THE IMPACT OF NATURAL DISASTERS ON DIVORCE RATE: HOUSING DESTRUCTION AS A CHANNEL

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Abstract

With the increasing frequency, natural disasters are affecting more and more people these days. We investigate the relationship between natural disasters and divorce rate in the United States, specifically through the channel of housing destruction. We used panel data of 50 states for the years 2000 to 2009 from multiple sources. Becker's marriage model suggests that destruction of houses through natural disasters is a great shock to a marital-specific capital and may be a trigger for a divorce. OLS regression with fixed effect reports a positive and significant relationship between divorce rate and per capita property damage through natural disasters, as hypothesized. The result was robust after the white's correction and instrumenting medium income and home price.

KEYWORDS: (Becker's Marriage Model, Natural Disasters, Divorce Rate)

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CHAPTER 1

INTRODUCTION

In the past 30 years, the frequency of natural disasters has been increasing steadily. According to the Center for Research on the Epidemiology of Disasters, the number of reported natural disasters increased from 100 in 1974 to 400 in 2004. With the growing frequency of natural disasters, more and more people are being affected each year in various ways. Some may lose a job, a house or even their friends and family. It is likely that some make important decisions after such life-changing events.

In Japan, after the Tohoku earthquake in 2011, the number of divorce consultations at law firms increased by 20 percent in Tokyo and doubled in the more directly affected area, Sendai (Hama, 2011). Psychologists, Cohan and Cole (2002), studied the effect of Hurricane Hugo on the divorce and marriage rate. They base their hypothesis on the previous psychology research, attachment theory and stress theory. Stress theory implies that stress is the cause of separation, while attachment theory suggests that the stress motivates people to stay together. Their final empirical finding indicates that after a disaster, divorce, marriage and birth rate increase among the residents of the most directly affected, South Carolina. This result leads them to a new theory; that natural disasters mobilize people to take actions.

This issue is not only an interest of economists and of psychologists, it is also an important issue to policy makers and to the general public. Divorce is associated with

greater dependence on the government and the cost to the public. A case study in Texas estimates that $3.18 billion was spent on the related consequences of divorce. This is 12 % of the total budget of Texas in 2008. Such government support includes cash support, food stamps and child care assistance (Schramm et al, 2013). In addition, Potter (2010) finds that the children with divorced parents tend to experience more psychosocial problems than those whose parents stayed together. This may be the cause of lower academic achievement for the children of divorced parents.

The purpose of this paper is to study the effect of natural disasters on the divorce rate in the United States. Specifically, it examines the effect of natural disaster through the channel of housing destruction. In this study, we assume that houses carry greater value within marriage than outside marriage, thus, it is a marriage-specific capital. Within the framework of Gary Becker' marriage model, a marital-specific capital, such as a house, increases the benefit of the marriage. This implies that destruction of houses reduces the marital benefit and may trigger a divorce. We empirically investigate the relationship between natural disasters and divorce rate in the United States by using state-level macro data from the year 2000 to 2009. We use OLS panel regression with fixed effect for our empirical analysis.

The final finding suggests that there is a positive and significant relationship between the property damage caused by natural disasters and divorce rate. Although the result is significant, the magnitude of the effect is small. This may be because natural disasters of smaller magnitude are also accounted for in our data. It is likely that only severe natural disasters impact divorce rate. Therefore, mild disasters in our data may be reducing the magnitude of the effect.

CHAPTER 2

THEORY

This chapter will explain the Becker's marriage model and its application to dissolution of marriage. It is a model upon which this project is based. He introduces a utility function and time and income constraint to enable an economic analysis of family formation. Within his model, marital-specific capitals are the key determinants of the relative benefit to the marriage. Marital-specific capitals are market or non-market goods which are specifically beneficial to that marriage (Becker, 1977). This may include children, houses and emotional comfort. This paper assumes that a house is a marital-specific capital. Families usually live in houses which are bigger than the one of a single person, and the size and certain equipment of current family houses carry more value within marriage than otherwise. Thus, this paper captures the loss of houses as destruction of a marital-specific capital. This, in turn, reduces the marital benefit and may trigger dissolution of a marriage.

