The Foreclosure-House Price Nexus: Lessons from the 2007-2008 Housing Turmoil

Charles W. Calomiris, Stanley D. Longhofer, and William Miles

June 17, 2008

Abstract

Despite housing's importance to the economy and worries about recent financial and economic turmoil traceable to housing market difficulties, little has been written on how distress in the housing market, measured by foreclosures, affects home prices, or how these variables interact with other macroeconomic or housing variables such as employment, housing permits or sales. Employing a panel VAR model to examine quarterly state-level data, our paper is the first to systematically analyze these interactions. There is substantial regional variation across states, which facilitates our ability to identify linkages among variables. Importantly, price-foreclosure linkages work in both directions; foreclosures have a significant, negative effect on home prices, while an increase in prices alleviates distress by lowering foreclosures. Similarly, employment and foreclosures have mutually negative effects on each other. We then exploit estimates of the path of future foreclosures to bound the extent of housing price declines for 2008-2009. Even under extremely pessimistic scenarios for foreclosure shocks, average U.S. house prices, as measured by the comprehensive OFHEO house price index (which we argue is the most reliable and useful measure of house prices to use for our purposes), likely will see only a small percentage decline or remain essentially flat for the 2008-2009 period.

[*] The authors thank Inessa Love for sharing her panel VAR methodology using Helmert de-meaning and her programs, and Mark Zandi for sharing Economy.com forecasts, as well as Michael Carliner, Robert Martin and Joseph Nichols for helpful comments and suggestions. An earlier version of this paper circulated under the title "The Foreclosure Crisis: How Far Will House Prices Fall?" Calomiris is Henry Kaufman Professor of Financial Institutions at Columbia Business School and Research Associate, National Bureau of Economic Research. Longhofer is Stephen L. Clark Chair of Real Estate and Finance, and Director, Center for Real Estate, Barton School of Business, Wichita State University. Miles is Associate Professor of Economics and Barton Fellow, Wichita State University.

I. Introduction

The US housing market is widely regarded to be in a state of crisis. Housing permits have been in a steady and deep decline since 2006 (a year prior to the outbreak of the subprime credit collapse). The collapse in the values of subprime mortgages, which began in the middle of 2007 has brought with it a substantial increase in foreclosures, and unusually large declines in house prices in some states – especially in Arizona, California, Florida, Michigan, Ohio, and Nevada. Widespread loose mortgage credit – as exemplified by the infamous "liar" mortgages of the 2005, 2006 and 2007 cohorts – is reflected in unprecedented default and foreclosure rates for those cohorts of mortgage originations. Now that the subprime "bubble" has burst, market participants are forecasting substantial increases in foreclosures going forward at least through 2008, fueled by weak underwriting standards in the past and continuing housing price decline.

In addition to the obvious difficulties that price declines and foreclosures create for participants in the housing industry and homeowners, housing has been shown to have a major impact on the economy (Leamer, 2007, Green, 1997, Coulson and Kim, 2000, Gauger and Snyder, 2003). Indeed, Leamer (2007) titles his study "Housing IS the Business Cycle," to illustrate the importance that the housing sector has in U.S. income fluctuations. Gauger and Snyder (2003) find that, while always important, the impact of housing on the economy has become more pronounced in recent decades.

Figure 1 illustrates the possible cause for concern about house price declines in the wake of widespread foreclosures. Using data for the 2007 year as a whole, if one regresses price change at the state level on foreclosures growth at the state level (where we use the OFHEO sale and refinancing index to measure price, and the Mortgage

Bankers Association quarterly delinquency surveys to measure outstanding foreclosures relative to mortgages), we find a close fit between the two series (an R-squared of 0.72). Of course, Figure 1's description of the low-frequency association between price change and foreclosures growth says nothing about the causal relationships between prices and foreclosures, and should not be interpreted as providing an estimate of the response of prices to foreclosure shocks. This regression line reflects a combination of three influences: (1) the responses of prices to foreclosure shocks, (2) the responses of foreclosures to price shocks, and (3) the responses of both foreclosures and prices to shocks originating in other variables.

We focus our attention in this paper on measuring the size of the effect that shocks to housing market distress (foreclosures) have on house prices, and use that estimated relationship to derive insights about the likely future price consequences of the turmoil of 2007-2008. To approach that question, we develop a dynamic model of the housing market at the state level, which is capable of disentangling the three contributing influences that explain the low-frequency association between foreclosure and price, and thus allowing us to gauge the potential housing-price and macroeconomic consequences of continuing mortgage distress.

Modeling the housing market at the state level is helpful for improving empirical identification. Quarterly data on the main housing variables of interest exist for each state going back to 1982 (as we describe in the Data Appendix). Furthermore, there has been substantial variation in housing market experience across states (as Figure 1 illustrates; see also Figure 3), which can be useful for identifying empirical linkages among variables. It is especially noteworthy in that regard that although there have been only three nationwide housing cycles since the 1980s, there have been numerous state-level or regional-level cycles, which often have entailed significant price growth decline and foreclosures.

Our paper is organized as follows. Section II reviews the existing literature. Section III presents the results of our estimation model, including simulated effects of foreclosure shocks on house prices. Section IV develops forecasts for house prices, for individual states and for the US as a whole, for 2008-2009, using the model developed in Section III and available state-level forecasts of foreclosures in the future kindly provided by Economy.com. Section V discusses differences in the meaning of housing price indices, and their relative desirability for our purposes. Section VI concludes.

II. Literature Review

Leamer (2007) notes that no macroeconomics textbook contains any lengthy treatment of real estate, despite its role as a leading indicator of business cycle conditions. Instead, academic studies tend to focus on aspects of the housing market and the broader economy in isolation from each other, such as examining the interaction of house prices and home sales, but nothing else. Despite the importance of housing to the economy, little has been written about the interaction between prices and foreclosures at the aggregate level, and to our knowledge nothing has been written that links prices and foreclosures dynamically within the broader context of the macroeconomic environment and other conditions in the housing market. This is an important omission when one considers that the impact of financial liquidation on measures of prices and output in the economy is sometimes quite large, as indicated, for example, by Anari, Kolari and Mason (2005).

Within the real estate literature, some studies have found important interdependencies among various market indicators. DiPasquale and Wheaton (1994) examine the impact of such variables as changes in land value, and financing and construction costs on housing starts. Coulson and Richard (1996) investigate the impact of severe weather events, such as extreme heat or precipitation, on starts and find an effect, although only in the north central region of the U.S. Coulson (1999) examines the time series properties of housing starts and completions, and finds that the two variables are cointegrated. Moreover, the author finds that completions are not much affected by factors such as materials costs, income, interest rates, or housing prices. This finding is supportive of the idea that once a housing start occurs, completion is a nearly foregone conclusion.

Several papers have examined the relationship between home prices and other variables. Clayton, Miller and Peng (2008) find that home prices and turnover in the home market predict each other, but that most of the positive co-movement between the two variables is caused by responses to common financial, labor market and mortgage shocks. Wheaton and Nechayev (2008) forecast home prices with population, income and interest rate regressors. The authors find that current fundamentals substantially under-predict the recent run-up in home prices. Neither paper examines the effect of financial distress on price movements.

Some papers have examined the effect of housing activity on aggregate economic activity as measured by GDP. Green (1997) examines residential investment and GDP, and finds the former Granger-causes the latter. Coulson and Kim (2000) find that residential investment shocks are important in predicting consumption and GDP growth. Gauger and Snyder (2003) use a vector error-correction (VECM) model and find, as did Green (1997), that residential investment has a positive impact on GDP. Leamer (2007) performs a series of estimations and historical decompositions and finds that residential investment is the best predictor of future recessions in the U.S.

There have been several papers measuring the effect of prices and sales volume on each other. Clayton, Miller and Peng (2008) find that sales and prices have mutually positive effects on each other. The authors find that most of the positive correlation can be explained be co-movement of prices and sales in response to other variables. Wheaton and Lee (2008), on the other hand, find that price increases predict lower sales, which is in keeping with standard demand-side stories and contradicts the results of Clayton, Miller and Peng (2008), as well as some models of loss aversion and down payment constraints which had been advanced to explain the positive sales-price correlation.

Little has been written about the empirical relationships between foreclosures, or other measures of financial distress, and home prices at the macro-level, although some have examined how price volatility may affect the probability of default (Foster and Van Order, 1984).

Recently, a number of studies have used micro data to assess the interaction of foreclosures and prices. Willen, Gerardi and Shapiro (2008) find, using data from Massachusetts, that the recent decrease in prices was a major catalyst in pushing sub-prime borrowers into foreclosure. Examining the opposite direction of causality, Lin, Rosenblatt and Yao (2008) use a random sample of about twenty percent of all U.S.

mortgages, including only those which are conforming, and find that there is a clear negative impact of foreclosures on prices of local homes. However, this effect is much larger during a housing downturn than during a boom, indicating the importance of the state of the housing cycle for the effects of foreclosures. Leonard and Murdoch (2008) investigate foreclosures in the greater Dallas area, and similarly uncover a negative effect of distress on prices, which diminishes as distance from the foreclosed property grows. Finally, Rogers and Winter (2008) examine foreclosures in St. Louis county. They find the expected negative impact. Interestingly, they also find that the marginal impact of additional foreclosures actually falls as foreclosures increase, which contradicts the proposition that rising foreclosures may have a rising marginal effect on prices.

Despite the recent increased interest in modeling the relationship between prices and foreclosures, illustrated by these papers, our study is the first of which we are aware to systematically investigate the interaction of financial distress, housing market conditions and the local economy.

III. A Quarterly Panel VAR Model of the State-Level Housing Market, 1981-2007

We model home prices and foreclosures at the state level, using quarterly data since 1981, and treat the growth of home prices and the foreclosure rate as part of a five-variable system of equations, which also includes the growth rates of employment, single-family permits, and existing home sales. We employ a panel vector autoregressive model (PVAR), which captures dynamic linkages among all the five variables, which are all treated as mutually endogenous.

The variables are defined as follows: the log difference of seasonally-adjusted total non-farm employment, the log difference of seasonally-adjusted existing home sales, the log difference of seasonally-adjusted single-family housing permits, the log difference of the OFHEO home price index (inclusive of same-home sales and refinancings; below, we also discuss results when we employ the sales-only index)[1], and the log of the ratio of outstanding foreclosures relative to total mortgages (based on Mortgage Bankers' Association surveys).

We also ran the model defining foreclosures as the log difference of the ratio of foreclosures relative to total mortgages, which produced very similar results. We report results using the log foreclosure ratio because doing so seems to better capture the effects of cumulative financial distress on house prices, as we explain further below. All data run from 1981 through the first quarter of 2008. Due to the forward (Helmert) de-meaning of observations employed we will lose the last observation, and thus our useable sample will run through the fourth quarter of 2007.[2] After some experimentation with different lag lengths, we found that eight quarterly lags encompassed quite well all the significant dynamic relationships among these five variables.

In order to generate impulse responses and variance decompositions, one must identify the sources of covariance among the residuals in each of the five equations. We follow the existing PVAR literature by employing the Choleski decomposition, which models the residuals matrix as a recursive, triangular system. The main advantage of that

[1] As we discuss in more detail below, we believe that including refinancings when measuring price change is desirable, given that doing so substantially reduces the possibility of selectivity bias in home prices over the cycle, given the way the OFHEO index is constructed.
[2] We follow Love and Ziccino (2006) in our methodology for Helmert de-meaning. This process was first proposed by Arelano and Bover (1995).

approach is its simplicity: one selects an ordering of variables that posits the degree of within-quarter endogeneity among each of the five endogenous variables.

We experimented with various possible orderings among the five variables and found that our key results regarding home prices (reported below) were robust to the orderings chosen. We report only one ordering: employment, sales, permits, price, foreclosures. Employment appears first in our ordering, since we assume that any correlations between within-quarter innovations in employment and the within-quarter innovations in our four housing sector variables reflect the role of employment as a source of disturbance (both with respect to the labor market and as a general macroeconomic barometer).

Foreclosures are placed at the end of our ordering because foreclosure reflects the strategic decisions of borrowers and lenders; thus we think it is appropriate to allow foreclosure decisions to respond to other variables within the quarter. We place price changes second to last in our system. Within-quarter price shocks are not strongly correlated with foreclosure shocks (the correlation is -0.095, as shown in Table 2) ;, allowing prices to follow the other three variables and precede foreclosures maximizes the extent to which contemporaneous price changes can reflect other influences within the quarter, while still allowing within-quarter foreclosures to respond to all other variables' changes within the quarter. Allowing prices to come late in the ordering seemed appropriate given that a primary objective of our study is to bound the potential downward movements in home prices resulting from other shocks.

The impulse responses (Figure 2) of the five endogenous variables to orthogonalized shocks that are identified by the recursive orthogonalization do not impose clear structural identifying restrictions. Still, it can be possible to connect observed impulse responses to structural influences in an intuitive way, based on the combination of observed patterns of response. For example, if a housing sales shock is associated with rising initial impulse responses for prices and permits, as in our study, that could be viewed as reflecting housing market demand-side influences. In the same way, if a housing price shock is associated with positive sales and permits impulse responses, as in our study, that too could be viewed as indicative of housing market demand-side influences.

