities to attract the reduced number of females. On the other side, pools with low sex ratios, more females than males, we expect to observe females marrying earlier and, in some cases, with less desirable mates since the chances of not getting married or getting married with a worst choice are higher.

The availability of mates will also affect the relation within the couple. In areas with high sex ratio females have more choices and are in a better situation to choose their partners. We expect to find women with higher labor market attainment and more bargain power to make decisions regarding the household allocation of resources and processes, such as reproduction and contraceptive use. And the opposite might be true for areas with low sex ratios. The effects on bargain power and situation in the household decision making process will affect the individual gains to marriage.

According to Becker (1991), gains to marriage will be highly influenced by the existence of eligible partners. An excess of one sex will demand from them more inputs into the marriage, because they will have a higher competition for the preferable mate. On the other hand, “less valuable" mates will be better off because there will be more

individuals with desired personal attributes. In general, individuals in excess will have a higher chance to “marry down" and scarce individuals will have a higher chance to “marry up". This will generate a redistribution process from the group in excess to those in the scarce group.

Most of the empirical research on sex ratio studies the effects on marital rates and labor market outcomes. In general, researchers analyze the effects of sex ratio on age at marriage and the percentage of married people across time for a single country or in a cross-section of states for one sole country. Another set of research on the effects of sex ratio focus on its effects on labor market outcomes, such as labor force participation and wages levels.

Bergstrom and Lam (1988) study the effect of cohort size on marital patterns for XXth century Sweden. They find that age difference between spouse’s change to accommodate different cohort sizes. If the size of the male cohort is smaller than the female one, it is observed a decrease in the number of population getting married and an increase in the age difference between spouses. For the United States, Goldman et al. (1984) estimate a measure of availability and observed how fertility fluctuations, taking the country as a whole, affects the marriage market for some cohorts. In a earlier work for the US, Freiden (1974) studies observes that sex ratio influence marital behavior finding that lower sex ratios increase the number of single women in the states. Grossbard-Shechtman (1993) and Angrist (2001) take a more economic approach focusing on labor market outcomes. They observe that sex ratio have an effect on level of income and labor force attainment for regions in the US and for specific ethnical groups.

The theory and literature discussed above shows that the empirical literature on marriage markets could be divide in two big groups. The first one concerned on how

individuals select their mates and trying to show evidence of homogamy in the marriage market, but they do not take many important factors into consideration. The second group studies how sex ratio (availability of mates) affects marital patterns and marital outcomes, but does not study how sex ratio can affect the mating process and the impact of the mating process on marital outcomes.

This paper proposes to study how the availability of mates, given by the regional sex ratios can affect the assortative mating and also try to shed some light on how couple formation given this scenario can affect marital outcomes.

3 DATA AND DESCRIPTIVE STATISTICS

In this paper, we use data from the 1990 Census (5% state) IPUMS files. The data are limited to individual who reside in the Metropolitan Areas of the United States (see map in the appendix). The IPUMS provide individual information on socioeconomic and demographic characteristics and permit us to match spouses and/or patterns using the household identification number as the key variable.

We extract individuals residing in the metropolitan areas that were married with the spouse present or not present. For this paper, we opt not to select the cohabitors since we believe that the behavior and the process leading to a marriage and cohabitation are different from each other. Males selected were between 20 to 32 years of age and females 18 to 30 years of age. The age difference between the two groups is to account for the observed difference in age at marriage of spouses widely discussed in the literature. Since we do not have information whether the union is a first marriage or not, we select young adults assuming that those would have a higher chance to be entering the first union and therefore being more affected by the sex ratio.

Spouses were grouped in 5 different educational groups: less than high school, high school diploma, less than college, college and more than college. The sex ratios were estimated for each one of the metropolitan areas using all individual in the same group selected before (we included singles, divorced and widows).

We would like to have a map showing the distribution of sex ratios across the Metropolitan Areas because we believe that would help understanding our results and would allow us to make a more in dept analysis of this phenomenon. A quick look of sex ratio and regions does not show a particular concentration of sex ratio in a region of the US and/or a very strong relation with levels of development. But, without a map is hard to really see how the distribution looks like.

