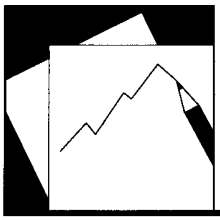
WP/11/105



IMF Working Paper

Has the Great Recession Raised U.S. Structural Unemployment?

Marcello Estevão and Evridiki Tsounta

INTERNATIONAL MONETARY FUND

 WP/11/105

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Western Hemisphere Department

Has the Great Recession Raised U.S. Structural Unemployment?

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Authorized for distribution by Charles Kramer

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Abstract

The recent crisis has had differential effects across U.S. states and industries causing a wide geographic dispersion in skill mismatches and housing market performance. We document these facts and, using data from the 50 states plus D.C from 1991 to 2008, we present econometric evidence that supports that changes in state-level unemployment rates are linked to skill mismatches and housing market performance even after controlling for cyclical effects. This result suggests some causality going from mismatches and housing conditions to unemployment rates. The numerical estimates imply that the structural unemployment rate in 2010 was about 1¾ percentage points higher than before the onset of the housing market meltdown at end-2006. Reversing this increase may require targeted active labor market policies and measures to expedite the adjustment in housing markets, as our results suggest weak housing market conditions interact negatively with skill mismatches to produce higher unemployment rates in the United States.

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I. INTRODUCTION

The financial crisis has hit the U.S. labor market strongly, creating large regional disparities and unequally affecting different segments of society. Not only have unemployment rates reached levels near post-World War peaks but unemployment duration is at historic highs.[2] The crisis affected some groups more severely, including men, youth, and low-skilled individuals and hit some sectors particularly hard, including manufacturing, construction and parts of the financial industry.

Such a high-magnitude shock—indeed the worst recession since the Great Depression—could have created structural labor market problems. In particular, some economic activities were dramatically depressed, while others have just faced a cyclical slowdown, and some states were much more affected by the crisis than others. Even if the large cyclical shock is reversed, it is possible that unemployed workers will need to move away from depressed activities and more affected states. The speed and efficiency of this reallocation would depend on several factors, including: (i) the easiness by which their skills can be remolded to different demands; (ii) the flexibility of wages across the country and sectors; and, (iii) the capital losses and credit constraints they would face if selling their houses or walking out from their underwater mortgages to migrate to more prosperous areas. Also, the monumental crisis has triggered decisive responses from the government, including increases in the generosity of unemployment insurance. That could curb job-search intensity, thus cementing the upward pressures on equilibrium unemployment coming, for instance, from possible geographic and skill mismatches.

This paper shows that the crisis has indeed created extreme disparities across states both in mismatches between the demand and supply of skills and in housing market performance, and estimates their impact on unemployment rates across the country. The analysis shows that the collapse in the housing market and the decline in the production of certain goods and services had a distinct regional pattern. For instance, Nevada, Florida, Arizona, and California were particularly hit by the housing bubble—accounting for more than half of foreclosures at the national level—while, say, Ohio and Michigan suffered with the manufacturing collapse, New York and Delaware hosted the restructuring of financial institutions, and Hawaii experienced shrinking tourism demand. After building an index of skill mismatches for each of the 50 states and the District of Columbia, we show that these mismatches and housing market conditions appear to be cyclical, although both have deteriorated at a higher rate in the current episode than in past downturns. We also find that skill mismatches have been more acute in states with depressed housing markets.

[2] There has been a trend increase in unemployment duration since the 1970s, partly explained by the baby boomers passing into their prime-working years (Abraham and Shimer, 2001), although the recent increase is certainly crisis driven and well beyond the documented trend.

Moreover, once we control for the endogeneity between unemployment, skill mismatches and housing conditions, mostly because of cyclical factors, we show that equilibrium unemployment rates have increased significantly in the United States following the Great Recession. Using a panel data model to relate changes in state-level unemployment rates to time dummies (which capture changes in the business cycle and macroeconomic policies), state GDP growth (which controls for local business cycles), a skills-mismatch index, and an indicator of housing hurdles, we find that a 17 percent increase in skill mismatches (as experienced by the average of the U.S. states since the onset of the recession) is associated with a third of the overall estimated increase in the structural unemployment rate. This result is broadly confirmed when we use the standard deviation of sectoral employment growth in a particular state and year as an indirect measure of shocks to the matching of skill demand and supply. Also, our results suggest that higher foreclosure rates and lower housing prices could be raising unemployment rates, confirming some preliminary evidence in Estevão and Barrera (2008).

Crucially, we show that increases in skill mismatches in states with worse housing market conditions (say, as measured by larger increases in foreclosure rates or larger house price declines) are associated with even higher unemployment rates, after controlling for all cyclical factors. A possible mechanism behind this effect is that bad local housing conditions may slow the exodus of jobless individuals from a depressed area, thus raising equilibrium unemployment rates. That would put in question the stylized fact of high labor mobility across U.S. regions (at least when compared to most other developed nations) during housing crisis.[3] Combined, we find that the impact of skill mismatches and higher foreclosure rates might have raised the natural rate of unemployment (often referred to as structural unemployment throughout the paper) by about 1½ percentage points since 2007. Interestingly, the increase is even larger, at around 1¾ percentage points since the onset of the housing market collapse at end-2006. Even though these estimates would still leave ample space for reductions in the unemployment rate from the current 8¾ percent level, we may begin observing slower job reallocation flows as the unemployment rate goes below 7 percent or so, with deleterious impact on wage and price inflation.

Given the interlinkages between housing and labor markets, effective measures to alleviate housing market strains, including controlling foreclosures and ensuring effective loan modifications, seem to be needed.[4] On the skill-mismatch side, targeted policies aimed at hiring the long-term unemployed, perhaps through subsidies to *net* hiring and retraining, would reduce structural unemployment rates. Improved employment services and job-search

[3] See Blanchard and Katz (1993). For instance Ferreira et al. (2010) and Frey (2009) discuss the recent slowdown in U.S. labor mobility.

[4] For a discussion of possible policies to tackle housing market problems, see IMF (2009, 2010a, 2010b) and Kiff and Klyuev (2009).

assistance could also be helpful. Both interventions would add to macroeconomic stimulus by allowing the cyclical recovery to make deeper inroads on unemployment rates. However, a brief review of the effectiveness of these policies in the United States suggests that great care is needed when utilizing these measures to maximize their effects.

The remainder of the paper is structured as follows. Section II briefly describes the labor market impact of the recent crisis. Section III explains the construction of a state-level skill mismatch index and discusses its developments across the country. Section IV goes over disparities in housing market performance during the crisis. Section V uses a panel data model to measure the impact of these factors on structural unemployment and perform some robustness tests. Section VI discusses policy implications and briefly reviews existing programs in the United States to improve labor quality and matching with existing vacancies. The final section concludes.

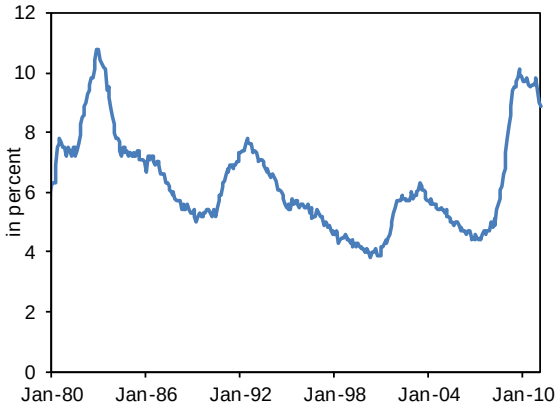
II. A Dismal Labor Market Situation

The financial crisis hit the U.S. labor market strongly (Figure 1). Aggregate employment declined by around 8½ million from the onset of the recession in December 2007 to its trough, before beginning to recover slowly in 2010. The unemployment rate spiked to a 27-year high of 10.1 percent in late 2009 (the second highest rate since data collection began in 1948), and it now rests at around 8¾ percent amid declining labor force participation. The employment losses were staggering. The economy, which had been losing fewer than 130,000 jobs per month on average prior to the Lehman Brothers' collapse in September 2008, experienced huge job losses—averaging over 750,000 per month from November to March 2009. As a result, the U.S. economy lost 1.2 million jobs in the fourth quarter of 2008—the largest quarterly decline since the end of World War II—and an even larger 2.5 million jobs in the first quarter of 2009 (a record 5.5 million in 2009 as a whole). By October 2009, the country had reached a peak 15.6 million people unemployed—substantially above the previous peak in 1982 of 12 million people. The crisis has hit some states particularly hard, with average unemployment rate in 2010 ranging from 3.9 percent in North Dakota to 14.9 percent in Nevada.

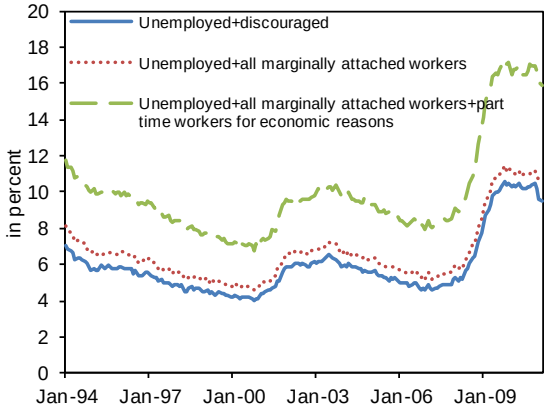
This is the hardest period for the unemployed to find work outside the Great Depression, with unequal effects on various population groups. Unemployment duration is at a historic highs in March 2011, and around 46 percent of all unemployed (another historic high) was out of employment in May 2010 for at least 27 weeks. Broader measures of labor underutilization (e.g., discouraged workers and involuntary part-time workers) reached historical highs during this downturn. While the unemployment rate for women remains below the post-Depression historical peak, male unemployment has surpassed it in October 2009 (reaching 11.4 percent). Unemployment rates for teenagers (16–19 years old) and individuals 25 year-old or older reached record post-Depression highs during this downturn, while in the remaining categories rates are very close to those highs. Joblessness is particularly acute in

Figure 1. Unemployment Developments

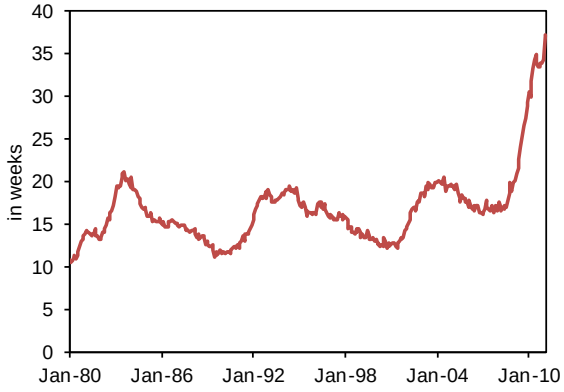
The unemployment rate peaked at a 27-year high...



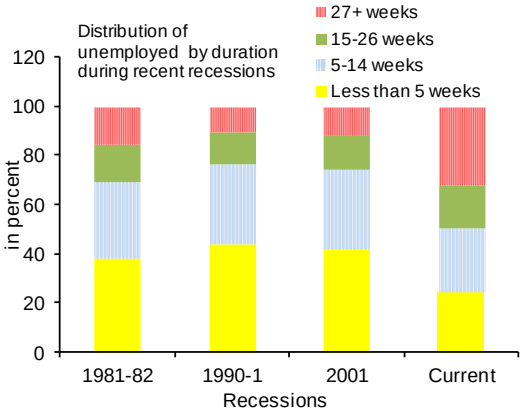
...and all measures of underutilization peaked at record highs as well.



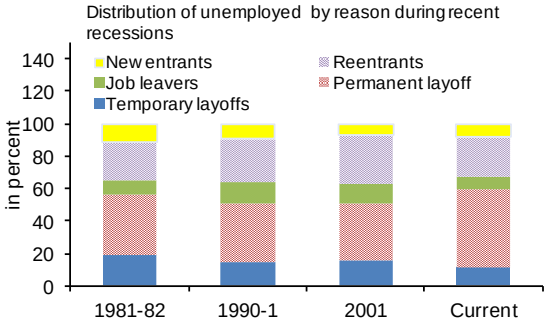
Average unemployment duration reached a record high...



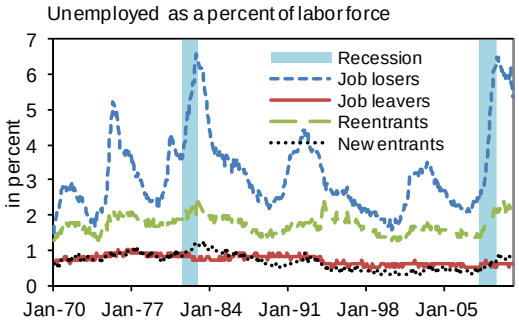
...while people that are unemployed for more than 15 weeks is at a historic level.



The majority of unemployed have lost their job permanently...



...as was the case in 1982.



Sources: Haver Analytics and authors' calculations.

the manufacturing sector, where around 2 million jobs had been lost since the start of the recession before hiring restarted in 2010. Low-skilled individuals with 25 years of age or older (with at most a high-school diploma, representing 37 percent of the civilian labor force) have been particularly hit. Moreover, one in seven individuals without a high-school diploma and one in ten high-school graduates are unemployed. All these labor market statistics have improved only a little in recent months.