Becker's Marriage Model

Becker analyses mechanism of divorce using his model (1981). Within this model, marriage can only exist between two individuals when the utility from their marriage is greater than the utility from their single lives. Within his model, family commodities are the benefits attributed to the marriage; these may include quality of meals, quality and quantity of children and health status. As an assumption, these

commodities are additive; and the aggregate is denoted as Z. With the assumption of constant scale to return of each commodity, the production function of each household can be written as:

$$Z = f(x_{1,}x_{2,} \dots x_{k,}\, t_{1,}t_{2,} \dots t_{m,}) \tag{2.1}$$

where x_i is market goods and services and t_i is time input into household activities by i'th family member. We also assume that the each member maximizes the household production with the budget constraint:

$$\sum_i^n w_i\, l_i + v \tag{2.2}$$

where w_i is the wage of the i'th family member, l_i is the time input into labor of the ith member and v is property income. Husband and wife would stay married only if their net benefit from the marriage exceeds the sum of the benefits from their single lives, and would get a divorce otherwise. Thus, in order for a divorce to occur, the following has to be true:

$$Z_{mf} \equiv Z^m + Z^f < Z_d^m + Z_d^f \equiv Z_d^{mf} \tag{2.3}$$

Z^f represents the commodity wealth of a wife in a marriage and Z_d^f represents the commodity wealth of a wife after divorce. Z^m and Z_d^m are defined in similar fashion. Within this model, it is possible that the commodity wealth of either side decreases while the combined wealth may increase after a divorce. This situation is made possible by the husband (if he is the beneficiary of the divorce) by paying his wife the compensation.

Hypothesis

As we mentioned previously, a family house is one of the important marital-specific capitals, and a sudden shock to the house may cause a drop in Z_{mf} ,while Z_d^{mf} remains relatively unchanged. This is possible as family houses worth more within a marriage than otherwise. Thus, we hypothesize that destruction of family houses may reduce the benefit to the marriage and triggers a divorce among couples.

CHAPTER 3

LITERATURE REVIEW

In this chapter, we will introduce previous studies which examined various factors affecting divorce rate. Firstly, it is likely that divorce rate is influenced by social and economic environment of the couples; such as income, religion and ethnicity. For example, Mullins, Brackett, Mackenzie, and Djamba (2012) examine the impact of medium income and religious affiliation on divorce rate. The study is on the 1990 and 2000 data at county-level in the United States. They find inverse relationships between medium income/shared religious affiliation and divorce rate. This may be because higher the income, the higher the marital benefit might be. Alternatively, couples with shared religious affiliation may face less difficulty in their marriages and may tend to stay married. Philips and Sweeney (2005) report that Mexican women have relatively lower divorce rate compared to back and non-Hispanic white groups. They additionally find that Mexico-born Mexicans have lower divorce rate than the US-born Mexicans. Cultural differences may be one of the factors creating this racial differences on divorce rates. Gautier, Svarer and Teulings (2009) find that by leaving urban area for more rural area, divorce rate decreases by 23%, and their median marriage duration increases from 7.24 to 8.13 years. The author attributes the result to the fact that there is better chance of meeting a potential partner for remarriage in urban area.

On a more micro level, studies suggest that couple-specific characteristics, such as age, education, income and employment affect divorce rate. For example, Greenstein (2006) uses the cross-country data of 1997 and 1998 of 71 nations and studies the effect of female-labor participation on the divorce rate. He reports a positive correlation between female-labor participation rate and divorce rate. This may be because labor participation by a wife implies less specialization of domestic activities and market activities within the marriage. Less specialization may lead to lower marital benefit and to higher divorce rate. Alternatively, Eldridge (1987) finds that age might be of importance as a determinant of divorce rate. He finds that there is a negative relationship between medium age at marriage and divorce rate. This result is thought to be caused by lack of maturity and economical and educational resources for the young. Tzeng and Mare (1995) reports a positive relationship between wife's educational attainment and divorce rate while they find no impact of husband's educational attainment on divorce rate. The result is attributed to the independent characteristics of highly-educated women. Becker (1977) finds, through empirical study, that an increase in the expected earnings of men reduces the probability of dissolution on the first marriages. It is also reported that an unexpected event, both favorable and unfavorable, tends to increase the divorce probability. He also reports that an increase in number of children reduces the chance of divorce in the first marriage.

The divorce rate may also be influenced by the changing environment. Amato and Beattie (2011) examine the relationship between unemployment rate and divorce rate, by using state-level data from 1960 to 2005 in the United States. Their finding is that after 1980, there is a negative and significant correlation between unemployment and divorce

rate. They attribute their result to the cost of divorce. On the other hand, Kawata (2008) reports a positive correlation between unemployment rate and divorce rate in Japan. The differences of the results in those two studies suggest the ambiguity of the effect of unemployment rate. Unemployment may decrease the benefit of marriage while increasing the relative cost to divorce. The direction of the impact may depend on whether the change in cost overweight or underweight the change in the benefits. Another reason for such a contradicting result may be cultural or legal differences of the countries studied; Kuwata's is in Japan and Amato's is in the US. It might be the case that divorce in the US is more expensive than the one in Japan.

