Rented vs. Owner-Occupied Housing and Monetary Policy

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Abstract

The housing market structure displays remarkable differences across countries, especially in terms of the relative size and the efficiency of the rental sector. In this paper, I propose a dynamic general equilibrium model with a housing market, both owner-occupied and rented, introducing collateral constraints for borrowers, in order to capture the wealth effects of the owner-occupied housing. Preference parameters, fiscal incentives and institutional factors will affect the housing tenure. Within this framework, I illustrate how monetary policy is transmitted differently through the housing market depending on these factors. From a normative perspective, I also study the impact of these parameters for the efficiency of monetary policy and its optimal conduct. Results show that when the relative size of the rental market is larger, monetary policy is more stabilizing than in the benchmark scenario. However, when the government subisdizes house purchases, the link between monetary policy and house prices is weaker and this creates an even more stable scenario. An optimal monetary policy analysis suggests that when the rental market relative size is large, monetary policy should respond more aggressively to inflation and disregard output, since the financial accelerator effects are stronger in this case.

Key words: Housing market, rental, owner-occupied housing, monetary policy

JEL: E21, E3, E51, E6

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1 Introduction

The housing market structure shows remarkable cross-country differences. In particular, these divergencies are especially important in terms of the relative weight, the efficiency and dynamics in the rental sector. The proportion of households that rent ranges between less than 10% in some Eastern European countries, until more than 50% in Switzerland, Japan or Germany [see figure (7) in the Appendix]. Within the European Union, we need to mention Germany and Spain, because of its high and low rental ratio, respectively. For example, in 2008, while the rental share in Europe was 33,2 % on average, it was of 15,5% in Spain and 56,8% in Germany.

This heterogeneity, which is due to several factors-preferences, taxation, development of the rental market, demographics and institutional efficiency, among others-, can have a significant effect in the transmission of different economic shocks and in the conduct of monetary policy.

First of all, the relative weight of the rental market can be a consequence of different household preferences or cultural factors. For example, in southern Europe, children tend to live with their progenitors during a longer period and, therefore, enter the house property market relatively late. Furthermore, they are frequently financially supported by their parents, and even receive their property from them [see Early (2004)]. Besides, there are cultural attitudes with respect to property that have an impact on the relative importance of the different forms of housing tenure. For example, for some consumers the owner-occupied housing is a symbol of social status or it implies the possibility of bequests which can be a life objective by itself. Differences in the prevalence of these motives contribute to explain the divergences in the cross-country housing tenure regime.

Institutional factors around the housing market represent another important divergence source across countries in therms of the relative proportion of the rental market size. Besides the specific market regulation, good functioning of the legal system has a direct effect on its efficiency. (Mora-Sanguinetti (2011) offers a detailed analysis of these elements for Spain and for other European countries). Given the evidence of cross-country differences in the capacity of the legal system to enforce contracts, Casas-Arce and Saiz 2010 analyze this topic with an international sample and estimate that the less efficient the legal system is, the lower the rental market share in the economy. Table A1 in the Appendix shows some legal system differences across countries that could affect the efficiency and well functioning of rental markets and therefore, ultimately its size.

On the other hand, tax incentives for house purchase enhance owner-occupied housing versus rental.

In the same way, fiscal deductions associated to mortgage interest payments also increase house purchases. Fiscal incentives to the rental sector would increase the relative size of this market. Finally, taxes on house transactions would also decrease the size of owner-occupied housing, having also negative effects on the housing market activity and potentially on labor mobility. Table A2 in the Appendix shows how in the majority of the OECD countries, governments have tended to give incentives to house purchases, through a favorable tax treatment to owner-occupied housing. This policy orientation-mainly through fiscal benefits to house purchases-has been common in many countries. However, there has recently been some other initiatives in order to promote rentals, given that an underdeveloped rental sector can be harmful for the economy.

It is also remarkable, the consideration of housing like a mechanism to generate wealth. In many countries, the access to credit markets requires a housing collateral and it implies a mortgage equity withdrawal. In those countries in which this practice exists, owning a house has an additional benefit that can positively affect the propensity of households to purchase houses. The size of the rental market will have then implications for the size of wealth effects and for the transmission of monetary policy. Wealth effects will depend on the relative proportion of owners and renters. Therefore, at the macroeconomic level, these effects will be larger the higher the fraction of property in the economy. In other words, the financial accelerator caused by wealth effects will be stronger in this case and monetary policy will potentially have larger effects on the economy.