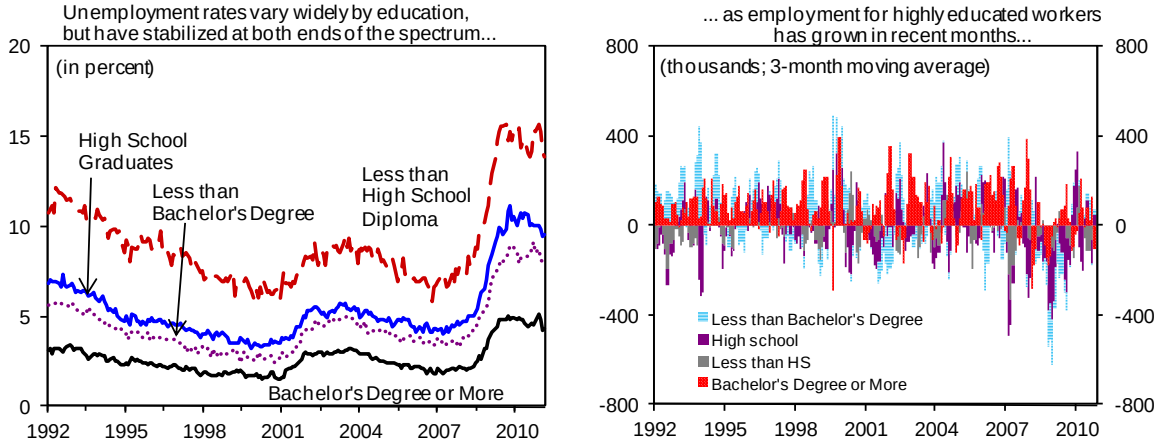
The sheer size of these shocks and their unequal effects on different segments of the population and sectors could have created a wedge between the available pool of skills and the demand for labor. An important source of mismatch between labor demand and labor supply is already taking shape and could intensify going forward; the unemployment rate for low-skill workers (in terms of years of schooling) has increased disproportionately during the current crisis, while demand for high-skill labor (which comprises a third of the U.S. civilian labor force) is already on the rise (Figure 2). Moving forward, this mismatch might intensify further as, for example, housing construction will probably remain lackluster for a while, while sectors that are more intensive users of qualified labor (e.g., the export and health sectors) may see a surge in investment and activity.[5]

III. Are Skill Mismatches on the Rise?

To study the importance of skill mismatches at this point in time, we construct an index of skill mismatches across the 50 states and the District of Columbia. The index also sheds light on the relative importance of structural and cyclical factors to explain the unprecedented job losses. The index captures how shrinking industries (such as construction and financial services during the recent downturn and manufacturing on a more structural basis) could have contributed to the swelling of a particular skill set among the unemployed, which may not necessarily be absorbed by expanding industries (e.g., health and education, or professional services). Our analysis on skill mismatches is undertaken using state-level data, as the crisis has had an important regional component, which will be useful when we interact this effect with state-level conditions in the housing market. Moreover, the use of state-level data increases not only the number of observations vis-à-vis time series models but also the heterogeneity of unemployment experiences, thus facilitating the identification of key parameters.

[5] The U.S. Bureau of Labor Statistics and Department of Labor (2010) report that the jobs for health care professionals and professionals in scientific and technical services will lead overall labor demand growth in the next decade.

Figure 2. Unemployment and Employment by Educational Attainment



Sources: Haver Analytics, U.S. Bureau of Labor Statistics, and authors' calculations.

The skill-mismatch index (SMI) is calculated by taking the difference between the skill "demand" and "supply" in a state. State skill demand is defined as the average proportion of high-, semi-, and low-skilled workers currently employed in a state. To calculate that we first ranked one-digit industries according to its skill intensity, defined by the average education attainment of its labor force in a benchmark year (using the 2006 Current Population Survey). Second, we grouped sectoral employment (as in the Current Employment Statistics database from the U.S. Bureau of Labor Statistics) in each of the three skill categories. Then, the percentage of employed individuals at each skill level in a state was calculated and was used to represent state skill "demand" at one point in time. The use of industry data to calculate demand for skill has the advantage of simplicity, as the data are readily available, and introduces industry composition of employment in our measure, thus capturing a key driver of the diverse employment performance across states during the recent recession. State skill "supply" was determined using educational attainment data from the U.S. Census Bureau for working-age population.[6] (See the appendix for additional details on data construction.)

Specifically the SMI for each state *i* at time *t* is constructed using the following formula:

[6] Data were interpolated for 2008–10 due to data limitations as explained in appendix I. Such interpolation, actually understates the skills mismatch index since it assumes higher labor mobility than actually observed during the current downturn.

$$Skill\ Mismatch\ Index_{it} = \sum_{j=1}^{3} (S_{iji} - M_{ijt})^2$$

Where:

j=skill level, S_{ijt}=percent of working-age population with skill level *j* at time *t* in state *i*, M_{ijt}=percent of employees with skill level *j* at time *t* in state *i*.

The skill-mismatch index can be interpreted in two ways.[7] First, cross-state information suggests which states are facing difficulties in employing their skill base. Second, comparing SMI values within a state across time allows identifying whether surges in SMIs are either cyclical or structural. Both types of analysis inform whether programs are needed to change labor force skills or attract an industry that would demand the particular set of skills available in a state. Surely, if unemployed workers are quite mobile across states, migration would also help such adjustments.

As expected, we find that the skill mismatch index typically rises during recessions. (Figure 3, see also appendix table.) In all states, but the District of Columbia (D.C.), the index exhibits cyclical patterns, with large surges during recessions.[8] The following observations are noteworthy:

- On average, skill mismatches increased in the country as a whole during this downturn with significant dispersion across states, in contrast to the experience of the 2001 recession (Figures 4, 5, and 6).

- For numerous states (including Arizona, Delaware, Florida, Hawaii, Michigan, Missouri, New Mexico, Ohio, and Wisconsin) the skills mismatch index (SMI) is near or at historic peak levels (data start in 1990). This is not surprising since in most of these states manufacturing (which is in a declining trend) has accounted for a large share of gross state product (GSP), including in the Great Lakes region as a whole. The level of skill mismatch varies across states with Nevada, New Hampshire and Vermont experiencing low mismatches, while states such as New Mexico, Arkansas, West Virginia, and Delaware experiencing very large

[7] The construction of this index is inspired by Peters (2000), who analyzes skills mismatches in Missouri's manufacturing sector, with skills proxied by educational attainment.

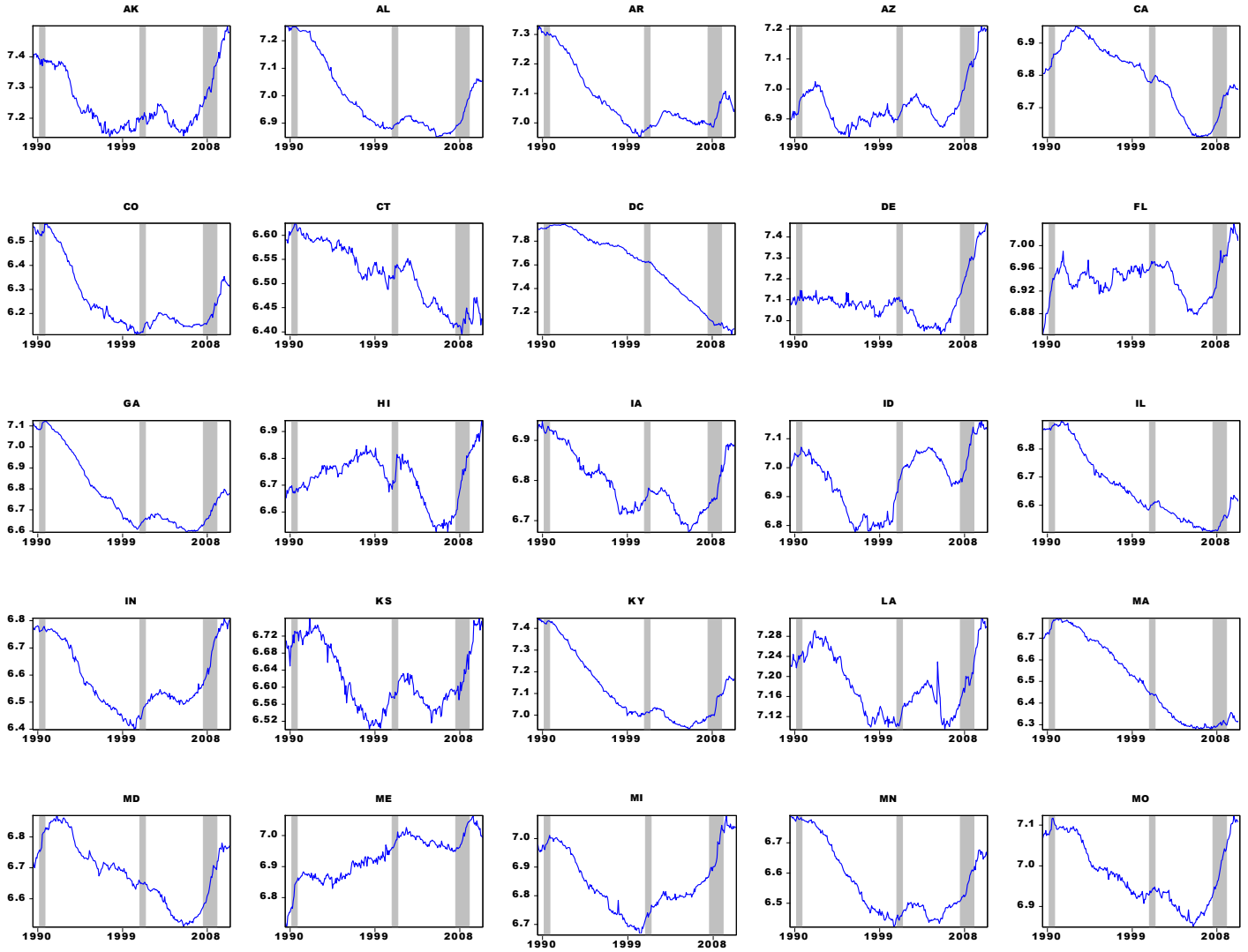
[8] It is not surprising that D.C. is an outlier given the large presence of the federal government and thus of less cyclical labor usage. D.C. has also seen a persistent downward trend in low-skilled population (possibly reflecting rapidly rising cost of living) and diminishing job opportunities for this segment of the population. In level terms, skill mismatches in D.C. remain large when compared to other states.

level of mismatches. Most Great Lakes states experience average skills mismatches—notably Michigan—while some areas in the northeast have large skill mismatches (e.g., the District of Columbia and New York). Southern states exhibit average skills mismatches (with Arizona at the higher end) while California and other western states are in the middle of the pack. (Figure 4).

- Importantly, *increases* in skill mismatches during the recent recession have varied across states. States that had specific characteristics (e.g., Delaware—a financial hub; Hawaii with large reliance on tourism and Michigan—an auto hub) have experienced disproportionate increases in skill mismatches (Figure 5).

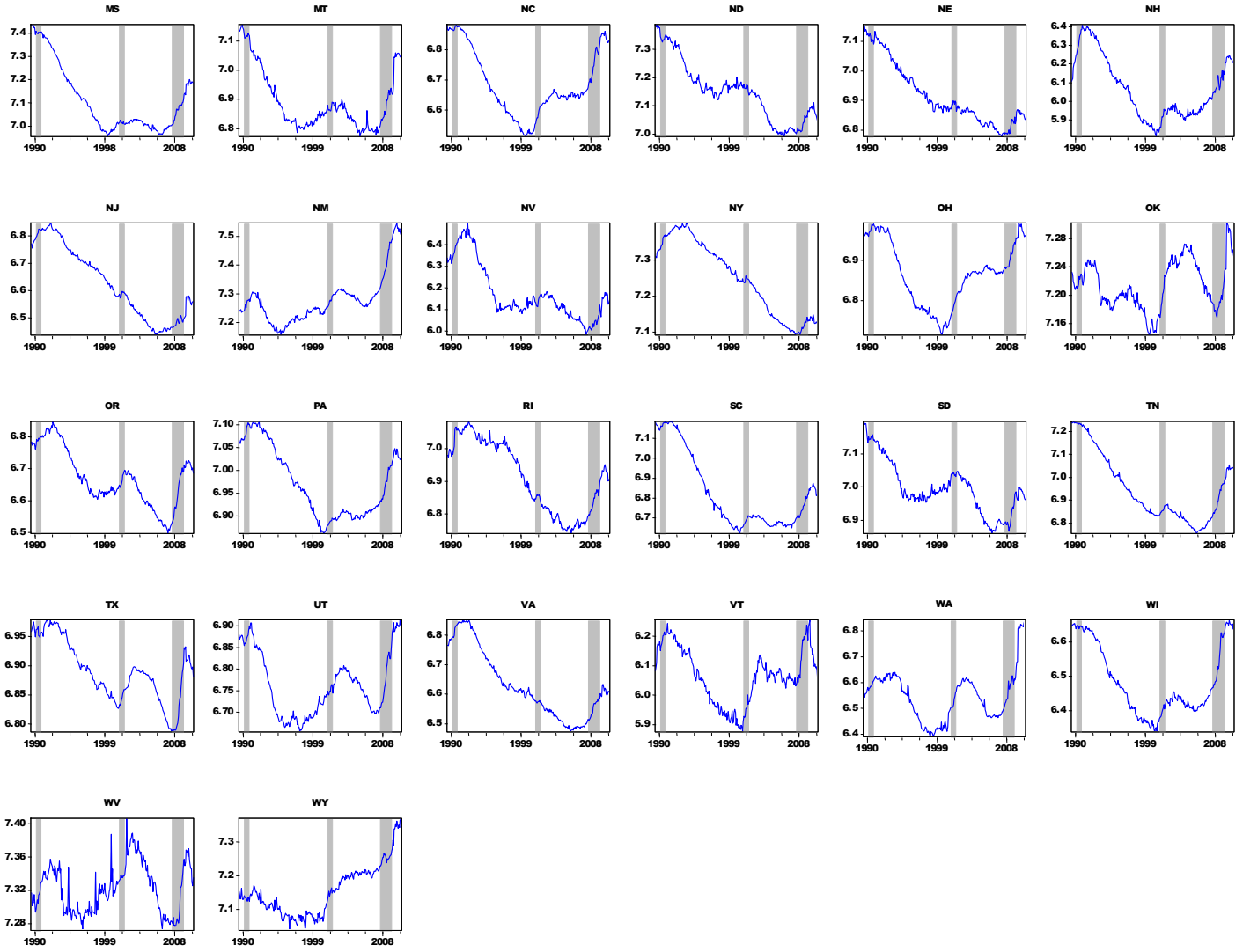
- Skills mismatches continued to rise in almost all states even after the recession has ended, partly explaining the stubbornly high unemployment rate; in fact Delaware and Washington State experienced a double digit percentage increase in their skill mismatch index in 2010.