Contribution of this paper is to study how natural disaster may impact divorce rate, particularly through a shock to their marriage specific capital, a family house. Therefore, this paper adds to the aforementioned body of the research on divorce determinants. Although Cole and Cohen have done psychological study on a similar topic, this study will differ from Cole's study in two ways. First, while their study focus only on one disaster, this paper will study all of the disasters which occurred between 2000 and 2009. This enables us to study not only the effect of natural disaster, but also of the magnitude of impact of disasters on divorce rate. In addition, this paper will focus on the economic theories of marriage instead of the Psychological one. Thus, instead of attachment and stress theory, we will focus on the monetary loss, specifically on the property damage.

CHAPTER 4

DATA AND DESCRIPTIVE STATISTICS

This chapter will discuss the data used in this study. Based on the literature reviewed in the previous chapter, 12 independent variables that are reported to have an impact on divorce rate are chosen as control variables. The data for 50 states, excluding Puerto Rico, was collected for the years 2000 to 2009 from different sources to improve the accuracy of the study. Some of the data have been scaled to measure the rates instead of head counts.

Divorce Rate

Divorce rates were obtained for the years 2001 to 2010 instead of 2000 to 2009 from the National Center for Health Statistics. The shift of one year is to capture the lagged effect of natural disasters and other control variables on divorce rates. The rates are based on provisional counts of divorces by state of occurrence. Rates are per 1000 total population residing in the area. Unfortunately, there is no data available for California and Indiana for the all-time period, and for Georgia from 2004 onward, for Hawaii from 2003 onward and for Minnesota, from 2005 onward. For Louisiana, only 2002 and 2003 data were available. For Oklahoma, the data becomes available after 2003. Those missing data points, especially California which is a disaster prone area, may cause some inaccuracy in the analysis. The mean of the divorce rate of 50 states from

2000 to 2009 is 3.88 with standard deviation of 0.95. The minimum is 1.7 in District of Columbia in 2007 and the maximum is 7.4 in Nevada in 2005.

Property Damage per Capita

Property damage by natural disasters was obtained from U.S. Natural Hazard Statistics from 2000 to 2009 in million dollar. It is annual aggregate damage by cold, flood, heat, lightening, tornado, tropical cyclone, wind and winter storm. It was then divided by the state population to estimate the per capita property damage. The state population dataset was obtained from ACS. Because it is a shock to the marital-specific capital, it may increase the divorce rate. The mean is 391.65 dollar with standard deviation of 2864.815, the minimum is 0 dollar in several state in several time periods. The maximum is 52777 dollars in Louisiana 2005, which is most likely caused by Hurricane Katerina. Becker (1977) implies that a loss of marital-specific good may reduce the benefit to the marriage. Therefore, we hypothesize a positive relationship between property damage and divorce rate.

Ratio of Couples with Children

The Ratio of couples with children was computed by dividing the number of married-couples by the number of married couple with children under 18 years of age. Both data were obtained from the American Community Survey (ACS) from the years 2000 to 2009. The mean is 0.44 with standard deviation of 0.0349. The maximum is 0.573 by Utah in 2004, and the minimum is 0.351 by District of Columbia in 2001. The fairly great percentage of couples with children Utah could be caused by Mormon

influence. According to Becker (1977), children are important marital-specific capital. Thus, greater ratio of married couples with children may lead to lower divorce rate

Home Price

Medium home price was obtained through the ACS as well. The mean of the medium home price of the 50 states for the years 2000 to 2009 is 170180.2 US dollars with standard deviation of 87773.82. The minimum is 73315 dollars by Washington State in 2000, and the maximum is 560200 dollars by Hawaii in 2008. Higher home price implies higher cost to divorce, thus, we hypothesize a negative relationship between home price and divorce rate. We will take the logarithm of medium home price for the analysis, as the impact of percent change of medium home price is more relevant than the one of 1 dollar change in our study.

