TORNADOES AS A NATURAL EXPERIMENT IN RATIONAL CHOICE

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ABSTRACT

On May 3, 1999 a series of tornadoes ripped through a residential area of Oklahoma City. Over 2,000 homes were totally destroyed. Those affected had to decide whether to rebuild in their original location or to out-migrate. There was a tremendous amount of uncertainty surrounding the decision, not the least of which was funding availability. The decision did not need to be made immediately because sufficient resources did not exist to rebuild this large a block of houses. Much of the uncertainty would be reduced if the decision was delayed. In this paper we examine the implications of the two common decision models of economics; rational and bounded rational choice, in the context of a natural experiment - the decision over out-migration after a tornado. Rationality implies a careful, deliberate approach with appropriate weight given to relevant issues. Bounded rationality puts more weight on reducing the informational requirement and relying more on experience to guide the decision. The evidence presented in this paper provides more support for the boundedly rational approach.

INTRODUCTION

On May 3, 1999, a series of tornadoes ripped through residential areas of metropolitan Oklahoma City, damaging or destroying over 2,000 homes. It should come as no surprise that many people decided to not to rebuild and remain in their original location. A rational individual, confronted with a damaged or destroyed home, would examine the available options and make the decision that led to the greatest level of utility, in expectation.

Under the circumstances the decision to move or remain does not need to be made instantly. Given the level of destruction, the myriad of private and public agencies offering assistance and the time necessary to rebuild, ample opportunity and incentive existed for individuals to carefully consider their options over housing location. The decision is of obvious importance to the individual suggesting that a rational choice approach would be most appropriate in these conditions.

Economists typically describe decisionmaking agents as completely rational; what Thaler [14] dubs “hyperrational”. Hyperrational individuals make choices under uncertainty that maximize their own expected utility. This model assumes a level of knowledge and numeracy that may not be appropriate in all circumstances and for all agents. Machina [6] summarizes the expected utility model and its implications.

Laboratory evidence from psychology [5] and other areas casts serious doubt on this model. The evidence suggests that people make systematic mistakes in probability and, therefore, often fail to make the correct decision. Even where the

stakes would seem to be quite high or life threatening, people fail to use probability properly [15]. Further, they often fail to understand that the choices offered are substantively identical. Paulos [10, p. 118] remarks, "we needn't resort to such clever examples to realize that how a question or statement is framed plays a big role in how someone responds." Collectively, this evidence suggests at least some modification to the hyperrational model of decision is in order.

Rabin [11] reviews the basic arguments against the hyper-rational model. Of particular interest to this work is the role of endowment and status quo effects. In the situation under consideration these concerns are allowed for. A number of other criticisms are brought up including bias and learning. We have attempted to capture these effects. Elster [3] emphasizes the role of emotions in the decision process and the need to include a greater role for them in economic models. He points out that rational individuals may have private and highly emotional associations with certain results that would lead to decisions that appear to be non-rational.

Palma, et al [9] show how the hyperrational agent is simply a special case of a more broadly defined decision maker; an imperfect one. This result relies on the distinction between global and local choices where individuals make choices on a single unit and then follow this with the next choice. In practice this error problem can be due to poor information, calculation ability or a time constraint.

Economists continue to use the hyperrational model for several reasons. When considering the model itself, small modifications may not improve the explanatory ability of the model to any great extent. Further, the modifications will likely complicate the analysis, so that the net gain from these changes is negative. A second defense of the model is that though the actual process may not be as detailed and exacting as described, people act "as if" they did go through the process. That is, the results indicate that given limited abilities, etc. people act like they made decisions based on the hyper-rational process.

"Bounded rationality" such as that put forward by Simon [13] is an alternative approach to decision making. In daily life it is often impractical for people to make decisions based on complete knowledge of alternatives and probabilities. Because of limited time, money, or unknown options, the bounded rationality model suggests decision-makers limit the complexity of their problem by reducing the set of options under consideration. The implication is simply that processing exhaustive information is impractical (costly), therefore the most economically efficient method to solving problems takes a cost-benefit approach.

Conlisk [2] presents four arguments in favor of adopting bounded rationality over hyper-rationality. His arguments are a combination of empirical research in favor of bounded rationality and against hyper-rationality and theoretical results that are better able to incorporate the human condition. They follow along the lines of cost-benefit analysis approach to optimization with a rational approach.