Figure 3. Skill Mismatch Index by State, 1990-2010



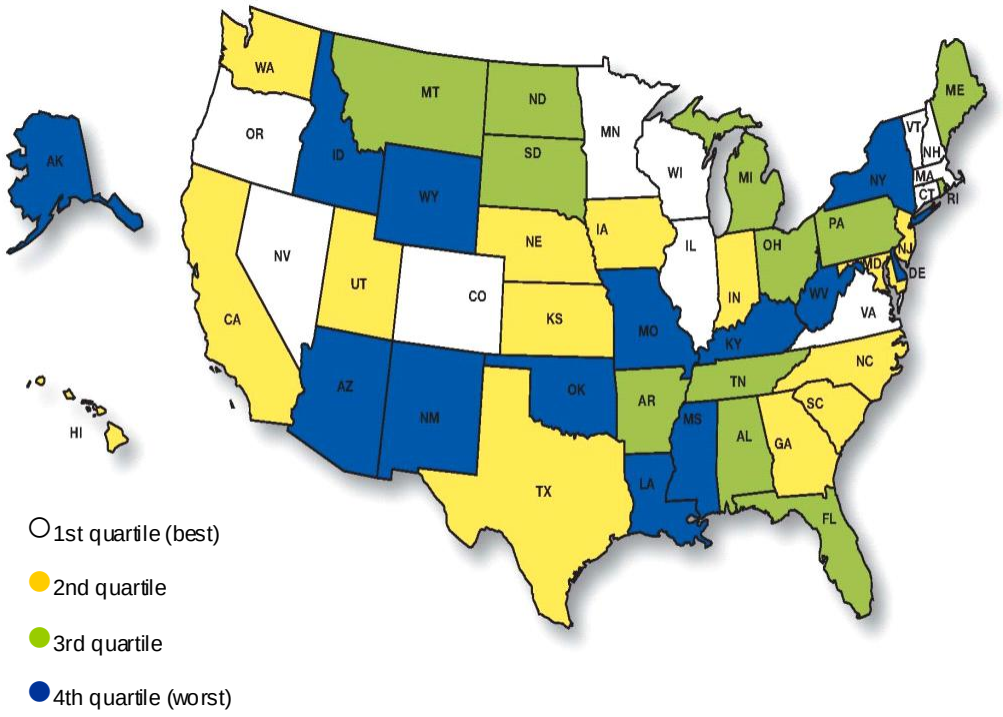
Sources: Haver Analytics, U.S. Bureau of Labor Statistics, U.S. Census Bureau, and authors' calculations.

Figure 3. Skill Mismatch Index by State, 1990-2010 (cont.)



Sources: Haver Analytics, U.S. Bureau of Labor Statistics, U.S. Census Bureau, and authors' calculations.

Figure 4. Skill Mismatch Index Level by State, 2010

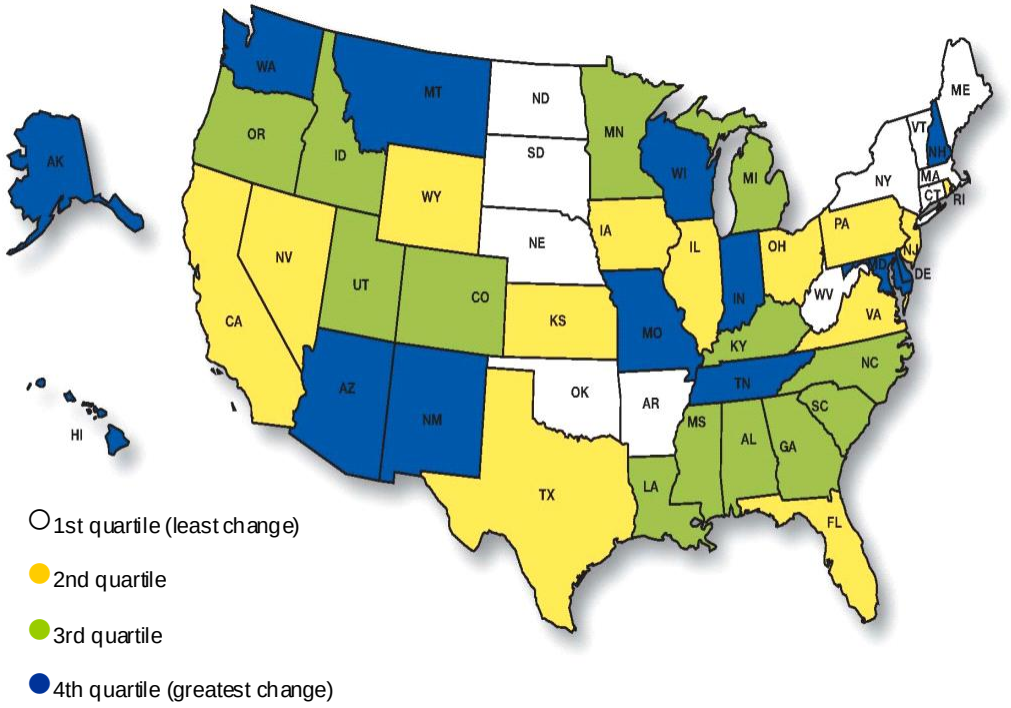


Sources: Haver Analytics, U.S. Bureau of Labor Statistics, U.S. Census Bureau, and authors' calculations.

Notes: 1st quartile [453.0,820.1], 2nd quartile [850.9,995.1], 3rd quartile [1016.3,1184.8], 4th quartile [1220.2,1849.3]. Annual levels are the average of 12 months.

Figure 5. Change in Skill Mismatch Index, 2007-2010

(in percent)

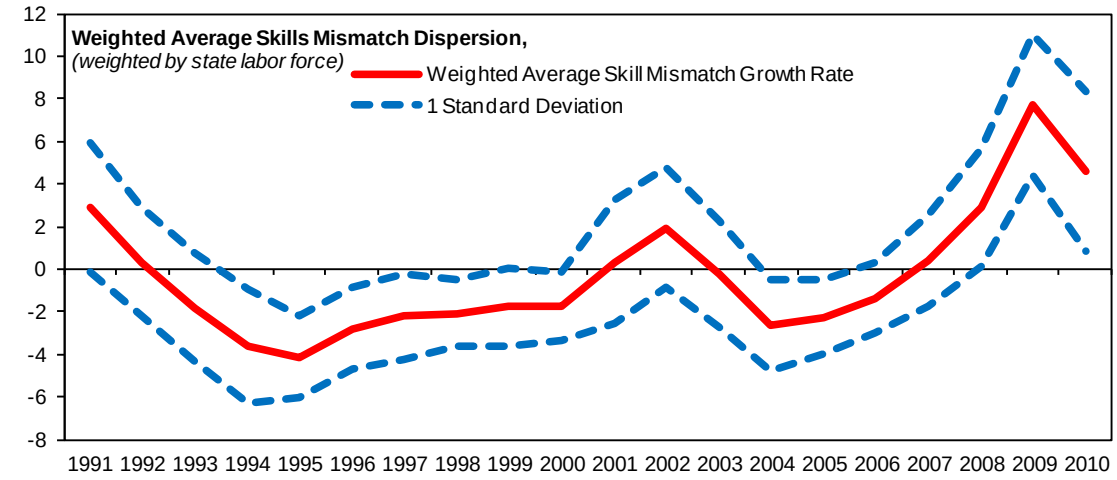


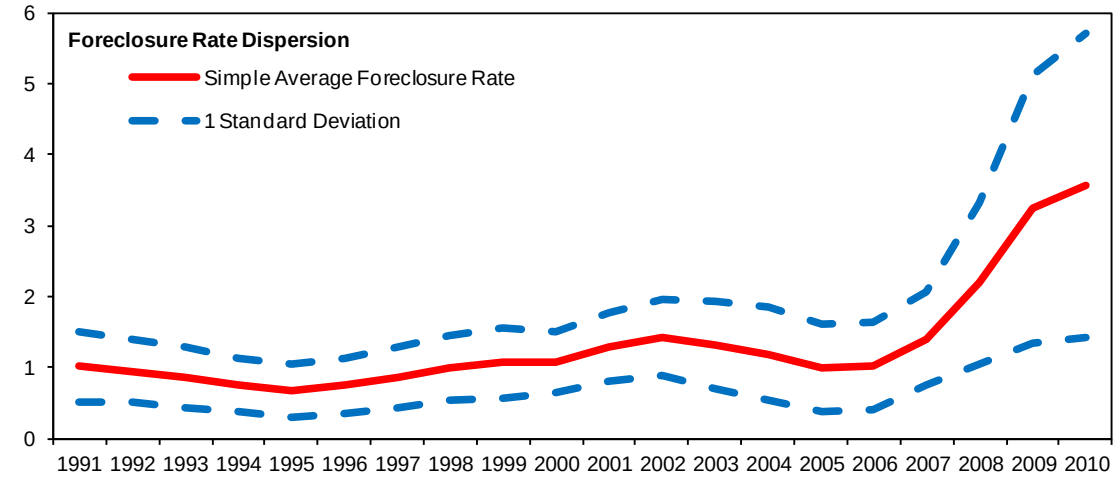
Sources: Haver Analytics, U.S. Bureau of Labor Statistics, U.S. Census Bureau, and authors' calculations.

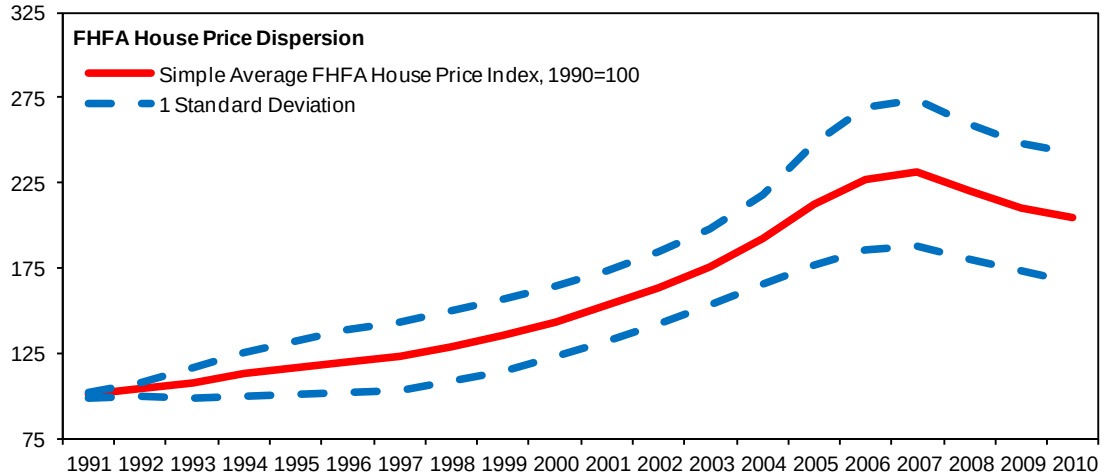
Notes: 1st quartile [-14.2,9.8], 2nd quartile [10.3,18.1], 3rd quartile [18.2,21.8], 4th quartile [23.5,44.0].

Calculated as the percent change from 2007-2010. Annual levels are the simple average of 12 months.

Figure 6. Labor and Housing Market Dispersion







Sources: Haver Analytics, Mortgage Bankers Association, U.S. Bureau of Labor Statistics, U.S. Census Bureau, U.S. Federal Housing Finance Agency House Price Index, and authors' calculations.
1/ House Price Index 1990=100, SA.

IV. HOUSING WOES ACROSS U.S. STATES

Unlike most previous U.S. episodes, this recession originated in the housing sector. Housing is not per se the most important sector in the U.S. economy, employing around 6 percent of the workforce and accounting for about 5 percent of U.S. GDP in 2007—figures that have been halved by the crisis. However, the current difficulties in the housing market—with near record-high delinquencies and foreclosures—and increasing negative equity issues amid sharp declines in house prices from their peak levels, could affect GDP and employment by more than its direct importance given that housing is the most important financial asset for a large share of the population.

Housing Market Indicators, end-2010Q4

	Delinquency rate	Foreclosure rate
United States	**8.2**	**4.6**
Nevada	12.0	10.1
Michigan	10.6	4.3
Indiana	10.2	4.8
Florida	10.1	14.2
Ohio	9.8	4.9
Arizona	9.5	5.7
California	9.2	4.5

Sources: Haver Analytics, Mortgage Bankers Association and authors' calculations.

