On foreclosure rates and the house price index: A cross-sectional analysis

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Abstract

This paper attempts to firmly establish the dependence of house price index on foreclosure rates, a prerequisite to substantiating "let-sink" foreclosure policy. In our paper, we first examine a simple linear regression model to show that there are omitted variables in the model, and therefore, more variables other than just foreclosure rates have to be considered. We then continue with the multiple linear regression model by looking at the influence of foreclosure rates, education, property tax, income tax, stimulus, and legal system upon house price index. By using this model, we show that most variables do not have statistical significance, individually or jointly, except for foreclosure rates and legal system. Finally, we reject the null hypothesis and conclude that house price index is significantly dependent upon foreclosure rates and the state legal foreclosure system.

1. Introduction

The housing market crash is considered the primary cause of the 2007-2009 recession in the United States. Lax banking regulation, underestimation of default risk, and stagnation of real estate demand contributed to the creation of the recession. From 2006 to 2007, foreclosure rates increased steadily, and in 2008, the Case-Shiller Home Price Index reported the largest price drop in the history of the index. This price drop had a direct negative impact on mortgage markets, mortgage-backed securities, and hedge funds. The effects spread to the rest of the economy, resulting in a full-blown recession, the worst since the Great Depression of the 1930s. The federal government was forced to provide almost $1 trillion in stimulus packages, while the Federal Reserve printed $600 billion to maintain liquidity. These bailout programs shifted much of the liabilities from private hands to the government on a scale never before seen.

As part of the stimulus packages, almost $50 billion were allocated to a mortgage rescue plan, to help up to 9 million borrowers (Goldman, 2009). While this might be the more politically viable policy, in this paper, we investigate if a “let-sink” policy might have been economically superior. By favoring an increase in foreclosures, as opposed to helping homeowners with failing mortgages, this counterintuitive policy could be better for the long-term welfare of the economy despite its short-term detriments, embracing free markets by foregoing a costly government bailout program that serves only to lengthen the time duration of the fall. We hypothesize that higher foreclosure rates correlate with lower house prices. If this hypothesis holds true, then we can safely assume that encouraging foreclosures in an economy with inflated house prices will lower house prices faster than the alternative approach. By shortening the duration of the bubble bursting, this “let-sink” policy, we believe, would allow the economy to rebound faster, providing all its benefits. Furthermore, this would free foreclosed homeowners of their debt and shift the liability to the banks. To investigate this, we will test our alternate hypothesis, which states that house prices across states correlate negatively with foreclosure rates. The null hypothesis predicts no correlation.

2. Literature Review

There exists an abundance of literature pertaining to house prices and foreclosures in America. The following four papers each provide a more detailed background in various aspects surrounding our paper, such as house prices, foreclosure rates, governmental responses, and risk reduction. While these papers provide a wealth of data and analysis, they lack diversity of rationale evaluation.

2.1. Economic effect of house prices on foreclosures

Foreclosures, house prices and the real economy (Mian et al., 2011) is perhaps the most similar to our research. It suggests that in the 2007-2009 period, foreclosures were responsible for a 20 to 30% decline in house prices. States without a judicial requirement for foreclosures are as much as twice as likely to foreclose, as expected. This paper goes a step further to eliminate any unobserved bias by tracking and comparing bordering regions by looking at zip codes. When shifting across borders, there is a discrete rise in foreclosure rates, other things being constant. This paper also shows that increase in foreclosures over time leads to a fall in residential investment, prices, and demand. It estimates that a foreclosure increase of 12.6 percent should decrease the house price by 5.3 percentage points (Mian et al., 2011). This paper essentially illustrates a decrease in demand, causing equilibrium prices to fall, in turn promoting foreclosure as a rational decision.

This paper also brings up an interesting dichotomy of states: judicial vs. non-judicial foreclosure systems. In judicial foreclosure states, a lender must sue a borrower in court before conducting an auction to sell a delinquent property, a long and costly process. Other states do not have such a requirement (non-judicial foreclosure states) and give lenders the automatic right to sell the delinquent property after providing only a notice of sale to the borrower. States with non-judicial foreclosure systems in the 2008-2009 fiscal years have 4.7 foreclosures per homeowner with a mortgage; however, in states with a judicial foreclosure system, the number is as low as 2.3 (Mian et al., 2011). The regression results point out that the judicial foreclosure process goes from being statistically insignificant in 2006 (-0.079, 0.049) to being statistically significant up to 5% levels in 2009 (-0.150, 0.049). Thus, according to Mian et al., this dichotomy significantly affects foreclosure rates (2011).

