Following the Herd: An Economic Analysis of the Effects of Herd Mentality on the U.S. Housing Bubble

by

Michael P. Spicer

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ABSTRACT

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One focus of economics in the recent years has been the integration of human behavior, including that of herd behavior, into economic thought. Herd behavior can be defined as the way that individuals, who have private information, end up acting together as a group inadvertently, without planned action. It is thought to be caused by incomplete information and subsequently information cascades. Does this behavior exist, and if it does, did it have any effect on the recent housing market? The last twelve years provide a good opportunity to test whether or not herd behavior exists in the housing market, and if it had any effect on the housing bubble. While controlling for other factors, time series regressions were run from the period of 1990 to 2009 in order to find evidence of herding in this market. Anecdotal evidence and regression results indicate that herd behavior does exist, that it does have effects on the housing market, and that it did help cause the recent housing bubble. Considering the high price of homeownership, herd behavior likely has effects on other markets, not just the market for homes. Policy actions should be taken in order to reduce the occurrence of this type of behavior in the future, to further limit the volatility of all markets, including housing and to help prevent future economic crises.

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Chapter 1

Introduction

Some economists dared to question basic assumptions pertaining to neoclassical economics. In this way, they opened a door for exploration in the world of economics, specifically in behavioral economics. The motivation behind this paper has to do with a certain type of behavior that is studied in behavioral economics, known as herd behavior. Herd behaviors occurs when people follow others into a market, or when people make decisions based partly on the actions of others. An expanded explanation of this behavior will be provided in this paper. Empirically proving that herd behavior exists has been difficult to this point.

That being said, the quantification, or even observance of human behavior in economic models is difficult to come by. This is especially true in the realm of macroeconomics, specifically with respect to regression analysis. The recent housing bubble in the United States was a period of economic disparity. This disparity has a variety of causes as discussed in this paper, however even when all of the normal and suspected causes are taken into account, there seems to be another element that is not accounted for. This may be herd behavior in the housing market during the recent housing crisis.

The central thesis questions that are pursued in this paper are as follows. Does herd behavior exist, and if so, is there evidence of its existence in the current Economic and psychology literature? Was herd behavior a contributing factor to the steep rise in housing prices in the years prior to the housing bubble bust? Can herd behavior be shown

to exist econometrically in the housing market, and is the effect robust? These questions, and others are answered in the subsequent thesis sections.

The collection of literature presented in the second and third chapters gives encouragement for the purpose of this thesis; which is to show that herding exists, that it has noticeable effects in the housing market, specifically during the recent financial crisis, and that its effects can be quantified to an extent through a proxy variable.

The second chapter reviews the literature of early behavioral economics, social learning, the bandwagon effect and herd behavior. In this literature, anecdotal evidence of herding exists. Examples of herd behavior in various markets, including the market for prime time television, the stock market and even the market for alcohol are shown. In this literature, evidence of herding exists.

Social psychology literature reviewed in chapter 3 shows additional support for the existence of herding and many experiments carried out by these psychologists can give economists some insight on whether the assumptions we hold so dear are actually realistic. Overall, psychologists find that human behavior and decision making is affected by group pressure and expertise. This has a high degree of importance pertaining to herd behavior.

Since this thesis is investigating a market during a bubble period, chapter 4 is dedicated to an investigation of speculative bubbles, with a historical overview of a few previous bubbles providing insights on the recent housing bubble. Based on the anecdotes from the historical bubbles, it appears that asset markets can have herding present.

Chapter 5 provides previous models used to represent herd behavior , including sequential and contagion models. The following chapter focuses on the unique aspects of

the housing market in addition to providing background on known causes of the recent housing bubble. Chapter 7 provides the econometric model used in the analysis of the housing market that attempts to provide quantitative evidence of herding. it may be reasonable to infer that the herd effect was involved in the recent housing bubble. Results of the econometric analysis and descriptive statistics of the data set can be found in chapter 8. The final chapter is a discussion of the results and contains concluding remarks on the implications of the research. In total, based on the anecdotal and empirical evidence exemplified in this thesis, one may conclude that herding existed in the housing market before and during the recent housing crisis.

Chapter 2

Social Learning, Herd Behavior, and Information Cascade

There is a rich and varied literature in both economics and psychology that leads us to the modern concept of herd behavior. This chapter reviews the literature on ideas including the bandwagon effect, the snob effect, and the veblen effect among others. A definition of herd behavior is established, and some anecdotal evidence for the existence of herd behavior in various markets in the real world is provided. An investigation of information cascade and a model for this phenomenon are also provided, as herd behavior is sometimes considered co-dependent on information cascade. The background information pertaining to herd behavior is necessary in order to understand the phenomenon and its economic importance, especially pertaining to the housing market.

A. Social Influence on Decision Making

Social influence is a powerful construct, one that often affects the behaviors and everyday choices of each individual. Whether it is deciding what brand of coat to buy, where someone should make a dinner reservation, or if a person should make a reservation for dinner at all, the behavior of others oftentimes has a great influence on the decisions individuals make, regardless if it is overt in nature. If a certain brand of coat is a popular buy, whereas another brand of coat appears to be overstocked and under worn, the conditions will likely alter the decision making process of a person in the coat market. In addition, many people, for example, identify the quality of a restaurant solely based on the number of occupied seats, or based on anonymous internet reviews. Coincidentally, many restaurants close off a portion of the restaurant in order to appear busy, only to open a larger section of the restaurant after more people arrive. In addition, many

restaurant owners and marketers are known to write their own, strong reviews and post them on the internet for all to see, in order to boost their reputation and subsequently their business. Therefore, it can be difficult to correctly assess the quality of a good based on the number of people consuming that good. Nevertheless, it is common for people to judge the quality of a certain good based on the number of other people consuming that good. This idea has to deal with the economic and psychological concept of herd behavior.

One situation was proposed by Keynes (1936) that may show people do not always make decisions based on their own private information, in a rational manner. One such scenario originally proposed by Keynes (1936), involved what has been dubbed, the "beauty pageant contest." The contest involves a fictitious posting of sets of pictures of beautiful women in a newspaper. Readers who want to be involved with the contest must choose the six faces that they feel are the most beautiful, and send in their answers. All of the readers who submitted six faces that included the one that was the most popular vote, would then be eligible to win a prize in a subsequent raffle. Keynes proposed that it is not the best strategy for the entrant to submit the faces they believe are the most beautiful, but rather submit faces that they believe the rest of the readers believe are the most beautiful based on general perception. In fact, he even went beyond this point, and said that the decision should go to another level, in which the entrants that wanted to win should select the faces based on the social perceptions of beauty of the other entrants. In other words, entrants would forego their personal information and opinion, and instead pick the 6 faces they believed others would think would be picked. With this in mind, Keynes (1936) proposed that this type of thinking could also be applied to the stock

markets and other decision-making models. This idea was likely one of the first contributions to the modern day field of behavioral economics, although it was certainly not the last.

B. The Origins of the Bandwagon Effect

Building upon the work of Keynes (1936), Leibenstein (1950) and his idea of the bandwagon effect likely changed economic thought forever. Without this idea, modern thought in economics would be far different, as he introduced various behavioral aspects to economic theory that were previously unaccounted for.

Theories relating to fads, fashions and following the purchases of other people are nothing at all new. One could even consider the writings of the Roman poet Horace as unknowingly involving reference to attaining items that an individual's peers acquire (Leibenstein, 1950). Nevertheless, most consider the writings that involve the interpersonal aspects of consumer demand to have come at some point in the 19th century. Veblen (1889) was one of those who made the field mainstream, specifically with respect to conspicuous consumption. Conspicuous consumption can be defined as a situation in which a consumer purchases goods and services that tend to be lavish in order to appear wealthy and to show that he or she has a certain level of income. In this way, the purchasing of goods and services is done to appear within a reputable social status, colloquially referred to as "keeping up with the Joneses." Veblen is oftentimes credited with the discovery and popularization of conspicuous consumption itself; however, John Rae began writing about this and similar topics in the mid-1830's (Leibenstein, 1950).

The idea of a "bandwagon effect" was used quite some time ago, in order to characterize a certain phenomenon in consumer behavior. Leibenstein (1950) defined the effect as the propensity for one individual to buy or consume a good based on other people buying or consuming the same good. He relaxed the economic notion that consumption by one individual is independent of the consumption of other individuals when resources are not scarce. By doing this, he allowed for the neoclassical model to better represent the motivation of consumer's by incorporating the dependency of one consumers' behavior on other consumers' behavior.. Leibenstein (1950) characterized the bandwagon effect as taking into account the "desire of people to wear, buy, do, consume, and behave 'like their fellows'; the desire to join the crowd, be 'one of the boys,' etc—phenomena of mob motivations and mass psychology." It is also representative of the "extent to which the demand for a commodity is increased due to the fact that others are also consuming the same commodity" (Leibenstein, 1950, 189). He considered this effect as part of the nonfunctional utilities that may be inherent in various commodities and goods. This is to distinguish from what he calls functional utility, or the utility derived from a good based on that goods' inherent qualities. This idea, that a good may be more valuable due to popularity rather than its inherent value is very important in the world of economics and marketing today.

Leibenstein (1950) realized that attempting to quantify behavior, through the bandwagon effect or otherwise, had inherent difficulty. The knowledge that consumers have is one problem. If one is to assume consumers are all omniscient with respect to knowing what everyone else's preferences are and what decisions they make, then the model is not a useful one since this is not the truth. At the same time, if a consumer is

considered ignorant, i.e. not having full information pertaining to others preferences and choices, then there must be a degree of ignorance associated with each person. An additional problem that Leibenstein (1950) faced was that an individual consumer's demand behavior could be a function of the total demand of all others in the market, or it could be a function based on all other consumers collectively or even separately. On the other hand, one could define a consumer's demand in multiple other ways and combinations. Even with these inherent issues, Leibenstein was able to work out some models of the bandwagon effect that have been expanded upon by others. One motivation of this thesis is to investigate human behaviors role in an economics model, expanding on the ideas that Leibenstein provided quite some time ago.

In addition to the bandwagon effect involving a positive effect with respect to individual consumption, social taboos can also be viewed as having the opposite effect (Leibenstein, 1950). In this way, people may not buy a good due to other people not buying or consuming a good. This behavior is just as important as buying things because of others buying things, since it can cause large shifts in markets. With this in mind, goods may actually have a negative price, or an amount that a person would have to be paid in order to consume a good. This seminal paper also defined the "snob effect" which is complementary to the bandwagon effect. The snob effect refers to a decrease in demand by a consumer as others tend to consume a certain good and vice versa. In this way, a person would be different, unique and would desire exclusivity. He also introduces what he deems as the veblen effect, which represents conspicuous consumption, or involving a higher demand as price of a good increases and vice versa. All of these effects have impact on consumer behavior, and each are incredibly

intriguing. The bandwagon effect is in a way the predecessor to what is now known as herd behavior or mentality. The author even brings up what he calls "the common herd", throughout his analysis. The points brought up by Leibenstein (1950) helped to pave the way for future endeavors and new fields in economics. Without the work of Leibenstein and Keynes, it is unlikely this thesis would be possible. The common herd that Leibenstein refers to is a precursor to what is now known as herd behavior.

C. What is Herd Behavior?

This section attempts to provide a reasonable, simple definition for herd behavior. It provides anecdotal examples of this phenomenon as well.

It is known that fertility choices, including but not limited to whether to have children, how many children to have if at all, and whether or not to use contraceptives, among myriad other decisions have been characterized by being influenced by the choices of others in the same vicinity and among the same social classes (Banerjee, 1993). This type of influence is complex and difficult to model. However, that does not mean attempts have not been made to achieve that end. One explanatory concept is that of herd behavior.

The term herd behavior refers to the phenomenon in which individuals, who have private information, end up acting together as a group inadvertently, without planned action. It encompasses the general idea that an individual's actions are dependent on not only the private information that one has, but also on the actions of others and the information derived from others. It is thought to be caused by incomplete information and subsequently information cascades, in addition to the inherent need in humans to feel as if they belong. The behavior is induced during a surprising number of situations,

sometimes even when private information suggests an alternative action or decision. The term originally came from the behavior of animal groups that move in a herd-like fashion, that appear to wander towards landmarks or rainfall. It is oftentimes referred to as herd mentality in humans, based on the complexity of human decision-making compared to that of other animals. The idea of herd mentality encompasses a medley of various disciplines, that sometimes agree and other times clash. An economic sense of the behavior may not coincide perfectly with the use of the term in social psychology or vice-versa.

Even with dissimilar information, as long as payoffs for doing an action are similar, herding may come as a result (Bikhchandani et al, 1998). There are plenty of examples that may be indicative of herd behavior in the real world, which will be presented in this paper.

a. *The Herd Effects of Tequila*

Akerlof and Kranton (2010) discuss an interesting case that occurred in Mexico and around the world in 1994. Due to the crash of the Mexican economy, other emerging countries had to endure plummeting stock market investment, as investors ran to try to escape from the market. The investors thought that since Mexico had a currency debacle, it was only commonplace that all other emerging market economies would also have currency crises. As a result, the "tequila effect" became a prime example of investor herd behavior. In lieu of doing market research, examining which countries had the best chance of thriving and which had the worst chance, investors instead garnered information from market portfolios as a tell all source of information pertaining to the

situation (Akerlof and Kranton, 2010). Rather than separating the bad apples from the good, the investors effectively threw away the whole bag. At the same time, industrialized countries experienced something close to the opposite of the tequila effect. In industrialized countries, since many were doing well at the time, investors became overly optimistic and overconfident in their decision-making. As a result, many of the investors were blinded by their own success, and herded into a string of bad-decision making in the financial markets as a result (Akerlof and Kranton, 2010). Other examples of herd behavior have been identified in addition to the herding inherent in the "tequila effect."

b. Herd Behavior in Investment and The Stock Market

According to Hey and Morone (2003) there are instances that occur in real markets that signify irrational herding by individuals participating in those markets. Possible instances include runs on certain foreign exchange currencies even as other information suggests it is unjustified and stock market bubbles and crashes that are not associated with the stock fundamentals (Hey and Morone, 2003). In addition, some have found a relationship between herd behavior and investment. Investments, according to classical economic theory, are made by agents that have rationally formed expectations. In this way, agents are supposed to use all the information around them from various sources to come to a conclusion and in turn make a choice to invest or not, and decide how much to invest if they choose to do so. However, a contrasting view is that group psychology may also drive investment, which in turn weakens the economic assumption that investments are made based on market information alone (Scharfstein and Stein, 1988). History shows that Keynes (1936) was critical of agents acting rationally and

ensuring efficiency over the long term. He believed that investors do not want to separate from their cohort of investors.

In this view, it would be better for the investor's decision to blend in with the decision making of other investors, rather than be contrarian and in turn damage their investment reputation. Keynes (1936) states, "worldly wisdom teaches that it is better for reputation to fail conventionally than to succeed unconventionally." In this way, any professional who wants to maintain a career as a highly-reputable investment manager, would likely follow a herd mentality, as long as they are concerned with others opinions of their ability (Scharfstein and Stein, 1988). Scharfstein and Stein (1988) suggest that this herding behavior of investment played a role in the stock market in the mid 1980's, specifically until the crash in October 1987. During this time, market professionals for the most part believed that the market was going to go down, and paradoxically, very few sold their shares. Scharfstein and Stein (1988) attribute this phenomenon to the idea that the money managers did not want to miss out on a bull market and look like fools if everyone else rode out the "up" market, while they missed out. At the same time, if everyone met the same fate of the market falling, the investors who held on to their shares would not look as bad; congealing with the group.

Gwynne (1986) saw a similar phenomenon with respect to the lending policy of banks to least developed countries (LDC's). He speaks of a specific credit analyst and his job to gain information about and analyze countries for a bank. However, larger firms had already done these tasks, in order to assess any particular countries risk. In this way, by following the other analyses, it was a win-win situation for the analyst. If the forecasting

was bad, at least thousands of others shared it, whereas if it was good, the herd would also lead him in the right direction.

Excessive stock market volatility has been attributed to herd behavior by various authors as well (Scharfstein and Stein, 1988). If one buys when others are buying, and sells when others are selling instead of relying on personal information, shocks in the market will be enhanced by the herd-like behavior. A shock that would have been small if everyone acted on their own private information as well as the decisions of others, is instead amplified to a great degree. Other evidence by Shiller and Pound (1986) may also imply herd behavior in the stock market. When they examined the factors that influenced institutional investors, they found that when stocks that recently underwent price run-ups were purchased, the main motivation behind the purchase was from others advice from sources like newsletters and other investment professionals (Scharfstein and Stein, 1988). At the same time, when stable stocks were purchased instead, the research that was done on those stocks was instead the main motivation. With this in mind, it becomes apparent that the opinion of others is taken into account with respect to institutional investors' decision making, possibly even more than fundamental research in the stock itself. Herd behavior can be present in a variety of contexts, and as shown by Scharfstein and Stein (1988) one cause may come as a consequence of rational attempts by managers to act in a way that will benefit their reputations as decision makers rather than benefit society as a whole.

One may ask whether herd behavior can be directly observed in financial markets Hey and Morone (2003) show through various models and an actual experiment involving real people, that herd behavior can be directly observed within these market

types. They found that during an instance where a person has bad but convincing evidence, he or she can push the market toward one end of the economic spectrum. In addition, herding can be seen in the model Hey and Morone (2003) created pertaining to price bubbles bursting then falling to their correct levels. Based on their results, Hey and Morone (2003) believe herd behavior could have a large impact on foreign exchange markets especially, relative to other market types. They also concluded that price volatility based on herding can be limited when the quality and quantity of information is higher in the market structure. Research done by authors such as Hey and Morone (2003) was a motivation for this paper, since they empirically provided evidence for the existence of herd behavior. Their results may not be applicable to the empirical model presented in this model, but they are results implying herd behavior exists nonetheless.

c. Network Television: An Example of Herding in Entertainment

Research done by Kennedy (1995) looked into the decision making processes of television networks and their introduction of different shows from the years of 1960 to 1989. Intuitively, if one station like CBS introduces a hypothetical new show, for example, CSI Alaska, then the other networks would likely not follow that behavior and instead differentiate to a dissimilar show archetype, as the benefit to introducing such a show by NBC, ABC or the WB would be reduced by CBS. At the same time, if the WB feels that CBS introduced the show based on taste preferences shifting in the television market, then it may be beneficial for the WB to imitate the choice of CBS providing CSI Alaska, by introducing a crime scene investigation series as well. Kennedy (1995) concludes that the networks tended to converge in their decisions to introduce new

shows, through the introduction of shows of the same categories as their cohorts. This would not be the intuitive result, which requires further discussion of the topic.

Although some may believe a differential hypothesis, in which competing companies within the same industry would introduce differing products in order to stand out from the crowd, it appears that the TV networks would rather strategically imitate than differentiate. The results of Kennedy (1995) cannot be generalized to all markets, however it is interesting that strategic imitation is used to such a high degree within the network television market. Many may question whether there are common information signals that each network observes in the market, which may not be viewable to a researcher or econometrician (Bikhchandani et al, 1998). This in turn would be an example of common decision making without imitation, rather just each firm following the current market information. Kennedy (1995) points out that after his discussions with CBS and NBC, they assured him that no reliable and shared source of information between all the networks exists. Even as each station does a great deal of research and development, joint market research does not occur very often. In addition to this, it would not be beneficial to any station to give away private information that may benefit other stations, and therefore, it would not make intuitive sense for any network to give or accept information relayed to or from other stations (Bikhchandani et al, 1998). Still, it is interesting to see that herd behavior exists in a market with so few large firms fighting for large audiences. One would intuitively reason that the networks would want to stand out rather than sell the same stories. If herding exists in this market, it is possible that herd behavior will exist in the housing market as well.

d. *Carbonation, Transportation and Legislation: A Recent Example of the Herd's Influence*

A very recent market bubble busted, with direct impact on college students and young adults across the country. This example involves the drink "Four Loko," which is an alcoholic, juice-flavored, malt beverage that was released in late 2007, by Phusion Projects LLC, a company founded by three young alumni of Ohio State University. The drink contains caffeine, guarana extract and taurine and it can contain as much as 12% alcohol by volume. Four Loko was the fourth fastest growing product by sales at all Seven-Elevens across the country in 2009, due to its popularity among young people, over-the-top advertising campaigns and its bold, colorful, camouflage imbued can. By early 2010, Four Loko was being sold in almost all European countries and 47 states in the US. Other substitute goods that provided drinkers with similar effects were produced, to capitalize on the rising market for what has been deemed CABs, or Caffeinated Alcoholic Beverages, including "Jooze" and "Crunk Juice" to name a few. College students on campuses across the country began consuming the beverage preferentially over other goods, and it appeared that Four Loko was a winning recipe for economic prosperity, beyond a mere fad. Herd behavior was rampant, as college students imitated one another in drinking the poorly flavored concoctions. Still, an untapped niche in the alcoholic beverage market presented an opportunity for entry to many.