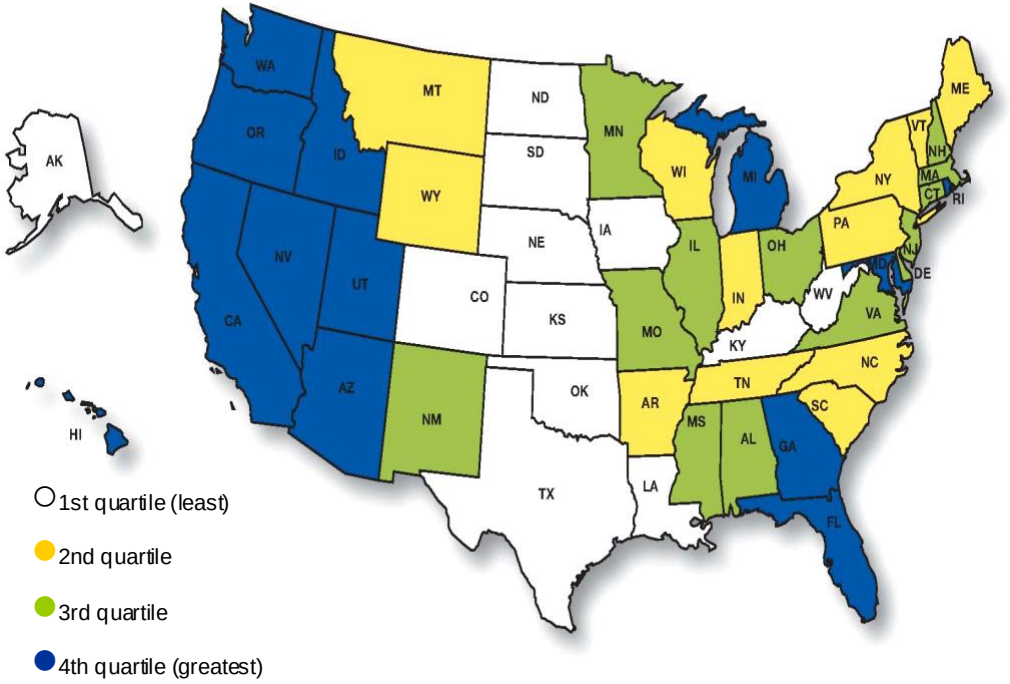
The difficulties in the housing market are well known; house prices as measured by the Case-Shiller index and the National Association of Realtors are both around 30 percent below peak levels, and one in 12 mortgages are late for at least 30 days and 4.6 percent of outstanding mortgages are in foreclosure. Significant declines can also been seen in FHFA house-price indices.[9] The numbers are particularly staggering in certain states, including Arizona, California, Florida, Michigan and Nevada, resulting in large disparities across states in foreclosure rates, housing prices, and the number of underwater mortgages (Figures 7 to 9).[10] The national average foreclosure rate was around 4½ percent at the end of 2010 and state-specific figures ranged from about 1½ percent in Alaska and Wyoming to double-digit rates in Florida and Nevada. The FHFA price indices show that, on average, house prices declined by over 15 percent from their peak levels in 2007, although some states experienced much larger declines; house prices declined

[9] Case-Shiller indices are only available for 20 major metropolitan areas but have a more inclusive sample of mortgages, including not only prime but also subprime and alt-A mortgages. FHFA prices have the advantage of covering the whole country but exclude prices of houses whose sales were financed with a subprime or an alt-A mortgage. Our analysis is based on FHFA house prices given the better geographic coverage; our results remain robust to using Case-Shiller house price indices.

[10] According to CoreLogic (2011), almost 70 percent of all mortgaged properties were underwater in Nevada in the last quarter of 2010, while less than 10 percent of the mortgaged properties in New York state and North Dakota had negative equity.

Figure 7. Decline in FHFA House Prices Since Peak

(in percent)

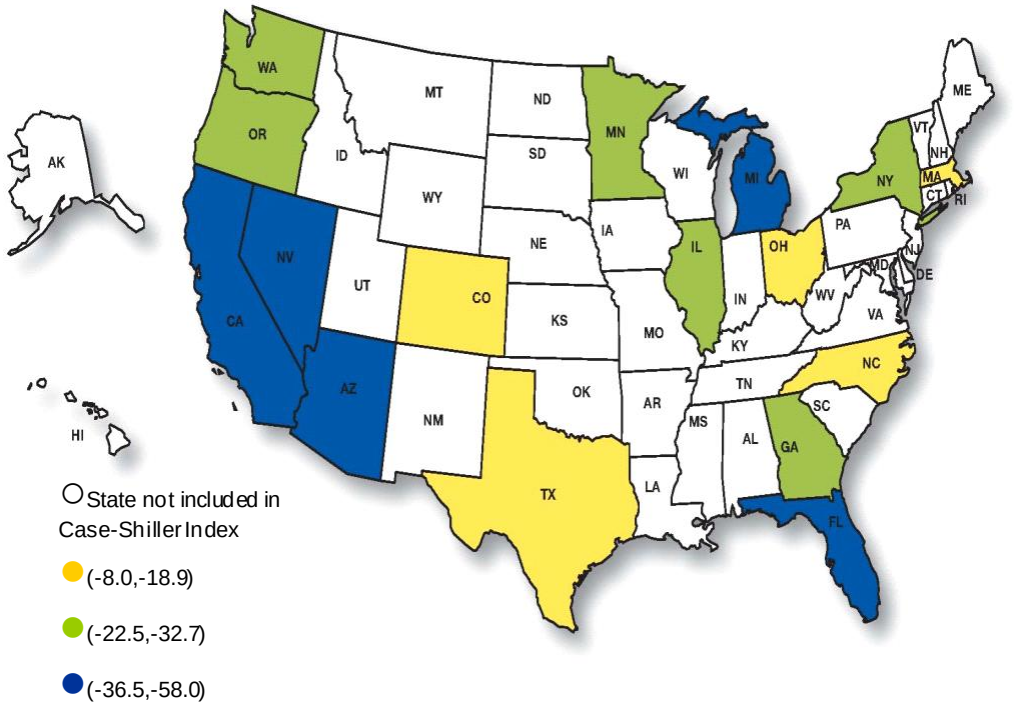


Sources: Federal Housing Finance Agency and authors' calculations.

Notes: 1st quartile [0,-3.8], 2nd quartile [--4.1,-7.8], 3rd quartile [-7.8,-15.2], 4th quartile [-15.8,-51.9].
Calculated as the percent change from the peak (2005-2007) to 2010 FHFA House Price Index (SA). Annual index is a simple average of 12 months. Index: 2000=100.

Figure 8. Percent Change in Case-Shiller House Price Index Since Peak

(in percent)

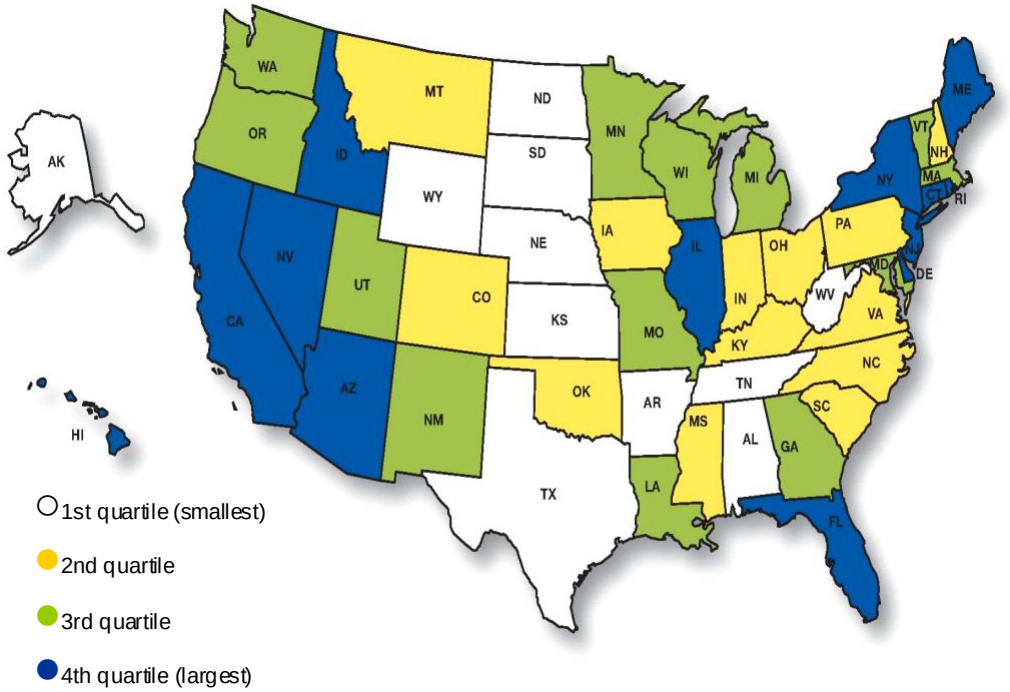


Sources: Standard & Poor's and authors' calculations.

Notes: 1st group [-8.0,-18.9], 2nd group [-22.5,-32.7], 3rd group [-36.5,-58.0]. Calculated as the percent change from peak (2005-2007) to 2010 Case-Shiller Index. Annual index is a simple average of 12 months. Index: 2000Q1=100.

Figure 9. Increase in Foreclosure Rates, 2005-2010

(in percentage points)



Sources: Mortgage Bankers Association, and authors' calculations.

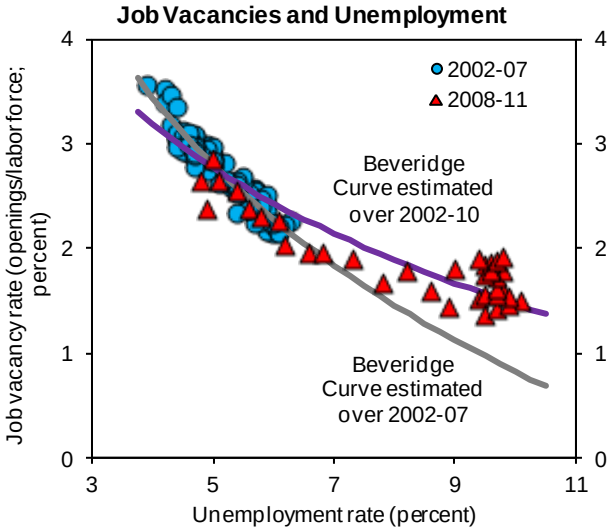
Notes: 1st quartile [0.6,1.4], 2nd quartile [1.4,2.29], 3rd quartile [2.3,2.9], 4th quartile [3.0,13.7].

Calculated as the percentage point change from 2005-2010. Annual levels are the simple average of 12 months.

by almost 50 percent in Nevada, about 40 percent in California, and 36 percent in Florida. This general picture is broadly confirmed for the states encompassing the metropolitan areas covered by the Case-Shiller indices. Overall, the standard deviation of changes in foreclosure rates and housing prices have grown dramatically during the recession (Figure 6) when compared to the other two recessions in the data sample (early 1990s and early 2000s), suggesting severe regional disparities in economic conditions.

Evidence on the dispersion in economic performance becomes even more acute once information on state-level housing market conditions and skill mismatches are combined (Figure 10). An index accounting for the interaction of levels and increases in skill mismatches and foreclosure rates show that while some states (California, Michigan, Ohio, Florida, and Arizona) are particularly hit by both shocks, other states (notably Montana, North and South Dakota, Nebraska, Kansas, Colorado, and Texas) have not fared as badly, even though all states have seen a deterioration in both aspects.

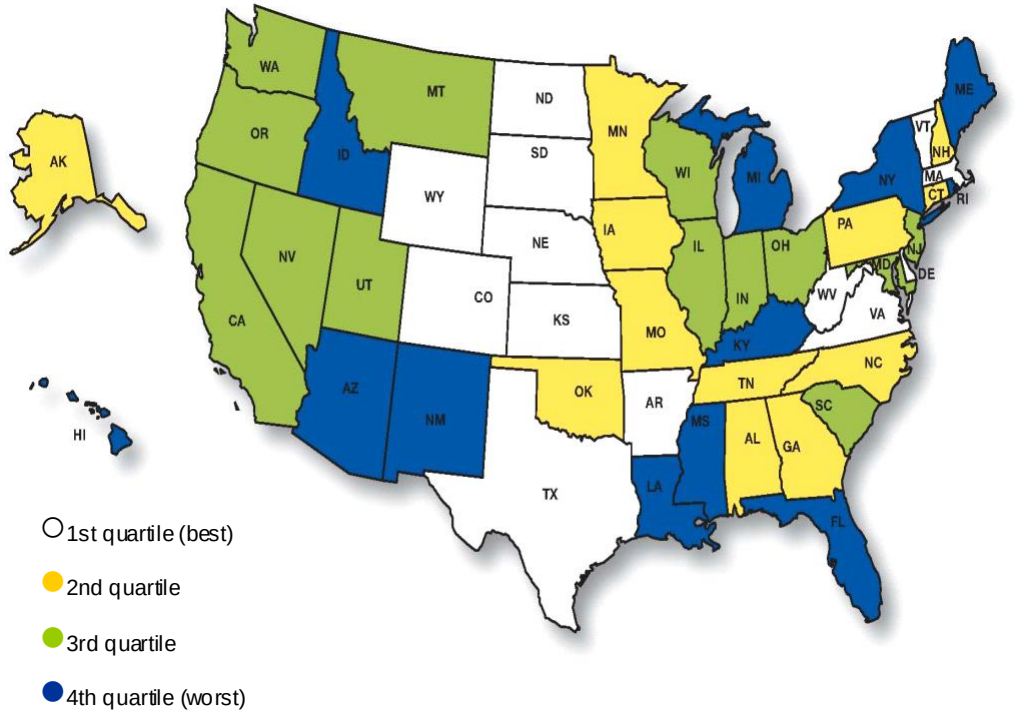
Coupled with data showing that inter-state migration has gone down during the crisis (Figure 11),[11] and an observed shift in the Beveridge curve, the evidence discussed thus far suggests that the usual labor market adjustment mechanism in the United States could be rusty. The Beveridge curve describes an inverse relationship between the unemployment rate and the job openings rate. In general, recessions do not fundamentally alter this relationship; they just result in a move along the curve: as the unemployment rate rises, the job openings rate falls. However, this recession appears to have altered this relationship, suggesting that while employers are looking for workers, they are having a harder time finding the right ones for the job. The size of the curve shift depends on the sample used to estimate the relationship. If data for the recent crisis and recovery is included in the estimation, the curve is forced to fit through the recent data (text chart). In that case, the upward shift in the Beveridge curve would be underestimated. If the sample ends before the recession started (end of 2007), the estimated



Estimated using monthly national data.
Sources: Bureau of Labor Statistics, Haver Analytics, and Fund staff estimates.