2.2. Federal mortgage modifications in foreclosures

This second paper, *Foreclosures, enforcement, and collections under the federal mortgage modification guidelines*, delineates the methods to abate the foreclosure crisis and their relative

successes (Mulligan, 2010). The federal mortgage modification initiatives are intended to prevent the foreclosures of delinquent home mortgages. Because this paper discusses these initiatives in depth, we review it to gain insight into the benefits or drawbacks of foreclosure prevention. These mortgage modification initiatives discourage reduction on principals (i.e. the house price), and they instead favor reduction of interest rates. The marginal income tax rates posed by programs like these are greater than 100 percent (Mulligan, 2010). Alternative tools could improve collections and efficiency, reduce the number of foreclosures, and reduce their total costs. We note, however, that this paper does not evaluate the possibility of lowering house prices as a potentially more durable foreclosure prevention tool.

2.3. Foreclosures, employment, and the legal foreclosure system

Charles Calomiris' paper, *The foreclosure- house price nexus: a panel VAR model for US states 1981-2009,* describes the relation between foreclosures, house price index, employment, permits, and sales on the properties. Calomiris looks at multiple previous publications, examining microeconomics effect and his own study to examine macroeconomics effects of these variables on each other. In his paper, he concludes that the house price index is correlated with foreclosure rate. In addition, he shows that impact of house price on foreclosures is 79% higher than the impact of foreclosures on house price index. Furthermore, Calomiris shows the negative correlation between employment and foreclosure rate due to borrowers and lenders' forecast of macroeconomic conditions which results in foreclosures. This paper also mentions the negative correlation between judicial foreclosures and foreclosure rates which is most visible in long-term house prices. However, with the judicial foreclosure system acting as a foreclosure insulator, there is no sudden change of house prices with change of unemployment rate.

2.4. Mortgage default risk and its potential derivatives market

The 1995 paper by Karl Case, Robert Shiller, and Allan Weiss, *Mortgage default risk and real estate prices: the use of index-based futures and options in real estate*, establishes that "periods of high default rates on home mortgages strongly tend to follow real estate price declines." Case et al. call for mortgage-holders to hedge their risk of default through index-based futures and derivatives (1995). While the bulk of this article examines the technical details concerning the establishment of such a housing derivatives market, the regression model predicts that foreclosure rates can be correlated to per capita net migration, average unemployment, and housing price changes, time delayed for two

years. Thus, foreclosure rates are shown to be intertwined with the wider economy, with long-term impacts.

Our paper contributes to the current literature in many unique ways. First and foremost, as opposed to a time series analysis, this paper is a singular cross sectional analysis of correlation between foreclosure rates and housing prices. Whereas Mian et al. analyze the effect of lower housing prices upon the decision to foreclose (2011), we analyze the effect of foreclosures upon housing prices. We include some explanatory variables which have not been included in any other publication. Furthermore, we explore the recovery timeframe following the housing collapse with a unique hypothesis. Most importantly, if our hypothesis is correct, its implications challenge the current predominant thinking on dealing with mass foreclosures. This paper could pave the way for a more thorough analysis of nonconventional economic policies.

3. Data

Our analysis requires the use of both a simple and multiple regression model with multiple variables. In the simple regression analysis, the dependent variable is House Price Index by state, while the main independent variable is the rate of foreclosure starts by state. However, the multiple regression model includes additional relevant explanatory variables. We include both average property tax and average income tax by state to account for ability to pay with tax burden factored in. Education levels, measured by percentage of bachelor degrees in the population, were included to account for unforeseen socioeconomic factors. We also include American Recovery and Reinvestment Act (ARRA) stimulus spending per capita by state in order to measure the effectiveness of the government's crisis mitigation attempts. Finally, we include a dummy variable to represent a state's legal foreclosure system being either judicial (1), or non-judicial (0). As mentioned in the literature review, a judicial foreclosure system dramatically increases foreclosure costs to the lender, which could impact foreclosure rates.