Outside of the laboratory setting, some precise evidence of the limitations of the hyper-rational model has been found by examining bids in certain game shows. The game show environment has the advantage of confronting individuals with choice under uncertainty, but where the expected values are directly quantifiable. Gertner [4], Metrick [7] and Berk, et al [1] all use network game shows as a "natural experiment" in choice. All find scant evidence of hyper-rational decisions. Metrick [7] notes that rational choice (bids) exists when the situation is simple and time sufficient to allow for easy calculation of the optimal bid. He argues that time constraints play a major role in less than rational bidding. This suggests a source of Palma's [9] theory on limited ability to calculate. Game show contests have the

advantage of being more like a normal decision situation than laboratory experiments and survey responses are likely to be. The results are, therefore, more like that of the daily decision process of the typical agent. Though games have the advantage of a fairly well controlled environment suitable for analysis, they do not constitute a truly natural state for decisionmaking.

Most decisions in everyday life do not follow the rational model because most decision-makers lack perfect information about the existing alternatives, the consequences of their decisions and often lack the requisite time to do thorough analysis. Unless people have a tremendous amount of information at hand, snap decisions are likely to be error-prone, independent of an intention to be hyper-rational. If an agent is thrust into a new situation, the hyper-rational model would suggest that decisions would be made slowly so that relevant information can be gathered. The eventual decision should lead to the highest level of utility possible, at least in expectation. In the same environment an individual using a "boundedly rational" approach would spend less effort on accumulating information and processing it. The net result of the decision itself is likely to be sub-optimal as certain relevant factors may be omitted. We would expect ex post utility to be higher for a person who made a carefully considered decision than for someone who made a snap decision. If rational choice reflects a preferred process then evidence of limiting options or failing to gather information, as would be expected with bounded rationality, should lead to lower utility.

One such new experience would be a tornado that destroyed a person's house. This presents a new environment in which the individual must make numerous decisions based on limited experience and initially limited information. A hyper-rational individual, in this type of situation, would be expected to weigh opportunities, investigate options and decide what to do about their house after some deliberation. A boundedly rational person might make the decision without gathering as much information and is likely to include considerations not typical of a rational individual. It is recognized that this decision might be a joint decision of family members. As such, the decision itself may not be optimal for a single entity, but the result of a complex set of compromises among individuals in the family. While this may influence the relative weights of various factors the decision process itself is the same for individuals, suggesting a more complex environment for the family. We treat the family as the optimizing unit and discuss it as an individual.

The May 3, 1999 tornado outbreak in Oklahoma City provides a unique situation to examine the decision making of agents in a natural though unfamiliar environment. Each household that suffered damage to their house in these tornadoes was confronted with the option to remain and rebuild or to relocate. The level of damage sustained in the area made an immediate decision virtually irrelevant. Construction companies were simply unable to provide immediate replacement and repairs for all the customers. Insurance companies rapidly provided compensation to interested parties though this did not mean immediate housing construction. Federal, state and local agencies were active in providing information and resources to all parties.

If "hyper-rationality" accurately describes the individual the remain/relocate decision should be the result of careful analysis and, given the initial level of uncertainty, one that took some time to reach. Key conditions concerning financial ability, convenience, etc. should be factored into the decision. Failure to take full consideration of the options and hasty decisionmaking should lead to sub-optimal results.

In this paper, we look at the factors that were considered in the remain/relocate decision, time to the decision and satisfaction with the decision for people whose houses were damaged in the May 3, 1999 OKC tornadoes. In the next section the data collection process and resulting data are discussed. In the third section we analyze the data for evidence of relevant decision criteria, time to decision and satisfaction level. The fourth section discusses the results and concludes.

DATA AND SURVEY

There were 2,242 homes listed as damaged by the Oklahoma City Tax Assessor as a result of the May 3, 1999 tornado that struck Del City and Midwest City, Oklahoma. In addition to the list of addresses and owners, the Assessor's office provided assessed value after the tornado and one year prior, and the level of damage sustained (25, 50 or 100%). These areas are in the southern part of Oklahoma City, OK. Phone numbers for 640 owners and/or residents at the time of the tornadoes were found. 197 answered the survey, giving a response rate of 31%. From this initial sample 129 were complete in the areas of interest to this study.

