Labor Market Dysfunction during the Great Recession

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ABSTRACT

This paper documents the abnormally slow recovery in the labor market during the Great Recession and analyzes how mortgage modification policies contributed to delayed recovery. By making modifications means-tested by reducing mortgage payments based on a borrower's current income, these programs change the incentive for households to relocate from a relatively poor labor market to a better labor market. We find that modifications raise the unemployment rate by about 0.5 percentage points and reduce output by about 1 percent, reflecting both lower employment and lower productivity, which is the result of individuals losing skills as unemployment duration is longer.

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1. INTRODUCTION

The Great Recession, which began in December of 2007, differs considerably from most other significant U.S. economic declines, as the recovery—particularly recovery in the labor market—has been remarkably slow. In fact, the Great Recession and the Great Depression are the only severe U.S. downturns in which job loss persisted so long following respective business cycle troughs. This paper documents the very weak labor market recovery during the Great Recession and evaluates mortgage modification policies as one channel for understanding why high unemployment has continued for so long during the Great Recession. We study mortgage modifications because some economists have presented evidence linking housing market weakness to labor market weakness (Ohanian and Raffo 2011) and because mortgage modification programs are means-tested and thus change the incentives for home borrowers to relocate to labor markets with more favorable job prospects.

Means-tested mortgage modifications reduce the cost of staying in a home by reducing mortgage payments, with the payment reduction based on the household's current earnings. This includes cases in which the borrower's income is limited to unemployment benefits and the borrower's current debt-to-income ratio is well above standard levels, so that a modified mortgage payment can be much lower than current payments. Mulligan (2009 and 2010b), among others, has suggested that this policy may be significantly contributing to high unemployment by distorting incentives. In addition to concerns about incentives, modification programs are controversial because redefault rates, which are the percentage of defaults on the modified mortgage, are high, ranging between 30 percent and 50 percent within one year of modifying.

This paper evaluates the impact of mortgage modification programs on unemployment and other macroeconomic variables by constructing a very simple model that integrates a model of search unemployment along the lines of Ljungqvist and Sargent (1998, 2004) with a model of homeownership, including mortgages, mortgage modifications, and location choice. By reducing mortgage payments based on current income, mortgage modification changes the incentives to accept job offers and to relocate to labor markets with more favorable job prospects.

In the model, households are located in a particular local labor market (island) in which they receive stochastic job offers and their skills evolve over time, as in Ljungqvist and Sargent (1998, 2004). Households can accept the job offer and remain in their local labor market, reject the offer and receive unemployment benefits, or relocate to another labor market. If the household has a mortgage, they choose whether to continue with an existing mortgage, which preserves their current flow of housing services, whether to walk away from the mortgage and rent either in their current labor market or in an alternative labor market, or whether to seek a one-time modification of their mortgage that reduces mortgage payments. Relocating is costly but offers a job-finding probability that stochastically dominates the job-finding probability on a household's current island. While employed, households accumulate skill in expectation, and, while unemployed, households decumulate skill in expectation. By changing the cost to a borrower of maintaining an existing mortgage, modifications increase the incentives for a household to remain in their current location and forgo more favorable job prospects in another location.

Our model of the modification process is motivated by various modification programs that have been in place since 2007, in which modifications reduce mortgage payments to a debt-service-to-income ratio (DTI) that depends on current income. Thus, households with low income, including those whose income is limited to unemployment benefits, can receive substantial reductions in their payments that increase the opportunity cost of relocating in the model economy.

We first analyze the implications of modifications by examining steady states of two economies that are identical, except one has modifications. We next conduct an economic turbulence experiment

along the lines of Ljungqvist and Sargent (1998) to assess how modifications impact the economy during a major recession. This experiment consists of two shocks:

- the layoff rate in the model is doubled for one period, and
- for those who are laid off, their human capital stock is reduced by one level.

The main finding from this experiment is that the unemployment rate rises by about 0.5 percentage points and real GDP declines by about 1 percent for several years after the modification policies are in place. A number of empirical features in the model economy correspond to data, including the rate of modifications, the redefault rate on modifications, and mobility. We also estimate that a 10 percent reduction in payments reduces the chance of a person walking away from a home by 11.3 percent, which is comparable to Haughwout, Okah, and Tracy (2009). We are then able to estimate that mortgagors who have a job at the date they request a modification are 48 percent less likely to default again.

The paper is organized as follows: Section 2 compares the Great Recession to other U.S. downturns. Section 3 summarizes mortgage modification programs during the Great Recession with a focus on the labor market impact of these policies. Section 4 presents the model economy. Section 5 presents quantitative experiments that assess the impact of today's modification programs. Section 6 concludes.

2. THE GREAT RECESSION COMPARED TO OTHER U.S. ECONOMIC DECLINES

This section compares the Great Recession to other economic declines. Figures 1 and 2 compare the Great Recession labor market to other postwar recessions and highlight a number of patterns that contrast sharply with those in other downturns. Figure 1 shows employment following each recession and Figure 2 shows employment during the Great Recession compared to the average of all other postwar recessions. Even abstracting from the size of employment loss during the recession, these two figures clearly suggest labor market dysfunction in which employment during the Great Recession is not recovering at a normal rate.

Figure 1
Change in U.S. Employment: Recoveries

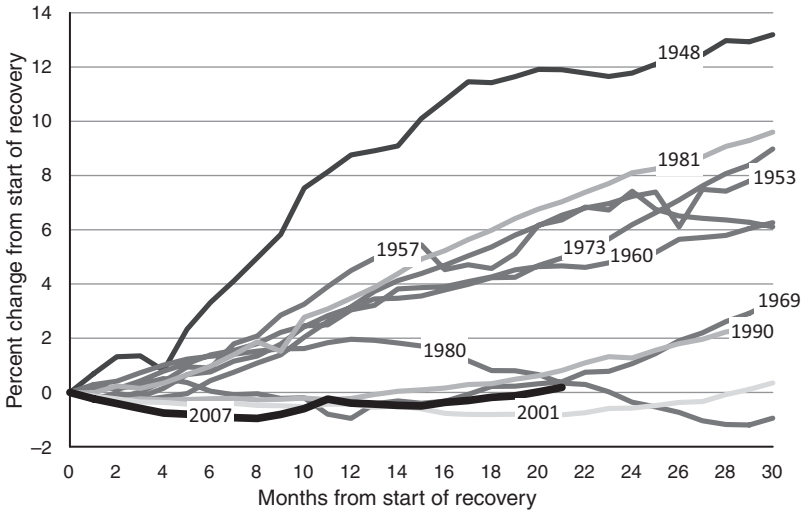
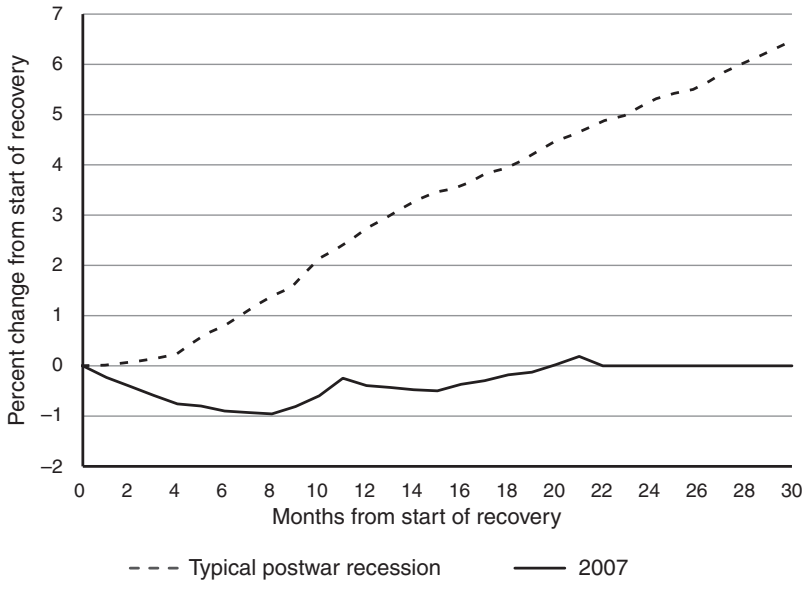


Figure 3 combines information from both the recession and the recovery by showing employment change in all post–World War II recessions 36 months after the start of the recession. There are only two postwar recessions that do not feature employment recovery three years after the start of a recession—the 2000–2001 recession and the Great Recession. Note, however, that the 2000–2001 recession was relatively mild so that, despite the slow recovery, employment was only about 1 percent lower three years after the start of that recession. In contrast, employment during the Great Recession is nearly 6 percent lower three years after it started. In terms of the most recent severe recessions, both the 1973 and 1981 recessions featured rapid labor market recoveries, with employment rising 3 percent above previous business cycle peak values.

Tables 1 and 2 provide a more comprehensive comparison between the Great Recession and other recessions and present additional evidence that the recovery from the Great Recession has been very slow. Table 1 shows the average recovery for detrended (2 percent annual growth) per capita output and its components and per capita employment through six quarters for all postwar recessions except the Great Recession. In the average recovery from a

Figure 2
Change in U.S. Employment: Recoveries



postwar recession, the economy is quite close to returning to trend. Table 2 shows the same variables for the Great Recession, which shows virtually no recovery relative to trend for any variable, with the exception of investment. This pattern is qualitatively very similar to that in the Great Depression.

Table 3 shows the same variables for the 1981–82 recession, which is the last severe recession in the United States. The recovery from the 1981–82 recession was quite fast, with all variables, including employment, either very close to trend or even above trend. This rapid recovery following the 1981–82 recession is consistent with standard neoclassical growth theory, which predicts that recoveries should be relatively fast following severe recessions, reflecting transition dynamics associated with diminishing marginal product of capital and low investment during the recession.

This evidence indicates that the recovery from the Great Recession has been comparatively very slow, with the restoration of jobs and output proceeding much more slowly than their postwar averages.

Figure 3
Total Change in U.S. Employment
(36 months after trough)

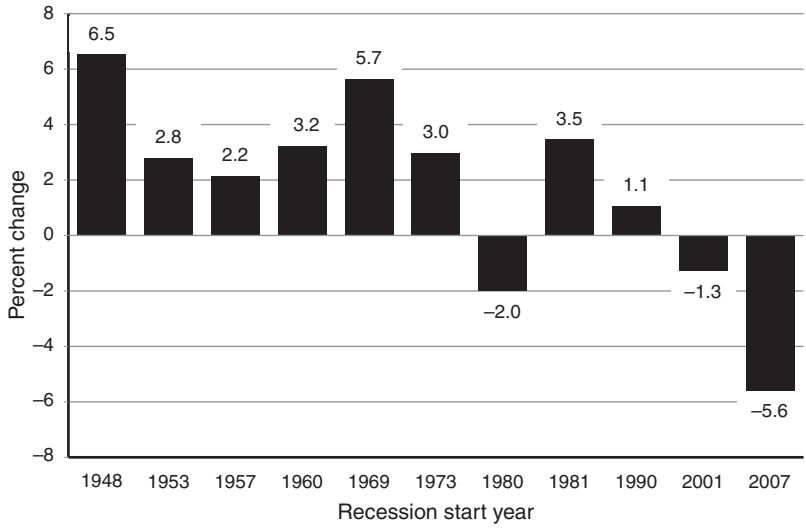


Table 1
Detrended Levels of Output and Its Components in a Typical Postwar Recovery (Excludes 2007 Recession)
(Measured quarterly from trough, Peak = 100)

Quarters from Trough	Output	Consumption	Investment	Government Purchases	Employment	Compensation to Employees
0	95.4	97.8	82.0	98.9	95.8	99.2
1	96.3	98.3	86.9	97.8	95.5	100.0
2	97.0	98.7	91.6	97.9	95.9	100.1
3	97.9	99.5	95.0	97.4	96.6	100.0
4	98.6	99.7	99.5	97.5	97.4	100.3
5	98.7	99.9	99.3	98.1	97.8	100.2
6	99.0	99.8	100.9	99.5	98.1	100.4

Sources: Output and components, Bureau of Economic Analysis; Employment, Bureau of Labor Statistics.