Our impulse responses display a number of reassuring and robust tendencies: in particular, foreclosure shocks (increases in quarterly foreclosures that are unforecastable on the basis of lagged values of the five variables and contemporaneous values of the other four variables) predict declining employment and declining prices. Foreclosure shocks, however, are associated with increases in sales and permits. These impulse responses are somewhat puzzling, and may reflect the fact that foreclosure shocks are more likely to occur late in the down phase of a housing cycle.

The variance decompositions (Table 3) gauge the importance of shocks originating in the five endogenous variables for each of the five variables. For the most part, the variables do not contribute importantly to each other's forecast variance, however, there are exceptions: sales and permits shocks are important for employment growth, employment shocks are important for foreclosures, and foreclosure shocks are important for all other variables, especially prices (foreclosure shocks explain 26% of the 20-quarter forecast variance of house price growth).

IV. Bounding the Effects of Foreclosures on House Price Decline

The dynamic, quarterly, state-level model developed in Section III can be used for a variety of purposes. Our primary purposes in constructing it are: (1) to measure the magnitude of foreclosure shocks on prices, in general, and (2) to apply the model to generate forecasts of housing price changes, by state and for the country as a whole, for 2008 and 2009. As Figure 3 shows, there is substantial variation across states in each of the variables in our model, which confirms the importance of taking account of state-level differences when forecasting price changes.

One approach to forecasting price changes for 2008 and 2009 would assume a zero-shock scenario for all five variables and derive implied housing prices using that scenario. We label this the "baseline" scenario. That scenario would be reasonable if one had no basis for believing that any of the five variables was likely to experience shocks during 2008 and 2009. Because our model is derived for de-meaned variables, we must add back the forecasted long-term mean to our simulated impulse responses in order derive forward-looking estimates of our variables, which also define implicit values of the levels of the four variables expressed in first differences. In the baseline scenario, we assume that the forward-looking means for 2008 and 2009 are equal to the sample means of the variables.

Although we construct and report this baseline scenario, one could argue that this constitutes too optimistic a scenario for the purposes of forecasting prices, especially over the next two years. In our PVAR model, any anticipated shocks (based on knowledge not captured by the lagged variables in the model) that are expected to occur in 2008 and 2009 should be incorporated into the simulation exercise for that period. One of our variables, foreclosures, may experience anticipated shocks over the next two years, and we take account of this by incorporating additional information on foreclosure estimates below. In contrast, we do not believe that there is a reasonable basis for assuming adverse shocks to employment, permits and home sales (that is, declines beyond what would be forecast from the data for 2006 and 2007). Recent labor data suggest that employment may be flat or even improve in 2008. Judging from a longer-term perspective based on previous housing cycles (that is, adding information about the housing cycle not already captured by our PVAR model in growth rates), it appears that permits have likely bottomed out, having fallen for six quarters by a much larger amount than in previous housing cycles. On similar grounds, it would also be difficult to argue for anticipated negative house sales shocks going forward. Figure 4, Panel A, displays the long-term cyclical patterns of housing permits and sales for the nation as a whole since 1980. Figure 4, Panel B, reports residential construction relative to GDP, which is available for a much longer time frame. These graphs show that, from the standpoint of the typical longer-term reversion of the growth of sales, permits, and residential construction, there is probably more reason to expect positive shocks (from the perspective of our PVAR model) in sales and permits than continuing negative shocks.

Foreclosures are different from the other variables in our model with regard to expected shocks because we are now aware of a sharp departure from historical practice in underwriting standards for the 2002-2007 cohorts of mortgages. Given the change to much looser lending standards over the past decade, the credit extended with little or no documentation, and the spreading use of sub-prime and so-called Alt-A loans, there are legitimate fears that foreclosures could potentially spike upwards substantially, and in excess of levels that would be forecast based on historical experience. Thus, we think it is necessary to allow estimates of adverse shocks to foreclosures to be greater than those that would be forecast under the baseline scenario, and also allow our model to take into account feedback effects from those anticipatable foreclosure shocks on the other variables in our five-variable system.

To take into account foreclosure shocks beyond those predicted by our model, we employ Mark Zandi's "Economy.com" forecasts for quarterly foreclosures at the state level, which were kindly provided to us by him.[3] Note that because foreclosures appear last in the PVAR ordering, foreclosure shocks only affect the other variables with a lag. After one quarter, all variables in the system are affected by foreclosure shocks, and in subsequent quarters, via the various channels that connect the five variables in our model. We employ the Economy.com forecasts of annual growth rates of home prices and foreclosures for the years 2010-2012 as our measures of long-term expected price growth and foreclosure rates (rather than using sample means, as is done for the other three variables in the system).

Although we only report the results of one version of our model here – which defines foreclosures as the log foreclosure ratio, uses the comprehensive OFHEO price index, and begins the estimation period in 1981 – we also experimented with seven other versions of the model (which are available from the authors upon request). The eight versions we ran varied according to the definition of foreclosures (log ratio vs. log difference of the ratio), the definition of house prices (log difference of the comprehensive OFHEO index vs. log difference of the purchase-only OFHEO index),

[3] We were provided forecasts of the seasonally-adjusted foreclosure start rate. We used these data to predict the log levels of the outstanding foreclosure rate. Details of this process are available in the Data Appendix.

and the starting date chosen (1982 vs. 1988). Table 4 reports the cumulative simulated average US house price change from the second quarter of 2007 through the end of 2009 for each of the versions of the model, using the Economy.com forecasts of foreclosures in the simulations. As Table 4 shows, the model that employs the comprehensive OFHEO index, defines foreclosures as the log ratio, and begins the sample period in 1982 results in the largest estimated cumulative average price decline from 2007 to 2009, which is -3.7%. There are two reasons to prefer this model to the others. First, as we discuss further below, using the foreclosure ratio, rather than growth rate, appears to allow us to capture important nonlinear effects. Second, given that the thrust of our findings is the limited effects of foreclosure shocks on house prices, it seems desire to be conservative by choosing the model that implies the largest price impact of foreclosure shocks.

One possible concern about the simulation results reported in Table 4 is that they are based on a linear model of the relationship between foreclosure growth and housing price change. The impact of foreclosures on prices may reflect nonlinear (or threshold) effects (that is, a rise in foreclosures when foreclosure rates are high may have a bigger effect on prices than a rise in foreclosures when foreclosure rates are low). This is a significant concern for our simulation, since the average foreclosure shock implied by the Economy.com forecasts for the 2008-2009 period raises the log of the foreclosure ratio by 0.22.

While we cannot incorporate nonlinearities into our PVAR model directly, we can estimate the model's house price equation on a stand-alone basis as a function of all of the variables already in our model plus the square of foreclosure growth for each of the eight lags of foreclosures included in the model, compare the effects of foreclosure shocks on prices in this quadratic form with the linear form already estimated (see the notes to Table 5 for a detailed description), and make adjustments to our model as implied by the differences between the linear and nonlinear model.

Table 5 reports the total effects at each lag of foreclosures on prices from the price equation, measured as the sum of linear and quadratic coefficients at each lag for the two foreclosure variables, evaluated at the mean of each state's projected foreclosure rate for 2008-2009, using the foreclosure-shock scenario. These total effects are also graphed in Figure 7. This provides a comparison of the impact of foreclosure growth on price growth (excluding the feedback effects that would be present in the full PVAR model) for the quadratic and linear functional forms. We emphasize that because this stand-alone regression (unlike our PVAR model) does not allow feedback effects among the variables in the system, it only provides a rough gauge of the differences in impact of foreclosure shocks on prices under linear and nonlinear specifications.

As Table 5 shows, the overall cumulative effects of the two functional forms are quite different; the quadratic version implies a 53 percent larger cumulative price decline from a foreclosure shock than the linear version. We interpret this to mean that taking into account nonlinear functional forms would produce greater simulated price declines than suggested by our linear model. To adjust for this nonlinear effect, we increase the Economy.com foreclosure forecasts by 53 percent. In our tables and figures we describe simulations derived from this assumed path of foreclosures as the "Foreclosure Shock" simulations.

We also construct "extreme-shock" simulations, which raises the Economy.com foreclosure projections by 75 percent rather than 53 percent. We regard this as a highly conservative scenario, since it implies actual foreclosure rates substantially greater than those that have been forecast by informed market participants, even after taking into account the effects of nonlinearity.

The predicted paths of foreclosures and prices, expressed both in growth rates and in levels, for the baseline, foreclosure-shock, and extreme-shock scenarios are presented graphically in Figure 5 for selected states and for the country as a whole.[4] The predicted paths of house prices vary by state significantly, which reflects differences in states' experiences in recent years. Overall, none of the three scenarios predicts a severe decline in price for the nation as a whole. Housing prices peak during our sample in the second quarter of 2007. The cumulative expected price changes between this peak and the end of 2009 under the three scenarios are -0.71 percent, -3.69 percent, and -4.49 percent, respectively. As Figure 6 shows, even under the extreme-shock scenario, not only is the average price decline likely to be low for the country as a whole, but few states are projected to experience significant decline. Only eleven states are projected to experience cumulative declines from 2007Q2-2009Q4 of more than 6 percent – in order of severity according to projected decline, Florida, California, Hawaii, Nevada, Maryland, Rhode Island, Arizona, Michigan, Minnesota, New Jersey and the District of Columbia.

Why are housing prices so robust in the face of large foreclosure shocks? Our interpretation of these results is that foreclosure shocks do not have as large an effect on housing prices as simple graphs (like Figure 1 above) might suggest. Furthermore, housing price growth is strongly mean reverting over the cycle, reflecting all the other

[4] Because our forecasts are state-level forecasts, the nationwide figures are the weighted-averages of the individual states, where weighting is based on the estimated number of housing units in each state (derived from annual estimates by the Bureau of the Census); in these calculations, Alaska and New Hampshire are excluded because of missing data for these states.

dynamic interrelationships captured by our model. For example, it may not be surprising that shocks that have already produced one and a half years of low housing starts (which has substantially reduced the pipeline of supply for housing) might help to limit the extent of housing price decline going forward.

We conclude that the effects of foreclosure shocks on prices may be much smaller than people have supposed. Even during the current foreclosure wave, our evidence indicates that foreclosure shocks have small effects on U.S. house prices.[5]

It is worth emphasizing that the unprecedented levels of foreclosures rates for the nation as a whole do not undermine the usefulness of our model for gauging the effects of foreclosures on prices. Because our estimates are derived from a model estimated at the state level, the domain of foreclosure values in our sample generally includes current observed levels. Thus, our findings cannot be dismissed on the basis of the unprecedented high foreclosure rates of recent times. Indeed, for many of the states in our sample, the current high foreclosure rate is not very different from previous peaks in that series (see Figure 3). Although on a national basis, projected foreclosures will be much higher than any previous national average (as shown in Figure 5), one does not observe such a large difference between the sample mean and the projected mean for many of the states in the sample.

V. Different Measures of Home Prices

Our model uses the comprehensive OFHEO sales and refinancings (all transactions) index as our measure of house prices in each state in each quarter. Even a

[5] We also note that one disaggregated study of home price decline (OFHEO 2007b) found no evidence that, on average, neighborhoods with high foreclosure rates suffered greater price declines, ceteris paribus.

casual observer of data on home price movements in recent quarters will have noticed that there are several measures reported in the press, they are constructed differently and that they offer very different pictures of the changes in U.S. home prices. The measured declines in housing prices based on the comprehensive OFHEO index are much smaller from those of the Case-Shiller index and the median sales price index, and differ somewhat from the OFHEO purchase-only index (which excludes refinancings). Is the comprehensive OFHEO index we employ biased in some way that might affect our results?

As we have already noted above, using the comprehensive OFHEO index results in a stronger price response to foreclosure shocks than using the purchase-only index. We also believe on a priori grounds that the comprehensive OFHEO index is the least biased concept of price to employ for the purposes of this study.[6]

Conceptually, the median home price index is far inferior to the other measures, since it does not control for quality differences in homes over time (which introduces important potential biases if homes of different quality have a greater or lesser probability of being sold at different points in the cycle).

The Case-Shiller index and the OFHEO indices are based on value comparisons over time for the same house. That is, a house only contributes to the index if and when a current transaction can be compared to a prior transaction. This avoids the need to try to control for home characteristics over time using a hedonic pricing model. There is still selectivity bias present in all the Case-Shiller and OFHEO indices, since the probability of a home with a given set of characteristics (e.g., lower value, poor condition, distressed

[6] It is noteworthy that central banks (e.g., the Fed and the Bank of Canada) also employ the OFHEO rather than the Case-Shiller index in their macroeconomic models of the U.S. economy, perhaps for some of the same reasons we enumerate here.

seller, renovated recently) being sold may vary over time. For example, if sellers who sell early in the cycle are selling because they are being offered prices that are very high (higher than fair value), or if sellers that sell late in the cycle (after the boom) systematically are eager to sell (and so underprice their homes compared to what a buyer with average patience would demand) that will make home prices appear more volatile than they actually are. The Case-Shiller and OFHEO purchase-only index potentially suffer much more from selectivity bias, since using only sales substantially reduces the number of observations used to construct the index (sales are about one third of the observations contained in the OFHEO sales and refinancings index, according to OFHEO 2007a).