The survey was conducted approximately 9 to 12 months after the tornadoes struck. The delay between the event and the survey allows for greater revelation of the actual decision. Immediately after the tornado people might have plans that were later changed. Since our interest is with actual behavior the time lag is a benefit. The lag is not without its negative effects. Due to the lag and the selection process the study is subject to some selection bias. If a resident moved out of the area we were unlikely to be able to contact them. The sample includes, therefore, only those people who remained in the Oklahoma City area.

The survey instrument used was based on Whitehead's [16] hurricane study. The survey was conducted from March through June 2000 by supervised students at the authors' institution. The time to answer the survey varied between 12 minutes and 35 minutes depending on how much the respondent chose to reveal when asked open ended questions. One of the surveyors wrote the following on his experience, "When I did make connections with the two people that would complete the survey, the information that they wished to provide was overwhelming in both volume and detail."

The survey (available on request) asked questions concerning respondent demographics, physical injury to self and other residents, structural damage, content damage, psychological condition including a Post-traumatic Stress Disorder diagnostic, level of satisfaction, decision to move and reasons for that decision. Some of the questions were directed and some were open-ended in an attempt to identify relevant decision variables.

The using Tax Assessor data on housing value the mean loss was 50%. Using the FEMA scale (25, 50 or 100% loss) 53% had at least 50% loss. Of those, 13% decided to move, as compared to 30% for a similar group reported by the Federal Emergency Management Agency. Overall 7% decided to move. This is an early indicator that the level of damage to the house may predict whether or not a person decides to remain. The subjects of the survey were disproportionately female at 63% and older, at 56 years of age. Average educational attainment was slightly more than high school and 77% were married. Table 1 gives definitions of damage variables, demographic variables used and summary statistics on those variables.

Table 1
Damage and Demographic Variables

Variable	***Definition***	***Mean***	***Std. Dev.***
PerLoss	Reduction in assessed value of house	0.497	0.319
FEMADamage	FEMA scale house value losses: 25%, 50% or 100%	60.853	36.154
Female	Respondent's sex: 1 = female, 0 = male	0.055	0.089
Age	Age, in years, of the respondent	56.283	13.363
Ed	Educational attainment of the respondent (1 = less than high school, 2 = high school, 3 = some college, no degree, 4 = 2-year degree, 5 = 4-year degree, 6 = advanced degree	3.279	1.566
Married	Marital status (1 = married, 0 = not married)	0.767	0.424

The financial condition of the individual, after the tornado, is essential to the decision to move or remain. The greater the reimbursement for damage, the better the financial health of the individual, ceteris paribus. It is also likely that the longer an individual has lived at and/or owned a property the healthier their finances are likely to be. The average respondent had owned the property of interest for over 17 years. The average time of residence at the property was also slightly over 17 years. An average of 93% of housing losses had been reimbursed; though some had received no reimbursement. Table 2 provides details of the tenure and reimbursement for losses to the house.

Table 2
Reimbursement and Tenure

Variable	*Definition*	*Mean*	*Std. Dev.*
PerReim	Proportion of losses to the house that had been reimbursed	93.318	16.306
OwnYears	Length of time that the respondent had owned the house	17.300	11.916
ResideYears	Length of time that the respondent had lived in the house	17.581	12.314

It is also the case that having lived in a given area for a longer period of time gives an individual greater knowledge of and satisfaction with a particular community. People who are new to an area are likely to have less knowledge about the relative benefits of the community and are likely to have a lower level of comfort with the community. Therefore, years of ownership and residency may influence the decision through accumulated knowledge. This knowledge might be captured in the form of an attachment to the fairly vague concept of "neighborhood". The survey included an open ended question asking for the reason that people decided to remain or move. A surprising number made reference to "neighbor" or "neighborhood."

Those who suffered some direct physical injury during the tornado might wish to move simply to avoid a reminder of unpleasant events. While this is not immediately a market based, rational approach it is consistent with a rational response to negative stimuli (see earlier discussion). Middleton, et al [8] show the strong and lingering psychological effects of the tornadoes in the form of Post Traumatic Stress Disorder. Table 3 presents summary statistics for the association with the neighborhood and physical injuries.

Table 3
Neighborhood and Injury

Variable	Definition	Mean	Std. Dev.
Neigh	Did respondent include "neighbor" or "neighborhood" in response to the question, "Why did you decide to remain(move)?"	0.271	0.446
YourHurt	Was the respondent physically injured by the tornado?	0.054	0.227

The decision made by those in the survey was whether to remain in the old location and rebuild/repair or to move. Given the level of damage it seems reasonable that some time might expire between the tornado and the decision. The survey asked how long it took people to come to their decision. Sixty-four percent decided to remain or move immediately after the tornado or never considered moving. Table 4 provides summary data on the decision and the speed of the decision.