Cross-country differences with respect to housing tenure has been the object of analysis in an extensive economic literature. In particular, there are three types of studies. On the one hand, there are papers which make a comparison of the rental market characteristics in different countries and obtain conclusions about the incidence of these features in the relative importance of owners and renters [Pomeroy and Godbout (2011), Earley (2004), among others]. A second group of studies analyses the relationship between the housing tenure regime and different economic variables, using microeconometric technics with panel or cross-section data for different countries, especially OECD [see for example Andrews and Caldera (2011) or Casas-Arce and Saiz (2010)]. Finally there are also studies which study the macroeconomic implications of the rental market relative size [see for example Ortega et al. (2011) for the Spanish economy].

In this paper, I propose a general equilibrium model which is able to capture the differences in housing tenure across countries. Wealth effects of owner-occupied housing are taken into account through the introduction of collateral constraints for borrowers. Cultural and preference factors are included in

the agents utility function. Housing-related taxation appears explicitly through house purchase and rental subsidies. The institutional factors are proxied by an efficiency parameter in the rental services production function. Through model simulations, I analyze how all these factors affect the steady-state values of relevant variables such as debt and rental market relative proportion. Then, I analyze how these features affect the monetary policy transmission mechanism by showing the dynamics of the model under the different scenarios. Finally, from a normative perspective, I study how all these structural and fiscal factors in the housing markets affect the efficiency and the optimal conduct of monetary policy.

The rest of the paper goes as follows: Section 2 presents the theoretical model. Section 3 simulates the model and shows how the steady-state values of debt and rental size are affected when preferences, taxation and efficiency vary. Section 4 displays the dynamics of the model through impulse responses. Section 5 computes policy efficiency frontiers. Section 6 discusses optimal monetary policy. Section 7 concludes.

2 The Model

Iacoviello (2005) proposed a way to introduce housing markets in a dynamic stochastic general equilibrium model, suitable to study the transmission of monetary policy through the housing market and analyze welfare. In Iacoviello-type models, there are two types of agents; savers and borrowers. These consumers differ in their discount factors and in the fact that borrowers have collateral constraints in order to have access to credit markets. In particular, savers are more patient than borrowers and the latter need housing collateral to borrow. Iacoviello (2005) has been extensively modified to answer different answers which are related with mortgage and housing markets. In this paper, I extend this model to include rental markets and be able to evaluate the implications of housing tenure on monetary policy.[1]

2.1 Consumers

2.1.1 Savers

Savers maximize its utility function by choosing consumption, housing services [2]and working hours. Note that the difference between this utility function and a standard one is that housing enters the utility function as an argument:

[1] Ortega et al (2010) also introduce rental markets in the Iacoviello model and evaluate the effect of different policy measures to enhance the rental market size for the case of Spain.

[2] It is assumed that housing services are proportional to housing stock.

$$\max E_0 \sum_{t=0}^{\infty} \beta_s^t \left(\log C_{s,t} + j \log H_{s,t} - \frac{(N_{s,t})^{\eta}}{\eta} \right),$$

where $\beta_s \in (0,1)$ is the patient discount factor, E_0 is the expectation operator and $C_{s,t}$, $H_{s,t}$ and $N_{s,t}$ represent consumption at time t, the housing stock and working hours, respectively. $1/(\eta - 1)$ is the labor supply elasticity, $\eta > 0$, and $j > 0$ constitutes the relative weight of housing in the utility function.

The budget constraint is:

$$C_{s,t} + b_{s,t} + q_{h,t} \left[(1 - \tau_h) (H_{s,t} - H_{s,t-1}) + (H_{z,t} - H_{z,t-1}) \right] \leq \frac{R_{t-1} b_{s,t-1}}{\pi_t} \tag{1}$$

$$+ w_{s,t} N_{s,t} + q_{z,t} A_z H_{z,t} + S_t + T_t, \tag{2}$$

where q_t is the real housing price and $w_{s,t}$ is the savers real wage. These agents can purchase or sell housing at the current price $q_{h,t}$, either to live in the house $(H_{s,t})$, or to rent it $(H_{z,t})$. Savers transform housing $H_{z,t}$ in rental services for borrowers through the following production function $Z_t = A_z H_{z,t}$ and obtain $q_{z,t}$ for rentals. A_z is a parameter which indicates the efficiency in the production of rental services and could be interpreted as a reduced form of the legal protection of owners. There exists a subsidy τ_h to house purchases. As it will be shown, this group of agents will choose not to borrow at all, since they are the savers in the economy. Savings are given by $b_{s,t}$, at the interest rate R_{t-1}. π_t is the inflation rate at period t. S_t are the profits that firms receive.T_t is a lump-sum government transfer.

