Protection Against the Housing Crisis: An Analysis of Industrial Diversity and Responsible Investment

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Introduction

Between 1970 and 1998 housing prices in the United States—adjusted for inflation—were essentially flat. In fact, housing prices generally tend to follow the Consumer Price Index, with the occasional small boom and bust cycles thrown in. Until very recently, the largest rise in housing prices was the approximately 75% increase seen immediately after World War II, which coincided with the end of the Great Depression and the beginning of the baby boom (Barry and Shiller). From 1999 through 2006, the US experienced an even larger rise in housing prices, which coincided with the March 2001 peak in the dot-com bubble in the stock market and infusion of the cheapest money ever available for mortgages into the US economy. The interest rate on a one-year adjustable rate mortgage (ARM) went from approximately 7% in 2000 to less than 4% in 2003 (U.S. Average Weekly Mortgage Rates). This dramatic reduction in interest rates allowed many thousands of people to purchase their first home or upgrade to a more expensive one.

By 2003, over two-thirds of households owned their homes and residential investment further intensified as spending on new homes, construction and renovation increased by 12% (Mishel, Bernstein and Allegretto; Bivens). It is clear that individuals' confidence in the construction industry—or more accurately, their confidence that prices would continue to increase—overrode any concerns about what would happen in an

economic downturn. This extreme consumer confidence served as "the fuel to the fire," ultimately producing an unsustainable housing bubble.

During the years leading up to the crash, housing prices rose at an unprecedented rate even after adjustment for inflation. This dramatic increase in homeowners' equity coupled with inexpensive loans, allowed ready access to a windfall of cash. Homeowners could repeatedly refinance, taking out larger and larger loans against their homes. Since saving rates were continuing to fall during this same period, it is safe to assume that most of these home equity loans were rapidly spent. For the new homebuyer, the rapidly escalating prices of homes meant taking out larger and larger loans, which frequently required the use of ARMs. The loans provided artificially low initial interest rates that allowed borderline borrowers to qualify, but rates increased sharply after the initial period. From 2000 to 2003 borrowers could simply refinance after a year at an even more attractive rate, but the refinancing party hit the wall in 2004-2005 as rates for ARMs started to rise sharply (U.S. Average Weekly Mortgage Rates). Many homeowners became overly leveraged and were unable to keep up with payments as interests rates began to rise, nor could they easily refinance to fix the problem. Not surprising, home foreclosures began to rise in 2005. As unaffordable homes hit the market and easy money dried up, housing prices could not continue to rise at the same pace; thus, home values began to decline in 2006. The housing bubble had officially burst. The increasing number of distressed sales further reduced home values, resulting in even more people failing to meet their payment obligations. The downward spiral in housing prices was seen in the majority of American cities. While the rise in housing prices was broadly observed across the country, not all cities experienced the same rates of rise nor did everyone suffer the

same rapid decline. What factors outside of the control of an individual, such as a city's industrial profile, served as a protector against the housing crisis of 2007?

Although there is much speculation and many theories regarding the causes and effects of the recent housing crisis, most hypotheses are not backed up by data. Our hope is to aid exploration of economic data and to promote well-informed discussion and policy-making by creating an accessible and reproducible repository of housing data and analysis. Our research began in 2009, with the collection and general analysis of all data sets related to the housing crisis. In 2010, we decided to take a close look into the industrial organization of American cities.

Hypotheses

We started with two main hypotheses. First, we theorized that industrial diversity would be protective against the housing crisis, where industrial diversity is measured based on the percentage of money being spent in major industires. Our belief was founded on the idea of diversification of investments, i.e. diverse portfolios are less risky. Thus, to survive unexpected cyclical changes, a city would need to diversify its industrial base and spending. Furthermore, we assumed that industrially diverse cities would have more employment and income stability. Secondly, we hypothesized that there would be a relationship between city spending in construction and housing prices. There would be more incentive to build if property values were increasing, so we would expect cities high housing prices to spend the most money in the construction industry.

Data and Tools

The two data sets we used were Federal Housing Finance Agency (FHFA) Housing Price Index (HPI), and the Bureau of Economic Analysis: Gross Domestic Product (GDP) by Metropolitan Statistical Area (MSA).