In total we select 6.070.558 individuals making 3.035.279 couples distributed across 264 regions. The age distribution shows a slightly concentration on older ages (near to 32 for males and 30 for females) indicating the effects of the fertility declining what makes young cohorts smaller than older ones. But in overall each individual age has approximately 9% of the total selected population. Regarding education, 28% of our selected group has a high school diploma and another 28% have some college. A very small percentage, 3%, has more than college what was expected given the age groups we used. And 16% have completed college. On average women are a little more educated than males, showing the increasing opportunities for females. Angrist observes the same patterns and also that college cities have low sex ratio indicating the prevalence of females in those regions.

4 METHODOLOGY

The paper uses three methodological approaches to study the effects of sex ratios on the marriage market. The first one is a graphical description of the marital patterns

according to regional sex ratios. We use box-plots of the percentage of single individuals in the region and the sex ratio to observed how the availability of mates affects the decision towards marriage. Also, we analyze graphically how spouse age differences vary across regions in relation to their sex ratios. We expect that sex ratios affect when individuals marry and with which group they marry. We are aware that are many other regional and individual factors affecting the decision of entering in a marriage which are not controlled in the analyzes made here, which is done in the second part of the paper.

The second approach observes how sex ratio affects marital outcomes as discussed above. We estimate OLS model having as dependent variables personal income and as explanatory variable the sex ratio, in this case controlling for regional characteriscts. According to the theoretical framework, we expect that males in areas with high sex ratio will have higher incomes because they had to invest more in their personal characteristics in order to be more attractive to the existent pool of females[1].

The last part of our analysis uses log-linear models[2] to study how sex ratios affect the marriage patterns. This model uses as a transition matrix as a measurement instrument and this matrix shows how males and females mate according to their personal characteristics, in our case the educational level.

The main diagonal represents the homogamy in the marriage market, individuals with similar levels of education getting married. To the right of the main diagonal we observe individuals marrying up, that is, the mate has better individual attributes than the

[1] We present this results in the appendix because we believe there is still much more work to be done with these test and estimations. The results are very preliminary, and we are not yet comfortable with them, and are use as an illustration about what we are planning to do in the future.
[2] This section is based on Blackwell (1993), and Hout (1983).

observed person does. And to the left of the main diagonal, we observe individuals marrying down, since they are mating with other with worst personal attributes.

The log-linear model identifies the associations between spouse's levels of education independent of the marginal distributions of spouse's educational levels. In other words, the model express the logarithmic of the cell frequency in a contingency table expanded to allow for all possible interactions in the table. The advantage of this model is that it permits tests of independence between the combination of variables and to control for marginal effects.

The model possibilities the research to study the following effects main diagonal and the variable composition. The basic model is the saturated since it contemplates all possible effects and interactions by reproducing the main contingency table. In this case, there is no difference between the expected and the observed table, the number of parameters in the same as the number of variables in the table.

The saturated model has the following format:

$\mathbf{F_{ij} = h t^{o}_{i} t^{d}_{j} t^{d}_{ij}}$, where Fij is the number of cases in the cell ij that are expected if the model is true, η is the geometric mean of cases in each cell and τ's are the effects of the distribution in the columns, the lines and the interactions.

We test 4 models, in addition to the null and saturated models. The first two models test if there is homogamy or not in the local marriage markets in the United States. The matrix we constructed represents two possible outcomes: marrying similar individuals and marrying different individuals.

The other two models test the hypotheses of marry-up and marry-down in the regional marriage markets according to effects of sex ratios. It is important to clarify that

we estimate each one of these models to a group of metropolitan areas divided in quartiles according to their sex ratio.

The paper estimates the following models:

1) Independence

$F_{ij} = \lambda^{0} + \lambda^{males} + \lambda^{females}$

2) Mobility-Immobility

$F_{ij} = \lambda^{0} + \lambda^{males} + \lambda^{females} + \lambda^{mobility - immobility}$

3) Males marrying-up

$F_{ij} = \lambda^{0} + \lambda^{males} + \lambda^{females} + \lambda^{marry-up}$

4) Males marrying-down

$F_{ij} = \lambda^{0} + \lambda^{males} + \lambda^{females} + \lambda^{marrying-down}$

To test the models we are going to use the values of the deviance according to the degrees of freedom. The basic idea is to compare a baseline model with more complex ones to verify if the introduction of other variables or if a more complex model improves the explanation of the observed frequencies in relation to the ones observed in the baseline model.

