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Does the rise of inequality of income –as measured by Gini coefficient have a negative effect on the marriage rate? Evidence of assortive mating in USA using fixed-effect model.

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Abstract

This paper analyses the relationship between the Gini coefficient and the marriage rate to find whether assortive mating may exist in USA. The author uses the panel data of 50 states in USA for 30 years to run a fixed state-effect model and a fixed time-effect model. The paper contains robustness check for the fixed effect model. The results provide strong evidence that the Gini coefficient has a negative effect on the marriage rate and the assortive mating may still exist in USA.

Jel code:

Keywords: *Gini Coefficient, Marriage Rate, Fixed Effect Model*

1. Introduction

For several years, my uncle, a dress designer with a high income, has been searching for a girlfriend to form a family. However he has dated four girlfriends in the recent 3 years but failed to get married. While it seems promising to him to get married to each of them at the first time, they broke up at the end because of the low income of the girl. It caused the opposition of my grandparents as well as the difference in the sense of value between my uncle and his girlfriend. It arouses my curiosity: does the gap of income really matter to the matching for men and women in the marriage market?

There is a tradition of assortive mating in my home country—China. In history, the princess usually chooses to get married with a noble. The story of Cinderella seldom happens in reality. When I learned sociology, the professor introduced the theory of property matching marriage: the men and women that have similar social status and income are more likely to get married at last.

During the recession between 2008 and 2010, the marriage rate falls evidently in most states of USA (i.e. CA from 6.7 in 2007 to 5.8 in 2009 per 1000 people; Utah from 9.6 in 2007 to 8.4 in 2010 per 1000 people) as the adverse shock may cause greater variance of income and make it harder for a stable family to form. The experience of my uncle and the economic phenomenon in USA both lead to the emergence of my question: Does the rise of inequality of income –measured as Gini coefficient have a negative effect on the marriage rate?

In this paper, I use the panel data at state level in USA to test the assumption. In the regression model, the marriage rate is the dependent variable and Gini coefficient is the

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independent variable. I add the growth rate of personal income per capita and absolute deviation of sex ratio as control variables to explain the variance of the marriage rate across states. I build a fixed time-effect regression model and a fixed state-effect regression model separately to analyze the relationship between the marriage rate and Gini coefficient by controlling different effects that may cause the bias. The result is that the marriage rate is negatively correlated with the Gini coefficient and it is significant at 1% level in both models (the coefficient is -18.4590 in fixed state-effect model and it is -9.1948 in fixed time-effect model), which provide a strong evidence for the negative effect of Gini coefficient on the marriage rate.

The paper contains six parts. After the first part—Introduction, the second part of the paper is the literature review of former research on relevant topic. Part 3 is the data resources and description. Part 4 is the body of the paper, which shows the model and identification methodology. Part 5 is the results for the robustness check and the fixed effects model. Part 6 is the end of the paper, which summarizes the paper, discusses the implications of the result and the future direction of research on this topic.

2. Literature Review

The Earlier researches noted declines in the marriage rate and tried to explain the trend in different ways. Other research relates marriage to assortive mating, which is the theory I build on in this research paper, to analyze relationship between the marriage rate and Gini coefficient. Iran researchers (Maysam et al 2011) even analyze the marriage rate and Gini coefficient in the specific country. However, no research have been done to analyze relationship between the marriage rate and the Gini coefficient within the US using the state data in time series.

2.1. The trend of marriage rate since recorded in 1867

Although the number of marriages has continued to rise until now, the trend of marriage rate before the 1970s fluctuated in cycles. A Researcher from the U.S. department of health (Edward B. Perrin 1973) noted that the marriage rate fluctuated with dips in 1930s and 1960s. The marriage rate has declined steadily since the 1970s from 10.2 per 1000 people in 1972 to 8.9 per 1000 people in 1995 (Michael R. Haines 1996). There is no doubt about the recent decline since the data comes from the Vital Statistics of United States, from the Centers for Disease Control and Prevention, which are population-level statistics.

2.2. Efforts trying to explain the trend of marriage rate

2.2.1. Policy change affects marriage rate

There are some articles trying to explain the fluctuation of marriage rate. Some of them attribute the declining of marriage rate to the changing policy.