Labor Participation by Both Wife and Husband

The ratio of labor participation by both wife and husband was computed by dividing the number married couple with both wife and husband employed by the total number of married couple. The both data were obtained from the ACS for the years 2000 to 2009. The mean of the 50 states for the years 2000 to 2009 is 0.50 with the standard deviation of 0.04. The maximum is 0.63 in Colorado in 2001. The minimum is 0.37 in West Virginia in 2002. We hypothesize a positive relationship between ratio of such families with divorce rate. The specialization of domestic activities and market activities increases the benefit of marriage, and such specialization can be facilitated by one of the spouse staying at home. Therefore, the greater the percentage of families with both wife and husband working, there might be a greater divorce rate (Becker, 1981)

Hispanic Population

The ratio of Hispanic population is computed by dividing the number of Hispanic residents by the total population. The both data were available from the ACS. The mean of this ratio for the 50 states for the years 2000 to 2009 is 0.088 with standard deviation of 0.09413. The maximum is 0.455 in New Mexico in 2009, and the minimum is 0.0056 in West Virginia 2000. Hispanic couples may have lower divorce rate compared to the white and black (Kreider & Field, 1996). Thus, greater number of Hispanic population may lead to lower divorce rate.

Population Density

Population density is computed by dividing the total area of each state by the corresponding population each year. Both data were obtained from the ACS. The mean is 372.19 with standard deviation of 1323. The maximum is 9822 in District of Colombia in 2009, and the minimum is 1.099 in Alaska 2000. As the previous study suggests, there might be more chance of meeting new mates in urban area than in rural area. This increases the chance of remarriage, raising the benefit of the divorce (Gautier, Svarer, & Teulings, 2009). Thus, we hypothesize a positive relationship between population density and divorce rate.

Income

Medium income was obtained from the Current Population Survey and measured in current US dollars. The mean is 45995.29 dollars with standard deviation of 7729.1. The maximum is 68059 dollars in New Jersey 2006, and the minimum is 29359 dollars West Virginia in 2002. High income may facilitate divorce for couples by allowing them

to pay for the cost. On the other hand, income may also increase the benefit from the marriage. The effect may differ for man and woman. Higher income of husband may increase the benefit of the marriage and prevent divorce, on the other hand, the effect may be opposite if the wife's income is high. Net effect of income cannot be hypothesized. We take the logarithm of medium income for the analysis, as the impact of the percent change of the medium income is more relevant than 1 dollar change in our study.

Unemployment Rate

Unemployment rate is obtained from the Current Population Survey for the years 2000 to 2009 for the 50 states. The rates are annual average and seasonally adjusted. The mean is 5.19 with standard deviation of 1.66. The minimum is 2.30 in Connecticut 2000. The maximum is 13.00 in Michigan 2009. As the contradicting findings from the previous studies suggest, relationship between unemployment rate and divorce rate may be ambiguous. Kawata (2008) reports a positive relationship, while Amato and Beattie (2011) report a negative relationship between divorce rate and unemployment. This may be caused by the uncertainty of the relative cost of divorce to its benefit. Thus, we cannot hypothesize the net effect of unemployment rate on divorce rate.

Marriage Rate by Sex

The marriage rate for female is obtained by dividing the number of married female over the total number of female per each state. Both data were available from the ACS for the 50 states for the year 2000 to 2009. The same method is taken for the marriage rate for male. The mean marriage rate for woman is 0.10 with the standard

deviation of 0.04. The minimum is 0.01 in District of Columbia in 2006. The maximum is 0.27 in Utah 2004. The mean marriage rate for male is 0.06 with the standard deviation of 0.02. The minimum is 0.0052 in Illinois 2001. The Maximum is 0.18 in Utah 2001. The result may be reflecting Mormon influence in Utah which enforces youth to marry at relatively young age. There might be a positive relationship between divorce rate and marriage rates. It is simply because the greater the ratio of married people, the greater chance of divorce there may be in the next time period.

GDP per Capita

This variable is used as an instrumental variable for income and home price separately. The source of this data set is the Bureau of Economic Analysis. The data was collected from the year 2000 to 2009 and measured in millions of current dollars. The mean of the 50 states over this time period is 41740.2 dollars with the standard deviation of 16093.8. The minimum is 22903.6 in West Virginia in 2000 and the maximum is 164033.7 dollars in District of Columbia in 2008.

Medium Age of Housing Structure

This variable is also used as an instrumental variable for home price. The medium year of housing structure built is obtained from the ACS from the year 2000 to 2009 for the 50 states. The year of the measurement was subtracted from the medium year of housing structure in order to obtain the medium age. The mean of the medium age is 32.82 years with the standard deviation of 8.509. The minimum is 15 years in Nevada and the maximum is 60 years in District of Columbia.