However, in mid-October 2010, when Central Washington University transported nine students to area hospitals, due apparently to excessive consumption of alcohol, Four Loko being the prime suspect, it seemed the Loko's luck was tapped. From this point on, talk of the drink being "blackout in a can" or "liquid cocaine," was prevalent among

parents and other naysayers, many of whom had never heard of the product or consumed it themselves before. Soon after, another school, Ramapo College in New Jersey, banned the drink from its campus. Countless schools began issuing warnings to students, or banning the drink outright as well, imitating each other in the process by using coined terms. Brusquely, state legislators stepped into the ring by banning the product one after the other, in succession, in the same herd like fashion. In mid-November a college student in Maryland consumed two Four Lokos and subsequently died in a car accident. The FDA deemed the product unsafe directly after this event, even as these CABs had been legally on the market for a few years. Fushion Projects LLC has since removed the energy-inducing ingredients from their products, in order to comply with the bans and complaints. Loko had an incredibly fast rise in sales from its beginnings, the makings of a positive herd mentality, to a sudden bubble burst, and an even faster herd mentality for exiting the market. Only a few isolated events caused the products complete demise, but information proliferation and cascade, over-exaggeration and herd mentality all contributed to the death of the Loko brand.

With these things in mind, the banning of this type of drink has occurred in a pre-packaged format, but what about the remaining drinks being served at bars that contain caffeination? Technically speaking, a Rum and Coke has alcohol and caffeine within the same drink. Vodka-redbulls or other alcoholic drinks mixed with caffeinated mixers are still allowed to be served in the bar market. However, very few people, if any, have looked into this aspect of the markets for energy and alcohol. Certainly there is herd behavior involved with the demand for vodka redbulls and other caffeinated beverages at bars, as college students and young adults order these drinks quite often, and imitate one

another to appear in the know. These type of drinks are still very dangerous for the same reasons Four Loko is considered dangerous, however they are allowed to be served. In any manner, it appears that Four Loko's popularity uprising, bubble bursting and subsequent downfall through illegality are all delicately intertwined in a web of clashing herds. It is apparent anecdotally that herd behavior exists in the real world based on these examples. In the case of the network television stations herding this shows that even large companies feed off, and imitate one another to survive in the real world of business. In addition, the Hey and Morone (2003) example showed that herding can be shown experimentally, as well as quantitatively to an extent. This collection of literature provides encouragement for the endgame of this thesis; to show herding exists in the housing market and that its effects can be quantified to an extent through a proxy variable.

D. The importance of Information: Information Cascades

This section examines the idea of information cascade, which is thought to play an important role in the creation of herd behavior. A model of this idea is also presented in this section.

Through communication, either verbal or non-verbal in nature, one can learn or view the consequences of another person's actions. It may be less time consuming and resource efficient to learn from the actions and thoughts of others, rather than seeking out and analyzing each and every alternative. It is often thought that children imitate the actions of others in order to learn and to acclimate. The same may be true of older people that make decisions. Decision makers oftentimes observe others and rationalize the

information gained from this observation. This influence is known as observational learning, or social learning (Bikhchandani et al, 1998). Social learning is involved to a high degree in herd behavior, and they are sometimes difficult to examine separately.

In the typical models of market equilibrium, economic theory leads economists to believe that simultaneously executing a large portion of trades will produce efficient outcomes as long as prices are set at the correct level, presumably by a Walrasian auctioneer (Avery et al, 1998). Many have asked what is the cause of the discrepancy between what happens in actuality and what should happen according to theory. Banaerjee (1992) suggests that herd behavior, or at least imitation in general, is at the root of this problem. This author is not alone, as Bikhchandani et al (1998) supports the same idea, specifically when consumers act in a sequential manner rather than in a concurrent one. Both papers showed that herd behavior can result from private information not publicly shared. In any case, this herding can cause serious problems, and at the very least a socially inefficient outcome (Hey and Morone, 2004). Several papers have indicated that the first few agents making a decision in the short run will have an overwhelmingly disproportionate effect on the long-run market outcome. The authors attribute this effect to what is known as information cascade.

A real life example of information cascade and its strong influence occurred in 1995, when two management leaders, Michael Treacy and Fred Wierseman published a business strategy book, and then unbeknownst to the general public, purchased fifty-thousand of their own books (Bikhchandani, Hirshleifer, & Welch, 1998). The thousands of books were specifically purchased from stores monitored by the New York Times best-sellers list. Subsequently, even with modest reviews at best, the book made the New

York Times bestseller list as a result. Following, the book made the bestsellers list week after week and continued to sell off the shelves, even without the authors doing anything else to promote their product. Bikchandani et al (1998) suggests this is the case since consumers learn and act based to a high degree on other consumers' actions. Just by being on the bestseller list, a book with moderate potential was catapulted into a great success. Although it could be argued that the book's success was as a result of being well written and business savvy, it is clear the business guru authors pinpointed a successful strategy for selling the book by dissembling what was going on in the market at that time, regardless of the actual contents.

There are many other examples of information cascades and their influences. One such example is ancient Romans hiring professional mourners to attend their families funerals in order to appear more attended and to make it seem as if people were mourning for a beloved family member. The brand Hennessy Cognac has been known to hire actors and models to buy their product in expensive restaurants in front of other consumers (Bikhchandi et al., 1998). With these examples in mind, it is important to remember that things may not always be what they appear at first sight. Information is easily distorted, and therefore it easily violates the traditional assumption that information is symmetric, and available to all. This is not the case. With this in mind, this information asymmetry that exists heavily affects herd behavior, and may even be a cause. Information cascade have been modeled in the economic literature, as is presented in this section.

a. An Example of a Sequential Decision Making Model of Information Cascade

A large number of experiments rely on pseudo-realistic scenarios that are controlled by the experimenter to simulate behaviors by a decision maker. Bikhchandi et al. (1998) uses two approaches, both probabilistic in nature, to model a behavioral scenario. In the first approach, each individual begins with a degree of private information, is then allowed to obtain a portion of information from their predecessors in the experiment, and finally is called to produce an action. This is called the observable actions scenario, since the individual decision makers do not know the private signals their predecessors see; only the final choice they made. In the second scenario, known as the observable signals scenario, the individuals are allowed to see the actions of their predecessors as well as the signals their predecessors viewed. These results of these scenarios can then be compared. This model is sequential in nature, which has advantages and disadvantages in the real world.

The authors specifically looked at an example which involved a risk neutral individual, and whether they select or reject a particular action. Each participant is given a high or low signal to base his or her decision on. A high signal means that the action is likely desirable, whereas a low signal means that the action is likely undesirable. The order that the individuals selected in, in addition to the individuals' selections are known to all participants as well.

The first individual could get a high or a low signal pertaining to the action, and will likely base his or her decision entirely on the signal. The second person could get a high or low signal, and will make a decision based on his or her private signal and the known decision of the predecessor. If the first person received a high signal and went

with the high-oriented action, then if the second person gets a high signal he or she will very likely go with that same decision. However, if he or she receives a low signal, then the choice is likely fifty-fifty for and against the action. The third person could view two people accepting the action, two people rejecting the action, or one person rejecting and the other accepting. If the first two accepted and he received a low signal, it is still likely that he will go against his private information and opt to accept the action or decision. In this way, a trickle-down effect occurs, and every person by this point onward will make the decision without consulting his or her private information. The decision will be the same as the first two people who selected, if they agreed, or the majority decision out of three if the first two did not agree. If the decision is to accept the action, the authors call this an "up cascade", whereas a rejection is considered a "down Cascade" (Bikhchandani et al, 1998). In total, this model and example are highly constrained and probabilistic, which is common for the sequential decision making models that exist.

One would assume that actions are a direct reflection of information and information signaling, and therefore if all actions of predecessors are able to be observed, then the aggregated information will improve until the true value is attained at some point in time. Nevertheless, Bikhchandani et al, (1998), by comparing their observable actions scenario to their observable signals scenario showed this is not always the case. Their results suggested that in the observable actions case, it was oftentimes found that individuals converged in decision making toward an entirely wrong action rather than the correct action. They did not find this in the observable signals case. The authors always found that the behavior of individuals was idiosyncratic, i.e. the first few decision makers effectively decided the choices of all the subsequent decision makers.

However, if it is played out in an experiment, there will be some who defect from the typical pattern displayed based on their private information. If a person uses his or her correct private information to make a decision that goes against the decisions of the previous agents, then all of the followers after this person would benefit and possibly make different decisions (Bikhchandani et al, 1998). "Such altruistic behavior by a number of individuals would ultimately lead to almost perfectly accurate decisions in the long run" (Bikhchandani et al, 1998). However, this is not the end result, since individuals instead act in their own self interest, and in turn rationally imitate others. Work done by Bernardo and Welch (1997) shows that the standouts, which may be irrationally overconfident in placing such heavy weight on their own private information compared to others, could end up being the most important decision makers as a result. Hirshleifer and Noah (1997) suggest a similar notion, in that social misfits or newcomers to a situation may provide insights and make decisions that benefit the society more than others.

Although these experiments are useful in some contexts, they are not very useful in quantifying behavior in economics. They set the stage for application of behavior and information signaling in economics, but they are difficult to apply in the real world, as economists' model rational individual behavior, which may not be realistic. Therefore, one goal of this paper is to attempt to apply the ideas herd behavior, which comes as a result of information cascade, to an econometric model.

This chapter has introduced various ideas pertaining to social influence, past ideas formulated with respect to the early roots of behavioral economics, information cascade, and most importantly herd behavior, and the markets it has been shown to influence. The

next chapter will dig deeper into the behavior of herd behavior, through the perspective of social psychology.

Chapter 3

Social Psychology's Far Reaching Influence

The purpose of this chapter is to show that herd behavior is not confined to the realm of economics and markets. Herd behavior has been accounted for in the realm of social psychology as well as economics. Although seemingly divergent fields, social psychology and economics are not mutually exclusive disciplines. For many decades, psychologists have come to find some insightful and counterintuitive experimental results that may make economists question some of the most fundamental aspects of neoclassical economic theory. Of the economists who have come to understand the implications of the experimental results with respect to economics, it would be difficult to argue that the acclaimed Robert Shiller was not a pioneer in this brand of thinking, albeit psychologists may have tried previously. Only by questioning economic assumptions, providing evidence against them, and integrating in human behavior into Economic models, can economists work to better understand economics in the real world, and apply that understanding. The following sections exemplify some of the fascinating results of social psychology experiments.

A. Social Psychologies' Early Experimental Results and "converging behavior"

Various experimental studies in social psychology provide interesting results with respect to human behavior, that have implications for our understanding of herd behavior in economics.

a. *Shedding Some light on Converging Behavior*

Early experimental results Muzafer Sherif (1936) was a pioneer in social psychology who wanted to see how the reality of individuals was perceived, and how social frames of reference would affect the decision-making capability of subjects under experimental conditions. A principle known as the "autokinetic illusion" was used as the foundation of his experiments. Basically, the phenomenon is useful because while in complete darkness, if a person does not have any other stimuli to anchor where a light is within the darkness, the participant will have a difficult time judging if a light stimulus moves, or how far that stimulus moves. In reality, in the experiment, the light never moves, it just appears to move. With this in mind, he placed subjects in a completely darkened room, and a stimulus of light would be shown in every trial. He would ask individuals to shout out how far they thought the light moved while in the darkness. The range of answers varied wildly on an individual basis, from centimeters to multiple feet.

However, an interesting phenomenon occurred when multiple people were shown the same stimulus within the same room, when they could hear each other shout out answers. Their answers began to converge towards a mean distance, or a social norm. If a person had said that the stimulus moved farther than the average response, then that person tended to lower the distance he or she estimated that the light moved. On the other side of spectrum, if a person thought the stimulus did not move as far as the mean movement response, then he or she tended to increase the guess distance. Not only did this affect the guesses within the room at that point, but the group experience actually tended to leave a lasting impression on each individual that would carry over into that

individual being in the room alone. In other words, if a person had been overestimating the distance compared to the mean, they tended to guess far lower than they had been before the group conformity experiment. This result was even seen up to a year after the group experience. Even with the most ambiguous of tasks, guessing the movement length of light that did not actually occur, this pattern could be observed. Clearly, a group of peers can influence decision making of the individual to a high degree. Not only does a group of peers affect decision making in the short term, but a group can leave an indelible impression on the beliefs of an individual. This is important because not only do groups influence the decision making of individuals, they help formulate the decisions of other groups. This influence could be very strong in economic markets.

b. *The Asch Experiment Paradigm*

Solomon Asch was a well knownsocial psychologist, who performed a variety of experiments that produced very surprising results for his period within the 1950's. The work has garnered far-reaching influence, well beyond his time, and has even shed light into additional realms like economics; which in turn changed the opinions of some economists and made it apparent in some economic models. It is first important to understand exactly what Asch's experiments entailed before the economic underpinnings that are challenged by his results are analyzed.

Asch wanted to know whether individuals would alter their behavior based on a majority opinion. Although a variety of scenarios were used in his experiments, the basic paradigm is as follows (Asch, 1951). In order to carry out the experiment, Asch would place seven to nine individuals within one room and would ask the individuals a series of questions pertaining to measurements of lines. Of the individuals, all but one were

deemed confederates, i.e. they would give the wrong answer to a question some of the time. The subjects were asked to match the length of one line to another line in a group of three unequal lines, and for the most part, the answer was relatively obvious. The non-confederate, or the main subject of the experiment, was intentionally placed in order to answer the question last, or at least after a majority of the confederates had already given their response. In the majority of cases, the confederates would agree with the subject on the correct line answer, but during some trials, most of the confederates, if not all would all intentionally answer the question incorrectly. In this instance, the non-confederate would have to go against the group in order to select a correct response, with his private information of the length of the line in the back of his mind. Each of the individuals utilized in the trials was a male college student.

A statistic was calculated, known as the majority effect, which measured the percentage of responses in which the non-confederate would side with the confederates on an incorrect selection. A control group with no confederates had almost no errors when selecting a line matchup. On the other hand, nearly a third of the responses by the non-confederate were conformed to the erroneous selection by the confederate majority. In addition, around a quarter of the participants were completely independent of the erroneous confederate group. Nevertheless, some subjects appeared to always defy the group if they presented a wrong answer, whereas others always coincided with the group in total conformity. Asch remarked that individuals' reactions varied, from completely assured of his or her self to very disoriented and confused with what to do in the task (Shiller, 2005). Much of the time, the subjects even appeared dismayed or incredibly

stressed before giving their pending decision, possibly due to fear of being seen as unintelligent or foolish (Asch, 1951).

In addition to the calculated statistic, Asch specifically wanted to know why individuals would side with the confederates at all if the task was so incredibly simple with respect to selecting the correct answer. Based on his original experiment, he first believed that his experiments exemplified the vast social pressures that individuals are under at all times, and how those social pressures could conflict with rational thought. However, in time, with the addition of more experimental evidence, this turned out not to be the full story.

A few years after the original conformity experiment, Deutsch and Gerard (1955) did a version of the study in which they told the subjects that they were anonymously placed in a group with individuals they could not see and could only see the responses of those individuals through a signaling board. The subjects would respond to a similar task as in Asch's experiment, but through pressing a button. Deutsch and Gerard (1955) made the experiment function with no group actually existing. One would assume that in this setup variant that the subject would not make any, or very few mistakes. Surprisingly, this was not the experimental result. The subjects actually made just as many mistakes when they were not in a face to face condition with a group, as if they had been. Therefore, the only explanation for this conforming behavior, was that the subjects believed that all the other people could not be incorrect, and that their personal thoughts must be in turn incorrect. "They were reacting to the information that a large group of people had reached a judgment different from theirs, rather than merely the fear of expressing a contrary opinion in front of a group. This behavior is a matter of rational

calculation: in everyday living we have learned that when a large group of people is unanimous in its judgment on a question of simple fact, the members of that group are most certainly right. The anxiety and distress that Asch's subjects expressed may have come partly from their conclusion that their own senses were somehow not reliable" (Shiller, 2005, pp 158). Therefore, not only can groups negatively influence decision making, but they can also cause psychological distress through making a person question their decision-making ability. This once again could have indelible effects on a rational person's thought process and subsequently a person's choice.

c. *A Shocking Revelation*

Stanley Milgram (1963) looked into the power of authority and how it affects the decision making of others. Interestingly, his original question was to find out if those who participated in the terrible Nazi war crimes were just subordinates following orders that were clearly not morally sound. A summary of the experiment is as follows: one subject was asked to deliver electric shocks to another individual in a room that was close by. The shocks were supposed to increase in voltage, while the experimenter told the subject to continue administering the shocks. Unknowingly to the subject, the person they were supposed to be delivering shocks to was actually a confederate that was to pretend to feel the shocks and as a result make fake noises that indicated severe pain and suffering. Eventually, as the shocks were at a very high voltage, and as the confederate pleaded with the subject to discontinue the administration of the shocks, many of the subjects continued the administration when being encouraged by the experimenter as he told the subjects the shocks would not cause any permanent damage. Almost two thirds of the subjects continued with the shocks at these incredibly high voltage levels, some even

deriving enjoyment from the encouragement of the experimenter. One way of interpreting this result would be to say that power of authority has a great deal of influence on the mind of a subordinate individual. Another way to interpret this result, would be to say that people learn over their lifetimes that experts tend to be right in a situation, even when their private information would indicate otherwise. In this way, the experimental results indicate that people learn to rely on authorities, and that their actions tend to reinforce this notion.

Milgram (1974) sums up his take on the experiment very well. "The legal and philosophic aspects of obedience are of enormous importance, but they say very little about how most people behave in concrete situations. I set up a simple experiment at Yale University to test how much pain an ordinary citizen would inflict on another person simply because an experimental scientist ordered him to do so. Stark authority was pitted against the subjects' strongest moral imperatives against hurting others, and, with the subjects' ears ringing with the screams of the victims, authority won more often than not. The extreme willingness of adults to go to almost any lengths on the command of an authority constitutes the chief finding of the study and the fact most urgently demanding explanation." If authority can be used in this way, to force a person into hurting another with no consequence, into what sphere does this authority figure not extend its influence? Clearly, authority figures can have a great impact on the decision making of the individual, and in turn can cause the masses to tweak their decision making towards a certain end. If authority figures have this much power over an individual's decision making, it is evident that they could probably influence large crowds of people as well.

This being said, if a media mogul, the President or the highest paid realtor told a person with inferior knowledge to do something, it is likely that they will follow.

