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Labor market institutions and homeownership*

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Abstract

To what extent *labor market institutions* can explain homeownership rate differences over time and across countries? Using data from 19 countries over fifty years, I find a positive correlation between employment rigidities and homeownership, and a negative correlation with wage rigidities. I rationalize these findings through a DSGE model where heterogeneous households face a housing tenure decision in presence of labor frictions. Labor rigidities affect housing tenure choice through their impact on employment and wage volatility. Labor institutions explain a relevant share of homeownership heterogeneity between countries and over time and labor reforms can interfere with policies targeted to increase homeownership.

JEL Classification: J08; J30; J50; R20; R21.
Keywords: Housing markets; Labor market institutions; DSGE; Labor reforms.

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1 Introduction

In the last decades homeownership rate changed significantly in many OECD countries while it remained almost the same in others. Housing wealth is one of the most important elements of households' portfolio and its dynamics affect many aspects of the economy. Housing tenure choice depends on housing prices, mortgages' supply and housing market conditions, but can also depend on elements that affect housing demand, such as income uncertainty. During the last decades there have been large changes in the legal framework of labor market in many countries and this fact is relevant because labor legislation can affect several elements that influence the housing tenure decision. In particular, labor market institutions can impact the income risk related to the volatility of employment and real wages. Understanding the importance of labor legislation for households' housing tenure decision has relevant policy implications, but the existing literature has provided no empirical or theoretical evidence about this relationship.

In this paper I investigate whether labor markets institutions (LMIs) play a role in explaining the heterogeneity we observe in homeownership rates across countries and over time. I provide empirical evidence on the relationship between LMIs and homeownership and I propose a tractable general equilibrium model to study the endogenous interactions between the housing market and the labor market. One main contribution of this paper is to shed light on the link between labor institutions and housing market. There is in fact an unexplained part of homeownership dynamics which the existing literature usually includes in the black box of *country preference* for homeownership. This paper helps to understand part of the unexplained housing dynamics, showing that LMIs have a broader impact on the housing market, with respect to the one usually considered by the literature and by policymakers.

To study relationship between LMIs and homeownership, I use data from 19 OECD countries over the period 1965-2014, considering a large set of labor market institutions, controlling for the elements that has been found to influence the housing tenure choice by the literature, such as changes in demographics, economic conditions, taxes on property and successions, financial market innovations, and housing market situation. From principal components and panel regression analyses I find that an overall more rigid labor market is positively correlated with homeownership. This is the result of the opposing effects of employment and wage rigidities. Indeed, employment rigidities, represented by employment protection, strong labor unions and generous unemployment benefits, are positively correlated with homeownership. On the other hand, real wage rigidities such as wage bargaining centralization, are negatively correlated with homeownership. These results can be explained by the fact that employment rigidities tend to reduce the volatility of employment, whereas generous unemployment benefits tend to smooth the negative impact of unemployment shocks. This reduces *de facto* real wage volatility without increasing employment volatility. Real wage rigidities instead reduce the volatility of real wages but they also increase the volatility of employment, as firms hit by a negative shock will be forced to adjust employment. Because housing tenure decision is largely affected by the risk of becoming unemployed higher employment volatility has a negative impact on homeownership.

To get evidence on the effects of specific labor reform episodes on homeownership, I use a difference in difference approach considering different groups of reforms that reduced labor rigidities.I find that reductions in employment protection and less generous unemployment ben-

efits are negatively correlated with homeownership, whereas reforms that reduce union power or that decentralize the wage bargaining are positively correlated with homeownership.[1] These findings confirm the results from the panel regression analysis and contribute to the literature on LMIs and macroeconomic outcomes.

To investigate the mechanism behind my empirical findings, I construct a Dynamic Stochastic General Equilibrium model where heterogeneous households face a housing tenure decision, in presence of search and matching frictions and labor market rigidities, both in terms of employment and wages. The model has enough details in the labor sector to be able to disentangle the heterogeneous effects of different labor institutions. In my model the housing market is directly linked to the labor market via an endogenous credit constraint which depends on households' expected income and its volatility. The credit constraints studied previously by the literature (see Iacoviello (2005) and Greenwald (2016)) considered only loan to value ratios or loan to income ratios, which cannot capture the role played by income uncertainty on housing demand and mortgage supply. The credit constraint in my model reflects the fact that financial institutions take into account the repayment ability of borrowers, given also the aggregate labor market uncertainty. In this framework there is more credit available for mortgages when household's income is higher and less volatile, while credit availability shrinks during times of low income or high uncertainty. The model that I propose contributes to the literature on housing and financial frictions because it allows to disentangle the effects of different labor market rigidities on the housing market, with the endogenous credit constraint acting as transmission mechanism.

The model is able to replicate second moments of wages and unemployment for US, France and United Kingdom, and it matches well homeownership rates of these countries. I use the model to perform two counter-factual experiments aimed at investigating how labor market institutions interact with the housing market. At first, I consider a hypothetical adoption of French employment protection, benefit replacement rates and unions' strength in US. As United States have more flexible labor institutions than France this experiment is useful to study the impact of an increase in labor market rigidity on homeownership. I find that this policy change would lead to a sizable increase in US homeownership. This effect on homeownership is driven, within the model, by the impact of different LMIs on the level and volatility of wages and employment.

As a second counter-factual experiment, I evaluate the impact of a labor market reform that took place in the United Kingdom in the 1980s, which reduced the benefit replacement rate. I find that this reform, if everything else was unchanged, would have leaded to a not-negligible reduction of homeownership. During the same period UK approved a reform aimed at stimulate homeownership, which indeed increased after the 1980s. My simulation results suggest that the labor reform undertaken in UK during the 1980s has dampened the positive impact of the specific housing policy implemented in the country. Hence, the results from counter-factual experiments indicate that LMIs play a not negligible role in driving homeownership dynamics.

[1] This finding is consistent with my previous results. Indeed, considering separately union coverage and extension of collective agreements in the panel regression analysis, I find that the former is negatively, whereas the latter is positively correlated with homeownership. The opposite effects for two similar institutions may suggest that the two indicators capture the dual role of labor unions, active both in wage bargaining and employment bargaining.

An implication of my findings is that models which want to study the impact of labor reforms on the entire economy, should also take into account also the direct effects of these reforms on the housing market.

The rest of the paper is organized as follows. Section 2 presents the literature related to this work. Section 3 describes the data for homeownership, labor market institutions and the covariates, and it presents the principal component analysis. Section 4 shows the panel regression results under different specifications and it presents the robustness checks. Section 5 describes the data on labor market reform episodes. Section 6 presents the results from the difference in difference analysis. Section 7 describes the theoretical model and presents the solution method and calibration. Section 8 shows the match of the model to the data and it describes the results from the counter-factual experiments. Finally, Section 9 concludes the paper.

2 Literature review

The literature related to this paper can be divided broadly into four groups. The first strand, represented by Chiuri and Jappelli (2003), Chambers et al. (2009), Andrews (2010), Andrews and Caldera-Sánchez (2011a), Andrews and Caldera-Sánchez (2011b), Andrews et al. (2011), Caldera-Sánchez and Johansson (2013), investigates the evolution of homeownership and housing demand. Some of these works investigate homeownership over time while others focus on cross-country comparisons. This literature has shown that demographic changes, macroeconomic conditions, innovations in the financial market and specific housing policies can explain part of homeownership evolution over time. The persistence of cross-country differences in the long-run instead is attributed mainly to country-based preferences and to different levels of mortgage market development. With respect to this first group of papers, I investigate an alternative driver of housing demand, namely income uncertainty caused by labor market rigidities.

The second strand of literature, represented by Haurin (1991), Robst et al. (1999), Ortalo-Magné and Rady (2002), Diaz-Serrano (2005b), Diaz-Serrano (2005a), Sinai and Souleles (2005), Davidoff (2006), investigates whether labor income risk and volatility affect housing tenure decision. These studies have found that labor income uncertainty is important for households' housing tenure choice. There is a widespread consensus among this literature on the fact that labor income risk and volatility have a negative effect on homeownership. In particular, Gathergood (2011) finds that unemployment risk at the household level reduces the probability that a renter becomes home owner. Attanasio et al. (2012), using a life-cycle model, find that individuals delay the purchase of their first residence when incomes are low or uncertain. Furthermore, an increase in income variance leads to a reduction in residential ownership. The main limitation of this literature is that it does not investigate the sources of income uncertainty. I contribute to this literature by linking labor market rigidities with their heterogeneous impacts on labor income volatility, being able to distinguish the opposite effects of employment and wage rigidities.

The third group of papers related to mine, composed by Oswald (1996), Henley (1998), Barcelo (2006), Battu et al. (2008), Rupert and Wasmer (2012), Bentolila et al. (2012), Bajari

et al. (2013) and Sterk (2015), focuses mainly on the effect of high levels of homeownership on labor outcomes, like unemployment spells and labor mobility. This strand of the literature has found that a higher level of homeownership is associated with lower labor mobility and longer unemployment spells, assuming that differences in homeownership were mainly due to country-specific preference for ownership. The impact of labor legal framework on homeownership has not been investigated by the existing literature. In this paper I take a different perspective and I investigate the possibility that an external source, such as labor market institutions, can affect both the homeownership rate and labor outcomes. I exploit cross-country and over time variation of labor market legislation accounting for both changes over time within a country and across countries.

Finally, this paper is related to the literature that studies the impact of labor market frictions on the volatility of macroeconomic outcomes and that has found that *employment rigidities* (ER) and *real wage rigidities* (RWR) have opposite effects on the volatility of employment and real wages. In particular, Rumler and Scharler (2009), Abbritti and Weber (2010), Abbritti and Fahr (2013) and Gnocchi et al. (2015) investigate the role of LMIs on the volatility of macroeconomic outcomes, such as inflation, output, unemployment and wages. This literature finds that employment rigidities tend to reduce the volatility of employment. On the one hand real wage rigidities reduce the volatility of wages, increasing at the same time volatility of employment. This is because when a firm is hit by a negative shock and cannot adjust wages it might be forced to reduce employment. Given that ER and RWR affect differently the volatility of employment and income, it is important to distinguish between the different types of labor rigidities to correctly evaluate the impact of labor market institutions on homeownership. I exploit the results of this literature to identify a channel that links labor market institutions with homeownership.

My paper creates a bridge between the literature on housing demand and the one on labor institutions and macroeconomic outcomes. With respect to the former, I consider a more detailed labor sector and this allows me to study the effects of specific labor legislations. With respect to the latter, I incorporate the housing market and study its dynamics.

3 Data description

I collected annual data for the period 1965-2014 for 19 OECD countries: *Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland United Kingdom and United States.* I analyze a relatively large sample of countries to account for possible country-specific differences in the level of homeownership. Moreover, the time period considered is long enough to consider long-run trends of homeownership and it includes the most significant labor market reforms for many of the countries studied.

3.1 Homeownership data

Homeownership rate is defined as the percentage of households that owns the main residence (OECD definition). Complete data on homeownership are relatively rare, as statistical offices of

different countries often use specific criteria to define homeownership.[2] Data on homeownership are obtained from the CEP-OECD Institutions Dataset constructed by Nickell (2006) from data by Andrew Oswald and the OECD Employment Outlook 2005[3] . I completed these data with information obtained directly from the statistical offices or central Banks of each country. Fig.1 shows the evolution over time of homeownership for each country. Some countries like Italy, Netherlands or Spain experienced a large increase in homeownership rate between 1965 and the 2014, whereas in other countries like Denmark, Japan or US it remained quite stable.

Fig.2, where countries are ordered according to their mean value of homeownership, shows more clearly the differences over time *between* countries. The red diamonds represent the mean value of homeownership for the entire period considered, while the blue circles show the evolution over time of homeownership within each country. As we can see, some countries that started with a relatively low level of homeownership experienced a large increase, while others had a much smaller variation.

3.2 Labor market institutions

I consider 14 different labor market institutions to be able to distinguish between rigidities related to employment and real wages. This distinction is important because different types of rigidities have opposite effects on the volatility of employment and wages. I combined data from a variety of datasets largely used by the literature on labor market institutions. I use the CEP-OECD Institutions Dataset, constructed by Nickell (2006), the ITCWSS database from Visser (2011) and directly the OECD Employment Protection Legislation Indicators. Table 8 presents a detailed description of each LMI and Table 9 shows the relative descriptive statistics. From the 1960s until the middle of 2010s employment protection for permanent contracts show very little variation, employment protection for temporary contracts instead experienced substantial reductions in protection for countries such as Germany, Italy, Portugal, Spain, and Sweden. Union concentration and coverage in the last decades increased in some countries and decreased in others, and the same is true also for union density. Looking at real wage rigidities, it is possible to observe substantial variation in the centralization and level of wage bargaining, as well in government intervention in the bargaining process. Minimum wage decreased substantially in Ireland, Japan, the Netherlands, Spain, and the United Kingdom. On the other hand unemployment benefits generally increased in generosity since 1965. The majority of labor market reforms took place between the 1980s and the 1990s, therefore these two decades drive the largest part of the over-time variation of my data.

3.3 Control variables

I include 15 control variables taken from different sources described in Table 10. The chosen controls were identified as important drivers of homeownership by the existing literature on

[2] A typical example is represented by the Scandinavian countries, which have different forms of dwelling's ownership and social housing. In case of conflict or ambiguity among different definitions I used the one of OECD, to have homogeneous data.

[3] The original dataset of Nickell (2006) spans from 1960 to 2003 and it includes 20 countries, but I had to exclude Portugal due to lack of data on homeownership.

housing.[4]. My controls include variables related to macroeconomic conditions, demographic changes, but also housing market conditions and taxation regimes on property and inheritance. Table 11 shows the relative descriptive statistics for each variable.

3.4 Principal component analysis

To capture the impact of different labor market institutions and their combinations having interpretable results, I use *principal component analysis* (PCA).[5] Abbritti and Weber (2010) have shown that labor market institutions influence each other and their interactions should be taken into account to evaluate their effects on the economy.

I adopt two different specifications for the construction of the principal components of labor market institutions.[6] As first specification, I divide the labor market institutions into four groups on the basis of economic meaning and their possible impact on the economy. I compute one component for each group and call each of them Economic Factors. This procedure allows me to disentangle the different effects of employment rigidities and wage rigidities, on homeownership. As second specification I consider all LMIs equally and I construct a measure of *overall rigidity* of the labor market. This is useful to understand the total effect of a more rigid labor market framework, since it is often the case that countries with more rigidity on employment present also more rigidity in wage setting.

3.4.1 Economic factors

As first specification I divide labor market institutions into four groups: (i) *Employment Protection legislation* (EPL) constructed with employment protection for permanent contract and employment protection for temporary contracts; (ii) *Unions' Strength* (UnS) that includes union density, union concentration, union coverage and extension of collective agreements; (iii) *Wage Bargaining* (WB) with bargaining coordination, bargaining centralization, tax wedge, government intervention in wage bargaining, level of prevalent wage bargaining and minimum wage setting and (iv) *Unemployment Benefits* (UB), with benefit duration, benefit replacement rate and unemployment benefits.

3.4.2 Statistical factors

As second specification I construct four *Statistical Factors* from the full group of labor institutions.[7] This is the most general specification possible, since it does not assume any specific economic relation between the institutions. To interpret these factors I compute the correlation for each of them with the original labor market institutions. SF1 is highly positively correlated with all the LMI, so I interpret the first component as a measure of *overall rigidity* in the labor market.[8]

[4]See Andrews and Caldera-Sánchez (2011b) and Andrews and Caldera-Sánchez (2011a) for an extensive discussion on this topic.

[5]Also Gnocchi et al. (2015) adopted principal component analysis for studying the impact of a large set of labor market institutions on macroeconomic outcomes.

[6]The principal components are obtained using correlation specification, equivalent to using standardized data.

[7]The analysis of the factors' loadings suggests to keep 4 factors: SF1, SF2, SF3, SF4.