Table 4
Decision and Decision Speed

Variable	Definition	Mean	Std. Dev.
Remain	Respondent's decision (1 = remain in original location, 0 = relocate)	0.930	0.256
Immed	Speed of decision (1=immediate decision, 0 = some time was taken to decide)	0.643	0.481

The survey contained questions that asked the respondent to rate on a scale of 1-5, where 1 is "not at all" and 5 is "very greatly" the importance of certain factors in their decision. The proximity of the former house to school or work are factors in any real estate choice. If an individual's employment changed or employer's location changed, when an opportunity presented itself to migrate to a more convenient location it would be taken. Financial considerations associated with moving and/or reconstruction influence the decision to remain as well. Table 5 gives details of the questions and summary statistics for the responses. All factors put forward were significantly greater than 1, suggesting some consideration was given to these factors. While all factors considered were given some weight by the average respondent only age, financial considerations and location relative to work were found have an average importance level of "slight". No factor was given larger importance.

Two of the variables used deal with the age of the respondent. The first is the actual age of the individual and the second is the weight they assigned to age in the decision process. It might be that these measures are collinear; older people may consider there age more than young people. The simple correlation coefficient between age and ConsiderAge is 0.25719 with a *p-valu*e of 0.0033. While correlated, these coefficient is sufficiently small that we choose to include both variables in regressions. In order to discern, ex post, how rational the decision was it is necessary to gauge the individual's satisfaction with the decision. Someone who errs in their decision is likely to be less satisfied with their lot. It stands to reason that a less rational decision should lead to less satisfaction. Table 6 shows summary statistics for the level of satisfaction associated with the survey participants.

Table 5
Expected Decision Factors

Variable	Variable	Definition	Mean
ConsiderSchools	To what extent do schools have to do with your decision?	1.71	(0.12)
ConsiderCost	To what extent do moving cost have to do with your decision?	1.65	(0.11)
ConsiderLocation	To what extent does location to work have to do with your decision?	2.01*	(0.10)
ConsiderTornado	To what extent does fear of another tornado have to do with your decision?	1.29	(.08)
ConsiderFinancial	To what extent does your financial condition have to do with your decision?	1.78*	(0.11)
ConsiderAge	To what extent does your age have to do with your decision?	2.26*	(0.13)
Consider Opportunity	To what extent does the opportunity to move have to do with your decision?	1.39	(0.09)

Standard error in parentheses
* not significantly different from 2 at 5% level

Table 6
Satisfaction Levels

Variable	Variable Definition	Mean (Std. Er.)
Satisfaction	How satisfied are you with your decision? (To remain of move)	4.357 (0.942)

RESULTS

There are three key elements to the decision process in this case. First is the actual nature of the decision and identifying those things that influenced the decision. Second is the speed of the decision. Third is the level of satisfaction with the decision.

Likert scale data, when used in OLS leads to inefficient estimates. To avoid this problem we adjusted the Likert scale data. We assigned a value of 1 to all observations above the mean and a value of 0 to those below.

The decision to remain or move, under the hyper-rational model, should be influenced by a number of direct factors as discussed above. Some of those factors will be identified directly in the thought process of the individual, such as finances. Other factors such as age and attachment to the neighborhood may enter directly or indirectly in the decision. These factors are likely to be associated with a boundedly rational model. A simple regression of the form:

$$REMAIN = \forall + \Gamma\exists_i X_i + ,$$

where the X_i are variables that might help to explain the decision, was used to identify which factors were important. Table 7 gives the results of various specifications of the regression.

There is a strong inclination to remain in the original location. The extent of the structural damage is an intuitively appealing factor in influencing the migration decision. Greater damage should lead to a greater tendency to move since there is less to work with and the options are much larger. Both measures of structural damage show results consistent with this suggestion. Reimbursement should be important as a low level of reimbursement for damage would make any move more expensive. Reimbursement was not significant in the regressions. Of the major factors we suggested as important to the migration decision only consideration of the

location relative to work and the simple opportunity to move were significant. More consideration of the location lead to a greater inclination to remain. Opportunity, when considered, led increased tendency to move. No other factor showed significance and a scant, though significant, portion of the variance in the decision could be explained.