The House Price Index, obtained from the Federal Housing Finance Agency, is a weighted index that broadly measures the motion in prices of single family houses. This index measures average price changes in repeat sales (or refinancing on the same properties), obtained from repeat mortgage transactions purchased and scrutinized by Fannie Mae and Freddie Mac (since Jan 1975). The HPI is widely accepted as a timely and accurate indicator of house prices at multiple different levels, from national to local. Because of the breadth, it also provides more information than others. This is an excellent indicator for motion of housing prices. The other two indices that we could have used are

Case-Shiller index and FNC Residential Price Index. However, due to the lack of availability of state level data for Case-Shiller index, we could not use it. The Residential Price Index has a lag time of about two months and focuses on metro areas rather than state level data. Therefore HPI was the indicator best suited for our purpose.

Foreclosure rates were obtained from the Mortgage Bankers Association, which offers state wide data including foreclosure starts. State by state income and property tax rates were obtained from Tax Foundation, a nonprofit tax rate aggregator (2013). We gathered percentages of bachelor's degrees by state from US Census data (2010). The Federal stimulus values were obtained from the Recovery Accountability and Transparency Board, calculated by dividing states' stimulus received in 2010 by state population. RealtyTrac provided the data on whether a state has a judicial or non-judicial foreclosure system. All dollar amounts are adjusted to 2005 dollars via CPI provided by Coinnews Media Group.

3.1. Descriptive Statistics

Table 1 shows the summary of all the data used in this paper. Each variable was recorded by state for all 50 US states. However, because 7 states do not have income tax, we chose to forego these 7 observations. Also, the House Price Index tracks the change in house prices over time; it is not an average of statewide house prices.

Variable	Observations	Mean	Standard Deviation	Min	Max
House Price Index	50	-3.7162	3.8083	-15.82	5.09
Foreclosure Rate	50	4.3056	1.81766	1.47	12.35
Education levels	50	27.172	4.731874	17.3	38.2
Property tax	50	0.0337783	0.0106218	.0159025	0.0584786
Income tax	43	0.0207291	0.0072691	0.0007622	0.0362228
Federal stimulus	50	286.5345	131.0943	169.2541	116.553
Population	50	6174425	6863725	564367	3.73E+07
Legal	50	0.4	.4948717	0	1

Table 1: Summary Statistics – Summary of all data input into STATA for regression analysis

3.2. Gauss Markov Assumptions

The zero conditional mean assumption (E(ε)=0) is fulfilled for the model. We can see this from the single regression model where average HPIs for any given foreclosure rate are arranged along a straight regression line ($fr = \beta_0 + \beta_1 dist + u$). The models do not show any exponential or

logarithmic properties. As foreclosure rate varies, Home Price Index variance stays almost the same except for one outlier value which could be caused by other factors like geographical location. Thus, we conclude that the error term does not depend upon the independent variable, so the homoscedasticity assumption holds for the models as well.

	hpi	fr	edu	proptx	inctx	stim	legal
hpi	1.0000						
fr	-0.5104	1.0000					
edu	0.1710	-0.0681	1.0000				
proptx	0.1896	0.1016	0.6047	1.0000			
inctx	-0.0153	-0.0888	0.3504	0.1626	1.0000		
stim	0.0194	-0.2711	0.0839	0.0085	-0.0121	1.0000	
legal	0.4784	-0.2248	0.2128	0.1628	0.0443	0.0918	1.0000

Figure 1: Statistical Correlation – Cross-correlation of variables using “corr” STATA command

The autocorrelation assumption holds for the model as well, as viewed in Figure 1. Even though there are high correlations between the independent variables, they are not perfectly correlated; therefore the assumption is fulfilled. The correlation between education and property tax arises from the correlation between education and income. People with higher education tend to earn more money, explaining the correlation between education and income tax. Furthermore, they can afford more expensive properties that require higher property taxes. With respect to the last variable, Calomiris claims that the correlation between legal foreclosure system and house price index is caused by the judicial foreclosure system acting as a free market barrier (2013).