The FHFA HPI data set reported the quarterly HPI between the years of 2000 and 2009. HPI is a weighted, repeat-sales index that measures average price changes in repeat sales or refinancing on the same properties. The information used to create the HPI is obtained by review of repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975 (OFHEO).

The Bureau of Economic analysis data set reported the GDP in millions of dollars for every MSA between the years 2001 and 2008. GDP measures the output of goods and services produced by labor and property located in the United States. These products can be used for immediate consumption, for investment, or for replacing depreciated fixed assets. We are able to determine how much money is being spent in different industries based on the amount of output produced. The GDP was divided into 109 total industries; however, for our research we analyzed only information concerning the nineteen largest and most prominent industries, as defined by the U.S. Department of Commerce. The industries analyzed are listed in Figure 1.

Figure 1: Industries Analyzed

Industry
Agriculture, forestry, fishing, and hunting
Mining
Utilities
Construction
Manufacturing
Transportation and warehousing, excluding Postal Service
Information
Finance and insurance
Real estate and rental and leasing
Professional and technical services
Management of companies and enterprises
Administrative and waste services
Educational services
Health care and social assistance
Arts, entertainment, and recreation
Accommodation and food services
Government
Trade
Education and health services

MSAs are areas with a "recognized population nucleus" and nearby communities that are socially and economically connected with that nucleus and have a minimum population of 50,000 (Office of Management and Budget; 1, 6). The MSA provided a common linked between the HPI and GDP data sets.

We used the program R, a statistical standard among statisticians, to download, clean, and analyze these large data sets. Clean data sets follow our "four-c's" requirement: consistent, correct, complete, and concise. Additionally, R allowed us to easily manipulate and visualize these data sets using minimal coding. R is extremely advantageous because it is open source and free to the public. Furthermore, all of the codes from the HPI and GDP data sets can be run smoothly without any use input, allowing our work to be completely reproducible

We also used GitHub, a very advanced website that is able to track any changes made to data from multiple individuals. GitHub is advantageous to both our research group and to the interested public. On GitHub, we are able to freely store large amounts of data and everyone in the research group can work on the same data without having to e-mail changes back and forth. In addition, others can view and download our data for free. The R download code or source, clean code, and exports code are all posted on GitHub.

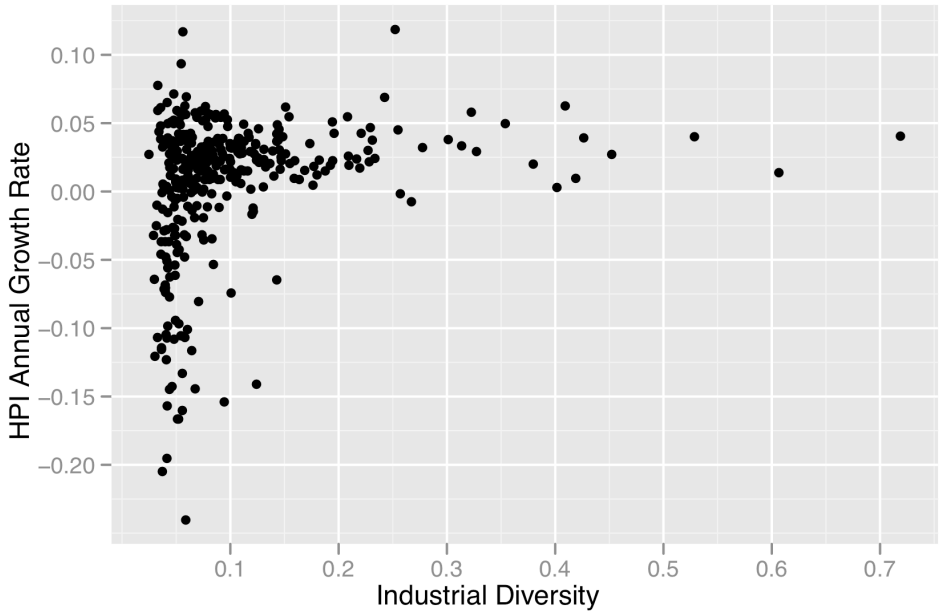
Analysis

We paid special attention to the HPI data recorded between the years 2006 and 2009. We calculated HPI average annual yearly growth/decline using the standard equation for finding average annual growth rate, as follows:

$$(\text{HPI in 2009} / \text{HPI in 2006})^{(1/3)} - 1.$$

When analyzing industrial diversity, we define diversity as the mean squared deviation from maximum diversity (i.e., equal spending in all industries). Cities with a diversity measurement between 0.0 and 0.2 spend a fairly equal amount among across all industries. Maximally diverse MSAs were more likely to experience a large change in housing prices, compared to MSAs with diversity measurements higher than 0.25 (Figure 2).

Figure 2: Industrial Diversity vs. HPI Annual Growth



This finding was surprising, so we examined the average percent of production/spending in certain industries and compared it to the annual average growth rate of HPI. Cities that spent a large percent of their total GDP in industries such as education, government, mining, or manufacturing were less susceptible to housing price changes (Figure 3). This pattern was consistent for all industries except for construction (Figure 4).

Figure 3: Production vs. HPI Growth Rate by Industry

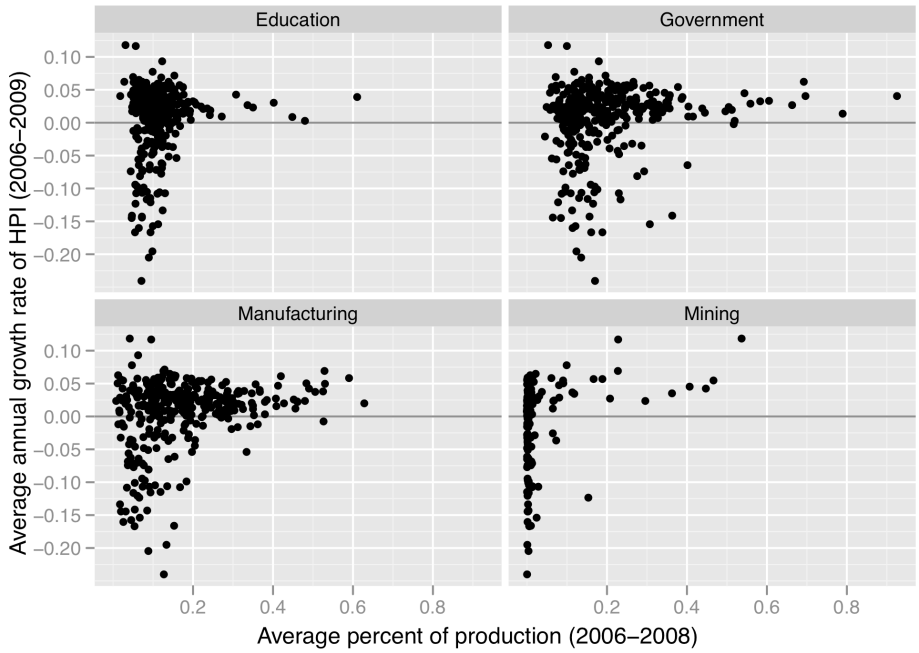
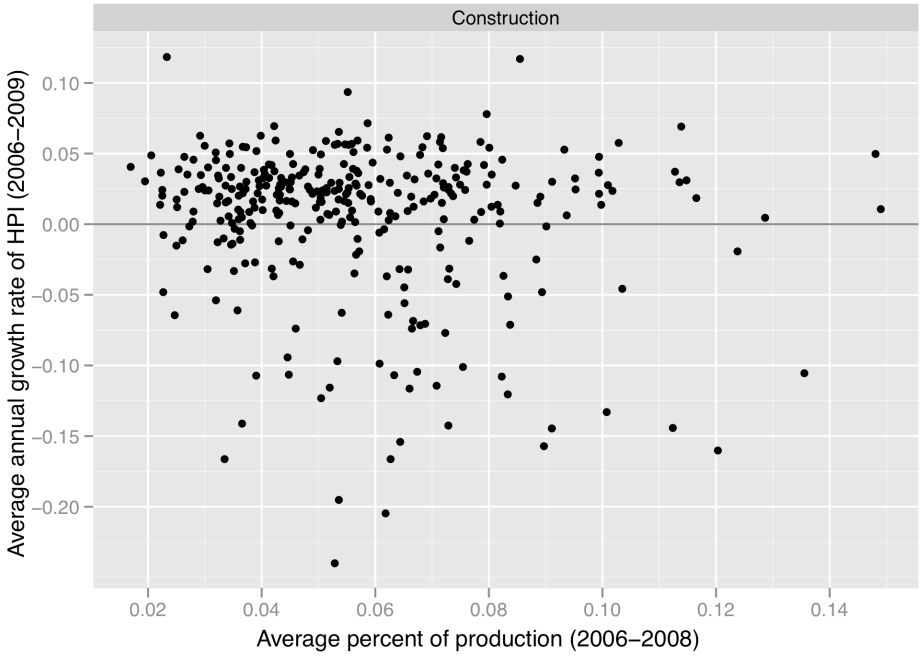