[11] Frey (2009) finds that geographic mobility has declined over the last two decades in the United States and has fallen sharply since 2007 amid the collapse in the housing market.

Figure 10. Composite Effect of the Crisis Since Onset of the Recession



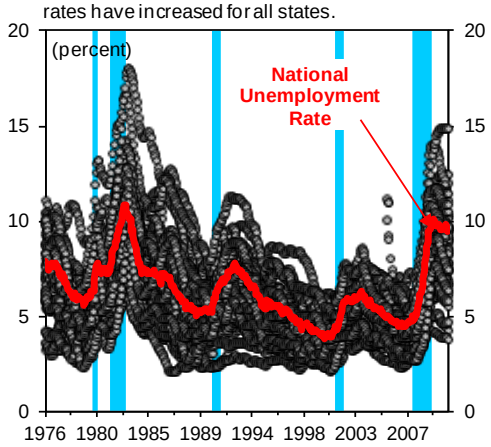
Sources: Haver Analytics, Mortgage Bankers Association, U.S. Bureau of Labor Statistics,

Notes: 1st quartile [33,79], 2nd quartile [80,103], 3rd quartile [105,128], 4th quartile [128,187].

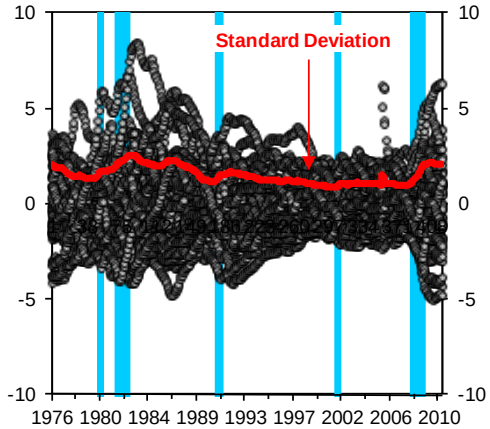
Composite score is calculated by ranking each of the 51 states including D.C. in four categories: 2010 SMI, 2010 foreclosure rate, percent change in SMI (peak to 2010), and percentage point change in foreclosure rate (peak to 2010).

Figure 11. Geographic Mismatches

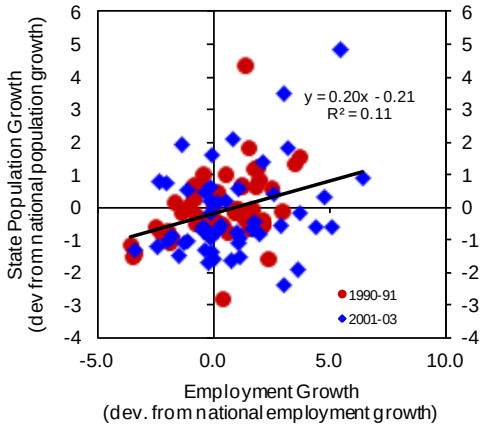
Since the onset of the recession, unemployment rates have increased for all states.



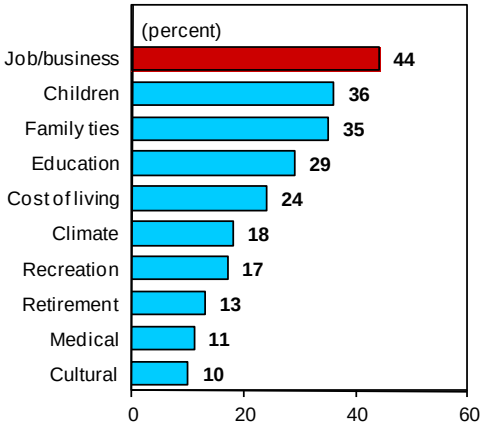
In contrast to the previous two recessions, unemployment rates are much more varied across states.



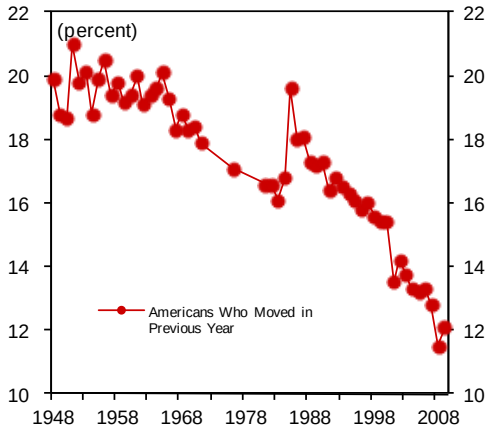
In the last two recessions, states with stronger job growth had above average population growth...



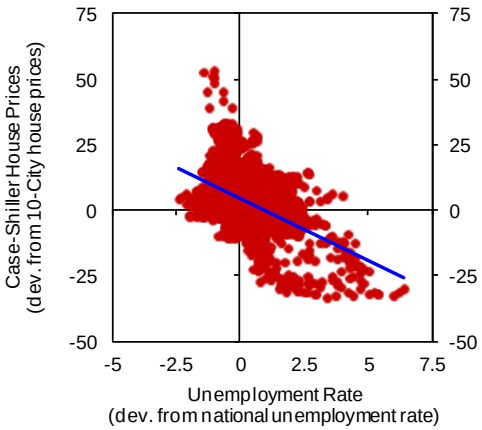
... in line with survey results indicating work-related reasons as a major reason Americans move.



Though Americans have been moving less, weak housing markets may have contributed to a drop in 2008...



...which could inhibit unemployment from falling, as house prices fell most where joblessness rose most.



Sources: Bureau of Labor Statistics; U.S. Census Bureau; Pew Research Center; Standard & Poor's/MacroMarkets, LLC; Haver Analytics; and Fund staff calculations.

concavity of the Beveridge curve may be incorrect. In that case, the upward shift in the Beveridge curve would be overestimated. The truth is probably somewhere in between but it is also affected by the fact that Beveridge curve shifts could be cyclical In past recessions and early recoveries, the Beveridge curve have seemed to shift at first, just to cycle through back to the original starting point after a few quarters. The recent episode could be consistent with this cyclical behavior although the shift seems quite sustained so far.

A key remark is that an increase in the underlying structural rate of unemployment does not need to be associated to observable slower mobility of workers now. Indeed, if the cyclical component of unemployment is still high, the general economic weakness and overall job scarcity would mask an increase in structural unemployment.[12] The important question to answer is the following: is the threshold for the unemployment rate consistent with low inflation pressures higher as a result of the crisis? This issue is developed further in the coming section.

V. Is Structural Unemployment on the Rise?

Model estimates

This section pulls together the previous arguments by investigating more systematically the relationship between unemployment, skill mismatches, and housing market conditions, all at the regional level. We use a panel data approach with annual information from 1991 to 2008 for all the 50 states plus the District of Columbia (descriptive statistics and data details are provided in the appendix). The estimated model relates annual percentage-point changes in the state-level unemployment rate to annual percent growth rate in state-level output, much in the flavor of the "difference" specification for the Okun's Law. It includes annual percent changes in state-level skill-mismatch indices and an indicator for housing conditions, the latter measured either in terms of percent changes of housing prices or the annual percentage point changes in mortgage foreclosure rates (ratio of foreclosed mortgages to total outstanding mortgages in the state). The sample used in the econometric analysis is limited to up to 2008, since GDP state-data were not available for 2009–10 when the bulk of the econometric analysis was. The estimated model can be written as:

$$\Delta u_{it} = \beta_S S_i + \beta_T T_t + \beta_Y \Delta y_{it} + \beta_M \Delta m_{it} + \beta_H \Delta h_{it} + \beta_{MH} \Delta m_{it} * \Delta h_{it} + \varepsilon_{it} \qquad (1)$$

[12] Indeed, recent research has shown that reported recent declines in migration pattern could be caused by measurement error. See Schulhofer-Wohl (2010).

Where, i and t refer to a state and a year, respectively, S_i is a state-specific dummy, T_t is a time-specific dummy, Δu_{it} is the annual percentage-point change in the unemployment rate for state i at time t, Δy_{it} is the log-difference of GDP for state i at time t, Δm_{it} is the log-difference of the skill mismatch index, Δh_{it} is a measure of housing market conditions in a state, and ε_{it} is a residual assumed to be i.i.d.

State-specific dummies capture institutional differences across the states, including in parameters of the unemployment insurance systems as well as labor market characteristics that are unchanged across time. Year-specific dummies control for aggregate variables that could affect the behavior of state-level unemployment rates, like interest rates and federal spending. Thus, both sets of dummies control for factors that could be driving contemporaneous movements in state unemployment and the other right-hand side variables. For instance, changes in policy interest rates affect unemployment rates directly through aggregate demand but also affect demand for housing through changes in housing affordability. State-specific business cycles are captured by changes in state-level GDP. The interaction term between changes in skill mismatches and changes in housing market conditions, $\Delta m_{it}*\Delta h_{it}$, captures the extent that those two effects are interrelated.

Estimates of state-level GDP, available from the Bureau of Economic Analysis (BEA) are subject to substantial measurement error, raising the need for constructing alternative measures, for robustness purposes. The BEA figures are in large part obtained by compiling information of production factor incomes earned and the costs of production, which could be dissociated to the actual location of production due, for instance, to tax incentives in neighboring states. To check for the best way to control for output changes at the state level, we construct alternatives to the BEA figure by mixing information on GDP by industry at the national level with employment payroll data at the industry and state levels. The first option uses the share of employment in sector j in state i to weigh nationwide sectoral GDP growth and create a proxy for state level activity in that sector. Formally:

$$\Delta\ln(GDP1_i) = \sum_j(\Delta\ln(GDP_j)*sh1_{ij}) \qquad (2)$$

Where $GDP1_i$ represents the constructed GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh1_{ij}$ represents the share of employment in sector j in total state i employment. Δ and $\sum$ are the difference and sum operators, respectively, while ln represents natural logs.

The second option uses the share of employment in a particular sector and state vis-à-vis national sectoral employment to distribute nationwide sectoral GDP across states. After summing across different sectors, the state-level growth rate in economic activity is calculated. Formally:

$$\Delta\ln(GDP2_i) = \Delta\sum_j(\ln(GDP_j*sh2_{ij}) \qquad (3)$$

Where $GDP2_i$ represents the calculated GDP of state *i*, GDP_j represents GDP of sector *j* at the national level, and $sh2_{ij}$ represents the share of employment in sector *j* in state *i* vis-à-vis aggregate sector *j* employment.

To decide which measure of state-level GDP growth better captures local business cycles, we compare simple Okun's Law estimates with each of the three available variables. As a criterion to choose the best measure, we compare estimates of Okun's Law coefficients for specifications of changes in the unemployment rate against GDP growth. The variables producing the coefficients for GDP growth closest to the international evidence of between -0.3 to -0.4 (see Batini, Estevão, and Keim (2010), which includes estimates for the United States) would be considered a better proxy for state-level changes in economic activity. As shown in Table 1 the alternative measures constructed here not only are of the same order of magnitude as estimates obtained at the national level across countries, but explain a larger share of changes in unemployment rate than the BEA official measure. The first alternative measure produces a -0.3 coefficient even if time dummies are used to control for aggregate time effects, while the BEA measure accounts for a smaller share of changes in the unemployment rate, producing a coefficient for the output growth variable five times smaller in the specification including time dummies (Table 1, column 4). We choose to report estimates of equation (1) using the first alternative measure of state-level GDP to capture the largest amount of local business cycle variation above and beyond the aggregate business cycle captured by the time dummies. This said, all the results discussed in the paper are qualitatively unchanged if the other measures (or a combination of them) are used instead.

Table 1. Okun Law Estimates with Alternative Measures of State-Level GDP

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: percentage-point change in unemployment rate *(numbers in parentheses are p-values)*					
	OLS					
Log-change in real GDP (BEA estimates) 1/	-0.136*** (0.00)			-0.059*** (0.00)		
Log-change in real GDP (Alternative Measure 1) 2/		-0.443*** (0.00)			-0.296*** (0.00)	
Log-change in real GDP (Alternative Measure 2) 3/			-0.374*** (0.00)			-0.166*** (0.00)
Time effects	No	No	No	Yes	Yes	Yes
Fixed state effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.15	0.51	0.50	0.61	0.77	0.80
Number of states, including D.C.	51	51	51	51	51	51
Observations	918	969	969	918	969	969

***Significant at a 1 percent level of significance.

1/ Data as published by the U.S. Bureau of Economic Analysis for the period 1991-2008 for 50 U.S. states plus the District of Columbia, using the BEA published figures. Data for 1991-2009 for the other two measures.