5 RESULTS

5.1 Graphical Analysis[3]

The analysis of sex ratio and spouse's age differences is shown in Figure 1. The figure plots the relationship between regional sex ratios and the age difference between spouses not controlling for regional characteristics. The figure shows that higher sex ratios are associated with smaller age differentials. That is, in regions with a higher proportion of males in relation to females, men tend to marry with women with more similar ages. And regions with lower sex ratios, more women then males, the age difference is higher.

[3] Figures are shown in the appendix.

The theory predicted that males in regions with higher sex ratios would marry younger women because they need to search for mates in different cohorts or mates with attributes different from the more desirable ones. Bergstrom & Lam (1988) found this for Sweden over the course of the XXth century. An alternative interpretation for this finding is that women of the same age are the less desirable mates, thus in regions where the pool of females is larger males have more choices and can choose the desirable younger females. On the other hand, where there is a "limitation" of possible mates they ought to choose the less desirable mates, in this case, women with similar ages. Therefore, we observe a reduction in age differentials in high sex ratio regions.

Part of the relationship between sex ratio and spouse's age differential may also be explained by regional marital characteristics. It would be very important to map the sex ratios in the US metropolitan areas to see if there is a concentration of a level of ration between males and females in any particular region what would also help us to explain the observed pattern of marriage in our study.

Figure 2 plots the relationship between regional sex ratio and the percentage of single males. The relationship shows that in regions with higher sex ratios, more males than women, there are more single males in that population. Figure 2 shows how the marriage squeeze affects the decision making process regarding marriage and how the availability of possible mates affects when an individual enters a union.

Figure 3 plots the same relationship for females. The graph shows that in regions with high sex ratio the percentage of single females is smaller than for regions with lower sex ratio. In addition to that, the effect on female's marital behavior is much stronger than the one observed by males. The same pattern, stronger effects for females, was found by Angrist (2001) when studying the effects of immigrants generation size on marital patterns

of the second generation of immigrants. Once again, the different sex ratios might also be reflecting regional differences that are not controlled in this visual examination. And, it is important to point out that the coefficient of correlation is very small. However, the slope which is the number of our interest gives us the predict sign.

5.2 Assortative Mating and Sex Ratios

We observe before that sex ratio seems to have an impact on the marital patterns. In high sex ratio regions the age difference between spouses is smaller than in regions with lower sex ratios, and also the number of single individuals vary according to the sex ratio levels. In this section we present the results of assortative mating, that is, we analyze how the different sex ratio affects the choice of mates according to personal characteristics. Since most of the characteristics are only observed by the individuals and not by the researchers, we opt to study the mating in relation to the educational level. Education is, possible, one of the easiest attributes to identify and play an important role in the decision about whom marries whom. We have some reasons to believe that, schools are a good example of marriage market (fits well in our swimming pool model), and individuals with similar levels of education seems to have a better relationship because they share similar desires and knowledge, and have similar expectations towards life.

Our hypothesis, however, is that fluctuations in sex ratios will affect how couples will be formed. Lower or high sex ratios affect the availability of mates, therefore affecting the decision making process. Our approach to study this effect is to estimate log-linear models for United States metropolitan areas taking into consideration their sex ratio. We estimate six models for each set of regions. The metropolitan areas were aggregate in quartiles according to their sex ratio.

Regions with low sex ratios compose the first quartile. In the first group the ratio between males and females is lower than 94.3, that is, there are about 94 males for every 100 females. The second quartile is composed by metropolitan areas with sex ratios between 94.3 and 101.29; the third for regions with sex ratios between 101.3 to 104.17; and the fourth quartile for regions where the sex ratio is larger the 104.17. According to our theory we expect to see more variance from the main diagonal in the first and fourth quartiles since they represent the extremes sex ratios in the USA.