B. Economic Importance

Shiller (2005) believes that the Asch and Milgram experiments are incredibly important for the understanding of the economic behavior of individuals in any market. Even when a person has private information that clearly does not coincide with a majority view on a topic or with the judgment of a so-called expert in a field, that person will tend to modify his or her behavior to the majority and or expert. This is even the case in completely unambiguous situations with clear answers as shown in Asch (1951). This may not be a completely irrational pattern of judgment, however. There are likely many instances that people have in which they have made a wrong decision, against the decision making process of the majority or an expert. By learning to align with others' decision-making rather than contradict the majority or expert, people may have learned to acclimate from their experiences, and as a result change behavior due to being risk adverse. Shiller (2005) believes this plays a large role in what he calls the overconfidence phenomenon. "…People are respectful of authorities in formulating the opinions about which they will later be so overconfident, transferring their confidence in authorities to their own judgments based upon them" (Shiller, 2005, pp 159). In this way, it should not come as a surprise that people trust the expert opinions of others, and as a result modify their own thought processes and behavior to coincide with those opinions. The implications of this phenomenon are far reaching, and may represent a herd like mentality that many fall into without a great deal of conscious thought.

Beyond even this notion, Shiller (2005) asserts that it is the capabilities of the human mind that have allowed successful computational processing for thousands of years prior to the advent of the internet, email or even the printed word. It is the ability of people to communicate effectively that has evolutionarily favored the Homo sapiens. Incessant conversation must have a purpose, and that purpose is likely to rapidly spread important information. It is when the information becomes complicated, like when trying to describe a certain market, the math involved with market predictions and economic statistics that the transmission of information becomes difficult, less frequent, and not perfect as we assume in many economic models (Shiller, 2005). Therefore, this idea must be taken into account when examining the most fundamental economic ideas and when developing economic models, as they pertain to the herd effect.

Chapter 4

Bubble, Bubble, Toil and Trouble

In this chapter, the economic debate over the phenomenon of the speculative bubble is defined and discussed in length. Examples of bubbles that have occurred are presented, including historical, famous bubbles and the dot-com bubble that occurred relatively recently in the United States. Before discussing the recent housing bubble, which is a main focus of this paper, what it means to be a bubble should be defined and discussed.

A. The Speculative Bubble

The speculative economic bubble is an economic phenomenon that is commonly talked about and argued over. Many support that speculative bubbles exist, plague the economy and can be prevented. Others argue that they do not actually exist or exist only in hindsight after they burst. A speculative economic bubble is a difficult term to define. At the core, it may be identified as a situation in which asset prices rise above the fundamental economic value of those assets. The speculative bubble is usually only used as a term ex post in order to explain how asset prices or entire national economies grow unsustainably large, then the situation quickly turns into a predicament. However, most economists agree that the recent financial crisis was linked to a housing bubble that occurred in the United States as a result of the practices occurring in the housing market in recent years. In order to delve deeper into the recent bubble, it is important to review the literature on speculative bubbles, look at examples of various bubbles and their effects that have occurred in the past.

B. Bubbles in the Literature

It is difficult to give an unambiguous definition of a bubble that applies to all situations. This is one of the reasons that the term is so vehemently contested and argued over. Those who believe the rational individual can overcome all traps of irrationality or false ideas tend to reject the idea of a speculative bubble. If all are viewed as rational, and all markets are efficient, then it follows that asset prices must in turn be driven solely by the fundamentals of the market (Thomas, 2003). Some support this idea and the possibility that bubbles do not exist.

Garber (1990) asserts that bubbles actually do not exist, but rather are an easy way for economists to glaze over the reality of underlying problems that could be identified, but are not due to difficulty in doing just that. Without teasing out all possible explanations and market fundamentals for why something occurred, an event should not be classified as a speculative bubble (Garber, 1990). Some economists may get caught up in the "grand brilliance" of events involving great speculation in the market, which provide great anecdotes, but lack in-depth analysis. Garber (1990) provides what he thinks are fundamental reasons that Tulip Mania and South Sea bubble are not truly bubbles. His thoughts will be discussed in greater detail when these events are examined.

Shiller (2005) does not agree with Garber. He defines a bubble as a "situation in which news of price increases spurs investor enthusiasm, which spreads by psychological contagion from person to person, in the process amplifying stories that might justify the price increases and bringing in a larger and larger class of investors, who, despite doubts about real the real value of an investment, are drawn to it partly through envy of others ' successes and partly through a gambler's excitement." It is important to have a sense of

how bubbles and market fundamentals may interact, in order to gain an appreciation for both sides of the argument pertaining to speculative bubbles. If speculative bubbles really do not exist, then this would detract quite a bit from my proposed ideas about herd behavior and its effects on the U.S. housing bubble.

Market fundamentals can be measured in a variety of ways, although one preferred measure is in terms of the discounted future cash flows an asset may accrue (Lansing, 2003). With this in mind, although bubbles are contested, it has been shown that even with these fundamental values calculated, asset prices do rise to the point of being too high for goods during bubble periods. This pattern normally occurs until prices become exceedingly high. An event usually plays a part in immobilizing the pattern of increased buying, which then causes a rapid decline in price and in turn results in many exiting the market for a particular good. Some have tried to analyze exactly why bubbles form, as asset prices become volatile and look quite different from their fundamental value. Wang and Wen (2009) used an empirical investigation to address this question. Through their data analysis, they concluded that boom-bust cycles provided by bubbles could produce massive asset price movements, many times more volatile than fundamental economics could predict. Possible causes of these run-ups in the prices of assets may include cultural changes, more media coverage of the business sectors, growth in investment, spurs of technology, government deregulation, an expansionary monetary policy, over-optimistic consumer sentiment and a perceived decline in inflation (Shiller, 2005). While these things may be causes, feed-back loops also contribute to bubble formation. For example, ostentatious stories of investors making windfall profits make

those investors and others more likely buy into a market, even if fundamentally the market is not a great one to invest in and the stories are embellished.

At the same time, another characteristic of most bubbles is that investors, who cause excessive price increases, begin explaining price increases based on outside causes which have nothing to do with the actual price increases. For example, a "new era" in economics could be this outside cause, or another such idea. In this way the new era is viewed as fundamentally different from the old era. Just by saying there is a new era occurring, influenced players can influence prices to continue to rise as more individuals enter the market and buy assets based on market forecasts. This creates a price spiral, which eventually becomes a bubble. Shiller (2005) compares this phenomenon to an Ouija board, in which "players are encouraged to interpret the meaning of movements in their hands and to distill forecasts from them." This being said, it may be the case that something other than market fundamentals is affecting the market itself.

Keynes (1936) stated eloquently the predicament that speculation and bubbles put the economy in and the difficulty in preventing such predicaments "If I may be allowed to appropriate the term speculation for the activity of forecasting the psychology of the market, and the term enterprise for the activity of forecasting the prospective yield of assets over their whole life it is by no means always the case that speculation predominates enterprise. As the organization of investment markets improves, the risk of predominance of speculation does, however, increase...Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation" (Keynes, 1936, 158-159). Even all of

this time ago, Keynes realized that speculation could cause a serious problem in the realm of economics, and that bubbles certainly played a part in this.

C. Famous Bubbles of the Past

There are various bubbles of the past that have been celebrated for the unique situations that were occurring at the time in the respective economic markets. This section will discuss Tulip Mania and the South Sea Bubble, two instances in which speculative bubbles, and possible herding, led to economic crises. In addition, this section provides a background on recent bubble that occurred in the U.S., known as the Dot-Com Bubble.

a. Tulip Mania

When one speaks of speculative bubbles of the past, it is highly likely that they will discuss Tulip Mania. Popular culture and general public opinion have linked an event that occurred in Holland, known as "Tulip Mania," during the mid-seventeenth century, to one of the first examples of a speculative market bubble. The older generations of economists give a warning to younger generations to avoid or remain skeptical when referring to speculative markets dealing with assets, so strongly that Tulip Mania has become a suitable synonym for the phenomenon of Ponzi schemes, chain mail and bubbles (Garber, 1989). Although authors' opinions differ, and it is difficult to separate fact from fiction, one thing is for certain; the event that occurred during this period appears ludicrous at face value to the point where it almost cannot be belied, yet still something strange did happen.

The event was really given life in a book written by Charles Mackay called the Extraordinary Popular Delusions and the Madness of Crowds, in 1841. Mackay proposed that large parcels of land, expensive animals, and years of wages were traded for tulips (Mackay, 1841). According to Mackay (1841), during this time period, tulips were the item that everyone in the Dutch society wanted to garner and use to their financial advantage. As Mackay (1841) stated so eloquently, "in 1634, the rage among the Dutch to possess them was so great that the ordinary industry of the country was neglected, and the population, even to its lowest dregs, embarked in the tulip trade." With this account in mind, many believe that the Dutch went from rational, fiscally responsible individuals, to those caught up in tulip-bulb market frenzy. Prices for tulips continued to rise at exponential rates, practically faster than any good within the known history of economics. Prices may have increased to the point in which a year of a skilled artisan's salary was less than a single common bulb (Mackay, 1841). It is hard in the present to realize just what tulips represented to the Dutch people. A novelty, a rarity, a sign of worldliness, a piece of the exotic East, an item to be collected and cherished, the tulip represented much more than what individuals give it credit for today (Goldgar, 2008).

The event, as characterized by Mackay, has been criticized by many recently although the situation fundamentally involved overpriced tulips, priced well above any intrinsic value, that caused a panic, and subsequent collapse of the market (Goldgar, 2008). Others have criticized Mackay, saying that he plagiarized the work from a previous author and additionally embellished the stories to the point of falsehood (Garber, 1989). Even as Mackay claimed that a large portion of his book is dedicated to Tulip Mania, in actuality it only comprised about 7 pages of his entire text (Garber,

1989). Therefore, his account must be taken with a grain of salt. One may question why the Tulip market was subject to so much envy and splurging.

The tulip was indigenous to Turkey, but reached parts of Europe by the mid sixteenth century. Eventually, the flower made its way into the Netherlands, where it flourished as a flower fit for the wealthy. The Dutch professional flower caretakers took matters into their own hands and created hundreds of varieties that eventually garnered very high prices. However, a turn in the market occurred when nonprofessionals entered the market around 1634, and the bulbs began fetching enormous prices, although some are skeptical of how high those prices actually were (Garber, 1989). The rarest bulbs could be sold for an extraordinary sum, whereas even the most common bulbs could garner a very hefty sum as well.

There were some serious underlying flaws in the market for tulip bulbs. These include the fact that the bulbs only sprouted one time a year and the tulips that arose were incredibly variable. Therefore, buyers and sellers usually negotiated payments in the form of contracts intended for future payment and subsequent delivery of the bulbs (Goldgar, 2008). With the established norms of effectively having spot and futures markets of a non-essential agricultural crop, participants in the market should have asked many questions at the time. What would happen if the bulbs never sprouted from the ground? What would happen if a buyer refused to pay? It seems inevitable that the market for tulip bulbs would fail because of these fundamental flaws.

Some authors have tried to rationalize what happened in Tulip Mania, by attributing the phenomenon to a variety of factors beyond a speculative bubble. Other

flowers that existed at the same time period in Holland saw a quick reduction in prices, although no other flower had prices that fell anywhere near as readily as the tulip. Nevertheless, some contest that this irrational event occurring in Holland was not really a bubble at all, but instead was the result of various outside influences. These influences may include but are not limited to, the bubonic plague making individuals fanatical, the possibility that the whole market was a game being played by the most wealthy bourgeoisie at the time, or even that the tulip was more of a status symbol than a flower. According to Goldgar (2008), it is hard in the present to realize just what tulips represented to the Dutch people. In this way, the tulip was indicative of the "snob effect" (Leibenstein, 1950).

Many cite as important the rapid rise in price of moderately rare bulbs and the rapid decline of these prices. However, not all agree that this instance was an example of market irrationalit; some claim rather an influx of too many bulbs within the market, which forced prices down. Since the tulip bulb is a non-essential agriculture crop, that could in theory be produced readily, rapidly and indefinitely, a rise in price for the tulip should in turn lead to further growing of the product until the market forces balance supply and demand at a market equilibrium (Garber, 1989). Yet, for the rarest of the rare bulbs, as had been done for decades, the very affluent continued paying top dollar to display them within their homes (Garber, 1989). The irrational aspect seems to be more focused on the fact that common bulbs also fell into exorbitant price ranges.

As commoners caught on to the tulip trade, there was an influx of buyers and sellers of tulip bulbs. This in turn led to a niche market instead expanding into something

quite extraordinary. At this point in time, the forms of communication were uncomplicated and not very fast. Yet, even with just word of mouth communication and basic forms of writing as a communication source, word spread like wildfire. This shows that even with the most basic of conditions, the behavior and opinions of others can cause drastic decision-making changes. This event may have been one of the first examples of herd behavior in an asset market. Even this far back in time, the existence of herd behavior could be implied by this event. In addition, in this case, herd behavior may be present in an asset bubble. This example parallels to a degree the market for housing during the recent bubble. Therefore, this further suggests that herding may exist in the housing market during the bubble period.

The Tulip metaphor still reigns evocative in today's culture of a speculative bubble, serving as one of the first personifying anecdotes of the economic crises of the past, regardless of what actually occurred. However, it is also interesting that in today's age it is thought that up to seventy percent of flower production and up to ninety percent of the flower market is in some way intertwined with the Dutch, with tulips anchoring the entire system (Goldgar, 2008). Even with this huge bubble bursting in the past, the tulip remains a staple and a very profitable asset. Maybe Tulip Mania was not such a bad omen for the Dutch after all.

b. Bubbles floating on the South Sea

The South Sea Bubble, similar to Tulip Mania, was an early, and almost undeniably bizarre occurrence in 1720. It occurred in Britain and is a very common event studied by economists. At this point in time, Britain had fragile banking and stock markets, as well as an increasingly growing and liberalized economy (Thomas, 2003). Investment opportunities were soaring, innovations were occurring, and change was readily occurring. England, however, was also in a great deal of debt due to the amount of wars the country started or became involved in. To say the least, the country was in a precarious position.

The South Sea Company was a joint-stock company which was created to challenge both the bank of England and the East India Company as a loan provider (Thomas, 2003). The South Sea Company bought out the English debt in exchange for a trade monopoly in the famed, rich South Seas in addition to a high interest rate from the crown. This occurred multiple times, and the government saw this as profitable. It could convert high interest debt that was also difficult to get rid of into stock of the South Sea Company (Thomas, 2003). This debt included both redeemable and irredeemable debt of the government. As a result, citizens could effectively buy the debt of England by buying these shares.

Not only was this a precarious situation, but the company began to spread inflated stories about itself, and speculation began to run rampant. In addition, politicians and other wealthy bourgeoisie were given very favorable deals on the stock, which in turn correlated the interests of the wealthy with the success of the company. Other companies started emerging into the market, similar to the South Sea Company, in order

to reap the incredible benefits. The government saw this as a problem, and in turn passed what is now referred to as the Bubble Act, which inhibited the formation of joint stock companies not given permission by the crown. This was supposed to give a boost to the South Sea company by adding another level of legitimacy, but instead, due to speculation, prices rose so high that people began selling off their stock for enormous profits. At this point in time, South Sea had taken on nearly eighty percent of the public's "irredeemables" and eighty-five percent of the "redeemables," an unsustainable amount of the public debt (Garber, 1990). In addition, speculative situations in other centers of commerce including in Paris and Amsterdam, were ending (Thomas, 2003). From September to October, the stock fell rapidly from 775 to 250 per share (Garber, 1990). At this point, it has been argued by some that a liquidity crisis then ensued while parliamentary backing was deficient, bringing down the shares of the company, and in turn making shareholders, especially those who had recently entered the market, lose an insurmountable amount of money (Thomas, 2003). Others, who escaped the market on time, made out with riches.

The failing of this company had a tremendous effect on England's economy, and as a result shed a negative spotlight on England's leadership. Many of those affected by the bubble lost all of their financial means, which is one of the reasons this speculative bubble has remained in the minds of economists and popular culture for around three hundred years. Although this event happened quite some time ago, speculative bubbles still continue to shape the way many think in the realm of economics. Historical bubbles, occurring in past centuries are not the only ones that economists have experienced,

however, as recently in the United States we have been plagued by the speculative bubble phenomenon.

c. Dot Com Bubble

During the period of 1995-2000, the internet became the next jousting ground in the long history of speculative bubbles. The internet entered many residences all around the world. It began with the release of the first web browser, in 1993, known as the Mosaic Web Browser (Shiller, 2005). The browser went public the following year, which allowed the emergence of the World Wide Web. However, not everyone at that point had access to the internet or a computer in general, and therefore it took a few years before the web really made its deciding mark on the world. Companies, especially those in the technology, began to see record earnings, which many attributed to the advent of the internet.

The recent advancement in technology was in the public spotlight. Many companies as well as consumers flocked towards new technology. Many companies saw the World Wide Web as a new horizon in business, and therefore began branching into that area. Other companies sprouted up, wanting to capitalize and reap the benefits of this new technology. These start-up companies are typically referred to as dot-com companies, based on their emergence on the internet, and the common .com added to their company names. These companies grew very quickly and stock prices in turn also grew at an exponential rate. Between 1998 and February 2000, "the internet earned over 1000 percent returns on its public equity. In fact, by this date, the internet sector equaled

6 percent of the market capitalization of all U.S. public companies and 20 percent of all publicly traded equity volume" (Ofek and Richardson, 2003, 1113)

However, not all was as it seemed. Behind the scenes, U.S. corporations were progressively recovering from a recession during the years of 1990 and 1991, in conjunction with the U.S. dollar being weak and a high demand for technological exports (Shiller, 2005). By the end of the year 2000, all of the returns through this incredible time period were effectively gone, and the bubble had burst. This may have been in part caused by substantial short sales restrictions for Internet stocks or by the fact that internet stocks were so incredibly volatile in the first place compared to non-internet based stocks (Ofek and Richardson, 2003). Other reasons may include investors being over-confident, speculation on individuals stocks being high and capital being easily obtained, all of which could have played a part in investors throwing money into technology rather than reading the market fundamentals. The Dot Com bubble put the U.S. economy in a precarious predicament, due to the failure of many startup companies. Consequently, this had adverse effects on the following years with respect to the U.S. economy. This coupled with the attack on September 11th, fighting wars on multiple fronts, and a long period of extremely low interest rates set by the Federal Reserve provided for an interesting mix in the early 2000's.

The various historical bubbles presented in this chapter all appear to have speculation influencing the market for each respective good. In the case of Tulip Mania, the tulip in effect became a luxury asset. However, as more individuals entered the market, it was clear that the market fundamentals would not hold up to such high demands considering tulips are a seasonal asset. The stock price for the South Sea

Company was incredibly inflated when compared to the actual fundamental worth. Once again, market fundamentals could not hold up, and the South Sea Bubble burst; although in this case the government in power at the time did help the formation and bursting of the bubble. The Dot-Com bubble is difficult to compare to the other two arcane bubbles, although the inflated price of stocks by companies that added a simple dot-com to their business name could not hold water for very long before the bubble burst. Incredibly high prices for goods with truly lower underlying values is underlying theme of these three bubbles. The other unifying factor is the number of people that herd into the market until it is flooded. It is as if everyone is in the market. This may imply herding is inherent in bubble formation based on these examples. With a historic understanding of existing bubbles, this exemplifies that bubbles can exist, specifically within asset markets, and that the housing market may be susceptible to herd behavior.

Chapter 5

Previous Models Used for Herd Behavior

This chapter examines a few of the various models used to represent herd behavior in economics and in other disciplines. Most of these models use an agent-based approach and provide for some interesting theoretical results. Nevertheless, there is very little empirical evidence of herd behavior that can be shown by these models, as most are math-based approaches of characterizing the behavior.

A. Sequential Models

Various disciplines including psychology, sociology, economics, and others have attempted to model herd behavior at the individual or group level. The majority of models use a great deal of probability, mathematics and specifically game theory in order to examine this behavior. It is also difficult to determine the difference between information cascade and herding in some of the models. However, for the majority of the models that exist involving information cascade and herding, it is almost always the case that information cascades tend to result in herd behavior. The investigation and modeling of behavior is nothing new, although recently progress has been made to involve the more intangible nature of human decision-making. Nevertheless, little has been done to investigate herd behavior from an econometric standpoint, as the following models indicate.