[8]SF1 is the only Statistical Factor on which I will focus in my analyses. SF2 is highly positively correlated with the UB institutions and SF3 reflects mainly the movements of minimum wage setting, EPL and the extension

3.4.3 Principal controls

Following the same reasoning adopted for labor market institutions, I construct principal components also of the set of covariates, chosen to control for the factors that can affect homeownership. From the original controls, I construct 5 principal components that I call *Principal Controls*.[9]

4 Empirical results

4.1 Panel regression analysis

In this section I document the correlation between labor market institutions and homeownership. In order to exploit both the cross-sectional and over time variation of the data, I adopt panel regression analysis including country fixed effects, year fixed effects and country-specific time trends. Country fixed effects account for the fact that there may exist country-specific preferences for homeownership. Year fixed effects account for time specific characteristics. Finally, the country-specific time trend allows for trends to vary across countries.
My baseline regression reads:

$$ho_{i,t} = \alpha + \beta' \mathbf{LMI}_{i,t} + \gamma' \mathbf{X}_{i,t} + \mu_i + \nu_t + cstt_{i,t} + \varepsilon_{i,t}$$

where $ho_{i,t}$ is homeownership rate at time t in country i. α is a constant, $\mathbf{LMI}_{i,t}$ is the vector of principal components obtained from labor market institutions and it is different for each specification of PCA: Economic Factors and Statistical Factors. $\mathbf{X}_{i,t}$ represents the set of principal components derived from the original control variables. μ_i are country fixed effects, ν_t are time fixed effects and $cstt_i$ represents the country-specific time trends. Following Nickell et al. (2005), I estimate a generalized least squares model, always calculating robust standard errors allowing for heteroskedasticity with cross-sectional correlation and panel specific first order serial correlation.

4.1.1 Evidence from Economic Factors

Table 1 shows the panel regression estimates using the four economic factors. Column (1) represents my baseline model with all Economic Factors, principal controls, fixed effects and time trends. Column (2), (3), (4) instead consider EPL with each of the others Factors UnS, WB and UB, one per time. The employment protection factor results significantly and positively correlated with homeownership in all the specification. Also unemployment benefit factor is positively correlated with homeownership. A priori, the effect of unions' strength is less clear. Indeed it depends whether UnS acts more as employment rigidity or wage rigidity. [10] In

of collective agreements. Finally SF4 is highly correlated with unemployment benefits, employment protection measures and with tax wedge.

[9] As alternative specification for the construction of the principal controls, I divide the covariates into 3 groups, according to their economic meaning: (i) Housing control; (ii) Economy control and (iii) Tax control. This leads me with three principal controls. Results under this alternative specification are used as robustness check.

[10] Petrakis and Vlassis (2000) find that if unions' power is sufficiently high, they bargain solely over wages supporting the right-to-manage model hypothesis; otherwise they bargain over both wages and employment.

all specifications UnS has positive and significant sign suggesting that labor unions represent more an employment rigidity than a wage rigidity. Finally, the wage bargaining component is significant and negatively correlated with homeownership, in line with the expectation that a more centralized wage bargaining is associated with lower homeownership rates, due to its impact on volatility of wages and employment.

Table 1: GLS regressions with Economic Factors

	(1)	(2)	(3)	(4)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership
EPL	0.315***	0.281***	0.254***	0.292***
	(0.0506)	(0.0412)	(0.0430)	(0.0415)
UnS	0.484***	0.407***		
	(0.0407)	(0.0314)		
WB	-0.287***		-0.199***	
	(0.0243)		(0.0211)	
UB	0.259***			0.304***
	(0.0231)			(0.0190)
Constant	67.92***	67.81***	68.06***	68.57***
	(0.395)	(0.376)	(0.408)	(0.388)
Observations	950	950	950	950
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

To better understand the results of EPL, in Table 2 I perform a panel regression using the two original measures of employment protection for permanent and temporary contracts, while I keep using the other Economic Factors. This exercise shows that actually all the positive correlation between employment protection and homeownership is driven by EPL on permanent contracts, whereas the coefficients for temporary contract are negative. By comparing the first column with the others, I find that results are robust to considering one factor at the time. A similar result has been found also by Faccini and Bondibene (2012), who investigated the impact of LMIs on unemployment volatility.

One possible explanation for this finding could be the fact that temporary contracts are *per se* detrimental for homeownership. Indeed households with a temporary contract may have more difficulties in accumulating the down payment for buying an house, and banks may be less willing to accord a mortgage to a temporary worker. Under this assumption, more protection to temporary contracts could increase the set of workers willing to accept this type of contract, instead of waiting for another job offer, but at the same time it does not generate any positive effect on homeownership.

Table 2: GLS regressions with Economic Factors and separate EPLs

	(1)	(2)	(3)	(4)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership
EPL (perm. contracts)	4.526***	4.823***	4.525***	4.689***
	(0.130)	(0.118)	(0.122)	(0.114)
EPL (temp. contracts)	-0.409***	-0.415***	-0.427***	-0.399***
	(0.0291)	(0.0281)	(0.0261)	(0.0253)
UnS	0.684***	0.528***		
	(0.0481)	(0.0466)		
WB	-0.304***		-0.176***	
	(0.0245)		(0.0222)	
UB	0.266***			0.306***
	(0.0278)			(0.0227)
Constant	63.66***	63.39***	64.17***	64.30***
	(0.391)	(0.362)	(0.400)	(0.368)
Observations	950	950	950	950
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4.1.2 Evidence from Statistical Factors

With respect to Statistical Factors, I focus only on SF1 which can be interpreted as a measure of *overall rigidity* of the labor market. Table 12 in the Appendix reports the panel regression estimates using the four Statistical Factors. Column (1) represents my baseline model. The other columns consider each factor taken separately. From the first column it is possible to see that the *overall rigidity* measure is positively and significantly correlated with homeownership rate. This suggests that a generally more protected labor market is associated with higher levels of homeownership. This result is in line with the idea that the positive impacts of employment protection and unemployment benefits prevail over the negative effect of a more centralized wage bargaining. In the second column instead, the coefficient of SF1 is negative and not significant, reflecting the fact that SF1 is the results of opposite forces.

4.1.3 Evidence from original LMIs

Table 13 in the Appendix shows panel regression results using the original LMIs. The results confirm a positive correlation between employment protection of permanent contracts and homeownership and a negative correlation with respect to temporary contracts protection. Union density and coverage have have a negative correlation whereas union concentration and extension of collective agreements present positive and significant coefficients. This result may be due to the fact that unions bargain over wages, but also over employment and it seems that the degree of concentration of labor unions acts more as an employment rigidity.

Wage bargaining centralization, level of wage bargaining, government intervention and tax wedge are negatively correlated with homeownership, as expected, as they are in the wage bargaining group of institution. Minimum wage has instead a positive coefficient. Minimum

wage has two different effects on the volatility of real wage: on one hand it lowers real wage volatility since it prevents wages to be set below a certain level. On the other hand, the fact that firms cannot set freely wages may lead to a relative higher unemployment during an economic crisis, because firms have to adjust employment instead of wages. These two effects act in opposite directions with respect to homeownership. The positive sign of the extension of collective agreements can be explained by the fact that these agreements can act also as employment protection.

4.1.4 Robustness checks

I perform a series of different robustness checks. As first, I want to asses whether the results depend on my use of specific principal controls. Hence I use panel regression analyses adopting an alternative specification for the principal controls. Under this choice, I divide the covariates into 3 groups according to their nature and I obtain three principal controls: (i) *Economy control*; (ii) *Housing control* and (iii) *Taxes control*. [11] Using these alternative components for the controls I get very similar results with respect to my baseline specification, as it is possible to see from Tables 14-16. As additional robustness check, I perform my panel regression analyses using the original covariates. I get again similar results to those of my baseline specification.[12] These checks seem to suggest that my results are not driven by the choice of principal controls.

Another type check I do is about the timing of the effects. Changes in labor institutions may take time to be implemented and tend to be announced in advance. My baseline specification, in which I consider *homeownership* at time t, allows for anticipation effects. If institutions are announced in advance and if homeownership responds to such announcements, a contemporaneous regression should capture this, since *homeownership* at time t will be affected by announcement in $t-1$ of institutional change at time t. If instead I disregard announcement effects, I would expect institutions announced and implemented in time t to affect household housing tenure decision in time $t+1$. I consider both timing and results are consistent even when using lead homeownership rate (see Tables 17-21).

Finally, a possible concern with this type of estimations is reverse causality. Hence, following a procedure largely used in the literature on labor market institutions, I collapse my data into 5-years not overlapping periods.[13] Then for LMIs I consider data at the beginning of each 5-years period, while I use the average of homeownership and controls over the period.[14] On one hand this procedure has the advantage of excluding the possibility of reverse causality, since the average rate of homeownership after the beginning of each sub-period should not affect the value of LMIs at the beginning of the same sub-period. On the other hand, it has the disadvantage of reducing significantly the amount of data and information I can use for my estimates. Indeed I am left with only 10 time periods and 19 countries. This could be potentially

[11] Economy control is composed by working population, real personal disposable income, financial reform index, net migration rate, long-term real interest rate, GDP growth and unemployment rate. Housing control comprehends real housing prices, rental cost, price to income ratio and price to rent ratio. Finally Taxes control includes property tax, succession tax and transaction tax.

[12] This robustness check is not included in the paper to save space and is available upon request.

[13] See for instance Rumler and Scharler (2009), Faccini and Bondibene (2012) and Gnocchi et al. (2015).

[14] This means for instance that for lustrum 1965-1969, for my principal component analysis and regressions, I use the value of LMIs in 1965, while for homeownership and the controls I use the average between 1965 and 1969.

a problem for panel regression analysis, since homeownership and LMIs have already relatively small variability and I am left with few observations. I still find significant results using the reduced dataset, in particular the estimates are very similar for EPL and UnS and UB also under this specification. WB instead presents a positive sign, although it is not significant in the main specification. Considering individual LMIs government intervention and level of wage bargaining have the expected negative sign. The statistical factor for overall rigidity has also the expected sign. Results under the 5-year interval specification are shown in the Appendix. (See Tables 22-24) These results confirm my previous findings and exclude the possibility that in the main specification estimates are driven by reverse causality.

5 Labor market reforms and homeownership

Using panel regression analysis I have shown that it exists a statistically significant correlation between labor market institutions and homeownership. The results are qualitatively in line with the theoretical and empirical literature that investigated the impact of LMIs on the business-cycles and macroeconomic outcomes. In this section I analyze specific labor reforms episodes to asses whether changes in labor market legislation, which changed employment and real wage rigidity, had an impact on homeownership rates. My approach is similar to Gnocchi et al. (2015) who analyzed the impact of labor market reforms on business-cycles.

5.1 Labor market reforms data

I gather information on labor market reforms from different sources. In particular for European countries, following Boeri and Garibaldi (2009), I use data from the 'Social Policy Reform Inventory' from Fondazione Rodolfo De Benedetti (FRDB), which covers the period 1970-2009. Moreover, I use information from the Database for Institutional Comparisons in Europe constructed by Cesifo-DICE. Finally, I use information from Gnocchi et al. (2015), who collected data regarding labor market reforms for Australia, Canada, Japan and USA.[15]

I restrict my attention to *structural* and *complete* reforms that *reduced* the rigidity of the labor market, which were not undo by later reforms.[16] According to the definition of the De Benedetti database, a structural reform is defined as one that changed *not marginally* the legislation on the topic that addresses. A complete reform is one targeted to the *entire workforce* and not only to a sub-group of it. This means that I will focus only on reform episodes that produced a non-marginal change in the labor regulation for the whole labor force. I look only at reforms that increased the flexibility of labor market because I want homogeneity in the reform episodes that I analyze and in the period considered there has been a larger number of this type of reforms.

Given the criteria that I just described, I consider for the difference in difference analysis four groups of reform that map exactly to the four groups used in the panel regression: (i) *employment protection reforms*; (ii) *replacement rate and unemployment benefits reforms*; (iii)

[15] I use Gnocchi et al. (2015) also to define reform episodes regarding wage bargaining structure, for which there no data availability in the other source I consider.

[16] The data I use provide information on the date the bill was passed and they include detailed description of the reform, and its scope.

wage bargaining reforms; (iv) *union power reforms.* In Table 25 and in the Appendix I describe more in details the reforms considered.

6 Evidence using difference in difference approach

I adopt a difference in difference approach (DD) to investigate the effects of specific labor market reform episodes on homeownership. I consider a labor market reform as a 'treatment' that is implemented in a country, but not in the others. For each type of reform considered, I divide the time period into pre-treatment and post-treatment grouping my sample of reform episodes into: (i) *employment protection reforms*; (ii) *replacement rate and unemployment benefits reforms*; (iii) *wage bargaining reforms*; (iv) *union power reductions.* The only countries in my sample that did not experience any structural and complete reforms in any of these groups, for the period considered, are Norway and USA. [17]

As alternative specification, I include in the control group of each reform type, all those countries that did not undertake important reforms in the sector considered. Under this second specification I also include dummy variables for other labor reforms that happened in these counties. Finally, I construct a version of the control groups comprehensive of all non-treated countries for each specific reform. Under this third specification, I take into account the fact that some of the countries in the control groups undertook reforms in different topic of the labor legislation. With respect to the treated groups instead, their composition changes on the basis of the type reform considered.

The main identifying assumption of my DD analysis is that the dependent variable of both treated and control groups presents a similar trend before the reform took place. Homeownership trend in each of the countries considered is driven by a variety of difference sources. In particular, I expect some of the covariates considered in the panel regression to be responsible for a large part of the difference in homeownership trends observed across countries. Therefore, in order to test the parallel trend assumption I perform a panel regression of homeownership over the set of covariates, including also time and country fixed effects.[18] Then I use the residuals of this regression for a visual inspection of parallel trends, for each of the reform I analyze. Figures 3-6 show that the parallel trend assumption, for a limited period before the reforms, is fulfilled for each group considered.

A critical assumption of my difference in difference analysis is that there is no unobserved variable correlated with homeownership, that co-moves systematically over time differently between treated and control groups. Since I consider all developed countries, this possible difference is less of a concern, but to verify this assumption, in Table 27 I show means and standard errors of the principal controls, used in the panel analysis, between treated and control countries. The hypothesis that treated and control groups are equal cannot be rejected at 5% level of

[17] Norway experienced a very large housing boom starting from the 1990s, for reasons not related to LMIs, and this may be a confounding factor for my estimates. I adopted alternative specifications for the control group, to check whether my results depend on the path of Norwegian housing market and qualitatively it does not seem to be the case.

[18] This is the model I estimate for obtaining the residual to test the parallel trend assumption:
$ho_{i,t} = \alpha + \gamma' \mathbf{X}_{i,t} + \mu_i + \nu_t + \hat{\varepsilon}_{i,t}$

confidence only for some pair and characteristic examined, providing mixed results. Therefore, to account for potential omitted variable bias, I include in my DD regression the set of control variables used also in the panel regression analysis.

Another important assumption of this identification strategy is that labor market reforms are not triggered by some elements that have a causal effect also on homeownership. I argue that, even if homeownership tends to be lower during recessions and this are periods when institutional reforms are more common, there is not a specific type of labor reform that is more likely. I control for this possibility including in the regression what I call the *initial condition* of homeownership, which consists in a five-years lag of homeownership rate. The length of this lag has been chosen to take into account the fact that in general it takes some time for an household to accumulate the sufficient down-payment to buy an house. This element accounts for the possibility that countries with different pre-existing levels of homeownership may have different propensity of undertaking labor reforms.