The Case-Shiller index suffers from additional problems. Most obviously, it does not go back as far in time, and it does not cover the entire U.S. market. Leventis (2007) reports that the Case-Shiller index omits 13 states and has incomplete coverage of another 29 states. According to the 2006 American Community Survey estimates of the number of single-family, owner-occupied units in each state, the Case-Shiller national index entirely misses states with 11.28% of the housing stock, has only partial coverage in states containing 78.58% of the housing stock, and has full coverage for states with only 10.13% of the housing stock. Furthermore, the omitted parts of the U.S. market seem to be doing better than the included parts. As Figure 8 shows (see also Calomiris 2007), the omitted or incompletely covered regions have had a different and more positive experience from the complete coverage regions, according to the OFHEO data (which are similar in coverage across regions).

It is also worth considering how the Case-Shiller and OFHEO indexes differ from the perspective of the macroeconomic relevance of the indexes. Because Case-Shiller covers all mortgage types (conforming, subprime, and jumbo), while OFHEO only covers conforming, and because Case-Shiller is a value-weighted index while OFHEO is equal-weighted, Case-Shiller provides a measure that is widely regarded as less useful for measuring the likely consumption wealth effect consequences of a house price change.

Theoretical and empirical work indicates that the most important group of homeowners from the standpoint of the elasticity of consumption to home price change is young homeowners who have invested significant equity in their homes. This group is better captured by the OFHEO index, which does not include subprime borrowers (many of whom have little wealth in their homes), or jumbo borrowers, who are wealthier. Value weighted also increases the weight attached to the wealthy.

From a theoretical standpoint, Buiter (2008) demonstrates that there should be no house price wealth effects for consumption in the absence of market imperfections related to borrowing constraints. This implies that consumption wealth effects related to house prices should be largest for younger individuals with substantial wealth in their homes (the group whose house prices are best captured by the OFHEO index). Macroeconomic modelers, including central banks, perhaps with this in mind, define house price wealth effects with respect to the OFHEO index.

From an empirical standpoint, there are also reasons to prefer the OFHEO index to that of Case-Shiller. The magnitudes of house wealth effects are controversial, as there have been mixed results in the empirical literature regarding the existence and magnitude of any house price wealth effect. Recent work by Case, Quigley and Shiller (2005) suggests that such an effect does indeed exist. In demonstrating the existence of a wealth effect, these authors employ the OFHEO index.

A recent microeconomic study by Gan (2007) criticizes existing empirical studies of the housing wealth effect in the U.S. (which she argues suffer from poor data availability) and provides estimates of housing wealth effects on consumption based on the household behavior of Hong Kong residents (for whom better data are available). She finds a marginal propensity to consume from household wealth of 1.6 percent, on average, which is much smaller than the magnitude found in many other studies, and she finds that the wealth effect is driven entirely by the behavior of young people who substitute between housing wealth gains and precautionary savings from income. If Gan's results generalize to the U.S., they imply that wealthier (older) homeowners have lower marginal propensities to consume out of their housing wealth, which implies a smaller prospective consumption decline per dollar of housing wealth decline in the U.S. today than if the decline in housing wealth were broad-based.

We performed a simple regression analysis of consumption, in which we regressed consumption on its own lags as well as the current and past house price index, and found no significant relationship of house prices, whether the index is defined as the OFHEO or the Case-Shiller. However, in terms of raw correlation, the OFHEO had a slightly higher correspondence to consumption than the Case-Shiller.

We conclude from these theoretical and empirical perspectives that from the standpoint of a macroeconomic interest in house prices, the OFHEO index is a much better indicator of a possible consumption response than the Case-Shiller index.

There is one aspect of the comprehensive OFHEO index which has received criticism. Since it employs refinancings, about two-thirds of the transactions included in the comprehensive index measure appraised value rather than sale value. In our view, this is not obviously an important problem. After all, banks rely on these appraisals to approve refinancings, often at very high leverage ratios. If appraisals for the purpose of refinancing were inaccurate, especially when leverage ratios are high, as in the U.S., lenders would be placed at significant risk. Furthermore, as shown in Table 4, relying on the purchase-only index has little effect on our results, and actually reduces simulated price declines in the wake of high foreclosures. This finding provides no support for the view that the comprehensive OFHEO index fails to measure price changes in response to changing market conditions.

VI. Conclusion

Our study is the first to model the high-frequency dynamic relationships among house prices, foreclosures, employment, house permits, and house sales. We do so using a PVAR model at the state level for the United States for the period 1981-2007.

We offer the following summary of our findings:

(1) It is important to take account of the enormous variation across states, which facilitates identification of links among variables.

(2) Foreclosures and prices are closely associated at low frequency, but that reflects a combination of linkages, not just the effects of foreclosure shocks on prices.

(3) Our PVAR model is able to identify the dynamic relations among the key housing market variables and the macroeconomy, taking advantage of the high degree of

variation in the experiences of different states over the past two decades. The identified relationships make sense, and the variables explain a large amount of each other's forecast variance.

(4) Combining our PVAR model and Economy.com forecast for foreclosure rates going forward, and after considering possible biases relating to nonlinearity in the foreclosure-price relationship, we conservatively (over-)estimate that the national average price decline for houses from the 2007:Q2 peak to 2009:Q4 will be roughly 4.49 percent. We conclude that a reasonable estimate of the future path of U.S. housing market prices is that they will remain essentially flat, on average, for the next two years, notwithstanding the large predicted increase in foreclosures.

(5) We show that, from a variety of perspectives, the OFHEO comprehensive measure of price change that we employ is the appropriate index of housing prices for our purposes. It is important for readers of our study to recognize that our measure of house price change (the comprehensive OFHEO index) has produced less volatile house price changes in the past, and has declined much less than the Case-Shiller or median sales indices in recent times. We argue that the comprehensive OFHEO index provides a more reliable picture of the representative house in each of the states, and a more important picture of the housing market from the standpoint of consumption wealth effects.

References

Anari, A., J. Kolari and J. Mason (2005). "Bank Asset Liquidation and the Propagation of the Great Depression." *Journal of Money, Credit and Banking,* 37, 753-773.

Arellano, Manuel and Olympia Bover (1995). "Another Look at the Instrumental Variables Estimation of Error Correction Models." *Journal ofEconometrics*, 68(1), 29-51.

Buiter, Willem H. (2008). "Lessons from the North Atlantic Financial Crisis." Unpublished manuscript, London School of Economics.

Calomiris, Charles W. (2007). "Not (Yet) a Minsky Moment." Columbia Business School Working Paper, October 5.

Case. K., J. Quigley and R. Shiller (2005) "Comparing Wealth Effects: The Stock market versus The Housing Market", *Advances in Macroeconomics*, 5, 1-34.

Clayton, J., N. Miller and L. Peng (2008). "Price-Volume Correlation in the Housing Market: Causality and Co-Movements." Unpublished manuscript.

Couslon, N. E. (1999). "Housing Inventory and Completion." *Journal of Real Estate Finance and Economics*, 18, 89-105.

Coulson, N. E. and C. Richard (1996). "The Dynamic Impact of Unseasonable Weather on Construction Activity." *Real Estate Economics*, 24, 179-194.

Coulson, N. E. and M. Kim (2000). "Residential Investment, Non-Residential Investment and GDP." *Real Estate Economics*, 28, 233-247.

DiPasquale, D. and W. Wheaton (1994). "Housing Market Dynamics and the Future of Housing Prices." *Journal of Urban Economics,* 35, 1-27.

Foster, C and R Van Order (1984). "An Option-Based Model of Mortgage Default." *Housing Finance Review*, 3, 351-372.

Gan, Jie (2007). "Housing Wealth and Consumption Growth: Evidence from a Large Panel of Households." Working Paper, Hong Kong University of Science and Technology.

Gauger, J. and Snyder, T.C. (2003). "Residential Fixed Investment and the Macroeconomy: Has Deregulation Altered Key Relationships?" *Journal of Real Estate Finance and Economics*, 27, 335-354.

Green, R. (1997). "Follow the Leader: How Changes in Residential and Non-residential Investment Predict Changes in GDP." *Real Estate Economics*, 25, 253-270.

Leonard, T. and J. Murdoch (2008). "Homeownership, Foreclosures on Neighborhood Quality." Unpublished manuscript, presented at the 2008 AREUEA midyear meeting.

Leamer, E. (2007). "Housing IS the Business Cycle", *NBER Working paper 13428.*

Lin, Z., E. Rosenblatt and V. Yao (2008). "Spillover Effects of Foreclosures on Neighborhood Property Values." Unpublished manuscript, presented at the 2008 AREUEA midyear meeting.

Love, I. and L. Ziccino (2006). "Financial Development and Dynamic Investment Behaviour: Evidence from a Panel VAR." *The Quarterly Review of Economics and Finance*, 46, 190-210.

OFHEO (2007a). "New 'Purchase-Only' House Price Indexes: Comments and Statistics (1Q2007)**.**" Table 1, p. 12.

OFHEO (2007b). "House Prices Weaken Further in Most Recent Quarter: First Quarterly Price Decline for U.S. since 1994." Pages 8-17 of the 1Q2007 HPI Release, November 29, 2007.

Rogers, W. and W. Winter (2008). "The Impact of Foreclosures on neighborhood Housing Sales." Unpublished manuscript, presented at the 2008 AREUEA midyear meeting.

Wheaton, W. and N. Lee (2008). "Do Housing Sales Drive Housing Prices or the Converse?" Unpublished manuscript.

Wheaton, W. and G. Nechayev (2008). "The 1998-2005 Housing 'Bubble' and the Current 'Correction': What's Different this Time?" *Journal of Real Estate Research,* 30, 1-26.

Willen, P., K. Gerardi and A. Shapiro (2008). "Subprime Outcome: Risky Mortgages, Homeownership Experiences, and Foreclosures." Unpublished manuscript, presented at the 2008 AREUEA midyear meeting.

Table 1 – Panel VAR Regression Results

		Employment	Sales	Permits	HPI	Foreclosures
Employment						
	L1	0.399702***	1.162652*	3.990796**	-0.019136	-2.140017**
		(0.039863)	(0.503227)	(1.418862)	(0.089524)	(0.713470)
	L2	0.202720***	0.613139	2.893245**	-0.112046	-0.557794
		(0.028122)	(0.440973)	(1.051846)	(0.079807)	(0.700723)
	L3	0.098326***	-0.359233	1.064496	-0.043000	-0.366241
		(0.025349)	(0.484226)	(0.968182)	(0.075616)	(0.758493)
	L4	-0.123412***	-0.186061	-1.434417	0.204454*	-0.182663
		(0.022480)	(0.448507)	(1.052604)	(0.083746)	(0.611040)
	L5	0.019607	0.194391	1.976591*	-0.086341	-0.386291
		(0.021092)	(0.439694)	(0.866468)	(0.072642)	(0.633853)
	L6	0.015775	-0.687481	1.401577	0.027847	1.941353**
		(0.017836)	(0.394824)	(0.824182)	(0.073159)	(0.666763)
	L7	0.023390	0.508244	1.546669*	-0.108545	0.640251
		(0.017252)	(0.378845)	(0.693752)	(0.066934)	(0.604947)
	L8	-0.048962**	-0.188016	0.582125	0.016060	0.015795
		(0.016850)	(0.346061)	(0.618150)	(0.080704)	(0.519287)
Sales						
	L1	0.002839***	-0.251266***	0.262331***	0.002941	-0.102247**
		(0.000838)	(0.026617)	(0.044184)	(0.003074)	(0.032113)
	L2	0.003780***	-0.104449***	0.261145***	0.005685	-0.020384
		(0.000963)	(0.022991)	(0.054765)	(0.003583)	(0.032303)
	L3	0.000698	-0.070913**	0.270109***	0.004653	-0.009800
		(0.000888)	(0.023058)	(0.051457)	(0.003934)	(0.030680)
	L4	0.000187	0.023803	0.123732**	-0.001243	-0.021280
		(0.000869)	(0.021743)	(0.039150)	(0.003403)	(0.030117)
	L5	0.000004	0.016779	0.124148**	0.006944*	-0.024590
		(0.000846)	(0.022322)	(0.038734)	(0.003471)	(0.030444)
	L6	0.000208	0.059451**	0.124981*	0.001861	-0.029940
		(0.000779)	(0.020823)	(0.048806)	(0.003277)	(0.032343)
	L7	0.000952	0.036284	0.126146**	0.001671	0.027349
		(0.000727)	(0.021388)	(0.047891)	(0.003308)	(0.027698)
	L8	0.000964	-0.003179	0.072283	-0.000604	0.030441
		(0.000739)	(0.020301)	(0.041591)	(0.003537)	(0.029753)

