

# Are American Homeowners Locked into Their Houses? The Impact of Housing Market Conditions on State-to-State Migration

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## Abstract:

U.S. policymakers are concerned that negative home equity arising from the severe housing market decline may be constraining geographic mobility and consequently serving as a factor in the nation's persistently high unemployment rate. Indeed, the widespread drop in house prices since 2007 has increased the share of homeowners who are underwater on their mortgages. At the same time, migration across states and among homeowners has fallen sharply. Using a logistic regression framework to analyze data from the Internal Revenue Service on state-to-state migration between 2006 and 2009, the authors discover evidence that "house lock" decreases mobility but find it has a negligible impact on the national unemployment rate. A one-standard deviation increase in the share of underwater nonprime households in the origin state reduces the outflow of migrants from the origin to the destination state by 2.9 percent. When aggregated across the United States, this decrease in mobility reduces the national state-to-state migration rate by 0.05 percentage points, resulting in roughly 110,000 to 150,000 fewer individuals migrating across state lines in any given year. Assuming that all of these discouraged migrants were job-seekers who were previously unemployed before relocating and then found a job in their new state would reduce the nation's unemployment rate by at most one-tenth of a percentage point in a given year. The cumulative effect over this period would yield an unemployment rate of 9.0 percent versus 9.3 percent in 2009. Recognizing that not all state-to-state migrants are job-seekers, not all job-seekers were previously unemployed, and not all previously unemployed job-seekers will successfully find work in their new location yields an unemployment rate that is virtually unchanged from the actual one that prevailed from 2006 to 2009.

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## **I. Introduction**

There is a growing concern among U.S. policymakers that decreasing labor mobility associated with negative home equity may be playing a role in keeping the United States mired in its highest and most prolonged period of unemployment since the Great Depression. Since May 2009, the nation's unemployment rate has hovered around 9 percent, exceeding what would be expected based on estimates generated from the observed growth in economic activity. At the same time, data from the Bureau of Labor Statistics show that despite an upward trend in job openings since the official end of the recession in June 2009, there has been little increase in hiring.<sup>1</sup>

This lack of recovery in the job market can have long-run consequences for individuals. Not only has the U.S. unemployment rate remained persistently high for an extended period of time, but nearly half of unemployed workers have been out of work for more than six months.<sup>2</sup> Such long-term unemployment is associated not only with lost income but also with deteriorating skills and a loss of work experience that may affect future labor market participation and lifetime earnings (see Congressional Budget Office 2007; Van Horn and Zukin 2011).

An underperforming labor market may partly be due to the inability of firms to find suitable workers. Indeed, some employers state that they cannot find workers with the right mix of skills, suggesting that some type of mismatch might be occurring. For example, a geographic mismatch in the national labor market may arise from workers who are unable to relocate to a region with better labor market opportunities.<sup>3</sup> Although mobility across states has been

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<sup>1</sup> Bureau of Labor Statistics. 2011. "Job Openings and Labor Turnover – October 2011." Economic News Release, December 13.

<sup>2</sup> Bureau of Labor Statistics. 2011. "Employment Situation Summary." Economic News Release, December 2.

<sup>3</sup> Another type of mismatch among job openings and unemployed workers may arise from demand shifts that favor certain industries, occupations, or skills over others. This dynamic process, which has been playing out gradually over decades, may very well have been accelerated or exacerbated during the Great Recession (Acemoglu and Autor 2010).

declining gradually for more than two decades, recently there has been a sharp downturn in state-to-state migration rates that predated the Great Recession that began in December 2007.<sup>4</sup> And although migration across labor markets has been shown to be procyclical, the drop in mobility during the Great Recession has been larger than has been typical of postwar downturns (Saks and Wozniak 2011). Moreover, there appears to be a disparate impact on the mobility of homeowners—between 2006 and 2009 the number of homeowners who moved out of state fell by 25.5 percent versus a decline of only 13.6 percent among renters.<sup>5</sup>

How might the recent housing bust affect state-to-state migration? Since 2007 the unprecedented widespread and deep drop in U.S. house prices has increased the share of homeowners that are underwater, meaning that they owe more on the mortgage than the house's current market price. According to CoreLogic, 10.7 million, or 22.1 percent, of all residential properties with a mortgage were in negative equity at the end of 2011:Q3.<sup>6</sup> An additional 2.4 million borrowers had less than 5 percent equity, referred to as near-negative equity, in 2011:Q3. Taking these figures together, CoreLogic estimates that negative equity and near-negative equity mortgages accounted for 27.1 percent of all mortgaged residential properties nationwide in 2011:Q3. This is almost identical to the number of homeowners who were underwater as of 2009:Q3, which indicates that housing market conditions have improved little over the last two years.

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<sup>4</sup> Data from the American Community Survey (ACS) shows that between 2006 and 2009 moves between states—which are usually employment-related—fell more than moves within states—which are more likely to be driven by a desire for newer housing, better schools, or shorter commutes (Donovan and Schnure 2011). In addition, a variety of data sources all show that interstate migration has fallen more sharply since the beginning of the recession and is now at its lowest point since World War II—roughly 1.6 percent (Frey 2009).

<sup>5</sup> Fletcher, Michael A. 2010. "Few in U.S. Move for New Jobs, Fueling Fear the Economy Might Get Stuck, Too." *The Washington Post*, July 30, section A1, p.13.

<sup>6</sup> CoreLogic. 2011. "Third Quarter 2011 Negative Equity Data Shows Slight Decline but Remains Elevated." Press Release, November 29.

These observations have raised concerns that the prolonged weakness in the U.S. housing market is keeping unemployment high by preventing homeowners who have negative equity from relocating to other states with better job markets. Having a negative equity position in their homes is likely to further deter homeowners from selling in an already weak housing market. Other options, such as engaging in a short sale or strategically defaulting on the loan, can be costly in terms of lost value or a damaged credit record. And in all likelihood, the number of underwater households is likely to persist as house prices continue to fall in many areas due to continually high levels of unemployment and foreclosure.

The concept of “house lock” is not new. A number of studies conducted prior to the Great Recession typically found housing market declines reduced geographic mobility (Quigley 1987; Stein 1995; Henley 1998; Genesove and Mayer 1997, 2001; Chan 2001; and Engelhardt 2003). However, much of that earlier research was restricted in terms of the geographic area studied (for example, New York City), the temporal horizon for moving (for instance, an eight-year time horizon), or the demographic group that was affected (for example, younger households). Moreover, prior to 2006 being in a negative equity position was quite unusual such that the characteristics of underwater households from earlier periods may differ from those during the current housing bust, possibly resulting in different impacts on mobility due to different underlying household traits and circumstances.

More recently, economists have revisited this earlier literature to provide new estimates of the impacts of negative equity on mobility, yielding mixed evidence of house lock. In part, this is due to insufficient longitudinal data that accurately measures both migration patterns and negative equity during the recent housing bust (Ferreira, Gyourko, and Tracy 2010; Schulhofer-

Wohl 2010).<sup>7</sup> Other studies using cross-sectional data covering the housing bust period to examine variation over time have suffered from a lack of concurrent data to match recent trends in negative equity with state-to-state migration (Molloy, Smith, and Wozniak 2011).<sup>8</sup> Because of the limited data on negative equity, other researchers have relied on proxy measures, typically matching trends in house price changes to the migration patterns of homeowners versus renters. This literature has also yielded mixed results, in part because of a lack of data on migration patterns by homeownership status over sufficient periods of time (see Aaronson and Davis 2011; Donovan and Schnure 2011; Farber 2011; Schmitt and Warner 2011).<sup>9</sup> Finally, although some of these studies control for national economic conditions none have used a comprehensive model to account for relative economic conditions and local amenities between origin and destination

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<sup>7</sup> Ferreira, Gyourko, and Tracy (2010) analyzed the American Housing Survey and find that between 1985 and 2005, homeowners who have negative equity were one-third less likely to move, reducing the two-year mobility rate by 4 percentage points. Schulhofer-Wohl (2010) re-analyzes the data from Ferreira, Gyourko, and Tracy (2010), coding situations where the home is occupied by different people who are renters or is found vacant to be cases where the homeowners had moved, rather than dropping these observations from the sample. With this change, Schulhofer-Wohl finds that homeowners who have negative equity are slightly more likely to move than homeowners who have positive equity. Regardless, the data series used in both papers ended just before the start of the recent housing bust, thus making it difficult to extrapolate their findings to the current situation.

<sup>8</sup> Molloy, Smith, and Wozniak (2011) analyze migration trends from the Internal Revenue Service (IRS) between 2006 and 2009 to determine the role of the housing market in the recent drop in migration activity. They find no evidence that states with a high share of households with negative equity experienced steeper drops in migration than those states with low shares of negative housing equity. However, their measure of negative equity is only for a single quarter at the end of their data period and fails to capture the variation across states over time.

<sup>9</sup> Aaronson and Davis (2011) use the SIPP to look at four-month migration rates of homeowners versus renters and find no evidence that migration rates fell more among homeowners in states that experienced large versus small house price declines between 2007 and 2009. Yet the analysis is based on four-month migration rates—a time horizon that may be too short to observe the impact of house price changes on migration. Donovan and Schnure (2011) analyze out-migration rates between 2007 and 2009 from the American Community Survey (ACS) and find evidence of house lock for county-to-county moves but not state-to-state moves. Yet in the ACS homeownership status is identified only after the move, leading to potentially biased estimates of migration depending on the degree to which migrants change tenure from owner to renter and vice versa. Farber (2011) uses the both the Current Population Survey (CPS) and the Displaced Worker Survey (DWS) and finds that mobility decreased more for unemployed renters than for unemployed homeowners. However, mobility rates calculated from the CPS rely on non-matches from the out-going rotation group sample—a crude measure of mobility as Farber notes. Schmitt and Warner (2011) also use the DWS and find that displaced workers were no less likely to migrate out of states with larger house-price declines than were displaced workers who lost their jobs in states with smaller house-price declines or price increases. Yet the DWS does not record homeownership status at the time of job loss so it is difficult to tell whether employment status changed before tenure status or vice versa.

states—although earlier work shows these to be significant determinants of migration (Sasser 2010).<sup>10</sup>

This paper contributes to the house lock literature in several important ways. First, we examine 2006 through 2009, the most recent period for which state-to-state migration data is available and the time during which the U.S. housing market deteriorated rapidly and the nation’s unemployment rate soared. Second, we make use of a time series put together by the General Accountability Office (GAO) to capture heterogeneity in the share of households experiencing negative equity over time and across states and match this with data on state-to-state migration from the Internal Revenue Service (IRS). Third, using a logistic regression framework developed in an earlier paper, we estimate the impact of negative equity on migration while controlling for changes in relative economic conditions as well as differences in time-invariant characteristics between origin and destination states. Finally, we do a back-of-the-envelope calculation to ascertain the potential impact of restricted mobility across states on the national unemployment rate.

Our results show that negative equity did indeed reduce state-to-state migration between 2006 and 2009. We find that a one-standard deviation increase in the share of underwater households in the origin state reduces the outflow of migrants from the origin to the destination state by 2.93 percent. For the average origin-destination pair, this effect decreases the mean rate of out-migration from 0.595 to 0.578 for every 1,000 initial residents—this result represents a

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<sup>10</sup> Sasser (2010) uses a logistic model of out-migration to analyze data from the IRS from 1977 through 2006. She finds that labor market conditions, per capita incomes, and housing affordability are all significant determinants of migration but that their relative importance has changed over time. For example, since the late 1970s the importance of housing costs as a determining factor in state-to-state migration has risen considerably as the variation in house prices across the country has increased. In contrast, labor market conditions were significant throughout the 30-year period, but more so during the recession in the early 1990s.

reduction of 85 migrants each year. Summed over all possible destination states, this would decrease the outflow from the average origin state by roughly 4,000 residents.

Yet the reduced mobility across states due to negative housing equity is small relative to the annual number of migrants in the United States. When aggregated across all possible origins and destinations, this effect reduces the national state-to-state migration rate by 0.05 percentage points, which translates into roughly 110,000 to 150,000 fewer individuals migrating across state lines in any given year. This is the proverbial drop in the bucket compared to the annual number of migrants typically observed—roughly 5.6 million in 2008–2009.

As a result, the reduction in state-to-state migration due to negative equity has had a negligible impact on the national unemployment rate. Assuming that all migrants who were constrained from relocating due to negative equity were job-seekers who were previously unemployed before moving and who subsequently found a job in their new state would reduce the nation's unemployment rate by at most 0.10 percentage points annually between 2006 and 2009. The cumulative effect over this period would yield an unemployment rate of 9.0 percent versus 9.3 percent in 2009. Recognizing that not all interstate migrants are job-seekers, not all job-seekers were previously unemployed, and not all previously unemployed job-seekers will successfully find a job in their new state yields a national unemployment rate that is virtually unchanged from the actual one that prevailed in each year. Given that current housing and labor market conditions were largely the same during 2011 as they were during 2009, we expect that our results will continue to be relevant for ongoing policy discussions aimed at reducing the nation's high rate of unemployment.

## **II. The Role of Negative Equity in Migration Decisions and Implications for the Labor Market**

Theoretical predictions about the effect of negative equity on mobility are ambiguous. On the one hand, people with negative equity may be liquidity constrained and unable to move unless they default on the loan, which they may prefer to avoid for a variety of reasons. Previous studies have shown that even a household without any financial constraints can become less mobile if nominal loss aversion leads the household not to sell the home after its price has fallen (Genesove and Mayer 1997, 2001; Engelhardt 2003). Further, owning a house with negative equity is like taking a highly leveraged position in the real estate market—the owner may want to continue holding onto the house in hopes of regaining its value if the house appreciates in the future.<sup>11</sup> In addition, downpayment requirements for mortgages may also prevent liquidity-constrained negative-equity homeowners from buying comparable houses in other locations if they cannot use the equity from the sale of their current home to purchase a new one. Finally, homeowners may not be willing to bear the additional costs associated with default, which could result in a damaged credit rating or losing their other assets in court.<sup>12</sup>

On the other hand, while many households may want to avoid defaulting on their mortgage, at increasingly higher rates of negative equity, the costs of default might appear more reasonable as there is a lower likelihood that prices will rise enough to cover the debt (Guiso, Sapienza, and Zingales 2011). This is especially true for households that have also suffered an income shock (due to job loss, adverse medical events, death, or divorce), resulting in the so-

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<sup>11</sup> Note that even if it is optimal to hold the house as an investment, the owners can still move if they find tenants to rent the property. However, there are transaction costs associated with being a landlord and these costs are likely to increase with distance if homeowners move across state lines.

<sup>12</sup> Vantage Score Solutions, a credit scoring firm, reports that there is a 20 percent drop in credit score due to mortgage delinquency and foreclosure without any other simultaneous delinquencies on other lines of credit (Bhutta, Dokko, and Shan 2010). In addition, most states have “recourse” laws that allow lenders to sue for a deficiency judgment against borrowers to seize other assets from the borrower if the foreclosure sale does not cover the remaining mortgage balance and the lender’s foreclosure costs.

called double-trigger effect (Foote, Gerardi, and Willen 2008). Yet even without any adverse event taking place, there does appear to be a certain threshold at which people are willing to walk away from their homes, even if they can afford their monthly mortgage payment—a tactic known as “strategic default.” Studies estimating the strategic default threshold indicate that the median borrower is likely to walk away from the home at a loan-to-value (LTV) ratio of roughly 120 to 160 percent (Bajari, Chu, and Park 2008; Bhutta, Dokko, and Shan 2010).<sup>13</sup> Strategic default is even more likely if the loan is made in a nonrecourse state where the lender cannot recoup their losses by seizing any of the borrower’s other assets (Ghent and Kudlyak 2010).

Clearly, the degree of negative equity is an important factor in determining the impact of the nation’s housing market downturn on state-to-state migration and may in fact be nonlinear in nature. At low levels of negative equity, homeowners may be liquidity constrained and unwilling to incur the costs of defaulting on their loans, thereby decreasing mobility. Yet at high rates of negative equity, mobility might increase as more homes fall into foreclosure and owners and tenants alike are forced to relocate—at least once they get through the foreclosure process. Thus it is largely an empirical question whether negative equity reduces geographic mobility and to what degree it might impact state-to-state migration.

Finally, what are the potential implications of house lock for the labor market? It is important to recognize that although state-to-state migration is generally associated with moving to a new labor market, not all households moving across state lines do so for job-related reasons—even during recessions. That said, basic tabulations from the Current Population

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<sup>13</sup> While the exact number of strategic defaults is difficult to determine, several studies have shown that they have been rising and account for a significant share of foreclosures. As of September 2009, strategic defaults accounted for 35 percent of defaults, up from 26 percent in March (Guiso, Sapienza, and Zingales 2011). In addition, a survey conducted in Nevada found that 23 percent of the state’s homeowners who went into foreclosure admitted to strategically defaulting (see Nevada Association of Realtors. 2011. “NVAR releases “Face of Foreclosure” report, showing 23 percent of Nevadans who lost homes walked away.” Press Release, January 26).

Survey (CPS) indicate that the reasons why people migrate may have shifted during the Great Recession—with some interesting differences between homeowners and renters (see table 1).<sup>14</sup> During the boom period (2003–2006) relocating for job-related reasons was the most common reason for moving among both owners and renters (roughly 40 percent), followed by family-related reasons and then housing related-reasons. Yet within these broad categories, significant differences in reasons for moving existed between homeowners and renters both before and after the recession that largely reflect differences in demographic characteristics between the two groups—with a few notable exceptions. For example, during the Great Recession and subsequent recovery (2007–2010), homeowners were significantly less likely than renters to move because they “wanted a new or better house/apartment” but were more likely to relocate for “other” reasons (a category which includes foreclosure)—possibly indicating the disparate impact of the housing market downturn on owner mobility. In addition, homeowners were significantly less likely than renters to move for a “new job or transfer” between 2007 and 2010 (28.1 percent compared to 37.6 percent) but no such differences were observed during the earlier period (2003–2006)—possibly indicating that house lock had a separate impact on labor market mobility during the Great Recession and the weak recovery.

As such, accounting for movements in relative economic conditions between origin and destination states will be key in order to accurately estimate the separate effect of negative housing equity on state-to-state migration. Previous research has demonstrated that labor market conditions, per capita incomes, and house prices are significant determinants of migration and

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<sup>14</sup> In 1997, the CPS began asking people who had moved in the past year their primary reason for moving. Note that individuals could list only one reason while it may well be the case that their migration decision was based on several different factors. In addition, tenure status (homeowner versus renter) is determined at the time of the survey in the destination state, not retrospectively as of a year ago in the origin state. Thus, some fraction of homeowners used to be renters and vice versa. Ideally one would want to know if you were a homeowner last year before you moved in order to understand whether house lock was a constraint. The *State of the Nation's Housing 2011* report by the Joint Center for Housing Studies shows that over this time period, about 70 percent of movers do not change tenure and are therefore identified correctly by using the tenure at destination.

that the magnitude of their separate impacts has varied and changed considerably over time (Sasser 2010).<sup>15</sup> The Great Recession led to rapid declines in all three of these factors as well as a corresponding drop in migration activity as workers who might otherwise have moved now have fewer opportunities and less means to do so (Frey 2009). Controlling for other factors that typically affect state-to-state migration—particularly the relative availability of job opportunities in destination states—will be important to accurately measure the impact of house lock on mobility.