2/ $\Delta \ln(GDP_i) = \sum_j (\Delta \ln(GDP_j) * sh1_{ij})$, where GDP_i represents GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh1_{ij}$ represents the share of employment in sector j in total state i employment. Δ and $\sum$ are the difference and sum operators. Ln represents natural logs.

3/ $\Delta \ln(GDP_i) = \Delta \sum_j (\ln(GDP_j * sh2_{ij})$, where GDP_i represents GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh2_{ij}$ represents the share of employment in sector j in state i vis-a-vis aggregate sector j employment. Δ and $\sum$ are the difference and sum operators. Ln represents natural logs.

The estimates suggest that increases in skill mismatches and deterioration in housing markets raise unemployment rates.[13] Table 2 shows estimates of equation (1) using foreclosure rates as a proxy for housing market conditions across states. The results show that higher state-level unemployment rates are associated with higher skill mismatches and worse housing market conditions even after correcting for the obvious cyclical relationship between all these variables, which are accounted for by the variables measuring state-level business cycles (state GDP growth), aggregate business cycle and other shocks (time dummies), and state-specific factors (state dummies). Moreover, skill mismatches in states and years facing bad housing conditions (and vice-versa) tend to be associated with larger increases in unemployment rates than otherwise, as the interaction term between the two variables has the right sign, though it is not significant. The interaction term is consistent with causality going

[13] Chen et al. (2011) find that sectoral shocks (as measured by an index of the cross section variance of stock prices) have a substantial impact on the unemployment rate, accounting for about half of the increase in the long duration unemployment rate during the Great Recession.

from skill mismatches and housing conditions to unemployment rates: as housing conditions get relatively worse in a state (i.e., foreclosure rate rises), individuals facing skill mismatches would probably (i) get reluctant to move to more prosperous states as that would entail capital losses in their housing wealth or (ii) find it difficult to move as foreclosures probably affected their credit score and thus hinder their job search capability.[14] Using micro-data for a similar sample period, Ferreira et al. (2010) present complementary evidence for this effect by showing that negative housing equity creates a lock-in effect that prevents people from moving to other states.[15]

[14] Campbell, Giglio and Pathak (2011) find that a foreclosure reduces the price of a house by 27 percent on average. Similarly, for neighboring properties, Klyuev (2008) reports that houses near foreclosed properties suffer an additional 1 to 9 percent price fall while Hartley (2010) finds that in areas with high vacancy rate, each extra unit of foreclosure is associated with a disamenity effect of -0.075 percent.

[15] Weakening job opportunities coupled with lock-in effects from negative equity could be behind the declining labor mobility during the recent downturn.

Table 2. Explaining State-Level Unemployment Rates 1/
Using Foreclosure Rates as a Proxy for State Housing Market Conditions

	(1)	(2)	(3)	(4)	(5) 2/
	Dependent variable: percentage-point change in unemployment rate *(numbers in parentheses are p-values)*				
	OLS				2SLS
Log-change in real GDP (Alternative Measure 1) 3/	-0.178*** (0.00)	-0.267*** (0.00)	-0.171*** (0.00)	-0.166** (0.00)	-0.264*** (0.00)
Log-change in skill mismatch index	0.041*** (0.00)		0.034*** (0.00)	0.032*** (0.00)	
Percentage-point (pp.) change in foreclosure rate		0.396*** (0.00)	0.362*** (0.00)	0.332*** (0.00)	0.666*** (0.00)
Log-change in skill mismatch*pp. change in foreclosure rate				0.012 (0.17)	
Time effects 4/	Yes	Yes	Yes	Yes	Yes
Fixed state effects	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.77	0.78	0.79	0.79	---
Number of states, including D.C.	51	51	51	51	51
Observations	969	969	969	969	969

*Significant at a 10 percent level of significance, **significant at a 5 percent level of significance, ***significant at a 1 percent level of significance.

1/ Panel approach; annual data for the period 1991-2009 for 50 U.S. states plus the District of Columbia.

2/ Instruments used: subprime share of mortgages (contemporaneous and 1 period lag).

2/ $\Delta \ln(GDP_i) = \sum_j (\Delta \ln(GDP_j * sh1_{ij})$, where GDP_i represents GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh1_{ij}$ represents the share of employment in sector j in total state i employment. Δ and $\sum$ are the difference and sum operators. Ln represents natural logs.

4/ Controls for business cycle variations and changes in national policies, e.g. policy interest rates.

The effects of housing market conditions on the unemployment rate are even stronger once we control for some residual endogeneity between changes in the unemployment rate and foreclosure rates. Column (5) presents estimates of the effect of changes in foreclosure rates on the unemployment rate using the share of subprime mortgage in total outstanding mortgages in a particular year and state as an instrument for changes in foreclosure rates.[16] The basic assumption is that while the share of subprime mortgages reflects a structural housing market condition—and is thus correlated to foreclosure rates in a state—it is not directly related to changes in the unemployment rate in a particular way. This estimate

[16] The estimates use contemporaneous and one-lagged subprime share as instruments. The results are very similar when using only contemporaneous values for the subprime share but the inclusion of a lag produces tighter standard errors.

suggests an effect going from changes in housing market conditions to changes in unemployment rates.

The basic results are robust to using different variables to capture housing market conditions and shocks to the matching between skill supply and demand. Table 3 presents qualitatively similar estimates as the ones shown in Table 2 using percent changes in FHFA housing price indices, as a proxy for housing market conditions across states. The Case-Shiller index is not available for all states, but results using the Case-Shiller series for a subset of states (each encompassing the index for a particular metropolitan area) have the same flavor as the ones using the FHFA series (estimates not reported, but available under request). The effects of housing market conditions on the unemployment rate are again even stronger once we control for some residual endogeneity between changes in the unemployment rate and housing prices. As was the case before, the estimate using the share of subprime mortgage in total outstanding mortgages as an instrument for changes in housing prices (column 5) produces a stronger effect of housing market conditions on unemployment rates. The interaction term between housing market conditions and skill mismatches has the right sign (negative in the case of using house price changes as the housing condition indicator) and is statistically significant, again reinforcing the story of house price declines being linked to underwater mortgages than might hinder labor mobility.

Table 3. Explaining State-Level Unemployment Rates /1
Using Housing Prices as a Proxy for State Housing Market Conditions

	(1)	(2)	(3)	(4)	(5) 2/
	Dependent variable: percentage-point change in unemployment rate *(numbers in parentheses are p-values)*				
	OLS				2SLS
Log-change in real GDP (Alternative Measure 1) 3/	-0.178*** (0.00)	-0.252*** (0.00)	-0.207*** (0.01)	-0.173** (0.04)	-0.206** (0.02)
Log-change in skill mismatch index	0.041*** (0.00)		0.019*** (0.01)	0.030*** (0.00)	
Log-change in FHFA house price index		-0.028*** (0.00)	-0.024*** (0.00)	-0.026*** (0.00)	-0.064*** (0.00)
Log-change in skill mismatch*log-change FHFA house price index				-0.003*** (0.00)	
Time effects 4/	Yes	Yes	Yes	Yes	Yes
Fixed state effects	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.77	0.78	0.78	0.79	---
Number of states, including D.C.	51	51	51	51	51
Observations	969	969	969	969	969

*Significant at a 10 percent level of significance, **significant at a 5 percent level of significance, ***significant at a 1 percent level of significance.

1/ Panel approach; annual data for the period 1991-2009 for 50 U.S. states plus the District of Columbia.

2/ Instruments used: subprime share of mortgages (contemporaneous and 1 period lag).

2/ $\Delta \ln(GDP_i) = \sum_j (\Delta \ln(GDP_j * sh1_{ij})$, where GDP_i represents GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh1_{ij}$ represents the share of employment in sector j in total state i employment. Δ and $\sum$ are the difference and sum operators. Ln represents natural logs.

4/ Controls for business cycle variations and changes in national policies, e.g. policy interest rates.

As a robustness check, we also estimate equation (1) using the standard deviation of changes in sectoral employment as a proxy for changes in skills mismatches, which again does not change the flavor of the basic results either (Tables 4 and 5). The key assumption in this alternative specification is that times of greater dispersion in sectoral employment growth are also times when skill mismatches would flare up. Formally, this variable can be written as,

$$\sigma_{ijt} = \left[\sum_{i=1}^{10} s_{ijt} \left(g_{ijt} - g_{jt} \right)^2 \right]^{1/2}$$

Where g_{ijt} is the percent change in employment in sector *i*, in state *j*, at time *t*; g_{jt} is the percent change in total employment in state *j*, at time *t*; and s_{ijt} is the share of employment in sector *j* in total employment in state *i*, at time *t*.[17] The results, using this alternative skills mismatch measure, are shown in tables 4 and 5 and are consistent with the basic results displayed in table 1: even after accounting for cyclical effects, shocks in sectoral dispersion (which should be correlated to shocks in skill mismatches) are significantly related to changes in unemployment rates. The interaction term between changes in housing conditions and this proxy for shocks to skill mismatches is significant in both specifications.

Simulating the effect of recent shocks on structural unemployment

Our results suggest that increases in skill mismatches and deterioration in housing conditions could explain a significant share of increased unemployment during the crisis. Using the coefficients in column (4) of Table 2, Figure 12 shows how much of the increase in joblessness from 2007 to 2010 can be explained by weak housing conditions and skill mismatches across U.S. states, dubbed "structural" conditions, as opposed to cyclical factors—all as defined in the estimated model. Some states have seen a large increase in structural unemployment factors (e.g. Florida, Arizona, and Nevada, Hawaii and Delaware) while others have seen only minor increases (e.g. D.C., Nebraska, West Virginia, and the Dakotas). For example, we find that 5½ percentage points (out of the 8 percentage points increase in the Florida unemployment rate) is explained by structural factors.[18] Turning to the aggregate structural unemployment rate, the range of models in Tables 2 and 3 suggests that it rose from end-2007 to 2010 by between 1 and 1½ percentage points (and by as much as 1¾ since the onset of the housing market collapse at end-2006). Adding these figures to a

[17] The ten sectors used in the calculation are the same as the ones listed in the appendix, with mining, lodging, and construction merged into one sector. The resulting variable is positively and significantly correlated with percent changes in our proposed skill-mismatch index (correlation coefficient = 0.48).

[18] In Nevada 3½ percentage pojnts out of the 10.2 percentage-point increase in the unemployment rate since 2006 can be explained by structural factors; structural factors explain 3 out of the 5 percentage-point increase in Delaware's unemployment rate and 3¼ out of the 6 percentage-point increase in Arizona's unemployment rate.

5 percent estimate for the structural unemployment rate in 2006 leads to a structural unemployment rate of around 6¾ percent rate by the end of 2010.[19]

Table 4. Explaining State-Level Unemployment Rates /1
Using Housing Prices as a Proxy for State Housing Market Conditions
Alternative Measure of Skill Mismatch Shocks

	(1)	(2)	(3)	(4)
	Dependent variable: percentage-point change in unemployment rate *(numbers in parentheses are p-values)*			
	OLS			
Log-change in real GDP (Alternative Measure 1) 2/	-0.200*** (0.00)	-0.252*** (0.00)	-0.195** (0.02)	-0.186** (0.03)
Std. deviation of sectoral employment growth	0.113*** (0.00)		0.071*** (0.00)	0.109*** (0.00)
Log-change in FHFA house price index		-0.028*** (0.00)	-0.029*** (0.00)	-0.005 (0.61)
Std. deviation of sectoral employment growth*log-change FHFA house				-0.011*** (0.00)
Time effects 3/	Yes	Yes	Yes	Yes
Fixed state effects	Yes	Yes	Yes	Yes
Adj. R-squared	0.77	0.78	0.78	0.79
Number of states, including D.C.	51	51	51	51
Observations	969	969	969	969

*Significant at a 10 percent level of significance, **significant at a 5 percent level of significance, ***significant at a 1 percent level of significance.

1/ Panel approach; annual data for the period 1991-2009 for 50 U.S. states plus the District of Columbia.

2/ $\Delta \ln(GDP_i) = \sum_j (\Delta \ln(GDP_j * sh1_{ij})$, where GDP_i represents GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh1_{ij}$ represents the share of employment in sector j in total state i employment. Δ and $\sum$ are the difference and sum operators. Ln represents natural logs.

3/ Controls for business cycle variations and changes in national policies, e.g. policy interest rates.

[19] All national averages reported here use the share of state-level labor force in the national labor force as weights. The estimate of 5 percent structural unemployment rate in 2006 was obtained by filtering state-level unemployment rates using a Hodrick-Prescott filter, and then averaging them. This figure is consistent with most other estimates for the national structural unemployment rate before the crisis.