Table 1 – Panel VAR Regression Results

		Employment	Sales	Permits	HPI	Foreclosures
Permits						
	L1	0.002041 ***	0.056678 ***	-0.291377 ***	0.004630 *	-0.046834 ***
		(0.000557)	(0.014339)	(0.073095)	(0.002033)	(0.014107)
	L2	0.001724 *	0.042428 ***	-0.144466 *	0.003465	-0.060820 ***
		(0.000742)	(0.009921)	(0.068179)	(0.002010)	(0.017195)
	L3	0.002488 ***	0.033093 **	-0.011806	0.001152	-0.050186 **
		(0.000705)	(0.010429)	(0.075987)	(0.001834)	(0.017780)
	L4	0.002065 ***	-0.003555	-0.019940	0.000975	-0.034131 *
		(0.000572)	(0.012282)	(0.065399)	(0.001990)	(0.016307)
	L5	0.002380 ***	-0.008470	0.034723	0.003481 *	-0.034792 *
		(0.000653)	(0.012470)	(0.055328)	(0.001711)	(0.017081)
	L6	0.001399 *	0.002749	-0.050021	0.001694	-0.036844 *
		(0.000587)	(0.010458)	(0.071671)	(0.002045)	(0.018101)
	L7	0.000105	-0.015840	-0.209010 *	0.003753 *	-0.016502
		(0.000538)	(0.010254)	(0.085817)	(0.001816)	(0.014060)
	L8	-0.000313	-0.019454	-0.137440 *	0.001623	-0.013375
		(0.000485)	(0.013214)	(0.067634)	(0.001726)	(0.012845)
HPI						
	L1	-0.005459	0.864046 ***	1.607469 ***	0.025877	-0.910381 ***
		(0.005879)	(0.130032)	(0.293966)	(0.045860)	(0.197272)
	L2	0.008598	0.423651 **	1.113285 ***	0.103935 *	-0.234117
		(0.006103)	(0.130021)	(0.330080)	(0.046908)	(0.222452)
	L3	-0.009180	0.223636	0.774800 **	0.119899 *	-0.617658 **
		(0.005374)	(0.133897)	(0.246822)	(0.050414)	(0.187955)
	L4	-0.008067	0.178210	0.901444 ***	0.106964 **	-0.291176
		(0.005329)	(0.112789)	(0.238550)	(0.036857)	(0.184257)
	L5	-0.009734 *	0.121851	0.604186 **	0.051992	-0.149291
		(0.004558)	(0.092479)	(0.201100)	(0.055007)	(0.147804)
	L6	-0.009610 *	0.087539	0.566473 **	0.018389	0.003648
		(0.004107)	(0.093601)	(0.195867)	(0.034494)	(0.138890)
	L7	-0.010670 **	0.191847 *	0.800464 ***	0.025357	0.136487
		(0.003811)	(0.094654)	(0.209222)	(0.039030)	(0.145194)
	L8	-0.004322	-0.029736	0.595480 ***	-0.002022	-0.005777
		(0.003104)	(0.087292)	(0.153848)	(0.021523)	(0.122687)

Table 1 – Panel VAR Regression Results

	Employment	Sales	Permits	HPI	Foreclosures
Foreclosures					
L1	-0.002593 ***	0.023659	0.108690 ***	-0.010422 ***	0.716992 ***
	(0.000549)	(0.013815)	(0.024006)	(0.002195)	(0.035988)
L2	0.000344	0.031819 *	0.037476	0.001860	0.207630 ***
	(0.000583)	(0.013501)	(0.020373)	(0.002544)	(0.048615)
L3	0.001485 **	-0.008694	0.009482	-0.003261	0.061486
	(0.000532)	(0.014999)	(0.017300)	(0.002790)	(0.045232)
L4	-0.001259 *	-0.007781	0.012388	0.001742	0.057642
	(0.000579)	(0.014683)	(0.019610)	(0.002372)	(0.039978)
L5	0.000594	0.011557	0.003807	0.002597	-0.008396
	(0.000578)	(0.014300)	(0.018908)	(0.002802)	(0.031446)
L6	-0.000457	-0.010606	-0.038180 *	-0.001816	-0.056287
	(0.000579)	(0.014848)	(0.019234)	(0.002518)	(0.031975)
L7	0.000166	-0.023710	-0.022152	0.002657	0.039016
	(0.000550)	(0.014258)	(0.019304)	(0.002859)	(0.033826)
L8	0.000590	0.002107	-0.028833	0.005709	-0.084044 **
	(0.000547)	(0.012584)	(0.018870)	(0.003214)	(0.030750)

Notes: Standard errors are presented in parentheses below the regression coefficients.
*** Coefficient significant at the 0.1% level.
** Coefficient significant at the 1% level.
* Coefficient significant at the 5% level.
The variables used in the analysis are as follows:

- **Employment** – Growth rate (log difference) of the seasonally-adjusted quarterly average of monthly total non-farm employment for the state.
- **Sales** – Growth rate (log difference) of the seasonally-adjusted annual rate of existing home sales for the state in the quarter.
- **Permits** – Growth rate (log difference) of the seasonally-adjusted quarterly average of the number of monthly single-family residential building permits for the state.
- **HPI** – Growth rate (log difference) of the quarterly OFHEO state-level house price index (all transactions) for the state.
- **Foreclosures** – Log level of the MBA quarterly foreclosure inventory as a percent of loans serviced for the state.

All regression variables were de-meaned using a Helmert transformation, while the actual values of the variables were used as instruments to obtain consistent estimates.

Table 2 – Residuals Correlation Matrix

	Employment	Sales	Permits	HPI	Foreclosures
Employment	1				
Sales	0.0500 (0.0000)	1			
Permits	0.0422 (0.0028)	0.2220 (0.0000)	1		
HPI	0.0164 (0.2441)	0.0386 (0.0062)	0.0440 (0.0018)	1	
Foreclosures	-0.0960 (0.0000)	-0.0389 (0.0058)	0.0010 (0.9455)	-0.0953 (0.0000)	1

Note: All variables are Helmert de-meaned log differences of levels except for foreclosures, which is uses the log foreclosure rate (see notes on Table 1 for a complete description of the variables); p-values reported in parentheses.

Table 3 – Variance Decompositions

	Lag	Employment	Sales	Permits	HPI	Foreclosures
Employment	4	0.9306	0.0281	0.0283	0.0026	0.0104
	8	0.8311	0.0690	0.0794	0.0063	0.0142
	20	0.7716	0.1002	0.0790	0.0351	0.0141
Sales	4	0.0046	0.9626	0.0123	0.0162	0.0044
	8	0.0062	0.9505	0.0145	0.0223	0.0065
	20	0.0062	0.9476	0.0156	0.0238	0.0067
Permits	4	0.0130	0.0645	0.8953	0.0167	0.0104
	8	0.0186	0.0661	0.8675	0.0317	0.0160
	20	0.0201	0.0668	0.8612	0.0352	0.0167
HPI	4	0.0005	0.0082	0.0053	0.9642	0.0218
	8	0.0085	0.0258	0.0192	0.9070	0.0396
	20	0.0129	0.0439	0.0255	0.8788	0.0389
Foreclosures	4	0.0353	0.0173	0.0122	0.0443	0.8909
	8	0.0627	0.0512	0.0425	0.1024	0.7412
	20	0.0795	0.1197	0.0712	0.2564	0.4731

Note: Percent of row variable explained by the column variable at the specified lag.

Table 4 – Cumulative Simulated U.S. House Price Changes between 2007Q2 and 2009Q4 by Model

Price Data Used	Log Level of Foreclosure Rate		Log Difference of Foreclosure Rate	
	1981-2007	1988-2007	1981-2007	1988-2007
OFHEO all-transactions index	-3.7%	-2.9%	+3.8%	+3.2%
OFHEO purchase-only index	-2.0%	-1.8%	-1.4%	-1.1%

Note: Eight different versions of the model were run based on the choice of data start point (1981 vs. 1988), price data used (OFHEO all-transactions index vs. purchse-only index), and foreclosure variable used (log level of the foreclosure rate vs. the log difference of the foreclosure rate). Table entries report the cumulative house price changes for the U.S. as a whole between 2007Q2 and 2009Q4 resulting from foreclosure rate shocks implied by Economy.com forecasts.

Table 5 – Difference in the Effect of a Change in the Foreclosure Rate on Home Price Appreciation using Linear and Quadratic Specifications

Lag	Linear Specification	Quadratic Specification	Percentage Difference
0	-0.00271	-0.00320	18.14
1	-0.00074	0.00041	-155.04
2	0.00089	-0.00100	-212.18
3	-0.00051	-0.00004	-92.18
4	0.00048	0.00185	285.80
5	0.00057	-0.00010	-117.64
6	-0.00050	-0.00050	-0.74
7	0.00077	0.00058	-24.77
8	0.00115	0.00108	-6.51
Cumulative	-0.00060	-0.00092	53.26

Note: Cumulative effects are the sum of all the lags, and represent the effect of a mean value (0.22 percent) shock that persists for nine periods. These effects are graphed in Figure 7.

Explanation of Table 4: The entries above were calculated as follows. For the second column (Linear Specification), fixed-effect panel regressions of the HPI growth rate on eight lags of all five system variables along with contemporaneous values of the four exogenous variables were run. As in the text, fixed effects were controlled for by Helmert de-meaning the data, while the actual values of the variables were used as instruments to obtain consistent estimates. The column 2 values are then derived by taking the coefficients for each lag of the log foreclosure rate and multiplying them by 0.22 percent, the mean value of the de-meaned log foreclosure rate derived from the Economy.Com implied foreclosure forecast. Thus, the table entries represent the total impact on the HPI growth rate from a mean value shock in the log level of the foreclosure rate the specified number of periods in the past.

For column 3 (Quadratic Specification), a quadratic term on the log foreclosure rate is included in the above panel regression. The values in this column are calculated in a similar fashion, providing an estimate of the total price impact (both linear and quadratic) of a mean value shock to the growth rate of foreclosures.

The final column is the percentage difference between the second and third column; a negative number indicates that a foreclosure shock has a bigger price impact under a linear specification than it does with a quadratic specification.

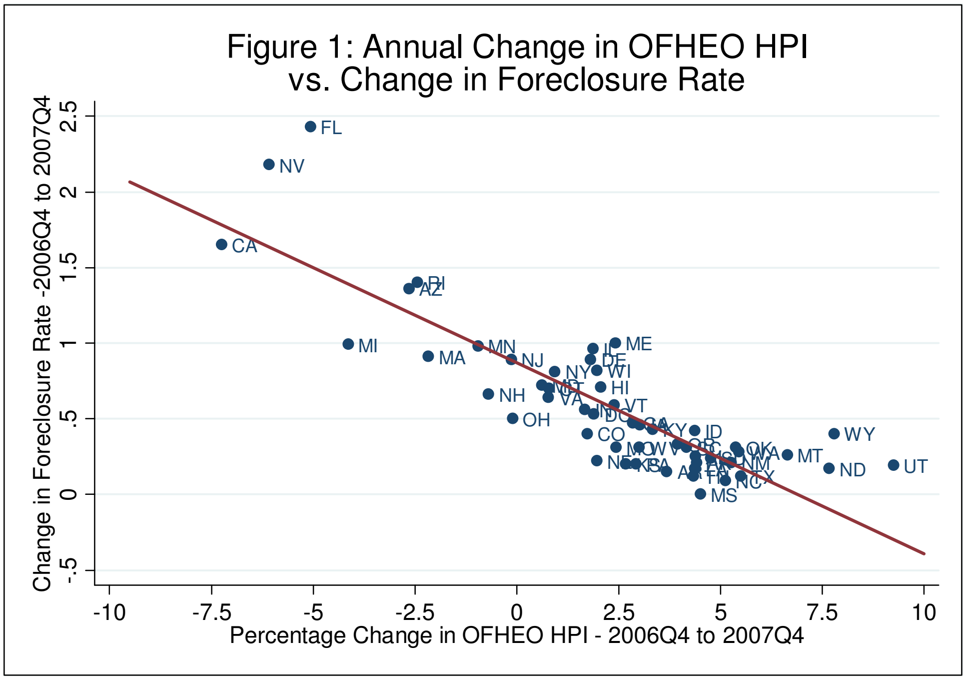
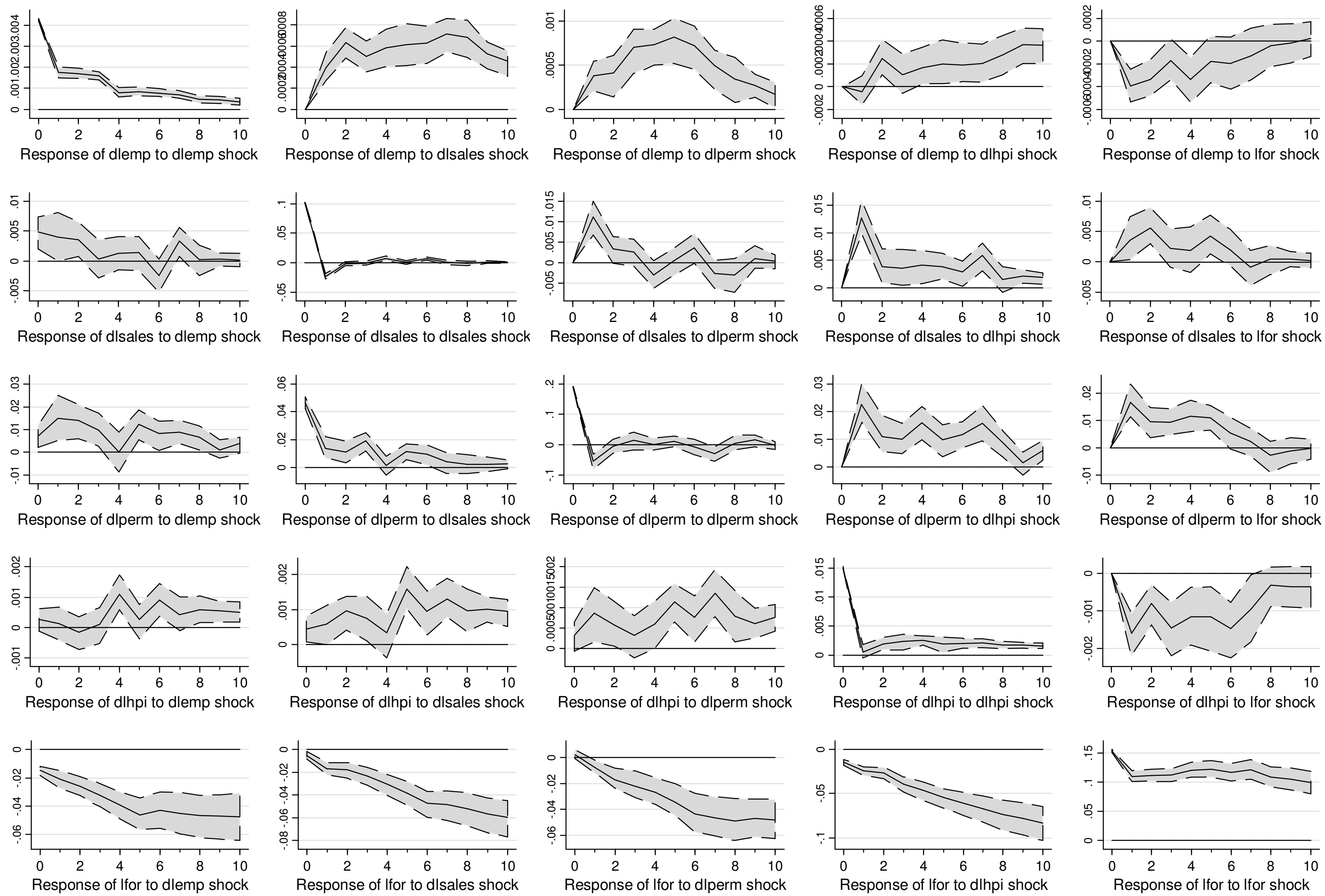