### **III. Measuring Negative Equity and State-to-State Migration Trends**

A key limitation of previous work on this topic has been the ability to match recent trends in negative equity with accurate data on state-to-state migration. Ideally, one would want a longitudinal dataset that is able to track the migration of U.S. households over some reasonable and representative time period and also includes information on current mortgage debt outstanding and current home values to determine whether a given household is underwater. Unfortunately, no such dataset exists. Longitudinal datasets such as the Survey of Income and Program Participation (SIPP) and the Panel Survey of Income Dynamics (PSID) that track individual migration over time do not contain information on mortgage debt and home values—only homeownership status. Other longitudinal datasets such as the American Housing Survey (AHS) is a house-based rather than a household-based panel, such that there is no information about where the former owners of a given house might have moved to.

Even using cross-sectional data has proved challenging as the time-series of the most commonly used data on negative equity and migration do not overlap for more than a few quarters. Negative equity, a rare phenomenon until the recent nationwide housing bust, was

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<sup>15</sup> For example, the importance of housing costs as a determining factor in state-to-state migration has risen considerably since the late 1970s as the variation in house prices across the country has increased.

previously measured only for particular regions of the country experiencing a housing downturn. As such, there is a dearth of historical data on the share of households experiencing negative equity at the state level. Indeed, CoreLogic’s estimates of the share of all mortgaged households with negative equity—one of the most popular measures cited in the press—is only available beginning in 2009:Q3—missing several years of house price declines during which the share of nonprime households with negative equity was rising at a rapid rate and varied considerably across states (see figure 1). Moreover, the most recent year for which data on state-to-state migration is currently available from either the Internal Revenue Service (IRS) or the American Community Survey (ACS) does not allow one to accurately match the timing of the CoreLogic measure with that of mobility but for only a few quarters.

To address this timing issue, we use two proxies to capture the variance in negative equity across states and over time—the share of *nonprime* households experiencing negative equity and the change in house prices from 2006:Q1 through 2009:Q4. The nonprime negative equity share is calculated by the Government Accountability Office (GAO) based on their analysis of CoreLogic’s active nonprime mortgage data and state-level house price index available quarterly from 2006:Q1 to 2009:Q4 (GAO 2010).<sup>16</sup> The change in house prices is captured by quarterly data on the nominal house price index reported by the Federal Housing Finance Agency (formerly the Office of Federal Housing Enterprise Oversight) in the U.S. Department of Housing and Urban Development.

Although neither of the measures we use in our analysis is ideal, both reflect changes in state-level housing market conditions during the residential real estate crash that are correlated to some degree with the prevalence of negative equity in a given state. For example, the share of nonprime households with negative equity calculated by the GAO is not perfectly correlated with

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<sup>16</sup> See the data appendix for more information on how this variable and others used in the analysis were constructed.

the situation of all mortgaged households in the state—nor all homeowners in the state.<sup>17</sup> It might be the case that a large fraction of nonprime households are underwater but that nonprime households make up only a small share of all mortgaged households within the state so that the overall impact is quite small.<sup>18</sup> We address this shortcoming by using the share of nonprime mortgages outstanding in a given state to weight the share of nonprime mortgages that are underwater. But we still do not have information on the *degree* to which these homeowners might be underwater—a factor that has been shown to be important when households are deciding whether or not to walk away from the home.<sup>19</sup> Finally, there is some degree of measurement error associated with any calculation of the share of households experiencing negative equity, although the direction of the bias is still under debate.<sup>20</sup>

Similarly, the change in house prices is not perfectly correlated with negative equity—just because prices have decreased sharply in a given state does not mean that a large share of households are underwater. The degree of negative equity among a state’s homeowners would

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<sup>17</sup> According to American FactFinder, 66 percent of housing units were owner-occupied and 68 percent of owner-occupied units had mortgages in 2009. Thus, even estimates of negative equity among all mortgaged households would imply that only 15 percent of owner-occupied homes have negative equity and about 10 percent of housing units are occupied by owners with negative equity.

<sup>18</sup> The GAO report from which we obtain our measure of negative equity states that "the CoreLogic Index that we used represents price trends at the state level. Depending on the degree to which homes financed with nonprime loans were concentrated in areas with house price trends that differed from statewide trends, our estimates could overstate or understate the number of nonprime borrowers with negative equity."

<sup>19</sup> In terms of strategic default, there seems to be little difference between homes with a little bit of positive equity and ones with a little bit of negative equity. For one thing, homeowners may not know which category they are in. Also, there is little benefit to strategic default when equity is near zero. As of 2009:Q4, CoreLogic estimated that among homeowners with a mortgage, roughly 4 percent owed between 100 percent and 105 percent, 3 percent owed between 105 percent and 110 percent, 6 percent owed between 110 percent and 125 percent, and 10 percent owed more than 125 percent (see CoreLogic. 2010. "Underwater Mortgages On the Rise According to First American CoreLogic Q4 2009 Negative Equity Data." Press Release, February 23).

<sup>20</sup> For example, Core Logic uses house price valuations which have a margin of error of roughly 10 percent of the sales price for about 55 percent to 75 percent of homes, depending on the region. Yet even by CoreLogic’s own measure, there are more homeowners who are slightly above water on their mortgages than those who are slightly underwater. So if home valuations are flawed, there is a greater chance that homes are incorrectly categorized as having slightly negative versus slightly positive equity (see Bialik, Carl. 2011. "Housing Statistics Hit Rough Waters." *The Wall Street Journal*, January 8). That said, the standard approach to computing negative equity does not incorporate the transaction costs of selling the property which can be 6 to 8 percent of the price of the home. These costs are typically paid out of the sale proceeds and the seller is left with the remaining equity. Thus, taking these costs into consideration would increase the number of homeowners who are categorized as having negative equity (see Humphries, Stan. 2011. "Debating Negative Equity." Zillow Real Estate Research Blog, January 24).

also depend on how much they still owe on their houses—if they owe anything at all. For example, homeowners who bought at the height of the housing market in 2006 are likely to have higher mortgage balances than those who bought their homes in earlier periods. In fact, there is good reason to believe that the change in house prices and the share of underwater mortgages might not move perfectly in tandem. Clearly, the number of households entering into negative equity territory typically rises as home prices fall. However, as more homes fall into foreclosure—either due to income shocks related to job loss or due to strategic default—the number of households with negative equity can decrease.<sup>21</sup>

#### *Recent Trends in Negative Equity and Migration*

Despite these drawbacks, our two proxy measures can at least be used in tandem to explore the period before the official start of the Great Recession during which housing prices had already started to fall in some parts of the country. For example, the share of nonprime households with a negative equity position was rising throughout 2006 even before nationwide house prices started to decline in 2007 (see figure 1). By 2008:Q3, the nonprime negative equity share had leveled off to about 36 percent. While the GAO’s nonprime measure captures the period during which the nation experienced the steepest reduction in house prices through 2008, prices have continued to fall since then. In comparison, the CoreLogic measure, which begins in 2009:Q3, indicates that the incidence of negative equity among *all* mortgaged households (roughly 23 percent) is lower than that among nonprime households—yet a high degree of negative equity appears to have persisted through 2011 even among the broader group. A more rigorous comparison of the GAO and CoreLogic measures confirm that the ranking of individual

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<sup>21</sup> For example, according to CoreLogic, Nevada experienced a large decline in the share of households with negative equity during 2010 year, with the negative equity share dropping from 68 percent to 60 percent. The reason for the Nevada decline is the high number of foreclosures that led to lower numbers of remaining negative equity borrowers (see CoreLogic. 2011. “New CoreLogic Data Reveals Q2 Negative Equity Declines in Hardest Hit Markets and 8 Million Negative Equity Borrowers Have Above Market Rates.” Press Release, September 13).

states is similar using either measure, although the GAO data exhibit greater variance across states.

Upon closer examination, the share of nonprime households experiencing negative equity varies widely across states and appears to be highly correlated with house price depreciation (see table 2). As of 2009, only 11 states had less than 5 percent of nonprime households underwater on their mortgages—these states were largely those that were immune to the house price boom and bust. Not surprisingly, states that experienced extreme price changes during the boom and bust—such as Arizona, California, Florida, and Nevada—had more than 50 percent of nonprime homeowners underwater. Between 2006 and 2008, states that experienced the greatest *increase* in the share of underwater mortgages also experienced the greatest drop in house prices (see figure 2).

At the same time, there have been important changes to the long-term trend in interstate migration during this period. According to state-to-state migration flows reported by the IRS, about 3 percent of the U.S. population moved across state lines each year during the late 1970s—a long enough distance to make a meaningful difference in their housing and labor market environment (see figure 3).<sup>22</sup> Yet there has been a steady downward trend in interstate migration rates over the past 25 years, the reasons for which are not entirely clear. Contrary to popular belief, the decline in state-to-state migration does not appear to be driven by any demographic or

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<sup>22</sup> The IRS provides annual data on the number of migrants moving from one state to another for the period 1975–1976 to 2008–2009. These migration flows are based on tax return data, and are calculated by comparing the addresses of households filing tax returns from April of year  $t$  to April of year  $t+1$ . The number of exemptions claimed on the tax returns is used as a proxy for the number of individuals migrating between states. Several limitations of the IRS data should be noted. First, a household must file a tax return for two consecutive years for the IRS to record migration data. Second, the IRS data do not always capture the movements of certain populations. For example, because the IRS only tracks federal tax filers, the data are likely to underestimate the migration of very low-income households, and of those that do not report their income to the IRS. Similarly, because the data are assembled as of the April filing date, they also underestimate the migration of very high-income households who often file exemptions at that time. Finally, because the estimates are based on the number of exemptions claimed by a given household, individuals that do not reside in one particular household for the whole year (such as college students) are often not counted as migrants even if they have changed residences.

socioeconomic trends. As noted by Molloy, Smith, and Wozniak (2011), migration rates have fallen for nearly every subpopulation and shifts in the composition of the population are too small to account for the downward trend in migration rates.<sup>23</sup>

This long-term secular decline in state-to-state migration reversed during the economic boom prior to the Great Recession, then fell afterwards. Although one would expect migration to decline in response to deteriorating economic conditions, mobility began to fall in 2006—well before the official start of the recession. A look back at figure 2 shows that this timing corresponds rather closely to the rise in the share of nonprime households experiencing negative equity—suggesting that the downturn in the housing market may have played a role in the sharp drop in state-to-state moves.

How do trends in migration and negative equity match up across states? Comparing the GAO’s measure of the share of nonprime homeowners with negative equity to the out-migration rate, the two series appear to be negatively correlated (see figure 4). States with large or moderate increases in the share of households with negative equity experienced large drops in out-migration. This certainly seems to be the case for states that experienced significant increases in the share of households with negative equity—California and Nevada. But even for more moderate increases—like those seen in Massachusetts—there appears to be a negative correlation, with out-migration dropping as the share with negative equity rises. However, in Iowa, where the share with negative equity has held relatively steady at under 5 percent, there was little change in out-migration. Similarly, the nominal change in the Federal Housing

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<sup>23</sup> For example, the aging of the U.S. population might be expected to reduce aggregate migration since the propensity to move decreases with age. However, Molloy, Smith, and Wozniak (2011) note that the fraction of the population aged 45–64 years increased by only 5 percentage points between 1981 and 2010. Based on the average differential in migration rates between this group and younger groups, such a shift would only be expected to reduce inter-state migration by a tenth of a percentage point – less than one tenth of the decrease that has occurred. Thus the authors rule out these compositional factors and focus on economic factors that might have changed the cost or benefit of moving.

Finance Agency (FHFA) house price index appears to be positively related to the out-migration rate—a finding consistent with a story of negative equity. The timing appears to be quite close with out-migration increasing as house prices increase and falling when house prices fall (see figure 5).

We observe a similar relationship in the aggregate when we look across the experiences of all states. Between 2006 and 2008, states with larger increases in the share of households with negative equity also saw greater reductions in their out-migration rates (see top panel of figure 6). Similarly, migration rates fell more in states with greater declines in nominal house prices between 2006 and 2008 (see bottom panel of figure 6).

Finally, one would expect that if negative equity were to have an impact on migration that it would operate primarily by constraining the mobility of homeowners relative to renters. Looking at migration rates and flows from the American Community Survey (ACS) reveals some interesting differences based on tenure.<sup>24</sup> Between 2006 and 2008, the migration rates of both renters and owners fell by a similar magnitude in terms of percentage points (see top panel of figure 7). Yet because the migration rate of homeowners is roughly one-fifth that of renters, a similar percentage point decline in the migration *rate* represents a greater percentage decrease in the *number* of households moving across state lines for homeowners versus renters. As a result, the number of migrant households headed by a homeowner fell by more than 10 percent each year between 2006 and 2008 while those headed by a renter fell by less than 5 percent each year during this period.<sup>25</sup>

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<sup>24</sup> Note that tenure status in the ACS is identified only after the move, leading to potentially biased estimates of migration depending on the degree to which migrants change tenure from owner to renter and vice versa. However, other studies have shown that such transitions are infrequent and that renter-to-owner transitions occur twice as often (20 percent) as owner to renter transitions (10 percent) suggesting that the magnitude of this bias is quite low (Joint Center for Housing Studies 2011).

<sup>25</sup> Note that in 2009 there was a small increase in the number of homeowner households that migrated that was entirely driven by those headed by an individual over 50 years old.

However, there are clearly a lot of other factors at play during this period. We know that migration is procyclical, so fewer people would be expected to move during the Great Recession. Part of the slowdown in migration is likely attributed to the sheer scope of the unemployment problem that has left few areas in the United States untouched. On the one hand, the recession is so broad-based that there are not a lot of job-related opportunities for which to move. However, some states have survived the downturn better than others, thanks to a strong local economy and the absence of a severe housing boom and bust. In the next section, we describe a model that will allow us to control for the relative economic conditions in the origin and destination states to make sure we are not overestimating the impact that negative equity has on declining out-migration trends.

#### **IV. Modeling the Determinants of Migration: A Logistic Regression Framework**

What economic factors might be expected to affect the migration decisions of individuals moving across state lines? Economic theory suggests that individuals will choose to migrate to places where they can maximize their utility. However, an individual's utility can encompass any number of variables including both noneconomic factors, such as the amenities of a given location and the nearness of family, and economic factors, such as the availability of jobs and the cost of living. When studying migration decisions, economists typically focus on the impact of economic factors such as relative labor market conditions, incomes, and cost of living, while trying to control for noneconomic factors (Greenwood 1985).

One way to determine the impact of negative equity on migration is to use a general model of state-to-state migration flows that controls for relative economic conditions in the origin versus the destination state, demographic characteristics of the origin state that affect the

propensity to move, as well as state-specific amenities that attract migrants. Using this approach, we explore three primary questions:

- **Does negative equity reduce state-to-state migration?** Do states with a greater share of households with negative equity have lower out-migration rates? Do states experiencing greater house price depreciation have lower out-migration rates?
- **What is the relative importance of negative equity versus other economic factors in reducing mobility?** Is negative equity as important as job opportunities, per capita incomes, or cost-of-living factors?
- **How much of an impact does the housing market have on the job market?** If negative equity does restrict state-to-state mobility, how many workers are affected? How much of an impact does negative equity have on the nation's rate of unemployment? On the unemployment rate of individual states or particular demographic groups?

Following the literature, the basic model is a logistic specification, where individuals are assumed to choose the location yielding the highest expected net discounted return on migration from among a finite number of destinations (Gabriel, Shack-Marquez, and Wascher 1992; Gabriel, Matthey, and Wascher 1995; Davies, Greenwood, and Li 2001). The probability that individuals will migrate from state  $i$  to state  $j$  in year  $t$  is then:

$$(1) \quad \Pi_{ijt} = \exp(Z_{ijt}) / [\sum_k \exp(Z_{ikt})] \quad i, j = 1, \dots, 48; \quad t = 1, \dots, \tau,$$

where the  $Z$  variables are indices of the expected return to moving to different places. A common normalization factor,  $\sum_k \exp(Z_{ikt})$ , constrains the individual probabilities to sum to one.

The likelihood that individuals will migrate from state  $i$  to state  $j$  in year  $t$  versus remain in state  $i$  is then given by the ratio  $\Pi_{ijt} / \Pi_{iit}$ . Taking the logarithm yields the following estimation equation:

$$(2) \quad \ln (\Pi_{ijt} / \Pi_{iit}) = Z_{ijt} - Z_{iit} \quad i, j = 1, \dots, 48; \quad i \neq j; \quad \text{and} \quad t = 1, \dots, \tau.$$

Note that the logistic specification assumes that individuals choose to migrate by comparing each potential destination state to the origin state in a pair-wise fashion.<sup>26</sup> This means that economic conditions in states other than a given origin and destination pair have no effect on the choice to migrate. While this assumption may be reasonable for many first-time migration decisions, it may not hold for repeat migrants.<sup>27</sup>

The model has several distinct features that are worth noting. First, it examines gross migration patterns—both inflows and outflows of people from each state—rather than trying to explain only net flows. State-to-state migration rates are calculated from the IRS data as the number of individuals moving from state  $i$  to state  $j$  in year  $t$ , as a percentage of the total number of people initially residing in the origin state  $i$  in that year. For each year of the analysis, the result is a 48x48 contingency table, for which the off-diagonal elements represent estimated place-to-place migration probabilities for every state combination. The dependent variable,  $Y_{ijt}$ , is the logarithm of the ratio of the migration rate to the rate at which individuals remain in the origin state.

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<sup>26</sup> In terms of economic theory, this assumption implies that individual choices satisfy the Independence of Irrelevant Alternatives (IIA) condition. Other studies that conducted limited tests of this condition found that they cannot reject its validity (Davies, Greenwood, and Li 2001).

<sup>27</sup> Studies find that individuals moving for the second time are more likely to return to their initial origin state than to move to other states, all else being equal (Lee 1974; Long and Hansen 1975; Vanderkamp 1971).