The difference in difference model, in its baseline specification, reads:

$$ho_{i,t} = \alpha + \delta_1(Reform_i \times Post_t) + \delta_2 Reform_i + \delta_3 Post_t + \theta ho_{it-5} + \beta' \mathbf{X}_{it} + \lambda_i + \gamma_t + cstt_{i,t} + \varepsilon_{it}$$

where $ho_{i,t}$ is homeownership rate at time t for country i, $Reform_i$ is a dummy that takes value 1 if the country undertook a labor market reform and 0 otherwise. $Post_t$ is a dummy that takes value 1 after the year of the reform and zero before. The interaction term $Reform_i \times Post_t$ capture the effect of interest. $\mathbf{X}_{it}$ is the vector of principal controls, λ_i and γ_t are country and year fixed effect respectively, moreover I include country-specific time trends $cstt_{i,t}$. Finally ho_{it-5} represents the five-years lag of homeownership. I adopt a generalized least square estimation, allowing for potential heteroskedasticity and panel-specific first order serial correlation.

It is relevant to notice that, since I consider reforms that reduce labor market rigidities, I expect to find opposite signs with respect to the panel regression analysis.

6.1 Results from difference in difference analysis

Table 3 reports results of the difference in difference estimates for the four groups of reforms. The first specification includes as control countries only Norway and USA. In the second specification the control groups are composed by those countries that did not undertake the reform investigated. In the Appendix I present also an alternative specification which adopts reform-specific control groups, but without the dummies for other type of reforms.

Table 3 shows that the two specifications are qualitatively very similar and differ only in terms of size-effect. The second specification is based on more observations and it is likely to be more accurate. Also my robustness specification presents similar results. This seems to suggest that the choice which countries to include in the control group is not driving the main results.

Employment protection reforms. Countries that passed reforms reducing employment protection at the beginning of 1990s had a statistically significant reduction in homeownership rate. Depending on the specification considered, this reduction varies between -6.701% and -2.465%, suggesting that a lower degree of employment protection is detrimental for homeownership. This is in line with the panel regression results, and with the findings of Faccini

and Bondibene (2012) and Gnocchi et al. (2015), who studied the impact of labor reforms on business-cycle volatility.

Replacement rate and unemployment benefits reforms. I find a significant decrease in homeownership rate due to the reduction in unemployment benefits or stricter duties to get the benefit caused by the wave of reforms in 2000. The reduction in homeownership varies between -3.116% and -1.328%, according to the different specifications. This confirms my findings from the panel regression analysis and it is in line with the literature that found a negative correlation between benefit replacement rate and unemployment benefits, and the volatility of unemployment (See Faccini and Bondibene (2012) and Gnocchi et al. (2015)).

Wage bargaining reforms. I find that the decentralization of the wage bargaining process, that took place in 1987, increased homeownership. This is consistent with my findings from panel regression analysis, and it is in line with the results of Abbritti and Weber (2010), who found that larger real wage rigidity leads to more unemployment volatility. The increase in homeownership due to reforms that decentralized wage bargain is sizable between 1.803% and 1.705%, depending on the control group specification.

Union strength reforms. Finally, reforms that reduced union power in UK had a positive impact on homeownership rates.[19] This result is actually consistent with my findings from panel regression using original LMIs. Indeed, panel regression analysis has shown that union density is negatively correlated with homeownership, and the reform that took place in UK in 1980 lead to a reduction of union density. The estimated coefficient varies between 10.75% and 6.02%.[20] The sign of these estimates is in line with the difference in difference estimates of Gnocchi et al. (2015), who found that those countries which implemented reforms reducing union power experienced an increase in unemployment volatility.

[19] In all specifications I include a dummy variable for the Housing Act approved in UK in 1980.

[20] The result with the third specification used as robustness is 6.360%.

Table 3: DD estimates

Controls:	(1)	(2)	(3)	(4)
Norway and US	EPL 91	UB 00	WB 87	UnS 80
Reform × Post	-6.701***	-3.116***	1.803*	10.75***
	(1.059)	(0.843)	(0.931)	(1.179)
Initial conditions	0.470***	0.591***	0.776***	0.335***
	(0.0603)	(0.0684)	(0.0631)	(0.0955)
Observations	180	225	180	135
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓
Controls:	(1)	(2)	(3)	(4)
all non-treated	EPL 91	UB 00	WB 87	UnS 80
Reform × Post	-2.465***	-1.328***	1.705***	6.026***
	(0.833)	(0.303)	(0.401)	(0.563)
Initial conditions	0.752***	0.711***	0.728***	0.727***
	(0.0295)	(0.0299)	(0.0291)	(0.0278)
Reforms Dummies	✓	✓	✓	✓
Observations	765	765	765	765
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.1.1 Robustness checks for difference in difference analysis

As robustness check for my difference in difference analysis I computed an alternative specification for the control groups. For each type of reforms I defined a control group composed by all those countries which did not undertook a reform of the type considered. This means that I have a different control group for each type of reform I analyze. Under this specification, I do not include the dummy variables for other types of reforms. Results are shown in Table 26 in the Appendix and are very similar to those of my two main specifications. As additional robustness check, I performed my main estimates with alternative lags of the initial conditions of homeownership, in order to asses the possible size of the bias. Also in this case the results are largely unchanged.[21]

[21] Results for the last robustness are available upon request.

7 The DSGE model

I build a Dynamic Stochastic General Equilibrium model to study the interactions between labor market institutions and the housing market. The model environment features heterogeneous households, savers and borrowers, who ex-ante differ in their personal discount factor. All households face a housing tenure decision in presence of different labor market frictions, such as search and matching *à* la Mortensen-Pissarides, Nash bargaining over wages and hours and time varying Rotemberg-type adjustment costs for wages and employment.

Households get utility from consumption and housing services, which can be obtained by owning or renting the main residence. Due to a tax advantage on homeownership, the savers always choose to own their main residence. The borrowers insead face an endogenous credit constraint which depends on their expected income and its volatility. Credit available for mortgages is therfore time varying and depends on the economic situation. It increases in periods of stability and it shrinks in period of high uncertainty. This feature generates a direct channel between housing market and labor market institutions, since labor rigidities have an impact of expected income and its volatilities. This assumption of the model reflects the fact that it is common for some households to become homeowners through inheritance or gifts, whereas for others a mortgage is necessary to buy a house. I assume that borrowers can rent part of their housing from the savers, who can own extra housing stock as investment.

The production and labor sectors of my model are mainly based on the work of Abbritti and Fahr (2013) who combine nominal rigidities with search and matching frictions in the labor market, allowing for explicitly defined employment and wage rigidities. Finally, in the economy is present a monetary authority that sets the interest rate.

7.1 Households

Savers. Households earn labor income and if unemployed, they get unemployment benefits b. They obtain returns from investing in a risk free bond a_t. They optimize over consumption, bond holdings and housing stock at each period in time. The utility function that savers maximize reads:

$$\max_{\{C^s, H^s, H_z, a^s\}} E_0 \sum_{t=0}^{\infty} \beta_t^s \left[\ln(C_t^s) + j_h \ln(H_t^s) - j_n \frac{(n_t)^{1+\gamma}}{1+\gamma} e_t^s \right]$$

where $\beta^s > 0$ is the discount factor of the patient households, C_t^s is consumption at time t, H_t^s represents the stock of housing owned. w_t is hourly wage, n_t are the hours worked and e_t^s is the employment status, which represents the share of employed among the household. Since households pool consumption, each member is fully insured against unemployment. $\gamma > 0$ is the inverse Frisch labor supply elasticity, $j_h > 0$ represents the relative weight of housing in the utility function, and j_n the weight of disutility from labor.

The maximization problem is subject to the following budget constraint:

$$\begin{aligned} C_t^s + \frac{a_t^s}{p_t r_t} + q_{h,t}[(1-\tau_h)(H_t^s - H_{t-1}^s) + (H_{z,t} - H_{z,t-1})] = \\ w_t n_t e_t^s + b(1-e_t^s) + \frac{a_{t-1}^s}{p_t} + q_{z,t} A_z H_{z,t} - AC_{h,t}^s + T_t \end{aligned} \tag{1}$$

$q_{h,t}$ is the real price of housing and $AC^i_{h,t} = \frac{\chi_h}{2} q_{h,t} H^i_{t-1} \left(\frac{H^i_t}{H^i_{t-1}} - 1 \right)^2$ is the quadratic adjustment cost which an household encounters to change the owned housing stock.[22] a^s_t represents the bond holding and its interest rate is given by r_t. p_t instead represents the price level for period t and b is the unemployment benefit, obtained by the share of households which is unemployed. τ_h represents the tax subsidy assigned to owned housing. [23] Savers choose to get housing services by owning their main residence, thanks to this favourable tax treatment and because they do not face any credit constraint. Moreover, savers can decide to own additional housing and rent it out to the borrowers, as investment.

Following Rubio (2019), I assume that savers transform extra-housing housing stock $H_{z,t}$ into rental services, using the following production function: $Z_t = A_z H_{z,t}$, where A_z represents the efficiency in the production of rental services and it could be interpreted as a proxy for the legal protection for homeowners. Extra-housing is rented at price $q_{z,t}$.[24] Finally, T_t is the lump-sum transfer received from the government.

Borrowers. The maximization problem of the borrowers is similar to the one of savers and it reads:

$$\max_{\{C^b, H^b, Z, a^b\}} E_0 \sum_{t=0}^{\infty} \beta^b_t \left[\ln(C^b_t) + j_h \ln(\tilde{H}^b_t) - j_n \frac{(n_t)^{1+\gamma}}{1+\gamma} e^b_t \right] \tag{2}$$

where $\beta^s > \beta^b > 0$ is the discount factor of the impatient households. The main difference is represented by $\tilde{H}^b_t$, a CES aggregator composed by owner-occupied housing, H^b_t and rented housing, Z_t. $\tilde{H}^b_t$ reads:

$$\tilde{H}^b_t = \left[\xi_h (H^b_t)^{\varepsilon_h} + (1 - \xi_h) Z^{\varepsilon_h}_t \right]^{\frac{1}{\varepsilon_h}} \tag{3}$$

where ξ_t indicates the preference for owner-occupied housing and ε_h is the elasticity of substitution on preferences between owner-occupied housing and rental services. This can be interpreted as the fact that some of the borrowers live in owner-occupied houses and the others live in rented houses. Equation (2) therefore represents the aggregate preferences of all household members with respect to each type of housing services.[25]

The maximization problem of borrowers is subject to a budget constraint similar to the one of savers, but it includes also a credit constraint, represented by equation 5:

$$C^b_t + \frac{a^b_{t-1}}{p_t} + q_{h,t}(1 - \tau_h)(H^b_t - H^b_{t-1}) + q_{z,t} Z_t = \frac{a^b_t}{p_t r_t} + w_t n_t e^b_t + b(1 - e^b_t)\theta - AC^b_{h,t} \tag{4}$$

and

$$a^b_t \leq \underbrace{[\Gamma_h + \Gamma_e(EI) - \Gamma_v vol(EI)]}_{\Gamma} E_t \left(\frac{\pi_{t+1}}{r_t} q_{h,t+1} H^b_t \right) \tag{5}$$

Here, a^b_t represents the outstanding debt of borrowers. $EI = w_t n_t e_t + b(1 - e_t)$ is the expected income, which is composed by labor income if employed, $w_t n_t e_t$, and unemployment benefits

[22] Alternatively, a linear adjustment cost has been proposed by Iacoviello and Pavan (2013).

[23] A more generous tax treatment for homeowners reflects the presence of policies that favour homeownership in many OECD countries.

[24] An alternative way of including renters in a similar framework was proposed by Alpanda and Zubairy (2016).

[25] Alternatively the CES aggregator can be thought as a representation of the share of renters at the country level.

if unemployed, $b(1-e_t)$. $vol(EI)$ is the standard deviation of expected income and is used as proxy for aggregate uncertainty. $\Gamma = [\Gamma_h + \Gamma_e(EI) - \Gamma_v vol(EI)]$ can be seen as the inverse of the down-payment (LTV ratio) necessary to get a mortgage.

The credit constraint of my model is endogenous and its novelty relies on the fact that it not only depends on the net present value of the housing stock owned through Γ_h, as common in the literature[26], but it also depends positively on the level of aggregate expected income through Γ_e, and negatively on its volatility through Γ_v. In this way, the housing market is endogenously linked to the labor market and it has pro-cyclical properties, as the credit available for mortgages shrinks during period of low expected income or high volatility.

The composition of the LTV ratio is consistent with the fact that lending criteria for assigning a mortgage take into account minimum down-payment, as well as future income and its uncertainty. Labor institutions interact with the housing tenure decision through their impact on the expected value and volatility of aggregate income.

Aggregation. Aggregate employment and consumption is a weighted average, based on the size of each of the household groups. The share of borrowers in the economy is represented by ν.[27] Following Andres et al. (2013), I assume that labor from savers and borrowers is pooled by a *labor union*, which weights the interest of the two groups according to their relative size. Even though savers and borrowers may have different reservation wages, they delegate the bargain process with firms to the labor union.

As a result of this assumption, all workers will receive the same wage and will work the same number of hours, having also the same rate of unemployment. This assumption is consistent with the fact that from the point of view of the firms, labor from savers and borrowers are perfect substitutes and there is no discrimination between groups. Another result of this feature of the model is the absence of wealth effect in the wage decision.

$$C_t = (1-\nu)C_t^s + \nu C_t^b \tag{6}$$

$$e_t = (1-\nu)e_t^s + \nu e_t^b \tag{7}$$

$$0 = (1-\nu)a_t^s + \nu a_t^b \tag{8}$$

C_t represents the aggregate consumption, e_t is aggregate employment and equation 8 states that bonds are in zero net supply.

7.2 Labor market

The labor market is characterised by search and matching frictions à la Mortensen and Pissarides (1994) that generate involuntary unemployment. Workers and firms need to match for becoming productive and the number of newly formed matches between workers and firms is given by m_t. Number of matches depends on vacancies posted v_t, and job seekers u_t, following a

[26] The standard credit constraint, adopted by Iacoviello (2005) and Andres et al. (2013) reads: $a_t^b \leq \Gamma_h E_t \left(\frac{\pi_{t+1}}{r_t} q_{h,t+1} H_t^b\right)$ and depends only on the level of the housing stock. Exceptions are represented by Pataracchia et al. (2103), who model a LTV dependent on riskiness of loans and Falagiarda and Saia (2017), who use an endogenous credit constraint dependent also on systemic and idiosyncratic risk.

[27] I assume that the proportion between savers and borrowers is constant over time.

constant return to scale matching technology, which efficiency is represented by the parameter $\bar{m}$. I denote by q_t the probability for a firm to fill an open vacancy and by f_t the probability for a worker to find a job. An exogenous fraction s of jobs is destroyed each period and unemployment rate u_t, is the sum of the fraction of savers and borrowers not employed after that the matching process has taken place.

Matching function:

$$m_t = \overline{m}(u_t)^{\zeta}(v_t)^{1-\zeta}$$

Job-seekers:

$$u_t = 1 - (1-s)e_{t-1} \tag{9}$$

Job-filling:

$$q_t = \frac{m_t}{v_t} = \overline{m}\left(\frac{v_t}{u_t}\right)^{-\zeta} \tag{10}$$

Job-finding:

$$f_t = \frac{m_t}{u_t} = \overline{m}\left(\frac{v_t}{u_t}\right)^{1-\zeta} \tag{11}$$

Employment:

$$e_t = (1-s)e_{t-1} + m_t \tag{12}$$

Unemployment rate:

$$ur_t = 1 - e_t \tag{13}$$

The timing of the actions is the following in each period: (i) workers and firms search on the labor market and new matches are formed; (ii) shocks realize; (iii) production in the final good sector occurs; (iv) some matches exogenously end and the separated workers enter unemployment group.

7.3 Production

The economy presents only one production sector populated by competitive firms that produce the consumption good. Firms are owned by the savers and use labor of both types of households and capital k_t as inputs in a constant returns to scale production function. Firms choose the number of vacancies v_t, at cost κ, and investment i_t, to maximize the expected sum of discounted profits, given the production function and the evolution of capital. In the economy there are also time-varying adjustment costs on wages and employment, $AC_{w,t}$ and $AC_{e,t}$, that are convex and potentially asymmetric.[28] These costs generate downward nominal rigidities and imply that wages and employment are more easily increased during booms than cut during recessions.[29] Total labor supply is the weighted sum of savers and borrowers labor. The maximization

[28] Adjustment costs over wages and employment are described in Appendix B.