Figure 1: Annual Change in OFHEO HPI vs. Change in Foreclosure Rate

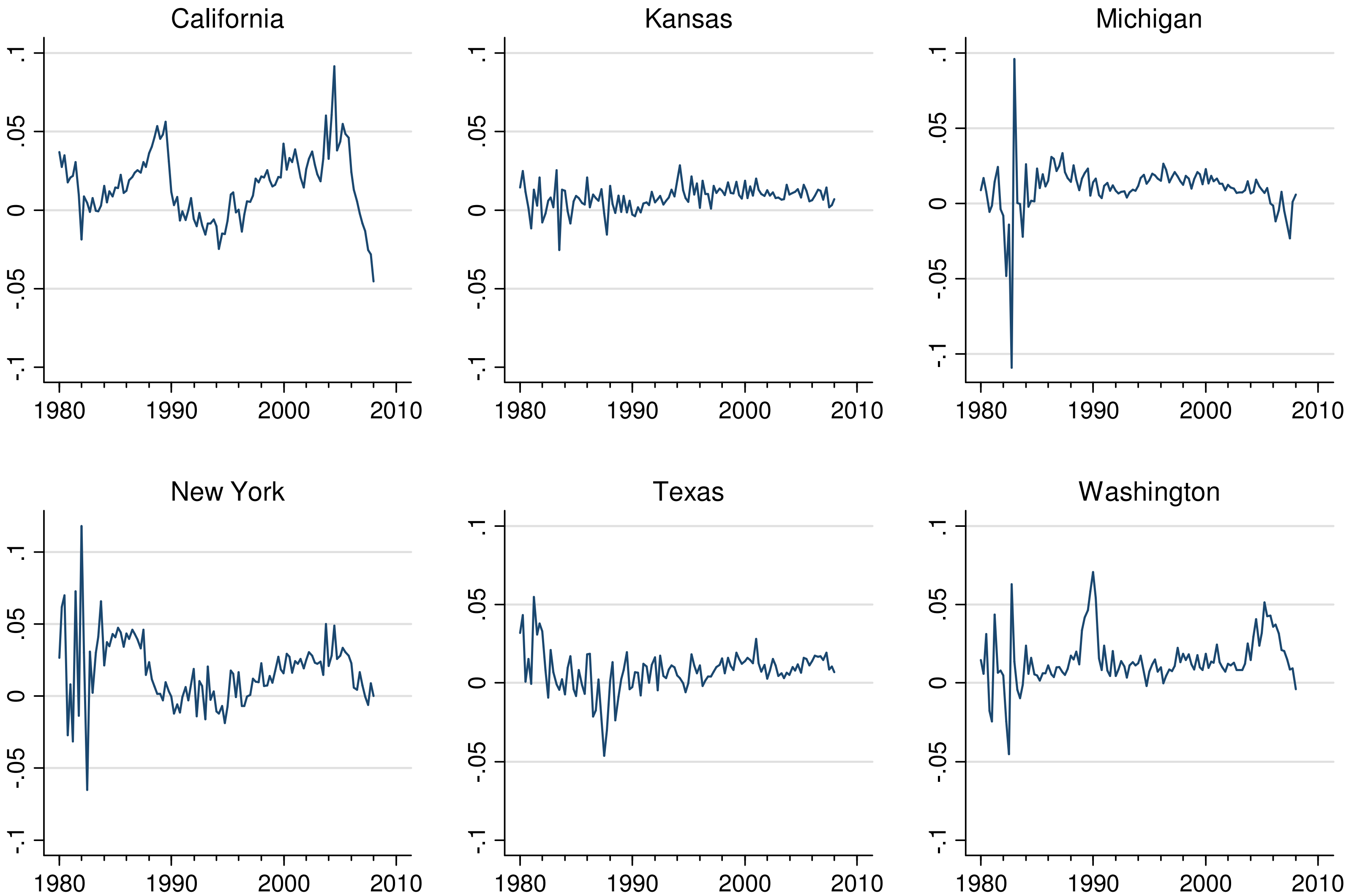
Note: Slope coefficient = –0.126 with an R-square of 0.72.

Figure 2: Impulse Response Functions



Note: Impulse responses are based on growth rates (difference of logs) of all variables in the system except the foreclosure rate, which is modeled as a log level. The impulse responses are derived using a Cholesky decomposition with the following ordering: employment, sales, permits, HPI, and foreclosure rate.

Figure 3 - Panel A: HPI Growth Rate in Selected States



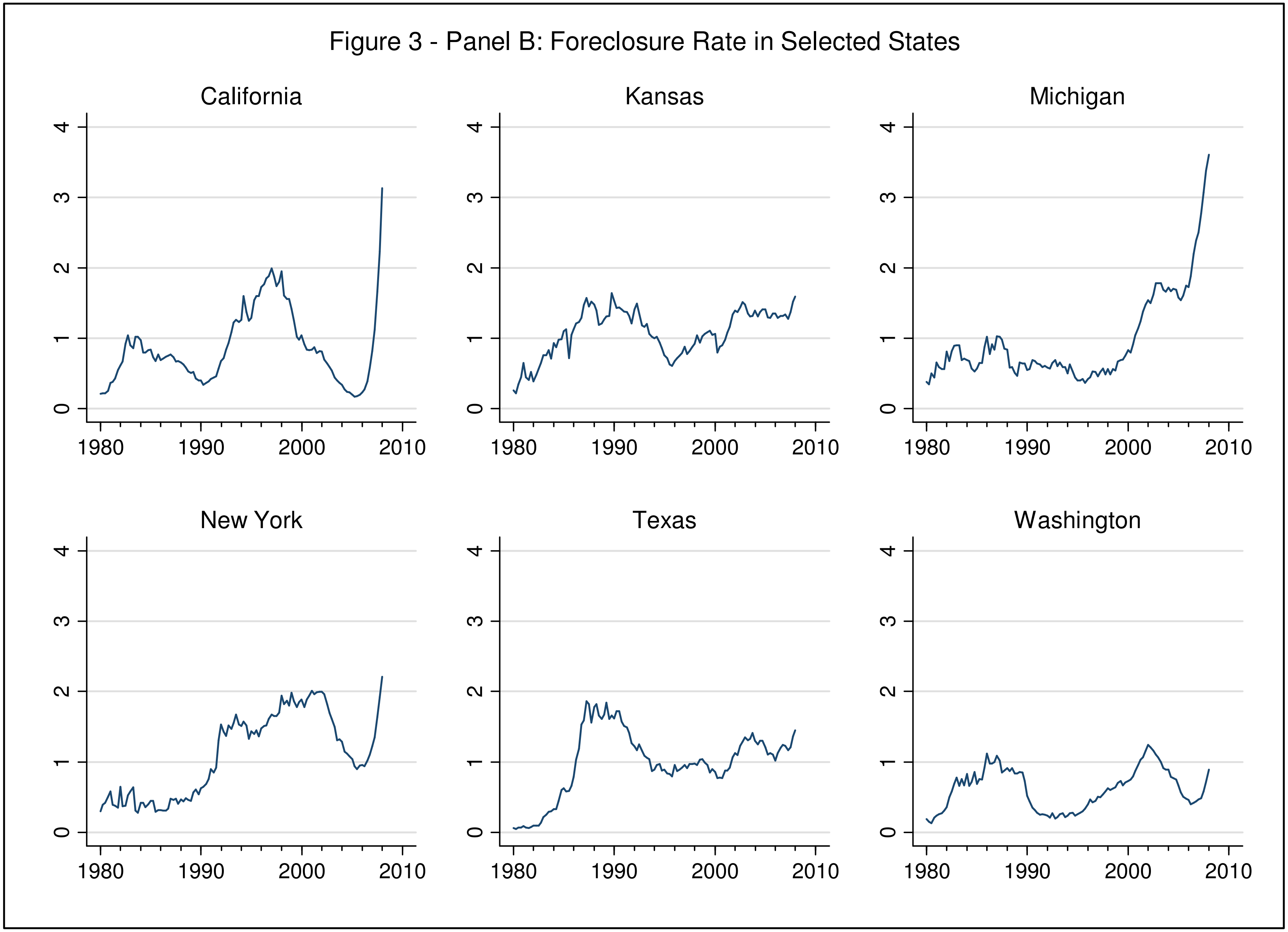
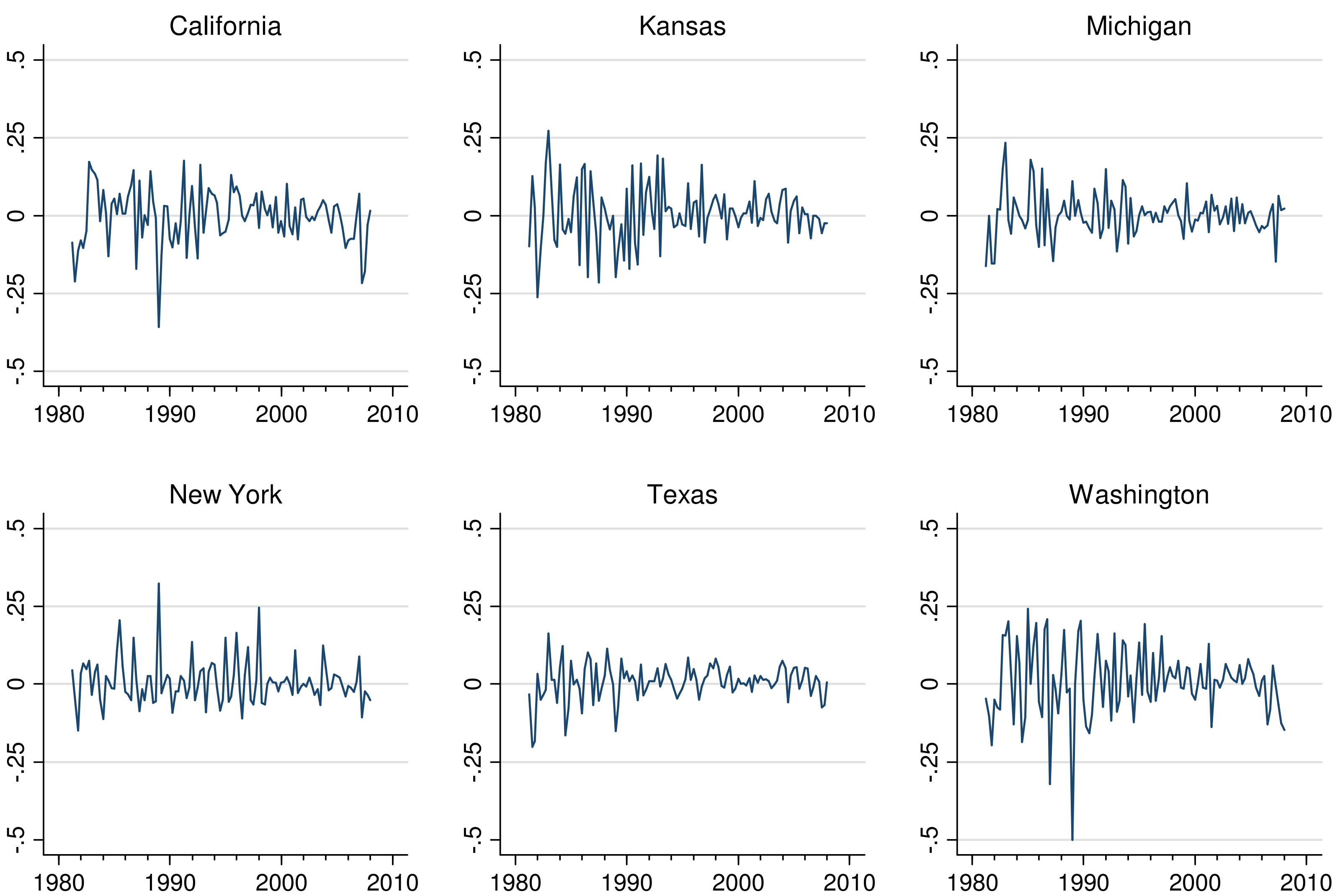