Granovetter (1976) influenced the literature on behavior and decision making specifically by looking at the individual level and in turn aggregating the individual decisions into a decision-making pool. His model was developed originally for use in sociology, but at the core, it is one of the first models pertaining to herding. His main

focus was on that of the threshold, which he defined as "the number or proportion of others who must make one decision before a given actor does so; this is the point where net benefits begin to exceed net costs for that particular actor" (Granovetter, 1976, 1420). He assumed that the actor used in his model was a rational, that individuals may require different levels of safety before taking on a riot or other herd action, and that individuals need a certain level of benefits in order to join a group in any behavior.

The model used a great deal of game theory and advanced mathematics in order to use a frequency distribution of thresholds to calculate an equilibrium number of individuals who make a specific decision. Granovetter (1976) also thought that all situations in addition to individuals were unique, and therefore it would be difficult to quantify an individual's behavior in a specific situation. The author was careful to differentiate between norms and thresholds as well, as he saw thresholds as being infused with elements usually associated with individual behavior that were lacking in a norm, including education, social class, and occupation in addition to others. At the same time, he believed his model gave some insight beyond the usual correlation of behavior with decision making, in that it allowed for aggregation and in turn a higher correlation between decision making and overall behavior.

One of his more interesting conclusions was the fact that some outcomes of events do not appear to intuitively be consistent with the underlying individual decision makers' thoughts, preferences and even actions. This conclusion sounds strikingly similar to one aspect of herd behavior as we view it today. He saw his model as accounting for, to a degree, this "paradox." Additionally, he believed that his work could be applied to riot behavior, voting, strikes and rumor diffusion, among a variety of other applications

(Granovetter, 1976). He also found that even within a group of people with incredibly similar preferences, frequency distribution outcomes may be drastically different from one another. The author also used his model to create an interesting figure pertaining to net benefits and threshold for an individual and joining in on riot behavior based on the number participating in the riot. He calculated the average threshold of joining in on this extreme herd behavior to be around thirty-eight percent of a crowd participating. Granovetter (1976) believed that his model was a step forward in bridging the gap between macro and micro levels of sociology, and possibly in turn the same could apply to economics. Many authors cite this paper as a seminal resource pertaining to sequential modeling, general behavior, and herding.

In the realm of economics, Banerjee (1992) effectively used an agent based model in order to delve into the topic of herd behavior. His so-called, "simple model" utilizes a sequential, probabilistic, and agent-based approach, which is very similar to Granovetter (1976). In order to show the herd effect, Banerjee created a game. One decision maker would make a choice and then would be followed by a decision maker that would make a choice. The second decision maker, and any decision maker thereafter, could in turn view the decisions of those who went before them. The result of Banerjee's model showed that herding could be observed in a model in which private information was known to some but was not shared with some or all of the other agents. At the same time, when acting in a sequential manner, individuals who have private information as well as public information garnered from those around them, tended to decide in a manner that could be detrimental to personal and even social welfare. The implications of this assessment could be viewed as far reaching, considering the social costs that could result.

Very similar results can be seen in the model created by Bikhchandani, Hirshleifer and Welch (1992), although their model involved a variety of modifications. These authors believed that beyond a certain point, all decision making becomes idiosyncratic to a very high degree in that the choices of a few individuals completely or nearly determine the decision making of all others down the propagation. Their model is similar to the sequential decision making models previously discussed, although further attention to detail is given by these authors. Their model differs from others in that they account for high and low signaling of information. For example, a low private signal would make a decision-maker question a particular decision, whereas a high signal would increase the likelihood of the decision-maker choosing a specific decision. The authors modify the existing herd behavior sequential models to attempt to integrate in the ideas of changing tastes or preferences, the idea of changing preferences as a result of differing individual payoffs and the fact that some agents may delay a choice instead of making one.

Although other models tend to take into account the quantity of information, and sometimes whether the information will lead to a less than optimal decision, Bikhchandani et al (1998) also takes into account the quality of information with respect to what they deem "precision." They give the example of a car mechanic who lives in a neighborhood with a variety of people that are going to purchase vehicles. If a cascade starts out in favor of buying a Toyota within the neighborhood, if the mechanic makes his decision relatively late in the sequential decision making model, others may in turn go against the cascade and follow the mechanic based on his or her expertise. From a different perspective, if a leading fashion designer decides first in a sequential decision

making model, this will entirely skew all of the subsequent agents to adopt a particular decision, unless the decision maker is at equal or above expertise level. In this way, modeling of expertise can provide some interesting results. The idea of capturing this "precision" in the model is not a new one. In fact, it is based on other long standing institutions, including the ancient Hebrew High Court and even the modern day U.S. Naval court. Both of these institutions vote in inverse order of ranking in order to decrease the likelihood of a top-down influence and in turn a fairer jury.

With these ideas in mind, Bihkchandani et al (1992) are basically the first to acknowledge that sequential decision making models are not entirely accurate in predicting behavior or providing for a long term view on a particular trend or fad. Small shocks occurring in a market can determine the degree in which a cascade or a herd is followed. These shocks include but are not limited to, the arrival of better informed individuals entering the market or model, the release of new public information and general shifts in the perception of adopting or rejecting a certain decision (Bihkchandani et al, 1992). Rather than just anecdotally speaking of these instances, Bihkchandani et al (1992) actually integrated this idea into their model by allowing for these shock types through a variety of means. Following the lead of these authors, this paper attempts to integrate herd behavior into a model as well, although, unlike these authors I make an econometric attempt.

B. The Contagion Model: A Theoretical Approach

Even individuals who are highly rational and aware of their decision making can sometimes participate in herd behavior. This is the case even if the individual is aware that herd behavior is occurring at the same time they are making a decision (Shiller, 2005). In this way, the decision to herd at the individual level may seem wholly rational. However, when this behavior is aggregated, it becomes clear that this creates an overall herding behavior which is highly irrational when looked at as a group. All models of informational cascade in turn are examples of a "failure of information about true fundamental value to be disseminated and evaluated" (Shiller, 2005, 160). Word of mouth communication is especially influential on the decision making of the individual.

Shiller (2005) compared herding behavior in economic modeling, and in turn word of mouth communication, to the modeling done by epidemiologists studying infection rates and mortality. In this way, contagion models could be applied to supplement our understanding of the way ideas and attitudes are transmitted pertaining to speculative bubbles (Shiller, 2005). In the simplest terms, an infection is has an infection rate, which can be defined as the rate in which an infection is transferred from a diseased individual to susceptible people around them. Conversely, there is a disease removal rate, which can be defined as how quickly the infected become free of disease through healing or death. Effectively, if a removal rate is zero, eventually nearly all if not all individuals susceptible to the disease will in fact get the disease. If the removal rate is more than zero but less than one, then the disease will likely follow a bell-shaped pattern, but not everyone will become infected. If the removal rate is equal to or higher than the infection

rate, then the disease will never occur. Although this may seem to be divergent from a possible model of herd behavior, it does to a degree tie into what may quantify the herding.

If a bad weather pattern strikes a certain area, this weather will force the residents inside near one another in close proximity. This in turn may lead to the infection rate becoming higher than the removal rate in this population, and in turn more individuals get sick. This type of thinking can be applied to herd behavior models according to Shiller due to word to mouth communication being similar to infection. Shiller (2005) believes that contagion models are not used often in describing economic phenomena due to the problem of mutation of the original "virus" or word of mouth communication, since people change the original message as it is passed along. However, with the advent of email communication, recorded teleconferences and the media, it is now possible to send persistent and accurate information, unlike that of the word of mouth communication we have dealt with in previous centuries.

In addition to this contagion model, Shiller cites the experiments of Alan Kirkman as a relevant source of information for herd behavior in financial markets. Kirkman has used contagion models in order to quantify ants exploiting their food resources. Through his experimental results, Kirkman found that even when presented with two exactly identical food sources the same distance away from the ants nest, the ants tend to overexploit one food source over the other food source. At the same time, they do exploit both sources to a degree. Even as the food sources continually are replenished, the attention of the ants tends to go from the favored source to the un-favored source until this role is reversed. Kirkman interprets this result as coming from the direct

communication between individual ants, due to pheromone recruitment and by tandem or contact recruitment. This, in terms of ants, would be word of mouth communication for humans. The contagion model has been used to quantify the behavior of the ants in this manner, and could, in theory, be applied to humans.

More practically, Shiller (2005) cites the work of sociologists that have used the contagion model to predict word of mouth communication and spread of ideas by quantifying the infection rate as the rate of communication of ideas, whereas the removal rate is the loss of information or loss of interest in that information. In this way, the dynamics of word to mouth communication could mimic a disease. Although incredibly useful to use for biological models, it is likely that the use of a contagion model to quantify human behavior is impractical at this point in time. Regardless if this type of model is practical as an application pertaining to herd behavior, it does add an interesting aspect that many do not consider.

The models previously used pertaining to herd behavior are varied, and include sequential decision making models and even a theoretical approach adapted from the work of epidemiologists. However, the unifying factor among these models is that they fail to be applicable in the real world. It is one thing to show that a behavior exists through theoretical models; it is another to show this exists in and has effects on real markets. Most of the models use an agent-based approach in addition to game theory, which are difficult ideas to apply to a whole market, like that of housing. Out of all of the literature concerning herd behavior, it is hard to find an attempt to econometrically capture herd behavior in an asset market. With this in mind, this thesis attempts to

identify herding in an asset market, through an econometric approach, with respect to the housing market and the recent bubble experienced in the United States.

Chapter 6

The Housing Market,

The Housing Bubble and its Suspected Causes

This chapter is dedicated to the housing market, which is the market that the empirical analysis in this paper uses to seek evidence of herd behavior. First, an examination of the unique aspects of housing is undertaken. From this point, housing bubbles are examined, including the recent housing bubble in the United States, which is another focus of this paper. The housing market conditions pre-bubble and during the bubble period are discussed. Taking this idea a step forward, a variety of the known causes of the housing bubble are then presented in greater detail.

A. Housing: A Unique Asset

This section presents the unique aspects of housing as an asset. Housing is an interesting good, since in most cases, individuals spend many times their yearly take-home income on residential purchases. In some ways, the purchasing of a home is the most important purchase many consumers make in their lives. Therefore, it is important to examine the ways that housing does and does not fit the standards of a normal asset.

The housing market is somewhat unique compared to the market for other goods. First of all, housing is a durable good. A single house, and the land that the house resides on, could last indefinitely, although buildings tend to depreciate to a degree over time. The vast majority of housing supply consists of already existing homes. Another facet of the homes, is that each one is different. Similar to a situation faced by car buyers and the

"market for lemons" it is difficult to assess the fundamental price of a home, since there is a great deal of heterogeneity and information asymmetry in the market. There is such a large variety of home types that it makes it difficult to quantify the value of a specific home based on the nuances therein. Thus, it is hard to juxtapose one home against another in a fair, objective manner.

In addition, there is a barrier to entry and exit in this market, unlike the market for many other goods. The financial barrier consists of the cost of finding a home, moving, real estate fees, legal costs, land transfer taxes, and deed fees, among others (Alhashimi and Dwyer, 2004). Not only do these costs exist, but they are also substantial, composing around fifteen percent of the total transaction cost for the seller and buyer (Alhashimi and Dwyer, 2004).

One of the more intriguing facets of the housing market, is the time it takes for things to get completed. Financing, design, construction, and a rate of transfer of property all can vary in time for each home purchase or sale, which produces lags. Therefore, the market adjusts at a slower rate than in a market for a typical asset (Alhashimi et al, 2004). Additionally, the real estate market is incredibly large, and therefore small changes in the market can have incredible effects on the overall economy.

Since homeownership can be considered both a consumptive good and an investment good, one would expect a return on the investment and a certain level of utility from using the good. This "duality effect" may help to explain why people tend to over-invest in and over-value homes (Alhashimi et al, 2004).

A seemingly negative aspect of homes is that they cannot usually be moved. In this way, the individual goes to the good, rather than the good going to the consumer. This is important, as one cannot just pack up their home and move it to another location that may be more in line with their tastes or preferences at a given time (Alhashimi et al, 2004). With respect to taste and preferences, the market for homes is also intriguing because people's preferences are very varied with respect to homes. Therefore, it becomes difficult to quantify how, for example, remodeling a home would affect the price of the home based on consumer preference.

Housing is clearly an extremely important industry for a variety of reasons. It serves as a gauge of the economic health of the U.S. and other economies around the world. Even though most people understand that housing is a unique good, in the scope of economics, it is typically treated and modeled through conventional market theory (Alkashimi and Dwyer, 2004). Rather than viewing housing for its perceived value, the product value is represented only through the market price of homes (Alkashimi and Dwyer, 2004). Some are highly critical of this idea, and believe that the only way to provide a realistic representation of the housing market is to integrate non-traditional economic ideas into house market modeling, which includes the behavior of buyers and sellers (Alkashimi and Dwyer, 2004). That being said, the empirical analysis presented in this paper attempts build on this idea by investigating behavior in the housing market, specifically the instance of herd behavior.

B. Housing Bubbles and Some Market Conditions Preceding the Recent Bubble

This section discusses housing market bubbles. It also discusses some of the interesting aspects of the housing market that were present during the recent housing bubble in the United. From this point, the known contributing factors of the housing bubble are discussed.

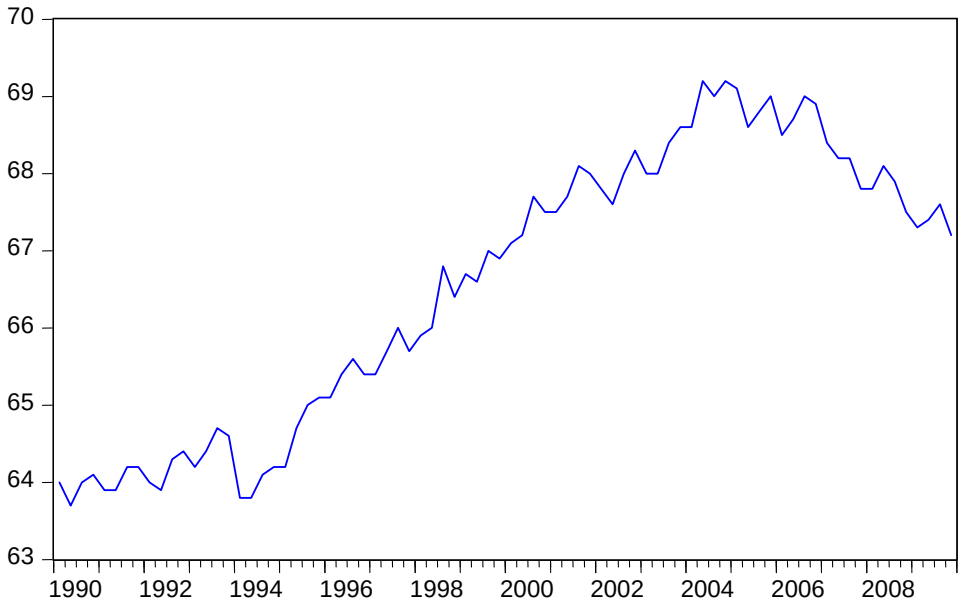
Bubbles can arguably occur in any economic market, including that of housing. Relatively similar to the historical bubbles presented previously, a housing bubble occurs when house valuations rise very quickly, until the point where they are unsustainable based on the underlying fundamentals of the economy. At this point, the price of housing in turn drops quickly, people stop entering the market, and individuals may be left with positive debt to equity ratios. Housing bubbles are thought to occur regionally or at a city-based level most often, and not as often at a national level, although national housing bubbles have been seen (Wong, 2002).

Housing crises and bubbles are nothing new, as many instances have occurred in the United States and abroad. Econometric analyses in the United States have shown that the areas that appear to have the most over-valued housing, on average suffer the biggest decline in home prices during gloomy housing market conditions (Himmelberg, Mayer and Sinai, 2005). In addition, research has shown that the 1997 housing market crash in Thailand, was marked by successive periods of rapid and persistent growth, excessive optimism pertaining to the housing market and high demand for housing (Wong, 2002). Some have argued that although it may seem counterintuitive to an extent, as a sector of the economy grows faster and at a persistent growth pattern, it may be the case that this in turn increases the volatility and vulnerability of that economic sector (Wong, 2002).

However, in the case of Thailand, housing was not the only issue, as a good portion of Asia was undergoing an overall financial crisis (Krugman, 2009).

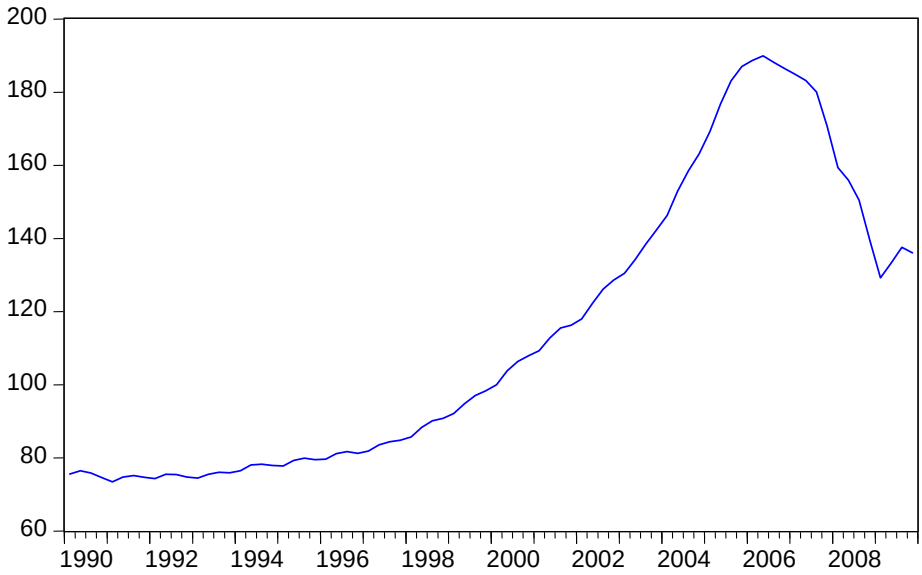
The U.S. recently underwent a crisis, which some refer to as the United States Housing Bubble or the 2008 Financial Crisis. Before this occurred, however, the market for housing did not appear, at first glance, to be in large trouble. Many people came into owning homes, allowing the U.S. to reach historical highs of homeownership as seen in figure 6-1.

Figure 6-1: Percentage of Non-Institutionalized Citizens that are Homeowners in the United States, from 1990 – 2009.



Source: FHFA

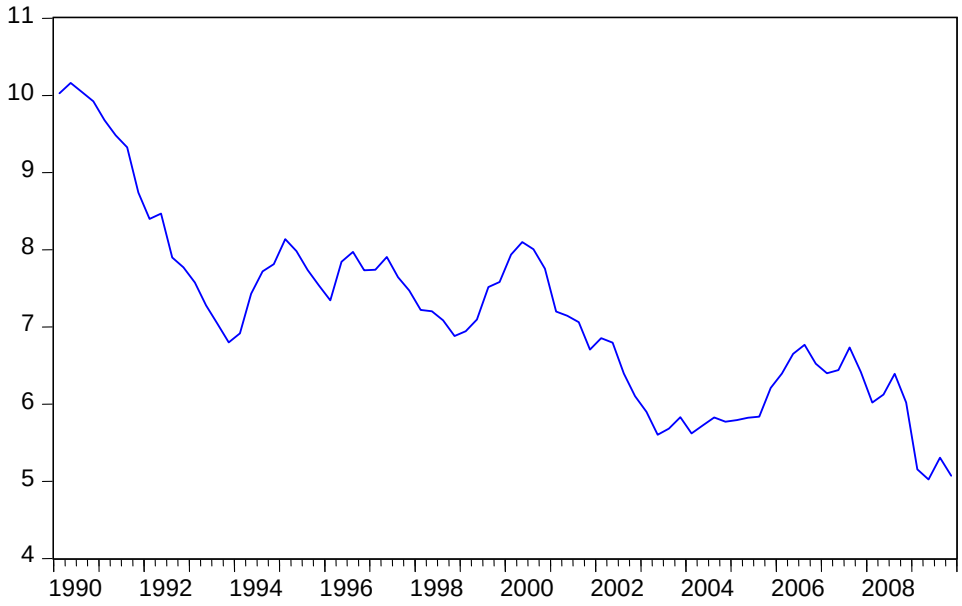
Figure 6-2: Federal Housing Finance Agency Housing Price Index, from 1990 to 2009



Source: FHFA

Those in the housing market prior to the bust saw a great deal of prosperity as a result of owning a home on average. The price of homes steadily rose over the years, and many believed that housing was a very sound investment. The few years prior to the bubble show a very steep incline in home prices. This information can be viewed in figure 6-2. In addition to the price of houses rising, mortgage rates were at very low levels. Mortgage rates during this time period can be seen graphically in figure 6-3. As can be seen in this figure, mortgage rates experienced a relatively stable decline over the years presented. Therefore, more individuals that previously could not enter the housing market, were able to accept loans and purchase homes due to these exceptionally low rates. It appeared that the market for housing was stable and prosperous for a period. However, things did not turn out as expected, and there are many reasons why things turned out that way.