The only comparable episode in which a severe downturn was followed by such a slow recovery is the Great Depression. Table 4

Table 2
Detrended Levels of Output and Its Components in Great Recession

(Measured quarterly from trough, Peak = 100)

Quarters from Trough	Output	Consumption	Investment	Government Purchases	Employment	Compensation to Employees
0	92.1	93.7	65.6	99.7	92.8	100.0
1	91.7	93.5	67.0	99.3	91.7	99.1
2	92.1	93.0	70.5	98.2	91.0	98.9
3	92.4	92.8	74.7	97.3	90.9	98.5
4	92.2	92.7	78.6	97.5	91.0	99.2
5	92.1	92.5	80.8	97.7	91.0	98.9
6	92.1	92.7	76.2	96.6	91.1	98.2

Sources: Output and components, Bureau of Economic Analysis; Employment, Bureau of Labor Statistics.

Table 3
Detrended Levels of Output and Its Components in 1981-II to 1982-IV Recession

(Measured quarterly from trough, Peak = 100)

Quarters from Trough	Output	Consumption	Investment	Government Purchases	Employment	Compensation to Employees
0	97.6	98.8	74.4	99.8	95.1	100.6
1	98.2	99.0	76.5	99.8	95.0	101.3
2	99.5	100.2	83.2	99.9	95.7	100.6
3	100.9	101.2	88.1	100.8	96.6	100.0
4	101.9	102.0	96.7	98.3	98.0	99.4
5	102.3	102.0	105.8	98.4	99.1	99.2
6	102.8	102.6	108.6	99.8	100.1	98.8

Sources: Output and components, Bureau of Economic Analysis; Employment, Bureau of Labor Statistics.

shows the severe depth and duration of the Depression, with relatively little recovery after its 1933 trough. Specifically, relative to 1929, per capita output is about 39 percent below trend, consumption is about 28 percent below trend, investment is about 75 percent below trend, and employment is about 25 percent below trend. And both the Great Depression and the Great Recession feature virtually no recovery in consumption, indicating that factors that are considered to be permanent are contributing to the slow recovery.

Table 4
Consumption, Investment, and Other Components of GNP, 1930–1939
(1929 = 100)

Year	Real GNP	Consumption		Investment (Nonresidential)	Government Purchases	Foreign Trade		Employment
		Durables	Nondurables			Exports	Imports	
1930	87.4	76.2	90.9	79.2	105.1	85.3	84.9	93.8
1931	78.1	63.4	85.4	49.4	105.4	70.6	72.4	86.7
1932	65.2	46.7	76.0	27.9	97.3	54.5	58.1	78.9
1933	61.9	44.4	72.2	24.6	91.7	52.8	60.8	78.6
1934	64.6	49.0	72.1	28.4	101.1	52.8	58.3	83.7
1935	68.1	58.9	73.1	34.4	100.1	53.8	69.3	85.4
1936	74.9	70.8	77.0	45.9	113.9	55.1	71.9	89.8
1937	76.0	72.2	77.2	53.6	106.3	64.3	78.3	90.8
1938	70.6	56.3	74.3	37.8	112.0	62.8	58.3	86.1
1939	73.5	64.3	75.0	40.5	112.9	61.7	61.6	87.5

Source: Cole and Ohanian (2001).

What accounts for such slow recoveries, particularly in the labor market, during these episodes? Ohanian (2009) and Cole and Ohanian (2004) present theoretic and empirical evidence that the severity and continuation of the Great Depression significantly reflected industrial and labor policies that increased industrial cartelization and increased labor bargaining power that, in turn, substantially increased relative prices and real wages. Real manufacturing wages (relative to trend) rose approximately 17 percent from 1929 to 1939, which is abnormal from the perspective of the normal forces of supply and demand. Specifically, low consumption and high unemployment during the decade should have reduced real wages and expanded employment relative to its low level. Ohanian (2009) presents evidence that high real wages during the early phases of the Depression were the result of Hoover's nominal wage maintenance program. Hoover promised firms protection from labor unions provided that industry maintain nominal wage levels and preserve jobs through work sharing. Cole and Ohanian (2004) present evidence that New Deal policies that promoted monopoly and union formation, including the National Industrial Recovery Act and the National Labor Relations Act, fostered higher real wages.

This interpretation of the Great Depression places economic policy, in particular policies that distorted competition and prevented some markets from clearing, at the center of the Great Depression and its labor market dysfunction. Some economists have also suggested that economic policies are contributing to the persistence of high unemployment today. Specifically, the federal minimum wage increased by about 24 percent, rising from $5.85 in 2007 to $6.55 in 2008 and then to $7.25 in July 2009, which may have priced a number of lower-skill workers out of the job market. Some economists also point to a number of executive orders signed by President Obama designed to promote the use of union contractors on large-scale federal construction projects.

This paper analyzes an alternative policy channel that can connect the coincidence between the severity of housing sector depression and the failure of the labor market to recover. In particular, Ohanian and Raffo (2011) document that the only OECD countries to experience severe labor market dysfunction during the Great Recession were also the countries with the most severe housing market downturns: Ireland, Spain, and the United States. The other OECD countries had much less employment loss and much less housing sector

contraction. We therefore analyze the impact of mortgage modifications on persistently high levels of U.S. unemployment. Mulligan (2009 and 2010b) has suggested that these policies distort individual behavior by changing the incentives to take jobs. We pursue this idea by considering the impact of mortgage modifications on location choice. In particular, by reducing the cost of servicing a mortgage, modifications change the incentives to relocate to labor markets with better job opportunities.

3. MORTGAGE MODIFICATIONS DURING THE GREAT RECESSION

This section summarizes mortgage modifications since 2007. Table 5 provides a national perspective on mortgage accounts (90 million accounts by 2010), broad modifications as defined below (11.4 million since 2007), and foreclosure starts (5.8 million since 2007). Following Adelino, Gerardi, and Willen (2009), we define a mortgage modification as a change in the interest rate, principal, or term of the mortgage, or more broadly, as any change to a mortgage that increases or decreases the present value of the loan (many modifications merely tack the current ''forgiven'' portion of the debt onto the end of the loan as a balloon payment). This may include an immediate payment in exchange for forgiveness of principal, such as a short sale (a pre-foreclosure sale) and a deed-in-lieu, in which a mortgagor hands over collateral property in exchange for a release from all obligations.

HOPE NOW, the alliance of mortgage industry entities that was initiated by the federal government, estimates that there have been about 14.2 million modifications that satisfy one of these modification definitions. Adelino, Gerardi, and Willen (2009), in their sample of mortgages, which covers roughly 60 percent of all mortgages through the fourth quarter of 2008, find that roughly 3 percent of borrowers who were 90 days or more in arrears received a narrowly defined modification while 8 percent received a broader form of modification.

Modifications fall into one of two categories:

- government modification programs developed by, or associated with, the Federal Deposit Insurance Corporation, the Federal Housing Finance Agency, the Troubled Asset Relief Program, or the Home Affordable Modification Program, and
- other modification programs.

Table 5
Modifications, Foreclosures, and Mortgage Accounts

	2007-III & IV	2008	2009	2010-I, II, III
Mortgage Accounts (Stock Var.)	97,205,000	97,705,000	93,760,000	90,893,333
Modifications Started (Broad Definition, Flow Var.)	912,671.00	2,258,603.00	4,253,364.00	3,691,320.00
Subset: HAMP Modifications (Broad Definition, Flow Var.)			1,023,224	891,967
Modifications Completed (Flow Var.)	206,240	961,355	1,239,428	1,413,271
Percent of Mortgage Accounts Modified (Broad Definition)	0.9	2.3	4.5	4.1
Percent of Mortgage Accounts Modified (Narrow Definition)	0.21	0.98	1.32	1.55
Foreclosure Starts (Flow Var.)	673,960	1,755,860	2,037,940	1,397,580
Percent of Foreclosure Starts	0.69	1.80	2.17	1.54

Sources: N.Y. Fed Consumer Credit Report; HOPE NOW.

Almost all modifications change the mortgagor's current payment by changing the mortgage interest rate, and/or the time profile of payments, and/or changing the term of the mortgage, and/or deferring payment of principal or forbearance. There have been about 1.9 million HAMP modifications, which account for about 17 percent of all permanent modifications, including the broad definition of modifications, and all other programs account for about 83 percent of modifications.

The three main government programs are HAMP, the FDIC Loan Modification Program, and the Federal Home Finance Agency Streamlined Modification Program. All the government programs feature modifications that reduce payments to either 31 percent or 38 percent of current income (DTI). This is accomplished by reducing the mortgage payment, subject to a minimum interest rate. This minimum interest rate is operative for a fixed period, after which the interest rate rises over time. If the initial interest rate adjustment does not satisfy the DTI requirement, then the term of the mortgage is increased, up to a maximum of 40 years. If these modifications together do not generate the required DTI, then principal is deferred to the end of the mortgage as a balloon payment in order to satisfy the DTI requirement of the program, and this deferred principal does not accumulate interest. Some programs also provide benefits to borrowers by paying off principal, waiving late fees, and recapitalizing arrears in principal, interest, and taxes. The median DTI for those receiving HAMP modifications is about 45 percent of current income when debt only includes mortgage principal, interest, homeowners insurance, and property taxes (''front-end'' DTI). The median ''back-end'' DTI is nearly 80 percent for HAMP modifiers, as this broader measure of debt includes other mandated payments, including credit card, auto, and other debt, and spousal and child support.

We focus on HAMP modifications since they represent the most frequently used modification among the government programs. Other government programs and nongovernment programs are similar along several dimensions. The main exception is that some programs reduce DTI for eligible applicants to 38 percent, rather than HAMP's 31 percent. Descriptions of some of the other programs are in Herkenhoff and Ohanian (2011b).

3.1 Home Affordable Modification Program

This section summarizes the HAMP program and how it evolved over time.

The Making Home Affordable Program was announced in February of 2009 and was operative by March of 2009. The program touted $75 billion for mortgage modifications. However, according to the Treasury's expense report, only $1 billion was spent through 2010. There were several changes to the program on June 1, 2010, but for the sake of space, we will only describe the pre–June 1, 2010 version of HAMP:

Eligibility: HAMP eligibility criteria are listed below, loosely quoted from Fannie Mae's *HAMP Servicing Guide* (2009):

- The mortgage loan is a first lien mortgage loan originated on or before January 1, 2009.
- The mortgage loan has not been previously modified under HAMP.
- The mortgage loan is delinquent or default is reasonably foreseeable.
- The borrower documents a financial hardship by completing a Home Affordable Modification Program Hardship Affidavit and provides the required income documentation. The documentation supporting income may not be more than 90 days old.
- The borrower has a monthly mortgage payment ratio of greater than 31 percent (mortgage payment over gross income).
- A borrower actively involved in a bankruptcy proceeding is eligible for HAMP at the servicer's discretion.
- The current unpaid principal balance is no greater than $729,750.
- The loan must pass a standardized net present value (NPV) test that compares the NPV result for a modification to the NPV result for no modification. If the NPV result for the modification scenario is greater than the NPV result for no modification, the servicer *must* offer the modification; otherwise, the servicer has the option of performing the modification at its discretion.

Unemployment Eligibility: Unemployed persons are eligible, and unemployment benefits count as qualified income. The February

2010 report includes statistics on the main hardship reasons. Roughly 57 percent of the permanent modifications were for people with employment problems, including outright unemployment.