Figure 3 - Panel B: Foreclosure Rate in Selected States
California
Kansas
Michigan
New York
Texas
Washington
0
1
2
3
4
1980
1990
2000
2010

Figure 3 - Panel C: Existing Home Sales Growth Rate in Selected States



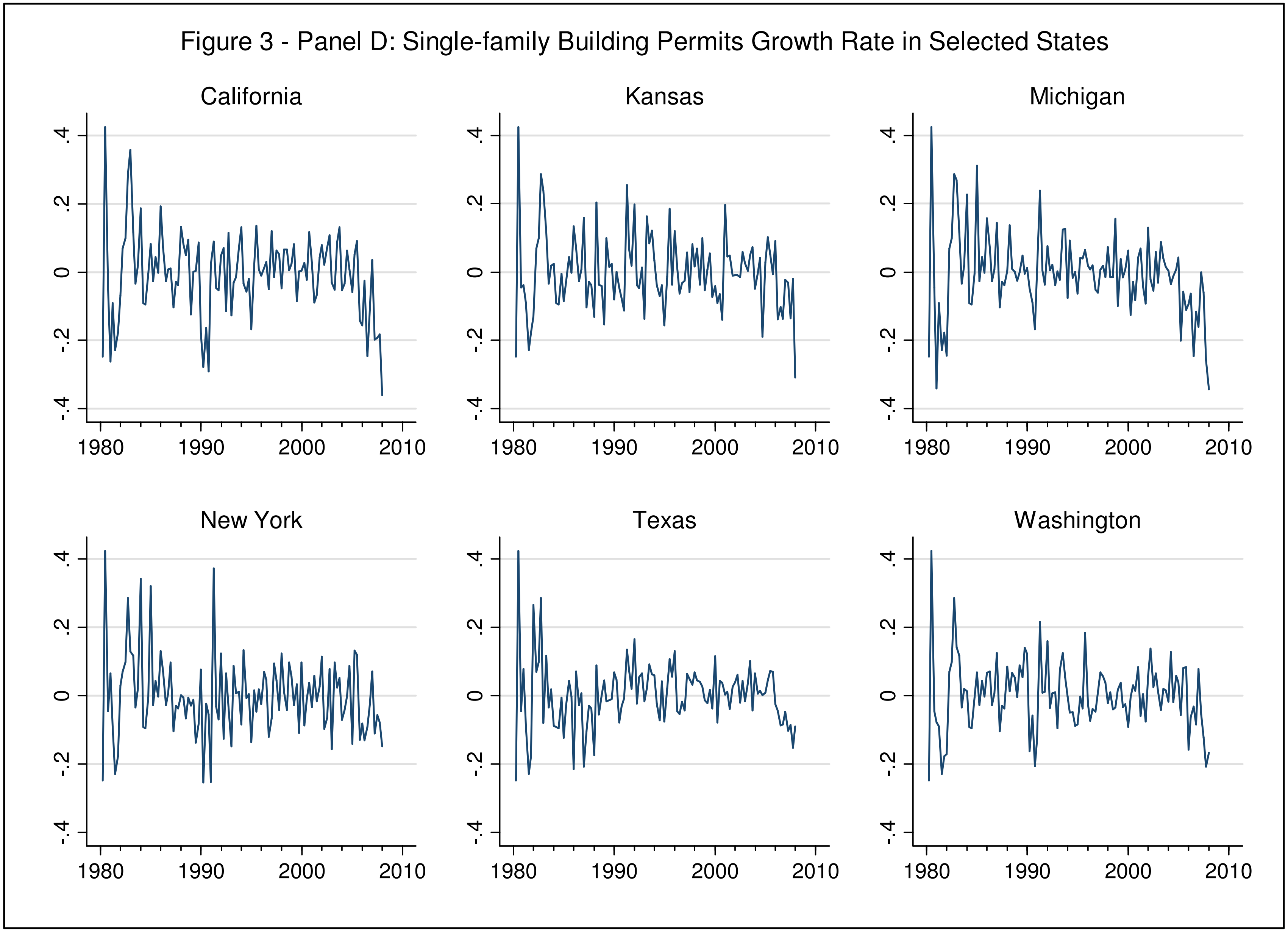


Figure 3 - Panel D: Single-family Building Permits Growth Rate in Selected States
California
Kansas
Michigan
New York
Texas
Washington
.4
.2
0
-.2
-.4
1980
1990
2000
2010

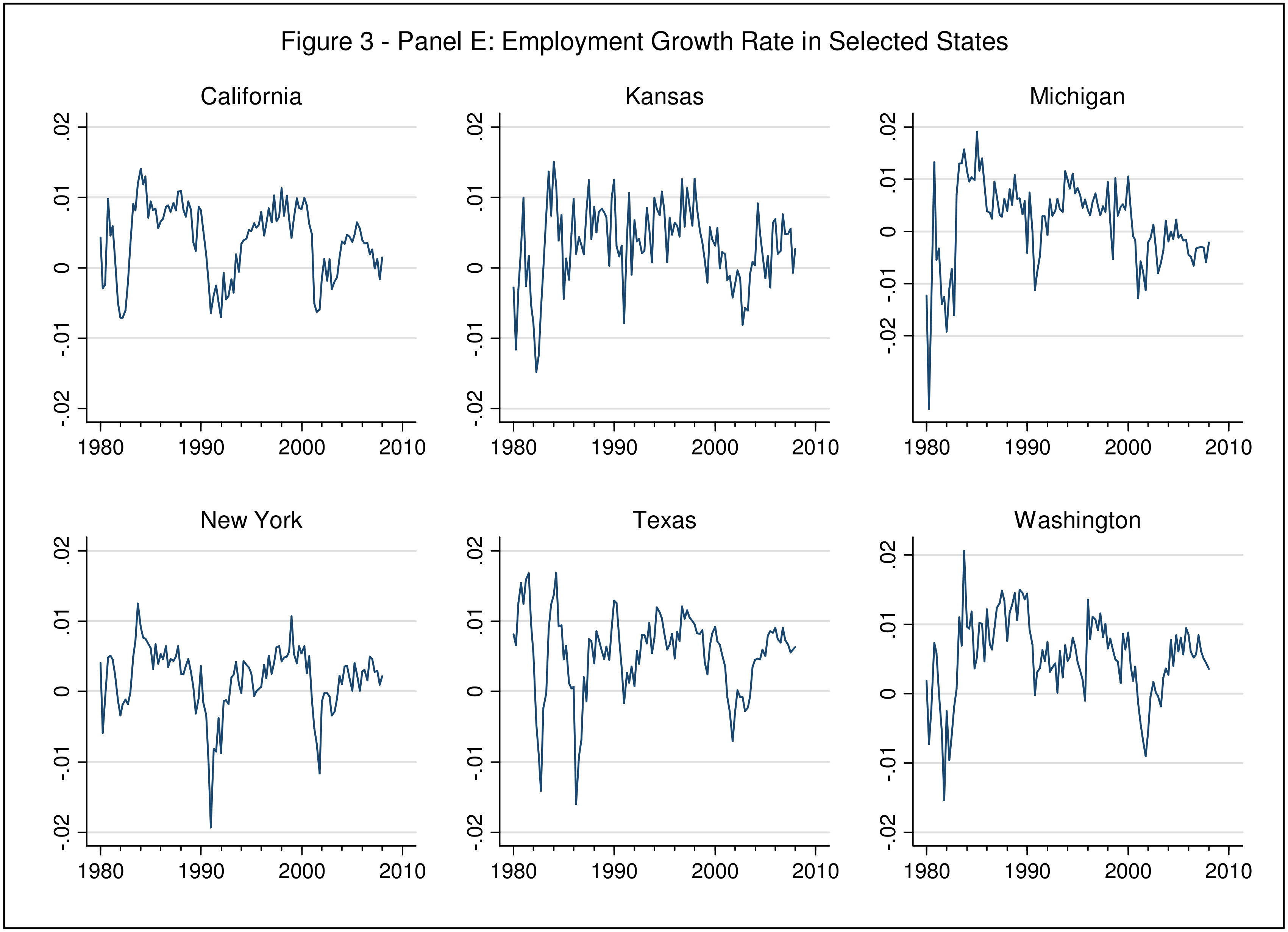


Figure 3 - Panel E: Employment Growth Rate in Selected States
California
Kansas
Michigan
New York
Texas
Washington
-.02
-.01
0
.01
.02
1980
1990
2000
2010

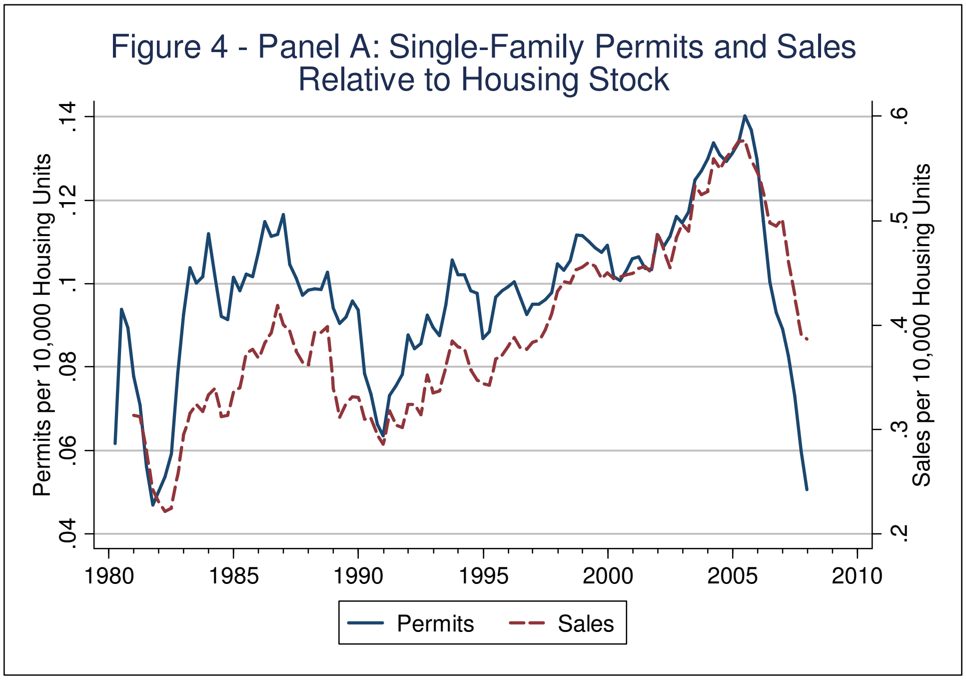


Figure 4 - Panel A: Single-Family Permits and Sales
Relative to Housing Stock
Permits per 10,000 Housing Units
Sales per 10,000 Housing Units
.04
.06
.08
.1
.12
.14
.2
.3
.4
.5
.6
1980
1985
1990
1995
2000
2005
2010
Permits
Sales