Figure 6-3: The Effective Interest Rate of Mortgages in the United States, from 1990 to 2009.



Source: FHFA

A series of many events occurred that triggered the crisis. The totality of this series is beyond the scope of this paper, but an overview of some of these events can shine some light on what happened. In late 2005 and early 2006, many of the adjustable rate mortgages with teaser rates that people fell victim to years earlier began to readjust to higher rates to reflect changes in the housing market. Payments became difficult for many, and some began to default on their loans. In 2006, Alan Greenspan ended his time as the head of the Federal Reserve Board (Guillén, 2009). That same year, housing prices peaked, as seen in figure 6-2. A few months later, Countrywide Financial, which at the time was the largest U.S. mortgage lender, began to release press reports that many people are unable to pay back the mortgages that they undertook, and this includes more than just those affected by the teaser-rate trickery. This foreshadows what will happen to many in the coming months. Signs of a rising economy were still present in October, as

the Dow Jones hits the highest recorded close ever at 14,164.53 (Connelly, 2009). However, as more borrowers defaulted on mortgages, the river of high-risk toxic assets that the financial sector was floating on to keep the price of housing high, and the economy on par, overflowed. On March 16, 2008, Bear Stearns was practically given away to JPMorgan Chase at the incredibly low price of $2 per share. This is an initial sign that the party is over for large investment banks. In July of the same year IndyMac fails. IndyMac was one of the first to fail that year, out of the 25 large banks that did fail (Connelly, 2009). At this point, people began realizing the housing market, and in turn, the whole economy was in trouble. "The crisis reached seismic proportions in September 2008 with the failure of Lehman Brothers and the impending collapse of the insurance giant American International Group (AIG). Panic fanned by a lack of transparency of the balance sheets of major financial institutions, coupled with a tangle of interconnections among institutions perceived to be "too big to fail," caused the credit markets to seize up. Trading ground to a halt. The stock market plummeted. The economy plunged into a deep recession." (Financial Crisis Inquiry Commission, 2011, xvi). These events, and a slew of others created a financial panic.

C. *An Overview of the Suspected Causes of the Housing Bubble and Crisis*

The U.S. experienced a housing bubble and a financial crisis on an unprecedented scale in the past few years. The United States fell into this depressed condition for a variety of reasons, although many are disputed and ambiguous. There has been a great deal of blame among various politicians, businesspersons, bankers, investors, and nonprofessionals over who or what caused the financial crisis. Although there is no

exhaustive list, many authors and economists have cited similar ideas as to why this crisis ensued. If these issues continue to occur, it is almost inevitable that the United States and the world will fall into another economic nadir, possibly below the depths of the recent crisis. For the purpose of this paper, it is important to understand the known and suggested causes of the housing bust, as many of these entities I try to control for in the econometric models for herd behavior, in order to give the variable of interest more credibility.

From the viewpoint of the Financial Crisis Inquiry Commission (2011), there were many causes to the financial crisis, some of which, even with the vast resources at their disposal, they were unable to document. "There was an explosion in risky subprime lending and securitization, an unsustainable rise in housing prices, widespread reports of egregious and predatory lending practices, dramatic increases in household mortgage debt, and exponential growth in financial firms' trading activities, unregulated derivatives, and short-term "repo" lending markets, among many other red flags. Yet there was pervasive permissiveness; little meaningful action was taken to quell the threats in a timely manner" (Financial Crisis Inquiry, 2011, 27). With this information in mind, in order to improve upon the general understanding of what occurred in the period before the crisis, it is important to delve further into some of the entities that were thought to play a role. One highly cited, possible contributing factor was the deregulation occurring in the banking industry over the last 31 years.

a. *The Glass-Steagall Act of 1933, its Repeal and Market Deregulation*

The laws that govern the financial and banking systems are incredibly important since they are meant to keep order in these industries. It would follow that taking away these laws may lead to a lack of order. It has been argued that the laws written pertaining to financial activities are created by politicians that may not understand economics well, or just blatantly ignore economic warning signs in order to gain favoritism, backing by those that will financially contribute to their campaigns and to appear strong in the national limelight (Ely, 2009). In addition, it is widely known that big business would rather have the government stay out of their business for the most part. With this in mind, the deregulation of the financial and banking industries, notably through the repeal of the Glass-Steagall Act, has been cited as a possible contributor to the housing bubble.

The Glass-Steagall Act of 1933, or Banking Act of 1933, was created in order to further regulate the financial sector, and to put in place safeguards. It established the FDIC, or the Federal Deposit Insurance Corporation in addition to bringing about banking reforms, many of which pertained to reducing speculation in the banking sector after the Great Depression. Most notably, the Glass-Steagall Act separated banks into commercial banks and investment banks (Krugman, 2009). With this reform completed, the normal commercial bank was extremely limited in risk participation in exchange for readily available credit from the Federal Reserve, known as the discount window. At the same time, this allowed the commercial banks to be FDIC insured, or insured by the American tax-payers dollar (Krugman, 2009). The purpose of this was to stop bank runs of the past including the bank runs occurring during the Great Depression. Investment

banks differ from commercial banks, in that they do not take deposits or provide loans on an individual level. Rather, for the most part, they tend to help companies in increasing capital by underwriting and acting as the agent in the issuance of securities (Krugman, 2009). In this way, the enactment of the Glass-Steagall Act did allow investment banks to take on risks, since they could not be vulnerable to bank runs like their counterparts of the past.

With this in mind, for the most part, this separation helped protect the banking market for over seventy years, even though there were some times of turbulence. In the 1980's, it has been argued, poor policy decisions in addition to what some believe was bad luck, contributed to the failure of S&Ls, a lender that specialized in home loans (Krugman, 2009). However, even though this occurrence was very bad for the United States economy, the U.S. subsequently recovered relatively quickly in comparison to the recovery time of panics and depressions before the enactment of the Glass-Steagall Act. In the early nineties, it was thought that the days of banking runs and crises were over and done with entirely, and many believed that the banking industry would be fine in regulating itself.

After waging a three-hundred million dollar war effort in congress, the lobbyists of the financial services and banking industries, with congressman Phil Gramm at the helm, finally succeeded in garnering support for the repeal of the Glass-Steagall Act in 1999 (Stiglitz, 2009). The repeal of this act led to what some see as a cultural shift in the world of banking (Stiglitz, 2009). The law that was meant to protect citizens from the excesses of the past, like those that led to the Great Depression, was revoked. The separation

between commercial and investment banks was now forever changed, and the roles of each became muddled. Many have argued that this deregulation was a prime suspect in contributing to the housing bubble formation, although financial institutions had themselves already been blurring the lines between commercial and investment banks in previous years.

In addition to the repeal of the Glass-Steagall Act, other instances of de-regulation of the banking and financial markets occurred prior to the U.S. housing bubble. Other examples of the deregulation during the recent decades include the Depository Institutions Deregulation and Monetary Control Act of 1980 and the Garn-St. Germain Depository Institutions Act of 1982. The first act allowed banks to set any interest rate they deemed fit, as well as giving banks with a high degree of similarity the ability to merge freely with one another (Federal Reserve Bank of Boston, 1980). The Garn-St. Germain Act allowed the usage of adjustable rate mortgages in the home mortgage market (Garcia, Cargill and Marie, 1982). These changes were beneficial to a degree as the older system was vulnerable to inflation. In addition to these more arcane changes, a more recent decision pertaining to deregulation occurred during April 2004. At this time, the Securities and Exchange Commission voted to allow large investment banks to have a debt-to-capital ratio of 30 to 1 or in some instances even higher. The debt-to-capital ratio before this vote was at 12 to 1 (Stiglitz, 2009).

Very little attention was given to this decision at that point in time, even though the effects of this decision were far-reaching. The debt-to-capital ratio measures the leverage of a company, i.e. to what degree a company is running off of borrowed money. By

allowing for the increase in the debt to capital ratio, large investment companies stretched their thin leverage even further, only having to cover a thirtieth of debt with physical capital. These numbers at first glance seem astronomical, similar to the astronomical dollar signs that some investment banks must have seen in the short-term after the alteration of this law. The Securities and Exchange Commission rationalized this decision by effectively announcing that banks were able to regulate themselves, rather than having a great deal of outside input. With this decision, it is evident that the S.E.C. was blinded by the positive outlook of banking, rather than remembering the dark past of banking and huge problems it caused when there was loose regulation in the industry. In hindsight, this decision was not a wise one. Deregulating in order to shed rules of the past and to spur innovation, stripped away the rules in place that would have helped protect the future.

The Financial Inquiry commission also viewed deregulation as a prime cause of the housing crisis in the United States. "More than 30 years of deregulation and reliance on self-regulation by financial institutions, championed by former Federal Reserve chairman Alan Greenspan and others, supported by successive administrations and Congresses, and actively pushed by the powerful financial industry at every turn, had stripped away key safeguards, which could have helped avoid catastrophe. This approach had opened up gaps in oversight of critical areas with trillions of dollars at risk, such as the shadow banking system and over-the-counter derivatives markets" (Financial Crisis Inquiry, 2011, 18). As the Committee states, the deregulation allowed for areas of the banking and financial sectors to grow increasingly out of control, specifically with respect to the shadow banking sector and the derivatives markets.

b. Banking in the Shadows, the Sub-Prime Boom, and Complex Derivatives

It seems that the only constant in the banking and financial industries is change. The traditional idea of a bank is an institution that allows for access to funds in exchange for individuals contributing money savings and checking accounts. In turn, banks invest most of the money that was placed in these accounts. Therefore, not all of the money or even a moderate percentage can be liquidated immediately. Due to the Glass-Steagall Act and because of having the FDIC insure banks, bank runs would not occur as had happened in the past based on this reason. With the repeal of this act, in combination with new instruments being used by banks, the situation became more complex, as banks worked as hard as possible to profit maximize at any cost. One way in which banks were able to realize large profits was through what is now known as the shadow banking industry.

The shadow banking industry is a term to define commercial banks and other companies that decided to take on a great deal of risk in order to gain a great deal of profit. Although the specifics are complicated, what in effect happened was a new, large and relatively unregulated player entered the financial market in full force. They were allowed to take on very risky endeavors', since the market had become deregulated. The shadow banking industry received its funds from commercial paper, short term borrowing and from money market mutual fund assets among other ways (Financial Crisis Inquiry, 2011) and the growth of this industry helped contribute to the crisis.

Another related contributor to the crisis was the exponential increase in the lending of subprime mortgages, which went from five percent of the market to nearly twenty percent of the market in a few years time (Akerlof and Shiller, 2010). A subprime

mortgage refers to a mortgage extended to an individual that may have difficulty in paying back the loan. Supporters of sub-prime mortgages believe that it allows for another demographic to gain access to home-ownership, while opponents usually cite a degree of engrained moral hazard in providing this type of loan.

The subprime industry itself was not highly regulated from the start, providing a very poor foundation for a burgeoning market, which ended up becoming a large piece of the housing market puzzle. In effect, the sub-prime market was a way for low-income earners to partake in the market for home loans. Programs like the Federal Housing Administration and the Veterans Administration, once helped those in need out through home-loan lending, which highly benefitted and protected the homeowners while at the same time being highly regulated. Through the thought process of the Reagan Administration, Alan Greenspan and those that were free-market enthusiasts, these programs took a back seat to private enterprise (Stiglitz, 2009; Akerlof and Shiller 2010).

These private enterprises charged higher interest rates and resetting interest rates, which were disadvantageous to the lower economic classes, but allowed the private companies to profit (Akerlof and Shiller, 2010). At the same time, the mortgage originations from these private companies were sometimes not appropriate for the clientele. By preying on those that were the least educated, least wealthy, most vulnerable and least informed, the private companies allowed predatory lending practices to flourish, issuing what are sometimes called NINJA loans; referring to originating a loan to someone with no income, no job and no assets. In effect, there was a positive feedback loop in the housing market. As more individuals began purchasing homes, the price of housing increased, and in turn, banks continued to loan money to individuals that were

progressively less credit worthy (Sachs, 2009). Even if an individual defaulted on his or her loan, the bank would be able to repossess the house, likely at a higher value due to the ever-increasing pricing in the housing market. With almost no regulation, loan originators were effectively able to do as they pleased. In 2007, it is estimated that up to forty percent of all subprime mortgages that were originated came from an automated underwriting system, that likely had very limited supervision (Browning, 2007).

In addition to being sub-prime, a large portion of the loans being issued during this time period came in the form of ARMs. By issuing ARMs, or Adjustable-Rate Mortgages, companies could lure in those interested in gaining a home loan through teaser rates, rates that were initially low but would rise in subsequent periods. In this way, the deal may seem like a good one that can be maintained by the borrower, but over time, the interest rate rises back to a level in which in many cases, the borrower could not afford. At this point, the consumer may default on the loan, and oftentimes the originator of the loan knew this full well. If this predatory lending was not enough, the originators of these loans would then bundle multiple loans, and their returns, into different packages to be sold as derivatives. A useful tool to repackage these risky mortgages was the auction rate security.

In 1984, Lehman Brothers invented what is known as an Auction Rate Security. It worked by having individual people provide long term lending to a borrowing institution, and the money would effectively be tied up for a period of many years. With this in mind, auctions would occur allowing for bids on the securities, which allowed for new investors to enter while other investors already in the market could leave. A penalty rate would result if there weren't enough bids at a specific auction. Overall, it allowed institutions

fast funds while those that originally invest in the auction rate security would have a safe investment (Krugman, 2009). This became a preferred funding resource for many institutions. It allowed for higher interest rates than conventional banking for the investor and fast access to money for the debtor.

However, not all was well in the market for auction rate securities. These securities, unlike the funds offered by conventional banks as loans, were not protected by the FDIC. The collapse of this industry occurred in 2008 as auctions failed, and investors in the market were stuck as no new investors sought to replace them. Those that used to be able to quickly access their money were instead only left with long term investments that they could not sell (Krugman, 2009). In this way, the bank run was back, although it did not occur at the level of conventional banks, rather the shadow banking industry (Krugman, 2009). Auction rate securities were not the only innovative investment vehicles involved in the housing crisis.

In 2000, a new investment vehicle came onto the scene, known as a CDO or collateralized debt obligation. This vehicle basically took the mortgage backed securities on the market, divided them, and sold them into tranches and allowed for them to be resold to investors (Madrick, 2010). This vehicle became more and more popular, as even with no collateral investors could get a good rate of return. As one author elegantly stated, "the machine that turned 100 percent lead into an ore that was now 80 percent gold and 20 percent lead would accept the residual lead and turn 80 percent of that into gold, too" (Madrick, 2010). However, behind the scenes, the toxic packages were increasingly being played off by companies as more appealing than they fundamentally were. This occurred as CDOs allowed for triple-B securities to be exchanged for double

and triple-A debt (Madrick, 2010). The origination of NINJA loans and the securitization of these loans into bundles allowed these toxic assets to be given a stamp of approval by the credit agencies. The credit ratings on these types of instruments also shed some light into a prime cause of the housing debacle.

c. *Faulty Credit Ratings*

Another aspect that many have suggested as a root cause of the financial crisis is that of reliance on sponsored credit rating agencies, especially the "The Big Three," which includes Fitch, Moody's and Standard & Poor's. Credit rating agencies are companies that provide credit ratings for various debt types, in addition to the debt instruments. Additionally, they give ratings for the servicers of the debt as well. In this way, the rating is supposed to be indicative of the debtor's ability to make due on the loan originated, in addition to rating the interest rate involved with the security. Credit rating agencies vary in type, from private companies, to government agencies, to other organizations (Stiglitz, 2009).

During the period prior to the financial crisis, credit rating agencies' standards were not properly aligned with standards of morality. It is difficult to trust credit ratings, for example, those generated by Standard & Poor's, when this company garners its income from the companies they are supposed to be grading on the basis of credit merit. The credit companies have every incentive to give the companies they are grading higher ratings, i.e. grade inflation, since they are the ones paying them to grade in the first place (Stiglitz, 2009). In addition, the credit rating companies did not look deeply into the complicated securities that they were rating. Nobody would do the hard work that needed to be done in order to expose the toxic assets that were being repackaged and sold as new

securities. “The rating agencies, like the investment banks that were paying them, believed in financial alchemy, that F-rated toxic mortgages could be converted into products that were safe enough to be held by commercial banks and pension funds. We had seen this same failure of the rating agencies during the East Asia crisis of the 1990s: high ratings facilitated a rush of money into the region, and then a sudden reversal in the ratings brought devastation. But the financial overseers paid no attention” (Stiglitz, 2009). With this in mind, if the larger credit rating companies said that Collateralized Debt Organizations, or auction rate securities, among the slew of other complicated securities were a safe bet concerning investment, then it was likely the case that many followed this advice to their own peril in the end. While all of these shady deals and profit at all-cost mechanisms were underway, it is difficult to see any regulation or interest by the leaders of the United States. These leaders may represent another contributing factor to the crisis.

d. The Federal Reserve and Leadership

Although deregulation, derivatives, the shadow-banking industry all contributed to the recent financial calamity, the leadership of the United States in various ways contributed to the issue. Some blame the policies of former chair Alan Greenspan for the problems that were bequeathed to Ben Bernanke. After the terrorist attacks of 2001, the Federal Reserve began putting money into the economy in order to offset any possibility of a downtrodden situation. In addition, the Federal Reserve lowered the Federal Funds rate, and kept the rate at too low level for an extended time period (Sachs, 2009). Although using an expansionary monetary policy tends to allow lower costs to borrow money, it may lead to inflation and a decline in U.S. greenbacks. With this type of easy

lending and borrowing occurring, individuals began placing their faith in the housing market. Although lower interest rates tend to encourage home and loan purchases, this time period provided a novel twist with a reliance on the new financial instruments being used in the housing market. At the same time, the Federal Government held back on investigating the questionable lending practices being performed by loan originators. As the housing bubble grew too large, with the price of housing too high, beyond that of what the market fundamentals suggested, pricing peaked, and the U.S. housing market faced a crisis.

It can become easy in hindsight to blame the financial crisis that occurred recently on those that were in charge, specifically pertaining to the Chairman of the Federal Reserve Board. However, some economists including Joseph Stiglitz believe that the removal of Paul Volcker as the Chairman of the Federal Reserve Board, and placing Alan Greenspan in that position was one old root that led to this financial crisis. Volcker had done many things correctly as the Chairman, including reducing inflation to a tolerable level and attempting to regulate the financial markets within the boards means, through tight monetary policy (Krugman, 2009). However, the president at the time, Ronald Reagan, was not in agreement with Volcker, as his belief was to let the invisible hand regulate economic markets. At the same time, the nation underwent the largest peacetime expansion in history while maintaining a balanced budget under Greenspan.