Some researchers build marriage matching models and argue that the legalization of abortion in 1970s has significant impact on the cost of marriage and leads to the declining trend of the marriage rate (Choo Eugene & Siow Aloysius 2006).

Others say that the new marriage movement—covenant marriage policy in some states has a positive effect on the marriage rate to prevent it from falling so sharply (Alan J. Hawkins, Steven L. Nock, Julia C. Wilson, Laura Sanchez and James D. Wright 2002). The covenant policy puts more limits on divorce and requires more pre-marital counseling that enhances the trust between the couples.

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2.2.2. Other ratios change affects marriage rate

A recent paper found that women's labor participation ratio is an important factor that affects the marriage rate (Emilio A. Parrado 2002). As more women go to work, they gain independence and equality; women's gain from a marriage decrease. The probability of a woman marrying will decrease, thus bringing down the marriage rate. Man requires more from his wife. As mentioned in the article, besides family skills, he may require the working skills and economic capability of the woman, which not only increase the median marriage age of women to meet the need, but also bring down the marriage rate.

The researchers of U.S. Department of Health conclude that the sex ratio is a factor that limits the marriage rate (Edward B. Perrin 1973). The maximum number of couples possibly married is restricted by the sex ratio. In the period of 1890 to 1910, a great of male immigrants moved to U.S. There were 112.5 unmarried men aged over 15 per 100 unmarried women in 1890. It increased to 115.3 in 1910. However, during the World War I, a lot of men were killed. Legislation of limitations on immigrant male imposed strong restrictions. The sex ratio of unmarried people went down to 99.3 in 1940, when the marriage rate rose to 12.1. As the sex ratio may have a significant effect on marriage rate and it varies among states, it should be a control variable that can explain the state effect. Since the evidence is clear here, my research paper will use sex ratio as an independent variable in the model.

2.2.3. Research that relates marriage to assortive mating or income inequality

In "A Theory of Marriage: Part II" (Gary S. Becker 1974) created a model of the marriage market and showed that mating of likes in education level, income, and ability is optimal for the couples. Utility-maximizing rational people will maximize their gains in a marriage by determining the difference of income, race and education level. People are willing to restrict the difference under a certain level to generate a positive synergistic effect. The study, conducted in Norway Oslo for the 5161 marriage license issued in 1962, has also provided evidence of occupational homogeneity with the coefficient of contingency (a measure for the correlation in contingency table: $\Phi = \sqrt{\frac{\chi^2}{N}}$) of 0.476 for the social status (Natalie Rogoff Ramsøy, 1966). Marriage tends to unite men and women of same or similar occupational status and income.

An article published in the New York Times ("Two Classes, Divided by 'I Do'", Jason De Parle 2012) also relates the income inequality to the marriage. As Andrew Cherlin pointed out "it is the privileged Americans who are marrying, and marrying helps them stay privileged". Assortive mating affects the marriage rate since people tend to make more efforts to find suitable mates to be privileged and consider more. The marriage rate is brought down. Assortive mating increases the income inequality, which make it more costly to find a spouse. Thus as the marriage rate has dropped to its lowest level, the income inequality has risen to a new high level in decades.

Controversy has arisen around relationship between marriage and income inequality. One researcher has ran a regression on the marriage rate and Gini coefficient for 34 OECD countries (Matt Bruenig 2012) but found no relationship between them. The slope of regression line is even positive but not significant.

However, the most relevant research here to relate the marriage rate to gini coefficient supports the negative relationship between marriage rates and income inequality. Because the data they use in the paper is more comprehensive, including a time series of gini coefficient, income per capita, urbanization ratio, literacy rate, monthly expenditure in Iran. "The Income Distribution Contribution to Marriage Rate in Iran" builds a linear regression model to regress the marriage rate on Gini coefficient and other variables mentioned before in Iran. (Maysam Musai, Mohsen Mehrara, Esmaile Esmaily 2011). They find that the coefficient for Gini coefficient on marriage rate is -0.26 and it is significant at 1% level. However, despite that the data is comprehensive, it is not adequate to show the negative relationship here. There are only 33 observations, which is a small number compared to the number of independent variables (5). Omitted variables such as sex ratio can be another cause of change in marriage rate. The bias can be ambiguous. In this paper, I also run the regression of marriage rate on the Gini coefficient. But I use the panel data of marriage rate and Gini coefficient in the states of USA, including 1492 observations. Instead of simple regression method, I use the fixed-effect model to control the state effect and time effect respectively for the robustness check. This paper will provide more convincing evidence for the negative relationship between marriage rate and Gini coefficient.