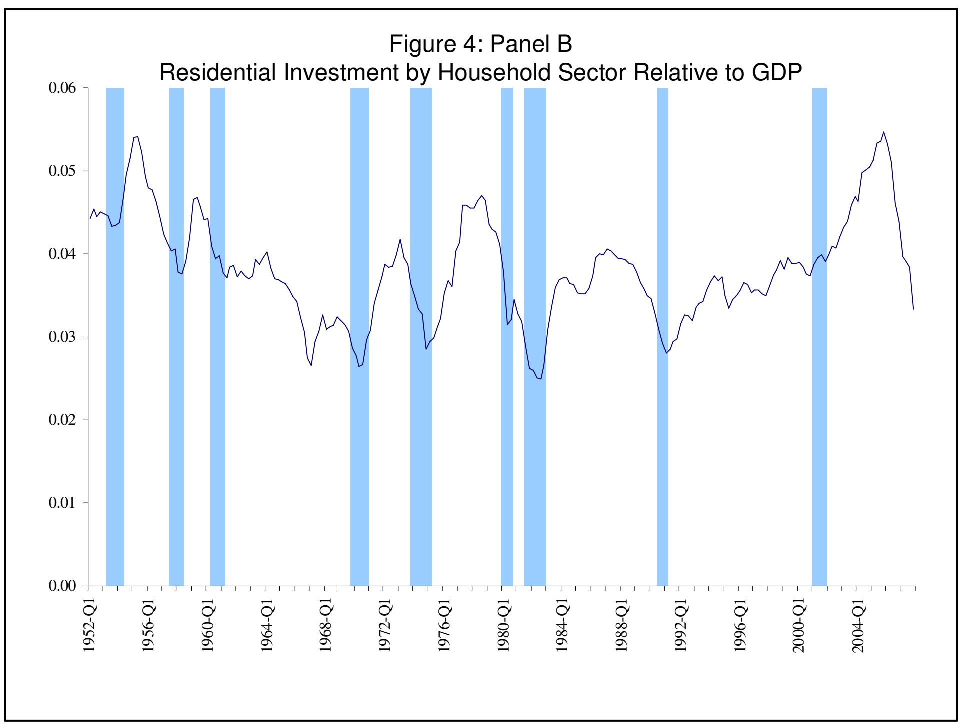
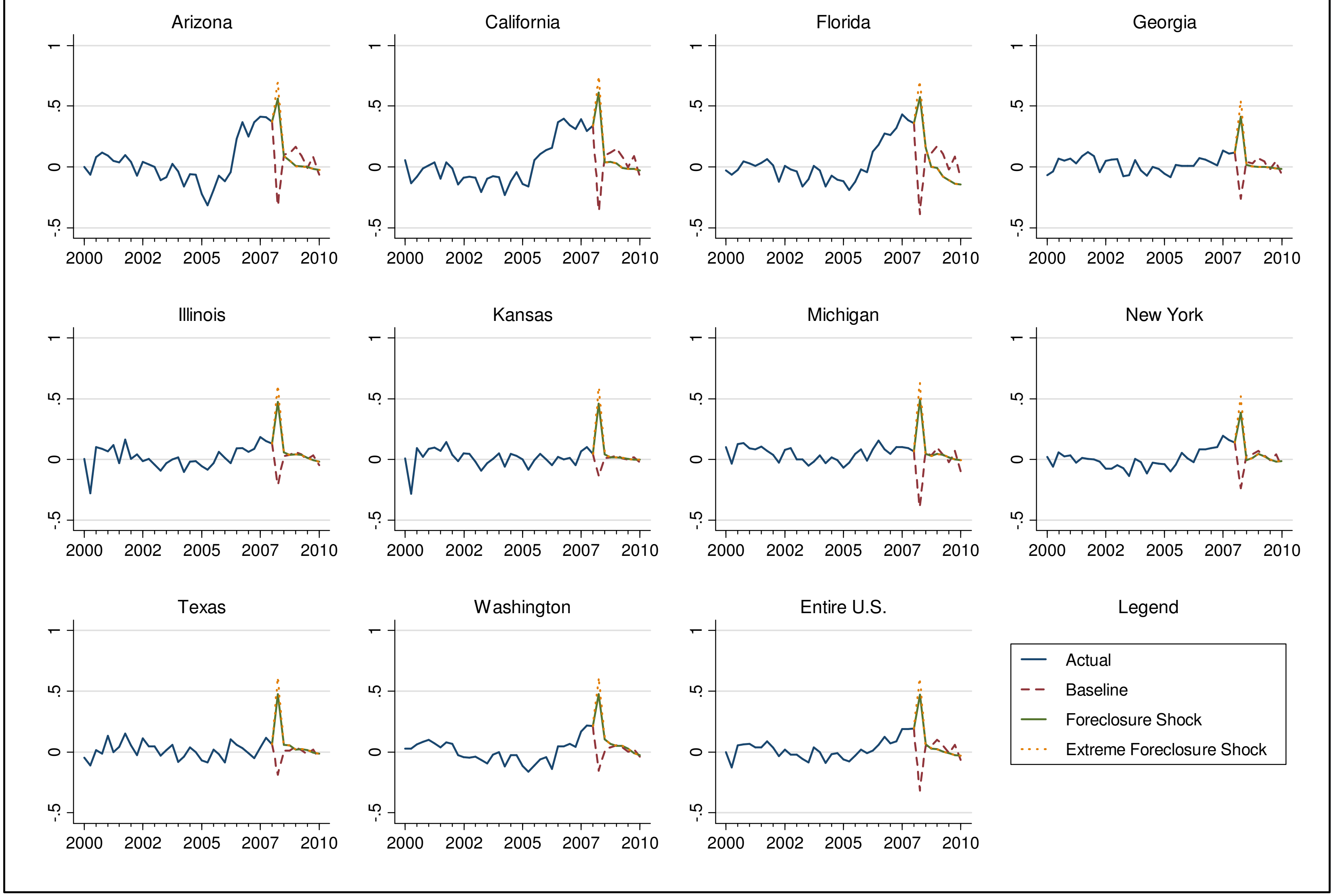
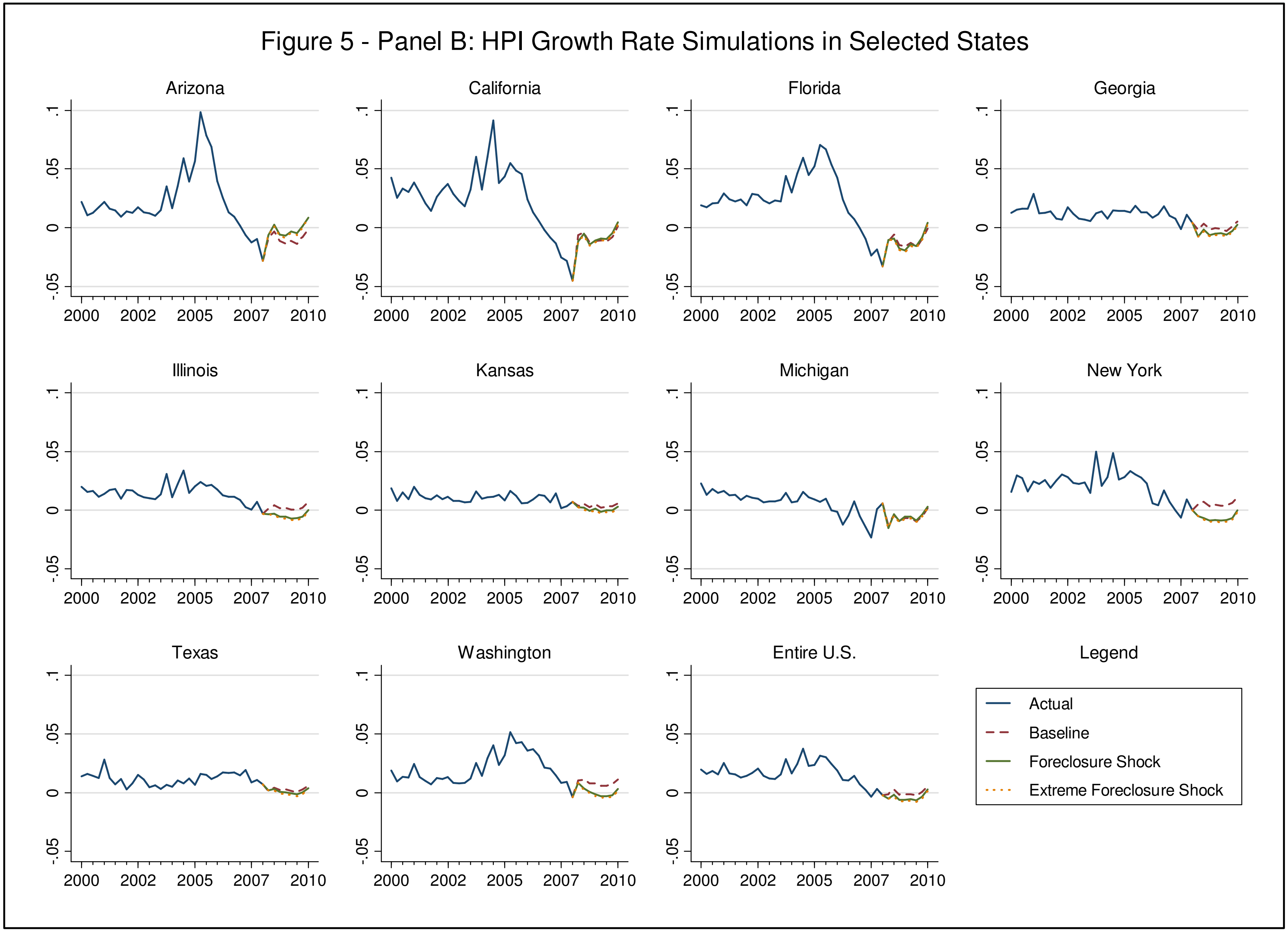


Figure 4: Panel B
Residential Investment by Household Sector Relative to GDP
0.00
0.01
0.02
0.03
0.04
0.05
0.06
1952-Q1
1956-Q1
1960-Q1
1964-Q1
1968-Q1
1972-Q1
1976-Q1
1980-Q1
1984-Q1
1988-Q1
1992-Q1
1996-Q1
2000-Q1
2004-Q1

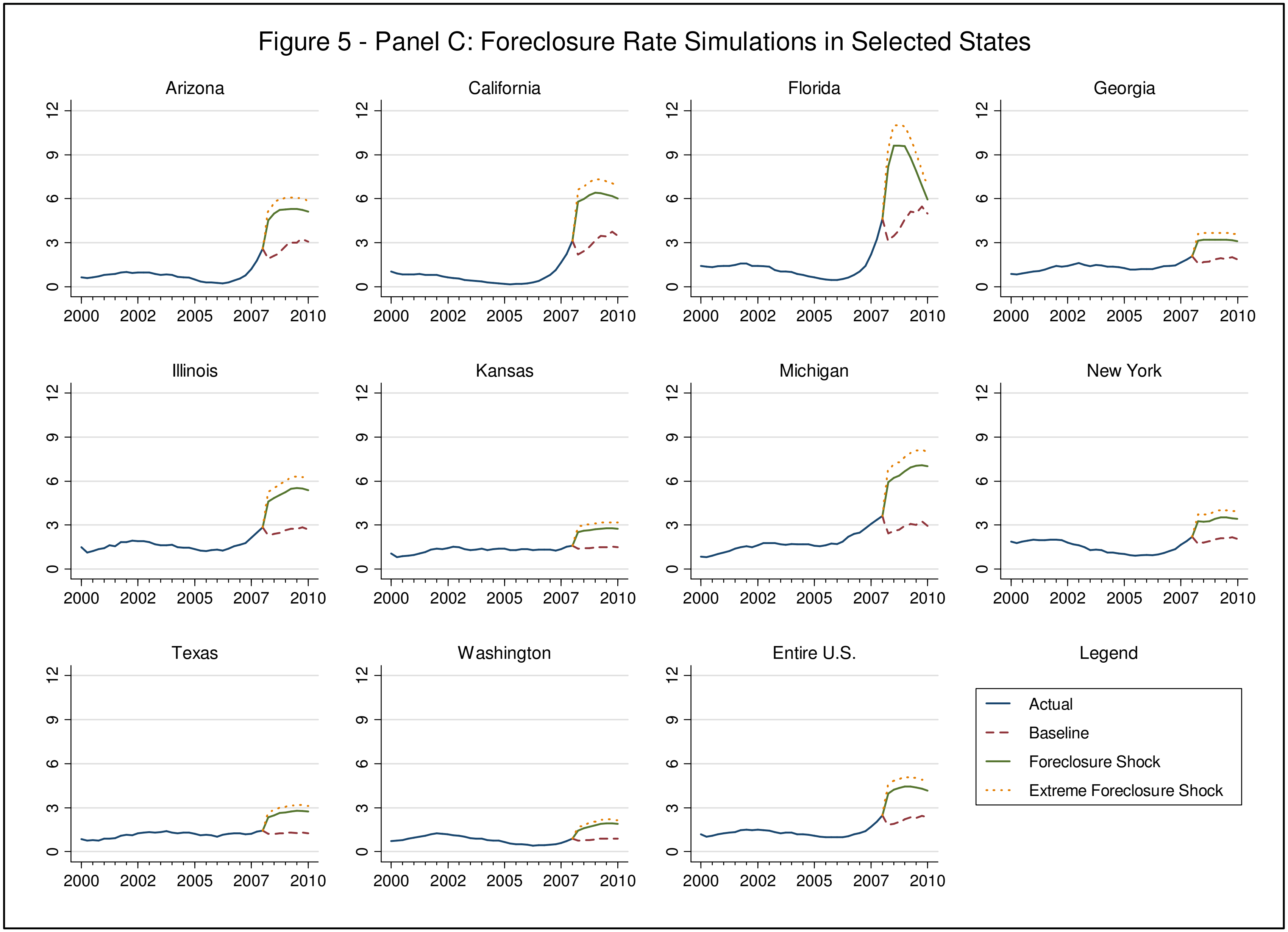
Figure 5 - Panel A: Foreclosures Growth Rate Simulations in Selected States