The first order conditions for this optimization problem are as follows:

$$\frac{1}{C_{s,t}} = \beta_s E_t \left(\frac{R_t}{C_{s,t+1} \pi_{t+1}} \right) \tag{3}$$

$$\frac{j}{H_{s,t}} = (1 - \tau_h) \left[\frac{q_{h,t}}{C_{s,t}} - \beta_s E_t \left(\frac{q_{t+1}}{C_{s,t+1}} \right) \right] \tag{4}$$

$$w_{s,t} = (N_{s,t})^{\eta - 1} C_{s,t} \tag{5}$$

$$\frac{q_{h,t}}{C_{s,t}} = \frac{q_{z,t} A_z}{C_{s,t}} + \beta_s E_t \frac{q_{h,t+1}}{C_{s,t+1}} \tag{6}$$

Equation (3) is the Euler equation, the intertemporal condition for consumption. Equation (4)

represents the intertemporal condition for housing, in which, at the margin, benefits for consuming housing equate costs in terms of consumption. Equation (5) is the labor-supply condition. Equation (6) is the first order condition of housing which is purchased to rent.

2.1.2 Borrowers

Borrowers solve the following problem:

$$\max E_0 \sum_{t=0}^{\infty} \beta_b^t \left(\log C_{b,t} + j \log \widetilde{H}_{b,t} - \frac{(N_{b,t})^{\eta}}{\eta} \right),$$

where $\beta_b \in (0,1)$ is the discount factor of the impatient agents. $\tilde{H}_t^b$ is a composite between owner-occupied housing and rental services, represented with a CES aggregator. ω_h indicates the preference for owner-occupied housing and ε_h is the elasticity of substitution between owner occupied-housing and rental on preferences. In this way, borrowers derive utility from the two types of housing:

$$\tilde{H}_{b,t} = \left[\omega_h^{1/\varepsilon_h} \left(H_{b,t} \right)^{(\varepsilon_h - 1)/\varepsilon_h} + (1 - \omega_h)^{1/\varepsilon_h} \left(Z_t \right)^{(\varepsilon_h - 1)/\varepsilon_h} \right]^{\varepsilon_h/(\varepsilon_h - 1)} \tag{7}$$

where $H_{b,t}$ is the owner-occupied borrowers housing stock and Z_t are rental services. Subject to the budget constraint and the collateral constraint:

$$C_{b,t} + \frac{R_{t-1} b_{b,t-1}}{\pi_t} + q_{h,t} \left(1 - \tau_h\right) \left(H_{b,t} - H_{b,t-1} \right) + q_{z,t} \left(1 - \tau_z\right) Z_t = b_{b,t} + w_{b,t} N_{b,t}, \tag{8}$$

$$b_{b,t} \leq E_t \left(\frac{1}{R_t} k q_{t+1} H_{b,t} \pi_{t+1} \right), \tag{9}$$

where $b_{b,t}$ represents borrowings. k can be interpreted as a loan-to-value ratio. The collateral constraints limits borrowings to the discounted present value of the borrowers owner-occupied housing. Note that this constraint creates a wealth effect because loans depend directly on housing value. The first-order conditions of this maximization problem are as follows:

$$\frac{1}{C_{b,t}} = \beta_b E_t \left(\frac{R_t}{C_{b,t+1} \pi_{t+1}} \right) + \lambda_t, \tag{10}$$

$$\frac{j}{\tilde{H}_{b,t}} \left(\frac{\omega_h \tilde{H}_{b,t}}{H_{b,t}} \right)^{1/\varepsilon_h} = \left(1 - \tau_h\right) \left(\frac{q_{h,t}}{C_{b,t}} - \beta_b E_t \frac{q_{h,t+1}}{C_{b,t+1}} \right) - \lambda_t k E_t q_{h,t+1} \frac{\pi_{t+1}}{R_t}, \tag{11}$$

$$w_{b,t} = (N_{b,t})^{\eta-1} C_{b,t}, \tag{12}$$

$$\frac{j}{\tilde{H}_{b,t}} \left(\frac{(1-\omega_h)\,\tilde{H}_{b,t}}{Z_t} \right)^{1/\varepsilon_h} = (1-\tau_z)\,\frac{q_{z,t}}{C_{b,t}}, \tag{13}$$

where λ_t is the Lagrange multiplier of the collateral constraint.[3] These first order conditions can be interpreted analogously to the ones of savers. An important difference, though, lies in the housing demand, equation (11). It equates the marginal utility of owner-occupied housing to the effective user cost of housing minus the marginal value of housing as collateral. Therefore, *ceteris paribus*, an increase in the value of the collateral has a positive effect in the owner-occupied housing demand of borrowers.