Table 7
Regressions on REMAIN

Variable	*Parameter Estimate*	*Parameter Estimate*	*Parameter Estimate*	*Parameter Estimate*
INTERCEPT	1.21968*** (0.21286)	1.20150*** (0.21264)	1.18361*** (0.21245)	1.16578*** (0.21220)
FEMADamage	-0.00193*** (0.0007)	-0.00190*** (0.00069)	_	_
PerLoss	_	_	-0.19538** (0.07878)	-0.19213** (0.07901)
ResidYears	0.00266 (0.0021)	_	0.00266 (0.00215)	_
OwnYears	_	0.00226 (0.00229)	_	0.00228 (0.00231)
YouHurt	0.00189 (0.10500)	-0.00009 (0.10546)	-0.00669 (0.10554)	-0.00851 (0.10600)
PerReim	-0.0002 (0.0142)	-0.000121 (0.00143)	-0.000145 (0.00144)	-0.00011 (0.00144)
Neigh	0.04610 (0.05134)	0.04756 (0.05162)	0.04752 (0.05173)	0.04885 (0.05201)
Female	0.00396 (0.04858)	0.00450 (0.04873)	0.00287 (0.04894)	0.00337 (0.04909)
Age	-0.00172 (0.00233)	-0.00144 (0.00233)	-0.00154 (0.00234)	-0.00128 (0.00234)
Ed	-0.02239 (0.01534)-0.02211	-0.02211 (0.01538)	-0.02254 (0.01545)	-0.02226 (0.01549)
Married	-0.04040.015387 (0.05793)	-0.03581 (0.05699)	-0.03641 (0.05734)	-0.03181 (0.05739)
ConsiderSchools	-0.01961 (0.06544)	-0.01761 (0.06557)	-0.01722 (0.06596)	-0.01529 (0.06609)
ConsiderCost	0.07511 (0.05943)	0.07282 (0.05952)	0.07425 (0.05996)	0.07203 ()0.06005
ConsiderLocation	0.10937 (0.05888)	0.11096* (0.05918)	0.10895* (0.05940)	0.11063* (0.05970)
ConsiderTornado	-0.03582 (0.07062)	-0.06855 (0.07073)	-0.06384 (0.07113)	-0.06652 (0.07124)
ConsiderFinacial	-0.02657 (0.05750)	-0.02208 (0.05769)	-0.02304 (0.05786)	-0.01856 (0.05804)
ConsiderAge	0.00261 (0.04948)	0.00016 (0.04992)	0.00126 (0.04986)	-0.00122 (0.05029)
ConsiderOpportunity	-0.14369** (0.06369)	-0.14550** (0.06441)	-0.14700** (0.06473)	-0.14879** (0.05329)
Immed	-0.03584 (0.05243)	-0.03509 (0.05282)	-0.03142 (0.05290)	-0.03057 (0.05329)
adj. R^2	0.0938	0.0891	0.0808	0.0763

Standard error in parentheses
*** = significant at 1%, ** = significant at 5%, * = significant at 10%