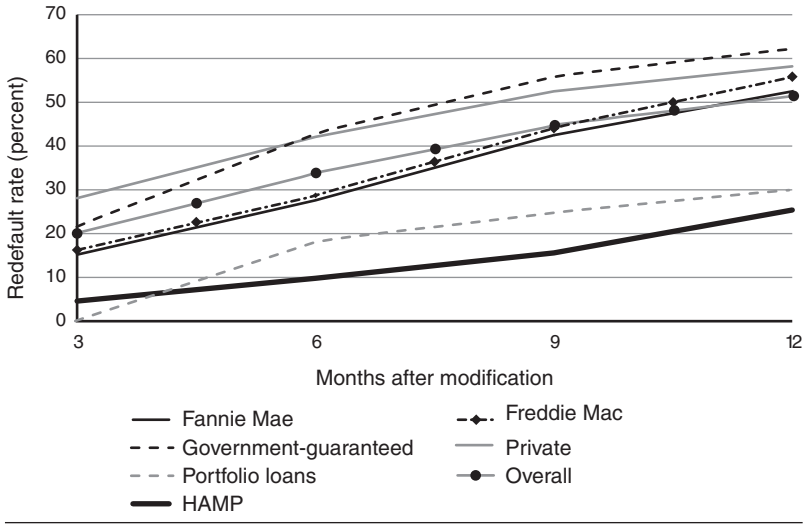
Terms of Modification:

- A borrower may be asked to complete a trial period. The trial period typically lasts three months. During this period, the bank verifies income and assesses whether the borrower can make the new payments.
- If a borrower has an adjustable-rate mortgage or interest-only mortgage, the existing interest rate will convert to a fixed–interest rate, fully amortizing loan.
- The following steps outline the process for determining the 31 percent monthly mortgage payment ratio:
    - Capitalize accrued interest, out-of-pocket escrow advances to third parties, and any other third-party fees that are reasonable and necessary.
    - Reduce the interest rate. The interest rate floor in all cases is 2.0 percent. The reduced rate will be in effect for the first five years, followed by annual increases of 1 percent per year (or such lesser amount as may be needed) until the interest rate reaches the Interest Rate Cap[1], at which time it will be fixed for the remaining loan term.
    - If necessary, extend the term and re-amortize the mortgage loan by up to 480 months to achieve the target monthly mortgage payment ratio.
    - If necessary, the servicer must provide for principal forbearance to achieve the target monthly mortgage payment ratio. The principal forbearance amount is non–interest bearing and nonamortizing. The amount of principal forbearance will result in a balloon payment fully due and payable upon the earliest of the borrower's transfer of the property, payoff of the interest-bearing unpaid principal balance, or maturity of the mortgage loan.

Performance: By June 1, 2010, there were 398,021 permanent modifications and 1,300,526 trials that had been started. The January 2011

[1] The ''Interest Rate Cap'' is the Freddie Mac Weekly Primary Mortgage Market Survey Rate for 30-year fixed-rate conforming loans as of the modification date.

Figure 4
Redefault Rates
(At least 60 days late)



Source: MHA and OTS.

MHA report claims that the pre–June 1, 2010 conversion rate (from trial to permanent) was roughly 41 percent. For HAMP modifications started in the fourth quarter of 2009, 81.6 percent had payment reductions of 20 percent or more (OTS Report 2010-III).

Figure 4 illustrates the redefault rates (which means the loan is again at least 60 days delinquent) for a cohort of HAMP permanent modifications. Annual redefault rates reach 30 percent even with sizeable reductions. Figure 4 also illustrates the redefault rates for government-guaranteed loans (e.g., Federal Deposit Insurance Corporation–insured), government-sponsored enterprise loans (e.g., Fannie Mae and Freddie Mac, see below), private loans with no government affiliation, and the loan portfolio of the participating institutions (i.e., the loans that the banks do not service for someone else).

Failed Trials and Rejections: Of those who had their trial period canceled, 44.2 percent received an alternative modification, 5.9 percent were somewhere in the foreclosure process, and only 6 percent

were current (MHA 2011). A person who fails a trial is no longer eligible for HAMP; however, a rejected person may re-apply. Pre–June 1, 2010, the lack of paperwork necessary led to many unsuccessful modifications (Norris 2009).

3.2 Alternative Modifications

HOPE NOW reports that of the approximately 4.2 million permanent modifications, 3.6 million were completed independently of HAMP guidelines. Pre–March 4, 2009, there were no HAMP criteria, and the streamlined modifications were used scarcely. The pre-HAMP modification performance is relatively poor. Very few loans are current—a mere 24 percent—and even fewer have actually been foreclosed upon—11 percent completed, 16 percent in process (OTS Report 2010-IV). Table 6 details a post-HAMP comparison of the modifications. The HAMP reductions hover around 35–40 percent, and the alternative reductions are also considerably generous, around 15–20 percent. The alternative modifications were similar in several respects to HAMP, though often focused on reducing payments to 38 percent DTI for eligible applicants instead of 31 percent as in HAMP.

For those who did not satisfy one or more eligibility criteria, modifications were still performed outside of HAMP. But in these cases, payments were reduced less than under HAMP and, as we will see below, led to higher redefault rates. Specifically, about 44 percent of canceled HAMP trials obtained an alternative modification, and about 30 percent of denied applicants obtained an alternative modification.

We now describe the performance of these modifications in terms of redefault rates, which are defaults on modified mortgages. Adelino, Gerardi, and Willen (2009) find that the redefault rate for pre-HAMP loans lies between 30 percent and 50 percent. Furthermore, there is a large fraction of loans (30 percent) that have a larger NPV after the modification. They also report that ''fewer than 5% of all of our troubled [90+ days past due] borrowers repaid their mortgages.''

In terms of reallocation, the government is allowing people to maintain their mismatch with the local labor market by providing loan modifications. Clearly, those who could not pay their mortgages initially are redefaulting. The process of modifying and then redefaulting is precisely the delay that we focus on in the model below.

Table 6
Comparison of HAMP Modifications and Alternative Modifications
(Percent)

	2009-IV	2010-I	2010-II	2010-III	2010-IV
Average HAMP Reduction	–39.4	–37.2	–37.8	–35.6	–35.9
Average Alternative Modification Reduction	–14.7	–15.1	–18.5	–20.7	–21.6
HAMP Modifications, Redefault Rates since 2009-I	11	13	17		
Alternative Modifications, Redefault Rates since 2009-I	12	24	32		

Source: OTS Report, 2010-IV.

3.3 Analyses of Current Modification Programs

We are unaware of studies that quantify the impact of modification programs on unemployment within an optimizing model framework. There are several related papers, including Mulligan (2010b), who considers the implicit marginal tax rates generated by actual guidelines for FDIC and HAMP modifications. Mulligan (2009) also discusses the incentive effects of mortgage modifications on employment and suggests that modifications have significantly increased unemployment, but he does not provide a quantitative assessment. Chatterjee and Eyigungor (2009) consider the HAMP program in a single-location dynamic stochastic equilibrium model with endogenous prices, but their model lacks an employment margin and therefore does not allow for employment incentive effects or relocation. Adelino, Gerardi, and Willen (2009) argue that there are few modifications because lenders expect to make more money foreclosing than modifying. Their conclusion is that preventable foreclosures are rarer than most people believe. The probability of redefault in their sample ranges between 30 percent and 50 percent depending on the quality of the mortgage and the type of modification. If a modification uses resources, it may be socially optimal to have few modifications. Gerardi and Li (2010) provide a useful summary and timeline of the policies that were enacted to save homes.

In terms of the link between housing and unemployment, Oswald (1996) hypothesizes that areas with high homeownership rates have higher unemployment rates. Green and Hendershott (2001) use a 1988–1992 Panel Study of Income Dynamics panel to track 9,000 U.S. household outcomes over time. Among their findings, they present evidence that supports the Oswald hypothesis and find significant heterogeneity in the effect of homeownership on unemployment outcomes. There are also studies that have presented evidence against the Oswald hypothesis. These studies primarily are based on European data. Vuuren (2009) studies panel data from the Netherlands and rejects a number of predictions of the Oswald hypothesis.

DiPasquale and Glaeser (1998) consider homeownership and mobility and argue that homeowners are less mobile. Studies based on U.S. data from the recent recession include Ferreira, Gyourko, and Tracy (2010), who use a panel from the American Housing Survey to document that negative equity (which is much more prevalent than modifications) greatly reduces mobility. Schulhofer-Wohl

(2010) disputes these mobility claims, suggesting that the empirical methodology of Ferreira, Gyourko, and Tracy is flawed. Winkler (2011) analyzes homeownership and homeowner mobility, and finds that homeownership reduces mobility by 40 percent and that homeownership also negatively impacts income.[2] While Winkler does not consider mortgage modifications, his economic environment is perhaps the closest to ours in that he also uses an optimizing model that includes locational choice.

4. MODEL ECONOMY

This section presents the model economy we use to assess the impact of mortgage modification programs on economic activity. We blend a search model of unemployment with housing and with the choice of relocating from one local labor market (island) to another island. To focus on the relocation effect and keep the model tractable, we model only the consumer side of the economy and treat prices exogenously. Herkenhoff and Ohanian (2011a) consider the employment incentive effect along with the large eviction delays in a related paper.

Households face a constant probability of death (δ) and maximize the sum of expected utility discounted using a fixed interest rate (r_h). With a one-month period, this means households discount the future using a discount factor $\beta = \frac{(1-\delta)}{(1+r_h)^{\frac{1}{12}}}$. They have preferences over sequences of a nondurable consumption good (c) and a flow of housing services, which is higher if a household owns a home (z_m) rather than rents (z_r). Mortgages are treated as a perpetuity. Thus, owning a home requires making a fixed mortgage payment each period ($\bar{m}$). The mortgage payment is tax-deductible. Renters pay a rental payment (r) each period, but this payment is not tax-deductible.

[2] He also finds that, after a labor shock, the homeowner subgroup has an unemployment rate that is 6 percent higher one or more years after the shock as compared to before the shock. However, renters show no significant difference in unemployment rates. The estimated job offer equation implies that the probability of receiving a job offer from another location is increasing in education (skill in our model). He also estimates the following offer rates: 16 percent of renters receive offers per period, 13 percent of homeowners receive offers per period.

Households are located on one of two symmetric islands, *A* or *B*. They are either employed (*W*) or unemployed (*U*). Each period, each household receives a wage offer drawn from a stationary Markov chain. Households can either accept the offer, or reject the offer and receive unemployment benefits. The household can also choose to relocate to the alternative island, which offers a job-finding distribution that stochastically dominates the distribution in their current island. If they relocate, they exit from their home permanently and incur a onetime utility cost (*MC*).

Mortgage modifications are challenging to model, as these programs may include many changes to the mortgage contract, several of which are difficult to represent recursively. Because mortgages are a perpetuity, all modifications are a temporary reduction in payments, which is exactly what HAMP and other modification programs do. This temporary reduction can lower payments enough so that people who would otherwise move choose to remain in their current location. We call this change in incentives to relocate the *relocation effect* of mortgage modifications.[3]

In our model, households may request a modification, but one time only, as is the case with many modification programs. A modification in the model works as follows: As long as an agent has a DTI between 31 percent and 75 percent (in the model notation described below, $\overline{DTI} > \frac{i\bar{m}}{w\pi_A} > \underline{DTI}$), the agent is eligible for a temporary modification that reduces mortgage payments as a fraction of his current gross income to 31 percent. However, to keep the state space tractable, the modification term ends with probability η. Since the modification depends on the mortgagor's current income, this means-testing of modifications means that the incentives to relocate in order to sample a better wage distribution are distorted, as the opportunity cost of relocating is higher, reflecting the fact that relocating means losing the modification.

Each agent's skills evolve over time, and skill evolution depends on employment status, which is motivated by Ljungqvist and Sargent (1998, 2004). Specifically, while employed, an agent's skills

[3] This model of modifications does not include another important element of the HAMP modification, which is a trial period for a modification. Specifically, in a trial period, the borrower may decline some offers because this would result in a more expensive modification later.

can increase or decrease, and the probability of increasing his skill level exceeds the probability of receiving a lower skill. For unemployed agents, their skills on average depreciate. Let π_A denote the skill of an agent on island A. The skill transitions are governed by a Markov chain, which is described in Section 4.3. We assume that the probability of finding a job increases monotonically with skill. To capture this, $f(\pi_A)$, which is the job-finding probability for an agent with skill π_A, is monotonically increasing. Layoffs occur with probability $1 - p_e$, with p_e denoting the probability of job continuation.

The period budget constraint for an employed mortgage borrower with taxable income I is given by:

$$c + \bar{m}(1 - \tau_l(I)) + T_m = w\pi_A(1 - \tau_l(I))$$

Employed agents earn income $w\pi_A$ where w scales the skill level π_A. Agents face a progressive income tax schedule that is summarized by the function $\tau_l(\cdot)$. We use a progressive income tax, as it allows the model to help match observed homeownership rates by increasing the incentive to own a home as income rises. This allows the model to generate regions in the state space in which consumers prefer renting and regions in which consumers prefer a mortgage. The tax function is piecewise linear, which we describe in detail in Section 4.2.