Figure 4: Production vs. HPI Growth Rate for Construction Industry

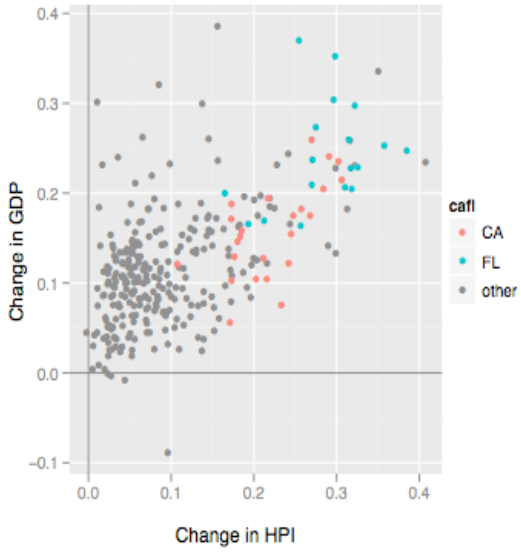


Consequently, we decided to take a closer look into the relationship between GDP spending in construction and housing prices. While our analysis covers all the metropolitan statistical areas, we also focused specifically on those in California and Florida based on the fact that these states were particularly badly hit by the housing crisis. Figure 5 shows a clear relationship between HPI and construction industry GDP changes between the years 2001 and 2007. The pink and blue data points are MSAs in California and Florida, respectively.

Figure 5: Change in HPI vs. Change in GDP (2001-2007)

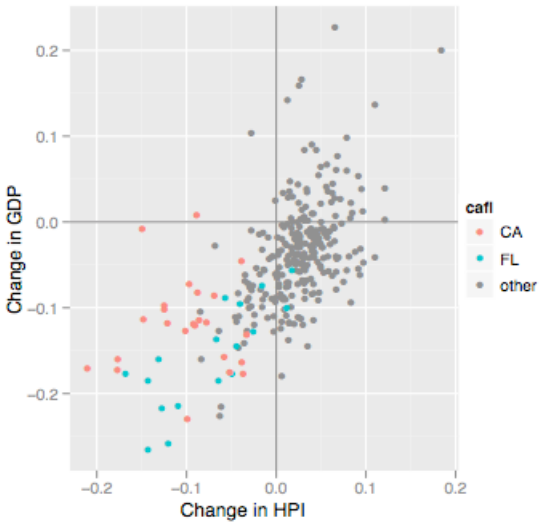
To better understand this linear relationship that changed over time (as shown in Figure 5), we must take a closer look into the individual years within that time period. In 2004, two years before the housing crisis, there is a positive linear relationship between change in HPI and change in GDP (Figure 6).