Table 5. Explaining State-Level Unemployment Rates /1
Using Foreclosure Rates as a Proxy for State Housing Market Conditions
Alternative Measure of Skill Mismatch Shocks

	(1)	(2)	(3)	(4)
	Dependent variable: percentage-point change in unemployment rate *(numbers in parentheses are p-values)*			
	OLS			
Log-change in real GDP (Alternative Measure 1) 2/	-0.200**	-0.267***	-0.191**	-0.187**
	(0.02)	(0.00)	(0.02)	(0.03)
Std. deviation of sectoral employment growth	0.113***		0.090***	0.084***
	(0.00)		(0.00)	(0.00)
Percentage-point (pp.) change in foreclosure rate		0.396***	0.377***	0.183
		(0.00)	(0.00)	(0.13)
Std. dev. sectoral employment growth*pp. change in foreclosure rate				0.052*
				(0.09)
Time effects 3/	Yes	Yes	Yes	Yes
Fixed state effects	Yes	Yes	Yes	Yes
Adj. R-squared	0.77	0.78	0.78	0.78
Number of states, including D.C.	51	51	51	51
Observations	969	969	969	969

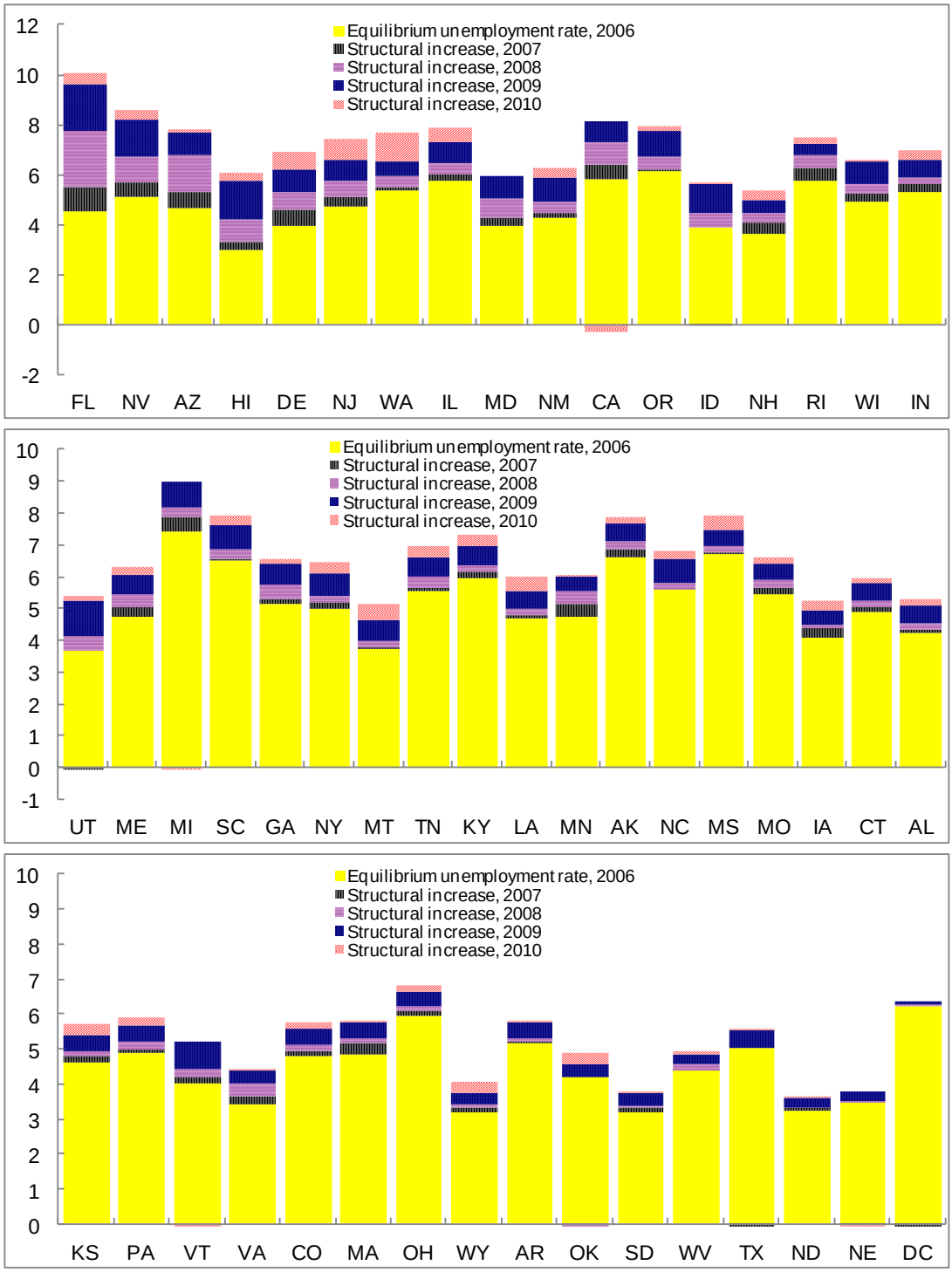
*Significant at a 10 percent level of significance, **significant at a 5 percent level of significance, ***significant at a 1 percent level of significance.

1/ Panel approach; annual data for the period 1991-2009 for 50 U.S. states plus the District of Columbia.

2/ $\Delta \ln(GDP_i) = \sum_j (\Delta \ln(GDP_j * sh1_{ij})$, where GDP_i represents GDP of state i, GDP_j represents GDP of sector j at the national level, and $sh1_{ij}$ represents the share of employment in sector j in total state i employment. Δ and $\sum$ are the difference and sum operators. Ln represents natural logs.

3/ Controls for business cycle variations and changes in national policies, e.g. policy interest rates.

Figure 12. Estimated Equilibrium Unemployment Rate at End-2010 By State 1/
(in percent)



Sources: U.S. Bureau of Labor Statistics and authors' calculations.
1/ Equilibrium unemployment rate in 2007 is estimated using an HP-filter for the period 1990-2006 for each state. The structural increase in the unemployment rate in 2007-2010 is the increase in the fitted unemployment rate value, as predicted by the model, from the increases in skills mismatches and housing hurdles.
Note: States are ordered based on the cumulative structural increase in the period 2008-2009.

We find that unfavorable housing market conditions roughly explain one percentage point of the increase in the structural rate of unemployment while deteriorating skill mismatches explain another one half percentage point. The interaction of skill mismatches and foreclosures explain the remaining one quarter percentage point. Our analysis suggests that the bulk of the increase in the structural unemployment rate occurred in 2009; with NAIRU rising by over ¾ percentage points; a third of which was explained by rising skill mismatches.[20] Overall, deteriorating housing market conditions were behind rising NAIRU until end-2009; thereafter the housing market showed signs of stabilization. In contrast, skill mismatches were solely responsible for almost one quarter percentage point increase in the NAIRU in 2010.

Going forward our estimates have little to say about the persistence of this structural increase in unemployment rates.[21] The U.S. economy is quite flexible and it is possible that current skill mismatches in the labor market and structural problems in housing markets will be cleared before too long. However, ongoing high mortgage delinquency rates and evidence of record-high rates of negative housing equity[22] suggest that the woes in that sector may indeed be affecting unemployment rates (maybe by constraining labor mobility) for a while. Also, the sharp rise in skill mismatches may have a deeper base than previous volatility, as the sector-specific shocks, including to housing, manufacturing/auto production, and financial services, have been enormous.

VI. Is Policy Intervention Warranted?

Increases in structural unemployment may pose significant social costs. In particular, rises in long-term unemployment and the share of permanent job losers have been shown to pose important economic costs. These include not only hampering labor market adjustment (Jacobson, Lalonde, and Sullivan, 1993)—a key reason in our view for the rise in equilibrium unemployment during the recent crisis—but also longer-term effects on welfare and potential output levels. For instance, workers displaced from long-term jobs in the early 1980s recession faced large income losses even 20 years after displacement (Von Wachter, Song, and Manchester, 2009) and serious health consequences for them (Sullivan and Von

[20] In 2009, the annual average unemployment rate increased by 3½ percentage points—the largest annual increase since 1948.

[21] Due to data limitations—the skills mismatch index is only available post 1990—our analysis does not shed light on the persistence question. The natural rate of unemployment has been on a decreasing trend since the mid-1970s (even during the recession periods), making the persistence question an important issue for future research.

[22] For instance, CoreLogic (2011) data show that over 65 percent of outstanding mortgages in Nevada are currently "under water", i.e. the value of the house is below the mortgage amount outstanding. The figures for Arizona, Florida, Michigan, and California are, respectively, 50.9 percent, 47.3 percent, 36.2 percent, and 31.8 percent.

Wachter, 2009; and Autor and Duggan, 2003) and their families (Oreopoulos, Page and Stevens, 2008; and Stevens and Schaller, 2009).[23]

Thus, public policy should aim at shortening the duration of unemployment spells and, more broadly, reducing structural unemployment rates. The hard part from the policymakers' point of view is to separate cyclical from structural determinants of the unemployment rate. The first type could be dealt with general macroeconomic stimulus, while the second type may require targeted policies. Our findings show that there is significant space to increase labor utilization through straightforward macro stimulus, as the current unemployment rate is in the neighborhood of 9 percent—say, about 2¼ percentage points above our estimated equilibrium unemployment rate. However, these macroeconomic stimulus measures would not be very effective for the share of unemployed not explained by cyclical factors.

If the composition of the output recovery does not significantly alleviate the mismatches between skill demand and supply, and housing markets and household balance sheets remain relatively depressed, the fundamental factors behind the higher equilibrium unemployment would limit the extent by which unemployment could decline without creating inflation. In this situation, government policies to remold labor force characteristics to changes in demand, to lower firms' labor costs directly, and to increase job-search efficiency could help to reduce unemployment. These policies could be grouped under the label of "active labor market policies" (ALMPs)[24] and have been shown to raise labor productivity and employment levels when well targeted, although cost-benefit evaluations are often elusive. [25]

In particular, the job bills enacted in response to the recent crisis, which extend unemployment insurance while providing subsidies to net hiring for small businesses, are welcome, since the former ensures that the unemployed receive some income for subsistence purposes,[26] while the latter encourages hiring by firms.[27] Card (1990) has found that firms respond to short-run reduced wage costs by raising hiring, while Bartik and Bishop (2009)

[23] For a succinct discussion of these effects see Katz (2010).

[24] ALMPs consist mainly of spending in training programs, targeted subsidies to job creation, public employment services and other expenditures aimed at promoting employment. Non-targeted policies to lower labor costs are not included in this definition, as they work as general macroeconomic policies.

[25] There is a large literature evaluating the effectiveness and costs of particular policies using micro data and experiment-evaluation techniques (see for instance the discussion in Heckman, Lalonde, and Smith, 1999).

[26] Other provisions included expanding the generosity of unemployment insurance: for instance, providing additional funds to states from the Unemployment Trust Fund and paying Consolidated Omnibus Budget Reconciliation Act (COBRA) costs to extend health insurance coverage to the unemployed. It is important to note that extending unemployment insurance benefits and boosting their generosity could reduce search effort by the unemployed and, thus, should be temporary.

[27] Kitao, Sahin, and Song (2010) argue that hiring subsidies and a payroll tax deduction can stimulate job creation in the short term but can cause a higher equilibrium unemployment rate in the long term.

and the Congressional Budget Office (2010) suggest that such tax credits are rather effective in terms of employment creation per budgetary cost.[28] Estevão (2007) shows that subsidies to direct hiring by the private sector have been the best alternative among a set of active labor market policies to raise employment rates sustainably across a panel of OECD countries.[29] As noted by Katz (2010), the main problems with previous active labor market packages, such as the 1977–78 New Jobs Tax Credit, were that (i) they did not reach small businesses, and (ii) they were highly complex—lessons to future measures. In addition, one cannot understate the risk of significant negative substitution effects, through the displacement of nonsubsidized workers, which could counteract the beneficial effects on employment. It is thus important that such policies are designed so as to minimize these negative effects.

Other welcome measures also were taken as part of the American Recovery and Reinvestment Act (ARRA) enacted in February 2009 including doubling the amount of money available to train and retrain workers, mostly through programs under the Workforce Investment Act[30] and providing enhancements to the Trade Adjustment Assistance (TAA) program.[31,32] Evidence suggests that employment services and job search assistance can be cost-effective in helping the unemployed find a job and can raise earnings at least in the short run (Meyer, 1995; and O'Leary and Straits, 2004). The economic returns to further education and training are also high (Jacobson, LaLonde, and Sullivan, 2005), since they could generate more efficient matching between job vacancies and unemployed workers through adjustments in job-seekers' skills—a key aspect given the ongoing reallocation of production factors across sectors in the United States. At the same time, training may also keep unemployed workers attached to the labor force, even after long periods of inactivity.

However, it is unclear whether the increased funds announced as part of ARRA are sufficient or whether they are used efficiently. For instance, since the Workforce Investment Act (WIA) was implemented in 1998, there has never been a rigorous evaluation of its effectiveness. In addition, the Government Accountability Office (GAO, 2007) finds that the process for allocating TAA funds to states does not adequately reflect the state's current

[28] On-the-job learning due to direct subsidies to job creation could lift labor demand and thus employment and wages by raising labor productivity.

[29] The other active labor market policies analyzed were labor market training and public employment services.

[30] This program provides one-stop centers in every state to help job seekers. Federal funds are allocated to states which in turn disburse them based on the training needs of their various localities.

[31] The TAA program offers a variety of benefits and services to workers who have lost their job due to foreign trade, including job training, income support, job search and relocation allowances, a tax credit to help pay the costs of health insurance, and a wage supplement to certain reemployed trade-affected workers 50 years of age and older.

[32] In addition to the already established programs, the Obama administration has also introduced a program that is specifically targeted to helping workers and communities affected by the fallout in the auto industry. The program provides training and job-search assistance to workers, as well as economic development assistance to the communities in which they live.

needs for training services. The study also points out that there are no effective TAA performance measurements and that less than half of the TAA eligible workers were aware or were informed of the availability of these programs.

Overall, the existing array of policies in the United States to assist the structurally unemployed needs revamping. Indeed, GAO (2007) has asserted that the federal job training policy remains fragmented and inefficient, with the federal government operating several dozen job training programs that are only loosely coordinated with one another.[33] Independent studies seem to indicate that the benefits of these programs modestly outweigh the costs, but that (i) they are not enough by themselves to lift their target populations (primarily welfare recipients, other poor adults and youth, and workers who have lost their jobs due to foreign trade) out of poverty and (ii) their benefits probably fade after four to five years (Almanac of Policy Issues Organization, 2001).