After-tax income finances nondurable consumption (c), the after-tax mortgage payment, $\bar{m}(1 - \tau_l(I))$, and T_m, which is obligated payments corresponding to other homeownership costs, including property insurance and homeowner association fees, and in addition, includes other mandated payments such as revolving debt service, child support, and spousal support. These other obligated payments are important to include in the model since their level affects the incentive to request a mortgage modification. Renters also face obligated costs, (T_r), where $T_r < T_m$.

If an agent cannot finance a mortgage, which means that the level of other obligated payments is greater than or equal to income, then the mortgagor is forced to leave the home and rent. While unemployed, agents are provided with unemployment benefits $b(\pi_A)$. Benefits are weakly monotone in the skill level with a 50 percent replacement rate and a benefit cap of $\bar{b}$ (see Section 4.2). As skills decumulate, benefits expire. This declining path of benefits is

adopted because it allows us to formulate the problem recursively while maintaining computational tractability. Moreover, this declining time path of benefits in the model reflects the fact that benefits do indeed decline over time.[4] Specifically, extended benefits or emergency unemployment compensation, both of which apply in many states after 26 weeks, can fall to only 24 percent of the original benefit level. Moreover, it is likely that other sources of financial support that unemployed individuals receive—including support from family, friends, unions, and charities—also decline.

An agent that searches on another island finds a job with probability $f(\pi'_B)$, where π'_B is stochastically drawn and depends on the previous island's skill, π_A.

4.1 Value functions

Let $S \in \{W, U, W^M, U^M, W^R, U^R\}$ represent the status of an agent. $W(\pi_A)$ is the value function of an agent with an offer and skill level π_A. $U(\pi_A)$ is the value function of an agent without an offer and skill level π_A. $W^M(\pi_A, \kappa)$ is the value function of an agent with an offer and a mortgage payment that has been reduced by $100 \times (1 - \kappa)$ percent. In other words, $\kappa = 0.75$ indicates a 25 percent reduction in payments. $U^M(\pi_A, \kappa)$ is defined similarly for an agent without an offer. $W^R(\pi_A)$ is the value function of a renter that has an offer and skill level π_A. $U^R(\pi_A)$ is defined similarly for an agent without an offer. In general, the superscript M indicates that the agent currently has a modification and the agent is no longer eligible to have a modification in the future. The M superscript will stay with an agent even when $\kappa = 1$, which means that the temporary modification period is over and the agent pays $1 \times \bar{m}$. The superscript R indicates that the agent is a renter.

As indicated above, mortgages are perpetuities with fixed payments. Once an agent defaults on a mortgage, the agent is a renter for the remainder of his lifetime. Agents are only allowed one modification in a lifetime, and the modification is structured to reduce payments to 31 percent of gross income. The modification term is

[4] Emergency Unemployment Compensation has different stages called ''tiers.'' With each tier there is a duration and a replacement rate. Tier 1 lasts 20 weeks and pays 80 percent of the maximum benefit amount. Tier 2 lasts 14 weeks and pays 54 percent of the maximum benefit amount, and so on. The last tier pays 24 percent of the maximum benefit amount.

stochastic: with probability η a modification ends. When a modification ends, the mortgage payment returns to its original level $\bar{m}$.

Gross income is $w\pi_A$ for employed people and $b(\pi_A)$ for unemployed people. At the time of the modification request, κ, which denotes the mortgage payment reduction, is set so that the new payment $\kappa \times \bar{m}$ is 31 percent of income: $\frac{\kappa(w\pi_A)\bar{m}}{w\pi_A} = 0.31$. After this initial period, κ becomes a fixed-state variable and will only change once the modification ends. When the modification period is over, $\kappa \rightarrow 1$, reflecting the fact that payments return back to $\bar{m}$. Mortgagors who decide to default or redefault are subject to a one-time moving cost $-MC$, which reflects the costs of leaving the home.

There are two important states for a mortgagor with no previous modification activity:

- the skill level π_A, and
- the employment status, which is summarized by S.

For this type of agent, $\mathbb{Q}_S(\pi_A)$ describes the choice set. This choice set will reflect eligibility restrictions for modifications. For instance, if the agent has an offer ($S = W$) and the payment ratio falls between the cap and the eligibility cutoff, $\overline{DTI} > \frac{\bar{m}}{w\pi_A} > \underline{DTI}$, then the choice set includes a modification option,

$$\mathbb{Q}_W(\pi_A) = \{\text{Accept Offer and Pay, Accept Offer and Modify,}$$
$$\text{Reject Offer and Pay, Reject Offer and Default}\}$$

If $\frac{\bar{m}}{w\pi_A} < \underline{DTI}$ or $\frac{\bar{m}}{w\pi_A} > \overline{DTI}$, then no modification is allowed and the choice set is now restricted,

$$\mathbb{Q}_W(\pi_A) = \{\text{Accept Offer and Pay, Reject Offer and Pay,}$$
$$\text{Reject Offer and Default}\}$$

There are three key states for a modified mortgagor:

- the skill level π_A,
- the modification payment reduction κ, and
- the employment status summarized by S.

For this type of agent, $\mathbb{Q}_S(\pi_A, \kappa)$ summarizes the choice set of the agent. Consider an unemployed modified agent ($S = U^M$),

$$\mathbb{Q}_{U^M}(\pi_A, \kappa) = \{\text{Search for Job and Pay, Redefault and Move}\}$$

In the value functions below, we drop the state π_A, which is already summarized in the value function, and we refer to $\mathbb{Q}_S$ as the choice set that implicitly summarizes the qualification criteria.

An agent that begins with an offer and has not previously modified starts the period with a value function $W(\pi_A)$. Recall that taxable income is given by (I). The agent has several choices:

- pay the mortgage, receive a utility flow $u([w\pi_A - \bar{m}](1 - \tau_l(I)) - T_m, z_m)$, accumulate on-the-job skills and face some probability of being fired $(1 - p_e)$;
- skip a payment and request a modification (so long as the payment ratio lies between $\overline{DTI}$ and $\underline{DTI}$);
- reject the offer (*notice that there is no lag between certain states*); or
- default and rent, which gives the agent the option to search on the other island.

For the model,

$$\begin{aligned} W(\pi_A) = \max_{\mathbb{Q}_W}\{&u([w\pi_A - \bar{m}](1 - \tau_l(I)) - T_m, z_m) \\ &+ \beta E_{\pi'_A|\pi_A,W}[p_e W(\pi'_A) + (1 - p_e)U(\pi'_A)], \\ &u(w\pi_A(1 - \tau_1(I)) - T_m, z_m) \\ &+ \beta E_{\pi'_A|\pi_A,W}[p_e W^M(\pi'_A, \kappa(w\pi_A)) + (1 - p_e)U^M(\pi'_A, \kappa(w\pi_A))], \\ &U(\pi_A), -MC + W^R(\pi_A)\} \end{aligned}$$

An agent that begins with an offer and a modified mortgage (either currently modified or modified in the past) starts the period with a value function $W^M(\pi_A, \kappa)$. With probability η, payments step back up:

$$\begin{aligned} W^M(\pi_A, \kappa) = \max_{\mathbb{Q}_{W^M}}\{&u([w\pi_A - \kappa\bar{m}](1 - \tau_l(I)) - T_m, z_m) \\ &+ \eta\beta E_{\pi'_A|\pi_A,W}[p_e W^M(\pi'_A, 1) + (1 - p_e)U^M(\pi'_A, 1)], \\ &+ (1 - \eta)\beta E_{\pi'_A|\pi_A,W}[p_e W^M(\pi'_A, \kappa) + (1 - p_e)U^M(\pi'_A, \kappa)], \\ &U^M(\pi_A, \kappa), -MC + W^R(\pi_A)\} \end{aligned}$$

An agent that begins the period without an offer and has not previously modified starts the period with a value function $U(\pi_A)$. The agent has several choices:

- pay the mortgage, receive a utility flow $u([b(\pi_A) - \bar{m}](1 - \tau_l(I)) - T_m, z_m)$;
- decumulate skills while unemployed and search locally, which results in a job with probability $f(\pi_A)$;
- skip a payment and ask for a modification (so long as the payment ratio lies between $\overline{DTI}$ and $\underline{DTI}$); or
- default and rent, which allows the agent the option to also search on the other island.

For the model,

$$\begin{aligned} U(\pi_A) = \max_{\mathbb{Q}_U} \{ & u([b(\pi_A) - \bar{m}](1 - \tau_l(I)) - T_m, z_m) \\ & + \beta E_{\pi'_A|\pi_A,U}[f(\pi'_A)W(\pi'_A) + (1 - f(\pi'_A))U(\pi'_A)], \\ & u(b(\pi_A)(1 - \tau_l(I)) - T_m, z_m) \\ & + \beta E_{\pi'_A|\pi_A,U}[f(\pi'_A)W^M(\pi'_A, \kappa(b(\pi_A))) \\ & + (1 - f(\pi'_A))U^M(\pi'_A, \kappa(b(\pi_A)))], \\ & -MC + U^R(\pi_A)\} \end{aligned}$$

An agent that has no offer and a modified mortgage (either currently modified or modified sometime in the past) starts the period with a value function $U^M(\pi_A, \kappa)$. With probability η, payments increase to their original level ($\kappa = 1$):

$$\begin{aligned} U^M(\pi_A, \kappa) = \max_{\mathbb{Q}_{U^M}} \{ & u([b(\pi_A) - \kappa\bar{m}](1 - \tau_l(I)) - T_m, z_m) \\ & + \eta\beta E_{\pi'_A|\pi_A,U}[f(\pi'_A)W^M(\pi'_A, 1) + (1 - f(\pi'_A))U^M(\pi'_A, 1)], \\ & + (1 - \eta)\beta E_{\pi'_A|\pi_A,U}[f(\pi'_A)W^M(\pi'_A, \kappa) \\ & + (1 - f(\pi'_A))U^M(\pi'_A, \kappa)], \\ & -MC + U^R(\pi_A)\} \end{aligned}$$

An agent that begins the period renting with an offer has a value function $W^R(\pi_A)$. This agent has two choices:

- continue to work on the same island, or
- quit and pick an island to search for a new job.