2.3. The gap my research paper intends to fill

According to all the relevant literature listed above, researchers have shown the trend of the marriage rate empirically. They have also tried to explain it and find the relationship with other variables empirically and theoretically. Researchers have mentioned policy changing, women's labor participation and sex ratio. They have provided the theory of assortive mating and empirical evidence in Norway. Iran researchers have provided the empirical evidence of negative relationship between marriage rate and Gini coefficient

However, no research trying to explain the marriage rate by the income inequality-Gini coefficient in US has been done before. I will use the improved methodology-fixed effect model, compared to the paper that provide empirical evidence in Iran to run the regression of state marriage rate on state Gini coefficient. I will add sex ratio as another independent variables as suggested by the paper of U.S department of health (Edward B. Perrin 1973) in time series. The data comes from National Vital Statistics System of CDC for the marriage rate and sex ratio. The data of state Gini coefficient in time series comes from the data base Michael Morrison posted in 2013.

My research paper intends to fill the gap in finding the relationship of marriage rate and Gini coefficient in US using the panel data to provide evidence of assortive mating in marriage market. It is the goal of my research paper to reflect the relationship between the economic variables and the variable of social stability and build link between the economy and society empirically.

3. Data Resources and Description

My basic dataset is the panel data for 51 US states covering the period from 1970 to 1991, 1995, and 1999 to 2005, which totals 30 years. Observations of six years (1992, 1993, 1996, 1997, 1998) in 1990s are unable to collect since the U.S. Department of Health is lack of funds to conduct more survey on marriage these years. Marriage rates for each state of US are collected from the yearly report of marriage rate in National Vital Statistics System of CDC. The state Gini coefficient from 1916 to 2005 comes from the data base Michael Morrison posted in 2013.

Other control variables are the growth rate of personal income per capita and the deviation of sex ratio. I got the state annual personal income (PI) per capita from data planet of the database from Bureau of Economic Analysis (Personal Income, Per Capita Personal Income, and Population No.003-017-001). Because holding other things constant, if the people are richer in their life (indicated by growth rate of personal income per capita), they are less worried about forming a stable family and get married. They are more looking forward to marriage as they accumulate more wealth to back their marriage. So I add the control variable of the growth rate of personal income per capita.

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For the sex ratio I got the population estimates for 1970 to 2005 by sex and age by the US Consensus Bureau (1970-1979 Intercensal State Estimates by Age, Sex, Race (PE-19); State Population Estimates and Demographic Components of Change: 1980 to 1990, by Single Year of Age and Sex; Population estimates: Detail (1980-Present)). I got the data of male and female population each year for each state in US and calculate population of 20 year-old and older by sex. Then I get the deviation of sex ratio by calculating the absolute sex ratio deviation from 100.

There is lack of marriage rate for Oklahoma from 2001 to 2003 and Connecticut for 6 years since the two states faces difficulty in funds to conduct the survey and report the accurate data. The panel data is therefore unbalanced.

4. Fixed Effect Model and Identification Strategy

4.1. Fixed Effect Model

To control for the state effect and the time effect of the panel data, I use fixed effect model to analyze the cross sectional result in fixed time-effect model and the time series result in fixed state-effect model. The two models follow here:

Fixed state-effect model:

$$Marriagerate_{it}=\beta_0+\beta_1 Gini_{it}+\beta_2 Growthrate_{it}+\beta_3 Absexra_{it}+\sum \boldsymbol{\gamma_i} S_i+\boldsymbol{u_{it}}$$