4. Results

The following results were achieved using STATA to perform both a simple linear regression and a multiple linear regression analysis to obtain the estimated equations.

4.1. Simple linear regression:

The first step in the data analysis was to make a simple regression model to see how house price index is influenced by foreclosure rate, with other things remaining constant. The STATA output is shown in Figure 2 and the simple linear regression model is shown in Equation 1.

Source	SS	df	MS		Number of obs =	50
					F(1, 48) =	12.01
Model	142.220109	1	142.220109		Prob > F =	0.0011
Residual	568.463266	48	11.8429847		R-squared =	0.2001
					Adj R-squared =	0.1835
Total	710.683375	49	14.5037424		Root MSE =	3.4414

hpi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fr	-.9372812	.2704705	-3.47	0.001	-1.481099	-.3934637
_cons	.3193579	1.262144	0.25	0.801	-2.218353	2.857069

Figure 2: Simple linear regression model – STATA output table of foreclosure rate vs. HPI

$$hpi = 0.31936 - 0.93728\, fr \quad (1)$$
$$(1.26214)\ \ (0.27047)$$

From Figure 2, we can see that foreclosure rate is negatively correlated with the house price index. With t = -3.47 and P = 0.001, we also find the result to be 99.8% significant using double-tailed t-statistics (critical t-value of 0.2% = 3.307). In addition, the 95% confidence interval of our result is between -1.481 and -0.393, which also suggests very accurate results. There are additional conclusions that can be drawn from the STATA output, mainly from the R-squared value, which is depicted in Figure 3. R-squared value of 0.2001 would suggest that we omitted some independent variables in our model. To investigate this issue more deeply, we have to generate multiple regression model with other possibly important variables.