Second, the model controls for relative economic conditions in the origin versus the destination state as measured by labor market conditions, per capita incomes, and housing affordability.<sup>28</sup> For example, deteriorating labor market conditions in the origin relative to other states are likely to lead to greater out-migration, as individuals move to seek jobs elsewhere. Higher relative incomes would have the opposite effect, as individuals are likely to remain in their home state and reap the greater economic benefits of their labor. Similarly, a more favorable cost of living, such as greater housing affordability, would also serve to lower out-migration from the origin, as individuals can get more “bang for their buck.”<sup>29</sup>

Finally, the model controls for different propensities to migrate among origin populations as well as unobservable amenities unique to individual states that do not change over time—such as climate, culture, and recreational features. To control for these different propensities to migrate across states, the model includes a vector of variables ( $T_{it}$ ) measuring the distribution of the population’s age, education, race, ethnicity, marital, and family status.<sup>30</sup> To account for time-invariant local amenities, the model includes a fixed effect for each state as both an origin ( $A_i^o$ ) and a destination ( $A_j^d$ ) in the vector of state characteristics.<sup>31</sup>

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<sup>28</sup> Note that all economic variables are measured from April of year  $t$  through March of year  $t+1$ , to match the timing of the IRS data on migration flows.

<sup>29</sup> Our previous research finds that while all three measures of relative economic conditions are significant determinants of migration, the magnitude of their impact varies and has changed considerably over time (Sasser 2010). For example, the importance of per capita income as a determining factor has fallen considerably since the late 1970s, while that of housing affordability has risen. Interestingly, the role of labor market conditions—while significant throughout the entire 30-year period—was most prominent during the recession of the early 1990s.

<sup>30</sup> Empirical studies have shown that younger individuals in their 20s and more educated individuals with a four-year college degree are more likely to migrate (Greenwood 1985; Rosenbloom and Sundstrom 2003). The former are often in the process of forming households, while the latter are often seeking better career opportunities. Mobility typically declines as individuals start families, establish careers, and form social ties in a given location. Migration also varies by race and ethnicity, with African-American and foreign-born U.S. resident populations having lower propensities to migrate than whites (Perry and Schachter 2003; Rosenbloom and Sundstrom 2003).

<sup>31</sup> Explicitly measuring such amenities with observable variables is difficult at best, and further complicated by the fact that local amenities are also capitalized to some extent in house prices and wage rates (Roback 1982; Greenwood and Hunt 1989; Mueser and Graves 1995). Such an approach is likely to bias the estimates because of variables that are inadvertently omitted from the regression equation. The fixed effects approach addresses this bias

Taking all these factors into consideration,  $Z$ , the final specification of the index variable of expected returns to moving, is a linear combination of the relevant demographic, economic, and location-specific amenities:

$$= \Phi_1 X_{it} + \varphi X_{jt} + \gamma T_{it} + \delta D_{ij} \quad \text{if } i \neq j \text{ (moving)}$$

(3)  $Z_{ijt}$

$$= \Phi_2 X_{it} + \varphi X_{jt} - \gamma T_{it} \quad \text{if } i = j \text{ (staying)}.$$

For  $i, j = 1, \dots, 48$  and  $t = 1, \dots, \tau$  and where:

$$\Phi_1 X_{st} = A_s^o + \beta_1 \text{NEQ}_{st} + \beta_2 \text{UI}_{st} + \beta_3 \text{PCI}_{st} + \beta_4 \text{HAI}_{st} \quad \text{for } s \text{ indexing origins (i)}$$

$$\Phi_2 X_{st} = A_s^d + \beta_2 \text{UI}_{st} + \beta_3 \text{PCI}_{st} + \beta_4 \text{HAI}_{st} \quad \text{for } s \text{ indexing destinations (j)}.$$

In the above equations,  $\text{NEQ}$  = a measure of negative equity in the origin state<sup>32</sup>,  $\text{UI}$  = state UI claims rate<sup>33</sup>,  $\text{PCI}$  = state real per capita income<sup>34</sup>, and  $\text{HAI}$  = state housing affordability index.<sup>35</sup>

The model also includes a variable to measure the transaction costs of moving between states  $i$

but does not control for amenities that may change over time. For example, the level of crime in one state relative to another may change over time, affecting an individual's decision to migrate.

<sup>32</sup> Measured as either the share of nonprime households with negative equity as calculated by the GAO or as the change in house prices as captured by the FHFA nominal house price index.

<sup>33</sup> The UI claims rate is calculated as the number of unemployment insurance claimants relative to the total number of workers covered by such insurance, based on data from the Bureau of Economic Analysis in the U.S. Department of Commerce.

<sup>34</sup> Annual per capita income is calculated based on quarterly data reported by the Bureau of Economic Analysis.

<sup>35</sup> Housing affordability is measured as the ratio of median household income to the income needed to purchase the median-priced house—with the latter taking into account movements in both house prices and interest rates. A higher ratio indicates greater affordability. Median household income is calculated from the U.S. Census Bureau's Current Population Survey. The income needed to purchase the median-priced house is calculated as the annual income needed to cover principal and interest payments on a 30-year fixed-rate mortgage with a 20 percent downpayment. Median house prices are constructed based on the house price index reported by the Federal Housing Finance Agency (formerly OFHEO). See Sasser, Zhao, and Rollins 2006 for more details on the components of this ratio.

and  $j$  ( $D_{ij}$ ), which are proxied by the distance between the most populous cities in the two states.<sup>36</sup> Thus, the state-to-state migration model that is estimated is:

$$(4) \quad \ln (\Pi_{ijt} / \Pi_{iit}) = Z_{ijt} - Z_{iit} \quad \text{or}$$

$$(5) \quad \ln (\Pi_{ijt} / \Pi_{iit}) = \Phi(X_{it} - X_{jt}) + 2\gamma T_{it} + \delta D_{ij}.$$

And the reduced-form equation is:

$$(6) \quad Y_{ijt} = \alpha + \beta_1 \text{NEQ}_{st} + \beta_2 (UI_{it} - UI_{jt}) + \beta_3 (\text{PCI}_{it} - \text{PCI}_{jt}) + \beta_4 (\text{HAI}_{it} - \text{HAI}_{jt}) \\ + 2\gamma T_{it} + \delta D_{ij} + \sum_s A_s^o F_{js} - \sum_s A_s^d F_{is} + \varepsilon_{ijt},$$

where the index of states ( $s$ ) in the sum over the state-level dummy variables ( $F$ ) runs from the first to the 48th destination. The error term,  $\varepsilon$ , captures the usual measurement and specification error.

## V. Measuring the Impact of Negative Equity on Migration: Regression Results

The results from the logistic regression model are generally consistent with a priori expectations and the descriptive trends discussed earlier. We report coefficients and standard errors for five different specifications for the period 2006 through 2008. The dependent variable is the logarithm of the out-migration rate between each origin and destination state-pair.<sup>37</sup> The independent variables of interest are the share of nonprime households with negative equity and

<sup>36</sup> The distance variable is a proxy for overall transaction costs, whether financial or psychic, and assumes that both increase with the distance between the origin and destination state.

<sup>37</sup> The out-migration rate for a given origin-destination state pair is calculated as the number of exemptions relocating from the origin to the destination state, relative to the initial number of exemptions (moving and nonmoving) residing in the origin state that year. We use the logarithm of the out-migration rate as the dependent variable for expositional purposes only. We find nearly identical results when we use the dependent variable derived in the model equal to the logarithm of the ratio of the migration rate to the rate at which individuals remain in the origin state. Similar results are also obtained when calculating the migration rate based on the number of returns, which represents households, rather than using the number of exemptions.

the rate of house price depreciation. We also include demographic controls as well as relative economic conditions in the origin state and the destination state.<sup>38</sup> All specifications include state and year fixed effects to control for state-specific amenities and general trends over time affecting all states.<sup>39</sup> Standard errors are clustered by origin-destination pairs, as the estimates are based on repeated observations of state-to-state migration over time, thereby reducing the amount of variation across individual observations.

### *Measuring the Impact of the Share of Nonprime Households with Negative Equity*

Using the share of underwater nonprime households, our results indicate that negative equity has a small but significant impact on state-to-state migration, even when controlling for relative economic conditions and demographic conditions (see table 3, columns 1–3). As expected, economic conditions are highly significant determinants of migration.<sup>40</sup> For example, when relative labor market conditions are worse in the origin state relative to the destination state (for example, when the unemployment insurance claims rate is higher), the out-migration rate is higher. The opposite is true when relative per capita incomes and housing affordability are better in the origin state relative to the destination state.<sup>41</sup> While accounting for relative economic conditions enhances the impact of negative equity on the out-migration rate, the inclusion of demographic characteristics reduces both the magnitude and significance of the coefficient

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<sup>38</sup> See Appendix Table A1 for summary means and standard deviation of the dependent and independent variables used in the analysis.

<sup>39</sup> State fixed effects are represented by a separate fixed effect for each origin and destination state. A specification including a fixed effect for each individual pair of states (48x48=2,256 pairs) yielded nearly identical results.

<sup>40</sup> Economic conditions are lagged one year to mitigate the endogeneity problems associated with the effect of migrants on labor market conditions, per capita incomes, and housing affordability. While an exogenous increase in the outflow of migrants may depress house prices in some areas, thereby affecting affordability, it is unlikely to have a large and immediate impact on the share of underwater households unless a state-wide housing bust is triggered. Given that most migrants are renters and the flow of migrants is relatively small compared to the origin population, this seems unlikely.

<sup>41</sup> Using alternative measures of labor market conditions (such as unemployment rates and employment growth) and of housing affordability (such as the OFHEO house price index) yields similar results.

slightly. Note that weighting the dependent variable by the share of outstanding mortgages that are nonprime does little to affect the results.

As discussed earlier, the impact of negative equity on migration is likely to be nonlinear. As households increasingly approach higher and higher rates of negative equity, the costs of default might appear more reasonable as there is a lower likelihood that prices will rise enough to cover the debt. As such, individuals might be more willing to walk away from their homes and thereby be free to move to another state. Although we cannot measure the degree to which individuals are underwater, we find some evidence of this phenomenon as measured by the stock of foreclosures in the origin state in the prior year. Higher rates of foreclosure in the origin state are associated with an *increase* in the out-migration rate, all else equal (see table 3, column 4). Moreover, including this variable in the regression serves to magnify the impact of negative equity on migration. This suggests that the impact of negative equity on migration operates primarily at low and moderate levels rather than at extremely high levels of negative equity, which would result in higher foreclosure rates.

We would also expect that as a higher share of households in a given origin state are underwater on their mortgages, the larger the impact will be on the out-migration rate from that state. The last column of table 3 demonstrates that indeed this is the case. States in the top third of the negative equity distribution have a significantly lower out-migration rate, all else equal.<sup>42</sup> Living in a high share state reduces the out-migration rate by an additional 1.71 percent compared to a low share state (see table 3, column 5).

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<sup>42</sup> The middle third of the negative equity distribution corresponds to having a share of households with negative equity that is greater than 5.6 percent and less than or equal to 21.0 percent. The top third of the negative equity distribution corresponds to having a share of households with negative equity that is greater than 21.0 percent.

To better measure the relative impact of negative equity versus other economic factors, the variables included in the regression have been standardized to have a mean of zero and a standard deviation of one. This allows us to interpret the coefficients from regression equation (3) as the effect of a one-standard-deviation change in relative economic conditions on migration. Thus, a one-standard deviation increase in the share of underwater nonprime households in the origin state—an increase of roughly 18 percentage points—reduces the outflow of migrants from the origin to the destination state by 2.93 percent (see table 3, column 4).<sup>43</sup> While measurable, this effect is small relative to that of the economic conditions included in the model. For example, a one-standard deviation deterioration in the UI claims rate in the origin versus the destination state—similar to that which occurs during a typical recession—increases the outflow of migrants from the origin to the destination state by 3.77 percent. Relative changes in per capita incomes and housing affordability have even greater impacts on state-to-state migration.

In terms of the number of migrants, the average impact of negative equity on state mobility is also quite small. For the average origin-destination pair, a one-standard deviation increase in the share of underwater nonprime households would decrease the mean rate of out-migration from 0.595 to 0.578 for every 1,000 initial residents—or a reduction of 85 migrants each year.<sup>44</sup> Summed over all possible destination states, this would decrease the outflow from the average origin state by roughly 4,000 residents.<sup>45</sup>

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<sup>43</sup> For example, this one standard deviation change is equivalent to that of Illinois, where the share of nonprime households with negative equity increased from 15.4 percent in 2006 to 33.9 percent in 2008.

<sup>44</sup> See Appendix Table A2 for a comparison of the impact of a one-standard-deviation increase in each economic factor.

<sup>45</sup> Note that in our model there are 47 potential destinations for a given state as our data exclude Alaska, the District of Columbia and Hawaii.

### *Measuring the Impact of House Price Depreciation*

Using annual house price appreciation yields similar results to those described the preceding section. Using a dummy variable indicating whether the change in house prices from the previous year was negative, we find that falling house prices have a small but significant impact on state-to-state migration, even when controlling for relative economic conditions and demographics. When house prices fall, the out-migration rate is reduced by 0.63 percent (see table 4, column 4). As with our earlier analysis, the degree to which prices fall is also correlated with out-migration. States in the middle and top third of the depreciation distribution have a significantly lower out-migration rate, all else equal.<sup>46</sup> Living in a moderate or high depreciation state reduces the out-migration rate by roughly an additional 1 percent compared to a low depreciation state (see table 4, column 5).

## **VI. Quantifying the Impact of Negative Equity on the Labor Market**

In the previous section we demonstrated that negative equity does indeed reduce state-to-state migration and that the magnitude of the impact is small but somewhat on par with that of other economic factors such as labor market conditions. How much of an impact does this reduced mobility have on the U.S. labor market in terms of the potential number of workers affected as well as the nation's aggregate unemployment rate?

To measure the impact of negative equity on the national labor market, we simulate aggregate mobility under two alternative scenarios. The first scenario predicts migration for 2006 through 2009 using observed data on negative equity, relative economic conditions, and demographics. The second predicts migration over the same period, holding constant the share

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<sup>46</sup> The middle third of the depreciation distribution corresponds to house prices falling between 2 and 10 percent in a given year. The top third of the depreciation distribution corresponds to house prices falling by more than 10 percent in a given year.

of nonprime households with negative equity at the levels observed in 2006. Thus we hope to simulate the counterfactual path of migration that would have occurred but for the unprecedented deterioration in housing market conditions across the United States.

Looking at the path of migration under our two alternative scenarios shows that housing market conditions had a measurable but small impact on aggregate state-to-state migration between 2006 and 2009. The top panel of figure 8 demonstrates that negative equity reduces the national state-to-state migration rate by roughly 0.05 percentage points each year. This translates into roughly 110,000 to 150,000 fewer individuals migrating across state lines in any given year (see bottom panel, figure 8). Compared to the typical annual flow of roughly 5.5 million state-to-state migrants per year, this represents a reduction of roughly 2 to 3 percent each year—roughly in line with the decrease in out-migration from the average state as indicated by our earlier regression analysis.

What is the potential impact of the reduction in state-to-state mobility associated with negative equity on the national labor market? The CPS showed that not all migrants are job-seekers—even in the wake of the Great Recession. Although the share of individuals who reported migrating across state lines for job-related reasons has increased in recent years, this still amounts to slightly less than half of all migrants (see the first row of table 5).<sup>47</sup> Moreover, not all individuals who move for job-related reasons were previously unemployed. Between 2007 and 2010, only 17.8 percent of individuals who moved for job-related reasons had been unemployed for at least one week during the previous year.<sup>48</sup> And of those individuals only 68.4

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<sup>47</sup> The sample is limited to individuals aged 23 to 64 who migrated across state lines to eliminate migration due to college completion or retirement from the labor force. The share who moved for job-related reasons is limited to those who cited their primary reason for moving as “new job or job transfer, look for work or lost job, or other job-related reason” and excludes those moving for a shorter commute or due to retirement.

<sup>48</sup> We focus on individuals making the transition from unemployed to employed in order to assess the impact on the unemployment rate. A similar calculation including those who made the transition from not in the labor force to employed could also be done to show the impact on the U6 rate.

percent, after having moved across state lines for a job-related reason, were employed at the time of the March survey.

Based on our simulations, we find that the overall impact of negative equity on aggregate migration has a negligible effect on the national unemployment rate. Using the difference in the predicted number of migrants under our two alternative scenarios yields fewer migrants annually between 2007 and 2009 due to the housing downturn. Assuming that *all* of these discouraged migrants were job-seekers who were previously unemployed before moving and subsequently found a job in their new location would reduce the nation's unemployment rate by at most one-tenth of a percentage point in a given year (see table 6). The cumulative effect over this period would yield an unemployment rate of 9.0 percent versus 9.3 percent in 2009. Recognizing that not all interstate migrants are job-seekers, not all job-seekers were previously unemployed, and not all previously unemployed job-seekers will successfully find a job in their new location yields an unemployment rate that is virtually unchanged from the actual one that prevailed in each year.

## **VII. Examining the Negative Equity Channel: Robustness Checks**

Although our analysis using the IRS data clearly demonstrates that negative equity has a significant impact on state-to-state migration, the question remains whether it is homeowners who are actually constrained. It could be the case that states where the housing downturn has been the most severe for homeowners in terms of house price declines are also states where rents have decreased, making it less attractive for renters to move to another state. If so, then our analysis would be capturing the lower migration of renters—who would not be affected by underwater mortgages and who would benefit from lower housing-related costs—rather than capturing the effect on homeowners.

Using the ACS, we can generate migration rates for “owners” versus “renters” separately to use as a placebo test for the impact of negative housing equity on mobility. If the housing bust primarily affected the mobility of homeowners then we would expect to the share of nonprime households with negative equity to have a significant negative impact on the migration rates of homeowners, but no such impact on the migration rates of renters.

Before we proceed with this exercise, one caveat is in order. As noted earlier in the paper, homeownership status in the ACS is identified only after the move occurs, leading to potentially biased estimates of migration depending on the degree to which migrants change tenure from owner to renter and vice versa. Typically, homeowners have far lower migration rates than renters and the likelihood of owner to renter transitions are much less likely than vice versa. However, current credit market conditions are likely to constrain renter-to-homeowner transitions while foreclosure activity is likely to increase homeowner-to-renter transitions. The net result may lead to estimates of homeowner mobility that are downward biased and estimates of renter mobility that are upward biased—producing a greater relative gap between homeowner and renter migration rates.

Yet a recent study by the Joint Center for Housing Studies at Harvard University found that the net result still favors more renter-to-owner transitions. Between 2007 and 2009, 10.7 percent of movers switched from owning to renting versus 19.5 percent of movers who switched from renting to owning.<sup>49</sup> *Moreover, the share of movers making these transitions has changed very little during the housing downturn.* Thus, on net, failing to capture these transitions will result in a larger downward bias on renter mobility than owner mobility, which would go in the direction of finding a smaller relative difference in mobility by tenure and hence lessen the impact of negative housing equity on interstate migration.

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<sup>49</sup> Joint Center for Housing Studies (2011) Table A-7.

Using the same logistic model from earlier, we find that negative equity has a significant impact on the state-to-state migration of homeowners but no detectable impact for renters. Controlling for other economic conditions and demographic characteristics, table 7 shows that a one-standard deviation increase in the origin state’s nonprime negative equity share decreases the out-migration rate among homeowners by 16.4 percent (see column 1). The second column demonstrates that there is no discernable impact on renters. Given that renters comprise upwards of 80 percent of all interstate migrants in a given year, it is not surprising that the large impact of negative equity on the migration of homeowners is less detectable in the aggregate when we use the migration rate for all households in column three.<sup>50</sup> Thus it appears that the impact of negative equity operates entirely through the reduced migration of homeowners.