[29] Abbritti and Fahr (2013) have shown that asymmetric adjustment costs are necessary to match the skewed distribution of growth rates of wages and unemployment, that we see in the data for US and other OECD countries.

problem of firms reads:

$$\max_{\{v_t,i_t\}} E_0 \sum_{t=0}^{\infty} \beta_t^s \left\{ \frac{\lambda_t^s}{\lambda_0^s} \left[Y_t - w_t h_t e_t (1 + AC_{w,t}) - AC_{e,t} - \frac{\kappa v_t}{\lambda_t^s} - i_t \right] \right\}$$

subject to

production function

$$Y_t = z_t k_t^{\alpha} (n_t e_t)^{1-\alpha} \tag{14}$$

evolution of capital

$$k_{t+1} = (1 - \delta)\, k_t + i_t$$

Technology shock, z_t, follows an AR(1) stochastic process:

$$\ln z_t = \rho_z \ln z_{t-1} + \varepsilon_t^z, \quad with \quad \varepsilon_t^z \sim N\left(0, \sigma_z^2\right) \tag{15}$$

The first order condition with respect to vacancies yields the *job creation condition* $\mathbf{J}_t$. Due to free entry the condition, $\mathbf{J}_t$ is equal to the expected cost of posting a vacancy, $\frac{\kappa}{\lambda_t^s q_t}$. By the definition of job creation condition, the expected cost of posting a vacancy equates the value of a filled vacancy which is given by revenues from output net of wages and adjustment costs for wages and employment, plus the expected continuation value of the job next period:[30]

$$\mathbf{J}_t \equiv \frac{\kappa}{\lambda_t^s q_t} = \underbrace{\frac{(1-\alpha) Y_t}{e_t}}_{\frac{\partial Y_t}{\partial e_t}} - w_t n_t (1 + AC_{w,t}) - \frac{AC'_{e,t}}{e_{t-1}} + \beta^s E_t \left\{ \frac{\lambda_{t+1}^s}{\lambda_t^s} \left[(1-s)\mathbf{J}_{t+1} + \frac{AC'_{e,t+1} e_{t+1}}{e_t^2} \right] \right\} \tag{16}$$

Maximizing with respect to capital yields the standard Tobin's Q for investment decisions (the shadow price of capital), which equates the marginal cost of investment to its expected benefit (the marginal product of capital):

$$1 = \alpha \frac{Y_t}{k_t} + (1 - \delta) \beta^s \frac{\lambda_{t+1}^s}{\lambda_t^s} \tag{17}$$

7.4 Nash Bargaining over Wages and Hours

Savers and borrowers delegate the bargain process with firms to a labor union, which follows the interests of all households, weighting the decision based on size of the two groups. Labor union maximizes the aggregate marginal value of employment for workers.[31]. As a result from this assumption, all workers receive the same wage, work the same number of hours and the have same rate of unemployment. Nominal wages and hours worked are bargained by maximizing

[30] Derivations are shown in Appendix B.

[31] This assumption has been adopted also by Andres et al. (2013)

the Nash product of workers and firm surpluses:

$$\max_{\{w_t,n_t\}} (\mathbf{N}_t - \mathbf{U}_t)^{\eta} (\mathbf{J}_t)^{1-\eta}$$

Where

$$\mathbf{N}_t = (1-\nu)\mathbf{N}_t^s + \nu \mathbf{N}_t^b \tag{18}$$

and

$$\mathbf{U}_t = (1-\nu)\mathbf{U}_t^s + \nu \mathbf{U}_t^b \tag{19}$$

Marginal value of employment for each type of household, with $i = \{s, b\}$:

$$\mathbf{N}_t^i = w_t n_t - \frac{(n_t)^{1+\gamma}}{\lambda^i(1+\gamma)} + \beta^i E_t \left\{ \frac{\lambda_{t+1}^i}{\lambda_t^i} \left([1-(1-f_{t+1})s]\mathbf{N}_{t+1}^i + s(1-f_{t+1})\mathbf{U}_{t+1}^i \right) \right\}$$

Marginal value of unemployment:

$$\mathbf{U}_t^i = b + \beta^i E_t \left\{ \frac{\lambda_{t+1}^i}{\lambda_t^i} \left(f_{t+1}\mathbf{N}_{t+1}^i + (1-f_{t+1})\mathbf{U}_{t+1}^i \right) \right\}$$

Wages. Bargaining over the nominal wage yields the optimal sharing rule, similar to the standard Nash bargaining solution:[32]

$$\omega_t \mathbf{J}_t = (1-\omega_t)(\mathbf{N}_t - \mathbf{U}_t)$$

with ω_t being the effective time-varying bargaining power of the worker:

$$\omega_t \equiv \frac{\eta}{\eta + (1-\eta)\tau_t} \tag{20}$$

and where τ_t reflects the evolution of current and expected wage adjustment costs. Its derivation is in Appendix B. In the absence of adjustment costs, τ_t is equal to 1, and I obtain the constant sharing rule, with $\omega_t = \eta$.

With adjustment costs the bargaining power becomes state-dependent. During periods of rising wages, $AC'_{w,t} > 0$, the effective bargaining power of workers decline whereas during periods of declining wages, the bargaining power of workers increase. The asymmetry in the wage adjustment cost function magnifies this effect, i.e. bargaining power increases by more in recessions than it is reduced in expansions.

The bargained wage becomes:

$$\frac{\omega_t \kappa}{\lambda_t^s q_t} = (1-\omega_t) \left[w_t n_t - j_n \frac{(n_t)^{1+\gamma}}{1+\gamma} \left(\frac{\nu}{\lambda_t^b} + \frac{1-\nu}{\lambda_t^s} \right) - b + \beta(1-s) E_t \left(\frac{\omega_{t+1}}{1-\omega_{t+1}} \frac{\kappa}{\lambda_t^s q_{t+1}} (1-f_{t+1}) \right) \right] \tag{21}$$

So the optimal real wage reads:

$$w_t = \frac{\omega_t}{(1-\omega_t)} \frac{\kappa}{\lambda_t^s q_t} \left[j_n \frac{(n_t)^{1+\gamma}}{1+\gamma} \left(\frac{\nu}{\lambda_t^b} + \frac{1-\nu}{\lambda_t^s} \right) + b - \beta(1-s) E_t \left(\frac{\omega_{t+1}}{1-\omega_{t+1}} \frac{\kappa}{\lambda_t^s q_{t+1}} (1-f_{t+1}) \right) \right] \frac{1}{n_t}$$

[32] See derivations by Arseneau and Chugh (2008).

Hours. The number of hours worked are also set to maximize the joint surplus. In the absence of wage adjustment costs, the marginal rate of substitution between consumption and hours worked equates the marginal product of labor of an hour of work for the firm ($mpl_t = \frac{\partial^2 Y_t}{\partial e_t n_t}$), adjusted for the relative price.

Wage adjustment costs reduce hours worked by reducing net productivity, introducing a wedge between the marginal rate of substitution and the marginal product of labor: the latter needs to be higher to compensate for the deadweight loss of the adjustment cost. A second effect leads to an intertemporal reallocation of hours worked, whereby hours increase when wages are larger than the marginal rate of substitution, and wages are growing. Equation for bargained hours reads:

$$\eta\left(\frac{1-\omega_t}{\omega_t}\right)\left[w_t - j_n(n_t)^{\gamma}\left(\frac{\nu}{\lambda_t^b}+\frac{(1-\nu)}{\lambda_t^s}\right)\right] = -(1-\eta)\left[\frac{(1-\alpha)^2 Y_t}{n_t e_t} - w_t(1+AC_{w,t})\right] \quad (22)$$

7.5 Closing the model

The monetary authority adopts an augmented Taylor rule, with nominal interest rate smoothing according to parameter ρ_r and responds to deviations from target inflation and output growth. The term ε_t^r captures an i.i.d monetary policy shock.[33]

$$r_t = r_{t-1}^{\rho_r}\left[r\left(\frac{\pi_t}{\pi}\right)^{\omega_\pi}\left(\frac{Y_t}{Y_{t-1}}\right)^{\omega_y}\right]^{1-\rho_r}\varepsilon_t^r \quad (23)$$

$$\varepsilon_t^r \sim N\left(0,\sigma_r^2\right)$$

The resource constraint states that output may be used for consumption, investment or to cover costs of adjusting wages, employment and housing stock (dead-weight losses). The goods market clearing condition reads:

$$C_t + i_t + T_t = Y_t - AC_{w,t} w_t n_t e_t - AC_{e,t} - \sum_{s,b} AC_{h,t}^i \quad (24)$$

I assume that housing supply is fixed and normalized to unity, hence:

$$H_t^s + H_t^b + H_{z,t} = 1 \quad (25)$$

Finally, the equilibrium government budget constraint is given by:

$$T_t = \tau_h q_{h,t}[(H_t^s - H_{t-1}^s) + (H_t^b - H_{t-1}^b)] \quad (26)$$

[33] In the model prices are flexible, but since debt contracts are set in nominal terms, inflation affects the borrowers' debt burden and hence monetary policy is still relevant. Therefore, I include also a monetary policy shock to have a better match with data volatility.

7.6 Calibration

The calibration presented in this section refers to quarterly data for US. To calibrate the model I choose parameters according to the consensus in the housing and the labor literature. For the household part I mainly relay on Rubio (2019), while for the production sector and the labor market I follow Abbritti and Fahr (2013) or I chose parameters according to model's steady-state relationships. Finally, adjustment costs of wage and employment, as well as LTV ratio are chosen to target specific moments of the data.

With respect to the labor market parameters governing the search and matching process, the matching function elasticity parameter ζ is set to 0.5 as in Abbritti and Fahr (2013). The job-finding rate is set to 0.45, to get a separation rate of around 0.06 as Abbritti and Fahr (2013). Given the separation rate, and a job filling rate of 0.9, I obtain a matching efficiency parameter $\overline{m}$ of 0.561.

Parameters related to housing in the utility function are calibrated to match empirical moments, such as average homeownership rate. Parameters in the utility function governing labor supply are calibrated to match unemployment and hours worked. The weight of housing in the utility function, j_h is obtained to match homeownership rate from the data and is set to 0.9969. The LTV ratio, which depend on the legal requirements, Γ_h is set to 0.8, corresponding to the average value for US in the last decades. Γ_e, the component of LTV that is related to expected income, is set to 0.7, as a proxy for the rule of thumb in the mortgage market, which suggests that the monthly mortgage payment should not exceed 30% of monthly income. Finally, the weight of expected income volatility in the credit constraint, Γ_v, is chosen as residual to match homeownership rate.

Disutility of labor, j_n, is set at 1.5, corresponding to 7/24 working hours and an unemployment rate of 6%. The inverse Frisch elasticity of labor supply γ is set at 4.0 as in Trigari (2009) and Christoffel et al. (2009). Capital has a share α of 0.3 in the firm production function and depreciates at rate δ of 3%. Union' bargaining power is 0.45, since Rubio (2019) used for US 0.4 and Andres et al. (2013) used 0.5. Firm vacancy posting costs κ results 0.254, which correspond to total vacancy posting costs equal to 1.5% of GDP. With respect to wage and employment adjustment costs, I set χ_e at 40.8 and ψ_e at -1700, making it more costly to lay-off workers than to fire them. Moreover χ_w is set at 40.5 and ψ_w at 24100, making wages downward rigid. Wages are not indexed against inflation such that ι is 0. These parameter values are based Abbritti and Fahr (2013) who calibrated their model to match the volatility and skewness of wage inflation and employment.

The Taylor rule places a weight ω_π of 1.5 on inflation and ω_y of 0 on output growth, with interest rate persistence ρ_r of 0.85. The monetary policy shock has 0 persistence and standard deviation σ_{mp} of 0.001. The technology shock has persistence ρ_z of 0.95 and standard deviation σ_z of 0.64 as in Abbritti and Fahr (2013).

I calibrate the model also for France and United Kingdom, to asses whether my model can replicate moments of economies with different levels of labor protection. The baseline calibrations for these countries differ from the one of US with respect to the parameters regulating the housing sector and those regarding the labor market. Indeed, legal requirements on LTV ratio, mortgage interest rates deductibility and taxation on housing, differ across these countries.

In particular, France and UK have a less generous tax treatment for owned housing. France presents also much larger employment and wage rigidities. With respect to UK. In the baseline calibration for UK I want to match data over the period 1970-2011, whereas in the section where I evaluate the impact of labor reforms I calibrate the model to match British data over the pre-reform period 1970-1980. Details on the model calibration for France and UK can be found in Appendix B.[34]

Table 4: Parameter Values - USA

Param.	Value	Description	Source
Households			
β^s	0.99	Time discount factor - savers	Rubio (2019)
β^b	0.98	Time discount factor - borrowers	Rubio (2019)
j_h	0.9969	Utility weight on housing services	Corresponds to 70% of homeownership for borrowers
j_n	319.36	Disutility of labor	Corresponds to 7/24 time allocation to work in SS.
γ	4	Inverse Frisch elasticity of labor supply	Trigari (2009), Christoffel et al. (2009).
Housing market			
χ_h	0.1	Adjustment cost parameter for housing	Close to zero, following Iacoviello (2005)
τ_h	0.25	Tax subsidy on homeownership	Rubio (2019)
ξ_h	0.5	Preference for homeownership	Indifference between ownership and renting
ϵ_h	0.5	Elasticity between renting and owning	Rubio (2019)
A_z	1	Efficiency of rental market	Rubio (2019)
ν	0.36	Share of borrowers in the economy	Rubio (2019)
Γ_h	0.8	Legal component of LTV	Average rate in USA
Γ_e	0.7	Weight of expected income in LTV	Rule of thumb: mortgage payment max 1/3 of monthly income
Γ_v	0.377	Weight of *Vol(EI)* in LTV	To match homeownership rate from the data
Firm production			
α	0.3	Share of capital in production	Andres et al. (2013)
δ	0.03	Capital depreciation rate	12% annual rate
η	0.45	Union's exogenous bargaining power	0.5 in Rubio (2019), 0.4 in Andres et al. (2013)
κ	0.226	Cost of posting a vacancy	Result of $q_{SS} = 0.9$ and $f_{SS} = 0.45$ in SS (1.5% of GDP)
Labor Market			
ζ	0.5	Elasticity of matching function	Petrongolo and Pissarides (2001)
b	0.074	Unemployment benefit	Corresponds to 15.6% of replacement rate in SS.
s	0.0522	Separation rate	Result of $ur_{SS} = 6\%$ and $f_{SS} = 0.45$
$\overline{m}$	0.6364	CRS matching technology	Corresponds to $q_{SS} = 0.9$ from Ravenna and Walsh (2011)
Adjustment costs			
ι	0	Wage indexation to inflation	Abbritti and Fahr (2013)
χ_w	40.5	Adjustment cost parameter - wages	To match volatility of wage
ψ_w	24100	Asymmetry parameter - wages	Abbritti and Fahr (2013): match skewness of wage inflation
χ_e	40.8	Adjustment cost parameter - employment	To match volatility of employment
ψ_e	-1700	Asymmetry parameter - employment	Abbritti and Fahr (2013): match skewness of employment
Monetary policy			
ρ_r	0.85	Persistence of interest rate	Abbritti and Fahr (2013)
ω_π	1.5	Weight of inflation in Taylor rule	Abbritti and Fahr (2013)
ω_y	0	Weight of output growth in Taylor rule	Abbritti and Fahr (2013)
Exogenous shocks			
σ_z	0.64	Std. deviation of technology shocks	Abbritti and Fahr (2013)
σ_{mp}	0.001	Std. deviation of monetary policy shock	Christoffel et al. (2009)
ρ_z	0.95	Persistence of technology shock	Smets and Wouters (2003)

I solve the model using second-order perturbation method, applying also pruning for stability, as proposed by Kim et al. (2008) and Abbritti and Fahr (2013).[35] This methodology is a local solution approach and consists in approximating the model around its steady state

[34] My baseline calibration for US, France and UK is based on data between 1970q1 and 2011q4.
[35] The model is solved using DYNARE version 4.4.

using a second-order Taylor approximation. As I do not need to linearize around the steady state, the model will be able to generate asymmetric responses to positive and negative shocks. Similarly to Abbritti and Fahr (2013), to get simulated first and second moments of the model, I simulate the model 1000 times for 166 periods. To have different starting points, I simulate additional 300 periods which I drop when it comes to the computation of simulated moments. Once I obtained the simulation of my model, I compare level of homeownership and volatility of unemployment and wages under different parametrization of labor market institutions.