TABLE 4.1

DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Divorce Rate	458	3.88	.95	1.70	7.40
Unemployment	510	5.19	1.66	2.30	13.00
Density	510	372.19	1323.31	1.09	9822.39
Children	510	.44	0 .03	0.35	0.57
Education	510	26.81	5.43	15.10	49.10
Marriage (female)	510	.10	.04	.01	0.27
Marriage (male)	510	.06	.02	.0052	0.18
Hispanic	510	.08	.09	.0056	0.45
Age	510	.13	.01	.09	0.19
Income	510	45995.29	7729.10	29359.00	68059.00
Home Price	510	170180.20	87773.82	73315.00	560200.00
Both Work	510	.50	.04	0.37	0.63
Damage	510	75.45	647.79	0.00	1 1734.24
GDP per Capita	510	0.041	0.016	0.022	0.16
Medium Age of Housing Structure	510	32.82	8.50	15.00	60.00

CHAPTER 5

RESULTS AND DISCUSSION

The table 5.1 displays regression results for our model. The standard errors are reported in blankets under the coefficients. The Hausman test comparing both random and fixed effects suggests random effect might be more consistent specifications. Nevertheless, it is likely that the key independent variables do change over time. Therefore, we report the fixed effect estimation instead of the random effect. In a robustness check, however, we find that RE and FE models generate similar. Both RE and FE report positive correlation between property damage and divorce rate at 5-10 % significance for different regressions. F statistics for the regressions 1, 2, 2*, 3 and 4 suggest that all the regression models are acceptable at less than 1 percent significance. We also find that the result is robust after white's correction and instrumenting variables which were suspected to have endogeneity issues.

TABLE 5.1

REGRESSION RESULTS: EFFECT OF PROPERTY DAMAGE ON DIVRCE RATE

	Regression 1	Regression 2*	Regression 2	Regression3	Regression4
Property damage	0.000154* (0.0000861)	0.000154* (0.0000861)	0.0001548* (0.000086)	0.0001637* (0.0000854)	0.0001673** (0.0000851)
Both Work	-0.0322** (0.0116)	-0.032236** (0.011690)	-0.0322** (0.0116)	-0.0342** (0.0116)	-0.0343** (0.0114)
Age	0.0937** (0.0449)	0.093707** (0.044914)	0.0933** (0.0442)	0.1020** (0.0431)	0.1051** (0.0427)
Hispanic	-1.0042** (0.4800)	-0.010042** (0.004800)	-1.0081** (0.4793)	-0.9511** (0.4763)	-0.9688** (0.4740)
Unemployment	-0.0820** (0.0393)	-0.082042** (0.039323)	-0.0829** (0.0392)	-0.0808** (0.0392)	-0.0782** (0.0389)
Density	-0.00017** (0.00004)	-0.000179** (0.000040)	-0.0001** (0.0000405)	-0.0001** (0.0000393)	-0.0001** (0.0000387)
Children	-0.0852** (0.0170)	-0.085285** (0.017025)	-0.0852** (0.0169)	-0.0924** (0.0148)	-0.0935** (0.0146)
Education	0.0311** (0.0137)	0.031117** (0.013713)	0.0311** (0.0136)	0.0258** (0.0122)	0.0245** (0.0120)
Marriage(Female)	0.1093** (0.0275)		0.1083** (0.0131)	0.1091** 0.0131	0.1093** (0.0131)
Home Price	-0.0317 (0.1690)	-0.031711 (0.169032)	-0.0309 (0.1200)	-0.0682 (0.1119)	
Income	-0.3970 (0.4624)	-0.397075 (0.462449)	-0.3976 (1.3163)		
Marriage(Male)	-0.0017 (0.0397)	0.109357** (0.027573)			
R^2 within	0.4212	0.4004	0.4212	0.4203	0.4198
wald-test F(Prob>p)	0.616 (0.4527)	7.9900 (0.6302)	0.2950 (0.6004)	1.0840 (0.3251)	0.688 (0.4284)
WoodridgeChi2 (Prob>Chi2)	9.2100 (0.5126)	1.082 (0.3253)	9.1900 (0.5138)	9.9800 (0.4421)	10.11 (0.4312)
observations #	458	458	458	458	458