Despite his success, some have argued that Greenspan flooded the market with liquidity through his role as the Chairman, while at the same time being non-regulatory to a fault. Stiglitz (2009) argues that Greenspan should have acted during the Dot Com Bubble and the recent Housing Bubble, as he believes Greenspan had all the tools and

information necessary to help curb the effects of these instances. With respect to the housing bubble, Greenspan could have done something to protect those in the market of buying home loans, by limiting predatory lending, interest-only loans and other "insidious" practices that were occurring at the time (Stiglitz, 2009). In order to prevent an economy going through a boom from overheating, the Federal Reserve Board has historically raised interest rates (Krugman, 2009). William McChesney Martin Jr., the longest serving Federal Reserve Board Chairman in history once said, the job of the Federal Reserve Board is to take away the punch bowl just as the party gets going" (Krugman, 2009, 142).

The signs that derivatives were dangerous came well before any housing bubble in the United States. Stiglitz saw these dangers while serving as the chairman of the Council of Economic Advisers under the Clinton administration (Stiglitz, 2009). Still, those in other positions of power, including Greenspan, decided to be reactionary rather than preventative due to the belief that any attempt to regulate the dangerous derivatives present at the time would be an impediment to innovation. Stiglitz (2009) argues that innovation can act in a negative fashion, as in the case of innovative financial derivatives, not just in a positive manner. In 1998, Brooksley Born, the head of the Commodity Futures Trading Commission urgently asked the Fed for intervention, however nothing was done (Stiglitz, 2009).

Greenspan and the Federal Reserve were not the only leaders in our country that made decisions critical to the formation of the financial crisis. The Bush Administration in June 2001 gave tax-cuts that were focused on upper-class Americans, and a subsequent tax cut two years later as an attempt to stimulate the economy. However, some have

argued, that these tax cuts did a great deal more harm than good, since the trickle-down theory did not play out the way it was intended, and in turn the Fed had to act to stimulate the economy. Therefore, the Federal Reserve Board provided record low interest rates and more liquidity. This made it exceedingly easy for individuals to procure loans for homes, including an unprecedented amount that sought loans far beyond their reach. At the time, this may have been a temporary fix, but this lead to a mortgage crisis with long-term ramifications on the U.S. and world economies (Stiglitz, 2009).

In addition to the tax cut, the newly lowered taxation on capital gains also led to some issues. It has been argued that the combination of a low capital gains taxation and tax-deductable interest led to excessive lending and borrowing in the housing market during this time period (Stiglitz, 2009). This helped the bubble grow to exponential levels, before bursting and causing economic hardship in the United States as a result. The President, the Federal Reserve, and those in power in the United States are partially to blame for contributing to the formation of the housing bubble and financial crisis.

Even with all of the factors presented prior that contributed to the United States Housing bubble and subsequent crisis, there still seems to be something missing. What caused an unprecedented number of people to enter the housing market within just a few years? Lax lending standards, white-collar crime, poor leadership and periods of innovation are nothing new, and yet there was an incredibly steep incline in housing prices and a rush of individuals into to the housing market. The econometric model that is presented in the next chapter will attempt to show that herd behaviour may account could reasonably account for a portion of this incline and decline in the housing market.

Chapter 7

Econometric Models

Used to Detect Herd Behavior in the Housing Market

As previously seen, many of the models for herd behavior are theoretical in nature, and do not do much in the way of measuring for herd behavior in real markets. Consequently, using just these models, it is impossible determine whether this behavior actually exists and the way in which it affects markets. Therefore, I attempt to formulate an econometric model to test whether herd behavior exists, specifically during and leading up to the recent financial crisis. The central idea of this chapter is the construction of the models that are used in the empirical analyses presented in this paper. The rationale for all variables used in the models is given in this chapter, as well as the data sources used for each variable.

Since there is no variable in the literature that is used to characterize the herd effect in economics, I use a proxy variable, the lagged change in the Case-Shiller Index. This may not be the ideal variable to use, but by controlling for other factors in the housing market, it is a reasonable proxy to observe herding in the market.

A. *Original Econometric Model to Identify Herding in the Housing Market*

To test for the evidence of herd behavior in the housing market, between 1990 quarter three and 2009 quarter four, I estimate the following equation:

Model 1: Original Econometric Model to Test for Herd Behavior in the Housing Market

$$y_t = \beta_0 + \beta_1 x_{1(t-2)} + \beta_2 D_{1\,t} + \beta_3 x_{3\,t} + \beta_4 x_{4\,t} + \beta_5 x_{5t} + \beta_6 x_{6\,t} + \beta_7 x_{7\,t} + \beta_8 x_{8\,t} + \varepsilon(1)$$

Where β_0 is the constant term and $\varepsilon(1)$ is the stochastic error term

Dependent Variables:

$\mathbf{y_t}$, represents the Status of the U.S. Housing Market

a) New Privately Owned Housing Units Started (Thousands of homes)

b) Residential Investment by households and homeowners (Billions of 2005$)

Independent Variables:

$\mathbf{x_1}$: Percentage Change in Case-Shiller Index, two quarters earlier

$\mathbf{D_1}$: The Repeal of the Glass-Steagall Act, Dummy Variable

$\mathbf{x_3}$: Price of Housing through the Case-Shiller Index, current period

$\mathbf{x_4}$: U.S. Consumer Confidence Index

$\mathbf{x_5}$: Civilian Employment Rate:
Employed non-institutionalized population/total non-institutionalized population

$\mathbf{x_6}$: Median Asking Rents (Real U.S. $)

$\mathbf{x_7}$: Mortgage Rate
Effective Interest Rate

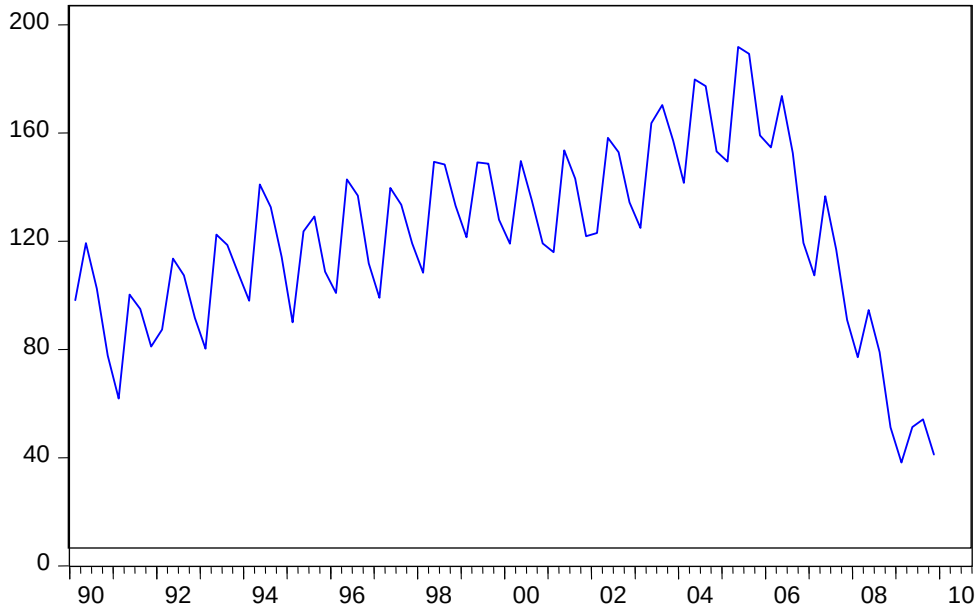
$\mathbf{x_8}$: Real Disposable Personal Income per capita

Rather than have a very complex model, the model used is a simple OLS time-series regression, in order to represent the housing market from 1990 quarter three to 2009 quarter four.

The variable "Housing starts," indicative of new privately owned housing starts, is used as one dependent variable in the model to represent the state of the housing market at any given time. Economists in the past have used housing starts as a diagnostic tool. In addition, it is one of the most extensively used variables to understand the dynamics at work in the housing market (Ewing and Wang, 2005). If housing starts

increase, this should indicate that the housing market is doing well, whereas if they decrease, it should be indicative of the housing market going on the decline. As can be seen in figure 7-1, housing starts fluctuate seasonally every year, but the general trend is an increase from the early 1990's to the last quarter of 2005 and into the early parts of 2006, until things went awry in the market.

Figure 7-1: New Private-Residential Housing Starts in the United States, Quarterly data in thousands of homes, during the period of 1990-2009.

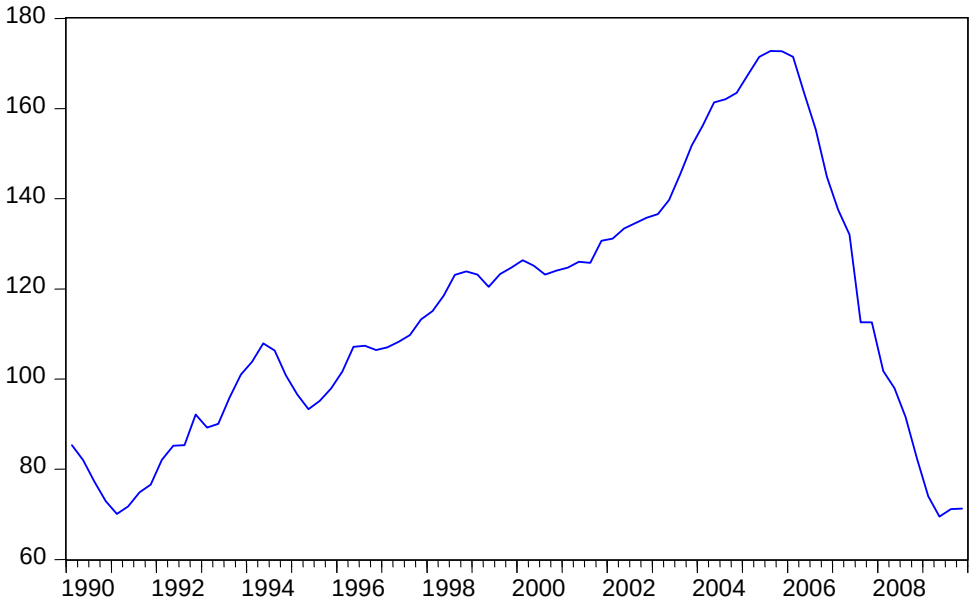


Source: U.S. Census Bureau

The second dependent variable used in this analysis is housing investment. This measure is in billions of U.S. dollars. The data used to construct this variable is representative of the amount of money that homebuyers invest into the housing sector, i.e. into their homes. This includes buying new property, purchasing existing homes, buying new homes, renovations among other aspects of putting money into housing. Housing investment over the period of 1990 to 2009 can be seen in Figure 7-1**.** This graph shows a similar trend to housing starts, minus the seasonality. In addition, the drop off after the last quarter of 2005 is even more dramatic than the drop seen in housing

starts. If people are willing to invest more money, then the housing market is likely doing well. If people are investing less money, this is likely indicative of a slump in the housing market. A brief glance at this graph can tell a great deal about what occurred in the housing market during this period. In addition to the dependent variables, the right side of my model is also relatively straightforward.

Figure 7-2: Housing Investment (Billions, $2005), during the period of 1990-2009



Source: Fair Model dataset

In selecting independent variables, I decided to keep the variables very intuitive in order for it to be easier to identify herding in the housing market if it existed. High levels of employment, high levels of consumer confidence, high rental prices, high homeownership prices, increased deregulation and very low mortgage rates were all apparent during the years prior the housing bubble bust, all of which has been documented previously in this paper (Financial Crisis Inquiry, 2011; Krugman, 2009). Therefore, in addition to other reasons, I used independent variables to characterize these phenomena during this time in my model. The independent variables that I used as

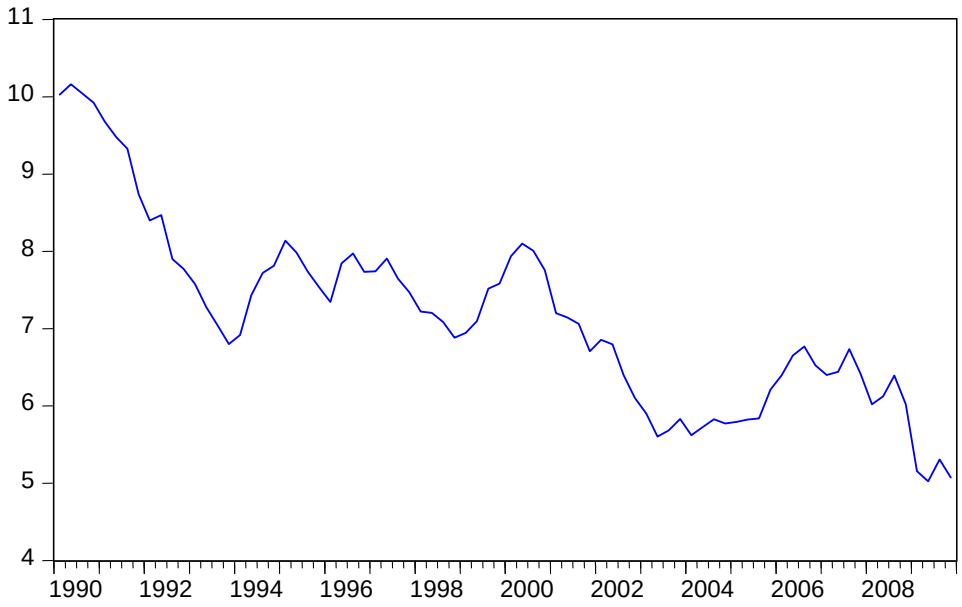
controls include the following: a dummy variable for the repeal of the Glass-Steagall Act, a variable for the mortgage rate, a variable for median asking rents, a variable representative of the civilian employment rate, a variable representative of the consumer confidence index and a variable for the Case-Shiller Index that is indicative of the price of homes in the housing market. I present further rationale for the inclusion of these variables, and others, in the following section.

The variable used to account for the interest rate at a given time in the mortgage market in my model began as the effective interest rate. Classically the mortgage originators have to serve outside investors that want the highest return on their investments and homebuyers that want the lowest interest rate possible. In this way, the cost of housing is affected by the mortgage rate, and therefore homebuyer demand is affected by the interest rate. As interest rates rise, investors tend to invest more in the housing market, while homebuyers tend to accept fewer loans. Conversely, as the interest rate falls, the purchasing costs of a loan are lower and in turn demand for mortgages increases. Therefore, interest rates are included in my model since they are extremely important to investment, loan originations, and loan acceptances by those in the housing market. I predict that the coefficient for the interest rate will be negative, and significant on the number of new homes built and on residential investment by homebuyers.

Instead of using the 30-year fixed mortgage rate, I decided to use the effective interest rate as a variable. The effective interest rate is defined as the contract rate in addition to including any initial fees or charges at the time of signing a mortgage loan, as calculated by the FHFA. Therefore, it takes into account fixed mortgage rates and adjustable rate mortgages. Since, as previously described, many of the loans originated in

the mid 2000's were adjustable rate mortgages, I felt this measure was more appropriate for the model. In addition, if a company offered no down payment and limited up-front fees, a customer is more likely to accept a loan origination from that company. With this in mind, I decided to use the effective interest rate in my model, because it gives a better measure of what individuals accepting a mortgage loan are actually facing in the market. Especially from around 2001 through 2005, as seen in figure 7-3, the effective interest rate hit a very low plateau preceding the housing bust.

Figure 7-3: The Effective Mortgage Interest Rate, from 1990 to 2009



Source: FHFA

Median asking rent is included in my original model, because renting of residence in economics is considered a substitute good to owning a home. It is thought that as the price of rent increases, those that rent will be more inclined to purchase a home, whereas if the price of rent decreases, those that own homes may consider a switch to renting. In this way, homeownership has a positive cross price elasticity of demand with respect to renting. With this in mind, I predict that the coefficient for the median asking rent

independent variable will be positive, and significant, since as rent rises, we expect more consumers to seek homeownership and vice-versa.

The confidence index is used to measure how optimistic the citizens of the United States are about the current economic situation. Confidence in the economy is usually linked to higher rates of spending rather than higher rates of saving. With this in mind, consumer confidence may prove important for those entering the housing market. If one is confident, he or she is more likely to pursue a home loan, to invest in housing or to start construction on a new home. The reverse is also true for those that lack confidence. Therefore, I expect consumer confidence to have a positive coefficient, and to be statistically significant in the model.

The percentage of employed non-institutionalized U.S. Citizens is another independent variable used in my original model. It has been shown that being employed and having higher real income have positive effects on housing starts and the housing market in general (Ewing and Wang, 2005). This makes intuitive sense, as someone is more likely to build a home if he or she is employed or has more expendable income from being employed. Employment was relatively high during the period preceding the crisis, although the dot com bubble did affect the employment to a large degree for a few years.

Real disposable income is another independent variable included in the original model. As disposable income rises, it should be the case that individuals will be able to spend more on housing, which would increase housing starts and housing investment. Therefore, I predict that this variable will have a positive coefficient and be significant in my regression analysis.

A dummy variable is used to account for the repeal of the Glass-Steagall Act in November 1999. By allowing the lines between conventional banks and investment banks to be blurred, this in turn allowed lax lending standards, the emergence of even more complicated securities, and general negligence in the financial sector to occur without any accountability. Therefore, this period of deregulation is included as an independent variable in the model through a dummy variable. The variable is meant to control for the deregulation occurring in the market at that point in time, which has been cited as a prime cause of the Financial Crisis, and likely influenced the lax lending practices occurring at the time (Financial Crisis Inquiry, 2011; Krugman, 2009; Ely, 2009). As a dummy variable, a value of 0 is given to any month before November 1999, whereas a value of 1 is given to all months following.

The Case–Shiller Home Price Indices are constant-quality house price indices for the United States. There are multiple Case-Shiller home price indices, including a national home price index, a 20-city composite index, a 10-city composite index, and twenty individual metro area indices. The data used in this model is at the national level. The index itself is calculated from repeat sales data of single-family homes. Karl Case and Robert Shiller developed the original approach in conjunction with Allan Weiss in 1987 (Shiller, 2005).

Case-Shiller Home Price Indices are inherently complex. They involve surveying current homeowners to indicate the purchase price of homes, as well as past purchase prices of homes. By using a repeated measures methodology of individual homes, this method looks solely at homes that have previously sold on the market. Excluding new construction, condominiums, and heavily remodeled homes, while only including homes

that have sold previously, in addition to using homes that are similar in stylization and size, this index can indicate what people are willing to pay for a home at any point in time. The point of doing this is to protect the index from any bias created by a change in the "mix of houses sold or of the increasing size and quality of newer homes" (Shiller, 2005, 234). In this way, the methodology works to attempt to hold the quality of the home constant over the given time period. There is one shortcoming, in that the data is reliant on the memories of "the surveyed homeowners for the earlier purchase price" (Shiller, 2005, 234).

Although the Case- Shiller Indices are the leading measure for diagnosis of the United States housing market, they are not the only indices available. The defunct U.S. Office of Housing Expertise Oversight or OFHEO, now the FHFA, created a similar index. This index also uses a repeat sales methodology. Nevertheless, there are a few differences in methodology. The CS indices are based solely on actual sales. Conversely, the FHFA uses actual sales and appraisals of homes as data collection sources. Shiller (2005) believes that appraisals are too sluggish to respond to market conditions, and hence he did not include them in his index, as this would cause the index to lag behind actual market trends.

Since there is no direct variable used to date to measure herding in economics, as previously stated, another variable must be used to see if herding can be observed in the housing market. In this model, change in the U.S. Case-Shiller Index is the proxy variable. I use this variable in an attempt to capture herd behavior within the housing market. By controlling for other variables that are thought to influence the housing market, the change in Case-Shiller Index would be one reasonable way to capture herd

behavior in the market. For example, if there is a change in the Case-Shiller Index, this would indicate individuals herding into or out of the housing market. This only can work if controls are put in place in the model, in order for this proxy variable to gain explanatory value. If herd behavior by those purchasing, or investing in homes is occurring, I would expect the change in the Case-Shiller Index to have a positive coefficient and to be significant with respect to housing investment and housing starts. As more people follow the herd into the market, there will be more homes built and more money invested into housing as a result.