Measures that directly deal with the interaction between weak housing markets and sluggish labor market adjustment—a pivotal issue in explaining the grim labor market statistics during this recession in our analysis—are missing. While expansionary macro policies address deficiencies in aggregate demand and ALMPs address incentive problems in the labor market, neither set of policies on their own would be enough to enhance the potential reduction in labor mobility due to stress in the housing market.

The Administration has already undertaken numerous measures to support the housing market, in isolation, including providing temporary tax incentives for home buyers and measures to mitigate the foreclosure epidemic. However, the latter have not been as effective as was originally envisioned, prompting the Administration to introduce additional measures in Fall 2010, including temporary foreclosure forbearance to the unemployed and some assistance to underwater mortgage holders—a long standing recommendation by IMF economists (IMF, 2008 and 2009). Further steps may be needed if housing continues to hurt household balance sheets for an extended period of time, thus also impacting consumption spending and the overall economic activity. Allowing mortgages to be renegotiated in courts ("cramdowns") seems to be the next best alternative, as advocated in IMF (2008, 2010a) given that existing government programs have consistently missed their desired targets.

VII. CONCLUSIONS

The recent crisis was not only very deep but produced significant sectoral and geographic dislocations in the U.S. economy. Our work shows that, as a result of these dislocations, mismatches between the demand and supply of labor market skills have risen in the economy

[33] According to GAO (2007) there were 40 federal programs in 1999 that spent an estimated $11.7 billion in job training or job placement assistance. Most of these programs were located in the Department of Labor, the Department of Education, and the Department of Health and Human Services.

as a whole and to a greater extent in some states. On top of that, housing markets behaved quite differently across the country, often interacting perversely with the amount of skill mismatches in the labor market.

Using econometric evidence that controls for the usual cyclical relation between unemployment, skill mismatches, and housing market conditions, we show that unemployment rates increase when skill mismatches and housing market conditions worsen—and often more so when these factors coincide. Applying these econometric estimates to the last two years of data, we conclude that the aggregate equilibrium unemployment rate in the United States is about 1¾ percentage points higher now than the 5 percent or so before the crisis. With actual unemployment rates fluctuating around 8¾ percent, an economic recovery that does not address labor market mismatches or structural housing market problems would begin to produce inflationary pressures as unemployment rates falls much below 7 percent.

It is important to note that our analysis does not address the degree of persistence of the increase in structural unemployment, given data limitations in the construction of the skills mismatch index. For that, longer time series for skill mismatches would be needed. In particular, ideally the deep recession of the early 1980s and episodes when skill mismatches increased rapidly could be considered (an area for future research).

Even though skill mismatches and regional differences in housing markets may improve with the recovery, a prudent approach would be to continue targeting measures to address these issues directly. There is significant macroeconomic stimulus in the pipeline, as policy interest rates are near zero, the Federal Reserve continues to expand its balance sheets, and the large fiscal stimulus is withdrawn only slowly. But these policies could be complemented by targeted measures to raise hiring and clear the housing market, although their cost and effectiveness should be closely evaluated given current fiscal challenges in the United States. In particular, more action to reduce structural problems could be paid for by reducing tax expenditures or enacting a forceful entitlements reform. Priority could be given to subsidies to net hiring, as academic research has shown they are more effective in raising employment rates than other active labor market policies, although the subsidies would need to be well targeted to avoid redundancy and waste. One alternative would be to condition the subsidies to the hiring of longer-term unemployed. Policies that improve the matching of job vacancies to unemployed workers, and enhance their skills could also help, but evidence on the past effectiveness of such efforts in the United States is mixed. Measures to raise the number of mortgage modifications and "cramdowns" could also be important, as they would help to clear the housing markets more quickly, while restoring household's balance sheets, thus also tackling cyclical unemployment.

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Appendix A.

Data Description

Data Description

Indicator	Description	Source
House Prices	House Price Index (purchase only, SA)	Federal Housing Finance Agency
	S&P/Case-Shiller Home Price Index, Existing Single-Family Residential Homes (Composite 20, SA)	Standard & Poor's, Fiserv and MacroMarkets LLC.
Unemployment Rate	Local Area Unemployment Statistics Database	Bureau of Labor Statistics
Subprime Share of Mortgages	Ratio of conventional subprime mortgages serviced in percent of total mortgages.	Mortgage Banker's Association
Foreclosure Rate	Mortgage foreclosure inventory	Mortgage Banker's Association
Real GDP	Data for pre-1997 were interpolated given a structural break in methodology from SIC to NAICS.	Bureau of Economic Analysis
Population by educational attainment	Aged 25 and older. Data were interpolated for select years (i.e., 1991-97,2001-03,2005, 2008), due to data limitations.	Census Bureau
Employment by state/industry	Current Employment Statistics database.	Bureau of Labor Statistics

Sources: Author's calculations.

Appendix B.

Calculating the Skills Mismatch Index (SMI)

Following Peters (2000) the SMI for each state *i* at time *t* is constructed using the following formula:

$$Skill\ Mismatch\ Index_{it} = \sum_{j=1}^{3} (S_{iji} - M_{ijt})^2$$

Where:

j=skill level, S_{ijt}=percent of population with skill level *j* at time *t* in state *i* (skill level supply), M_{ijt}=percent of employees with skill level *j* at time *t* in state *i* (skill level demand).

- **Skill Level Supply--**Using Census Bureau's data, we divide each state's population (aged 25+ years old) into three skill levels based on their educational attainment: low-skilled—having less than high school diploma; semi-skilled—having a high school diploma but less than a bachelor's degree; and high-skilled—having at least a bachelor's degree. Data were interpolated for years when direct information was not available (namely 1991–97, 2001–03, 2005, 2008–10).

- **Skill Level Demand--**We divide all industries included in the *Establishment Survey* (one-digit industrial specification) into three categories based on their "skill-intensity" in 2006 (base year). Namely, using data from the 2006 Current Population Survey (Table 7) for individuals between 18 and 64 years of age, we calculate the proportion of employees in each industry by their educational attainment (a proxy of skill intensity as defined above). Using weights of 1 to 3 (larger weights reflecting higher educational attainment), we ranked the industries based on their "skill intensity". Industries with a weighted average lower than 80 percent of the total average are called low-skilled, while industries with weighted average between 80–120 percent are characterized as semi-skilled. All other industries are labeled high-skilled industries. Based on this classification, industries are classified as follows:

For each skill level demand, the number of employees by industry and state from the *Current Employment Statistics* database from the Bureau of Labor Statistics are used.[34] The percent

[34] All series are seasonally adjusted; Census Bureau's X-12 Arima seasonal adjustment program was used for data that were not available in seasonally adjusted terms. For the District of Columbia, Delaware, Hawaii, Nebraska, Maryland, South Dakota and Tennessee, the combined series "Mining, Logging, and Construction" was used to construct the demand for low-skilled workers.

of employees with low skill level in each state, for example, is then defined as the proportion of all employees hired by low skilled industries (namely mining and logging and construction).

Low Skilled	**Semi Skilled**	**High Skilled**
Mining and Logging	Manufacturing	Information
Construction	Trade, Transportation, and Utilities	Financial Activities
	Leisure and Hospitality	Education and Health Care
	Other Services	Professional and Business Services
		Government

Cross-State Characteristics (average, all years)

	Skill Mismatches							Unemployment	Housing	
	Low Skilled	Semi Skilled	High Skilled	Low Skilled	Semi Skilled	High Skilled	SMI	Unemployment	Delinquencies	Foreclosures
	Percent of population (25+ years)			Percent of employed			(level)	(in percent of labor force)	(in percent of mortgages)	
AK	11.3	63.8	24.9	9.5	38.2	52.3	1418.2	7.1	4.0	1.2
AL	24.8	56.1	19.1	6.0	49.3	44.7	1096.6	5.4	6.4	1.0
AR	24.7	58.5	16.8	5.1	51.7	43.3	1192.3	5.7	5.6	1.1
AZ	18.6	58.0	23.5	7.5	42.9	49.5	1041.0	5.7	5.1	1.4
CA	22.1	51.0	26.9	5.1	44.5	50.5	894.2	7.2	4.2	1.5
CO	13.0	54.9	32.1	7.1	42.6	50.3	526.2	4.9	3.6	1.1
CT	15.6	52.8	31.6	3.6	43.9	52.5	678.6	5.2	4.2	1.5
DC	20.4	38.8	40.8	1.7	21.2	77.1	2033.8	7.4	5.2	1.5
DE	16.9	58.4	24.6	5.8	41.7	52.5	1208.2	4.6	4.5	1.3
FL	19.6	57.8	22.6	7.0	44.5	48.5	1033.9	5.9	5.7	2.6
GA	21.7	54.2	24.1	5.2	47.4	47.4	889.7	5.3	6.6	1.3
HI	14.7	58.7	26.6	5.4	44.9	49.8	834.7	4.4	2.9	1.2
IA	14.1	64.6	21.3	4.5	50.2	45.3	894.4	4.0	3.7	1.1
ID	15.2	63.0	21.5	7.3	45.4	47.3	1060.8	5.3	3.9	1.0
IL	18.3	55.6	26.1	4.4	47.1	48.5	784.7	6.2	5.1	1.8
IN	18.1	62.4	19.5	5.0	54.0	41.0	729.4	5.1	6.1	2.0
KS	14.0	60.2	25.8	5.1	47.1	47.8	752.0	4.8	4.4	1.3
KY	25.9	56.7	17.4	5.7	49.8	44.5	1246.3	6.2	5.0	1.4
LA	24.8	56.6	18.6	9.2	42.9	47.9	1318.7	5.9	7.5	1.6
MA	15.0	51.5	33.5	3.7	41.9	54.5	678.9	5.6	4.2	1.2
MD	16.1	52.2	31.7	6.5	39.0	54.5	802.8	4.9	5.2	1.4
ME	14.7	62.0	23.3	5.1	46.2	48.7	1021.5	5.5	4.3	1.5
MI	16.7	61.5	21.8	4.1	49.3	46.6	946.4	7.0	5.8	1.5
MN	12.3	60.3	27.4	4.3	46.9	48.8	716.8	4.5	3.5	1.1
MO	18.9	59.3	21.8	4.8	47.1	48.1	1078.1	5.5	5.1	1.0
MS	27.1	55.8	17.1	5.3	51.4	43.2	1236.9	7.0	8.5	1.6
MT	13.2	62.5	24.3	7.1	44.2	48.7	989.3	5.1	3.3	0.8
NC	22.1	55.6	22.4	5.7	50.7	43.7	806.0	5.5	5.6	1.1
ND	16.0	61.6	22.4	6.1	43.1	50.8	1278.9	3.5	2.8	0.7
NE	13.4	62.6	24.0	4.8	45.9	49.4	1013.2	3.2	4.4	1.0
NH	12.7	58.2	29.0	4.1	50.1	45.8	436.8	4.5	4.1	1.0
NJ	17.4	52.5	30.1	3.8	44.1	52.1	759.9	5.9	5.0	2.1
NM	20.8	55.9	23.3	8.4	37.7	54.0	1449.0	6.1	4.5	1.3
NV	18.6	62.6	18.8	10.0	53.4	36.6	483.6	6.1	5.4	2.0
NY	20.1	52.0	28.0	3.7	37.9	58.4	1413.6	6.2	4.9	1.8
OH	17.3	61.6	21.2	4.3	49.6	46.1	960.7	6.0	5.6	2.2
OK	19.3	60.1	20.6	6.6	43.2	50.3	1358.2	4.9	5.5	1.7
OR	14.7	60.1	25.2	5.6	46.5	47.8	790.5	6.6	2.9	0.8
PA	18.0	59.4	22.6	4.6	46.6	48.9	1068.0	5.7	5.5	1.7
RI	21.6	52.3	26.1	3.8	45.4	50.8	1008.5	6.4	4.5	1.2
SC	23.5	55.9	20.6	6.1	49.7	44.2	936.7	6.2	6.1	1.6
SD	15.8	62.4	21.8	5.1	46.6	48.3	1093.2	3.4	3.1	0.7
TN	24.2	56.3	19.5	4.6	51.5	43.9	1052.3	5.8	6.7	1.2
TX	23.9	52.8	23.2	7.4	44.4	48.2	982.7	6.0	6.5	1.2
UT	12.0	61.9	26.2	6.9	44.2	48.9	866.2	4.4	4.7	1.2
VA	18.4	51.8	29.8	6.2	41.9	51.9	760.8	4.3	4.3	0.8
VT	13.5	56.8	29.7	5.3	48.5	46.2	432.2	4.4	3.2	0.9
WA	12.9	59.6	27.6	6.3	45.2	48.5	699.1	6.2	3.3	0.8
WI	15.0	62.6	22.4	4.3	52.7	43.0	658.0	4.8	3.5	1.1
WV	24.7	60.1	15.1	8.5	45.2	46.3	1512.3	7.0	5.8	1.0
WY	12.1	66.2	21.7	15.4	39.7	44.9	1281.4	4.7	3.2	0.7
US	18.0	57.8	24.2	5.8	45.5	48.7	984.4	5.5	4.8	1.3
Max	27.1	66.2	40.8	15.4	54.0	77.1	2033.8	7.4	8.5	2.6
State	MS	WY	DC	WY	IN	DC	DC	DC	MS	FL
Min	11.3	38.8	15.1	1.7	21.2	36.6	432.2	3.2	2.8	0.7
State	AK	DC	WV	DC	DC	NV	VT	NE	ND	ND

Sources: Haver Analytics, U.S. Bureau of Labor Statistics, U.S. Census Bureau, and authors' calculations.