8 Simulation results

Labor market institutions affect in a not trivial way the level and volatility of labor outcomes and the endogenous constraint that I propose in this paper allows to study the impact of different labor legislations on housing tenure decisions. This type of analysis could not have been possible adopting a standard exogenous credit constraint. Indeed, in a framework like the one of Iacoviello (2004), the labor market does not influence directly the credit available to borrowers for mortgages and consequently the share of homeowners in the economy. The first part of this next section is to evaluate how well my model can match the data. Once I have established that the model can reproduce efficiently relevant moments of the data, I can perform counter-factual experiments. To validate the results of my model I present a comparison between model's simulations and data for US, France and UK.

The choice of the countries has been done to be able to perform different types of counter-factual experiments. US did not undertake any complete and structural labor reform in the last decades and it has flexible institutions both in terms of employment and wage. Hence US is particularly suitable to evaluate the impact of introducing more rigidity in the labor market. UK instead has been chosen because in the 1980s it experienced a large cut in benefit replacement rates. I use this event to evaluate the effect of specific labor market reforms on the housing market and their possible interference with specific housing reforms.

8.1 Model's match with the data

To validate my counter-factual experiments I show that the model can match quite well the empirical data. I compare quarterly data for US, France and UK over the period 1970q1-2011q4 with simulations results from my model. I evaluate second moments of wages, unemployment and output both from the model and from the data. Finally, I check model's match with home-ownership data. Original data come from the OECD Economic Outlook and Main Economic Indicators, as for Abbritti and Fahr (2013). Table 5 shows that the model fits well the volatility of wages, *Vol(w)* and of unemployment rate, *Vol(ur)*. Moreover it matches the homeownership rate, *ho%*, while it does a less good job in matching output volatility, *Vol(Y)*.[36] The volatility of expected income, *Vol(EI)* instead, is not compared with the original data since it is more difficult to compute a corresponding variable from the original data.

[36]With a different calibration of vacancy posting costs, I get a better match of output volatility. This comes at the cost of loosing precision in the match of unemployment volatility. Since the focus of my analyses is on unemployment and wage volatilities, I decided to keep my baseline calibration.

The model's moments compare with the data are those relevant for the credit constraint and in turn for the housing tenure decision. From Table 5 it is possible to see that USA presents a lager unemployment volatility with respect to the other countries. Volatility of wages in US instead, is smaller than France and UK. The second part of my analysis, reported in the next section, consists on evaluating what would be the impact of changes in labor market institutions for the volatility of wage and employment and for homeownership rate.

Table 5: Model match with the data

	United States		France		United Kingdom	
	Data	*Model*	*Data*	*Model*	*Data*	*Model*
Vol(Y)	1.59	1.27	1.10	1.97	1.53	1.03
Vol(w)	0.92	0.92	1.22	1.22	2.24	2.23
Vol(ur)	11.87	11.87	6.17	6.16	8.56	8.67
Vol(EI)	-	0.87	-	1.52	-	2.16
ho%	66.44%	66.44%	53.51%	53.51%	62.45%	62.44%

Note: This table reports average level of homeownership rate $ho\%$, derived from annual data from 1970 to 2011. Y is GDP per-capita, w is nominal wage and ur is unemployment rate. The first column for each country shows the original data, each second column reports the simulation results of the model.

8.2 Counter-factual experiments

In this section I conduct two different counter-factual experiments. In the first experiment I evaluate the impact on the housing market of a hypothetical increase in labor market rigidity in the US. I calibrate my model for the USA economy and I evaluate what would be the change in homeownership rate if USA would adopt labor market institutions as in France. I chose to apply French LMIs to US because I want to evaluate a large change in labor legislation. At the same time I want to consider institutions which are actually adopted in some country to compare two feasible labor regimes. France indeed has a stricter legislation both for employment and wage protection with respect to US. In the second experiment I look at a real labor reform that took place in UK in the 1980s that reduced benefit replacement rates. I evaluate the impact on homeownership, everything else equal. This second experiment allows me to evaluate the impact of labor reforms on the housing market and assess if their effect can actually have a relevant size.

Table 6 shows the results from a hypothetical change of US LMIs toward French labor institutions. To perform this counter-factual experiment, I introduce in the US economy higher employment protection by reducing the separation rate, s. Moreover, I increase unions' strength by augmenting the bargaining power of the labor union, η. Finally, I increment the benefit replacement rate, brr, to reach the French level. Column (3) presents the impact on homeownership applying all French labor market institutions together in US. The result is an increase of 3.24% in homeownership rate. This result is driven mainly by the fact that a more rigid labor market leads to a significant reduction in unemployment volatility and a smaller reduction in wage and

expected income volatility. This translates to a less binding credit constraint and therefore to a higher level of homeownership. Indeed, even if larger frictions in the labor market increase unemployment level, more generous unemployment benefits and the reduction in employment uncertainty overcome the potential negative effects.

Column (4) to (7) instead show what would happen if US would introduce one French institution at the time. The overall effect seems to be driven mainly by the positive impact that high benefit replacement rates have on homeownership. This can be explained by the fact that the generosity of unemployment benefits impact directly the credit available to borrowers, whereas changes in employment protection and union's strength have an indirect effect, through the change in wages and unemployment.

It is possible to see that the volatility of wages is the variable which is impacted the most by an increase of labor rigidity. All the labor institution that I consider in this policy experiment were found to be positively correlated with homeownership, so the results are in line with my empirical findings.[37]

Table 6: USA policy experiment

		France *Labor Market Institutions applied* in USA			
	Baseline	All LMIs	Brr ↑	UnS↑	EPL↑
Vol(Y)	1.27	1.27	1.27	1.27	1.27
Vol(w)	0.92	0.88	0.89	0.92	0.89
Vol(ur)	11.87	2.69	5.19	7.10	3.44
Vol(EI)	0.87	0.81	0.83	0.87	0.84
EI (*level*)	0.45	0.45	0.46	0.45	0.45
$ho\%$	66.44%	68.46%	67.96%	66.50%	66.65%
$\Delta ho\%$	-	3.04%	2.29%	0.10%	0.31%

Note: EI is the expected income. Volatilities of output, Y, nominal wage, w, unemployment rate, ur, and expected income, EI, are represented by standard deviations. $ho\%$ is the rate of homeownership in percentage points. $\Delta ho\%$ indicates the percentage change of homeownership.

Table 7 presents the results from the second counter-factual. I calibrate my model to match relevant moments of UK economy before the labor reform undertaken in 1980. How the model match original data can be seen comparing column(1) with column (3). In 1980 UK also approved the so called *Housing Act*, which included a large sell of state-owned houses. This Act had the effect of increasing significantly homeownership in UK. Therefore, the British context of the 1980s can be a good case study for assessing the potential interference between labor reforms and housing related reforms. As second step, I change the parameter related to benefit replacement rate of the model for UK, to evaluate the effect of the labor reform as if everything else was unchanged. What I find is that the reduction in benefit replacement rate would reduce homeownership by 1.42%. After the Housing Act in the 1980 actually homeownership rate

[37] I do not present any policy experiment regarding the centralization of wage bargaining as I do not have a clear mapping between this institution and a parameter of my model.

increased in UK by 29.76%. On the light of my findings, it is possible to say that homeownership rate would have increased even more without the effect of unemployment benefits cut. The mechanism in place is the same as in the previous experiment. In this case, less generous unemployment benefits increased the volatility of wages, unemployment and expected income, without affecting the levels. A higher level of uncertainty lead to less credit available for borrowers and consequently less homeownership.

Table 7: UK reforms evaluation

	Data		*Simulation: Benefit replacement rate* $\downarrow$	
	Pre-1980	Post-1980	Pre-1980	Post-1980
Vol(Y)	1.71	1.36	1.03	1.03
Vol(w)	3.76	1.37	3.74	3.88
Vol(ur)	9.28	7.76	9.38	14.69
Vol(EI)	-	-	3.66	3.79
$ho\%$	50.40%	65.40%	50.40%	49.69%
$\Delta ho\%$	29.76%		-1.42%	

Note: volatilities of output, Y, nominal wages, w, and unemployment rate, ur, are represented by standard deviations. $ho\%$ is the rate of homeownership in percentage points. $\Delta ho\%$ indicates the percentage change of homeownership.

8.3 Robustness

As first robustness check, I evaluate the impact of changes in labor market institutions adopting a standard exogenous credit constraint: $a_t^b \leq \Gamma E_t \left(\frac{\pi_{t+1}}{r_t} q_{h,t+1} H_t^b \right)$. This constraint is not affected by labor market condition as Γ depends only on legal requirements on LTV ratio. As we can see from Table 28 in Appendix B, changes in LMIs have no effect on the credit available to households and they also have no impact on the homeownership rate. This robustness check shows the importance of considering an endogenous credit constraint. Indeed, existing models with exogenous constraints are not suitable for investigating the interactions between labor market and housing market.

As second robustness check, I compute a version of the model without adjustment costs for employment and wages. As it is possible to see from Table 29 in Appendix B, the model under this specification can still replicate fairly well the average homeownership rate but it does a poorer job in matching second moments of the labor market. The volatility of wages and unemployment are crucial aspects for the dynamics of credit available to borrowers in my model, hence the adoption of adjustment costs improves significantly the ability of the model to study the interactions between labor institutions and the housing market.

9 Conclusions

This paper investigates the role of labor markets institutions in explaining the heterogeneity we observe in homeownership rates across countries and over time. The main novelty consists in the new perspective taken on the mechanism that link labor market and housing market. Indeed, the relevance of labor legislation for housing tenure choice has not been investigated by the existing literature which focused on the effects of a high level of homeownership on labor outcomes. In this paper I investigate the impact of labor legislation on the volatility of employment and real wages, which in turn affect the decision of buying or not the main residence.

Using panel data from 19 OECD countries over the period 1965-2014 I find empirical evidence that an overall more rigid labor market is positively correlated with homeownership. Disentangling between employment and wage rigidities, I find that employment protections, unemployment benefits and the strength of labor unions are positively correlated with homeownership, whereas a centralized wage bargaining is negatively correlated with the share of homeowners in the economy. The opposite effects on homeownership of different labor market institutions can be explained by the fact that different LMIs affect differently elements that are important for the housing tenure choice. I use a difference in difference approach to look at the effects of specific labor reforms episodes. I find that reforms that reduced employment protections or made less generous the unemployment benefits had a significant negative impact on homeownership. On the other hand, reforms that reduced union coverage or decentralized the wage bargaining had a positive impact on homeownership.

To rationalise my emprical findings, I construct a general equilibrium model where heterogenous households face a housing tenure decision in presence of search and matching frictions and labor market rigidities in terms of employment and wages. The model has enough details in the labor sector to disentangle the heterogeneous effects of different labor institutions. Housing market and labor market are directly linked via an endogenous credit constraint which depends on the expected income and its volatility. The model is able to replicate second moments of wages and unemployment, moreover it matches well the homeownership rates for US, France and United Kingdom. The key features of my model make it suitable to evaluate how specific labor frictions can affect the housing tenure choice. Using model's simulations and counterfactual analysis I study the impact of changes in labor market institutions on homeownership rate. As first experiment, I introduce la French bor market institutions in the US calibration, keeping everything else equal. I find that an overall more rigid labor market would lead to an increase in US homeownership. As second experiment, I evaluate the impact of a reform that sharply the reduced the benefit replacement rate in UK in 1980. I find that this reform, if nothing else would have changed, would have lead to a reduction in homeownership.

The results of this paper suggest that the interactions between labor market and the housing market are broader than what previously highlighted by the literature. I show that labor market institutions affect the hosing tenure decision through their impact on employment and wage volatilities. I also show that changes in labor legislation have a non negligible impact on the housing market. The main implication of these results is that when it comes the evaluation of a labor market regime or reform we should take into account their effect on the housing market.

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A Appendix

The appendix is structured as follows. Section A.1 describes the data about homeownership, labor market institutions and controls used in the panel regression analysis. Section **??** presents the principal component analysis. Section A.2 shows the robustness checks of the panel regression analysis. Section A.3 describes the labour market reforms used in the difference in difference estimation. Section A.4 presents the alternative specifications of the difference in difference analysis. Section B shows model's derivations and robustness checks.

A.1 Data description

A.1.1 Homeownership data

Figure 1: Homeownership rate

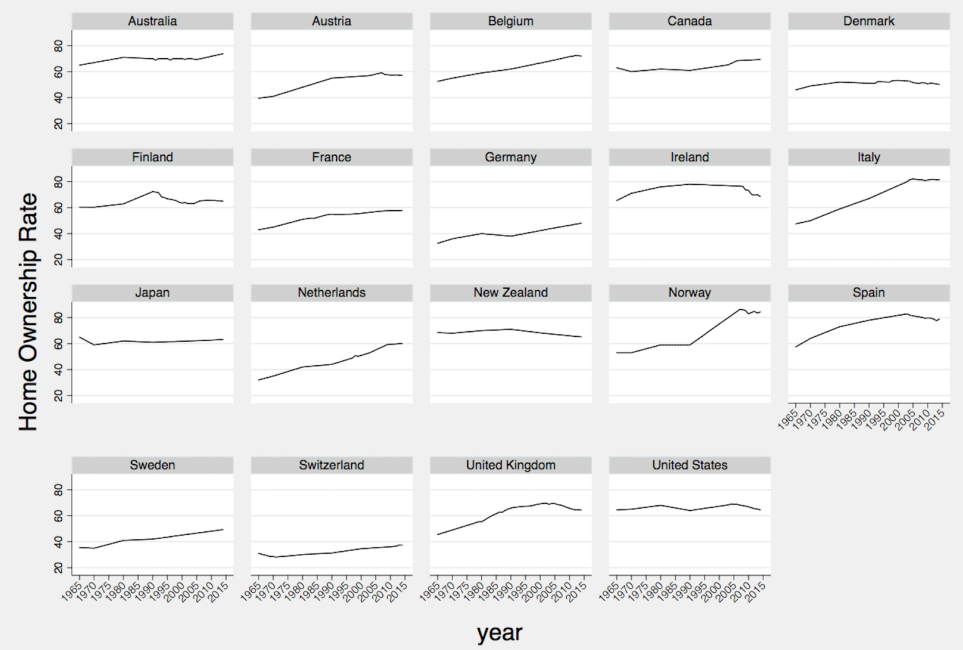
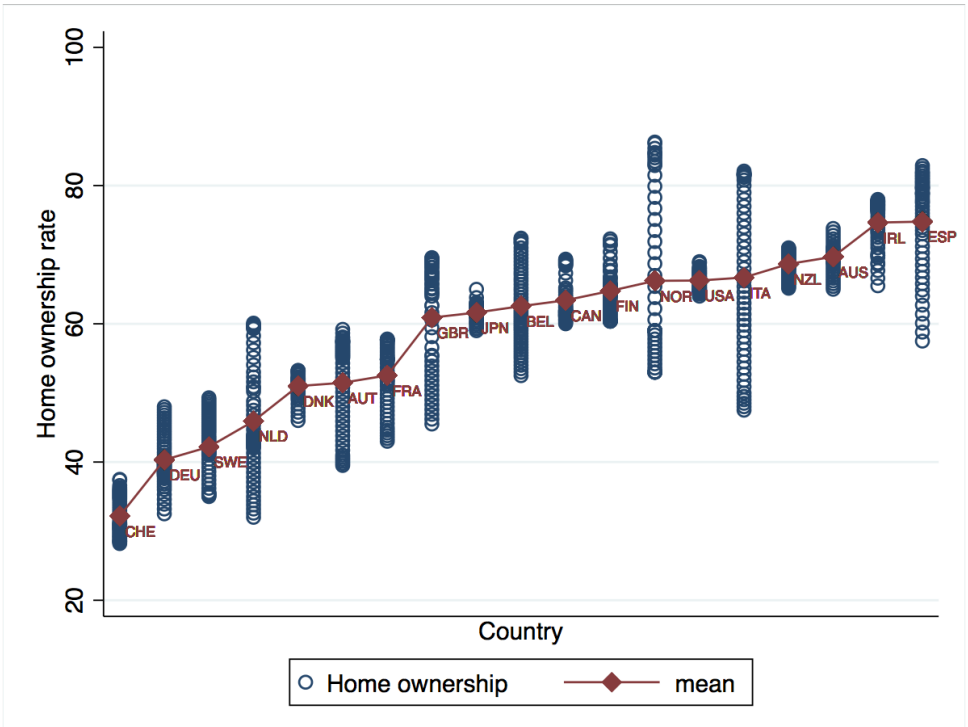