Table 8
Regressions on Immed

Variable	Parameter Estimate	Parameter Estimate	Parameter Estimate	Parameter Estimate
INTERCEPT	0.88945**	0.90201**	0.84322**	0.85534**
	(0.37430)	(0.37074)	(0.37103)	(0.36751)
FEMADamage	-0.00432***	-0.00434***	_	_
	(0.00117)	(0.00117)		
PerLoss	_	_	-0.49638***	-0.49931***
			(0.13267)	(0.13192)
ResidYears	-0.00403	_	-0.00401	_
	(0.00383)		(0.00382)	
OwnYears	_	-0.00601	_	0.00600
		(0.00406)		(0.00405)
YouHurt	-0.04914	-0.06255	-0.05367	-0.06719
	(0.18917)	(0.18857)	(0.18846)	(0.18786)
PerReim	-0.00126	-0.00135	-0.00116	-0.00124
	(0.00256)	(0.00255)	(0.00256)	(0.00255)
Neigh	0.01106	0.01977	0.01565	0.02444
	(0.09253)	(0.09233)	(0.09239)	(0.09220)
Female	0.03632	0.03937	0.03757	0.04064
	(0.08749)	(0.08710)	(0.08735)	(0.08696)
Age	0.00829**	0.00889**	0.00851**	0.00912**
	(0.00413)	(0.00408)	(0.00411)	(0.00406)
Ed	-0.02655	-0.02674	-0.02709	-0.02728
	(0.02754)	(0.02740)	(0.02749)	(0.02735)
Married	-0.10044	-0.10723	-0.09036	-0.09705
	(0.10216)	(0.10145)	(0.10207)	(0.10136)
ConsiderSchools	0.04662	0.04451	0.05478	0.05274
	(0.11785)	(0.11722)	(0.11771)	(0.11709)
ConsiderCost	0.05043	0.05136	0.04317	0.04403
	(0.10700)	(0.10637)	(0.10702)	(0.10640)
ConsiderLocation	-0.01264	-0.02062	-0.01896	-0.02699
	(0.10611)	(0.10586)	(0.10609)	(0.10584)
ConsiderTornado	-0.09827	-0.10239	-0.09237	-0.09652
	(0.12692)	(0.12617)	(0.12675)	(0.12599)
ConsiderFinacial	-0.18624*	-0.19429*	-0.17957*	-0.18757*
	(0.10212)	(0.101456)	(0.10194)	(0.10139)
ConsiderAge	-0.20604**	-0.19311**	-0.20998**	-0.19706**
	(0.08703)	(0.08743)	(0.08683)	(0.08722)
ConsiderOpportu	-0.15358	0.15264	0.15370	0.15273
nity	(0.11494)	(0.11433)	(0.11471)	(0.11409)
adj. R^2	0.1674	0.1753	0.1704	0.1784

Standard error in parentheses
*** = significant at 1%, ** = significant at 5%, * = significant at 10%

TABLE 9
Regressions on SATISFACTION

Variable	Parameter Estimate	Parameter Estimate	Parameter Estimate	Parameter Estimate
INTERCEPT	2.31375*** (0.84997)	2.32450*** (0.84156)	2.38811*** (0.83740)	2.39801*** (0.82925)
FEMADamage	0.00074 (0.00250)	0.00079 (0.00249)	_	_
PerLoss	_	_	0.01421 (0.28200)	0.02022 (0.28097)
ResidYears	0.00266 (0.00754)	_	0.000273 (0.00754)	_
OwnYears	_	0.00727 (0.00802)	_	0.00726 (0.00802)
YouHurt	-0.98762*** (0.36831)	-0.95758*** (0.36782)	-0.97093*** (0.36777)	-0.94144*** (0.36732)
PerReim	0.00749 (0.00500)	0.00761 (0.00498)	0.00757 (0.00500)	0.00769 (0.00499)
Neigh	-0.00099 (0.18076)	-0.01976 (0.18073)	0.00086 (0.18094)	-0.01765 (0.18093)
Female	-0.24670 (0.17043)	-0.25408 (0.16998)	-0.24265 (0.17054)	-0.24995 (0.17010)
Age	0.00528 (0.00820)	0.00347 (0.00813)	0.00504 (0.00819)	0.00326 (0.00812)
Ed	0.2238 (0.05433)	0.02238 (0.05414)	0.02168 (0.05436)	0.02170 (0.05417)
Married	0.13803 (0.20016)	0.14360 (0.1913)	0.13631 (0.20016)	0.14188 (0.19914)
ConsiderSchools	0.51535** (0.22963)	0.51456** (0.22876)	0.51686** (0.22992)	0.51606** (0.22906)
ConsiderCost	-0.40862** (0.20997)	-0.40602** (0.20899)	-0.41153** (0.21036)	-0.40896** (0.20941)
ConsiderLocation	0.12921 (0.20973)	0.14322 (0.20966)	0.12661 (0.21009)	0.14057 (0.21004)
ConsiderTornado	-0.48260** (0.24867)	-0.46891* (0.24775)	-0.48370** (0.24874)	-0.47037* (0.24781)
ConsiderFinancial	-0.01387 (0.20189)	-0.00383 (0.20135)	-0.01751 (0.20174)	-0.00747 (0.20121)
ConsiderAge	-0.08273 (0.17358)	-0.09905 (0.17412)	-0.08377 (0.17374)	-0.09989 (0.17428)
ConsiderOpportunity	0.31866 (0.23053)	0.31896 (0.22976)	0.32433 (0.23074)	0.32452 (0.22998)
Immed	-0.05334 (0.18431)	-0.03716 (0.18458)	-0.06836 (0.18462)	-0.05224 (0.18491)
Remain	1.08990 (0.33295)	1.07572 (0.33104)	1.06848*** (0.33073)	1.05466*** (0.32889)
adj. R^2	0.1781	0.1833	0.1775	0.1826