2.1.3 Firms

2.1.4 Intermediate-goods producers

The intermediate goods markets is perfectly competitive. The homogeneous intermediate good is produced according to the following technology:

$$Y_t = N_{s,t}^{\gamma} N_{b,t}^{(1-\gamma)}, \tag{14}$$

where $N_{s,t}$ and $N_{b,t}$ represent the savers and borrowers labor supply, respectively.[4] γ represents the labor-income ratio of patient agents. Free entry in the sector implies the following zero-profit condition, which implies the following labor demand for both agents:

$$w_{s,t} = \frac{1}{X_t}\gamma\frac{Y_t}{N_{s,t}}, \tag{15}$$

$$w_{b,t} = \frac{1}{X_t}\,(1-\gamma)\,\frac{Y_t}{N_{b,t}}, \tag{16}$$

where X_t is the *markup* or the inverse of the marginal cost.[5]

[3] Through simple algebra it can be shown that the Lagrange multiplier is positive in the steady state and thus the collateral constraint holds with equality.

[4] By symmetry, I omit the indices corresponding to each intermediate good.

[5] The complete derivation of this problem is available under request.

2.1.5 Final Goods Producers

A continuum of monopolistically competitive firms produce final goods. Prices are set following the Calvo (1983) mechanism. This implies the following log-linear approximation of the New Keynesian Phillips curve for inflation:

$$\log \pi_t = \beta_s E_t \log \pi_{t+1} + \frac{(1-\theta)(1-\theta\beta^s)}{\theta} \log X_t, \tag{17}$$

where θ is the probability for firms of not changing prices.

2.1.6 Monetary Authority

The central bank sets interest rates according to a Taylor rule:

$$R_t = (R_{t-1})^{\rho} \left[\pi_t^{(1+\phi_\pi)} R\right]^{(1-\rho)} \varepsilon_{R,t} \tag{18}$$

where $0 \leq \rho \leq 1$ is the parameter associated to the interest rate smoothing and $\phi_\pi > 0$ measures the interest-rate response to inflation. R is the steady-state value of the interest rate. $\varepsilon_{R,t}$ is a white noise shock with 0 average and σ_ε^2 variance.

2.2 Equilibrium Conditions

The equilibrium condition for the goods markets is the following:

$$Y_t = C_{s,t} + C_{b,t}, \tag{19}$$

Housing supply is fixed and normalized to unity:

$$H_{s,t} + H_{b,t} + H_{z,t} = 1 \tag{20}$$

The equilibrium government budget constraint is given by:

$$T_t = \tau_z q_t^z Z_t + \tau_h q_t^h \left[(H_{s,t} - H_{s,t-1}) + (H_{b,t} - H_{b,t-1})\right] \tag{21}$$

3 Simulation

3.1 Parameter Values for Benchmark

Table 1 presents a summary of the simulation parameter values:

Table 1: Parameter Values

β_s	0.99	Savers discount factor
β_b	0.98	Borrowers discount factor
j	0.1	Housing weight in the utility function
$\eta - 1$	1	Inverse of the labor-supply elasticity
k	0.8	Loan-to-value ratio
γ	0.64	Savers labor-income share
X	1.2	Steady-state Markup
θ	0.75	Probability of not changing prices
ε_h	2	Elasticity of substitution between owner-occupied and rental
ω_h	0.5	Preference for owner-occupied housing
ρ	0.8	Interest-rate smoothing
ϕ_π	0.5	Inflation coefficient
A_z	1	Rental market efficiency