Alternatively, we can make use of all the individual level data in the ACS by employing a difference-in-difference-in-difference model. Ideally, we would compare the change in state-to-state out-migration rates of homeowners in states where a large share of households became underwater versus the out-migration rates of homeowners in states where few experienced negative equity:<sup>51</sup>

$$(7) \quad E = \Delta M_{OHt} - \Delta M_{OLt},$$

where:

$M_{OHt}$  = out-migration rate of homeowners in states where the change in the share of homeowners with negative equity is “high”

and

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<sup>50</sup> According to the 2010 American Community Survey, renter households accounted for 76.7 percent of migrants during the previous year.

<sup>51</sup> States in the low category are those where the change in share of households with negative equity was less than 3 percentage points, corresponding to the bottom third of the distribution. Those in the high category are states where the change was greater than 10 percentage points, corresponding to the top third of the distribution (AZ, CA, CT, FL, ID, IL, IN, MD, MI, MN, NV, NJ, RI, UT, VA, WA).

$M_{OLt}$  = out-migration rate of homeowners in states where the change in the share of homeowners with negative equity is “low”

However, out-migration from the “high” states might have been affected by factors other than negative equity—such as deteriorating labor market conditions. To control for these other economic factors, we use renters as a control group in each state:

$$(8) \quad E = \Delta(M_{OHt} - M_{RHt}) - \Delta(M_{OLt} - M_{RLt}).$$

One caveat to this approach is that renters are quite different from homeowners in terms of observable and possibly unobservable characteristics. For example, renter households are generally younger than homeowner households, more likely to be minorities, have slightly lower levels of education, and are less likely to be married or live with children (see table 8). All of these traits serve to make renters more geographically mobile than homeowners—renters are about five times more likely to move across state lines. If the difference-in-difference-in-difference analysis is to hold up, we have to assume that the selection into who becomes an owner versus a renter does not vary systematically across low versus high states nor over time. Both of these are pretty strong assumptions. As a partial solution we will also control for observable characteristics as best we can.

Using this framework, we find that the decrease in migration rates of homeowners relative to renters was greater in states with high versus low shares of households with negative equity. The differences over time show that homeowners in low negative equity states experienced a  $-0.117$  percentage point decrease in their migration rate between 2006 and 2008 compared with a decrease of  $-0.410$  percentage points for homeowners in high negative equity states, resulting in a second difference of  $-0.293$  percentage points (see table 9). In contrast,

renters in low negative equity states experienced a  $-0.007$  percentage point drop in their migration rates over the period relative to a decline of  $-0.002$  for renters in states with high negative equity shares, resulting in a positive second difference of  $0.005$  percentage points. Taking the triple difference between owners and renters shows that owners in states with high negative equity shares saw their relative out-migration rates—relative to renters—fall significantly by  $-0.298$  percentage points compared with owners in states with low negative equity. Similar results are obtained when we use the change in house prices.

But given that renters and homeowners vary significantly in terms of observable characteristics, we translate our difference-in-difference-in-difference model into a regression framework:

$$(9) \quad \ln M_{ijkt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 \tau_t + \beta_3 \delta_j + \beta_4 \delta_k + \beta_5 \text{OWNER}_i + \beta_6 (\tau_t \cdot \delta_j) + \beta_7 (\tau_t \cdot \text{OWNER}_i) + \beta_8 (\delta_j \cdot \text{OWNER}_i) + \beta_9 (\tau_t \cdot \text{HIGH}_j \cdot \text{OWNER}_i) + \varepsilon_{ijkt}$$

where:

$M_{ijkt} = 1$  if household  $i$  migrates from state  $j$  to state  $k$  in year  $t$

$X_{it}$  = vector of observable demographic characteristics of household head (age, race, ethnicity, education, marital status, children)

$T_t = 1$  if 2008 and 0 if 2006

$\delta_j$  = a full set of origin dummy variables

$\delta_k$  = a full set of destination dummy variables

$\text{OWNER}_i = 1$  if the household head is an owner (only known in destination)

$\text{HIGH}_j = 1$  if the origin state has a high negative equity share

$\varepsilon_{ijkt}$  = stochastic error term.

In the above equation, the time and state fixed effects control for the time series changes in migration rates and the time-invariant characteristics of states respectively. The owner dummy controls for the time-invariant characteristics of homeowners relative to renters. The second-level interactions control for changes over time in each state, changes over time for all owners, and time invariant characteristics of owners in each state. The triple interaction term captures the variation in migration rates specific to owners (relative to renters) in high negative equity states (relative to low) in 2008 (relative to 2006).

We find that negative equity decreases the likelihood of moving for homeowners relative to renters (see table 10). The coefficient reported in the table is that on the triple interaction: owner\*2008\*dummy for whether the individual lives in a high negative equity state. The coefficients represent the change in the log odds of the outcome for a one unit increase in the predictor variable. For example, the first column of table 10 shows that living in a state with a high share of households experiencing negative equity decreases the odds of leaving the state by a factor of 0.829. Adding in the usual demographic and economic controls from before does little to change the magnitude or the significance of the coefficient. If instead we use the actual change in the share of households with negative equity, we find that a one-standard deviation change in the share decreases the odds of leaving the state by a factor of 0.347. Yet this initial result decreases in significance as we add in controls for the destination state, demographic characteristics for the origin state, and relative economic conditions.

Using house price appreciation, we find similar but weaker results. For example, with no controls, living in a state experiencing falling house prices decreases the odds of leaving the state by a factor of 0.844 (see table 10). Yet the initial result is no longer significant once we add in the state dummies for the destination state.

## **VIII. Conclusion**

Policymakers are concerned that negative home equity arising from the severe decline in the U.S. housing market may be constraining geographic mobility and consequently serving as a contributing factor in the persistently high national unemployment rate. Indeed, the drop in house prices since 2007 has increased the share of homeowners that are underwater. At the same time, migration across states and among homeowners has fallen sharply.

Using a logistic regression framework to analyze data from the IRS on state-to-state migration, we find evidence of house lock but also find that it has a negligible impact on the U.S. unemployment rate. A one-standard deviation increase in the share of underwater nonprime households in the origin state reduces the outflow of migrants from the origin state to the destination state by 2.93 percent. When aggregated across the nation, this reduces the aggregate state-to-state migration rate by 0.05 percentage points each year, resulting in 110,000 to 150,000 fewer individuals migrating across state lines in any given year.

Assuming that all of these discouraged migrants were job-seekers who were previously unemployed before relocating and who subsequently found a job in their new state would reduce the nation's unemployment rate by at most 0.10 percentage points each year. The cumulative effect over this period would yield an unemployment rate of 9.0 percent versus 9.3 percent in 2009. But in fact not all migrants are job-seekers, not all job-seekers were previously unemployed, and not all previously unemployed job-seekers will successfully find a job in their new location. Taking these factors into account yields an unemployment rate that is virtually unchanged from the actual one that prevailed each year.

Perhaps this result is not surprising given that homeowners, who are much less likely to move than renters, account for roughly 20 percent of all state-to-state migrants in a given year.

Additional evidence from the ACS demonstrates that the reduction in migration stems entirely from fewer homeowners moving across state lines. There is no detectable impact on the migration of renters. Thus, even though the housing market crash has had a disproportionate impact on the migration of homeowners, because they account for a minority of migrants the impact on the labor market is negligible at best.

Given that housing and labor market conditions have improved little since 2009, we believe our analysis is relevant to the current policy debate regarding how best to reduce the persistently high rate of unemployment. Based on our findings, it seems reasonable for policymakers to continue to focus on efforts that stimulate aggregate demand in order to reduce the national unemployment rate. Although policies aimed at reducing the impact of negative equity on homeowners may help some households to move to states with better job opportunities, our estimates indicate that such measures are unlikely to have a measurable effect on reducing unemployment at the national level by alleviating geographic labor market mismatches. Instead, increased efforts to alleviate the housing sector's drag on the economy—such as helping more homeowners to refinance or stemming the tide of foreclosures—may be more effective at stimulating aggregate demand and reducing the high rate of joblessness during the recovery.

## References

- Aaronson, Daniel, and Jonathan Davis. 2011. "How Much has House Lock affected Labor Mobility and the Unemployment Rate?" Chicago Fed Letter Number 290: September. Chicago: Federal Reserve Bank of Chicago. Available at [http://www.chicagofed.org/digital\\_assets/publications/chicago\\_fed\\_letter/2011/cflseptember2011\\_290.pdf](http://www.chicagofed.org/digital_assets/publications/chicago_fed_letter/2011/cflseptember2011_290.pdf).
- Acemoglu, Daron, and David H. Autor. 2010. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics*, Volume 4B, ed. Orley Ashenfelter and David E. Card, 1043–1171. Amsterdam: Elsevier.
- Bajari, Patrick C., Sean Chu, and Minjung Park. 2008. "An Empirical Model of Subprime Mortgage Default from 2000 to 2007." Working Paper No. 14625. Cambridge, MA: National Bureau of Economic Research.
- Bhutta, Neil, Jane Dokko, and Hui Shan. 2010. "The Depth of Negative Equity and Mortgage Default Decisions." Finance and Economics Discussion Series No. 35. Washington DC: Federal Reserve Board of Governors. Available at <http://www.federalreserve.gov/pubs/feds/2010/201035/201035pap.pdf>.
- Chan, Sewin. 2001. "Spatial Lock-in: Do Falling House Prices Constrain Residential Mobility?" *Journal of Urban Economics* 49(3): 567–586.
- Congressional Budget Office. 2007. "Long-Term Unemployment." Available at <http://www.cbo.gov/ftpdocs/87xx/doc8770/10-31-LongtermUnemployment.pdf>.
- Davies, Paul, Michael Greenwood, and Haizheng Li. 2001. "A Conditional Logit Approach to U.S. State-to-State Migration." *Journal of Regional Science* 41(2): 337–360.
- Donovan, Colleen, and Calvin Schnure. 2011. "Locked in the House: Do Underwater Mortgages Reduce Labor Market Mobility?" May 31. Available at <http://ssrn.com/abstract=1856073>.
- Engelhardt, Gary V. 2003. "Nominal Loss Aversion, Housing Equity Constraints, and Household Mobility: Evidence from the United States." *Journal of Urban Economics* 53(1): 171–195.
- Farber, Henry S. 2011. "Job Loss in the Great Recession: Historical Perspective from the Displaced Workers Survey, 1984–2010." Working Paper No. 17040. Cambridge, MA: National Bureau of Economic Research.
- Ferreira, Fernando, Joseph Gyourko, and Joseph Tracy. 2010. "Housing Busts and Household Mobility." *Journal of Urban Economics* 68(1): 34–45.
- Foote, Christopher L., Kristopher Gerardi, and Paul S. Willen. 2008. "Negative Equity and Foreclosure: Theory and Evidence." *Journal of Urban Economics* 64(2): 234–245.

Frey, William H. 2009. *The Great American Migration Slowdown: Regional and Metropolitan Dimensions*. Washington DC: The Brookings Institution. Available at [http://www.brookings.edu/~media/Files/rc/reports/2009/1209\\_migration\\_frey/1209\\_migration\\_frey.pdf](http://www.brookings.edu/~media/Files/rc/reports/2009/1209_migration_frey/1209_migration_frey.pdf).

Gabriel, Stuart A., Janice Shack-Marquez, and William L. Wascher. 1992. "Regional House-Price Dispersion and Interregional Migration." *Journal of Housing Economics* 2(3):235–256.

Gabriel, Stuart A., Joe P. Matthey, and William L. Wascher. 1995. "The Demise of California Reconsidered: Interstate Migration over the Economic Cycle." *Economic Review* No. 2: 30–48. San Francisco: Federal Reserve Bank of San Francisco.

Genesove, David, and Christopher Mayer. 1997. "Equity and Time to Sale in the Real Estate Market." *American Economic Review* 87(3): 255–269.

Genesove, David, and Christopher Mayer. 2001. "Loss-Aversion and Seller Behavior: Evidence from the Housing Market." *Quarterly Journal of Economics* 116(4): 1233–1260.

Ghent, Andra C., and Marianna Kudlyak. 2010. "Recourse and Residential Mortgage Default: Theory and Evidence from U.S. States." Working Paper 09-10R. Richmond, VA: Federal Reserve Bank of Richmond. Available at [https://www.richmondfed.org/publications/research/working\\_papers/2009/pdf/wp09-10r.pdf](https://www.richmondfed.org/publications/research/working_papers/2009/pdf/wp09-10r.pdf).

Government Accountability Office. 2010. "State-Level Information on Negative Home Equity and Loan Performance in the Nonprime Mortgage Market." GAO-10-633R, May 14. Washington, DC: United States Government Accountability Office. Available at <http://www.gao.gov/new.items/d10633r.pdf>.

Greenwood, Michael. 1985. "Human Migration: Theory, Models, and Empirical Studies." *Journal of Regional Science* 25(4):521–544.

Greenwood, Michael, and Gary Hunt. 1989. "Jobs versus Amenities in the Analysis of Metropolitan Migration." *Journal of Urban Economics* 25(1):1–16.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales. 2011. "Moral and Social Constraints to Strategic Default on Mortgages." Working Paper No. 15145. Cambridge, MA: National Bureau of Economic Research.

Henley, Andrew. 1998. "Residential Mobility, Housing Equity, and the Labour Market." *The Economic Journal* 108 (447): 414–427.

Internal Revenue Service. "Supplemental Documentation for Migration Data Products." Statistics of Income Division. Available at <http://www.irs.gov/taxstats/article/0,,id=213802,00.html>.

Joint Center for Housing Studies. 2011. *The State of the Nation's Housing*. Cambridge, MA: Harvard University. Available at <http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/son2011.pdf>.

King, Miriam, Steven Ruggles, J. Trent Alexander, Sarah Flood, Katie Genadek, Matthew B. Schroeder, Brandon Trampe, and Rebecca Vick. 2010. *Integrated Public Use Microdata Series, Current Population Survey: Version 3.0*. [Machine-readable database]. Minneapolis: University of Minnesota.

Lee, Anne. 1974. "Return Migration in the United States." *International Migration Review* 8(2): 283–300.

Long, Larry, and Kristin Hansen. 1975. "Trends in Return Migration to the South." *Demography* 12(4): 601–614.

Molloy, Raven, Christopher L. Smith, and Abigail Wozniak. 2011. "Internal Migration in the United States." Finance and Economics Discussion Series 2011-30. Washington, DC: Federal Reserve Board. Available at <http://www.federalreserve.gov/pubs/feds/2011/201130/201130pap.pdf>.

Mueser, Peter, and Philip Graves. 1995. "Examining the Role of Economic Opportunity and Amenities in Explaining Population Redistribution." *Journal of Urban Economics* 37 (3): 239-259.

Perry, Marc and Jason Schachter. 2003. "Migration of Natives and the Foreign Born, 1995 to 2000." Census 2000 Special Reports. Washington, DC: U.S. Census Bureau.

Quigley, John. 1987. "Interest Rate Variations, Mortgage Prepayments, and Household Mobility." *Review of Economics and Statistics* 69(4):636–643.

Roback, Jennifer. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy* 90(6): 1257–1278.

Rosenbloom, Joshua, and William Sundstrom. 2003. "The Decline and Rise of Interstate Migration in the United States: Evidence from the IPUMS, 1850–1990." Working Paper No. 9857. Cambridge, MA: National Bureau of Economic Research.

Ruggles, Steven, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. 2010. *Integrated Public Use Microdata Series: Version 5.0* [Machine-readable database]. Minneapolis: University of Minnesota.

Saks, Raven, and Abigail Wozniak. 2011. "Labor Reallocation over the Business Cycle: New Evidence from Internal Migration." *Journal of Labor Economics* 29 (4): 697–739.

Sasser, Alicia, Bo Zhao, and Darcy Rollins. 2006. "The Lack of Affordable Housing in New England: How Big a Problem? Why Is It Growing? What Are We Doing about It?" New

England Public Policy Center, Working Paper 06-01 Boston: Federal Reserve Bank of Boston. Available at <http://www.bostonfed.org/economic/neppc/wp/2006/neppcwp0601.htm>.

Sasser, Alicia. 2010. "Voting with Their Feet: Relative Economic Conditions and State Migration Patterns." *Regional Science and Urban Economics* 40(2-3): 122-135.

Schmitt, John, and Kris Warner. 2011. "Deconstructing Structural Unemployment." Washington, DC: Center for Economic and Policy Research. Available at <http://www.cepr.net/documents/publications/dws-2011-03.pdf>.

Schulhofer-Wohl, Sam. 2010. "Negative Equity Does Not Reduce Homeowners' Mobility." Working Paper 682, December. Minneapolis, MN: Federal Reserve Bank of Minneapolis. Available at <http://www.minneapolisfed.org/research/WP/WP682.pdf>.

Stein, Jeremy C. 1995. "Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects." *Quarterly Journal of Economics* 110(2): 379-406.

U.S. Census Bureau. 2009 "Design and Methodology of the American Community Survey." U.S. Government Printing Office, Washington, DC, April. Available at [http://www.census.gov/acs/www/Downloads/survey\\_methodology/acs\\_design\\_methodology.pdf](http://www.census.gov/acs/www/Downloads/survey_methodology/acs_design_methodology.pdf)

.

Van Horn, Carl, and Cliff Zukin. 2011. "The Long-Term Unemployed and Unemployment Insurance: Evidence from a Panel Study of Workers Who Lost a Job During the Great Recession." Research Brief, John J. Heldrich Center for Workforce Development, Edward J. Bloustein School of Planning and Public Policy. New Brunswick, NJ: Rutgers University.

Vanderkamp, John. 1971. "Migration Flows, Their Determinants, and the Effects of Return Migration." *Journal of Political Economy* 79(5): 1012-1031.

## Data Appendix

### Migration Data

#### *Number of Migrants, Internal Revenue Service*

The Internal Revenue Service (IRS) provides annual data on the number of migrants moving from one state to another for the period 1975–1976 to 2008–2009. These migration flows are based on tax return data, and are calculated by comparing the addresses of households filing tax returns from April of year  $t$  to April of year  $t+1$ . The number of exemptions claimed on the tax returns is used as a proxy for the number of individuals migrating between states. For example, the data show the number of exemptions moving from Massachusetts to New Hampshire and vice versa for each year.

Several limitations of the IRS data should be noted. First, a household must file a tax return for two consecutive years for the IRS to record migration data. Second, because of privacy concerns, the IRS does not report migration flows for which there are fewer than 10 observations in a given year for a particular state pair. This censoring eliminated 28 observations over the 30-year time period.