Standard error in parentheses
*** = significant at 1%, ** = significant at 5%, * = significant at 10%

Given the large level of uncertainty associated with this type of disaster it seems reasonable that a victim would pause for thought and gather information before making the migration decision. The survey asked people when they made their

decision to remain. Many answered that the decision was immediate. This would seem to suggest a failure of rational choice. However, rapid decisions are not necessarily non-rational. We looked for variables that might determine the speed of that decision. A regression of the form:

$$IMMED = \alpha + \Sigma\beta_i X_i + \varepsilon$$

where the X_i are variables that might help to explain the speed of decision making. Table 8 gives the results of various specifications of the model.

The extent of the damage, by either measure used, was negatively and significantly related to the speed of the decision. This is consistent with rational choice in that a more complicated situation requires are more careful and time consuming decision process. Older people were more likely to make a rapid decision. This would also appear to be consistent with rational choice in the sense that older people are more experienced decision makers (better able). However, this is also consistent with the boundedly rational decision maker because this appeals to experience as opposed to a strict reasoning processes.

Finally, a rational decision is one that maximizes utility under the conditions presented. Since the utility involved is personal there is no reason, a prior, to assume that remaining is a better choice than migrating. Rapid decisions are not necessarily poor decisions if properly calculated. Satisfaction, therefore should be high for all people making the decision, regardless of the process and details that can be exposed through survey data. After any decision is made, the implication of that decision in terms of its effectiveness should be evaluated. Using the same explanatory variables as before, but including the variable REMAIN and IMMED, we ran the regression:

$$SATISFACTION = \alpha + \Sigma\beta_i X_i + \varepsilon$$

The results are given in Table 9.

The evidence suggests that hasty decisions, careful consideration and demographic variables provide little or no information about satisfaction with the decision. Being injured reduces satisfaction with all decisions which suggests that emotions do play a role in the decision, though not necessarily a positive role. Remaining was a significant and positive factor in the level of satisfaction with the decision, as was the consideration of school location. Considering tornadoes in the decision had a negative and significant coefficient. Given that tornadoes, in the area of interest, are a random event considering the likelihood of future tornadoes is not a rational act.

CONCLUSION

In this paper we examined the outmigration decision of people affected by the May 3, 1999 tornadoes in Oklahoma City. The decision-making process and motivational factors involved in the choice to remain in their location or to move was our primary focus. The decision-making models used to explain the findings were the hyper-rational model typical of economic theory and boundedly rationality model.

The rational model suggests a deliberate process. Given the situation under examination this would imply time would be taken between the tornado and the outmigration decision. It would also imply that certain substantive issues would be

relevant, notably convenience of the location and financial considerations. Our results indicate little time, if any, was taken in making this decision. Further, we found little evidence of the influence of financial wear-with-all , material condition or convenience in the decision. Therefore it seems highly unlikely that the hyper-rational model is completely applicable.

Making this major decision in the absence of knowledge and without considering financial implications would suggest that many people would suffer ex post regret. However, we found no such evidence. An instant decision left people just as happy as a careful decision. Emotional factors, such as personal injury and future tornadoes did influence the decision and the associated level of happiness with the decision.

Finally, the data suggest there the level of satisfaction for respondent's is higher when they remain than when they move. This may be evidence of a non-monetary "endowment" effect. Despite damage to the house and reimbursement for the damage to the house individuals may feel insufficiently well off to move. Under these circumstances remaining is a preferred decision.

The hyper-rational model, in its details, fits poorly with the migration decision of the people who's houses were damaged in the May, 3, 1999 Oklahoma City tornadoes. Few material considerations were significant in the decision and some inappropriate factors were considered. This behavior suggests the "bounded rational" model is more appropriate. The result of the decision, as measured by self-reported satisfaction levels, were consistent with the "as if" defense of the hyper-rational model. The evidence is consistent with Palma et al's description of rational choice as a special case. There is some irrational behavior and some rational behavior that leads to improved outcomes. The limited amount of evidence of careful consideration, without loss, suggests strong ability to find the best solution so the "as if" defense survives. The boundedly rational model survives for precisely the same reason, though it can be argued that support is much stronger since the process described is far closer fit.

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