Fixed time-effect model:

$$Marriagerate_{it}=\boldsymbol{\alpha_0}+\boldsymbol{\alpha_1} Gini_{it}+\boldsymbol{\alpha_2} Growthrate_{it}+\boldsymbol{\alpha_3} Absexra_{it}+\sum \boldsymbol{\delta_t} T_t+\boldsymbol{u_{it}}$$

i is the state number that represents a state and t is the time. $Marriagerate_{it}$ is the state marriage rate in a year (one married per thousand people). $Gini_{it}$ is Gini coefficient of a state in America in that year. $Growthrate_{it}$ is the growth rate of personal income per capita compared to the last year of the state. $Absexra_{it}$ is the absolute sex ratio deviation (male per 100 female for 20 years old and older) for the state and $Absexra_{it}$ =|sex ratio-100|.

In the fixed state-effect model, the series of S_i are n-1 dummy variables (there are n states included) that represent if the observations are from the state number i. $\boldsymbol{\gamma_i}$ is the unique state-effect imposed on the marriage rate.

In the fixed time-effect model, T_t are T_num-1 binary variables (T_num is the number of years observed) that represent if the observations are from year t. $\boldsymbol{\delta_t}$ is the unique time-effect imposed on the marriage rate. The cross sectional analysis can be used here under the time-effect control.

4.2. Identification strategy and Robustness Check

To provide the evidence for the question in this paper, I have to test if $\beta1<0$ and $\alpha1<0$ significantly. If it is true, the paper can provide strong evidence for the negative effect of inequality on the marriage rate.

In order to test whether the fixed effect model is more appropriate, I adopt the Hausman test for the fixed state-effect model for the panel data (test the null hypothesis that random effect model is preferred- pool the panel data without fixed-effect). I also test the fixed time-effect model.

The other thing I do is to drop the data of state of Nevada. Because the Nevada's law makes it easiest in the US and even the world to get married, the marriage rate keeps at over 100 per thousand people and is extraordinarily high. People over 16 years old can get married and it just takes on average 10 minutes to get married. It attracted the couples from the whole world to get married here and over 90% couples married here are not local residents but from all parts of the world. The marriage rate does not reflect the real impact of the local Gini coefficient based on the little population of Nevada. The panel data therefore contains 1491 observations of 50 states in 30 years in USA.

The strength of the strategy is that it imposes controls of state-effect and time-effect using different model for time series and cross-sectional analysis based on the comprehensive data for 50 states in USA of 30 years. Control variables including sex ratio and personal income are added to make the model more accurate and capture the real effect of Gini coefficient on marriage rate. Compared to the strategy that other papers use (either time series data in Iran or cross sectional data for OECD contries), the evidence this paper provides using the panel data and fixed-effect models is more convincing. The identification strategy is more improved than those in the articles written before on the effect of the Gini coefficient on the marriage rate.

However, since it is so hard to find the treated group for the marriage rate holding other conditions the same in the reality in US, the model can not draw a conclusive proof for the assortive mating in reality—rising Gini coefficient reduce people marriage rate and make them difficult to find the lover. The omitted variables, such as legislation in different states and education levels, even the popularity of dating shows (ABC TV shows: The Bachelor) may not all be explained by the time effect or state effect in the models. I will try to find more data for these variables and improve the strategy in the future research.

5. Results

In the Robustness check, both the tests for the fixed state-effect model and time-effect model reject the null hypothesis and support the use of fixed effect model. Using the fixed effect models, I find that $\alpha 1 < 0$, $\beta 1 < 0$ and they are both significant at 1% level. It implies the negative effect of Gini coefficient on the marriage rate and provides strong evidence.