In addition, the IRS data do not always capture the movements of certain populations. For example, because they include only federal tax filers, the data are likely to underestimate the migration of very low-income households, and of those that do not report their income to the IRS. Similarly, because the data are assembled as of the April filing date, they also underestimate the migration of very high-income households who often file extensions at that time. Finally, because the estimates are based on the number of exemptions claimed by a given household, individuals that do not reside in one particular household for the whole year (such as college students) are often not counted as migrants even if they have changed residences. For more information, see <http://www.irs.gov/taxstats/article/0,,id=212683,00.html>.

#### *Number of Migrants, American Community Survey*

The American Community Survey (ACS) also provides annual data on the number of migrants one year and over moving within or between states. These are calculated by the U.S. Census Bureau from the one-year 2006, 2007, 2008, 2009, and 2010 ACS estimates, and include individuals living in group quarters.

#### *Number of Migrants, American Community Survey Public Use Microdata Samples*

State-to-state migration estimates at the household level for renters versus owners are obtained from one-year ACS Public Use Microdata Samples. These files were obtained for the years 2005–2010 from the University of Minnesota’s Integrated Public Use Microdata Series (IPUMS-USA) (Ruggles et al. 2010).

#### *Reasons for Moving, Current Population Survey*

Estimates of cross-state movers by reason of migration are obtained from the CPS March Supplement. These files were obtained for the years 2004–2011 from the University of Minnesota’s Integrated Public Use Microdata Series, Current Population Survey (IPUMS-CPS) (King et al. 2010).

### *Resident Population*

Annual estimates of the total resident population by state and of the United States as a whole come from the U.S. Census Bureau. The estimates are as of July 1 of each year and cover the period from 1975 through 2010.

### *Migration Rates*

The out-migration rate for a given origin-destination pair is calculated as the number of migrants (e.g. the exemptions from the IRS data) moving from the origin state to the destination state per every 1,000 initial residents in the origin state. The total out-migration rate for a state is calculated as the total number of migrants leaving the origin state for any destination per every 1,000 initial residents in the origin state. In-migration rates and net migration rates are similarly calculated based on the number of in-migrants and the number of net migrants (in-migrants minus out-migrants) per state.

## **Economic Data**

### *Unemployment Insurance Claims Rate*

The Unemployment Insurance (UI) claims rate is calculated as the number of unemployment insurance claimants relative to the total number of workers covered by such insurance, based on data from the Bureau of Economic Analysis in the U.S. Department of Commerce. To match the timing of the IRS data on migration flows, the UI claims rate is calculated from April of year  $t$  through March of year  $t+1$ , and is available from 1975 to 2010. The UI claims rate corresponding to the ACS migration data is calculated over the calendar year, and is available from 1986 to 2010.

### *Unemployment Rate*

The annual unemployment rate is calculated based on seasonally adjusted monthly unemployment rates from the Bureau of Labor Statistics in the U.S. Department of Labor. To match the timing of the IRS data on migration flows, the annual unemployment rate is calculated as the average unemployment rate over the year from April of year  $t$  through March of year  $t+1$ . The annual unemployment rate corresponding to the ACS migration data is calculated as the average unemployment rate over the calendar year.

### *Employment Growth*

Employment growth is calculated as the year-over-year percentage change in seasonally adjusted nonfarm payroll employment, based on data from the Bureau of Labor Statistics/Haver Analytics. To match the timing of the IRS data on migration flows, the annual growth rate is calculated as the growth rate from the second quarter (Q2) of year  $t$  to the first quarter (Q1) of year  $t+1$ . The annual growth rate corresponding to the ACS migration data is calculated as the growth rate from the first quarter (Q1) to the fourth quarter (Q4) of year  $t$ .

### *Per Capita Income*

Annual per capita income is calculated based on quarterly data reported by the Bureau of Economic Analysis/Haver Analytics. To match the timing of the IRS data on migration flows, annual per capita income is calculated as the average from Q2 of year  $t$  to Q1 of year  $t+1$ . Annual per capita income corresponding to the ACS migration data is calculated as the average from Q1 to Q4 of year  $t$ .

### *CPI*

The CPI (featuring all items less shelter) is obtained on an annual basis from the Bureau of Labor Statistics. Data is available from 1971 to 2010.

## **Housing Data**

### *Negative Equity Share*

Negative equity share for each state is obtained from Government Accountability Office report GAO-10-633R, which has negative equity share available quarterly from 2006:Q1 to 2009:Q4 based on an analysis of CoreLogic active nonprime mortgage data and CoreLogic's state-level house price index. Additional negative equity data is obtained from CoreLogic's Negative Equity Report available quarterly since 2009:Q3, which includes single-family residential properties with a mortgage but is unavailable for several states.

To match the timing of the IRS data on migration flows, annual negative equity share is calculated as the average negative equity share from Q2 of one year through Q1 of the following year. As a result, some years of annual negative equity share represent less than four quarters of averaged data. Annual negative equity share corresponding to the ACS migration data is calculated as the average quarterly negative equity share within a given calendar year.

### *Federal Housing Finance Agency (FHFA) House Price Index*

The house price index is based on quarterly data reported by the FHFA (formerly the Office of Federal Housing Enterprise Oversight) in the U.S. Department of Housing and Urban Development. To match the timing of the IRS data on migration flows, the annual house price index is calculated as the average house price index from Q2 of one year through Q1 of the following year. The annual house price index corresponding to the ACS migration data is calculated as the average quarterly house price index within a given calendar year.

### *Housing Affordability Index*

The housing affordability index is calculated as the ratio of median household income to the income needed to purchase the median-priced house. Median household income is calculated from the U.S. Census Bureau's Current Population Survey.

The income needed to purchase the median-priced house is calculated as the annual income needed to qualify for a loan to purchase the median-priced house. The latter is based on the assumption that the annual cost of owning a home, including principal and interest payments, equals 28 percent of annual income. That is the lending industry standard used to determine whether potential buyers have enough income to qualify for a mortgage.

Financing is assumed to be a conventional 30-year fixed-rate mortgage with an 80 percent loan-to-value ratio (that is, the buyer has made a 20 percent downpayment). Median prices are based on the house price index reported quarterly by the FHFA (formerly OFHEO), and measured on an annual basis from Q2 of year  $t$  through Q2 of year  $t+1$  for the IRS migration data and on a calendar year basis for the ACS migration data. Interest rates are based on the Mortgage Interest Rate Survey (MIRS) conducted by the Federal Home Financing Board.

Real estate taxes and homeowners' insurance are not included in the calculation because such data are unavailable by state over the entire time span. However, given that both taxes and insurance typically vary in proportion to the value of a house, it is likely that most of the variation related to housing affordability is captured by movements in house prices and mortgage rates.

#### *House Price Appreciation*

House price appreciation is calculated on an annual basis from the FHFA House Price Index. House price appreciation matching the IRS data uses the annual FHFA HPI calculated from Q2 of one year through Q1 of the following year, and house price appreciation matching the ACS uses the calendar year calculation of the FHFA HPI.

#### *Foreclosure Rates*

Foreclosure rates are obtained on a quarterly basis from the Mortgage Bankers Association/Haver Analytics, and are calculated as the total number of loans in the legal process of foreclosure as a percentage of the total number of mortgages in the pool during a quarter (not seasonally adjusted inventory foreclosures). To match the timing of the IRS data on migration flows, annual foreclosure rates are calculated as the average from Q2 of year  $t$  to Q1 of year  $t+1$ . Annual foreclosure rates corresponding to ACS migration data is calculated as the average from Q1 to Q4 of year  $t$ . Data is available 1979 to 2010.

#### *Share of Nonprime Mortgages*

The share of subprime mortgages is calculated on a quarterly basis for each state as the number of conventional subprime mortgages divided by the number of total mortgages. This data is obtained from the Mortgage Bankers Association/Haver Analytics from all serviced mortgages. To match the timing of the IRS data on migration flows, annual shares are calculated as the average from Q2 of year  $t$  to Q1 of year  $t+1$ . Annual shares corresponding to ACS migration data is calculated as the average from Q1 to Q4 of year  $t$ . Data is available 1998 to 2010.

### **Demographic Data**

#### *Age Structure*

This variable indicates the share of total resident population for each of five selected age groups: 20–24 years old, 35–44 years old, 45–54 years old, 55–64 years old, and 65+ years old. The variable is calculated using the U.S. Census Bureau's annual estimates of the total resident population, by single year of age, for all states and the District of Columbia, and for the United States as a whole, for the period 1980–2010. Whereas other years correspond to the July estimates, age structure for 2010 corresponds to the Demographic Profile which represents age as

of April 2010. Data for the period 1974–1979 were available by selected age groups only, which coincide with the ones used here.

#### *Educational Attainment*

This variable indicates the number of people who have completed at least four years of college, expressed as a share of the total population aged 14 years and above. The variable is calculated using microdata from the Current Population Survey’s March Supplement, available from the Integrated Public Use Microdata Series (IPUMS) at the Minnesota Population Center (King et al. 2010). The variable includes all states and the District of Columbia, and the United States as a whole, for the 1977–2010 period.

#### *Race/Ethnicity*

This variable represents the share of total resident population that is black, Asian & Pacific Islander, and Hispanic. The black and Asian & Pacific Islander categories include only individuals who are of non-Hispanic origin. The variable is calculated using annual estimates of the total resident population by race and Hispanic origin from the U.S. Census Bureau, for all states and the District of Columbia and the United States as a whole, for the period 1981–2010. For 1980, the variable is calculated using microdata from the 1980 Census, as available from the IPUMS (Ruggles et al. 2010). For 2010, the variable is calculated using the April 2010 redistricting data. Data for Asian & Pacific Islanders and Hispanics are not available prior to 1980. Data for blacks are available for the entire period.

#### *Family Structure*

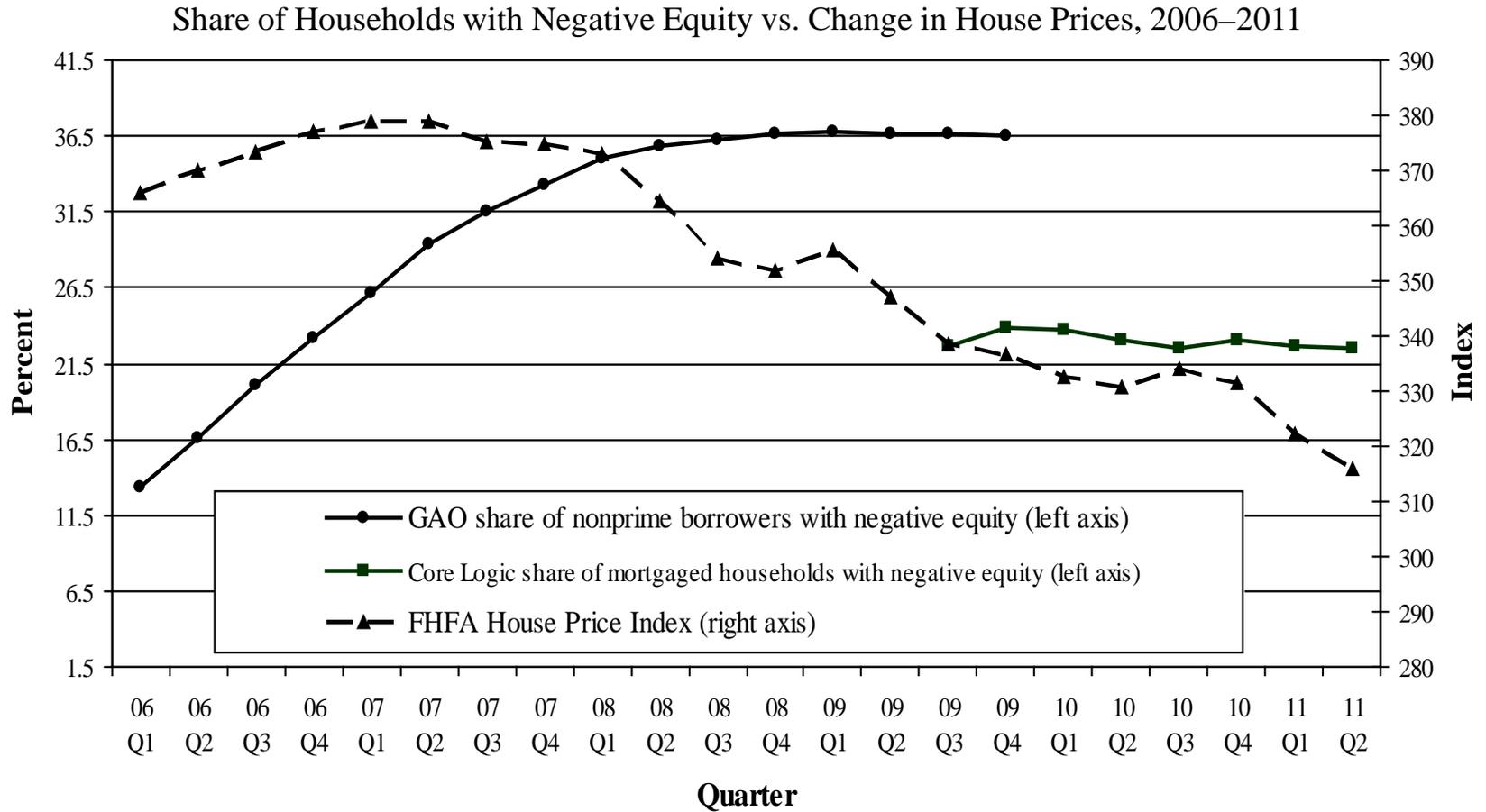
The analysis includes two family structure–related variables: (1) the percentage of individuals who are currently *married* (spouse present or absent), expressed as a share of the total population aged 14 years and older; and (2) the percentage of individuals who currently *have at least one child* residing with them (including stepchildren and adopted children), expressed as a share of the total population. Both variables are calculated using microdata from the Current Population Survey’s March Supplement, available from the IPUMS (King et al. 2010). The variables include all states and the District of Columbia, and the United States as a whole, for the period 1977–2010.

### **Other Data**

#### *Distance*

The distances between the most populous cities in each state—determined by population data from the U.S. Census Bureau, as of July 1, 2005—are calculated using the City Distance Calculator service provided by Geobytes, Inc. This software uses the latitude and longitude of the cities to calculate the distances between them. These straight-line distances may differ from the driving distances between any two cities.

Figure 1

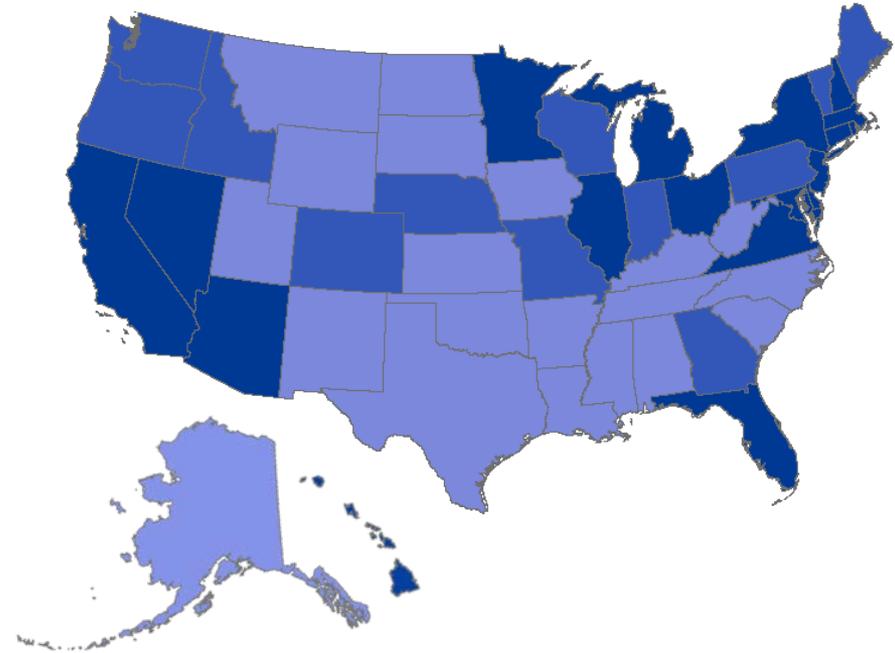
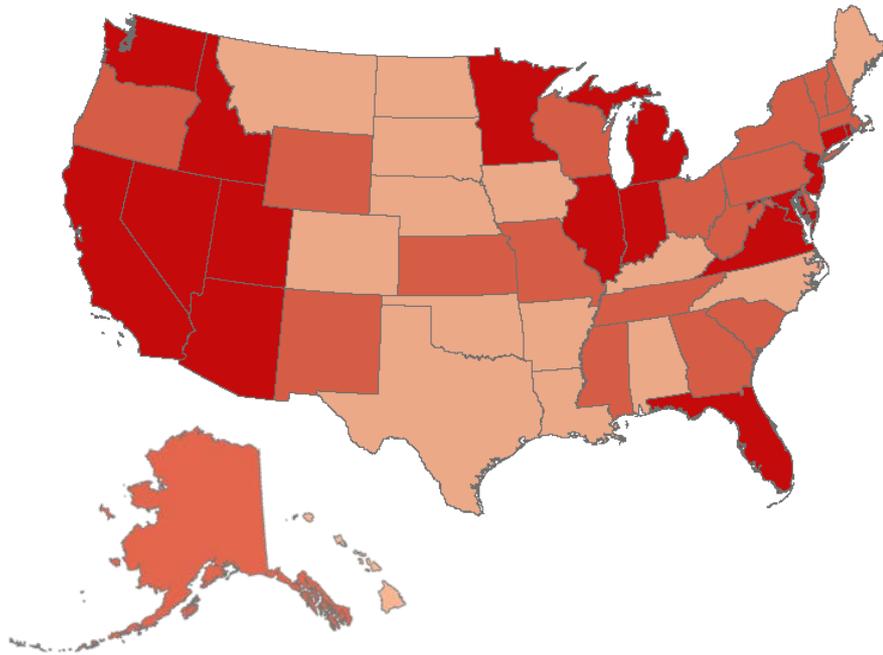


Sources: GAO share as reported in Government Accountability Office report GAO-10-633R, “Nonprime Negative Equity” (May 2010). Core Logic share as reported in CoreLogic Negative Equity Reports, 2009:Q3–2011:Q2. Available: <http://www.corelogic.com/about-us/researchtrends/negative-equity-report.aspx>. FHFA House Price Index, not adjusted for inflation or seasonally adjusted, as reported from Haver Analytics.