Table 1 - Assortative Mating in relation to education and sex ratio Metropolitan Areas - First Quartile

Model	Deviance	df	dDeviance	(%) R^2
Null	46454.18	24		
Independent	18363.24	16	28090.94	60.47
Mobility-Imobility	7884.62	15	38569.56	83.03
Males Marry Up	11587.89	15	34866.29	75.06
Males Marry Down	10810.69	15	35643.49	76.73
Saturated	0	0	46454.18	100.00

Source: Author's caculation using US Census and SAS

Table 2 - Assortative Mating in relation to education and sex ratio Metropolitan Areas - Second Quartile

Model	Deviance	df	dDeviance	(%) R^2
Null	67644.3	24		
Independent	28374.95	16	18079.23	38.92
Mobility-Imobility	11770.1	15	34684.08	74.66
Males Marry Up	18445.25	15	28008.93	60.29
Males Marry Down	15428.94	15	31025.24	66.79
Saturated	0	0	46454.18	100.00

Source: Author's caculation using US Census and SAS

Table 3 - Assortative Mating in relation to education and sex ratio Metropolitan Areas - Third Quartile

Model	Deviance	df	dDeviance	(%) R^2
Null	65253.99	24		
Independent	28875.37	16	17578.81	37.84
Mobility-Imobility	11068.16	15	35386.02	76.17
Males Marry Up	17803.72	15	28650.46	61.67
Males Marry Down	15372.37	15	31081.81	66.91
Saturated	0	0	46454.18	100.00

Source: Author's caculation using US Census and SAS

Table 4 - Assortative Mating in relation to education and sex ratio Metropolitan Areas - Fourth Quartile

Model	Deviance	df	dDeviance	(%) R^2
Null	59857.31	24		
Independent	26155.47	16	20298.71	43.70
Mobility-Imobility	9079.58	15	37374.6	80.45
Males Marry Up	15441.25	15	31012.93	66.76
Males Marry Down	12931.29	15	33522.89	72.16
Saturated	0	0	46454.18	100.00

Source: Author's caculation using US Census and SAS

The null model is estimated without the use of any covariate. The deviance statistic from this model reports the total amount of variability that is available to be explained.

Then reductions in a model deviance in subsequent model fits with covariates allow us to calculate the equivalent of R-square in standard normal theory models (Flynn, ?)[4].

The model with the highest percentage in r-square (R^2) is the one that presents the best fit to our estimates. In other words, it is the more parsimonious model. For all quartiles of sex ratio the model that have the best fit is the mobility-immobility one. This model indicates that individuals tend to marry others with similar levels of education, which characterizes a homogamy tendency on the US marriage markets despite the fluctuations in sex ratios.

Pullum & Peri (1999) studying the marriage markets in Uruguay, not considering the sex ratios, observe the same pattern of homogamy. Their paper considers more variables than ours (e.g. political affiliation, religion, type of occupation, etc) does for recent weddings in the capital of Uruguay. For the metropolitan areas of the United States, the same process seems happen. Individuals tend to marry similar ones independent of the sex ratios. It is clear the evidence of homogamy in the marriage market.

A second stage of estimates not presented here, uses the sex ratio as one of the explanatory variables affecting the formation of couples on the marriage market. The idea of this model is to test the marginal effects, that is, the chances of an event happening given the sex ratio. As before, we did not find any significant effect of the sex ratio on the mating process. The model using sex ratio has the worst fit.

A third alternative, according to the literature less valuable, consists of analyzing the odds-ratios from the saturated model to check how marital pattern differs in each one of our

[4] There is a huge literature on the estimation and analysis of log-linear models based on general linear model theory. For this paper, I did not cover even a small part of it, instead I rely on papers that used such methods in order to understand the application and analysis. Flynn cites Cameron & Windmeijer (1998) and Long (1997) as two good sources to study the method.

quartiles. This method allows us to observe if there is higher or lower chances of a mating happening given the different sex ratios. Once again, the highest odd ratios are for marriage between individual with similar personal attributes, that is, similar levels of education of each one of the quartile groups.

The two alternative measures seem to confirm our basic model and goes on the opposite direction of our analytical framework. There is a predominance of homogamous marriages in the metropolitan areas of the United States despite the observed differences in sex ratios across the regions. The results also seem to contradict the idea of marriage squeeze, which suggests that the availability of mates affect the process of mating.