5.1. Result for the Fixed State-effect Model

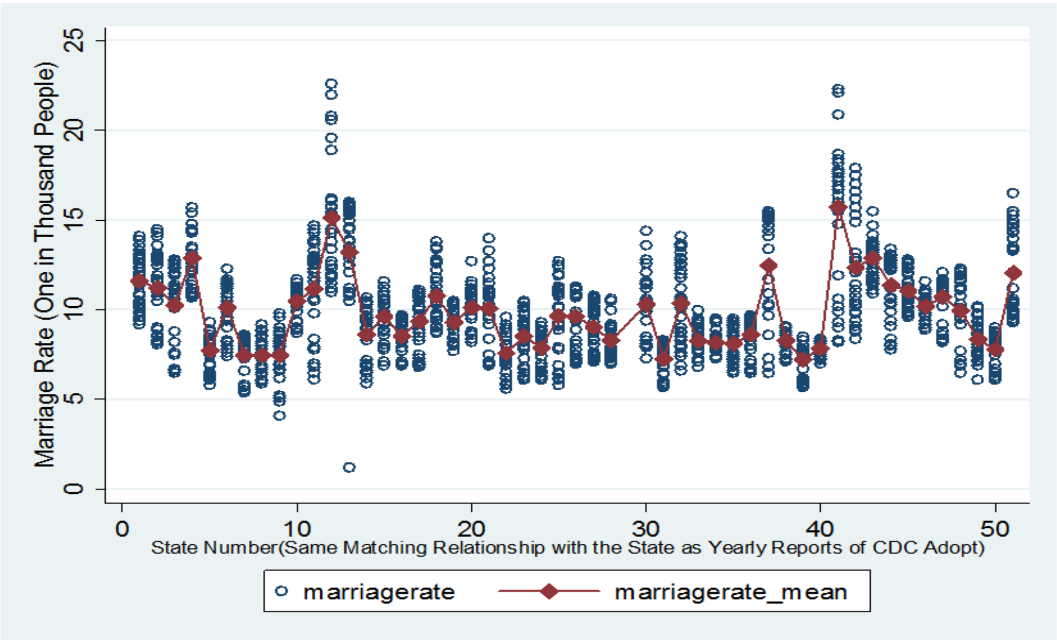

Figure 1: State-effect—heterogeneity across states in the variance of marriage rate

The figure here shows that the panel data of dependent variable--marriage rate varies across states. It is necessary to control the state effect in the fixed-effect model.

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The result of fixed state-effect model is:

Table 1: Regression Results for the fixed state-effect model

	β_1 (Gini)	β_2(Growthrate)	β_3(Absexra)	β_0(Constant)
Regression Results	-18.459***	0.05972***	-0.04917*	19.447***
	(0.9959)	(0.1174)	(0.02799)	(0.6935)
Number of observations	1491			
Number of groups	50			
R-squared	0.731			
F-stat	F(3, 1438)=261.50 Probability>F=0.0000			

Legend: * p<0.10 **p<0.05 *** p<0.01

It is the most important to get the result that β1<0 and it is significant at 1% level under the fixed state-effect model. The marriage rate is negatively related to the Gini coefficient (-18.459) and if the Gini coefficient increase from 0 to 1, the marriage rate will drop 18.459 per thousand people. Marriage rate is positively related to the growth rate of income per capita (0.05972). It is significant at 1% level. A rise of 1% growth rate compared to the last year will cause 0.05972 per thousand people rise of marriage rate. The marriage rate is negatively related to Absolute Deviation of Sex Ratio (-0.04917). It is significant at 10% level. For each deviation of sex ratio from 100 of those 20 years old and older (one more male per 100 females if there are more males than females or one less male per 100 females if there are less males than females), the marriage rate will go down by 0.04917 per thousand people.