Figure 2

Change in Share of Nonprime Households with Negative Equity, 2006–2008

Percent Change in Federal Housing Finance Agency HPI, 2006–2008



-  Less than a 3-percentage point difference
-  Between a 3- and 10-percentage point difference
-  Greater than a 10-percentage point difference

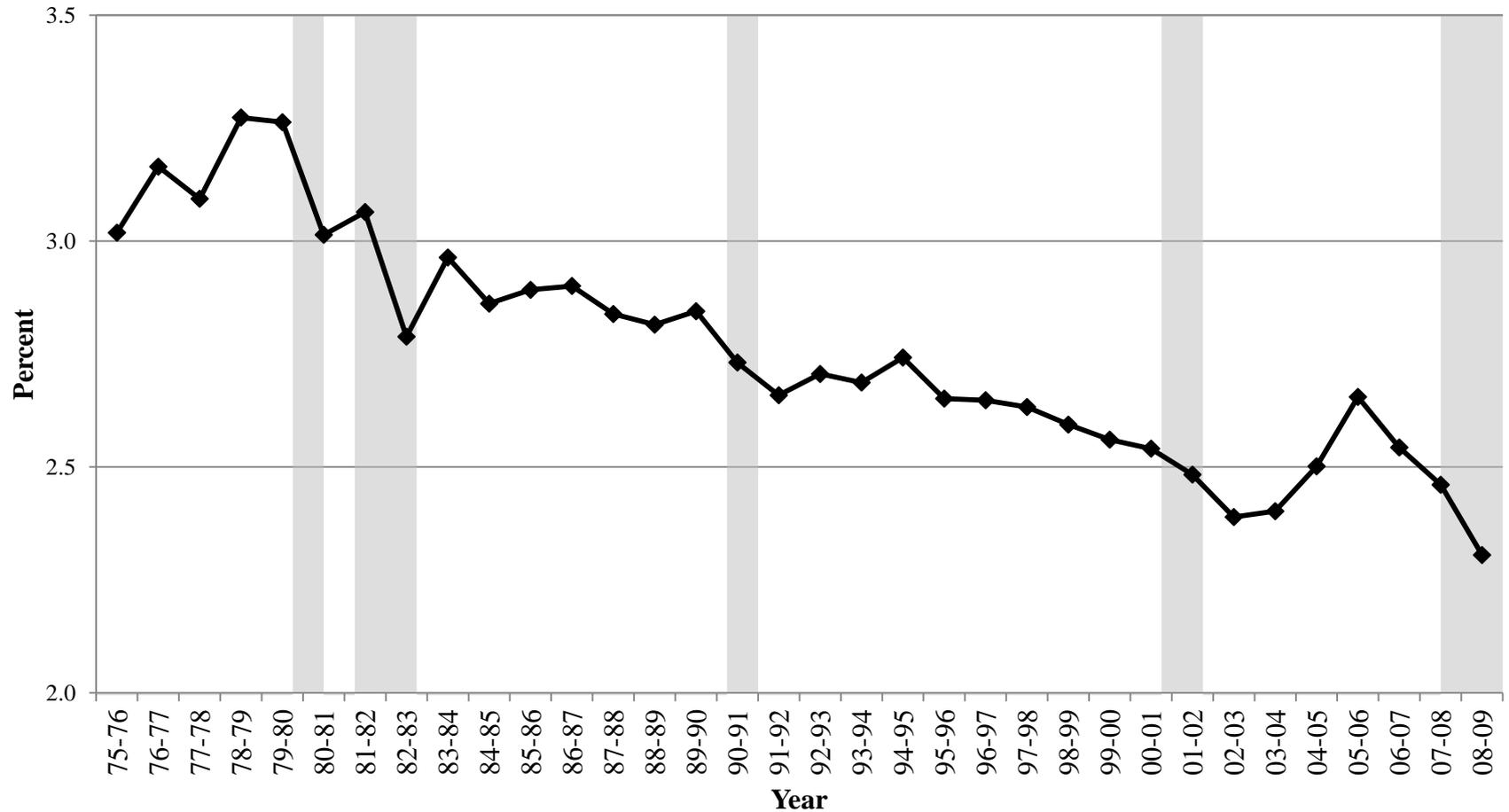
-  Percent change greater than 2 percent
-  Percent change between 2 and -2 percent
-  Percent change less than -2 percent

Sources: Negative equity share as reported in Government Accountability Office report GAO-10-633R, “Nonprime Negative Equity” (May 2010); FHFA House Price Index as reported from Haver Analytics.

Note: Annual negative equity and FHFA HPI values are obtained by averaging over four quarters corresponding to IRS out-migration flows.

Figure 3

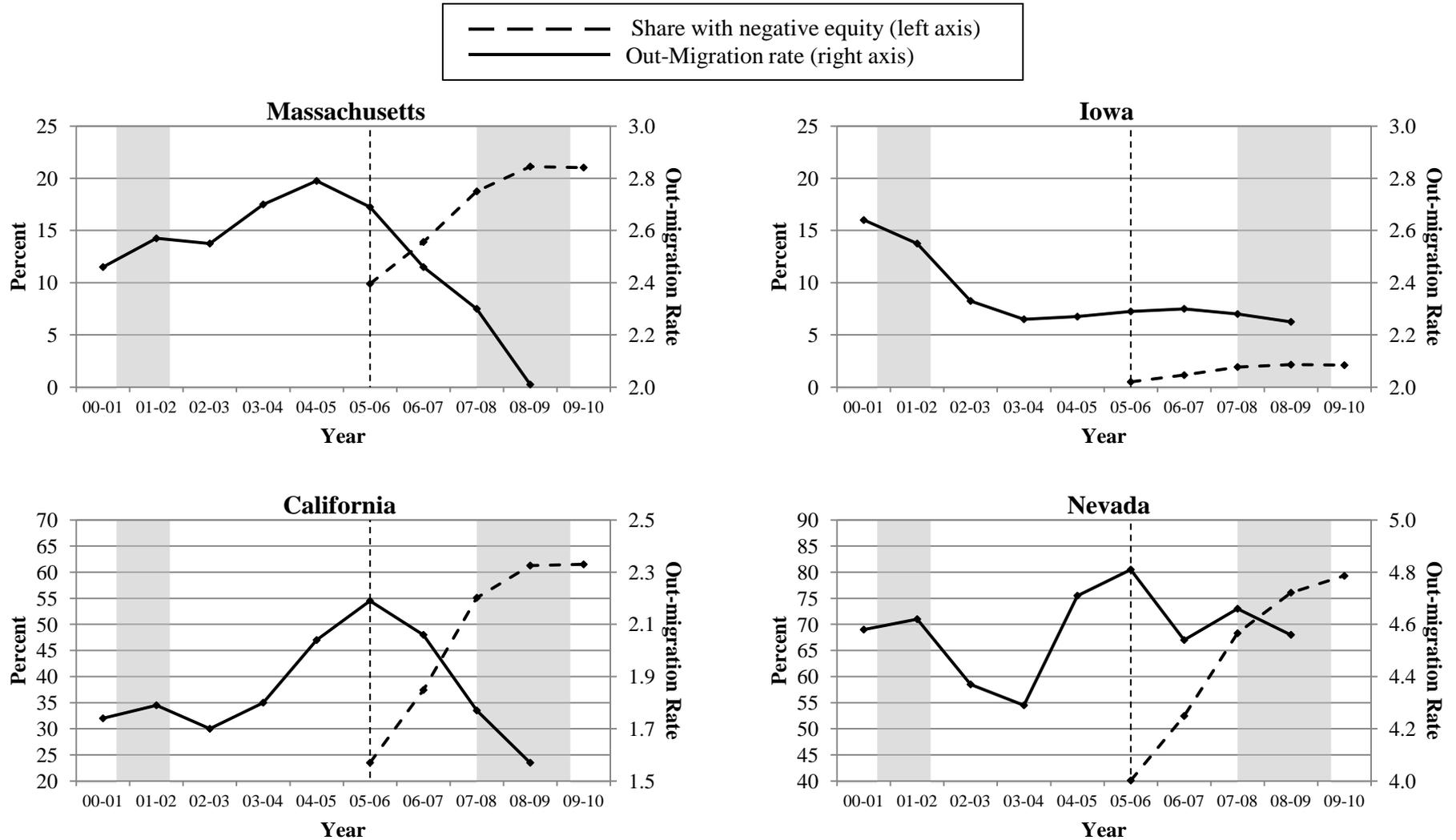
Total Domestic State-to-State Migration Rate for the United States, 1975–2008



Source: Authors' calculations from the Internal Revenue Service state migration data.  
Note: Shading represents National Bureau of Economic Research U.S. recession periods.

Figure 4

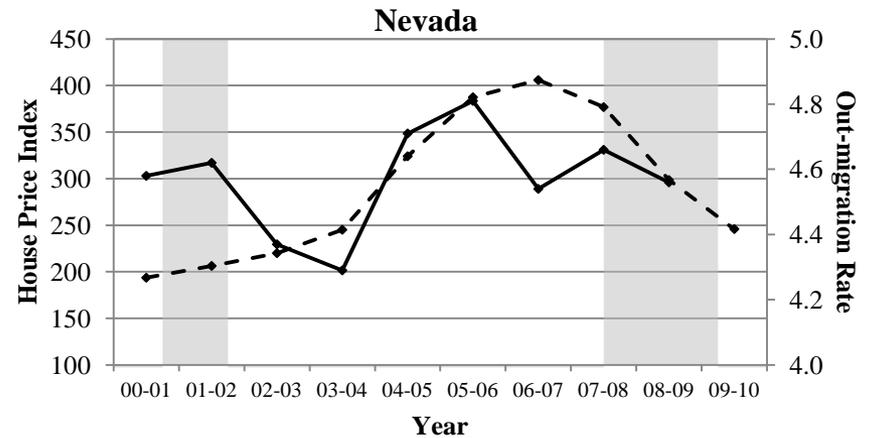
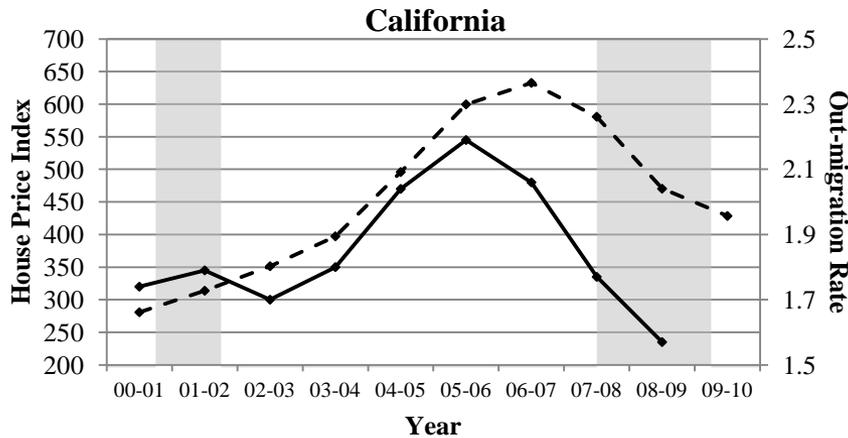
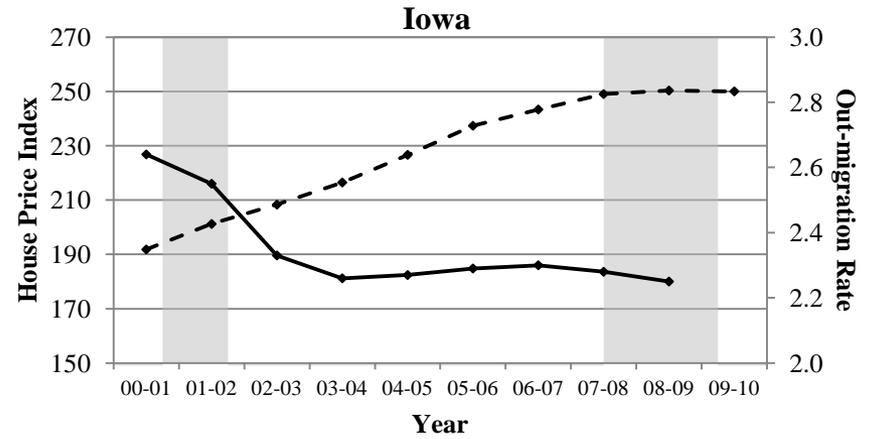
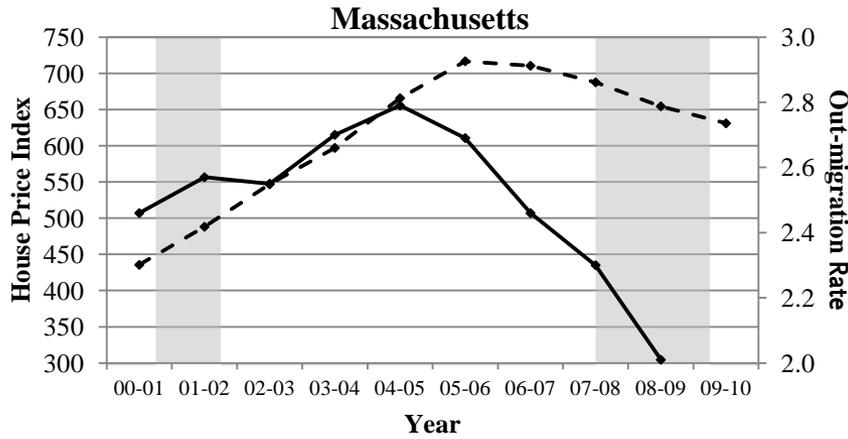
Share of Nonprime Homeowners with Negative Equity vs. Out-Migration Rates for Selected States, 2000–2008



Source: Authors' calculations from the Internal Revenue Service state migration data.  
 Note: Shading represents National Bureau of Economic Research U.S. recession periods.

Figure 5

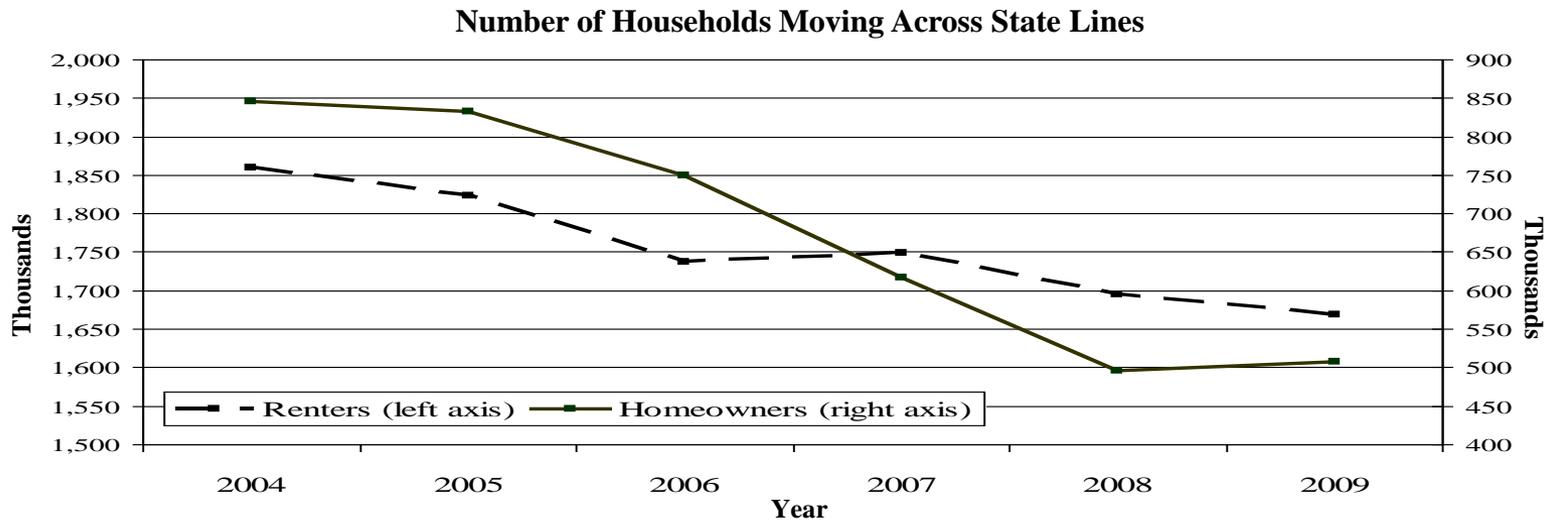
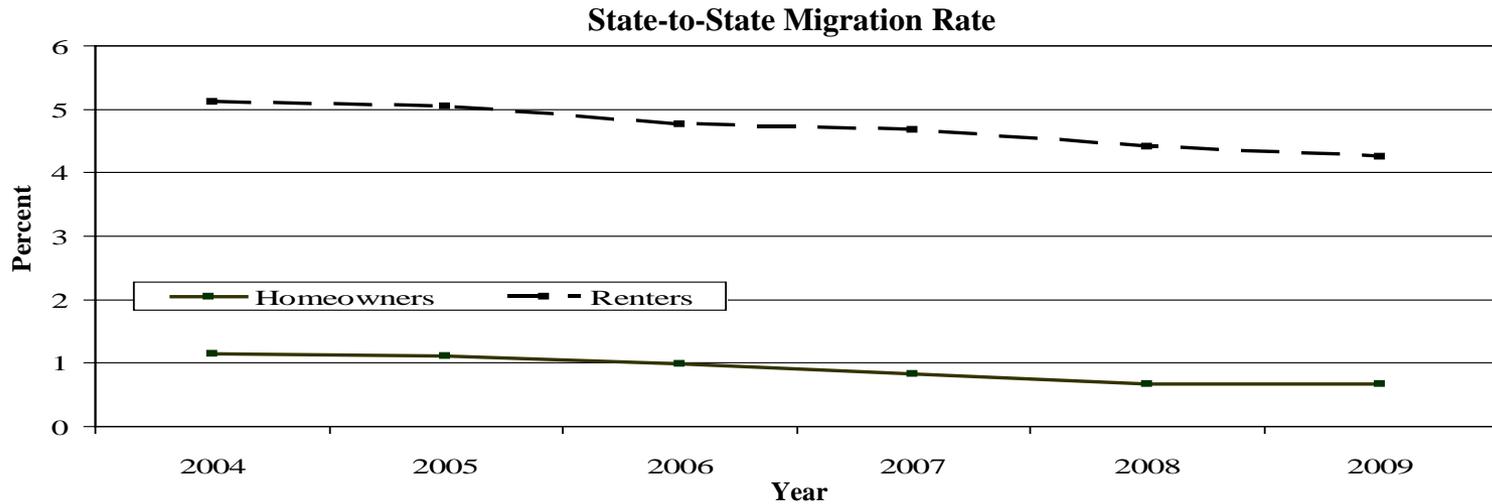
Change in House Prices vs. Out-Migration Rates for Selected States, 2000–2008



Source: Authors' calculations from the Internal Revenue Service state migration data.  
 Note: Shading represents National Bureau of Economic Research U.S. recession periods.