6 CONCLUSION

This paper attempted to discuss the patterns of marriage in the metropolitan areas of the United States and how sex ratios can affect marital rates and the mating selection process. The idea to understand the marriage market and how couples are formed is traditional in economics and sociology. For our knowledge, however, little attention was paid on how the availability of mates can affect the selection process, so far the literature focused on how sex ratio affects the number of single and married people, spouses age differentials and labor marker outcomes. The contribution of this paper is twofold: analysis the impact of sex ratio on the mating process and studies metropolitan areas in the US, previous works focused on the whole country and/or states.

Studying metropolitan areas as local marriage markets and using the sex ratio in each one of these regions provide a good opportunity to understand the effects of this variable several marital outcomes. It should be stressed, however, that some of the observed effects may also be reflecting regional and individual characteristics affecting the marriage

process. But they provide good and interesting insights on how the marriage market works in the United States.

Impacts of the sex ratio on marriage markets were estimated using a variety of methodological approaches. The graphical analysis showed us that fluctuations in sex ratios are correlated to the percentage of single people in a particular area and also affects spouse's age differentials. In our estimates, the impacts for females seems to be much more stronger than the impact on males. Our results are similar to others studies discussed in the current state of the literature.

The impacts of the sex ratios on individual incomes need to be better studied. Our estimates show unexpected results but that can be explained by what we observed in the graphical analysis. We believe that a better specification of model, controlling for individual characteristics might give us more realistic estimates of the impacts of sex ratio on these variables, if there is any impact.

The mating process was investigate using a log-linear model, based on the general linear model theory. The effects of sex ratio were estimated using three different approaches and all gave us similar results. There is evidence of a strong tendency to homogamy on marriage markets despite variations in sex ratios. Males and females tend to marry persons with similar personal attributes. We did not find evidence that a marriage squeeze affects the way individuals select their mates. We can speculate that men and women will wait the necessary amount of time in order to meet a more desirable mate, or they will migrate to other regions to find a mate if the marriage market where they live is not good, but this alternative was not considered in our model.

The paper was a first trip into a fascinating topic and several questions remained unanswered and are possible topics for future research. The first one is the construction of a

better estimate of mates availability that takes into consideration the educational composition of each region. Second, estimates models controlling for regional characteristics that might help us to understand better the problem. Third, expand the analysis to all US counties or municipalities and try to make an analysis over time. And last but not least, study the impacts of mating in the household decision making process. It would be very interesting to see if couples with different attributes have different behaviors and, in the case that sex ratio affects bargain power, how the couples differ across regions in a country.

The study of marriage cannot be concentrated only on the process of couple formation as most of the literature is. The process of mating is important and interesting but does not tell the whole story society is interested in. One (or several) question(s) remains unanswered: what happen within the household after the mating process is done? How the marriage formation influences personal, couple and family outcomes (such as labor force participation, fertility and resource allocation)?

The study of this problem should be one of the main interest of social scientists and policy makers. The understanding of the decision making process within the household and the household economics can shine light in the study of society as a whole and in the effectiveness or not of public policies.

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8 APPENDIX

In our analytical framework we discussed how sex ratio could affect individual behavior towards marriage. In regions with high sex ratio we expect to find males investing more in personal attributes in order to make themselves for attractive to the small pool of prospective mates. And in this regions, females would have more bargain power being able to decide when and with whom to get marry with in a more comfortable situation. We predict that in this case females also would invest more in the personal attributes (education and labor market) since marriage will be not very difficult, given the existence of possible mates and it is not the sole solution for support.

We estimated two simple OLS models, the tables are not show in this paper only the main effects, regressing males income and females income (a measure of personal attributes) to sex ratio, controlling and not controlling for regional characteristics. We find that an increase in the sex ratio (more males than females) reduce the level of income for both sex, contrary to what we were expecting[5]. We observe that average wages in areas with high sex ratios are about 7% lower than the average for males, and about 13% lower for females.

The possible explanation for our results is related to what we observed in the previous graphical analysis. In regions with higher sex ratios, females seem to marry at younger ages and very fast, given the smaller percentage of single women, and this is an indicator of low investments in human capital. Also, we observe that males are married with women of similar wages. We assume that those men also married at young ages and did not invest in their human capital, what can lead to lower level of incomes.

[5] We believe there are better estimates for this model and ours carries some problems. We do not control for individual characteristics (education, occupation, age) and other regional characteristics.