*p-value<0.10, **p-value<0.05 Note: OLS with fixed effect estimation is used

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Empirical Results

Effect of Property Damage per Capita

In all the regressions, the property damage has a significant and positive effect on divorce rate. It is a result consistent with our hypothesis which suggests that a shock to a marital specific capital, a houses, may reduce the benefit of marriages and increase divorce rates. For the first regression, with $1 million increase in per capita property damage, there may be 0.000154 percentage increase in divorce rate; which seems like a small change. The small coefficients may be caused by including mild disasters which does not impact divorce rates. Additionally, although the result is significant, it might be the indirect effect. In this scenario of indirect effect, divorce rate is affected by a change in income, which was caused by a natural disaster. In order to account for such endogeneity problem, income and home price will be instrumented. This will be discussed in detail in robustness check section.

Effect of Children

There are significant and negative relationships between the percentage of couples with children and divorce rate in all the regressions. 1 percentage increase in couples with children decreases divorce rate by 0.0852 percentage for the first regression. The result is consistent with the hypothesis and the previous literature (Becker 1977). As the children are marital-specific capitals, they raise the benefit of marriages and hinder divorces.

Effect of Unemployment

There were inverse relationships between unemployment and divorce rate in all of the four five regression. For the first regression, 1 percent increase in unemployment rate

decreases the divorce rate by 0.08 percent. This may be because high unemployment rate may make divorce relatively more expensive for more couples, as suggested by the previous literature on the cost-side analysis of divorce (Amato and Beattie, 2010).

Effect of Population Density

There are inverse relationships between density and divorce rate in all five regressions. For the first regression, with 1 unit increase in the population density (Population/ Square Miles) decreases the divorce rate by 0.0001793 percent. The result is not consistent with the previous study which reports a higher divorce rate in urban area (Gautier, Svarer and Teuling, 2009). It is possible that high density areas provides more options for a marital partner, and thus one may be more likely to find a more appropriate partner for their first marriage.

Effect of Wife and Husband's Labor Participation (*Both Work*)

The percentage of families with both wife and husband working have negative effect on divorce rate in all of the regressions. For the first regression, 1 percentage increase of such families decreases the divorce rate by 0.032 percentage. This result is not consistent with the earlier hypothesis. As husband and wife specialize in market and non-market activities separately, gain from their marriage is expected to rise (Becker 1977). The labor participation of both husband and wife may hinder the specialization in domestic non-market and market activities, thus it should theoretically have positive correlation. On the other hand, the result may be reflecting the situation when the *bothwork* variable picks up the low income individuals which need two separate income

for a family. Alternatively, when both wife and husband work, the total household income may be greater, and this may be the factor decreasing the divorce rate.

Effect of Marriage Rate by Female and Male

Female marriage rate has a positive effect on the divorce rate in all regressions 1 percentage increase in the female marriage rate, there is 0.1 percentage increase in divorce rate in the next time period. The positive relationship between married female rate and divorce rate is consistent with our initial hypothesis. The prevalence of married female makes the divorce more likely in the next time period.

Male marriage rate is insignificant, but it is very likely that the significance was robbed away by female marriage rate when including both variables. After removing female marriage rate variable from the regression 1, the significance of male marriage rate increased substantially. This result as can be seen by comparing regression 2 and regression2* from table 5.1. This suggests that percentage of married individuals, both female and male, have the same positive effect on divorce rate in the next time period.

Effect of Percentage of Young People in the Population (*Age*)

The ratio of young people (18 to 24 in age) has a positive impact on divorce rate in all the five regressions. For the first regression, with 1 percent increase in such individuals increases the divorce rate by 0.93 percent. This result might be caused by two factors. The first is that abundance of young population may provide better opportunities for remarriage, which may be an incentive for divorce. The second factor is that the young states may have more of young couples than other states. As the previous literature suggests, couples in the early state marriage are more likely to divorce (Becker 1977).

Effect of the Percentage of Hispanic Population

There are inverse relationships between Hispanic percentage and the divorce rate in all the regressions. 1 percentage increase in the ratio of the Hispanic population decreases the divorce rate by 1.0 percent. This result is consistent with the previous literature which reports the lowest divorce rate for the Hispanic population among black and white. (Kreinder and Fields, 2002) The result could be explained by the differences in cultures.

Effect of Education

There are positive relationships between the educational attainment and the divorce rate. A 1 percent increase in the individuals with bachelor's degree increases the divorce rate by 0.03 percentage in the first regression. The positive relationship may be explained by the financial independence for the highly educated individuals.