Figure 6: Change in HPI vs. Change in GDP (2004)



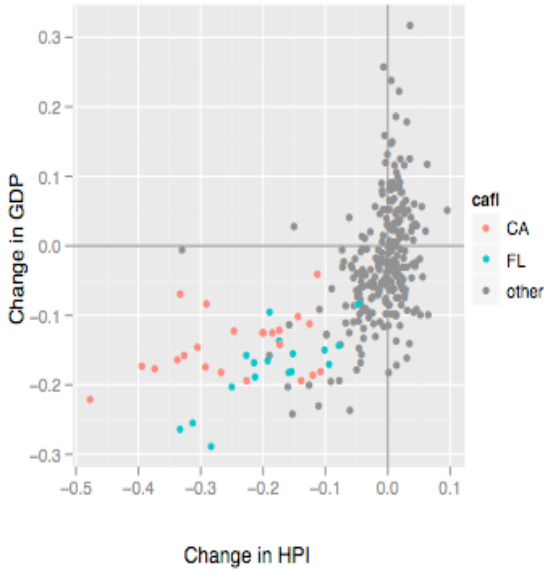
Florida and California have the highest house prices and the highest construction spending. This supports our hypothesis that people in cities who experienced large increases in housing prices were much more willing to spend money in the construction industry because they were confident the market would continue to flourish. In 2006, at the beginning of the housing crisis, GDP and house prices decreased drastically in California and Florida (Figure 7).

Figure 7: Change in HPI vs. Change in GDP (2006)



It is interesting to note that the MSAs experiencing less extreme changes decided to decrease in their construction spending although their housing prices continued to steadily rise. Finally, in 2007, the change in housing prices appears to stabilize among all states, with the exception of Florida and California, which experience further dramatic decreases (Figure 8).

Figure 8: Change in HPI vs. Change in GDP (2007)



This data shows us that MSAs most affected by the housing crisis were those that saw the greatest increases in prices and spent the most on construction during the housing boom. If Florida and California had spent less money on construction when their housing market was booming, they could have been saved from becoming the two hardest hit states during the crash.

Discussion

This study provides important information on the relationship between cities' industrial profiles and investment during the recent economic downturn. In contrast to our initial hypotheses, our research shows that industrial diversity is not protective; however, cities that spend a larger percent of money in education, government, mining and manufacturing are more protected. A review of how these sectors faired during the recession helps explain out study's findings. A good example of how well the education sector has done relative to others can be found in the almost 20% increase in salaries between 2005 to 2009 for starting elementary school teachers in North Carolina (NC Public School Salary). The protective nature of government employment is highlighted by the stability of the government sector during the worst part of the recent recession. While private sector employment fell by 6.9 million jobs between December 2007 and July 2009, state and local government employment rose by 110 thousand jobs or 0.6 percent (www.rockinst.org/pdf/government_finance/2009-08-20-State_Local_Employment.pdf) . As for mining, precious metals increase in value and energy prices rise during an economic crisis, again leading to a high demand and stability. The protective nature of manufacturing was most surprising. A closer look at the date revealed that the cities with the highest percent of production from manufacturing had oil refineries or General Motors (GM) production plants. At the time, both the oil industry and GM were very stable, hence stability was observed in the manufacturing industry as a whole. We doubt that manufacturing will remain protective given the recent problems with those industries, but that data is not yet available.

In contrast, we have shown a non-protective relationship between spending in construction and HPI. It is clear that cities that spent a greater proportion of their dollars in construction felt the effects of an economic downturn earlier. It is reasonable to believe cities that overbuilt were more likely to be over-leveraged and overly dependent on projected revenues from an ever-expanding housing market. It appears cities that were more restrained in their construction spending were more protected against the severe economic effects of the housing crisis.

We hope that this research will shed some light on what is still a poorly understood housing crisis. While the roots of the crisis, i.e., cheap mortgage dollars and runaway housing prices, are not likely to be seen again anytime soon, this study may provide guidance about what to do in the next boom-bust cycle. Obviously, simple diversification cannot prevent a bad outcome. Leaders need to focus on what are the likely drivers of the bubble, and try to reign in some of the excesses before the inevitable crash.

Future Work

We would like to develop a website that will allow users to easily access the data they are interested in, which would otherwise be a daunting task for those who wish to use a data set of this size. Because our analysis and findings also involve large amounts of information, we are exploring interactive graphical methods for displaying this information. We also hope to continue our analysis of the other data sets we have collected. Some possible areas of interest are migration patterns between MSAs with large housing price changes, the affect of the housing crisis on vacation cities and the

comparison of average commute times for residents in cities that were and were not hit by the crisis.

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