For the model,

$$\begin{aligned} W^R(\pi_A) = \max_{\mathbb{Q}_{W^R}} \{ & u(w\pi_A(1 - \tau_l(I)) - r - T_r, z_r) \\ & + \beta E_{\pi'_A|\pi_A,W}[p_e W^R(\pi'_A) + (1 - p_e)U^R(\pi'_A)], U^R(\pi_A)\} \end{aligned}$$

An agent that begins the period renting without an offer has a value function $U^R(\pi_A)$:

$$U^R(\pi_A) = u(b(\pi_A)(1 - \tau_l(I)) - r - T_r, z_r) + \beta \max\{E_{\pi'_A|\pi_A,U}[f(\pi'_A)W^R(\pi'_A) + (1 - f(\pi'_A))U^R(\pi'_A)], E_{\pi'_B|\pi_A,U}[f(\pi'_B)W^R(\pi'_B) + (1 - f(\pi'_B))U^R(\pi'_B)]\}$$

4.2 Functional Forms, Parameters, and Results

The utility function is given by:

$$u(c, z) = \log(c) + z$$

The job-finding probability is strongly monotone in the interior and weakly monotone in the tails. This functional form captures the intuition that it is easier for persons with high skills to find jobs.[5]

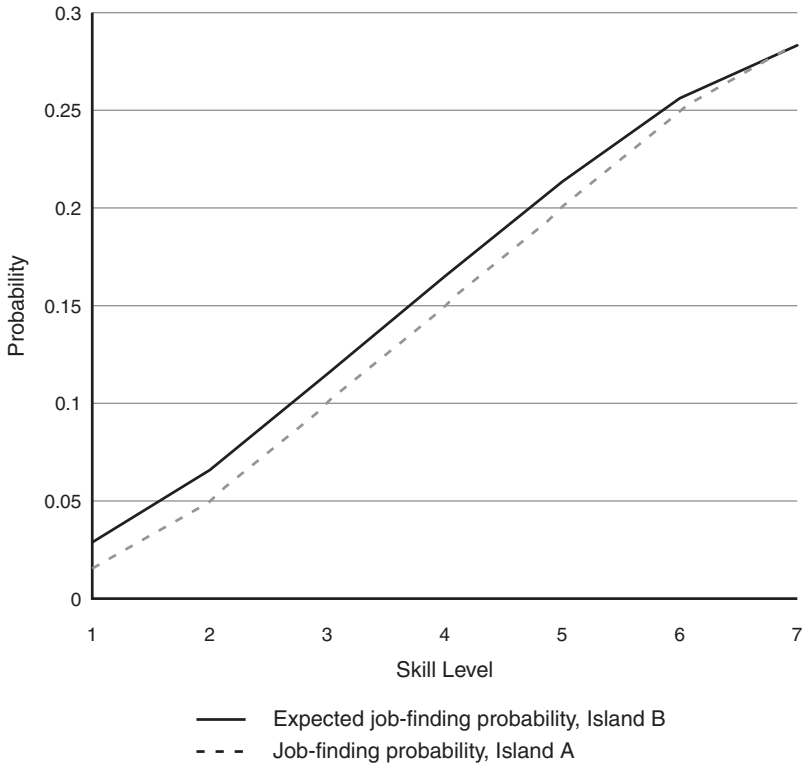
$$f(\pi_A) = f_c \cdot \max\left\{ \underline{f}, \min\left\{ \bar{f}, \frac{\pi_A - \underline{\pi}_A}{\overline{\pi}_A - \underline{\pi}_A} \right\} \right\}$$

This job-finding function is graphed in Figure 5 for $f_c = \frac{3}{10}$, which is used in the simulations. The expected job-finding rate on the alternative island is also graphed and shows the expectation of an island A agent with skill π_A finding a job on island B. This functional form is in line with Shimer's (2008) estimate that the probability of being reemployed in the next month, on average, for all workers in the Current Population Survey dataset is 28.6 percent. We match on average that renters have 3 percent more job offers, as estimated in Winkler (2011).

Unemployment benefits are monotone in the lower half of the support with a 50 percent replacement rate, but benefits are capped by $\bar{b}$. For the simulations that follow, $\bar{b}$ is set at approximately one-half the mean observed wage. Given the skill process described below, benefits last on average for two years:

[5] Mincer (1991) presents evidence supporting this choice. We make use of the following notation: $\underline{x}$ is the lower bound of x and $\bar{x}$ is the upper bound of x.

Figure 5
Job-Finding Probability for Different Skill Levels
(7 is highest skill level)



$$b(\pi_A) = \frac{1}{2} \cdot w \cdot \min\{\pi_A - \underline{\pi}_A, \bar{b}\}$$

The income tax function is described below:

$$\tau_l(I) = \tau_{1/5}\mathbb{I}(I < I_{1/5}) + \cdots + \tau_{4/5}\mathbb{I}(I_{3/5} < I < I_{4/5}) + \tau_{5/5}\mathbb{I}(I_{4/5} < I)$$

This describes an average rate that is applied to all labor income, and the cutoffs are income quintiles, which are defined by $I_{x/5}$ for $x \in \{1, \cdots, 5\}$.

4.3 Parameter Values

The period length is one month. Given the period length, there are several parameter values: the wage (w), the interest rate (r_h), the death probability (δ), the probability that a modification ends (η), the probability of continued employment (p_e), the modification cutoffs for debt to income ($\overline{DTI}$ and $\underline{DTI}$), the mortgage payment ($\bar{m}$), the rental payment (r), the housing utility flow (z_m), the renter utility flow (z_r), non-mortgage debt payments for a homeowner (T_m), non-mortgage debt payments for a renter (T_r), the costs of foreclosure and leaving a house, (MC), the tax schedule $\tau_l(\cdot)$, the grid for skill levels, the transition probabilities, and the initial draws.

The wage rate is set to unity. The annual household discount is set to 6 percent, which is in line with Livshits, MacGee, and Tertilt (2007). The death probability δ is set such that the average lifetime is 42 years. η follows from the HAMP modification program, which reduces payments for five years. The probability of remaining employed, p_e, is set to match the average job duration of 4.6 years (Ljungqvist and Sargent 1998). Modifications reduce mortgage payments to 31 percent of current gross income. The upper limit on debt to income, $\overline{DTI} = 0.75$, is set to match the modification rate (note that by picking the cap to match this moment, the initial front-end DTI of a mortgagor is larger than in the data since the option value of modifying skews this decision) and DTI = 0.31 is taken from the HAMP servicer manual. The fixed mortgage payment $\bar{m}$ is set such that, in the absence of modifications, the average mortgage-payment-to-income ratio is 20 percent, as in Corbae and Quintin (2010). The rental payment r is set to 90 percent of the mortgage payment (U.S. Census Bureau 2011, Table 2-13). The flow from housing z_m is picked to be the log of the average mortgage payment $z_m = \log(\bar{m})$. z_r is scaled in proportion to payments: $z_r = \frac{r}{\bar{m}} z_m$. The fixed cost for a mortgagor, T_m, is set to match the difference between the back-end and front-end DTI of a modifier, which is roughly 30 percent in the HAMP data. T_r is set to match the fraction of people renting, which is about 35 percent.[6] The cost of foreclosure and leaving a house to become a renter, MC, is set to one year's worth of the median wage in order to match the annual migration rate of

[6] The 2000 Census shows a 66 percent homeownership rate.

6.3 percent as reported in Davis, Fisher, and Veracierto (2010).[7] Once an agent becomes a renter, the agent is free to move between locations without any additional cost. The tax schedule $\tau_l(\cdot)$ matches the average effective tax rates by income quintile as published by the Congressional Budget Office (2007). By quintile, the tax rates are 4.3 percent, 9.9 percent, 14.1 percent, 17.3 percent, and 25.2 percent.

The grid for π_A has seven nodes that are evenly spaced between $[\frac{1}{2}, 14\frac{1}{2}]$. Ljungqvist and Sargent (2004) use a process calibrated to two weeks with 11 nodes. In their model, agents lose one node with a 10 percent chance. We follow their setup and have agents move down twice as fast in the unemployed state (10 percent chance of moving down one level every four weeks while unemployed; 5 percent chance of moving down one level every four weeks while employed). Agents keep their original skill level 80 percent of the time while employed, 85 percent of the time while unemployed, and 70 percent of the time when searching on another island. Employed agents move up one slot with a probability of 15 percent, and unemployed agents move up one slot with a probability of 5 percent. (In our model, unlike Ljungqvist and Sargent, the unemployed can increase their skill level.) A person who searches on another island moves up one slot 15 percent of the time and moves up two slots 10 percent of the time. While this matches the wage gains in Kennan and Walker (2011) and renter offer rate in Winkler (2011), this generous process for movers generates an upper bound on the effects of modifications on unemployment.

This human capital process captures much of the dispersion and volatility of monthly income. According to monthly Survey of Income and Participation Program (SIPP) data from 2001, the coefficient of variation (σ/μ) for monthly income ranges from 0.78 to 0.26 depending on where an individual falls relative to the poverty line; for example, those at least 150 percent above the poverty line have an average coefficient of variation of 0.31 for monthly earnings and 0.28 for monthly income (Bania and Leete 2009).

Table 7 illustrates the moments that we try to match by picking appropriate parameters. Several other references are included in the tables for completeness.

[7] While this may seem high, this is conservative in lieu of Kennan and Walker (2011), who find an average moving cost of $312,000.

Table 7
Reference Moments

Description	Data	Model	Parameter	Source
Demographics and Unemployment				
Average Time until Layoff	4.3 years	4.3 years	Firing rate	Ljungqvist and Sargent (1998)
Expected Duration of Working Life	42.7 years	42.7 years	Death rate	Ljungqvist and Sargent (1998)
Homeownership Rate (HR)	66.20%	61.00%	Renter's fixed payment	U.S. Census Bureau (2000)
Adjustment to HR for Negative Equity	−5.60%			Haughwout, Peach, Tracy (2009)
Mean Duration of Unemployment in Weeks (Great Recession)	18.5 weeks	18.1 weeks	Job-finding rate	Bureau of Labor Statistics (Table A-12)
Renting and Default				
Ratio of Renter Payment to Mortgage Payment	0.9	0.9	Ratio of payments and ratio of housing flows	American Housing Survey (2003)
Modifications				
1-Year HAMP Redefault Rate (HAMP Data Summary 2010-III)	25.40%	29.82%	Transition probabilities and DTI cap	OTS 2010-IV (Table 3)
Duration of Modification	5 years	5 years	Stochastic term probability	HAMP Servicing Guide (2009)
Median of Back-End DTI Minus Front-End DTI	33.9%	30.0%	Mortgagor fixed costs	HAMP Data Summary (p. 3, January 2011)

Table 7
Continued

Description	Data	Model	Parameter	Source
Median Front-End DTI before Modification	45.3%	59.0%	DTI cap	HAMP Data Summary (p. 3, January 2011)
Median Back-End DTI before Modification	79.2%	88.0%	DTI cap	HAMP Data Summary (p. 3, January 2011)
Median Front-End DTI after Modification	31.0%	31.0%	Modification scalar	HAMP Data Summary (p. 3, January 2011)
Median Back-End DTI after Modification	62.4%	60.0%	Modification scalar	HAMP Data Summary (p. 3, January 2011)
Modification Rate Per Annum (Broad)	1.4% to 4.5%	1.76%	Transition probabilities and DTI cap	(FRBNY Quarterly Report on Household Credit and Debt, Nov. and HOPE NOW)
Average Quarterly Foreclosure Rate until 2006	0.25%	0.38%	Transition probabilities	Corbae and Quintin (2010)
Migration and Moving				
1-Year MSA Migration Rate, Tax Data	6.36%	8.52%	Moving costs	Davis, Fisher, and Veracierto (2010)
Income Process				
Coefficient of Variation $\times$ 100, Monthly Income, 150+% of Poverty Income	24.8	21.9	Transition probabilities	Bania and Leete (2009), Table 2

5. THE IMPACT OF MORTGAGE MODIFICATIONS IN THE MODEL ECONOMY

The following section presents analyses to evaluate the quantitative impact of modifications on unemployment levels, unemployment duration, and skill levels (productivity). We consider two experiments:

- a comparison of steady states between an economy with no modifications and one with modifications, and
- a one-time economic turbulence analysis along the lines of Ljungqvist and Sargent (1998 and 2004), in which we follow the economy over time after there is a one-time, unanticipated, large, exogenous destruction of jobs.

5.1 Steady State Comparison

We solved for a stationary mass of agents using the techniques outlined in Hopenhayn (1992). We use value function iteration on the grids described above to solve for the policy functions, and we proxy the unit mass of agents on each island with a large number of simulated agents. The stationary mass of 300,000 agents is symmetric across islands, with island *A* movers exactly offset by replica island *B* movers. The results in Table 8 are for an economy that gives modifications in the same proportion as observed in HAMP data. To capture current conditions, the newly born agents are born with mortgages; they are randomly endowed with skills over skill slots 2 to 6; and 9 percent of them start unemployed.[8]

5.2 Steady State Discussion

The duration of unemployment increases in the modification economy, which is the consequence of the lower incentive to relocate. Specifically, low-skill workers and unemployed mortgagors receive, on average, large mortgage payment discounts to reduce payments to 31 percent of their current income. The modification program thus subsidizes unemployment/low skills by reducing the opportunity cost of staying in the local labor market. In the no-modification world, there is no such subsidy, and as a result, the incentive to relocate to the labor market with better job prospects is higher. As a consequence, the modification policies generate 30 basis points of

[8] Recall, there are seven possible skill slots, so agents are not started in the extremes.