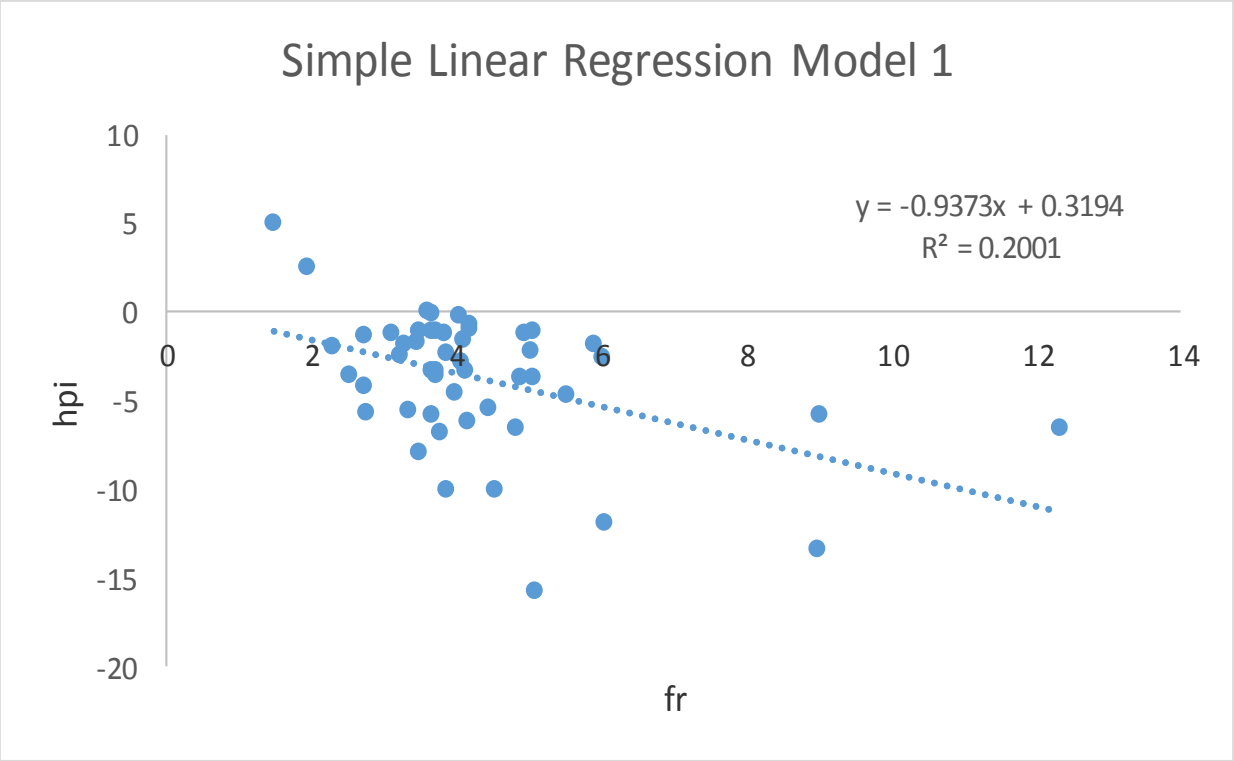

Figure 3: Simple Linear Regression Graph – Foreclosure rates (*fr*) against House Price Index (*hpi*)

4.2. Multiple linear regressions:

We have generated a few multiple regression models to find out if there is any significant variable that we dismissed in the simple regression model. The most comprehensive model is shown in Figure 4 and the corresponding linear regression model is shown in equation 2.

Source	SS	df	MS		
Model	296.986216	6	49.4977026	Number of obs	= 43
Residual	345.624012	36	9.60066699	F(6, 36)	= 5.16
				Prob > F	= 0.0007
Total	642.610227	42	15.3002435	R-squared	= 0.4622
				Adj R-squared	= 0.3725
				Root MSE	= 3.0985

hpi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fr	-1.650436	.4339497	-3.80	0.001	-2.530527	-.7703451
edu	-.0131774	.1305624	-0.10	0.920	-.2779701	.2516154
proptx	78.3795	57.96575	1.35	0.185	-39.1805	195.9395
inctx	-57.15653	70.72235	-0.81	0.424	-200.5881	86.27504
stim	-.0087185	.0073506	-1.19	0.243	-.0236261	.0061892
legal	2.745394	1.002149	2.74	0.010	.712942	4.777846
_cons	3.189341	4.052199	0.79	0.436	-5.0289	11.40758

Figure 4: Unrestricted Multiple Linear Regression Model – STATA output with additional variables

$$hpi = 3.189 - 1.650\,fr - 0.013\,edu + 78.379\,proptx - 57.156\,inctx - 0.00872\,stim + 2.745\,legal \quad (2)$$
$$(4.052)\ (0.4339)\quad (0.1306)\quad (57.96)\quad (70.72)\quad (0.00735)\quad (1.0021)$$

The model shown in Figure 4 and Equation 2 includes the additional independent variables influencing the house price index. From the figure, we can see that the R-squared statistic more than doubles, indicating the new independent variables' impact on the model. Although the R-squared value increased, it is still only 0.4622, possibly indicating that some independent variables are still omitted.

Using the t-statistics data, we can determine the significance of every individual variable. We only consider a variable significant if its double-tailed significance is greater than 90%. This criterion was fulfilled solely by the foreclosure rate and legal system variables, with the significance of foreclosures increasing to 99.9% from the original 99.8% in the simple regression, and the significance of legal foreclosure system being 99%. In this model, the 95% confidence interval for foreclosure rates is between -2.53 and -0.77, and the 95% confidence interval for the legal foreclosure system is between 0.71 and 4.78. The relationship between the house price index and legal system is positive, indicating that prices are higher with a judicial system than without, corroborating previous literature results.

4.3. Robustness Test: F-test and dummy variables

To test if there is joint significance between the education, property tax, income tax, and stimulus, we create a restricted model excluding these variables and apply the F-test. The restricted model is shown in Figure 5, and the corresponding linear regression model is shown in Equation 3.