In order to account for the time-delays in the housing market, I also lag the change in Case-Shiller variable in various instances. Through multiple regressions, I found that a lag of two quarters was appropriate. With this being said, the Case-Shiller Index itself is also used as an independent variable in my original model. As the price of a good rises, demand for that good is supposed to decline as long as housing is a normal good. Therefore, since the CS index is a measure of housing price, I predict that the coefficient for this independent variable will be negative and significant in the model with respect to housing starts and housing investment. In this way, this control variable is used to tease out the difference between the lagged rate of change of the index and the index itself. I am not interested in how the price index affects the number of homes built or housing investment, but rather herding in the market. By including this variable, it makes herding as a result of a change in the Case-Shiller Index more evident, rather than being muddled through omitting a variable related to price.

B. *Modified Econometric Model to Identify Herding in the Housing Market*

Although the original model I estimated was not a deficient one, it did have some flaws and, consequently, improvements were made in order to create results with more clarity. Therefore, a few tweaks, including the introduction of a lagged dependent variable in some cases, were instituted in order to garner better results.

As a second model, which is used extensively in my analysis, to test for the evidence of herd behavior in the housing market, between 1990 quarter three and 2009 quarter four, I estimate the following equation:

Model 2: Modified Econometric Model to Identify Herding in the Housing Market

$$y_t = \beta_0 + \beta_1 x_{1(t-2)} + \beta_2 D_{2\,t} + \beta_3 x_{3\,t} + \beta_4 x_{4\,t} + \beta_5 x_{5\,t} + \beta_6 x_{6\,t} + \beta_7 x_{7(t-1)} + \varepsilon(2)$$

Where β_0 is the constant term and $\varepsilon(2)$ is the stochastic error term.

Dependent Variables:
y_t, represents the Status of the U.S. Housing Market
a) New Privately Owned Housing Units Started (Thousands of homes)
b) Residential Investment by households and homeowners (Billions of 2005$)

Independent Variables:
x_1: Percentage Change in Case-Shiller Index, two quarters earlier
D_2: The Repeal of the Glass-Steagall Act, Dummy Variable
x_3: Price of Housing through the Case-Shiller Index, current period
x_4: U.S. Consumer Confidence Index
x_5: Civilian Employment Rate:
Employed non-institutionalized population/total non-institutionalized population
x_6: Mortgage Rate
Effective Interest Rate
x_7: Lagged Dependent Variable, one quarter earlier

In my second model, I dropped the median asking rent variable and the real disposable income variable from the model for a few reasons. For one thing, median asking rent did not appear to be a significant factor pertaining to my dependent variables when regressions were executed. Real personal disposable income and median asking rent had high levels of multicollinearity with each other and a few of the other variables. Therefore, I decided it was best to eliminate median asking rent and the real disposable income per capita from the empirical model.

After dropping this variable, I decided to tweak the model by adding for some of my regressions a lagged dependent variable for housing investment. Lagged dependent variables are sometimes used in econometric models in order to show dynamic effects that are inherent in the market that is being analyzed (Keele and Kelly, 2005). With respect to housing investment, usually the amount that a person is investing in one quarter is affected by the amount they have invested in the previous quarter. For example, if a person invests 100,000$ in quarter one, rather than immediately pull out of the market entirely, the person is likely to continue investing money in the subsequent quarter. Obviously this is unlikely to happen quarter after quarter, but considering the dynamic nature of housing investment, including it as at least a single lagged dependent variable on the right hand side of the model is reasonable to capture some of this dynamic effect in the model. I expect that the lagged dependent variable for housing investment will have a positive and significant coefficient in my model. With that being said, some do contest lagged dependent variables use in econometric models (Keele and Kelly, 2005). Therefore, in order to satisfy critics on both sides of this argument, OLS

regressions were run with and without the inclusion of a lagged housing investment dependent variable in the model.

A. Data Sources

The data sources for the variables used in my model are all reliable sources for macroeconomic data. Much of the data comes from databases used by economists all over the world. All of the data covers the period from 1990 quarter three to 2009 quarter four. Data for previous periods was not available for certain variables, which is why the analysis utilizes this period of time. A description of each data selection is described in the following section.

The data for the civilian employment and for consumer confidence were obtained through the DRI-WEFA Economic Database. The DRI obtains this data from the Conference Board, a highly trusted source for economic data. The Conference Board is a research association that is said to work for the interest of the public by providing information for the betterment of society. The consumer confidence data is specifically the U.S. Consumer Confidence Index. The data is obtained through surveying the public, a task carried out by the Nielsen Company. The data collected is based on surveys collected from 5000 households. The participants are asked questions pertaining to current market conditions in addition to their expectations of future market conditions. More weight for the index is placed on the opinions of future expectations held by the individuals surveyed. Surveying for this measure began in the late 1960's, and the index is benchmarked to allow for 1985 to be the baseline year at 100.

The Federal Housing Finance Agency is the source of data for the effective interest rate. The Federal Housing Finance Agency aggregates data on various mortgage rates including the average interest rate on 15-year, fixed rate loans and the contract rate based on all mortgage loan types, comprised of fixed and adjustable-rate mortgage rates. The data for the conventional 30-year commitment rate for fixed-rate mortgages used comes from the Federal Housing Finance Agency as well, although this data did not prove useful in analysis portion of the thesis.

The data for the Case-Shiller Index and Change in Case-Shiller Index was provided by Robert Shiller, through his website. Until 2002, the firm Case Shiller Weiss, Inc. created the indices, although they were later produced by Fiserv Lending Services. Most of the indices are also managed by Standard & Poor's, and are readily available to the public on their website.

The index used in this econometric model comes from the identical dataset used in Irrational Exuberance, with the addition of data for the recent years, by Robert Shiller (2005). It was created by creating a nominal home price index that was then deflated by the consumer price index. The index is updated quarterly on his website. His data set uses 1890 as the baseline year at 100 on the index.

The number of new private owned housing unit starts data was provided by the U.S. Census bureau through their website. The data specifically pertains to single residency housing starts, in order to weed out the number of actual residences started from apartment complexes, condominiums and other related housing types.

The data obtained for housing investment in billions of 2005$ comes directly from the dataset used in the Fair Model. The Fair Model was created by Ray Fair, of Yale

University, as a forecasting and macroeconomic tool. It is used by many economists, researchers, students and professors around the world for these and other purposes. With the data sources and models in place, various regressions were run to determine if evidence of herding could be identified in the housing market during the period of 1990 quarter three through 2009 quarter four.

Chapter 8

Results of the Econometric Models

This chapter presents the results of the regression analyses based on the models previously presented in this paper. On the whole, my results show that the change in the Case-Shiller index lagged two quarters, which is my proxy variable for herd effect, is significant and positive for nearly every regression condition. This is what I had expected to occur in order to show some evidence of herding in the market. This conclusion can be supported in nearly all versions of my model, including when there are additional lags added to the independent variables, when there is a lagged dependent variable placed in the regression, and when controlling for the Case-Shiller index itself in the Model.

A. Results for Housing Starts and Housing Investment

In my first set of models, I used the dependent variable "Housing Starts" to see if I could identify any evidence for herding in the housing market. Table 1 contains three models of regressions that were executed. Although the results in model 1 appear at first glance to be good ones, when a multicollinearity matrix is constructed, it turned out that the median asking rent and the real disposable income per capita variables were highly correlated with one another and with the Case-Shiller Index. Therefore, these variables were dropped in order to estimate a second model.

The estimation gained in the second model showed promising results. All of the variables were significant to at least the 10 percent level, with the exception of the dummy variable for the repeal of the Glass-Steagall act and the Case-Shiller Index. The coefficients on these variables also did not make intuitive sense, considering deregulation should imply a positive coefficient, not a negative one as seen in this model and the Case-

Shiller Index had a coefficient of zero in this case. Since these variables did not appear to be significant in the model, they were also dropped as control variables in order to obtain a third model.

The results from the third model were even more encouraging than the previous model. All of the independent variables were significant and the coefficients matched my earlier predictions. In addition, the adjusted R-squared value was relatively high, the F-statistic was very strong and the Durbin-Watson statistic was relatively strong. The effective interest rate had a negative coefficient of 7.29, and was significant to beyond 1 percent. Therefore, based on this model, it would be reasonable to believe that an increase in the effective interest rate deters housing starts. Civilian employment had a positive coefficient, and was also significant to beyond the 1 percent level. This being said, based on this model, as employment increases, one can infer that the number of housing starts also increases. Consumer confidence had similar results to that of civilian employment, although the coefficient over ten times smaller. Consumer confidence may lead to an increase in housing starts in the United States' housing market. With these control variables in place, the most important result of this model is that the change in Case-Shiller Index lagged two periods, was significant beyond one percent and had a very large, positive coefficient of 15.24. From this model, one may deduce that for a one percent increase in the change in the Case-Shiller index with this lag could account for 15, 240 housing starts in one quarter. This is a very robust result, and although it may not be the only conclusion one could derive, it is supported econometrically.

Table 8-1: Results from time series Ordinary Least Squares Regressions Testing for Herd Behavior in the U.S. Housing Market

Dependent Variable: HOUSING STARTS (in Thousands)			
Variable	**Model 1**	**Model 2**	**Model 3**
CONSTANT	-261.4866	-266.70*	-266.25*
	(180.73)	(152.52)	(150.26)
Change CASESHILLER(-2)	7.04**	15.30***	15.24***
	(3.18)	(2.81)	(2.65)
GLASS-Steagall DUMMY	23.06**	-0.38	
	(9.91)	(9.27)	
Effective Interest Rate	-18.89***	-7.52**	-7.29***
	(4.19)	(3.41)	(2.22)
CIV EMPLOYMENT	9.192362	6.02**	5.97**
	(2.88)	(2.7)	(2.57)
CONSUMER CONFIDENCE	0.69***	0.56***	0.56***
	(0.18)	(0.20)	(0.18)
CASE-SHILLER	0.63***	0.00	
	(0.17)	(0.07)	
MED. ASKING RENT	0.1		
	(0.14)		
Real Disposable Income per Capita	-30.28***		
	(8.33)		
Adj. R-Squared	0.72	0.66	0.67
F-Statistic	26.20	25.59	39.46
Prob. (F-Statistic)	0.00	0.00	0.00
Durbin-Watson	1.78	1.62	1.62

Coefficients and Standard Errors are Listed, Standard Errors in Parentheses

***** Indicates significance of the independent variable at the $p \leq .01$ level**

**** Indicates significance of the independent variable at the $p \leq .05$ level**

*** Indicates significance of the independent variable at the $p \leq .10$ level**

Time Period: 1990 Q3 to 2009 Q4

Table 8-2: Results from time series Ordinary Least Squares Regressions Testing for Herd Behavior in the U.S. Housing Market Using a Lagged Dependent Variable

Dependent Variable: Housing Starts (in Thousands)				
Variable	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Constant	-85.82	-76.54	-76.63	53.07
	(186.42)	(145.00)	143.83	(34.45)
CHANGE CASE-SHILLER(-2)	5.14	9.19***	9.20***	8.99***
	(3.14)	(2.92)	(2.82)	
GLASS-STEAGALL DUMMY	16.70*	0.11		
	(9.84)	(8.36)		
EFFECTIVE INTEREST RATE	-14.61***	-5.45*	-5.45*	-4.91*
	(4.34)	(3.12)	(3.12)	(2.89)
MEDIAN ASKING RENT	-0.12			
	(0.13)			
REAL DISPOSABLE INCOME	-19.49**			
	(9.01)			
CIV EMPLOYMENT	5.11	0.39	2.23	
	(3.18)	(2.58)	(2.56)	
CONSUMERCONFIDENCE	0.58	0.48**	0.47**	0.53***
	(0.18)	(0.18)	(0.18)	(0.06)
CASE-SHILLER	0.45**	-0.02		
	(0.17)	(0.06)		
HOUSINGSTARTS(-1)	0.28**	0.42***	0.42***	.45***
	(0.11)	(0.10)	(0.10)	(0.09)
CASE-SHILLER (-2)				-0.03
				(0.06)
Adj. R-Squared	0.74	0.72	0.72	0.72
F-Statistic	25.97	29.42	34.81	34.49
Prob. (F-Stat)	0.00	0.00	0.00	0.00
Durbin-Watson	2.01	2.03	2.04	2.06

Coefficients and Standard Errors are Listed, Standard Errors in Parentheses

***** Indicates significance of the independent variable at the $p \leq .01$ level**

**** Indicates significance of the independent variable at the $p \leq .05$ level**

*** Indicates significance of the independent variable at the $p \leq .10$ level**

Time Period: 1990 Q3 to 2009 Q4

When examining the models involving the lagged dependent variable in the model, most of the results are similar to those already presented without a lagged dependent variable included. I encountered the same multicollinearity issues with median asking rent and real disposable income. They were once again dropped from the model.

After dropping these variables in the model it became apparent that the model was coming together more and all the coefficients seemed to match my original predictions. All the variables were significant except for the constant, the Glass-Steagall dummy variable and the Case-Shiller index of the current year. With all the previous discussion pertaining to the deregulation of the mortgage and financial markets in Shiller (2005), Krugman (2009) and the Financial Crisis Inquiry (2011), I had predicted that the repeal of the Glass Steagall Act would have a significant, positive impact on the number of housing starts during the time period. However, this seemed to not be the case based on my model. This could be due to the fact that many of the complicated securities, back-office negligence and deregulation of the banking system had been going on long before this act; rather the act just set in stone that these things were then legal. Since the Glass Dummy was so insignificant in the model, I decided to drop this variable. The decision not to regulate derivatives may have been more significant a factor.

With that in mind, I had hoped that dropping this variable would allow for the other variables to become significant. For the model, I found that this was not the case. Rather, civilian employment and the Case-Shiller index of that year remained insignificant in this version of the model. That being said, this version of the model produced a high r-squared value, a low probability that the model is not significant and a strong Durbin Watson statistic. The variable of interest is positive and very significant,

even to the one percentile. This is evidence supporting herding occurring in the housing market, as the proxy variable for herding is significant and has a predicted positive sign. The effective interest rate had a negative coefficient, and was significant to ten percent, which makes intuitive sense since as the interest rate rises, less people are likely to join the housing market. When using a lagged dependent variable for the number of housing starts in the previous period, my regression provided a positive coefficient and a very significant effect of housing starts in the previous period on housing starts this period. This also seems to fit my prediction, as those investing in the housing market are likely to be investing over a longer period of time than a single quarter. Overall, most of the results came out as expected, although I predicted that the current Case-Shiller Index and Civilian Employment would have been significant in the model.

Civilian unemployment was not significant, but did have a positive coefficient as expected. This is intriguing, since it makes intuitive sense that as more people have jobs, more people are likely to start homes. However, it may be the case that it has more to do with the quality or pay of the job, rather than just having a job in general. For example, many people could be employed during a given period at low end jobs that do not have high pay or the chance to move up in a company. There could be an influx in these types of jobs as well during a given period. Therefore, just being employed may not mean someone would be able to join the housing market, as quality of the job is also important. The Case-Shiller index, current period, had a negative coefficient as expected but was not significant with respect to the number of housing starts. Although I predicted this to be significant, it is easy to understand why it may not be. In this model, the Case-Shiller of the same time period is used. Since the index would be posted at the same time a person

decided to actually start a home, it probably does not affect the decision very much. This is due to the fact that it is likely people that are starting new homes would be looking at housing prices before actually entering the market, and not at exactly the same time they entered the market. Therefore, I thought it would be appropriate to lag the Case-Shiller Index to see if this changed the results garnered.

By lagging the Case-Shiller Index two periods in the same way I had done to the change in Case-Shiller Index, I expected that the variable would gain some significance in the model. The results can be seen in Model 7. Although the probability measurement did drop, the variable did not have a statistically significant effect on housing starts. The coefficient itself is also very small. Therefore, it is only reasonable to conclude that the index doesn't affect many people's decision to start a new home, at least based on this model. Contractors may attempt to predict the value of the future index when planning home builds as well. All the other variables fit their predicted coefficient signs and were significant to at least the ten percent level.

Based on this regression of my model, it appears that a one percent change in the Case-Shiller index two quarters prior, leads to an increase in 89,890 new housing starts in one quarter. This is a large amount considering in a normal quarter there are around 425,000 houses built in one quarter on average. The herding effect in the housing market is very prevalent, and more important than most think based on these regression results. In addition, a one percent rise in the interest rate appears to deter 49,000 new home starts according to this model, which makes a great deal of sense. Consumer confidence was also an important contributor, as a one point increase was indicative of five thousand, two hundred new homes in a quarter.

Table 8-3: Results from time series Ordinary Least Squares Regressions Testing for Herd Behavior in the U.S. Housing Market		
Dependent Variable: HOUSING INVESTMENT (Billions of 2005$)		
Variable	Model 8	Model 9
CONSTANT	-272.61*** (86.73)	-275.21*** (86.32)
CHANG CASESHILLER(-2)	13.06*** (1.60)	13.35*** (1.53)
GLASS-Steagall DUMMY	3.57 (5.27)	
Effective Interest Rate	-7.73*** (1.94)	-7.81*** (1.53)
CIVEMPLOYMENT	6.038** (1.52)	6.04*** (1.52)
CONSUMERCONFIDENCE	0.29** (0.11)	0.28** (0.11)
CASE-SHILLER	0.10 (0.04)	0.11*** (0.03)
Adjusted R-squared	0.84	0.845317
F-statistic	70.51	85.15828
Prob(F-statistic)	0.00	0.00
Durbin-Watson stat	1.09	1.12
Coefficients and Standard Errors are Listed, Standard Errors in Parentheses ***** Indicates significance of the independent variable at the p ≤ .01 level** **** Indicates significance of the independent variable at the p ≤ .05 level** *** Indicates significance of the independent variable at the p ≤ .10 level** **Time Period: 1990 Q3 to 2009 Q4**		

Based on the Durbin Watson statistics shown by Model 8 and 9, it is questionable whether they should be included as reasonable results due to autocorrelation. In model 8, all of the coefficients were as expected except for the Case-Shiller Index. The Case-Shiller index was also insignificant in addition to the dummy variable being insignificant. I dropped the dummy variable in model 9, which boosted the Durbin-Watson a small amount, but not enough that the result can be fully trusted. All of the variables in model 9 came out to be highly significant, including the Case-Shiller Index. However, this variable had a positive coefficient that was not expected. It could be the case that as people saw prices in the housing market rising, they believed that the prices would keep rising and therefore thought that housing investments were a good investment. In any rate, the variable of interest was significant beyond the one percent level and had a positive correlation. This is what I would expect to occur, while controlling for all possible variables that do not conflict with the econometric model. Therefore, it is reasonable to infer that this result may show that herding was a contributing factor in the housing market during the period of 1990 quarter three and 2009 quarter four.

Table 8-4: Regression Analysis for Herd Behavior on Housing Investment, with a Lagged Dependent Variable

Dependent Variable: Housing Investment				
Variable	Model 10	Model 11	Model 12	Model 13
Constant	57.82***	39.55	39.96***	168.31***
	(20.81)	(5.93)	(5.50)	9.95
Chg CaseS-hiller (-1)	9.27***	0.85	0.96*	8.8***
	(1.7)	(0.57)	(0.55)	(1.92)
Chg Case-Shiller (-2)	9.07***	1.62***	1.76***	12.41***
	(1.81)	(0.58)	(0.57)	(2.04)
GlassSteagallDummy	1.19	1.96		
	(5.07)	(1.44)		
Effective Interest Rate	-4.49**	-3.06***	-3.06***	-10.37***
	(1.77)	(0.5)	(0.5)	(1.35)
ConsumerConfidence	0.40***	0.03		
	(0.1)	(0.03)		
Case-Shiller(-2)	0.14***	- 0.06***	-0.05***	
	(0.04)	(0.01)	(0.01)	
Housing Invest(-1)		0.92***	0.93***	
		(0.03)	(0.03)	
Adj. R-Squared	0.87	0.99	0.99	0.8
F-Statistic	78.27	953.76	1322.26	98.19
Prob(F-Stat)	0	0	0	0
Durbin-Watson	1.09	2.03	1.99	0.84

Coefficients and Standard Errors are Listed, Standard Error in Parentheses

***** Indicates significance of the independent variable at the p ≤ .01 level**

**** Indicates significance of the independent variable at the p ≤ .05 level**

*** Indicates significance of the independent variable at the p ≤ .10 level**

Time Period: 1990 Q3 to 2009 Q4

The regressions I ran with Housing Investment as my dependent variable had some similar results to those presented for Housing Starts. In model 10 I did not include a lagged dependent variable for housing investment, but did include a second lagged variable for the change in the Case-Shiller Index for one quarter prior. I also lagged the Case-Shiller index itself for two periods to account for In this case, almost all the variables in the model were significant, with the exception being the Glass-Steagall Act dummy variable. This was a similar situation to what occurred with the dependent variable being housing starts. However, in this case, by not providing the lagged dependent variable for housing investment, the Durbin-Watson statistic was at a very low level, below one. Therefore, it is difficult to accept this model based on the chance it is plagued with autocorrelation.