Effect of Income and Home Price

Although medium income and home price were hypothesized to have negative relationship with divorce rate, neither of them has a significant effect on divorce rate in the first five regressions. In addition, *income* and *home price* may have endogeneity problems. There is a possible scenario where natural disasters cause a change in income which, in turn, causes a change in divorce rate. A similar scenario may be possible for home price; where natural disasters drives a change in home price which, in turn, impacts divorce rate. In order to account for these issues, those two variables will be instrumented. This will be discussed in detail in the next section of robustness check.

Robustness Check

Wooldridge test for autocorrelation implies that there are no auto-correlation issues in any of the regressions. Modified Wald tests also suggest that there is no heteroskedasticity for any of the regressions. Although there is no problem detected regarding heteroskedasticity and auto correlation, there are some issues regarding multi collinearity (see table 7.2). There are high collinearity between marriage rate of female and male, between logarithm of medium income and medium home price, and between educational attainment and logarithm of medium income. Collinearity might have been an issue if we did not have a significant result as it may take away significance from significant results. Nevertheless, as we already have significant results for property damage, it should not be a concern in our study. On the other hand, the robust regressions shown in table 7.1 suggest that home price, which was insignificant in the original regression, is now significantly affecting divorce rate. Colinearity between *homeprice* and *income* might be the factor lowering the significance of the home price.

In order to account for possible issues of endogeneity of *income* and *homeprice*, an instrumental variable approach is used by applying two stage least square method. *Income* is instrumented for using *State GDP per capita* and *homprice* is instrumented for using both GDP per cpita and medium age of housing structure. The regression results are shown in the table 7.3 and 7.4. For the case of *homeprice*, which included two instrumental variables, the Sargan stat was1.69 with p-value of 0.19; this indicates that the instruments are not over-identified. The first stage F statistics were 6.99 for *income* and 2.49 for *homeprice*, this indicate the weakness of the instruments. However, property damage was still a significant predictor of divorce rate.

CHAPTER 6

CONCLUSION

Through this study, we examined the impact of natural disasters on divorce rate; particularly through the channel of housing destruction. After several robustness testing, we find a positive and significant relationship between property damage through natural disasters and divorce rate. We used OLS panel regression with fixed effect for our analysis. This result holds through several sensitivity tests.

The result was robust after the white's correction and instrumenting the variables with possible endogeneity issues. As *Income* and *homeprice* were suspected to have endogeneity issues, these variables were instrumented. The *property damage* stayed significant in both regressions where *income* and *homeprice* were instrumented. However, as the instrumental variables are weak in our case, robustness of the result is not fully justified. For the study, it would be advisable to find different and stronger instrumental variables for *income* and *homeprice*. In this manner, we will be able to justify or dismiss housing destruction as the true channel of natural disasters impacting divorce rate.

Although the impact of natural disasters through housing destruction are significantly positive, its coefficients are very small. This may be because divorce rate is only affected by severe natural disasters. In our measurement of property damage, we could not separate natural disasters by its severity, as the property damage is measured as

annual aggregate. For the studies, it may be worthwhile to find data which allows us to differentiate natural disasters by severity.

Despite some of these limitation of this study, we find some empirical evidence for a positive relationship between divorce rate and property damage by natural disasters. This result is consistent with the theoretical marriage model by Becker (1981).

Chapter 7

APPENDIX

TABLE 7.1

REGRESSIONS AFTER WHITE'S CORRECTION: EFFECT OF PROPERTY

DAMAGE ON DIVROCE RATE

	Regression1	Regression2	Regression3	Regression4
Property Damage	0.0001548** (0.0001548)	0.0001548* (0.0000398)	0.0001637** (0.000399)	0.0001673** (0.0000412)
Both Work	-0.0322** (0.0092)	-0.0322** (0.0093)	-0.0342** (0.0077)	-0.0343** (0.0079)
Age	0.0937** (0.0423)	0.0933** (0.0491)	0.1020** (0.0436)	0.1051** (0.0426)
Hispanic	-1.0042** (0.2035)	-1.0081** (0.1977)	-0.9515** (0.1878)	-0.9688** (0.1916)
Unemployment	-0.0820** (0.0249)	-0.0829** (0.0238)	-0.0808** (0.0238)	-0.0782** (0.0243)
Density	-0.0001** (0.000029)	-0.0001** (0.000028)	-0.0001** (0.0002)	-0.0001746** (0.0000258)
Children	-0.0852** (0.0126)	-0.0852** (0.0130)	-0.0924** (0.0076)	-0.0935** (0.0074)
Education	0.0311** (0.0054)	0.0311** (0.0053)	0.0258** (0.0470)	0.0245** (0.0047)
Marriage(Female)	0.1093** (0.0412)	0.1083** (0.0136)	0.1091** (0.0134)	0.1093** (0.0133)
Home Price	-0.0317 (0.0614)	-0.0309 (0.0556)	-0.0682* (0.1119)	
Income	-0.3970 (0.5028)	-0.3976 (0.5076)		
Marriage(Male)	-0.0017 (0.0526)			