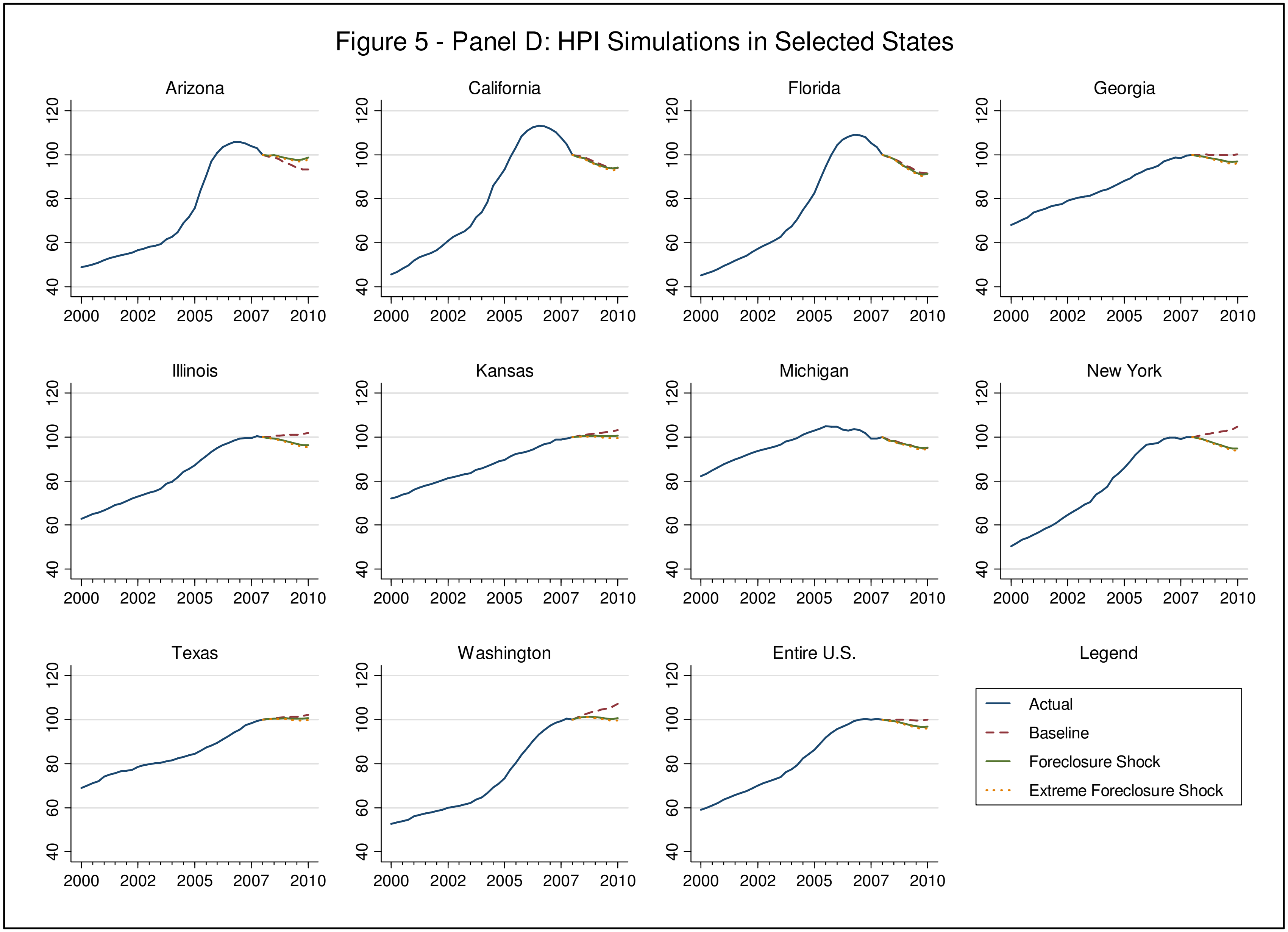
Note: The variable graphed in this panel is the quarterly log difference of the percent of mortgages in foreclosure; the Entire U.S. forecasts are the weighted average of the state forecasts, where weighting is based on the estimated housing stock in each state. The Foreclosure Shock scenario is based on Economy.com forecasts, adjusted for possible non-linear effects. The Extreme Foreclosure Shock scenario assumes foreclosures are 75 percent higher than those in the Economy.com forecasts.



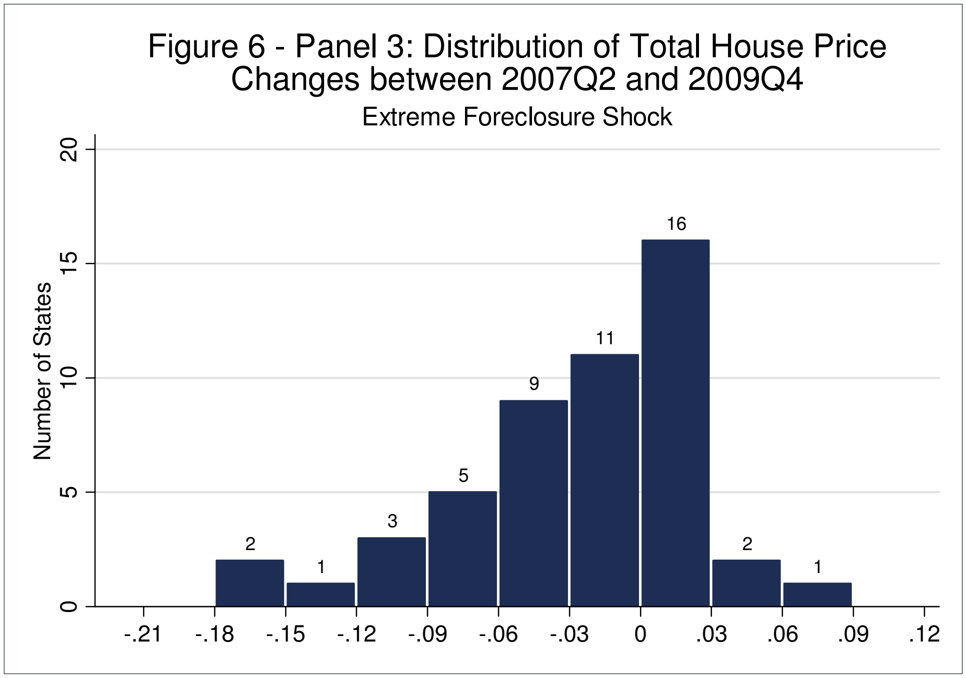
Note: The variable graphed in this panel is the quarterly log difference of the OFHEO HPI; the Entire U.S. forecasts are the weighted average of the state forecasts, where weighting is based on the estimated housing stock in each state. The Foreclosure Shock scenario is based on Economy.com forecasts, adjusted for possible non-linear effects. The Extreme Foreclosure Shock scenario assumes foreclosures are 75 percent higher than those in the Economy.com forecasts.



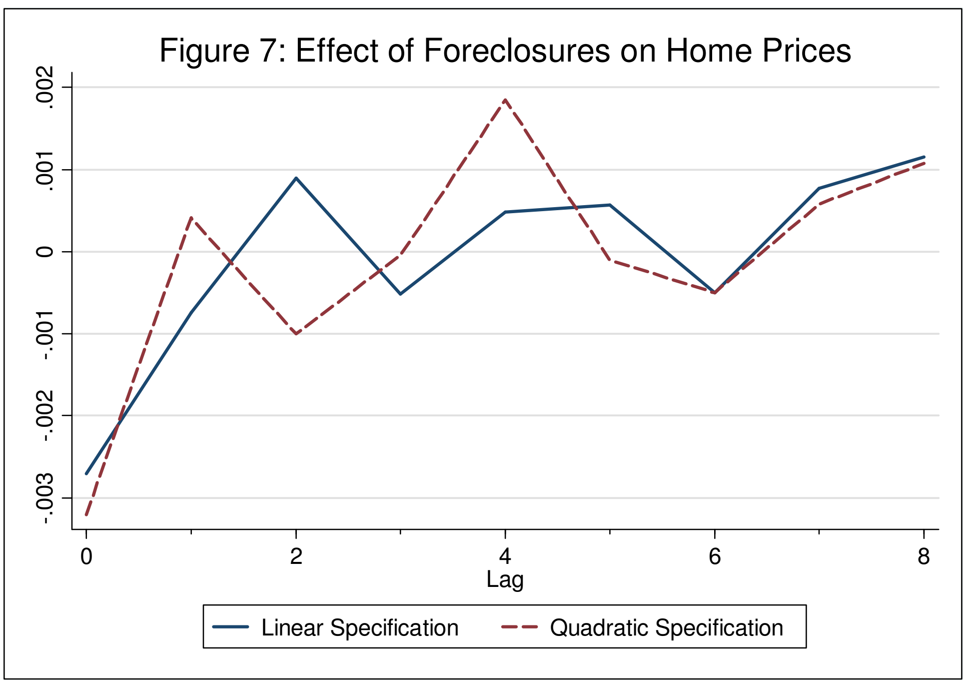
Note: The variable graphed in this panel is the percent of mortgages in foreclosure; the Entire U.S. forecasts are the weighted average of the state forecasts, where weighting is based on the estimated housing stock in each state. The Foreclosure Shock scenario is based on Economy.com forecasts, adjusted for possible non-linear effects. The Extreme Foreclosure Shock scenario assumes foreclosures are 75 percent higher than those in the Economy.com forecasts.



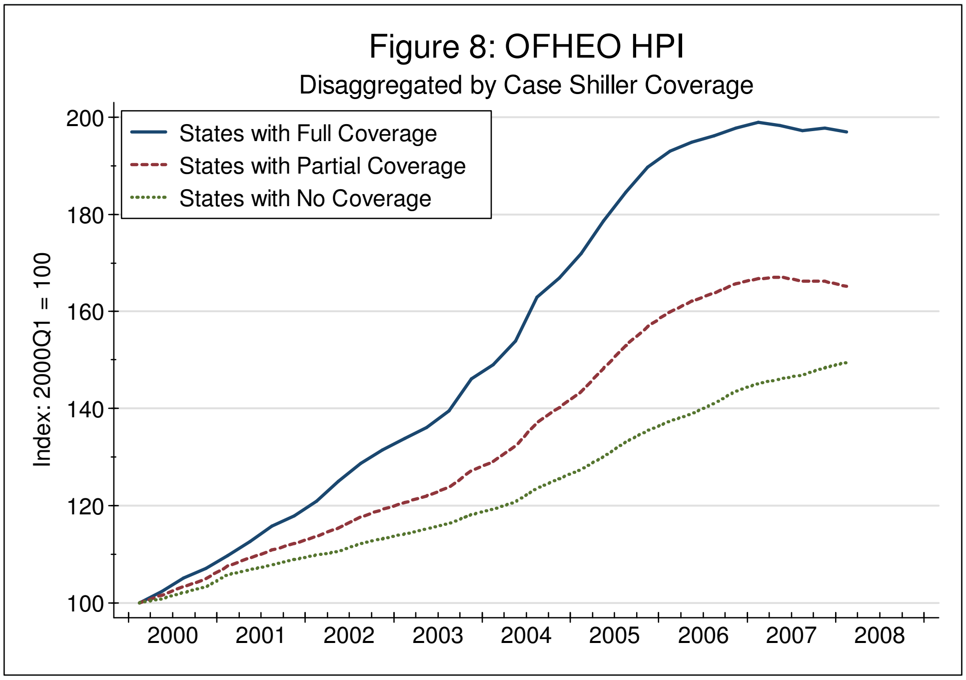
Note: The variable graphed in this panel is the OFHEO HPI (all transactions index) for each state, renormalized to set 2008q1 = 100; the Entire U.S. forecasts are the weighted average of the state forecasts, where weighting is based on the estimated housing stock in each state. The Foreclosure Shock scenario is based on Economy.com forecasts, adjusted for possible non-linear effects. The Extreme Foreclosure Shock scenario assumes foreclosures are 75 percent higher than those in the Economy.com forecasts.



Note: Alaska and New Hampshire are not included because of data limitations; the District of Columbia is included.



Note: Lines show the total impact of a mean value (0.22 percent) log foreclosure rate shock on the HPI growth rate at the specified lag if the impact of foreclosures is modeled using the indicated specification. A detailed description of their calculation is provided in the notes to Table 5.



Note: This figure shows the weighted-average of OFHEO state-level price indices aggregated on whether the states are covered in the Case-Shiller national house price index. Weighting is based on the estimated number of housing units in each state according to the 2006 American Community Survey.