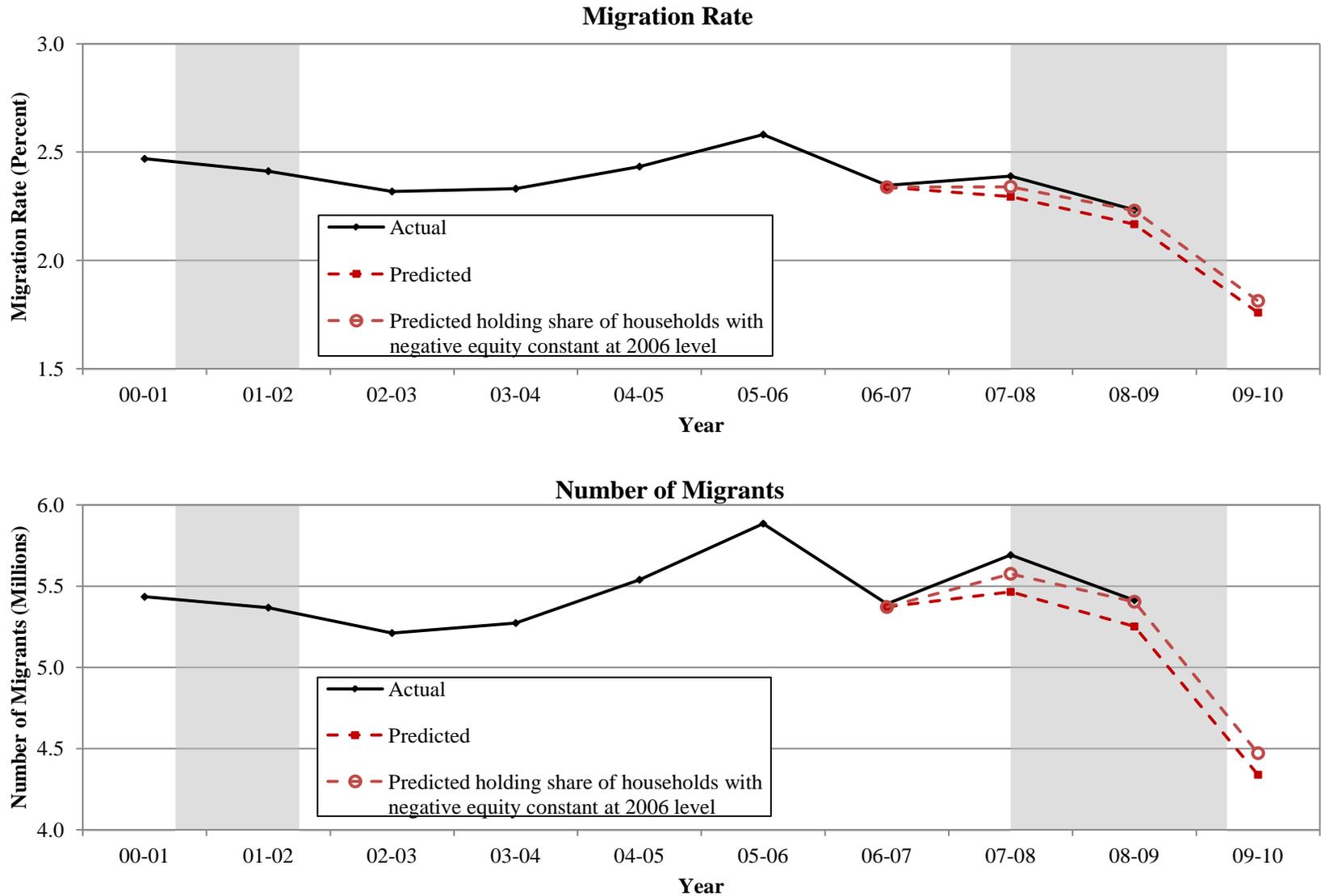
Figure 7  
Migration Trends for Owners versus Renters, 2004–2009



Source: Authors' calculations from the American Community Survey public-use microdata, 2005–2010.

Notes: Sample is restricted to households headed by individual 16 years of age or older, excluding group quarters and individuals moving from abroad. Tenure is determined after migration and does not capture owner to renter transitions and vice versa.

Figure 8  
Actual versus Predicted Migration Under Alternative Scenarios, United States



Source: Author's calculations from the Internal Revenue Service state migration data.  
Note: Shading represents National Bureau of Economic Research U.S. recession periods.

**Table 1**  
**Primary Reason for Moving Across States**

Reason	2003–2006			2007–2010		
	Owner	Renter		Owner	Renter	
<b>Family-related</b>	<b>25.1%</b>	<b>24.6%</b>		<b>28.9%</b>	<b>22.9%</b>	
Change in marital status	5.8%	5.2%		5.6%	3.6%	***
To establish own household	3.0%	5.0%	***	4.0%	4.0%	
Other family reason	16.3%	14.4%	**	19.4%	15.3%	***
<b>Job-related</b>	<b>40.8%</b>	<b>44.3%</b>		<b>43.7%</b>	<b>51.8%</b>	
New job or job transfer	29.8%	31.3%		28.1%	37.6%	***
To look for work or lost job	3.3%	5.0%	***	6.4%	6.3%	
To be closer to work/easier commute	1.5%	2.7%	***	1.6%	3.3%	***
Retired	2.7%	0.6%	***	1.9%	0.4%	***
Other job related reason	3.5%	4.8%	***	5.6%	4.2%	**
<b>Housing-related</b>	<b>24.1%</b>	<b>17.8%</b>		<b>13.4%</b>	<b>11.9%</b>	
Wanted to own home/not rent	8.0%	0.5%	***	3.5%	0.2%	***
Wanted a new or better house/apartment	6.6%	6.3%		1.9%	3.4%	***
Wanted better neighborhood/less crime	2.3%	2.4%		1.6%	2.0%	
Wanted cheaper housing	2.2%	4.0%	***	3.7%	3.8%	
Other housing reason	4.9%	4.5%		2.6%	2.5%	
<b>Miscellaneous</b>	<b>10.1%</b>	<b>13.3%</b>		<b>14.0%</b>	<b>13.4%</b>	
To attend/leave college	2.1%	6.0%	***	1.9%	5.9%	***
Change of climate	2.5%	2.0%		3.6%	1.9%	***
Health reasons	2.2%	1.5%	*	2.6%	1.4%	**
Other reason	3.4%	3.8%		6.0%	4.1%	***

Source: Authors' calculations from the Current Population Survey, 2004–2011.

Notes:

Sample is limited to individuals between 23 and 64 years of age who migrated across state lines.

Tenure is determined after migration and does not capture owner to renter transitions and vice versa.

"Other reason" includes natural disaster, foreclosure or eviction, no response, and "other".

\*Indicates significance at the 10-percent level, \*\*at the 5-percent level, and \*\*\*at the 1-percent level.

**Table 2**  
**Share of Nonprime Households with Negative Equity by State, 2009**

State	Negative Equity Share	State	Negative Equity Share	State	Negative Equity Share
Alabama	4.4%	Maine	3.1%	Ohio	25.4%
Arizona	68.5%	Maryland	39.7%	Oklahoma	0.5%
Arkansas	5.6%	Massachusetts	21.0%	Oregon	14.6%
California	61.5%	Michigan	76.0%	Pennsylvania	6.2%
Colorado	5.1%	Minnesota	37.3%	Rhode Island	53.8%
Connecticut	25.3%	Mississippi	5.0%	South Carolina	10.3%
Delaware	8.8%	Missouri	19.2%	South Dakota	0.4%
Florida	71.8%	Montana	2.9%	Tennessee	6.2%
Georgia	20.8%	Nebraska	3.7%	Texas	5.3%
Idaho	36.4%	Nevada	79.3%	Utah	23.0%
Illinois	35.9%	New Hampshire	9.6%	Vermont	7.3%
Indiana	23.5%	New Jersey	24.7%	Virginia	39.4%
Iowa	2.1%	New Mexico	11.8%	Washington	15.7%
Kansas	10.3%	New York	10.5%	West Virginia	23.8%
Kentucky	4.9%	North Carolina	4.0%	Wisconsin	15.0%
Louisiana	3.2%	North Dakota	0.2%	Wyoming	7.8%

Source:  
Government Accountability Office report GAO-10-633R, “Nonprime Negative Equity” (May 2010).

Notes:  
Annual data are obtained by averaging over three available quarters corresponding to IRS out-migration flows for 2009 (2009:Q2–2009:Q4)  
Alaska, Hawaii, and the District of Columbia have been excluded.

**Table 3**  
**Estimating the Relationship between Negative Equity and State-to-State Migration Flows, 2006–2008**

Independent variable	Dependent variable: Log of the Out-Migration Rate				
	1	2	3	4	5
Share of households with negative equity in origin state	-0.0237 *** (0.0089)	-0.0422 *** (0.0091)	-0.0211 * (0.0120)	-0.0293 ** (0.0126)	
Origin state is in the middle third of the negative equity distribution					-0.0069 ** (0.0031)
Origin state is in the top third of the negative equity distribution					-0.0171 *** (0.0045)
Relative UI claims rate differential (lagged one year)		0.0369 ** (0.0160)	0.0409 ** (0.0166)	0.0377 ** (0.0167)	0.0376 ** (0.0166)
Relative per capita income differential (lagged one year)		-0.1341 *** (0.0220)	-0.1640 *** (0.0241)	-0.1594 *** (0.0242)	-0.1577 *** (0.0243)
Relative house affordability index differential (lagged one year)		-0.0445 *** (0.0092)	-0.0368 *** (0.0096)	-0.0408 *** (0.0098)	-0.0433 *** (0.0099)
Foreclosure rate (lagged one year)				0.0224 ** (0.0099)	0.0029 (0.0097)
Percent of population aged 20 to 24 years			0.0187 (0.0378)	0.0115 (0.0377)	0.0351 (0.0388)
Percent of population aged 25 to 34 years			0.0634 (0.0531)	0.0567 (0.0528)	0.0620 (0.0519)
Percent of population aged 35 to 44 years			0.0207 (0.0708)	0.0193 (0.0707)	0.0365 (0.0707)
Percent of population aged 45 to 54 years			-0.0383 (0.0444)	-0.0516 (0.0441)	-0.0530 (0.0431)
Percent of population aged 55 to 64 years			-0.1038 ** (0.0409)	-0.1124 *** (0.0408)	-0.1153 *** (0.0421)
Percent of population aged 65 plus years			-0.0637 (0.0668)	-0.0782 (0.0671)	-0.0798 (0.0635)
Percent of population black			-0.4988 * (0.2799)	-0.5394 * (0.2822)	-0.5569 ** (0.2776)
Percent of population Hispanic			-0.3361 * (0.1815)	-0.3937 ** (0.1848)	-0.6463 *** (0.1977)
Percent of population Asian & Pacific Islander			-0.4909 *** (0.1286)	-0.5044 *** (0.1290)	-0.4509 *** (0.1291)
Percent of population with a college degree			0.0109 (0.0104)	0.0119 (0.0105)	0.0078 (0.0105)
Percent of population married			0.0177 *** (0.0052)	0.0180 *** (0.0052)	0.0162 *** (0.0053)
Percent of population with children			0.0035 (0.0039)	0.0042 (0.0039)	0.0001 (0.0039)
State fixed effects included?	Yes	Yes	Yes	Yes	Yes
Year fixed effects included?	Yes	Yes	Yes	Yes	Yes
R-squared	0.8105	0.8107	0.8109	0.8109	0.8109
Number of observations	6582	6582	6582	6582	6582

Source: Authors' calculations using data on state-to-state migration from the Internal Revenue Service.

Notes:

Alaska, Hawaii, and the District of Columbia have been excluded because data on unemployment insurance claims rate are unavailable for some years.

Louisiana and Mississippi were excluded in 2006 due to migration that occurred in response to Hurricane Katrina.

All specifications use a logistic regression model estimated using OLS.

All specifications include a measure of distance between origin and destination states.

The dependent variable is the log of the out-migration rate between each origin-destination state pair for the period April of year  $t$  to March of year  $t+1$ .

The share of households with negative equity is the share of subprime households calculated by the GAO to have negative equity using the CoreLogic data.

The middle third of the negative equity distribution are states where the share of households with negative equity is greater than 5.6 percent and less than or equal to 21.0 percent.

The top third of the negative equity distribution are states where the share of households with negative equity that is greater than 21.0 percent.

Relative economic differentials are calculated as the difference between relative conditions (relative to the nation) in the origin state minus the destination state.

Both per capita income and housing affordability index are measured in logarithms of real (\$2006) values.

Lagged independent variables reflect values from April of year  $t-1$  to March of year  $t$ .

State and year fixed effects are also included. State fixed effects include a dummy for each state as an origin and destination.

Standard errors are in parentheses, clustered by state for specifications, including fixed effects.

\*Indicates significance at the 10-percent level, \*\*at the 5-percent level, and \*\*\*at the 1-percent level.

**Table 4**  
**Estimating the Relationship between Negative House Price Appreciation and State-to-State Migration Flows, 2006–2008**

Independent variable	Dependent variable: Log of the Out-Migration Rate				
	1	2	3	4	5
Dummy variable indicating nominal house price depreciation in origin	-0.0136 *** (0.0024)	-0.0170 *** (0.0024)	-0.0068 *** (0.0026)	-0.0063 ** (0.0027)	
Origin state is in the middle third of the depreciation distribution					-0.0115 *** (0.0034)
Origin state is in the top third of the depreciation distribution					-0.0117 *** (0.0043)
Relative UI claims rate differential (lagged one year)		0.0357 ** (0.0161)	0.0407 ** (0.0166)	0.0392 ** (0.0167)	0.0420 ** (0.0172)
Relative per capita income differential (lagged one year)		-0.1289 *** (0.0213)	-0.1630 *** (0.0240)	-0.1596 *** (0.0243)	-0.1527 *** (0.0240)
Relative house affordability index differential (lagged one year)		-0.0453 *** (0.0091)	-0.0388 *** (0.0096)	-0.0406 *** (0.0098)	-0.0406 *** (0.0098)
Foreclosure rate (lagged one year)				0.0106 (0.0097)	0.0309 ** (0.0151)
Percent of population aged 20 to 24 years			0.0207 (0.0379)	0.0135 (0.0382)	0.0183 (0.0378)
Percent of population aged 25 to 34 years			0.0618 (0.0522)	0.0518 (0.0524)	0.0721 (0.0525)
Percent of population aged 35 to 44 years			0.0136 (0.0691)	0.0042 (0.0689)	0.0255 (0.0691)
Percent of population aged 45 to 54 years			-0.0387 (0.0438)	-0.0519 (0.0445)	-0.0508 (0.0430)
Percent of population aged 55 to 64 years			-0.0984 ** (0.0427)	-0.1070 ** (0.0423)	-0.1059 (0.0417)
Percent of population aged 65 plus years			-0.0768 (0.0614)	-0.0923 (0.0642)	-0.0500 (0.0655)
Percent of population black			-0.4823 * (0.2729)	-0.5359 * (0.2827)	-0.4982 (0.2716)
Percent of population Hispanic			-0.4221 ** (0.1870)	-0.4851 ** (0.1923)	-0.2341 (0.2208)
Percent of population Asian & Pacific Islander			-0.4568 *** (0.1291)	-0.4700 *** (0.1307)	-0.4312 *** (0.1363)
Percent of population with a college degree			0.0131 (0.0104)	0.0132 (0.0104)	0.0169 (0.0106)
Percent of population married			0.0166 *** (0.0053)	0.0165 *** (0.0053)	0.0166 *** (0.0052)
Percent of population with children			0.0031 (0.0039)	0.0031 (0.0039)	0.0037 (0.0039)
State fixed effects included?	Yes	Yes	Yes	Yes	Yes
Year fixed effects included?	Yes	Yes	Yes	Yes	Yes
R-squared	0.8106	0.8107	0.8109	0.8109	0.8109
Number of observations	6582	6582	6582	6582	6582

Source: Authors' calculations using data on state-to-state migration from the Internal Revenue Service.

Notes:  
Alaska, Hawaii, and the District of Columbia have been excluded because data on unemployment insurance claims rate are unavailable for some years.  
Louisiana and Mississippi were excluded in 2006 due to migration that occurred in response to Hurricane Katrina.  
All specifications use a logistic regression model estimated using OLS.  
All specifications include a measure of distance between origin and destination states.  
The dependent variable is the log of the out-migration rate between each origin-destination state pair for the period April of year  $t$  to March of year  $t+1$ .  
Negative house price appreciation is calculated using the FHFA index.  
The middle third of the negative equity distribution corresponds to having house price depreciation that is less than -2 percent but greater than -10 percent.  
The top third of the negative equity distribution corresponds to having house price depreciation that is less than -10 percent.  
Relative economic differentials are calculated as the difference between relative conditions (relative to the nation) in the origin state minus the destination state.  
Both per capita income and housing affordability index are measured in logarithms of real (\$2006) values.  
Lagged independent variables reflect values from April of year  $t-1$  to March of year  $t$ .  
State and year fixed effects are also included. State fixed effects include a dummy for each state as an origin and destination.  
Standard errors are in parentheses, clustered by state for specifications, including fixed effects.  
\*Indicates significance at the 10-percent level, \*\*at the 5-percent level, and \*\*\*at the 1-percent level.

**Table 5**  
**Measuring the Share of State-to-State Migrants Moving for Job Change-Related Reasons**

	All working age adults		Owners		Renters	
	2003–2006	2007–2010	2003–2006	2007–2010	2003–2006	2007–2010
Share who moved for job change-related reason	39.3%	45.5%	36.6%	40.1%	41.0%	48.2%
Share of job change-movers who were previously unemployed	13.9%	17.8%	11.1%	17.2%	15.5%	18.0%
Share of previously unemployed job change-movers who are now employed	76.0%	68.4%	67.9%	62.8%	79.4%	70.6%

Source: Authors' calculations from the Current Population Survey, 2004–2011.

Notes:

Sample is limited to individuals between 23 and 64 years of age who migrated across state lines.

Tenure is determined after migration and does not capture owner to renter transitions and vice versa.

Share who moved for job change-related reason is equal to the percentage of state-to-state migrants who cited their primary reason for moving as "new job or job transfer, look for work or lost job, or other job-related reason."

Share of job change-movers who were previously unemployed is equal to the percentage of state-to-state migrants moving for job change-related reasons who were unemployed for at least one week in the previous year.

Share of previously unemployed job change-movers who are now employed is equal to the percentage of previously unemployed state-to-state migrants moving for job change-related reasons who report as of the March survey that they are employed.