The discount factor for savers, β_s, is set to 0.99 corresponding to an annualized interest rate of 4% in the steady state. The discount factor for borrowers is set to 0.98.[6] The weight of housing in the utility function, j, is set to 0.1, which implies a GDP to housing wealth ratio of approximately 1.40 in the steady state, consistent with US data. The parameter η takes the value of 2, implying a labor-supply elasticity of 1.[7] Concerning the value which proxies the loan-to-value ratio, k, is set to 0.8, an average for the US and Europe data. In order to set the value of the labor-income share of savers to 0.64, I follow Iacoviello (2005) estimates. The steady-state markup takes the value of 1.2. The probability of firms not changing prices is fixed to 0.75, which implies that prices change on average every four quarters. Concerning the value for ε_h is set to 2, following Ortega et al (2011).[8] For ω_h, I pick 0.5 as a reference, implying

[6] Lawrance (1991) estimates discount factors for low-income consumers between 0.95 and 0.98 at a quarterly frequency. I take the most conservative value.

[7] Microeconomic estimations suggest values in the range of 0 and 0.5 (for males). Domeij and Flodén (2006) find that, in the presence of credit constraints, these estimated vales have a 50% downward bias.

[8] However, subsequent sections make a sensitivity analysis for these parameters.

that owner-occupied housing and rentals have the same weight in the utility function. For the Taylor rule parameters, I use $\rho = 0.8$ and $\phi_\pi = 0.5$, the first one implying a realistic degree of interest-rate smoothing and the second one consistent with the initial value proposed by Taylor in 1993. Initially, I set subsidies to purchase and rent to 0. I normalize the rental market efficiency, A_z, to 1.

3.2 Factors influencing the relative proportion of house purchase versus rental

In this section, I analyze how the values of some parameters affect the steady-state size of rentals with respect to property housing. In particular, I consider the relative preference of owner-occupied housing versus rental, the fiscal treatment to housing, i.e. subsidies to housing purchases or rentals, and the rental efficiency parameter which proxies the efficiency of institutions.

3.2.1 Preferences

As stated in the introduction, the different relative weight in rental markets could in part obey to differences in household preferences or cultural factors. Then, we could think that German households simply prefer to rent while Spanish ones have developed a preference towards purchasing, which could be the consequence of cultural factors. In the model that has been presented, this factor would be included in the parameter ω_h, which represents the preference for owner-occupied housing in the utility function. The following table presents how the steady state values for debt and the relative proportion of owner-occupied versus rental change in the model when this parameter varies:

Table 2: Steady-state values for different ω_h

	$\omega_h = 0.2$	$\omega_h = 0.4$	$\omega_h = 0.5$	$\omega_h = 0.8$	$\omega_h = 0.9$
Debt/GDP	0.31	0.65	0.83	1.42	1.63
Rental/Purchase	0.30	0.22	0.18	0.07	0.04

As expected, the model generates a situation in which the higher the weight of owner-occupied housing with respect to rental in the borrowers utility function, the larger is the debt ratio in the economy and the lower the proportion of renting with respect to house purchase. The parameter ω_h reflects how preferences affect the different weight of the rental sector across countries. Low values of this parameter imply that owner-occupied housing has less weight in the utility function and thus the model generates a low debt-to-GDP ratio, since agents do not borrow so much to purchase housing, they

prefer to substitute it by rentals. As a consequence, the proportion of rentals with respect to purchases is larger.

3.2.2 Tax incentives

Tax incentives is also a crucial factor in the housing sector. The housing market is a target for economic policy. In particular, there are many fiscal exemptions and subsidies in investments and activities related to housing [see for instance ECB (2003)]. Taxes and subsidies directly affect the agents decision taking in housing matters. In particular, taxation affects the choice between housing investment and investment in other assets, the choice between new and second-hand housing and the choice between purchase or renting a house. Tables 3 and 4 reflect how these subsidies affect the model steady-state values:

Table 3: Steady-state values for different τ_h

	$\tau_h = 0$	$\tau_h = 0.05$	$\tau_h = 0.15$	$\tau_h = 0.25$
Debt/GDP	0.83	0.95	1.27	1.80
Rental/Purchase	0.18	0.16	0.13	0.09

Table 3 shows how the debt values and the proportion of rents versus purchase change when a subsidy to house purchases is introduced. As it would be expected, when the subsidy increases, the debt ration increases as well because agents borrow more to finance their housing. However, the relative proportion of rental decreases because rentals are the substitute for house purchases, which increase with the subsidy.