5.2. Result for the Fixed Time-effect Model

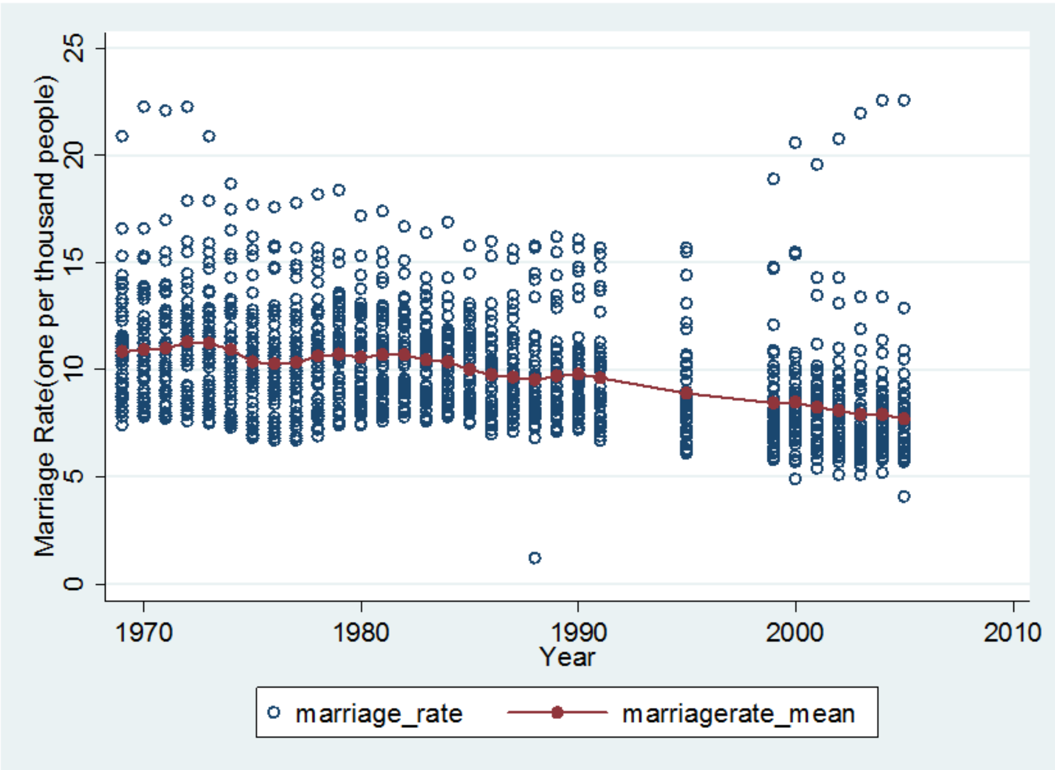

Figure 2: Time-effect—heterogeneity across years in the variance of marriage rate

The figure 2 shows the mean of marriage rate in USA change over time and it generally goes down. Time-effect should be considered here.

The result of fixed time-effect model is:

Table 2: Regression Results for the fixed state-effect model

	α_1 (Gini)	α_2(Growthrate)	α_3(Absexra)	α_0(Constant)
Regression Results	-9.1948***	0.4535***	-0.2427***	19.447***
	(1.9879)	(0.1426)	(0.03003)	(0.6935)
Number of observations	1491			
Number of groups	50			
R-squared	0.703			
F-stat	F(32, 1409)=34.92 Probability>F=0.0000			

Legend: * p<0.10 **p<0.05 *** p<0.01

The most important coefficient α1 is below zero and it is significant at 1% level under the fixed time-effect model. The marriage rate is negatively related to the Gini coefficient (-9.1948). If the Gini coefficient increases from 0 g to 1, the marriage rate will drop 9.1948 per thousand people. The marriage rate is still positively correlated with the growth rate with α_2=0.4535 and it is significant at 1% level. The significant level of absolute sex ratio deviation improves a lot in the fixed time-effect model compared to the fixed state-effect model. The α_3=-0.2427 and it is significant at 1% level. The fixed time-effect model also provides the strong evidence of the negative effect of Gini coefficient on the marriage rate.

5.3. Robustness Check for the Fixed Effect Model

5.3.1. Hausman Test for Fixed State-effect Model

Alternately, there is another option of model to run the regression called the random effect model, which simply assumes that the other effects are random and independent across states and time and pools the panel data instead of assuming the state-effect is constant over time.

To reject the hypothesis that the random effect model is preferred and support the fixed state-effect model, I adopt the Hausman test. The Hausman test result is:

Table 3: Hausman test for fixed state-effect model

	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
gini	-18.45901	-18.50068	.0416638	.1425644
growthrate	.0597234	.061263	-.0015396	.
absexra	-.0491728	-.0596408	.0104681	.0086982

```
—— Coefficients ——
                 b = consistent under Ho and Ha; obtained from xtreg
  B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       29.59
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

χ^2=29.59 and P(X2>29.59)=0.0000 and the degree of freedom is 3. We reject the null hypothesis that the random effect model is preferred and support the use of fixed state-effect. Fixed state-effect model is preferred for the data.

To avoid potential bias caused by the different ways in stata used for the fixed state-effect model, I use three different ways in stata to run the regression and get the same results for β1, β2, and β3.

Table 4: Different ways to run fixed state-effect model with the same result

Variable	fixed	ols	areg
gini	-18.459015***	-18.459015***	-18.459015***
growthrate	.05972336***	.05972336***	.05972336***
absexra	-.04917278	-.04917278	-.04917278
_cons	19.447394***	21.217887***	19.447394***
N	1491	1491	1491
r2	.35298133	.73059764	.73059764
r2_a	.32958427	.7208557	.7208557

legend: * p<0.05; ** p<0.01; *** p<0.001

5.3.2. Testing for Fixed time-effect Model

To test whether using fixed time-effect model is necessary, in addition to plotting the diagram of marriage rate mean over time, using the hypothesis test to reject the null hypothesis that all Tt=0 is also required.

Here is the result of test for the fixed time-effect model:

```
testparm _Iyear*

   F( 29,   1409) =     7.78
        Prob > F =     0.0000
```

The null hypothesis that all T_t =0 is rejected. So the fixed time-effect model is also necessary.

5.4. Potential problems and Efforts to Address Them

This paper tries to address the problem if fixed effect model is suitable for the data by conducting two robustness checks. The results show it is appropriate to use fixed effect model for the data

There could possibly be reverse causality problem since the more people get married, the income gap between families is larger. However, the data I use here is calculated as personal income Gini coefficient but not as households.

Another potential problem is that since there are many more potential factors that can affect the marriage rate, a perfect treated group cannot be set up for the test of only variable change of income inequality. A conclusive proof can't be drawn that the rising of Gini coefficient causes the marriage rate to go down. But I have included some important control variables here (sex ratios and growth rate of personal income) for the states in USA to explain the volatility of the marriage rate and find more accurate effect of changing in Gini coefficient on the marriage rate. I use fixed effect models that absorb the constant time effect or state effect caused by other omitted variables. However, there are potential omitted variables that can change over time such as legislation of marriage in the state and educational level. More reliable data on the omitted variables is needed. Since it is hard to find the treatment group, Granger causality test can be adopted for the more comprehensive data.

Despite of the potential problems and limitations, this paper uses the more comprehensive penal data of USA and convincing methodology (fixed effect model) to investigate the relationship between the marriage rate and the Gini coefficient to find if there is assortive mating in US today as compared with other similar articles. There are still limitations to overcome, but it provides a stronger evidence for the negative effect of inequality on the marriage rate.

6. Summary and Conclusion

The experience of my uncle—he broke up with four girlfriends because of the income gap—motivates me to investigate the effect of inequality on the marriage rate. The fact that assortive mating exists inspires me to ask the whole new question that no former research tried to solve in USA.

I use the fixed state-effect model and fixed time-effect model to control for the constant variance caused by the omitted variables and add the control variables including growth rate of income per capita and absolute deviation of sex ratio (the balance of male and female). The robustness check of the fixed effect models supports them. The result is that β_1=-18.459<0 and α_1=-9.1948<0, both of them are significant at 1% level. Also the marriage rate is positively correlated with the growth rate of income per capita and negatively correlated with the absolute sex ratio deviation. The balance of males and females is also important as suggested in the yearly reports of U.S. Department of Health.

The result provides strong evidence that the Gini coefficient has a negative effect on the marriage rate in USA and the assortive mating may exist in the country.

The research can also be done in other countries because assortive mating exists widely due to the history and my uncle's experience. Gini coefficient may also have negative effects on the marriage rate in some of the countries in the world.

Thus, the implications of the results can be inspiring because the economic shock can have a larger impact on the stability of society by affecting the marriage rate and may reduce the happiness. Government may focus more on social security program to reduce the shock of inequality and maintain the social stability. The paper also builds the link between the economy and society here.

The evidence provided in this empirical paper will also inspire researchers to further explore the reasoning behind the phenomenon. Hence, the result that the paper provides strong evidence that the Gini coefficient has a negative effect on the marriage rate is important.

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