However, when including the lagged variable for housing investment, as seen in model 11, the issue with autocorrelation seemed to go away. The amount of variation that my model accounted for increased in comparison to when it was not included as well. In addition, the housing investment lagged variable was very significant in the regressions run. I had hoped the Glass-Steagall repeal dummy variable would be significant with respect to housing investment, but it appears that was not the case; likely for the same reasons presented prior for housing starts. In each case, the effective interest rate had a negative coefficient, meaning that an increase in the rate led to a decrease in housing investment. In all cases, this variable was significant in the model to a high degree. In regression 2, the lagged independent variable for change in Case-Shiller index for one period prior was not significant at the ten percent level. This was likely due to the inclusion of the insignificant Glass Steagall Act dummy variable and the consumer

confidence variable, which would skew the coefficients and also make other independent variables look less significant in the model. When the Glass-Steagall Act variable and the consumer confidence variable were removed, however, every independent variable became significant to a high degree.

When the lagged dependent variable was included, consumer confidence became insignificant. Prior to this, in other regressions run, it was significant. This may be due to people's confidence in a market being better shown by where they put their money, rather than how they filled out a survey. If they invested their money in the housing market in the prior period, this could indicate a level of consumer confidence specific to the housing market. Similar to betting, people place their money where they are most confident it will pay off. Therefore, the lagged investment in housing may overshadow or possibly even account for, the consumer confidence

The lagged dependent variable for housing appeared exceedingly important as a predictor for the present time period housing investment. For every dollar invested in the prior period, more than ninety cents extra was invested into housing in the subsequent period. This is pretty interesting, and shows that housing investment usually occurs over periods longer than a single quarter. This makes sense, as renovations, building new homes, investing in a new properties and so on takes time.

With respect to the variable of interest, the change in the Case-Shiller Index, the results are as expected. The proxy variable for herd effect was significant in every case when insignificant variables were omitted. This was the case in the change in Case-Shiller Index of one period prior ad of two periods prior. Similar to the results for housing starts, the results support a high degree of herding in the market. It was

interesting to note that both lags seemed to elicit a change in the amount invested in the housing market.

B. Descriptive Statistics of Significant Variables

Presented below are the descriptive statistics of the variables that were found to be significant within the regressions run, or at least significant in most of the regressions run. The average amount of investment in housing per quarter almost 115 billion U.S. 2005$, while there were around 121 thousand houses started each quarter during the period of 1990 through 2009.

Table 8-5: Descriptive Statistics of Significant Variables

	HOUSING INVEST (Quarterly, Billions, 2005$)	HOUSINGSTARTS (Monthly, in thousands)	Change in CASE-SHILLER (2 Qt. lag)	Effective Interest Rate	CONSUMER CONFIDENCE	CIV EMPLOYMENT
Mean	114.97	121.15	0.94	7.15	89.02	62.70
Median	112.57	121.61	0.96	7.09	91.73	62.8
Maximum	172.74	191.76	3.71	10.16	115.10	64.6
Minimum	69.48	38.13	-2.40	5.02	33.35	58.37
Std. Dev.	28.80	33.71	1.13	1.20	16.84	1.17
Skewness	0.32	-0.32	-0.72	0.58	-1.00	-1.08
Kurtosis	2.26	2.89	4.65	3.13	4.17	5.27
Jarque-Bera	3.16	1.48	16.08	4.58	17.97	32.57
Probability	0.21	0.47	0.00	0.10	0.00	0
Sum	9197.41	9692.50	74.80	572.11	7121.66	5016.17
Sum Sq. Dev.	65541.25	89823.39	101.71	113.71	22409.55	108.40
Observations	80	80	80	80	80	80

Chapter 9

Discussion and Conclusions

This chapter investigates some econometric issues that must be addressed pertaining to the models used in this paper, it summarizes the findings of the econometric analyses used and also discusses some of these results in further detail. In addition, this section is dedicated to discussing policy implications of the results, and sheds light on some of the motivations behind this paper.

There was a variety of econometric issues that could be considered problematic when creating and when finalizing the models presented in this paper. These may include omitted variable bias, problems caused by the endogenous variables, problems with autocorrelation of variables, multicollinearity and lag issues.

One of the first econometric issues that my model may exemplify is that of omitted variable bias. Other variables of interest that data could not be obtained for include the number of loan originations per quarter, the percentage of subprime mortgages issued out of total mortgages issued, the number of home loan applications filed and the subprime rate. I would have also liked to somehow characterize the number of securitizations, maybe by the total number, although this was not feasible based on the data available. Therefore, it is possible that there was some omitted variable bias from not including these variables in addition to leaving out other variables that were not presented in the model or were not previously listed. I attempted to include as many variables as I could at first, since it is better to begin with too many variables than too few variables (Schmidt, 2005) when running the first regressions. This is the case as one can eliminate

insignificant variables in a model, but adding significant variables when others are being eliminated is difficult.

Based on the size of the housing market, it is likely that that there are many other variables that affect housing starts and housing investment that are not included in the model. If this is the case, it is likely that my model would compensate for these omissions by under or overestimating the other factors presented in the model. Even if this was the case however, it is unlikely that this would over or underemphasize the variables in the model to the point where it would drive those of significance into a classification of insignificance or vice-versa.

In addition to possible omitted variable bias, with respect to endogeneity and reverse causality in my model, it is certainly possible that there is some involved, considering the nature of the housing market. It is well documented that there is endogeneity between the housing market and many macroeconomic variables (Ewing and Wang, 2005). With this in mind, it is likely that there are some endogeneity issues within the current version of my model. It is certainly possible that housing starts or housing investment could appear independent of many of the variables used, or not used, during a static time period. That being said, these dependent variables could still be influenced by the variables used in the previous time period or periods. For example, the percentage of people employed two periods earlier could have large effects on housing investment, but the percentage employed within the same period may not have a significant or large effect.

With this being said, this raises some issues with lagging variables. Not all of the variables were lagged in the model. Regressions were attempted with differing lags for

the independent variables, although the results of those regressions are not shown in this paper due to lack of estimating power pertaining to the dependent variable. There are likely other lags that could have been tried to see if they affected the results, although not every lag over the 20 year period was attempted. Therefore, it is possible that lagging certain variables over certain time intervals could have lead to more succinct, more significant and more reliable results. In addition to this type of lag issue, there may be other inherent lag issues in my current model. For example, it may be the case that the current effective rate of interest may not be as revealing as if the effective rate of interest was lagged a quarter or two with respect to the model dealing with housing starts. This may be the case since individuals that take out a mortgage may not immediately purchase a home within that month or even quarter. Sometimes, these processes drag on, while at other times, for example if a house is empty rather than occupied, the process could quickly occur. Even with these econometric issues, the results provided can give some key insight into some of the facets of the housing market during the housing bubble.

For the most part, in all of the regressions presented, the Durbin-Watson Statistics calculated are reassuring. A Durbin-Watson Statistic ranges from 4 to 0. Any Durbin-Watson calculated below around 1 and anything above 3 is indicative of strong autocorrelation in the model. If the number is below one, this statistic provides evidence for positive autocorrelation. If the calculation is above three, it is likely that there is some negative autocorrelation in the model. If the statistic has a value around 2, this is evidence supporting no autocorrelation in the model. If autocorrelation is present in the model, it means that there is a relationship between values of the residuals when there should not be one. Although it is difficult, or even impossible to directly observe

autocorrelation of the error terms, autocorrelation can be observed in the residuals produced in regression analysis. Specifically, it is an issue because it contradicts the assumption that error terms are uncorrelated in ordinary least squares regressions. This causes a problem, since it causes higher than actual t-scores and underestimated standard error calculations. Most scores above one are acceptable, as there is likely to be some autocorrelation in statistical models, especially when accounting for the fact that the housing market is dependent on many related entities. In addition, in all macroeconomic time series regressions, there is likely to be a small degree of autocorrelation that cannot be controlled for or cannot be reduced. Nevertheless, based on the Durbin Watson scores, my regression results appear to lack a high degree of autocorrelation, which is a good thing, since all of my regressions have a score higher than one and most scores float around 2. Therefore, autocorrelation does not seem to play a major role in my model. However, some of the scores did fall around one, so one must be wary before accepting those results. Additional tests likely need to be run to figure out the cause of the autocorrelation.

There is a possibility that my model would measure the effect of new housing starts, or housing investment on the change in Case-Shiller Index. This is the problem of reverse causality, which could be undermining my model. This is the case, as additional investment in homes could affect the Case-Shiller Index and in turn effect the change in the Case-Shiller Index. Therefore, to negate this issue, and to ensure that I am measuring for herding in the housing market, in addition to other reasons, I lagged the independent variable, the change in Case-Shiller Index. In this way, it would be impossible for the current year housing starts or investments to alter changes in the index, periods before.

Econometric issues were not the only interesting results created by the models and regressions, however.

A few of the results of the regressions were surprising, and did not match the predicted results. First off, it was interesting to see that average market rent did not play a large role in the number of housing starts or housing investment based on my models. It is likely that homeownership and renting of residence are imperfect substitutes in reality. There are too many differences between the two entities to consider them a as adequate substitutes. They both do provide shelter, comfort and a variety of other qualities, but they are not the same. For one thing, renting requires a landlord or a company to rent from that is in charge, whereas as a homeowner a person is in control of the property for the most part. In addition, unless there is some type of rent to own agreement, a renter will never own the property. A renter does not get a long term asset in return for their monthly payments, as they would if they were paying a mortgage towards owning a home. These differences, among many others, may help to explain why rental prices are not significant in this housing market model.

There may be one contradicting idea pertaining to the way that consumers think about housing. As the price of housing increases, the demand for houses is theoretically thought to be reduced, since the cost of housing is increased relative to other consumptive goods (Ewing and Wang, 2005). However, it is possible that rising home prices were actually enticing to those entering the housing market, as long as they believed that the price of housing was going to rise indefinitely. Therefore, this brings up an interesting discussion as to whether housing is a normal good. To an extent, as the price of housing increases, the demand in this case seemed to increase. This is not what normally would

be expected from a normal good, rather these are the characteristics of a veblen, or possible giffen good. What made those that entered the housing market think that housing was such a great investment? Maybe it was a herd effect, where everyone else was doing it, so it must have been the right thing to do.

It is interesting that in some of the regressions run, by controlling for the Case-Shiller index in the model, the coefficient negative in some regressions and positive in others. For the most part, when a lagged dependent variable for housing investment is included in the model, the Case-Shiller index, lagged or not, produces a significant negative coefficient. This is what I expected to occur, due to a rise in price being indicative of a decrease in demand.

There are some ideas pertaining to why bubbles are persistently occurring in the U.S. Economy. Some involved in economic affairs view bubbles as the only thing keeping the United States economy functioning (Janszen, 2008). In this view, the only thing able to stop one bubble is the formation of another, like dominos crashing into each other on a financial wave barely able to keep the U.S. above water. In this way, it is no longer the business cycle, but rather the U.S. bubble cycle that drives the economy (Janszen, 2008). Janszen (2008) sees the subprime mortgage crisis as a "sideshow" to the other problems slowly creeping up on those involved in the U.S. housing market. In his eyes, the subprime market was only important after the real bubble burst; when the hyperinflation of housing prices could no longer be sustained by the average home buyer, and in turn lenders sought different, and more susceptible clientele to fill this gap. He also contests that the media had a large role in affecting the views of the public in a positive fashion, by showing the illustrious homes, McMansion-like homes and playing

commercials on television for the get-rich-quick house flipping schemes. Still, the housing bubble itself was one great spectacle, not exactly like anything the U.S. had encountered before, albeit similar in some ways.

As a result of the housing bubble, President George W. Bush and the Federal Reserve Board instituted a "limited bailout" in order to support those that could not pay their mortgage debts by themselves (Financial Crisis Inquiry, 2011). In addition, the U.S. government shelled out hundreds of billions of dollars pertaining loans, as well as billions in order to rescue large government backed agencies like Fannie Mae. The Federal Government has even agreed to provide almost unlimited financial backing for Freddie Mac and Fannie Mae through 2012.

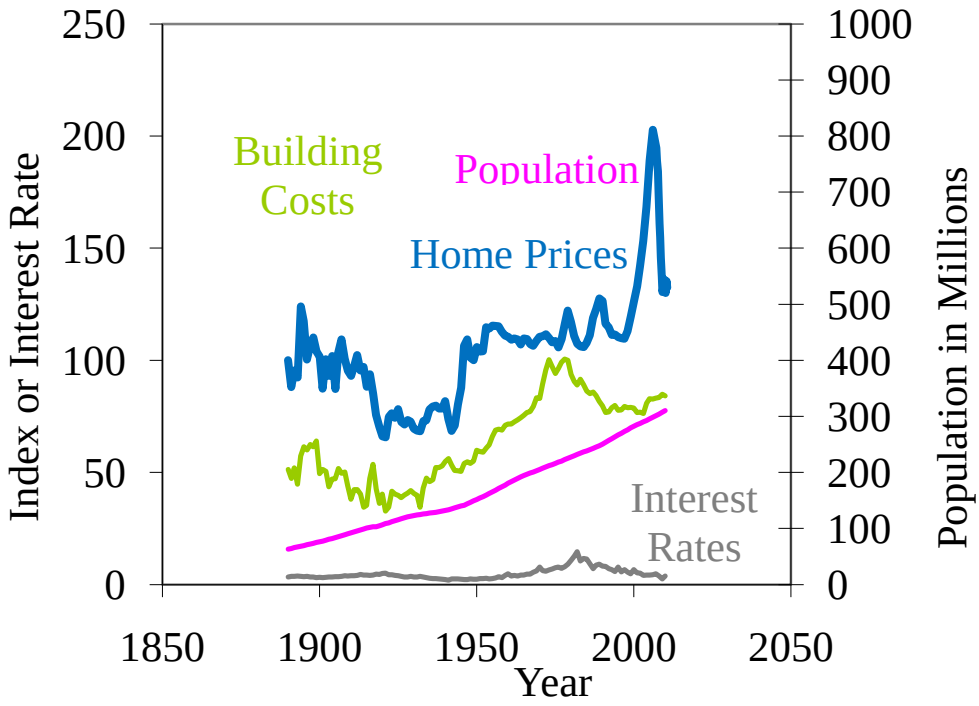
With this amount of money being used to protect these large companies, it is all too sad that the government could not have identified the problem and been preventative, rather than pay for the problem afterwards in a reactionary fashion. Therefore, in the future, the government and economists should look for similar signs occurring in asset markets, before it problems become too large to prevent.

The causes of the housing bubble and financial crisis that recently occurred in the United States are countless and complicated. The Housing bubble was not the result of a single entity, policy decision, person in power or flaw in economic thought. Instead, it was a system failure, the combination of myriad decisions proliferating into a perfect storm (Stiglitz, 2009). In 2007, we faced a serious problem which the combination of the known causes could not fully account for.

Based on the results of the regressions, it appears that herd effect may have played a role in the housing market, leading up to and during the housing bubble. The

literature provides anecdotal support in other markets for herd behavior, while there was clearly a frenzy of individuals entering the market. These graphs, figure 9-1 and 9-2 sum up the motivation for this thesis.

Figure 9-1: The Incredible Spike in Housing Prices from 2000-2007

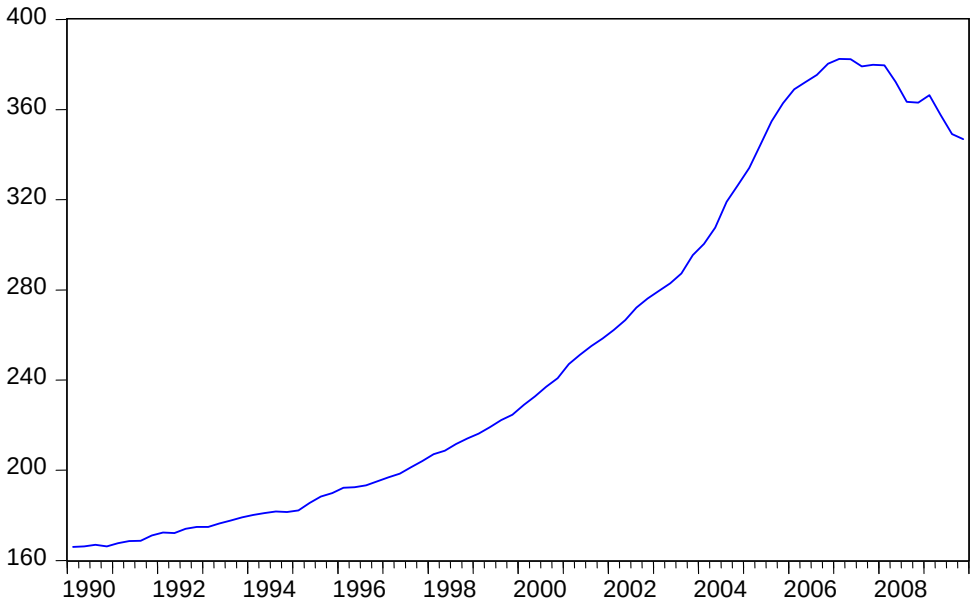


Source: Robert Shiller

It is clear that something was going on in the housing market that was unusual over the period of 1990 to 2009. By looking at this graph of the Case-Shiller Index, containing information on the housing market for the last 20 years, is clear that the situation the U.S. housing market just faced was unique in the housing market. With this being said, something was occurring in this market; something that is very difficult to account for based on the macroeconomic market fundamentals. One of the purposes of this thesis was to attempt to identify that herd behavior exists in the housing market and determine whether it contributed to this steep rise in home prices and subsequent decline

after the housing bubble burst. Using the lagged change in Case-Shiller Index, as a reasonable proxy variable for the herd effect, and after providing robust econometric results, it is a reasonable inference that the herd effect was present in the housing market and it did contribute to the housing bubble.

Figure 9-2: Closer Look at the Case-Shiller Index: The period of 1990-2009



Source: Robert Shiller

With that being said, it is likely not the biggest contributor. For lack of a better proxy variable for herd effect, the change in the lagged change in the Case-Shiller Index appeared to be a reasonable proxy variable to use when controlling for all other sensible factors, that based on basic economic theory, influence the housing market. Considering the high price of homeownership, herd behavior likely has effects on other markets, not just the market for homes. Policy actions should be taken in order to reduce the

occurrence of this type of behavior in the future, to further limit the volatility of all markets, including housing and to help prevent future economic crisis.

Further research should be done in trying to identify a better proxy variable for herd effect. In addition, testing out this econometric method in other asset markets should be done, to see if it can be applied across multiple markets.

With respect to policy concerns, the public should be better educated with respect to the housing market. All seniors in high-school should be placed in a class that teaches life skills, including those involved with purchasing, owning and taking care of a home and mortgage. In addition, the public should be warned to a degree about herd effect. If people do not know this behavior exists, then they will not know when they are swept up in it. In addition, the United States Government should keep a closer eye on the housing market and all large asset markets, as bubbles could wreak havoc in the future just as they did recently.

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