Table 8
Steady State Comparison

Modification Policy in Place?	Yes	No	Ratio
Unemployment Rate	7.71%	7.40%	1.084
	(0.015085)	(0.014023)	-
Average Unemployment Duration	18.1081 Weeks	17.3597 Weeks	1.043
	(0.024106)	(0.021994)	-
Average Renter Unemployment Duration	17.695 Weeks	17.0168 Weeks	1.040
	(0.033485)	(0.028446)	-
Average Skill of Employed	12.8805	12.9526	0.995
	(0.0024433)	(0.0025297)	-
Average Skill of Unemployed	11.0629	11.5008	0.995
	(0.0068475)	(0.0068613)	-
Annual Migration Rate	8.53%	10.68%	-
	(0.051711)	(0.05259)	-
Quarterly Foreclosure Rate	0.38%	0.56%	0.685
	(0.0029566)	(0.0041526)	-
Modification Rate Per Quarter	0.44%	NaN%	-
	(0.0016293)	(NaN)	-
Redefault Rate within 12 Months	29.82%	NaN%	-
	(0.22319)	(NaN)	-
Mean Pay Reduction	0.45126%	NaN%	-
	(0.00039674)	(NaN)	-
Fraction of Modifiers with Offer	0.40316%	NaN%	-
	(0.0022109)	(NaN)	-
Average Mortgagor DTI	0.13713%	0.1864%	0.736
	(0.00018456)	(0.00014419)	-
Percentage Renting	0.38397%	0.4807%	0.799
	(0.002414)	(0.0024185)	-

Note: Standard errors in parentheses. NaN = not a number.

higher unemployment. Unemployment is about 50 basis points higher in the turbulence experiment, which is described below.

In addition to the 30–basis point steady state difference in unemployment, the average duration of unemployment in the modification economy is about one week longer, which is about a 10 percent increase. Duration increases because there are more households staying in local (poor job prospect) labor markets. By moving, households expect to move up one skill level, and this is proportional to their chance of finding a job. This implication of higher unemployment duration in the modification economy is consistent with a key fact reported by Winkler (2011), which is that homeowners have a lower hazard rate out of unemployment after an adverse labor shock.

Mobility falls in the modification economy to a migration rate of about 8 percent per year, compared to a 10 percent migration rate in the economy without modifications. This impact on mobility is moderate compared to that estimated by Kennan and Walker (2011), who find that a $10,000 subsidy for moving results in a 2 percentage point rise in mobility. In our model, agents receive a 45 percent reduction in payments, on average, for five years. Mapping this into the $6,000 median annual reduction in payments observed in HAMP data, there is an undiscounted subsidy to modifiers of about $30,000, which is about one-third as large as that estimated by Kennan and Walker.

We also find that the quarterly foreclosure rate is about 20 basis points lower in the modification economy, and the fraction of renters is much lower. The foreclosure rate is higher in the no-modification economy for the same reason that unemployment is lower, which is because more households leave the local labor market when modifications are unavailable. While the difference in the foreclosure rates between the two economies is fairly small, there are large differences in the number of renters. Because modifications are always available, this quarterly 20–basis point difference generates a much higher steady state mass of renters. Specifically, about 48 percent are renters in the non-modification steady state, while about 38 percent are renters in the modification steady state.

To compare our results to those in the literature, we estimated the following equation:

$$D_{i,t=12} = \beta_0 + \beta_1 \pi_{i,t=1} + \beta_2 \kappa_{i,t=1} + \beta_3 JO_{i,t=1} + \epsilon_i$$

The variable i indexes the individual. We estimate this in the cross section where $D_{i,t=12}$ is an indicator of default within 12 months after modification, $\pi_{i,t=1}$ is the skill level at the date of modification, $\kappa_{i,t=1}$ is the payment reduction expressed as a fraction, $JO_{i,t=1}$ is a job offer indicator at the date of modification, and ϵ_i is the error term.

The estimated results, which are in Table 9, are very similar to the empirical results presented in Haughwout, Okah, and Tracy (2009), who estimate a proportional hazard model of the form $D_t = \exp(\alpha(t)) \exp(X_\gamma)$. Since their coefficients are in a nonseparable exponential form, it is difficult to directly compare the results. However, they report that ''the data indicate that a 10 percent reduction in the required monthly mortgage payment is associated with around a

Table 9
Hazard for Redefaulting within 12 Months
(Dependent variable: 12-month redefault indicator)

Constant	0.85509
	(0.17707)
$\pi_{(i,t=1)}$ (Skill)	−0.14873
	(0.008327)
$\kappa_{(i,t=1)}$ (New Payment)	1.1396
	(0.52317)
$JO_{(i,t=1)}$ (Job Offer Dummy)	−0.47614
	(0.070691)

Note: Standard errors in parentheses.

13 percent reduction in the re-default hazard.'' In our model, if payments are reduced by 10 percent (i.e., κ is reduced by 0.1), then the redefault probability falls by 11.3 percent $= 0.1 \times 1.13$. This is roughly the same as their empirical results. Haughwout et al. did not have data on individual employment status, but our model provides results about this effect on redefault. Our estimated equation predicts that a person who has a job at the date of requesting a modification is 48 percent less likely to default one year later as compared to an unemployed person. Likewise, an increase in skill, which is a proxy for income, also reduces the probability of default.

The median modified mortgage payment declines by about 45 percent, compared to a median decline of about 40 percent reported by HAMP. Without the cap on the qualifying DTI, the reduction in the model would be much larger, as households would tend to wait to take the modification until their income is very low. Given that payments are reduced to 31 percent of current income and a modification can be taken one time only, there is an option value to wait to modify.

5.3 Economic Turbulence Experiment

Ljungqvist and Sargent (1998, 2004) analyze the impact of labor market policies by conducting what they refer to as ''turbulence experiments.'' Specifically, they analyze policies in an economy that has a one-time large exogenous destruction of jobs, and in which the skill level of the unemployed declines. We pursue a similar turbulence experiment to analyze the consequences of mortgage modifications in the model with a one-time large job destruction and a reduction in skills of those who are unemployed.

Specifically, our turbulence experiment is as follows:

- we double the layoff rate ($2 \times (1 - p_e)$) for one period; and
- for those who are laid off, their skill level is cut by one notch from their initial condition skill level.

The layoff shock and skill shock are unanticipated. We simulate a unit mass (approximated by 300,000 individuals) and follow them for two years after the shock, and compare the following variables over time between the modification economy and the nonmodification economy:

- the unemployment rate,
- average skill level,
- modification rate,
- the redefault rate, and
- the unemployment survival function.

Modifications are allowed one time only and can be applied for from the initial date of the shock until the end of the second year. The results of this experiment are illustrated in Figures 6 through 9.

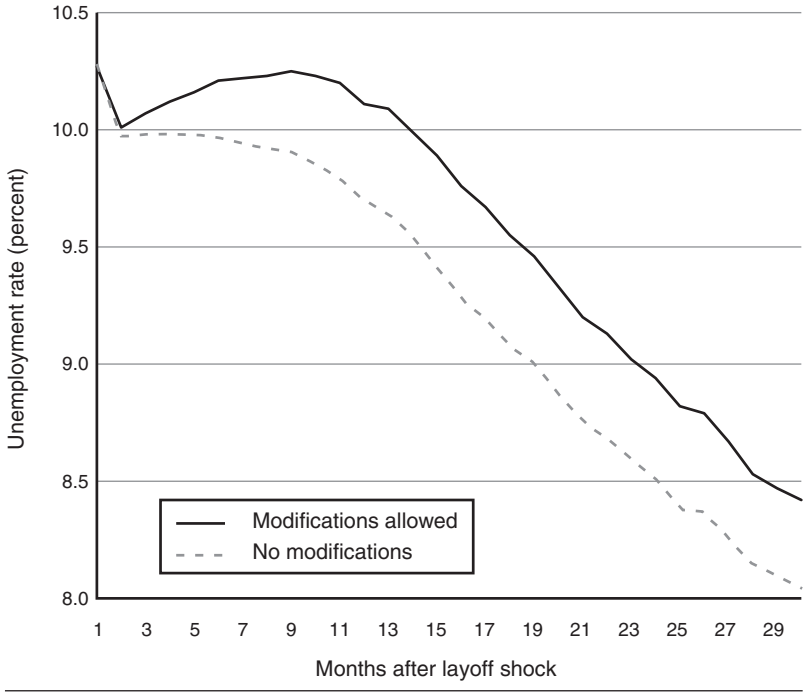
The initial conditions, which are identical across the modification and nonmodification economies, are as follows: 35 percent begin as renters, 65 percent begin as mortgagors, and the initial mean front-end DTI is 14 percent with a 2 percent standard deviation. The initial mean back-end DTI is 21 percent with a 4 percent standard deviation. The initial skills are distributed uniformly over skill slots 3 to 6.[9] Figures 6 through 9 compare the turbulence experiments for the modification and nonmodification economies.

5.4 Turbulence Discussion

The main findings are that modifications raise unemployment, increase the duration of unemployment, reduce the average skill level, reduce worker mobility, and reduce foreclosures. Specifically, the unemployment rate in the modification economy is about one-half percentage point higher than in the nonmodification economy. The 0.5 percent difference in unemployment is reached after about 10 months and continues at about that level for the 30-month horizon that we have examined. While this program does not account for

[9] There are seven slots in total, and no one begins in the extremes.

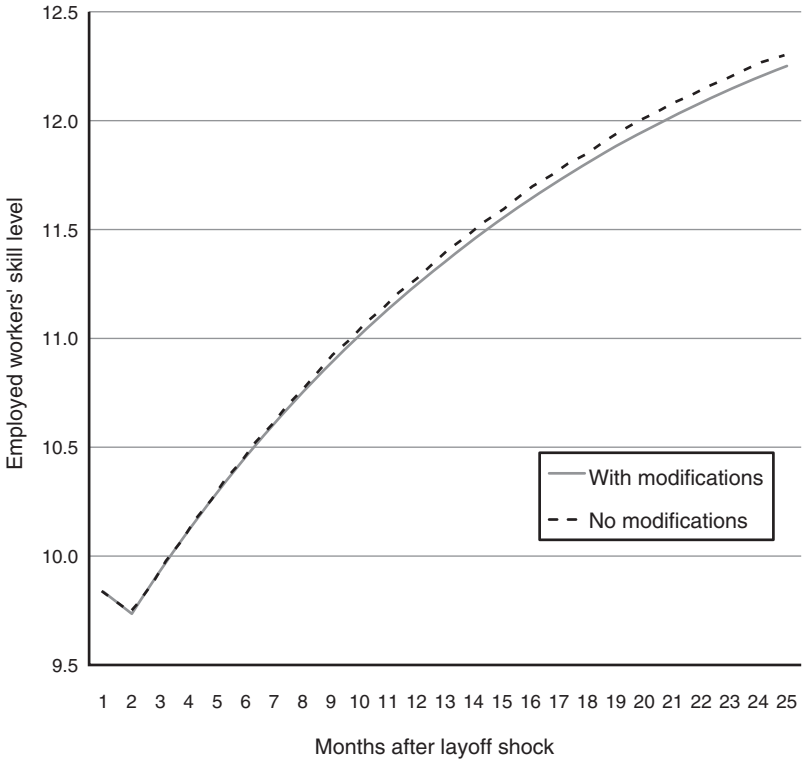
Figure 6
Turbulence Experiment: Unemployment Rate



the bulk of the increase in current unemployment, it does generate a persistent increase in unemployment, corresponding to about 730,000 unemployed individuals given the current size of the U.S. labor force. Unemployment duration in the modification economy is about 18.1 weeks, compared to 17.3 weeks in the economy without modifications.