Source	SS	df	MS
Model	236.233133	2	118.116566
Residual	474.450245	47	10.0946861
Total	710.683378	49	14.5037424

Number of obs	= 50
F(2, 47)	= 11.70
Prob > F	= 0.0001
R-squared	= 0.3324
Adj R-squared	= 0.3040
Root MSE	= 3.1772

hpi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fr	-.8822964	.2503591	-3.52	0.001	-1.385954	-.3786388
legal	2.80628	.919567	3.05	0.004	.9563495	4.65621
_cons	-1.039896	1.247488	-0.83	0.409	-3.54952	1.469727

Figure 5: Restricted Linear Regression Model – STATA output of the restricted model

$$hpi = -1.04 - 0.882\,fr + 2.806\,legal \quad (3)$$
$$(1.25)\ (0.25)\qquad (0.92)$$

$$F = \frac{(R^2_{UR} - R^2_R)/q}{(1-R^2_{UR})/(n-k-1)} \quad (4)$$

$q = 4$: Number of restrictions

$k = 6$: Number of independent variables

$n = 50$: sample size of unrestricted model

The restricted multiple regression shows high significance of both foreclosure rates and legal system on house price index. We use Equation 4, the restricted model, and the unrestricted model to calculate the F-statistics. The calculated value for the F-test is 2.172, whereas the critical value is 2.69 for α = 0.05 in the right tail confidence; therefore, we fail to reject the null hypothesis. As a result, we conclude there is no joint significance of education, property tax, income tax, and stimulus.

$$hpi = \beta_0 + \delta_0 legal + \beta_1 fr + \delta_1 legal \cdot fr + u \quad (5)$$

For non-judicial foreclosure systems, the intercept and the slope in Equation 5 are equal to β_0 and β_1 respectively. However, according to this equation, states with non-judicial foreclosure systems would have an intercept and slope equal to $\beta_0 + \delta_0$ and $\beta_1 + \delta_1$ respectively. The values for δ_0 and δ_1 are the differences between change in house prices and foreclosure rates with respect to judicial and non-judicial legal systems. After the generation of the new variable which models the relationship between legal system and foreclosure rates, we use a regression analysis.

Source	SS	df	MS	Number of obs =	50
Model	236.35833	3	78.78611	F(3, 46) =	7.64
Residual	474.325045	46	10.311414	Prob > F =	0.0003
				R-squared =	0.3326
Total	710.683375	49	14.5037424	Adj R-squared =	0.2891
				Root MSE =	3.2111

hpi	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
legal	2.540254	2.586935	0.98	0.331	-2.666976	7.747484
fr	-.8990938	.2954034	-3.04	0.004	-1.49371	-.3044776
frl	.0630783	.5724447	0.11	0.913	-1.089193	1.21535
_cons	-.9657974	1.428931	-0.68	0.502	-3.842086	1.910491

Figure 6: Interactions between Dummy Variables

$$hpi = -0.9657974 + 2.540254legal - 0.8990938fr + 0.0630783frl + u$$

As seen in Figure 6, the slope and the intercept of the judicial foreclosure systems are higher, implying that the price in general is higher for the judicial foreclosure system, and a higher foreclosure rate has a lesser lowering effect on the prices, because foreclosure rates and house price index are inversely related.

5. Conclusions

Although there have been many studies pertaining to foreclosure rates and house prices after the 2007-2009 recession, they lack diversity in rationales. Our paper attempts to expand the current literature by widening the conversation, encouraging evaluation of alternate economic policies. Namely, we are trying to firmly establish the dependence of house price index on foreclosure rates, a prerequisite to substantiating "let-sink" foreclosure policy, which asserts that a quicker fall without expensive government intervention would expedite recovery.

In our paper, we first examine a simple linear regression model to show that there are omitted variables in the model, and therefore, more variables other than just foreclosure rates have to be considered. We then continue with the multiple linear regression model by looking at the influence of foreclosure rates, education, property tax, income tax, stimulus, and legal system upon house price index. By using this model, we show that most variables do not have statistical significance, individually or jointly, to the data except for foreclosure rates and legal system. Finally, we reject the null hypothesis and conclude that house price index is significantly dependent upon foreclosure rates and the state legal foreclosure system.

This conclusion is important because the housing market crash was the primary cause of the recent recession, and we have established the impact of foreclosures upon drops in housing prices. Furthermore, this conclusion enables a future, more intensive study upon "let-sink" foreclosure policy. An example study methodology would examine the relationship between foreclosure rates and time-delayed GDP growth. Another study could determine the economic value of the judicial foreclosure system.

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