Table 4: Steady-state values for different τ_z

	$\tau_z = 0$	$\tau_z = 0.05$	$\tau_z = 0.15$	$\tau_z = 0.25$
Debt/GDP	0.83	0.81	0.75	0.70
Rental/Purchase	0.18	0.20	0.23	0.28

If, on the contrary, there is a subsidy for rentals, we see in table 4 the opposite effect. When rentals are encouraged, the debt-to-GDP ratio decreases and the relative proportion of rentals in the economy increases.

3.2.3 The efficiency of institutions

Institutional factors related to the housing market are another source of cross-country heterogeneity with respect to the weight of the rental market. Mora-Sanguinetti (2011) analyzes these elements for

Spain and other European countries. Besides the specific regulation of the rental market, among these factors, we include the well functioning of the law system, which is crucial for the rental market efficiency. We can proxy this efficiency in the model by the technological parameter A_z. Table 5 shows how this parameter affects the steady-state values of the model:

Table 5: Steady-state values for different A_z

	$A_z = 1$	$A_z = 2$	$A_z = 3$	$A_z = 4$
Debt/GDP	0.83	0.53	0.39	0.31
Rental/Purchase	0.18	0.24	0.28	0.30

We see that the more efficient the rental market is, the less borrowers are indebted because they prefer to rent instead of purchasing. Therefore, the proportion of rentals with respect to house purchases also increases with the rental market efficiency.

4 Model Dynamics

4.1 Benchmark

Here, I present impulse responses to an increase in the interest rate corresponding to a one standard deviation (0.29 percent).[9]

This restrictive monetary policy action, as expected, reduces economic activity and inflation. Real housing prices move inversely with the interest rate, as any asset price. On the other hand, the increase in the housing financing cost makes borrowers reduce their housing stock with mortgages and substitute them for rented houses. Furthermore, this effect is reinforced first by an initial fall in housing prices, which reduces the value of owner-occupied housing as a collateral, and second by the fall in the rental price. The rental price falls because owners expect a rapid recovery in real housing prices.[10] The fall in the rental price produces an increase in rented houses. Both borrowers and savers reduce their consumption. Savers, given the interest rate increase, smooth their consumption and intertemporally substitute, consuming less in the present to be able to consume in the future. Borrowers, however, suffer a negative effect in their consumption due to their collateral constraint. The fall in housing prices and

[9] Iacoviello (2005) estimates a Taylor rule for the US and finds a value of 0.29 percent at a quarterly frequency. I use this value as an empirically plausible one.

[10] This effect can be observed rewriting equation (6)as $q_{z,t}A_z = q_{h,t} - \beta_s E_t \left(\frac{C_{s,t}}{C_{s,t+1}}\right) q_{h,t+1}$

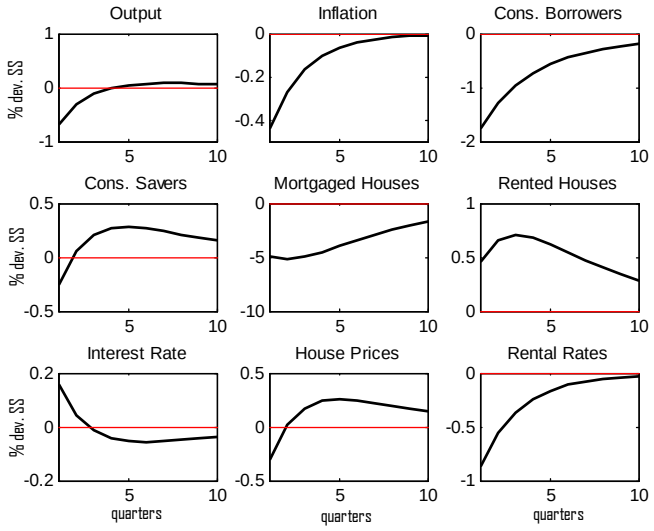

Figure 1: Impulse responses to a monetary policy shock. Benchmark

in housing demand, reduce the collateral value for mortgages and causes a larger fall in consumption. This decrease in consumption implies a reduction in economic activity and inflation.

4.2 Preferences

Figure 2 presents impulse responses to a monetary policy shock. The solid line corresponds to the case in which consumers have a high preference for owner-occupied housing. The dashed line represents consumers preferring rented houses more strongly.