Figure 2: Homeownership rate, mean by country



A.1.2 Labor market institutions

Table 8: Description of Labor Market Institutions

LMI	Description	Source
Employment protection for permanent contracts (EPR)	EPR measures the strictness of regulation of individual dismissal of employees on regular/indefinite contracts. It is expressed in a 0-6 scale.	OECD
Employment protection for temporary contracts (EPT)	EPT measures the strictness of regulation on the use of fixed-term and temporary work agency contracts. It is expressed in a 0-6 scale.	OECD
Union density (UD)	Ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners. Constructed using both survey and administrative data.	OECD
Union coverage (UC)	This indicator refers to the percentage of workers covered by collective agreements normalized on employment.	CEP-OECD
Union concentration (CONC)	Summary measure of concentration of unions at industry and sectoral level. CONC ranges between 0-1.	CEP-OECD
Extension of collective agreements (EXT)	Mandatory extension of collective agreements to non-organized employers. It has a 0-3 scale, where 3 indicates that the extension is virtually automatic and more or less general.	ITCWSS
Wage bargaining centralization (CENT)	Summary measure of centralization of wage bargaining, taking into account both union authority and concentration at multiple levels. Derived from Iversen's centralization index, it ranges between 0-1.	CEP-OECD
Government intervention in wage bargaining (GOVINT)	Index of government intervention in the wage bargaining process. It spans between 1 and 5, where 1 means no intervention.	ITCWSS
Bargaining level (LEVEL)	Index between 0 and 5, which indicates the predominant level where the wage bargaining takes place. e.g. firm level, industry, nation level.	ITCWSS
Tax wedge (TW)	Tax wedge is the sum of the employment tax rate, the direct tax rate and the indirect tax rate. It is a measure of market inefficiency.	CEP-OECD
Minimum wage setting (MWS)	Degree of government intervention and discretion in setting the minimum wage. It ranges between 0 and 8, where 0 indicates no minimum wage.	ITCWSS
Benefit duration (BD)	Benefit duration index. It captures the level of benefits available in the later years of a spell relative to those available in the first year.	CEP-OECD
Benefit replacement rate (BRR)	It indicates the average across the first five years of unemployment for three family situations and two money levels. The data are taken from OECD Indicators database.	CEP-OECD
Unemployment benefits (UB)	Indicator of unemployment benefits which combines the amount of the subsidy with their tax treatment, their duration and the conditions. By Allard(2005).	CEP-OECD

The two indexes of employment protection (EPR and EPT) are proxies for the cost of firing a worker and they reflect the duality of treatment between permanent and temporary contracts, which is present in many countries. They represent a quite net measure of employment rigidity since they both reduces job flows. There is no clear evidence that higher EPL raises overall unemployment level, and the same time it has been shown that EPL tend to increase unemployment spells and long-term unemployment.[38]

Union density (UD) indicates the ratio of trade union members over total employees. Union coverage (UC) instead captures the proportion of workers covered by collective agreements signed by labor unions. Union concentration (CONC) represents the proportion of total union members in the largest 1-10 unions, providing a proxy for the power of strike actions. Finally extension of collective agreements (EXT), is a measure similar to UC, but not normalized to employment. These measures can be seen as proxies for the strength of labor unions and it is therefore important to consider all of them to understand the real impact of union power, which could be both over employment and over wages.

Rigidities representing wage bargaining are: (CENT) an index of the degree of centralization of wage bargaining, (LEVEL) the predominant level at which bargaining takes place, (GOVINT) an index of government intervention in collective agreements, (MWS) the presence and the level of minimum wage and (TW), a measure of tax wedge. TW represents the inefficiency of labor

[38] See Bentolila and Bertola (1990) and Nickell and Layard (1999).

market, since a high tax wedge influences the reservation wage of workers. These institutions represent real wage rigidities, which are expected to reduce the volatility of wages, but at the same time increase the volatility of employment.

Finally, unemployment benefit institutions are represented by benefit duration (BD), benefit replacement rate (BRR) and an indicator of the combination of the two (UB). These are expected to increase the degree of real wage rigidity in the economy on one side, since they increase the reservation wage that workers are willing to accept, but on the other side they also reduce the negative impact of facing an unemployment shock. Depending on which of the two effects prevails the final impact of unemployment benefits could be in favour or detrimental for homeownership.

Table 9: Descriptive statistics for Labor Market Institutions

Variable	Obs	Mean	Std. Dev.	Min	Max
Employment protection (temp.)	950	1.84	1.46	.25	5.25
Employment protection (perm.)	950	1.99	.79	.26	3.55
Union density	950	39.52	19.49	7.55	83.86
Union coverage	950	68.46	26	7	99
Union concentration	950	.32	.11	.14	.59
Wage bargaining centralization	950	.41	.19	.08	.98
Government Intervention	950	2.6	1.24	1	5
Level of wage bargaining	950	3.01	1.34	1	5
Ext. of collective Agreements	950	1.35	1.24	0	3
Minimum wage	950	-3.72	2.96	-8	0
Tax wedge	950	46.36	14.82	10.6	85.6
Benefit duration	950	.46	.36	0	1.16
Unemployment benefits	950	12.06	8.5	0	42.1
Benefit replacement rate	950	27.13	13.11	.35	65.21

A.1.3 Control variables

The sample of my controls includes: (i) population between 15 and 64, as % of the total population, in order to capture the potential effect of the aging of a country; (ii) real house prices; (iii) price to income ratio, which is the ratio between housing prices and average income; (iv) price to rent ratio, equal to nominal house prices divided by rent cost, to control for the convenience of the outside option with respect to buy an house; (v) real personal disposable income index, since it has been shown that wealthier households are more likely to be home owners; (vi) real interest rate of each country, to capture the changes in the possibility of accumulate down-payment and to control for the conditions of the mortgage market; (vii) net migration rate (per 1000 inhabitants), because migration flows may influence significantly the housing market and homeownership rate; (viii) the financial reform index by Abiad et al. (2008), which is a synthetic measure of 7 different indicators of financial markets efficiency; (ix) revenues from taxes on property, as % of GDP; (x) revenues from taxes on immovable property, as % of GDP; (xi) revenues from taxes on estate, inheritance and gifts, as % of GDP and finally (xii) revenues from taxes on financial and capital transactions; (xiii) GDP growth, to control for macroeconomic conditions; (xiv) unemployment rate; (xv) rent cost.

Table 10: Description of control variables

Variable	Source
Working age population as % of total population	OECD,Employment and Labor Market Statistics
Long term real interest rate	OECD. Economic Outlook Database
Real house prices: seasonally adjusted, index based in 2010	OECD Analytical House Price database
Rent cost	OECD
Price to income ratio, index based in 2010	OECD, Analytical House Price database
Price to rent ratio, index based in 2010	OECD, Analytical House Price database
Real Personal disposable income Index, quarterly data	Adrienne and Martínez-García (2011)
Net Migration rate (per 1000 inhabitants)	OECD, Economic, Environmental and Social Statistics
Financial reform index (normalized)	Abiad et al. (2008)
Revenues from taxes on property, as % of GDP	OECD, Comparative Tables
Revenues from taxes on immovable property, as % of GDP	OECD, Comparative Tables
Revenues from taxes on estate, inheritance and gifts, as % of GDP	OECD, Comparative Tables
Revenues from taxes on financial and capital transactions	OECD, Comparative Tables
GDP growth	World Bank

Table 11: Descriptive statistics for control variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Pop. 15-64	950	65.58	2.38	58.01	69.92
Real house prices	950	71	30.23	22.8	169.24
Rent cost	950	55.89	33.34	2.8	146.3
Price to rent ratio	950	82.11	37.11	8.2	199.69
Price to income ratio	950	92.79	35.01	14.7	213.65
Personal disposable income	950	81.29	18.24	38.22	126.47
Financial Reform Index	950	.71	.28	.1	1
Net Migration rate	950	2.44	3.9	-13.2	22.2
Property tax	950	1.99	.96	.38	5
Tax on immovables	950	1.13	1.01	0	4.18
Tax on successions	950	.19	.15	0	.92
Tax on transactions	950	.46	.36	0	4.36
Real interest rate	950	7.35	3.59	.55	21.25
GDP growth	950	2.86	2.59	-8.27	12.88
Unemployment rate	950	6.05	4.08	0	26.1

A.2 Robustness checks for panel regressions

Table 12: GLS regressions with Statistical Factors

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
SF1 (Overall rigidity)	0.320***	-0.0218			
	(0.0307)	(0.0198)			
SF2	-0.112**		0.119***		
	(0.0453)		(0.0253)		
SF3	1.179***			1.048***	
	(0.0463)			(0.0335)	
SF4	-0.522***				-0.396***
	(0.0320)				(0.0225)
Constant	70.54***	67.81***	67.80***	68.94***	68.69***
	(0.455)	(0.389)	(0.386)	(0.427)	(0.409)
Observations	950	950	950	950	950
Controls	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: GLS regressions with individual LMIs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
EPL (temp. contracts)	-0.541***	-0.413***													
	(0.0362)	(0.0213)													
EPL (perm. contracts)	3.369***		4.779***												
	(0.174)		(0.115)												
Union density	-0.0146***			0.0255***											
	(0.00451)			(0.00205)											
Union coverage	-0.0673***				-0.0302***										
	(0.00279)				(0.00144)										
Union concentration	4.199***					0.618***									
	(0.434)					(0.205)									
Ext. of coll. Agreements	1.814***						1.104***								
	(0.0718)						(0.0410)								
Wage bargain centralization	-6.014***							-1.424***							
	(0.427)							(0.200)							
Gov. Intervention	-0.253***								-0.365***						
	(0.0184)								(0.0165)						
Level of wage bargaining	-0.0617**									-0.0987***					
	(0.0309)									(0.0169)					
Minimum wage	0.614***										0.684***				
	(0.0282)										(0.0207)				
Tax wedge	-0.0626***											-0.0818***			
	(0.00589)											(0.00292)			
Benefits duration	-2.037***												-1.111***		
	(0.168)												(0.0843)		
Unemployment benefit	0.113***													0.102***	
	(0.00550)													(0.00339)	
Benefit replacement rate	-0.0225***														-0.0115***
	(0.00324)														(0.00168)
Constant	77.51***	68.39***	63.41***	66.77***	70.58***	67.77***	64.53***	68.62***	68.56***	68.15***	73.36***	70.42***	68.81***	67.73***	68.01***
	(0.697)	(0.381)	(0.377)	(0.385)	(0.431)	(0.388)	(0.370)	(0.408)	(0.437)	(0.405)	(0.421)	(0.412)	(0.391)	(0.401)	(0.390)
Observations	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

GLS using alternative specification for principal controls:

Table 14: Panel GLS Statistical Factors using PC housing, taxes and economy

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
SF1 (Overall rigidity)	0.461***	0.549***			
	(0.155)	(0.143)			
SF2	0.491***		0.871***		
	(0.178)		(0.144)		
SF3	0.904***			0.870***	
	(0.223)			(0.188)	
SF4	-0.280*				-0.383***
	(0.160)				(0.130)
PC housing	-0.0908	-0.169**	-0.171**	-0.193***	-0.158**
	(0.0795)	(0.0694)	(0.0680)	(0.0685)	(0.0730)
PC taxes	-0.0711	-0.209*	-0.127	-0.0617	-0.218*
	(0.124)	(0.122)	(0.117)	(0.121)	(0.120)
PC economy	0.409***	0.344***	0.313***	0.362***	0.305**
	(0.137)	(0.124)	(0.118)	(0.129)	(0.121)
Constant	69.24***	68.48***	66.80***	69.02***	69.28***
	(1.142)	(0.826)	(0.811)	(0.814)	(0.863)
Observations	850	850	850	850	850
Controls	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Panel GLS Economic Factors using PC housing, taxes and economy

	(1)	(2)	(3)	(4)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership
EPL	0.146***	0.0583**	0.00439	0.105***
	(0.0375)	(0.0282)	(0.0252)	(0.0298)
UnS	0.528***	0.470***		
	(0.0291)	(0.0210)		
WB	-0.222***		-0.144***	
	(0.0187)		(0.0135)	
UB	0.379***			0.422***
	(0.0187)			(0.0142)
PC housing	0.204***	0.0931***	0.134***	0.215***
	(0.0136)	(0.0105)	(0.0112)	(0.0119)
PC taxes	-1.064***	-0.995***	-1.019***	-1.088***
	(0.0277)	(0.0205)	(0.0186)	(0.0216)
PC economy	0.209***	0.260***	0.188***	0.182***
	(0.0173)	(0.0137)	(0.0143)	(0.0144)
Constant	68.97***	68.31***	68.77***	69.49***
	(0.348)	(0.327)	(0.359)	(0.351)
Observations	950	950	950	950
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Panel GLS separate EPLs, using PC housing, taxes and economy

	(1)	(2)	(3)	(4)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership
EPL (perm. contracts)	4.655***	4.831***	4.525***	4.637***
	(0.122)	(0.113)	(0.108)	(0.103)
EPL (temp. contracts)	-0.488***	-0.536***	-0.541***	-0.501***
	(0.0324)	(0.0289)	(0.0266)	(0.0268)
UnS	0.769***	0.698***		
	(0.0447)	(0.0426)		
WB	-0.243***		-0.108***	
	(0.0238)		(0.0208)	
UB	0.378***			0.389***
	(0.0250)			(0.0193)
PC housing	0.168***	0.0400**	0.0826***	0.167***
	(0.0187)	(0.0175)	(0.0171)	(0.0174)
PC taxes	-1.197***	-1.135***	-1.107***	-1.188***
	(0.0313)	(0.0259)	(0.0251)	(0.0257)
PC economy	0.401***	0.473***	0.386***	0.377***
	(0.0241)	(0.0209)	(0.0204)	(0.0210)
Constant	64.45***	63.83***	64.91***	65.26***
	(0.345)	(0.321)	(0.358)	(0.336)
Observations	950	950	950	950
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

GLS using homeownership at $t+1$:

Table 17: GLS Statistical Factors using homeownership at $t+1$

	(1)	(2)	(3)	(4)	(5)
VARIABLES	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb
SF1 (Overall rigidity)	0.0700**	0.00813			
	(0.0292)	(0.0224)			
SF2	0.0720		0.0850*		
	(0.0446)		(0.0435)		
SF3	0.0365			0.0210	
	(0.0334)			(0.0275)	
SF4	-0.0918***				-0.0733***
	(0.0292)				(0.0249)
Constant	61.23***	63.84***	63.93***	60.62***	64.82***
	(2.834)	(1.646)	(1.588)	(3.058)	(1.363)
Observations	931	931	931	931	931
Controls	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18: GLS Economic Factors using homeownership at $t+1$