*p-value<0.10, **p-value<0.05

TABLE 7.2

Multi-Collinearity

	damage	Bothwork	HomePrice	Income	Age	Hispanic	Marr(m)	Marr(f)
Damage	1.0000							
Both Work	-0.0664	1.0000						
Home price	-0.0858	0.1603	1.0000					
Income	-0.1139	0.4520	0.6398	1.0000				
Age	0.0609	0.1673	-0.0280	0.0246	1.0000			
Hispanic	-0.0344	-0.3563	0.2466	0.1395	0.0435	1.0000		
Marr(m)	0.0101	-0.1881	-0.4228	-0.4443	0.3575	-0.0355	1.0000	
Marr(f)	0.0008	-0.2057	-0.4234	-0.4615	0.3391	-0.0257	0.9497	1.0000
Children	0.0204	0.0475	0.1703	0.4173	0.3243	0.3849	0.1874	0.1983
Education	-0.0895	0.4042	0.5161	0.6604	-0.1485	0.1492	-0.4998	-0.5381
Density	-0.0185	0.0396	0.2884	0.0880	-0.1760	0.0129	-0.3163	-0.3626
Unemployment	0.0629	-0.3699	0.0556	-0.0068	0.0281	0.1308	-0.1885	-0.1940

Note. Marr(m) = Marriage male, Marr(f) = Marriage female

TABLE 7.3

REGRESSION WITH INCOME INSTRUMENTED BY GDP PER CAPITA: EFFECT OF PROPERTY DAMAGE ON DIVORCE RATE

	First stage	Second stage
Income		1.415 (1.170)
Unemployment	-0.004 (0.003)	-0.076** (0.0400)
Density	-0.0000709** (6.52e-06)	-0.0001397** (0.0000475)
Children	1.654** (0.141)	-11.788** (2.591)
Education	0.012** (0.001)	0.007 (0.019)
marriage_female	-0.283** (0.124)	11.202** (1.357)
Hispanic	-0.204** (0.045)	-0.761 (0.508)
Age	-2.010** (0.409)	13.288** (5.075)
Homeprice	0.078** (0.010)	-0.200 (0.158)
bothwork2	0.218** (0.113)	-4.146** (1.307)
Property damage	-1.79e-11** (8.12e-12)	1.95e-10** (9.07e-11)
Gdppercapita	4.963806** (0.542007)	
F(9, 437)	6.99	0.71
R^2(overall)	0.77	0.40
#observation	458	458

*p-value<0.10, **p-value<0.05

TABLE 7.4

REGRESSIONS WITH HOME PRICE INSTRUMENTED BY GDP PER CAPITA AND MEDIUM AGE OF HOUSING STRUCTURE: EFFECT OF PROPERTY DAMAGE ON DIVORCE RATE

	First Stage	Second Stage
Home price		0.766 (1.833)
Unemployment	-0.029* (0.015)	-0.0582 (0.0685)
Density	0.0000814** (0.0000157)	-0.000244 (0.000154)
Children	-1.110 (0.674)	-7.661** (2.665)
Education	-0.00167 (0.00545)	0.0323** (0.0146)
marriage_female	-0.0399 (0.524)	10.863** (1.383)
Hispanic	0.419** (0.190)	-1.328 (0.896)
Age	-0.971 (1.76)	10.081* (4.948)
Income	1.397** (0.171)	-1.502 (2.580)
bothwork2	-0.630 (0.465)	-2.729 (1.668)
Damage	-1.61e-11 (3.42e-11)	1.67e-10* (9.48e-11)
GDP per capita	0.0658 (0.0685)	
House construction year	-0.00194 (0.00173)	
F stat	2.49	1.04
R^2(overall)	0.45	0.36
#observation	458	458
Sargan Stat (p-value)		1.698(0.192)

*p-value<0.10, **p-value<0.05

Chapter 8

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