**Table 6**  
**Quantifying the Impact on Aggregate Unemployment**

	2006	2007	2008	2009	Cumulative Total 2007–2009
Predicted number of migrants	5,371,022	5,464,885	5,251,459	4,338,265	20,425,631
Predicted number of migrants holding negative equity share constant at 2006 levels	5,371,022	5,575,666	5,403,929	4,471,442	20,822,059
Difference	0	-110,781	-152,470	-133,177	-396,428
Moved for job-related reason (45.5%)	0	-50,384	-69,344	-60,570	-180,298
And were previously unemployed (17.8%)	0	-8,948	-12,315	-10,757	-32,020
And are now employed (68.4%)	0	-6,119	-8,422	-7,357	-21,898
<b>Actual Unemployment Rate</b>					
Total number of unemployed, age 16+	6,991,000	7,077,000	8,962,000	14,319,000	
Total number of civilian labor force participants, age 16+	151,409,000	153,126,000	154,331,000	154,206,000	
Unemployment rate, age 16+	4.62%	4.62%	5.81%	9.29%	
<b>Estimated Unemployment Rate</b>					
Unemployment rate less all additional migrants	4.62%	4.55%	5.71%	9.20%	9.03%
Less only those moving for job-related reasons	4.62%	4.59%	5.76%	9.25%	9.17%
Less only those who were also previously unemployed	4.62%	4.62%	5.80%	9.28%	9.26%
Less only those who are also now employed	4.62%	4.62%	5.80%	9.28%	9.27%
<b>Difference</b>					
Unemployment rate less all additional migrants	0.000	-0.072	-0.099	-0.086	-0.26
Less only those moving for job-related reasons	0.000	-0.033	-0.045	-0.039	-0.12
Less only those who were also previously unemployed	0.000	-0.006	-0.008	-0.007	-0.02
Less only those who are also now employed	0.000	-0.004	-0.005	-0.005	-0.01

Source: Authors' calculations based on data from the Internal Revenue Service and the Current Population Survey, various years.

Notes:

Predicted number of migrants based on a logistic model where the dependent variables is the log of the out-migration rate. See Figure 8.

Percent moving for job-related reasons, percent unemployed in the previous year, and percent now employed are from Table 5.

Data on actual number of unemployed, civilian labor force, and the unemployment rate from Haver Analytics.

**Table 7**  
**Estimating the Relationship between Negative Equity and State-to-State Migration Flows, 2006–2008**  
**American Community Survey**

Independent variable	Dependent variable: Log Out-Migration Rate		
	Owner Households	Renter Households	All Households
Share of subprime households with negative equity in origin state	-0.201 *** (0.042)	0.003 (0.036)	-0.064 ** (0.032)
Controlling for relative economic conditions	-0.196 *** (0.044)	-0.012 (0.038)	-0.074 ** (0.034)
Controlling for relative economic conditions and origin demographics	-0.164 ** (0.068)	-0.019 (0.060)	-0.047 (0.054)
Dummy variable indicating negative house price appreciation in origin	-0.034 ** (0.015)	-0.009 (0.013)	-0.020 * (0.011)
Controlling for relative economic conditions	-0.033 ** (0.015)	-0.010 (0.013)	-0.020 * (0.011)
Controlling for relative economic conditions and origin demographics	-0.005 (0.019)	-0.009 (0.016)	-0.006 (0.015)
State fixed effects included?	Yes	Yes	Yes
Year fixed effects included?	Yes	Yes	Yes
Number of observations	3,012	3,012	3,012

Source: Authors' calculations based on migration data from the American Community Survey PUMS for 2007 and 2009.

Notes:

Household migration rates were calculated using the American Community Survey PUMS for 2007–2009.

Alaska, Hawaii, and the District of Columbia have been excluded because data on unemployment insurance claims rate are unavailable for some years.

Louisiana and Mississippi were excluded in 2006 due to migration that occurred in response to Hurricane Katrina.

All specifications use a logistic regression model estimated using OLS, and include a measure of distance between origin and destination states.

The dependent variable is the log of the out-migration rate between each origin-destination state pair.

The share of households with negative equity is the share of subprime households calculated by the GAO to have negative equity using the CoreLogic data.

Negative house price appreciation is calculated using the FHFA index.

Relative economic differentials are calculated as the difference between relative conditions (relative to the nation) in the origin state minus the destination state for the UI claims rate, per capita incomes, and housing affordability, lagged one year.

Demographic controls include age, race, ethnicity, education, marital status, and the presence of children.

State and year fixed effects are also included. State fixed effects include a dummy for each state as an origin and destination.

Standard errors are in parentheses, clustered by origin and destination state

\*Indicates significance at the 10-percent level, \*\*at the 5-percent level, and \*\*\*at the 1-percent level.

**Table 8**  
**Demographic Characteristics of Owner versus Renter Households, 2006**

Percent of households where the head is:	Owner Households			Renter Households		
	Migrants	Non-Migrants	Migration Rate	Migrants	Non-Migrants	Migration Rate
Total number of households	833,081	74,118,695	1.1%	1,823,373	34,360,289	5.0%
Age 20–29 years	13.5%	5.5%	2.7%	38.8%	24.2%	7.8%
Age 30–39 years	24.2%	15.9%	1.7%	24.7%	23.1%	5.4%
Age 40–49 years	21.7%	23.4%	1.0%	15.8%	19.7%	4.1%
Age 50–59 years	17.2%	22.7%	0.8%	9.5%	13.9%	3.5%
Age 60+ years	23.1%	32.5%	0.8%	9.1%	18.0%	2.6%
African-American	6.5%	8.1%	0.9%	15.5%	19.4%	4.1%
Asian	4.3%	3.4%	1.4%	6.2%	4.4%	6.9%
Caucasian	84.5%	83.8%	1.1%	71.5%	65.6%	5.5%
Other	4.7%	4.7%	1.1%	6.8%	10.5%	3.3%
Hispanic	7.4%	7.9%	1.0%	10.1%	17.0%	3.1%
With a high school degree	17.8%	27.5%	0.7%	21.8%	30.5%	3.6%
With some college	19.7%	20.7%	1.1%	22.7%	22.5%	5.1%
With an Associate's degree	7.7%	7.9%	1.1%	7.1%	6.9%	5.2%
With a B.A. degree or higher	47.9%	32.3%	1.6%	38.3%	20.0%	9.2%
Married	65.7%	62.8%	1.2%	35.7%	28.8%	6.2%
Has own children present	38.8%	42.6%	1.0%	29.2%	37.8%	3.9%

Source: Authors' calculations from the 2006 American Community Survey.

Notes:

Sample is limited to households headed by individuals age 16 years and over, excluding those who live in vacant and group quarters.

Tenure is determined after migration and does not capture owner to renter transitions and vice versa.

Migration rate calculations corresponds to state-to-state migration from previous year (2005).

Table 9

## Raw Difference-in-Difference Estimates of the Impact of Negative Equity on State Migration, 2006 to 2008

	2006	2008	Difference over time
<b>Using Change in the Share of Households with Negative Equity</b>			
<b>Mean Migration Rate of Owner Households</b>			
States where the change in the share of households with negative equity is "low"	0.809 (0.090)	0.692 (0.083)	-0.117
States where the change in the share of households with negative equity is "high"	1.131 (0.106)	0.721 (0.085)	-0.410
Difference across states Difference-in-Difference	0.322	0.029	<b>-0.293</b>
<b>Mean Migration Rate of Renter Households</b>			
States where the change in the share of households with negative equity is "low"	0.052 (0.222)	0.045 (0.208)	-0.007
States where the change in the share of households with negative equity is "high"	0.044 (0.21)	0.043 (0.20)	-0.002
Difference across states Difference-in-Difference	-0.008	-0.002	<b>0.005</b>
Difference-in-Difference-in-Difference (Owners-Renters)			<b>-0.298 **</b>
<b>Using Change in House Prices</b>			
<b>Mean Migration Rate of Owner Households</b>			
States where the change in house prices is positive or zero	0.868 (0.093)	0.651 (0.080)	-0.217
States where the change in house prices is highly negative	1.228 (0.110)	0.698 (0.083)	-0.530
Difference across states Difference-in-Difference	0.360	0.047	<b>-0.313</b>
<b>Mean Migration Rate of Renter Households</b>			
States where the change in house prices is positive or zero	4.722 (0.212)	4.494 (0.207)	-0.228
States where the change in house prices is highly negative	3.861 (0.19)	3.682 (0.19)	-0.179
Difference across states Difference-in-Difference	-0.861	-0.812	<b>0.050</b>
Difference-in-Difference-in-Difference (Owners-Renters)			<b>-0.363 **</b>

Source: Authors' calculations from the American Community Survey Public Use Micro Sample, 2007 and 2009.

## Notes:

Sample is household heads, age 25 to 64 years, not living in group quarters, in the continental United States, excluding the District of Columbia.

Louisiana and Mississippi were excluded in 2006 due to migration that occurred in response to Hurricane Katrina.

Migration rates for renters and homeowners are calculated using tenure in the destination state as supplied by the American Community Survey.

Tenure is determined after migration and does not capture owner to renter transitions and vice versa.

The share of households with negative equity is calculated by the General Accounting Office using data supplied by CoreLogic.

The change in the shares between 2006 and 2008 were categorized into thirds as "low" (0 to 3 percentage points), "medium" (3 to 10 percentage points), and "high" (greater than a 10-percentage point increase).

House price appreciation is calculated by the authors using the nominal FHFA house price index.

The change in house price appreciation between 2006 and 2008 was categorized into "positive or zero" (greater than -1 percent), "negative" (less than -1 percent), and "negative high" (greater than -4 percent).

Standard deviations are in parentheses.

\*Indicates significance at the 10-percent level, \*\*at the 5-percent level, and \*\*\*at the 1-percent level.

**Table 10**  
**Regression Difference-in-Difference Estimates of the Impact of Negative Equity on State Migration, 2006 to 2008**

Independent variable Measuring Negative Equity	Coefficient on Owner*2008*High Negative Equity State			
	1	2	3	4
<b>Using change in the share of households with negative equity</b>				
Dummy variable indicating the change in the share in the origin state is in the top third of the distribution	0.829 *** (0.056)	0.830 ** (0.062)	0.839 ** (0.061)	0.839 ** (0.069)
Actual change in the share in the origin state, 2006–2008	0.347 *** (0.088)	0.391 * (0.209)	0.422 * (0.212)	0.416 (0.236)
<b>Using change in house prices</b>				
Dummy variable indicating change in house prices in the origin state is negative	0.844 ** (0.058)	0.869 (0.076)	0.888 (0.077)	0.890 (0.089)
Dummy variable indicating the change in house prices in the origin state was in the bottom third of the distribution	0.785 *** (0.042)	0.821 (0.123)	0.831 (0.116)	0.828 (0.131)
State dummies for origin included?	Yes	Yes	Yes	Yes
State dummies for destination included?	No	Yes	Yes	Yes
Demographic controls included?	No	No	Yes	Yes
Economic controls included?	No	No	No	Yes
Number of observations	164,179,648	164,179,648	164,179,648	164,179,648

Source: Authors' calculations from the American Community Survey Public Use Micro Sample, 2007 and 2009.

Notes:

Sample is household heads, age 25 to 64 years, not living in group quarters, in the continental United States, excluding the District of Columbia.

Louisiana was excluded in 2006 due to migration that occurred in response to Hurricane Katrina.

Migration rates for renters and homeowners are calculated using tenure in the destination state as supplied by the American Community Survey.

Tenure is determined after migration and does not capture owner to renter transitions and vice versa.

The share of households with negative equity is calculated by the General Accounting Office using data supplied by CoreLogic.

The change in the shares between 2006 and 2008 were categorized into thirds as "low" (0 to 3 percentage points), "medium" (3 to 10 percentage points), and "high" (greater than a 10 percentage point increase).

House price appreciation is calculated by the authors using the nominal FHFA house price index.

The change in house price appreciation between 2006 and 2008 was categorized into "positive or zero" (greater than –1 percent), "negative" (less than –1 percent), and "negative high" (greater than –4 percent).

All regressions include a full set of state origin dummy variables, a full set of state destination dummy variables, a dummy variable for 2008, and an owner dummy variable.

Second level interactions are captured by interacting each state dummy with the 2008 dummy and the owner dummy separately, as well as interacting owner and 2008.

The coefficient reported in the table represent the change in the log odds of the outcome for a one-unit increase in the predictor variable.

Demographic controls include age, race, ethnicity, education, marital status and children.

Economic controls include relative economic differentials for the UI claims rate, per capita income, and a housing affordability index.

Relative economic differentials are calculated as the difference between relative conditions (relative to the nation) in the origin state minus the destination state.

Standard errors are in parentheses, clustered by state.

\*Indicates significance at the 10-percent level, \*\*at the 5-percent level, and \*\*\*at the 1-percent level.

**Table A1**  
**Sample Statistics for Dependent and Independent Variables, Internal Revenue Service, 2006–2008**

	2006		2007		2008		2006–2008	
	Mean	Standard deviation						
<b>Migration and population</b>								
Number of out-migrants from state i to state j	<b>2,604</b>	5,336	<b>2,523</b>	4,966	<b>2,400</b>	4,587	<b>2,506</b>	4,962
Number of initial residents in origin state i	<b>4,769,419</b>	5,005,453	<b>4,847,764</b>	5,096,665	<b>4,939,249</b>	5,215,159	<b>4,854,482</b>	5,108,997
Out-migration rate from state i to state j	<b>0.624</b>	1.013	<b>0.598</b>	0.998	<b>0.567</b>	0.959	<b>0.595</b>	0.990
<b>Negative equity measures</b>								
Origin share of subprime households with negative equity	<b>11.14</b>	13.944	<b>17.43</b>	18.580	<b>20.17</b>	20.837	<b>16.25</b>	18.407
Origin share with house price depreciation	<b>2.08</b>	14.3	<b>20.83</b>	40.6	<b>56.25</b>	49.6	<b>26.39</b>	44.1
<b>Economic conditions</b>								
Origin UI claims rate	<b>12.2</b>	4.5	<b>12.5</b>	4.6	<b>18.6</b>	6.6	<b>14.4</b>	6.0
Origin real per capita income	<b>\$38,784</b>	\$5,798	<b>\$39,672</b>	\$5,847	<b>\$39,273</b>	\$5,609	<b>\$39,243</b>	\$5,763
Origin real housing affordability index	<b>1.05</b>	0.26	<b>1.10</b>	0.26	<b>1.20</b>	0.27	<b>1.12</b>	0.27
<b>Origin demographic characteristics</b>								
Percent of population age 20 to 24 years	<b>0.073</b>	0.008	<b>0.072</b>	0.007	<b>0.072</b>	0.007	<b>0.072</b>	0.008
Percent of population age 25 to 34 years	<b>0.129</b>	0.010	<b>0.130</b>	0.010	<b>0.131</b>	0.010	<b>0.130</b>	0.010
Percent of population age 35 to 44 years	<b>0.141</b>	0.009	<b>0.138</b>	0.009	<b>0.135</b>	0.009	<b>0.138</b>	0.009
Percent of population age 45 to 54 years	<b>0.147</b>	0.009	<b>0.147</b>	0.009	<b>0.147</b>	0.009	<b>0.147</b>	0.009
Percent of population age 55 to 64 years	<b>0.108</b>	0.008	<b>0.111</b>	0.008	<b>0.114</b>	0.009	<b>0.111</b>	0.009
Percent of population age 65 plus years	<b>0.128</b>	0.015	<b>0.129</b>	0.015	<b>0.131</b>	0.015	<b>0.129</b>	0.015
Percent of population black	<b>0.103</b>	0.094	<b>0.104</b>	0.094	<b>0.104</b>	0.094	<b>0.104</b>	0.094
Percent of population Hispanic	<b>0.095</b>	0.097	<b>0.098</b>	0.098	<b>0.100</b>	0.099	<b>0.098</b>	0.098
Percent of population Asian	<b>0.026</b>	0.022	<b>0.027</b>	0.023	<b>0.028</b>	0.023	<b>0.027</b>	0.023
Percent of population with a college degree	<b>0.228</b>	0.045	<b>0.236</b>	0.048	<b>0.242</b>	0.046	<b>0.235</b>	0.047
Percent of population married	<b>0.527</b>	0.030	<b>0.530</b>	0.026	<b>0.521</b>	0.026	<b>0.526</b>	0.028
Percent of population with children	<b>0.290</b>	0.014	<b>0.290</b>	0.017	<b>0.284</b>	0.016	<b>0.288</b>	0.016
Number of observations	<b>2070</b>		<b>2256</b>		<b>2256</b>		<b>6582</b>	

Source: Authors' calculations based on data from the Internal Revenue Service.

Notes:

Alaska, Hawaii, and the District of Columbia have been excluded because data on unemployment insurance claims rate are unavailable for some years.

Louisiana and Mississippi were excluded in 2006 due to migration that occurred in response to Hurricane Katrina.

The number of out-migrants is the number of exemptions moving between each origin-destination pair for the period April of year t to March of year t+1.

The number of initial residents is the total number of exemptions (moving and non-moving) residing in the state as of April of year t.

The out-migration rate is the number of out-migrants per 1,000 initial residents.

The share of households with negative equity is the share of subprime households calculated by the GAO to have negative equity using the CoreLogic data.

Negative house price appreciation is calculated using the FHFA index.

See the data appendix for further details on economic conditions and demographic characteristics.

**Table A2**  
**Impact of a One Standard Deviation Change in Independent Variables on Migration Flows Between the Origin and Destination States, Internal Revenue Service**

	Sample mean out-migration rate per 1,000 residents	Sample mean number of out-migrants	Sample mean number of initial residents	Percent change in out-migration rate for a 1SD increase in the independent variable	New implied out-migration rate for a 1SD increase in the independent variable	Implied change in number of out-migrants for a 1SD increase in the independent variable
<b>Negative Equity Share</b>						
Share of households with negative equity in origin state	0.595	2,506	4,854,482	-0.029	0.578	-85
Relative UI claims rate differential	0.595	2,506	4,854,482	0.038	0.618	109
Relative per capita income differential	0.595	2,506	4,854,482	-0.159	0.501	-461
Relative house affordability index differential	0.595	2,506	4,854,482	-0.041	0.571	-118
<b>Negative House Price Appreciation</b>						
Dummy variable indicating negative house price appreciation in origin	0.595	2,506	4,854,482	-0.006	0.592	-18
Relative UI claims rate differential	0.595	2,506	4,854,482	0.039	0.619	113
Relative per capita income differential	0.595	2,506	4,854,482	-0.160	0.500	-461
Relative house affordability index differential	0.595	2,506	4,854,482	-0.041	0.571	-117

Source: Authors' calculations based on data from the Internal Revenue Service.

Notes:

Alaska, Hawaii, and the District of Columbia have been excluded because data on unemployment insurance claims rate are unavailable for some years.

Louisiana and Mississippi were excluded in 2006 due to migration that occurred in response to Hurricane Katrina.

Sample mean migration rate and number of initial residents can be found on table A1.

Percent change in out-migration rate for a 1SD increase in the independent variable is equal to the coefficient on the independent variable of interest from column 4 of tables 3 and 4.

New implied migration rate is equal to the sample mean migration rate multiplied by the coefficient on the independent variable of interest.

Change in the number of migrants is equal to the new implied migration rate multiplied by the number of initial residents per 1,000.

The share of households with negative equity is the share of subprime households calculated by the GAO to have negative equity using the CoreLogic data.

Negative house price appreciation is calculated using the FHFA index.

See the data appendix for further details on relative economic conditions.