The average skill level of the employed in the modification economy is about 0.5 percent lower than in the nonmodification economy. Figure 7 illustrates that this difference grows over time as the low-skilled unemployed modifiers eventually reintegrate back into the workforce and drag down the average. It is interesting to note that the modification rate in the first year following the job destruction shock is about 4 percent, which is close to the peak rate of modifications of 4.5 percent in 2009. The median modifier in this economy

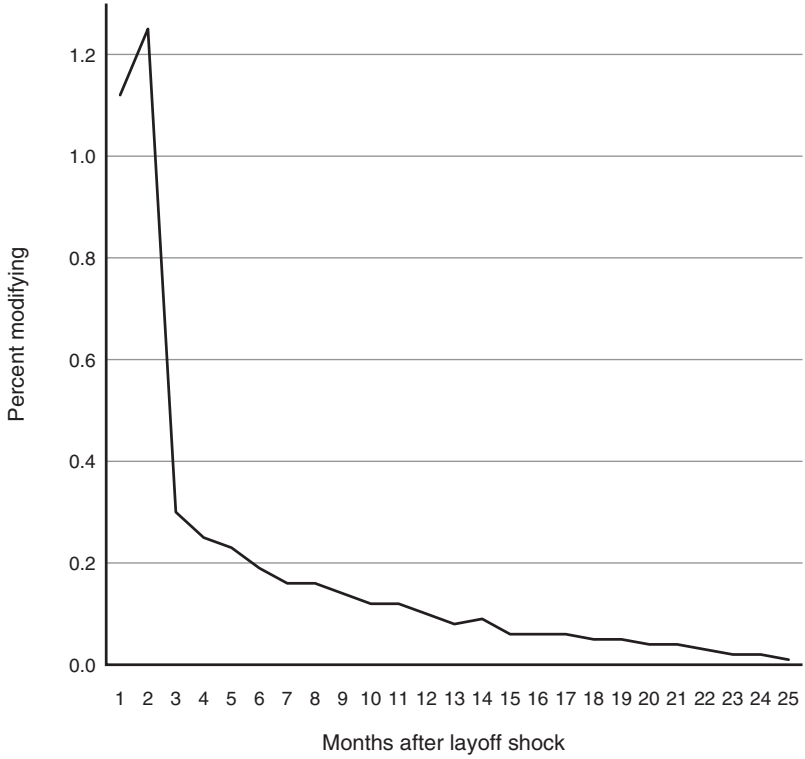
Figure 7
Turbulence Experiment: Employed Workers' Skill



has a back-end DTI of 0.88 as compared to a back-end DTI of 0.79 in the data.

Despite relatively generous modifications, there are a number of redefaults in the modification economy. Many of those who lose their job in the turbulence experiment choose to modify immediately. Of those who modify, many redefault shortly afterward. Specifically, 41 percent of modifiers redefault within one year, which is very similar to the 48 percent rate reported by the Office of Thrift Supervision for overall mortgages (OTS 2010-IV, Table 3). As in actual experience, many modifications are unsuccessful from the perspective of keeping the mortgagor in his home. Of those who successfully modify, it is precisely those with low skill who pay their modified mortgages that create the difference between the two economies. These

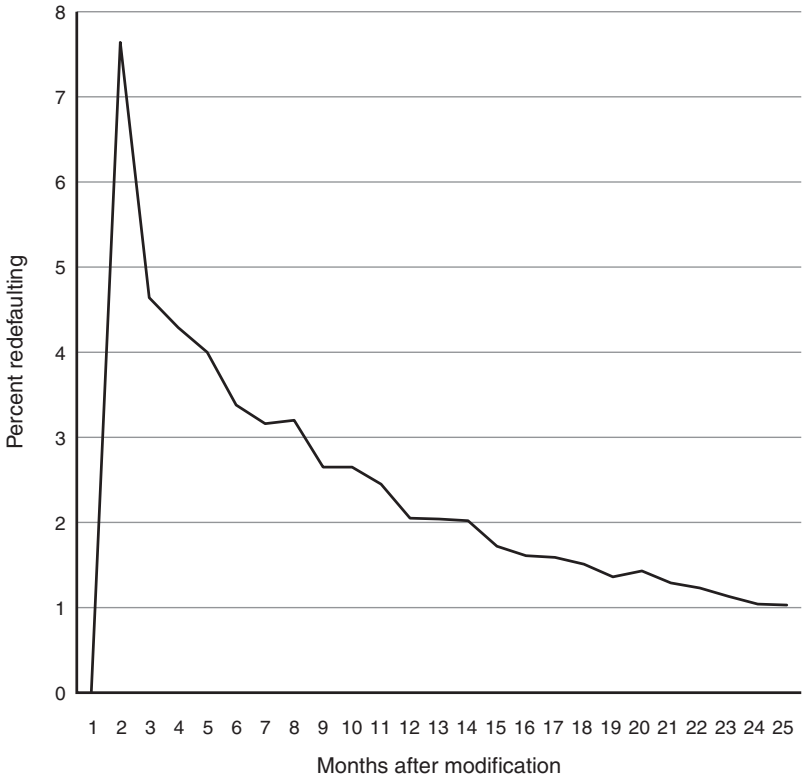
Figure 8
Turbulence Experiment: Percent Modifying Each Month



successful modifiers change the speed of recovery by delaying relocation to better job markets. Moreover, note that while the redefault rates settle down over time, there is still a persistent flow of new modifications even after the initial shock. This means that agents who do not lose their job in the initial period of job destruction do make use of the modification afterward.

These results also have implications for the recent change in the Beveridge curve. Specifically, many economists, including Hall (2010a and 2011), note that the Beveridge curve has shifted recently such that the efficiency of labor market matching is significantly lower today than in the past. While our model does not have a vacancy dimension, it is consistent with less efficient matching as

Figure 9
Turbulence Experiment: Modifications that Default



modified households choose to stay in relatively poor labor markets and thus may be consistent with a shifted Beveridge curve.

6. CONCLUSION

This paper has documented the slow recovery of the labor market from the Great Recession and has analyzed the impact of mortgage modification programs on why recovery has been delayed. These modification programs are means-tested, as the extent that mortgage payments are reduced by a modification depends on a borrower's current economic circumstances, including circumstances in which income is limited to unemployment benefits. Means-testing thus

changes the incentives for workers to relocate from relatively poor labor markets to better labor markets. Our findings indicate that these policies, as modeled in this version of the paper, can add about 0.5 percent to the unemployment rate and reduce per capita income by about 1 percent, which reflects both lower employment and lower worker productivity through skill erosion.

In terms of understanding why unemployment remains so high, it appears that other factors in addition to modifications are impacting current labor markets. Hall (2011) analyzes a model in which high real interest rates, combined with labor market rigidities, are important. It would be of interest to blend Hall's world with the modifications presented here, as well as to consider sectoral issues, given that some sectors of the economy, such as housing, have been more severely impacted.

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Comment

Robert E. Hall

The Herkenhoff-Ohanian paper has two purposes. The first is to demonstrate just how bad conditions have been in the labor market since the cyclical peak of employment in 2007. They compare the persistent shrinkage of employment to the similar, but much larger, shortfall in the Great Depression. The second part of the paper puts one program under a powerful microscope to see if its adverse effects on unemployment are an important part of the story of high recent unemployment.

Figures 1 through 3 and Tables 1, 2, and 4 of their paper make it clear how low employment growth has been in the recovery that began in mid-2010 compared to earlier recoveries, with the sole exception of the Great Depression. The authors diagnose ''labor market dysfunction.''

Their implicit hypothesis is that labor market factors account for the poor performance of the economy. The paper contains no mention of events in financial markets that figure so prominently in other discussions of the deep and persistent slump in the labor market that began in 2007. My own view—see Hall (2011)—assigns most of the blame for high unemployment on forces outside the labor market, notably the bulge in household capital and corresponding household debt inherited from the middle of the past decade and the paralysis of monetary policy resulting from its inability to depress the interest rate below zero. The paper's brief discussion of the Great Depression similarly omits the financial driving forces that others have emphasized.

That said, labor market dysfunction, or at least a decline in the efficiency of the hiring process given the widespread availability of

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willing workers, may well be part of the explanation of the explosion of unemployment. On this, see Davis, Faberman, and Haltiwanger (2010), which pursues very different ideas about the subject.

The Herkenhoff-Ohanian paper concentrates on one hypothesis about recent changes in the labor market. The hypothesis is that policies intended to help families deal with their inability to meet their mortgage payments may have the unintended consequence of limiting their incentives to look for jobs available in areas sufficiently remote to require moving houses. The policies unquestionably tie families to their existing homes and thus limit geographic mobility. The question is how much of the bulge in unemployment results from families' response to the incentives. The paper's answer is very little. Table 8 shows that their model, tuned to deliver an unemployment rate of 7.7 percent in the presence of the HAMP policy for mortgage assistance, predicts a rate of 7.4 percent without that program. In this respect, the paper supports the view that most of the rise in unemployment is the result of other forces, including diminished demand for labor arising from the financial crisis and diminished efficiency of reallocating unemployed workers to jobs for reasons other than HAMP.

The authors approach the task of quantifying the effects of HAMP on unemployment in a thoroughly modern way. First is a detailed description of HAMP and its statement in mathematical form. Second is embedding HAMP in a family dynamic program, laid out in wonderful detail in Section 4.1. Families assign a value to their current status, which depends on their employment opportunity and residential status (owner with original mortgage, owner with modified mortgage, or renter). A family chooses an action, such as applying for a mortgage modification through HAMP, when that action delivers a higher expected value than other actions available at the time.

The key interaction between mortgage modification and unemployment is that workers generally face better job opportunities in distant labor markets, thanks to mismatch in the locations of the unemployed and the location of jobs. Signing up for HAMP makes the choice to look for work in a distant market less likely because a move requires a homeowner to default on a mortgage, become a renter, and lose the benefit of HAMP.

The third step is to solve the model for its steady-state equilibrium (a nontrivial piece of computation). The reader is spared the details

of this aspect of the work. The final step is to adjust parameter values so that the equilibrium of the model matches known features of the labor and housing markets, as shown in Tables 7 and 8. Here the authors apply the econometric method of indirect inference. They are unable to provide information about the sampling accuracy of their parameter estimates—normally a standard feature of indirect inference—because they draw their reference moments from a variety of sources and thus lack the covariance matrix that would be needed for the calculation of sampling errors. That said, it would be desirable in future work to try to give some indication of the potential magnitude of sampling variation.

Armed with a complete computational model, the authors compare, in Table 8, an economy intended to resemble the actual economy, including HAMP, with a similar economy differing only in the absence of HAMP. In addition to the lower unemployment in the non-HAMP economy, the table shows more migration, more foreclosures, and much more propensity to rent in the non-HAMP economy.

The results in Table 8 should be compared to other estimates of the effect of HAMP and to other data on the current U.S. economy. The authors note the increase from 38 percent to 48 percent in the fraction of families renting their homes but do not go on to compare those figures to actual data. Prior to the crisis, 31 percent of U.S. families were renters, a figure that rose to almost 33 percent recently. Thus the model modestly overstates the incidence of renting in normal times (it says 38 percent) but seriously overstates any possible effect of HAMP because renting rose by about 3 percentage points from all the influences operating recently—all of which point upward—while the model predicts an increase of 10 percentage points from HAMP alone.

Other research has considered some issues that Herkenhoff and Ohanian take up. The evidence on any general decline in geographic mobility postcrisis is mixed, but it is fair to say it has not been large (nor was its level very large precrisis). Kothari, Eksten, and Yu (2011) show that mobility rates for homeowners fell by less than trend after the crisis, while rates for renters rose. The fact that the change in mobility for owners was less than for renters gives a bit of support to the hypothesis that geographic mobility among homeowners was impaired by recent events. Saks and Wozniak (2009) show as well that interstate mobility fell a small amount in the years since 2007.

Kothari et al. (2011) show that mobility among unemployed homeowners declined from 2006 to 2010. Saks and Wozniak (2009) show that, as a general matter, mobility has been lower in recent decades in years with high unemployment, suggesting that the recent declines in mobility may not be the result of programs such as HAMP that were not present during past periods of high unemployment.

Kothari et al. (2011) show that geographic moves for job reasons are generally low for both homeowners and renters, but lower for owners. Job-related mobility fell by more between 2006 and 2010 for renters than for owners.

Ferreira, Gyourko, and Tracy (2010) find that negative equity has a small but statistically unambiguous negative effect on mobility among homeowners. This finding supports the hypothesis that economic factors relating to housing, as studied by Herkenhoff and Ohanian, are a factor in mobility decisions. Schulhofer-Wohl (2011) presents a similar finding.