	(1)	(2)	(3)	(4)
VARIABLES	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb
EPL	0.118***	0.0907***	0.0593*	0.0828**
	(0.0405)	(0.0335)	(0.0320)	(0.0322)
UnS	0.507***	0.367***		
	(0.0378)	(0.0270)		
WB	-0.329***		-0.241***	
	(0.0228)		(0.0197)	
UB	0.258***			0.288***
	(0.0206)			(0.0170)
Constant	67.21***	67.28***	67.37***	68.00***
	(0.414)	(0.399)	(0.425)	(0.407)
Observations	931	931	931	931
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 19: GLS separate EPLs, using homeownership at $t+1$

	(1)	(2)	(3)	(4)
VARIABLES	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb
EPL (perm. contracts)	4.555***	4.713***	4.509***	4.573***
	(0.115)	(0.107)	(0.109)	(0.101)
EPL (temp. contracts)	-0.464***	-0.476***	-0.488***	-0.471***
	(0.0275)	(0.0284)	(0.0237)	(0.0253)
UnS	0.667***	0.547***		
	(0.0457)	(0.0403)		
WB	-0.346***		-0.228***	
	(0.0220)		(0.0192)	
UB	0.209***			0.256***
	(0.0249)			(0.0204)
Constant	63.18***	62.98***	63.68***	63.88***
	(0.407)	(0.384)	(0.419)	(0.390)
Observations	931	931	931	931
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 20: Panel GLS with individual LMIs using PC housing, taxes and economy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
EPL (temp. contracts)	-0.552***	-0.542***													
	(0.0361)	(0.0182)													
EPL (perm. contracts)	3.029***		4.615***												
	(0.172)		(0.101)												
Union density	-0.0187***			0.0335***											
	(0.00407)			(0.00174)											
Union coverage	-0.0733***				-0.0360***										
	(0.00282)				(0.000818)										
Union concentration	4.178***					0.951***									
	(0.395)					(0.154)									
Ext. of coll. Agreements	1.871***						1.312***								
	(0.0782)						(0.0395)								
Wage bargain centralization	-5.815***							-0.718***							
	(0.418)							(0.135)							
Gov. Intervention	-0.255***								-0.343***						
	(0.0179)								(0.0133)						
Level of wage bargaining	-0.0704**									-0.0709***					
	(0.0300)									(0.0111)					
Minimum wage	0.618***										0.674***				
	(0.0258)										(0.0193)				
Tax wedge	-0.0751***											-0.0817***			
	(0.00567)											(0.00214)			
Benefits duration	-2.049***												-0.907***		
	(0.163)												(0.0608)		
Unemployment benefit	0.112***													0.105***	
	(0.00502)													(0.00254)	
Benefit replacement rate	-0.0115***														0.00160
	(0.00288)														(0.00112)
PC housing	0.459***	0.144***	0.0296**	0.131***	0.184***	0.117***	0.145***	0.122***	0.122***	0.126***	0.155***	0.0701***	0.0886***	0.266***	0.119***
	(0.0232)	(0.0126)	(0.0126)	(0.0105)	(0.0103)	(0.0102)	(0.0113)	(0.0101)	(0.0133)	(0.0106)	(0.0136)	(0.0109)	(0.0100)	(0.0112)	(0.00999)
PC taxes	-0.153***	-0.984***	-1.130***	-0.995***	-0.981***	-1.016***	-1.000***	-1.013***	-0.996***	-1.025***	-0.559***	-0.796***	-0.915***	-0.948***	-1.020***
	(0.0349)	(0.0189)	(0.0236)	(0.0181)	(0.0171)	(0.0164)	(0.0250)	(0.0170)	(0.0266)	(0.0168)	(0.0222)	(0.0181)	(0.0186)	(0.0208)	(0.0171)
PC economy	0.395***	0.292***	0.338***	0.271***	0.199***	0.221***	0.282***	0.208***	0.166***	0.216***	0.453***	0.179***	0.227***	0.139***	0.214***
	(0.0322)	(0.0134)	(0.0182)	(0.0134)	(0.0137)	(0.0120)	(0.0167)	(0.0135)	(0.0183)	(0.0135)	(0.0178)	(0.0150)	(0.0126)	(0.0155)	(0.0124)
Constant	78.67***	69.41***	64.22***	67.28***	71.83***	68.51***	64.82***	69.12***	69.57***	69.10***	73.26***	71.05***	69.51***	68.92***	68.74***
	(0.649)	(0.338)	(0.350)	(0.336)	(0.371)	(0.344)	(0.335)	(0.355)	(0.387)	(0.354)	(0.387)	(0.388)	(0.346)	(0.360)	(0.344)
Observations	950	950	950	950	950	950	950	950	950	950	950	950	950	950	950
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 21: GLS with individual LMIs using homeownership at $t+1$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
VARIABLES	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb	F.ho_comb
EPL (temp. contracts)	-0.623***	-0.526***													
	(0.0366)	(0.0195)													
EPL (perm. contracts)	3.290***		4.627***												
	(0.170)		(0.110)												
Union density	-0.0125***			0.0250***											
	(0.00473)			(0.00160)											
Union coverage	-0.0670***				-0.0277***										
	(0.00300)				(0.00124)										
Union concentration	4.018***					0.0975									
	(0.409)					(0.206)									
Ext. of coll. Agreements	1.778***						1.099***								
	(0.0704)						(0.0369)								
Wage bargain centralization	-6.409***							-2.033***							
	(0.411)							(0.156)							
Gov. Intervention	-0.244***								-0.366***						
	(0.0171)								(0.0174)						
Level of wage bargaining	-0.0402									-0.106***					
	(0.0288)									(0.0153)					
Minimum wage	0.622***										0.682***				
	(0.0278)										(0.0198)				
Tax wedge	-0.0663***											-0.0925***			
	(0.00589)											(0.00260)			
Benefits duration	-1.965***												-1.049***		
	(0.153)												(0.0713)		
Unemployment benefit	0.113***													0.0979***	
	(0.00543)													(0.00311)	
Benefit replacement rate	-0.0251***														-0.0117***
	(0.00311)														(0.00174)
Constant	78.38***	68.28***	63.10***	66.49***	70.03***	67.57***	64.23***	68.58***	68.16***	67.88***	72.98***	70.37***	68.42***	67.44***	67.69***
	(0.722)	(0.395)	(0.404)	(0.402)	(0.433)	(0.407)	(0.391)	(0.418)	(0.464)	(0.421)	(0.440)	(0.425)	(0.411)	(0.422)	(0.413)
Observations	931	931	931	931	931	931	931	931	931	931	931	931	931	931	931
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

GLS using 5-years intervals data:

Table 22: Panel GLS Economic Factors 5-years intervals

	(1)	(2)	(3)	(4)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership
EPL (perm. contracts)	6.607***	6.901***	7.138***	7.023***
	(1.793)	(1.717)	(1.736)	(1.736)
EPL (temp. contracts)	-0.647**	-0.665**	-0.621**	-0.557*
	(0.313)	(0.294)	(0.284)	(0.290)
UnS	1.216**	1.345***		
	(0.515)	(0.475)		
WB	0.101		0.445*	
	(0.291)		(0.269)	
UB	0.172			0.205
	(0.311)			(0.296)
Constant	61.57***	61.27***	62.10***	62.66***
	(2.522)	(2.408)	(2.403)	(2.406)
Observations	190	190	190	190
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 23: Panel GLS Statistical Factors 5-years intervals

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
SF1 (Overall rigidity)	0.508*	0.481*			
	(0.306)	(0.285)			
SF2	0.372		0.676**		
	(0.393)		(0.342)		
SF3	0.302			0.531	
	(0.445)			(0.432)	
SF4	-0.153				0.0370
	(0.296)				(0.321)
Constant	66.57***	67.85***	67.71***	68.00***	67.92***
	(2.035)	(1.940)	(2.062)	(2.031)	(2.115)
Observations	190	190	190	190	190
Controls	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 24: Panel GLS with individual LMIs 5-years intervals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
VARIABLES	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
EPL (temp. contracts)	-0.746**	-0.840***													
	(0.317)	(0.242)													
EPL (perm. contracts)	2.688		6.365***												
	(1.866)		(1.733)												
Union density	-0.0853*			0.0275											
	(0.0497)			(0.0336)											
Union coverage	-0.00906				0.0461*										
	(0.0310)				(0.0240)										
Union concentration	-5.971					1.383									
	(5.794)					(4.061)									
Ext. of coll. Agreements	2.243***						1.003*								
	(0.733)						(0.538)								
Wage bargain centralization	1.392							1.804							
	(4.725)							(3.029)							
Gov. Intervention	-0.0705								-0.191						
	(0.273)								(0.179)						
Level of wage bargaining	-0.277									0.342					
	(0.308)									(0.211)					
Minimum wage	0.450**										0.688***				
	(0.219)										(0.225)				
Tax wedge	0.00621											-0.0230			
	(0.0573)											(0.0444)			
Benefit duration	-3.051*												0.577		
	(1.768)												(1.441)		
Unemployment benefits	0.198***													0.0830**	
	(0.0554)													(0.0391)	
Unemployment benefit	-0.0905*														-0.00171
	(0.0499)														(0.0307)
Constant	72.32***	68.83***	62.35***	66.70***	64.32***	67.92***	64.33***	66.73***	68.47***	66.24***	73.14***	68.78***	67.13***	67.71***	67.92***
	(5.318)	(1.817)	(2.146)	(2.571)	(2.746)	(2.398)	(2.499)	(2.783)	(2.079)	(2.218)	(2.563)	(2.538)	(2.310)	(2.108)	(2.069)
Observations	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CSTT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

A.3 Labor market reforms description

A.3.1 Employment protection reforms

The 'Social Reform Inventory' constructed by FRDB identifies three different categories of employment protection reforms: (i) reforms that shorten the notice period for firing an employee; (ii) reforms that reduced or removed the costs of dismissal; and (iii) reforms aimed at relaxing restrictions for fixed-term contracts. The reforms I consider took place in 1991 and reduce the notice period for dismissal in the case of Finland, while in the case of Italy I consider a reform that made less stringent the economic dismissal.[39]

A.3.2 Replacement rate and unemployment benefits reforms

This group of reforms refers to both changes in replacement rate and in unemployment benefit legislation. In particular, all the reforms I consider involve more stringent requirements to obtain unemployment benefits, or they lower the entity and shorten duration of the benefits. The wave of reforms analyzed took place in 2000. In particular Austria reduced replacement rates and made more stringent the eligibility criteria fro unemployment benefits. Spain enforced the duties to get unemployment benefit and made them stricter. Finally Sweden imposed the rule that after three rejections of job offers, a person is not entitled anymore for the benefit.

A.3.3 Wage bargaining reforms

As no formal data about wage bargaining reforms are available, I relay on the list of reforms identified by Gnocchi et al. (2015) using information contained in the labor market indexes. In particular they looked at the degree of coordination in the wage bargaining process, the government involvement in wage bargaining and the extent to which collective agreements are extended to non-unionized workers. With respect to wage bargaining reforms I investigate the wave of reforms that took place at the end of the 1980s. The reforms I consider decentralized the level of wage bargaining to the firm level in Denmark in 1987 and liberalized fixed-term contract and reduced government intervention in Spain in 1986. [40]

A.3.4 Union power reductions

With respect to reforms that reduced the power, or at least the influence of labor unions, following Gnocchi et al. (2015) I consider the waive of Thatcher's labor market reforms that took place in 1980 in the United Kingdom. I need to take into account the fact that in 1980 UK approved also the *Housing Act*, which consisted in the sell of part of the state-owned houses which were rented at a subsidized rental. This reform had a very strong impact on the housing market, since it increased homeownership, generating potential confounding issues for

[39] Potentially, I can identify another wave of employment protection reforms that affected France and Japan in 1986. I excluded this wave of EPL reforms since the countries interested experienced also subsequent institutional reforms on the same topic.

[40] Since the date of the reforms in the two countries is different, I consider 1987 as year of treatment, capturing a potential delay impact of the reform in Spain but excluding the possibility that the Danish reform had a significant anticipation effect.

my estimates. In my difference in difference estimates, I will take the impact of this housing reform into account with a specific dummy variable.

Table 25: Description of labor market reforms

EPL		
Finland	1991	The notice period was shortened from 2 months to $1-2$ weeks.
Italy	1991	The administrative authorization in case of individual dismissal for economic reasons is abolished.
UB & RR		
Austria	2000	Replacement rates are lowered and eligibility criteria are stricter.
Spain	2000	Duty to actively seek for a job is enforced. Unemployed rejecting three suitable job offers loose the benefit. An offer is suitable if job is identical to previous jobs. After 12 months, unemployed must accept any other job after retraining.
Sweden	2000	Duty to actively seek for a job is enforced. Unemployed rejecting three job offers loose the benefit.
WB		
Denmark	1987	Bargaining shifts down to the industry level or firm level.
Spain	1986	Liberalization of fixed-term contracts, reductions in government intervention.
UnS		
United Kingdom	1980	Thatcher's labor market reforms: Social Security Act (No.2) and Employment Act.

A.4 Robustness of difference in difference

As robustness check for the difference in difference analysis I construct a different control groups for each of the reforms considered. In my baseline DD regressions the control groups were composed only by those countries that did not undertake significant labor market reforms in the period considered. Now I construct the control groups including all countries that are not *treated* by the specific reform that I investigate. Table 26 presents the results for these DD regressions.

Table 26: DD estimates, with different controls for each reform

Controls: Selection of non-treated	(1) EPL 91	(2) UB 00	(3) WB 87	(4) UnS 80
Reform × Post	-5.380***	-2.367***	1.548***	6.360***
	(0.786)	(0.372)	(0.422)	(0.706)
Initial conditions	0.518***	0.741***	0.744***	0.678***
	(0.0513)	(0.0403)	(0.0381)	(0.0356)
Observations	315	360	450	495
Controls	✓	✓	✓	✓
Country FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
CSTT	✓	✓	✓	✓

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results are similar with those of my baseline DD regression.

A.5 Check of identification assumptions of difference in difference

Table 27: Treated and control groups' mean characteristics

Controls	**PC 1**	**PC 2**	**PC 3**	**PC 4**	**PC 5**
Control group	-.306	.029	.662	-.839	-.573
	(.211)	(.112)	(.157)	(.051)	(.081)
EPL91	-.142	-.831	-1.091	.460	.490
	(.187)	(.113)	(.076)	(.076)	(.057)
UB00	.048	-.829	-.881	-.133	-.134
	(.159)	(.142)	(.098)	(.086)	(.078)
WB87	-.465	.303	-.953	.321	.425
	(.224)	(.113)	(.137)	(.106)	(.091)
UnS80	-.973	2.77	1.43	-.230	.271
	(.331)	(.090)	(.154)	(.104)	(.055)

Check of parallel trend assumption:

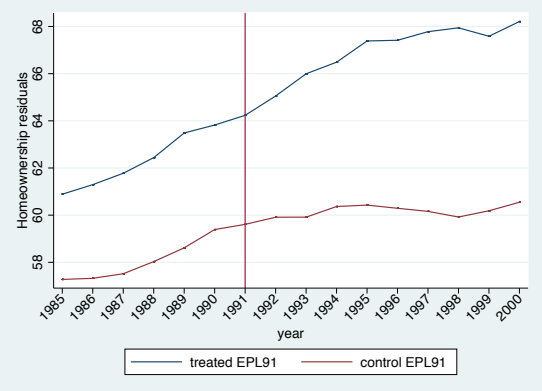


Figure 3: EPL reforms 1991

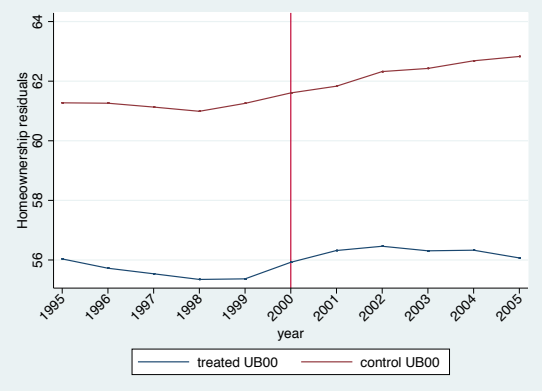


Figure 4: UB reforms 2000

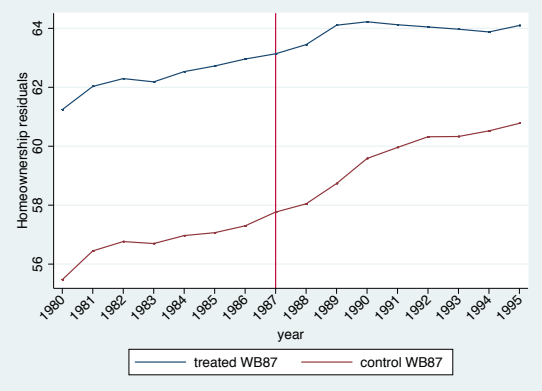


Figure 5: WB reforms 1987

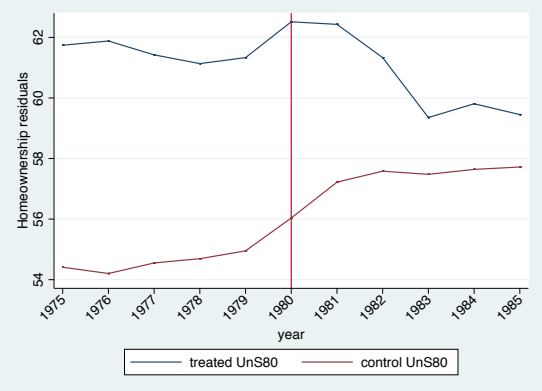


Figure 6: UnS 1980

B Model appendix

B.1 Savers

I can rewrite the savers' problem using a Lagrangian equation:

$$\mathcal{L} = \max_{\{C^s, H^s, H_z, a^s\}} E_0 \sum_{t=0}^{\infty} \beta_t^s \left\{ \ln(C_t^s) + j_h \ln(H_t^s) - j_n \frac{(n_t)^{1+\gamma}}{1+\gamma} e_t^s \right\} +$$

$$+\beta_t^s \left\{ \lambda_t^s \left[w_t n_t e_t^s + b(1-e_t^s)\theta + \frac{a_{t-1}^s}{p_t} + q_{z,t} A_z H_{z,t} - AC_{h,t}^s + T_t - C_t^s - \frac{a_t^s}{p_t r_t} \right.\right.$$

$$\left.\left. - q_{h,t}[(1-\tau_h)(H_t^s - H_{t-1}^s) - (H_{z,t} - H_{z,t-1})] \right] \right\}$$

The first order conditions for this optimization problem are:

$$\frac{1}{C_t^s} = \beta^s E_t \left(\frac{r_t}{C_{t+1}^s \pi_{t+1}} \right) \tag{27}$$

$$\frac{j}{H_t^s} = \frac{q_{h,t}}{C_t^s} \left[(1-\tau_h) + \chi_h \left(\frac{H_t^s}{H_{t-1}^s} - 1 \right) \left(\frac{H_t^s}{H_{t-1}^s} \right) \right] - \beta^s E_t \frac{q_{h,t+1}}{C_{t+1}^s} \left[(1-\tau_h) + \chi_h \left(\frac{H_{t+1}^s}{H_t^s} - 1 \right) \left(\frac{H_{t+1}^s}{H_t^s} \right)^2 \right] \tag{28}$$

$$\frac{q_{h,t}}{C_t^s} = A_z \frac{q_{z,t}}{C_t^s} + \beta^s E_t \frac{q_{h,t+1}}{C_{t+1}^s} \tag{29}$$

Equation (27) represents the intertemporal condition for consumption, the Euler equation. Equation (28) is the intertemporal condition for owned housing, where marginal benefit from consuming housing services equates marginal the cost in terms of consumption. Equation (29) is the FOC for housing which is bought to be rented out to borrowers.

B.2 Borrowers

I build the Lagrangian function of the borrowers problem, with λ^* being Lagrangian multiplier for the collateral constraint:[41]

$$\mathcal{L} = \max_{\{C_t^b, H_t^b, Z_t, a_t^b\}} E_0 \sum_{t=0}^{\infty} \beta_t^b \left\{ \ln(C_t^b) + j_h \ln(\tilde{H}_t^b) - j_n \frac{(n_t)^{1+\gamma}}{1+\gamma} e_t^b \right.$$

$$+\lambda_t^b \left(\frac{a_t^b}{p_t r_t} + w_t^b n_t e_t^b + b(1-e_t^b)\theta - AC_{h,t}^b - C_t^b - \frac{a_{t-1}^b}{p_t} - q_{h,t}(1-\tau_h)(H_t^b - H_{t-1}^b) + -q_{z,t} Z_t \right)$$

$$\left. +\lambda_t^* \left(\Gamma E_t \left(\frac{\pi_{t+1}}{r_t} q_{h,t+1} H_t^b \right) - a_t^b \right) \right\}$$

[41] The Lagrange multiplier of the collateral constraint, λ^* is positive in steady-state and therefore the collateral constraint is always binding and it holds with equality, as it has been shown by Rubio (2019).

The first order conditions are:

$$\frac{1}{C_{b,t}} = \beta^b E_t \left(\frac{r_t}{C^b_{t+1}\pi_{t+1}} \right) + \lambda^*_t p_t r_t \tag{30}$$

$$\frac{j_h}{(\tilde{H}^b_t)^{\varepsilon_h}} \xi_h (H^b_t)^{\varepsilon_h - 1} = \frac{q_{h,t}}{C^b_t} \left[(1-\tau_h) + \chi_h \left(\frac{H^b_t}{H^b_{t-1}} - 1 \right) \left(\frac{H^b_t}{H^b_{t-1}} \right) \right]$$

$$- \beta^b E_t \frac{q_{h,t+1}}{C^b_{t+1}} \left[(1-\tau_h) + \frac{\chi_h}{2} \left(\frac{H^b_{t+1}}{H^b_t} - 1 \right) \left(\frac{H^b_{t+1}}{H^b_t} \right)^2 \right] - \lambda^*_t \Gamma E_t \left(\frac{\pi_{t+1}}{r_t} q_{h,t+1} \right) \tag{31}$$

$$\frac{j_h}{\tilde{H}^{\varepsilon_h}_t} \frac{(1-\xi_h) Z^{\varepsilon_h}_t}{Z_t} = \frac{q_{z,t}}{C_{b,t}} \tag{32}$$

The FOCs for the borrower have similar interpretation, with respect to those of the savers with a relevant difference in the housing demand equation (31). In this case in fact, the demand equation relates the marginal utility of owner-occupied housing with the effective user cost of housing minus the marginal value of housing as collateral. This means that, ceteris paribus, an increase of the collateral's value has a positive impact on the owner-occupied demand for housing of borrowers. Finally equation (32) represents the FOC with respect to the rented housing.

B.3 Firm sector

Here I present the equations describing the asymmetric adjustment costs of employment and wages, derived from Abbritti and Fahr (2013):

$$AC_{w,t} = \frac{\chi_w}{2} \left(\frac{\pi^w_t}{\pi^\iota_t} - 1 \right)^2 + \frac{1}{\psi^2_w} \left(\exp\left\{ -\psi_w \left(\frac{\pi^w_t}{\pi^\iota_t} - 1 \right) \right\} + \psi_w \left(\frac{\pi^w_t}{\pi^\iota_t} - 1 \right) - 1 \right) \tag{33}$$

$$AC_{e,t} = \frac{\chi_e}{2} \left(\frac{e_t}{e_{t-1}} - 1 \right)^2 + \frac{1}{\psi^2_e} \left(\exp\left\{ -\psi_e \left(\frac{e_t}{e_{t-1}} - 1 \right) \right\} + \psi_e \left(\frac{e_t}{e_{t-1}} - 1 \right) - 1 \right) \tag{34}$$

where:

$$\pi^w_t = \frac{w_t}{w_{t-1}} \pi_t \tag{35}$$

$$\pi_t = \frac{p_t}{p_{t-1}}$$

The derivatives with respect to employment read:

$$AC'_{e,t} = \frac{\partial AC_{e,t}}{\partial (e_t/e_{t-1})} = \chi_e \left(\frac{e_t}{e_{t-1}} - 1 \right) + \frac{1}{\psi_e} \left[1 - \exp\left\{ -\psi_e \left(\frac{e_t}{e_{t-1}} - 1 \right) \right\} \right] \tag{36}$$

$$AC'_{e,t+1} = \frac{\partial AC_{e,t+1}}{\partial (e_{t+1}/e_t)} = \chi_e \left(\frac{e_{t+1}}{e_t} - 1 \right) + \frac{1}{\psi_e} \left[1 - \exp\left\{ -\psi_e \left(\frac{e_{t+1}}{e_t} - 1 \right) \right\} \right]$$

B.4 Nash bargaining derivations

$$\begin{aligned}\tau_t &\equiv -\frac{\partial \mathbf{J}_t/\partial w_t}{\partial(\mathbf{N}_t - \mathbf{U}_t)/\partial w_t} \\ &= 1 + AC_{w,t} + AC'_{w,t}\frac{\pi_t^w}{\pi_t^\nu} - (1-s)\left[\frac{(1-\nu)\beta^s\lambda_{t+1}^s}{\lambda_t^s} + \frac{\nu\beta^b\lambda_{t+1}^b}{\lambda_t^b}\right] E_t\left[AC'_{w,t+1}\frac{n_{t+1}}{n_t}\frac{(\pi_{t+1}^w)^2}{\pi_{t+1}^{1+\nu}}\right]\end{aligned} \tag{37}$$

$$AC'_{w,t} = \frac{\partial AC_{w,t}}{\partial(\pi_t^w/\pi_t^\nu)} = \chi_w\left(\frac{\pi_t^w}{\pi_t^\nu} - 1\right) + \frac{1}{\psi_w}\left[1 - \exp\left\{-\psi_w\left(\frac{\pi_t^w}{\pi_t^\nu} - 1\right)\right\}\right] \tag{38}$$

$$AC'_{w,t+1} = \frac{\partial AC_{w,t+1}}{\partial(\pi_{t+1}^w/\pi_{t+1}^\nu)} = \chi_w\left(\frac{\pi_{t+1}^w}{\pi_{t+1}^\nu} - 1\right) + \frac{1}{\psi_w}\left[1 - \exp\left\{-\psi_w\left(\frac{\pi_{t+1}^w}{\pi_{t+1}^\nu} - 1\right)\right\}\right]$$

B.5 Model calibration for France and United Kingdom

In this section I describe the model calibration for France and United Kingdom.

France: the matching function elasticity parameter ζ is set to 0.5 as in the US case. Job-finding rate is set to 0.32. Separation rate is set to match unemployment rate of 8.4%. Given these values, I than obtain separation rate of 0.0432. Given the separation rate and a job filling rate of 0.9, I obtain the matching efficiency parameter $\overline{m}$ which yields 0.5367. Tax benefit for owned housing is set to 0.2, less generous with respect to USA. The weight of housing in the utility function, j_h is obtained from SS, to match homeownership rate and corresponds to 1.0634. The share of total LTV ratio, which depend on the legal requirements, Γ_h is set to 0.65, lower than US. Γ_e, the component of LTV that is related to expected income, is set to 0.73, which means that French mortgage sector is less developed than the US one. Finally Γ_v, which is the weight of expected income volatility in the credit constraint, is chosen as residual to match homeownership rate.

Disutility of labor, j_n, is set at 327.7, corresponding to 7 daily working hours and an unemployment rate of 8.4%. The inverse Frisch elasticity of labor supply γ is set at 4.0 as for USA. Capital has a share α of 0.3 in the firm production function and depreciates at rate δ of 3%. Union's bargaining power is 0.5. Firm vacancy posting costs help calibrate the job-finding and job-filling rates, suggesting κ at 0.334, implying total vacancy posting costs amount to 1.5% of GDP. With respect to wage and employment adjustment costs, I set χ_e at 1.4 and ψ_e at -24100 making it more costly to lay-off workers than to fire them. Moreover χ_w is set at 22 and ψ_w at 24100, making wages downward rigid. Wages are not indexed against inflation and the Taylor rule parameter and the shocks are calibrated as for USA.

United Kingdom: the matching function elasticity parameter ζ is set to 0.5 as in the US case. Job-finding rate is set to 0.4. Separation rate is set to match unemployment rate of 7%. Given these values, I than obtain separation rate of 0.502. Given the separation rate and a job filling rate of 0.9, I obtain the matching efficiency parameter $\overline{m}$ which yields 0.6. Tax benefit for owned housing is set to 0.2, less generous with respect to USA. The weight of housing in the utility function, j_h is obtained from SS, to match homeownership rate and corresponds to 1.0634 The

share of total LTV ratio, which depend on the legal requirements, Γ_h is set to 0.75, a bit less than US. Γ_e, the component of LTV that is related to expected income, is set to 0.7, as in US. Finally Γ_v, which is the weight of expected income volatility in the credit constraint, is chosen as residual to match homeownership rate.

Disutility of labor, j_n, is set at 322.79, corresponding to 7 daily working hours and an unemployment rate of 7% The inverse Frisch elasticity of labor supply γ is set at 4.0 as for USA. Capital has a share α of 0.3 in the firm production function and depreciates at rate δ of 3%. Union's bargaining power is 0.46, very close to France. Firm vacancy posting costs help calibrate the job-finding and job-filling rates, suggesting κ at 0.2872, implying total vacancy posting costs amount to 1.5% of GDP. With respect to wage and employment adjustment costs, I set χ_e at 30.5 and ψ_e at -3000 making it more costly to lay-off workers than to fire them. Moreover χ_w is set at 9.63 and ψ_w at 24100, making wages downward rigid. Wages are not indexed against inflation and the Taylor rule parameter and the shocks are calibrated as for USA.

B.6 Model robustness checks

Table 28: USA policy experiment, with *standard* credit constraint

		France *Labor Market Institutions applied* in USA			
	Standard constraint	All LMIs	Brr ↑	UnS↑	EPL↑
Vol(Y)	1.266	1.267	1.269	1.267	1.265
Vol(w)	0.935	0.916	0.913	0.935	0.917
Vol(ur)	11.761	3.971	5.928	7.791	4.710
Vol(EI)	0.886	0.864	0.854	0.885	0.868
Level (EI)	0.453	0.453	0.455	0.454	0.451
$ho\%$	66.44%	66.44%	66.44%	66.44%	66.44%
$\Delta ho\%$	-	0.00%	0.00%	0.00%	0.00%

Note: volatilities of output, Y, nominal wages, w, and unemployment rate, ur, are represented by standard deviations. $ho\%$ is the rate of homeownership in percentage points. $\Delta ho\%$ indicates the percentage change of homeownership.

Table 29: Match with the data, without AC_w and AC_e

	United States		France		United Kingdom	
	Data	*Model*	*Data*	*Model*	*Data*	*Model*
Vol(Y)	1.59	1.15	1.10	1.27	1.53	1.02
Vol(w)	0.92	0.83	1.22	0.77	2.24	0.87
Vol(ur)	11.87	6.83	6.17	1.16	8.56	3.10
Vol(EI)	-	1.02	-	1.07	-	0.89
ho%	66.44%	66.47%	53.51%	53.55%	62.45%	62.41%

Note: This table reports average level of homeownership rate $ho\%$, derived from annual data from 1970 to 2011. Y is GDP per-capita, w is nominal wage and ur is unemployment rate. The first column for each country shows the original data, each second column reports the simulation results of the model.