By necessity, the paper concentrates its detailed modeling on HAMP and the decisions of interest—signing up for HAMP, defaulting and becoming a renter with no further impediment to searching in a more favorable labor market, or staying put without HAMP and keeping an existing job. The interaction between housing and labor market decisions is nicely captured. On the other hand, many aspects of the labor market are streamlined relative to models that concentrate on that market and neglect housing decisions. In particular, the model lacks the key idea of the Diamond-Mortensen-Pissarides theory of unemployment: endogenous tightness. In that model, wage bargaining is central to the behavior of unemployment. When unemployment is high, the bargaining position of a worker is reduced because alternative jobs are hard to find. If the result is a lower wage, employers' incentives to create jobs are correspondingly higher, and unemployment returns to its normal level. If wages do not reflect the lower bargaining power of workers—if they are sticky instead—the self-correcting mechanism is less effective, and unemployment can be high and persistent. Because recent experience has shown that unemployment can, in fact, become high and then persist at high levels, the neglect of the feedback mechanism in the paper is probably not a major reason to question its findings.

Of course, the paper does not find that the labor market became dysfunctional as a result of a program, HAMP, that helped keep

people in their existing houses and dissuaded them from moving to places with more favorable job opportunities. It finds only a small effect of HAMP. The notion that the real harm to workers came from factors outside the labor market—the same factors that led to serious declines in consumption and investment spending—remains largely intact after the authors' careful examination of HAMP.

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Comment

John V. Leahy

If one looks at the economy today, there are three big imbalances: unemployment, the housing sector, and government finances. The authors are to be commended for taking a step toward tackling the first two. My main criticism will be that, while the authors make a start, they did not go far enough. They chip off a small piece of the unemployment problem and a small piece of the housing problem. In reality, these problems are much larger than what we see in their model.

This critique is certainly unfair. The model is already very complicated and challenging to solve. Extending it would entail major effort. Still, I see this paper as an interesting first step, and it is useful to consider where further steps might take us.

I will begin by briefly describing their argument and the setup of their model. This will give me a background on which to place my comments. I will close with some general comments about the state of housing and questions that still need to be answered. I believe that commenter Robert Hall's discussion will focus more on unemployment and migration.

THE MODEL

The paper begins with the observation that the current recession differs from the typical postwar recession: there has been little rebound toward trend after the initial drop-off in output. In this, the authors argue the current slump is more like a miniature Great

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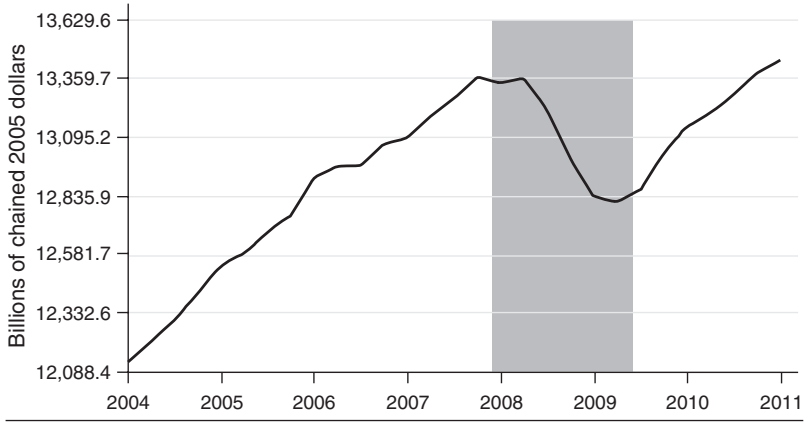
Figure 1
Real Gross Domestic Product



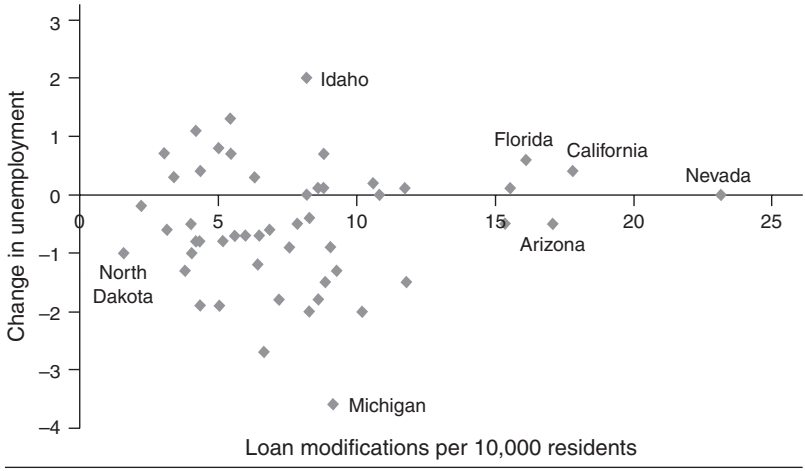
Source: U.S. Department of Commerce, Bureau of Ecconomic Analysis.
Note: Shaded area indicates recession.

Depression than a recession. Figure 1 shows the behavior of GDP since 2004. It is easy to see that there has been little mean reversion. The postrecession trend looks very similar to the prerecession trend. It is as if the economy experienced a permanent downward shift in its growth trajectory.

The remainder of the paper attempts to explain this shift and why the unemployment rate has remained so high for so long. In earlier work, the authors had some success in attributing the length of the Great Depression to the effects of government regulation. They search for a similar storyline in the current recession. This search leads them to consider housing, particularly mortgage modification. Their argument is that mortgage modification, by making it cheaper for borrowers to remain in their homes, may lead workers to remain in poor labor markets rather than move to where employment opportunities are better.

To get a quick check on the potential magnitude of this channel, I plotted data on unemployment and mortgage modifications at the state level. If one simply plots the level of mortgage modification on the level of unemployment, one gets a strong positive correlation that likely reflects the fact that poor economic conditions cause both

Figure 2
Loan Modifications and Changes in the Unemployment Rate



Source: Office of Thrift Supervision, ''OCC and OTS Mortgage Metrics Report, 3rd Quarter 2010,'' Table 50.

Note: Change in unemployment is from June 2009 to April 2011. Loan modifications are as of the third quarter of 2010.

to rise. Figure 2 instead plots the change in unemployment against mortgage modification at the state level. The x-axis is the number of modifications per 10,000 residents in the third quarter of 2010. The y-axis is the change in the unemployment rate between June 2009 and April 2011. The modification programs began in 2009 and ramped up during the year, so June seemed like a reasonable starting point. April 2011 was chosen as the end point because it was the latest data available at the time of the conference when these papers were presented. There is not much of a pattern in the figure. A regression reveals a slight upward slope that is statistically insignificant. If we take the estimates at face value, eliminating modifications would reduce unemployment by less than a quarter of a percent. This estimate is consistent with the small number that the authors' theoretical model generates. Still, this may be an overestimate, as we have not fully controlled for the effects of unemployment on modifications.

The author's theoretical analysis builds on a model of labor flows. The model has exogenous job-offer and -destruction rates, a skill ladder in which employed workers accumulate skills and unemployed workers decumulate skills, and three decisions: a decision to accept or reject a job; a decision to pay a mortgage, accept a modification, or default; and a decision to stay in one location or move to another. Modification involves a reduction in interest payments, and default involves a cost of entering a default state. The decision to move increases an agent's job-finding rate, but an agent must default in order to move, so in effect it is the decision to default that improves an agent's job prospects. Incomes of working agents fluctuate over time.

It is useful to think of the model as a large map. The locations on this map correspond to whether an agent is employed or unemployed, on the one hand, and has a mortgage that is current, modified, or in default, on the other. The model describes how agents move between these various states. In any given period, they may choose to move to a worse state (i.e., from employment to unemployment), or from a current mortgage to a modified mortgage, or to default. Movements from between employment and unemployment or from default to modification also happen by chance.

The main result of the analysis is that allowing modifications raises the unemployment rate. This follows directly from the assumption that those in default have a higher job-finding rate. There is also an amplification effect that comes from skill accumulation. The higher unemployment rate causes agents to lose skills, which further reduces their productivity and hence job prospects. All in all, the mechanism can explain about half of a percent rise in unemployment.

My first observation regarding the model concerns the plausibility of the mechanism. In the model, one has to default in order to move to a new location and improve one's job prospects. I do not know the data, but my intuition tells me that only a small fraction of agents who move have defaulted on their mortgages. The vast majority sell their homes, pay off their loans, and then move. The model shuts down this channel to focus on the lock-in effect of loan modification.

My second observation is that each agent moves independently across employment and mortgage states. Agents do not interact. There is no equilibrium. There is no house price that equalizes the supply and demand for housing. There is no wage that responds to

unemployment. There is no consumption-savings decision, with its effect on interest rates and capital accumulation.

Of these, the lack of a role for house prices is the most troubling, since house prices would appear to be at the center of our recent troubles. In the model, agents default to escape mortgage payments and to increase their chance of finding a job. There is no role for negative equity. Mortgage payments never exceed the value of a home. When I think of someone being locked into a poor labor market, I think of someone who cannot afford to sell his home, not someone who enjoys low interest on a modified mortgage.

Among the missing interactions are the spillover effects, in which some agents' attempts to sell their homes to get out from under their mortgages reduce the prices of all houses, and hence the position of other borrowers. Missing also are the effects of mass default, which may lead to fire sales as lenders attempt to reduce inventories of repossessed homes. Missing are the effects on the banks themselves, as they see their equity position eroded by a worsening mortgage portfolio. Plenty of good research focuses on specific issues at the expense of other concerns. The model shows that the direct effect of mortgage modification on mobility is small. The question remains whether the interaction with some of these other missing channels is more significant.

My third observation regards the welfare implications of the model. Default and modification are both good outcomes in this model. Every mortgage holder in the model wants to modify his loan, since modification reduces payments without any cost. The only reasons that mortgage holders do not modify immediately is that some are prevented by the debt-to-income threshold, while others are waiting to modify at even better terms in the future. It would seem that the model is missing some cost to modification. Maybe it is the implication of modification for the agent's credit score. Maybe it is the effect that modification will have on the agent's ability to borrow in the future. Maybe it is some notion of commitment or obligation to pay one's debts. Whatever it is, it does not appear to be an insignificant omission.

While modification is unambiguously good in the model, default comes with costs, but also a big benefit. One needs to default in order to improve one's chances of finding a job. The more agents default, the more quickly they find jobs, the lower is employment

and the higher is the skill level of the population. It would seem that the model is missing some costs of default as well. I have already mentioned the effect on the banking sector and the effect on house prices. One might also imagine an effect on the federal budget through government mortgage guarantees. Omitting these costs reduces the model's usefulness as a tool to evaluate modification as a policy.

My fourth observation regards what we learn about the mortgage modification as a policy. The main lessons are that modification has only modest effects on labor mobility and that there may be a surprisingly large option value to delaying modification. Everyone wants to modify, but only a few actually do. This may help to explain why so few take up these programs. Beyond this, we learn very little about modification as a policy. One might like to know how modification today will affect the decision to borrow in the future. Will borrowers assume that they will be bailed out again? One might want to know how it will affect banks. Will they demand higher interest rates as a cushion? One might want to know who is paying for this insurance and how it is being priced, if at all.

BUTTRESSING THE HOUSING MARKET

I want to close with a few comments about the housing market. The past few years have seen a massive effort by nearly all branches of government to support house prices. Fannie Mae, Freddie Mac, and the Federal Housing Administration now back over 90 percent of new mortgages (Inside Mortgage Finance Publications 2010). There have been large increases in conforming loan limits. The Federal Reserve has purchased large quantities of mortgage-backed securities. There has been a homebuyer tax credit and mortgage modification.

This has largely been an effort to contain the problems caused by declining house prices rather than a solution to these problems. The plan, if there is one, appears to be ''hope that the economy improves and the problem goes away.''

There is a lot that we do not understand about these efforts. The housing market is a very large market, and efforts to move it cannot be costless. What are the costs and benefits of these efforts? The loan guarantees and security purchases expose the government to significant risks. What is the fiscal exposure? Are there alternatives?

How do we extricate the government from this market and move to a more balanced and sustainable system?

The authors have written an interesting paper on an important topic. In my comments, I tried to point out some of the things that were missing. I am sure that none of this is news to the authors. All modeling efforts involve choices of where to focus attention and what to simplify. I look forward to seeing where they take this research in the next few years.

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