Given an increase in the interest rates and the consequent fall in house prices, mortgaged houses fall in both cases. However, when the preference for owner-occupied housing is lower, mortgaged houses decrease more strongly because they have less value in terms of utility for consumers. This sharper decrease in mortgaged houses in the case of low preference for owner-occupied housing produces a stronger fall in the collateral held by borrowers. Then, in this case, borrower's wealth decreases in a larger amount and, in order to compensate for that, rented houses fall. When consumers have a preference for owner-occupied housing in the utility function, wealth does not decrease as much and, given the fall in rental rates, they can also increase their rented houses. When consumer's preference for rented houses is stronger, even though rental rates also fall, the decrease in wealth makes them cut rented houses for the level of consumption not to fall dramatically (notice that consumption has a stronger weight in the utility function than housing). As a result, given that borrowers readjust their rentals, at the aggregate level, there is no substantial difference between the two scenarios.

Figure 2: Impulse responses to a monetary policy shock. High versus low preference for owner-occupied housing

4.3 Tax incentives

Figure 3 displays impulse responses to a monetary policy shock given different fiscal treatment for housing. In particular, the solid line represents the case in which owner-occupied housing is subsidized. On the contrary, the dashed line is the case in which rented houses are subsidized.

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4.4 The efficiency of institutions

In figure 4 we can see impulse responses to a monetary policy shock for different degrees of rental market efficiency. The argument here is similar to the preference case. Here, when rental markets and their related institutions are very efficient, given the intrinsic attractiveness of rental, an increase in the interest rate makes mortgaged houses decrease strongly. However, this decrease in owner-occupied housing together with the fall in house prices makes borrowers less wealthy. In order to compensate for this and maintain consumption, rented houses have to decrease. When rental markets are less efficient, mortgaged houses do not fall as much so that wealth does not decrease so strongly. This, together with the fall in rental rates, makes rented houses increase.

Figure 3: Impulse responses to a monetary policy shock. Favorable fiscal treatment to owner-occupied housing versus rentals

5 Policy Frontiers

In order to see the implications of these structural and fiscal factors in housing markets for the efficiency of monetary policy, I compute policy frontiers. These frontiers, also known as Taylor Curves, display the trade-off that central banks face when trying to stabilize output and inflation. Then, a curve which is closer to the origin represents a situation in which monetary policy is more efficient in the sense of stabilizing inflation and output at the same time.[11]

Figure 5 displays the Taylor Curve for two different values of the parameter that dictates the preference for owner-occupied versus rented houses. The solid line represents a situation in which owner-occupied houses are preferred with respect to rented ones. The dashed line represents the opposite case. We can see from the figure that monetary policy is more efficient when consumers prefer rented houses. Given the same change in the interest rate, when borrowers prefer rented houses, changes in house prices do not affect as much the real economy, providing a more stable scenario. Collateral effects may exacerbate the trade-off between output and inflation variability, so that an environment in which these effects are softened by preferences may deliver more economic stability.

Figure 6 displays the case in which, preferences over owner-occupied housing versus rentals are symmetric but fiscal treatment is different. In one situation, subsidies are given to house purchases

[11] I compute the Taylor curves as the minimum values of inflation and output variance for different values of the policy rule parameters. In order to generate the trade-off, I consider cost-push shocks with a 0.02 standard error. Inflation is measured on a quarterly basis.

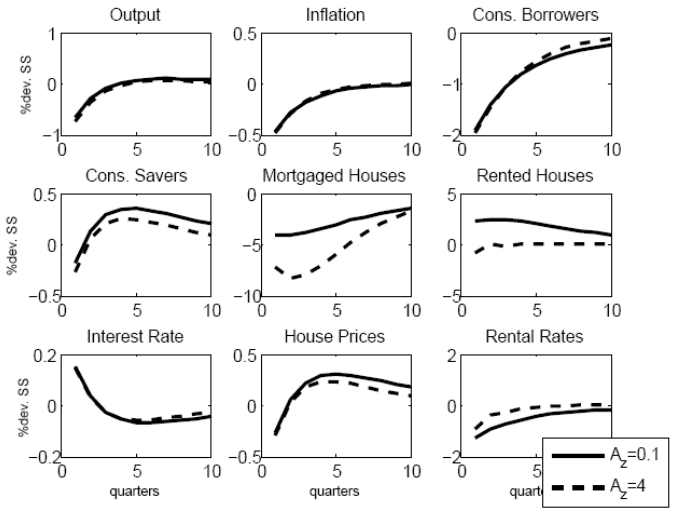

Figure 4: Impulse responses to a monetary policy shock. More versus less efficient institutions

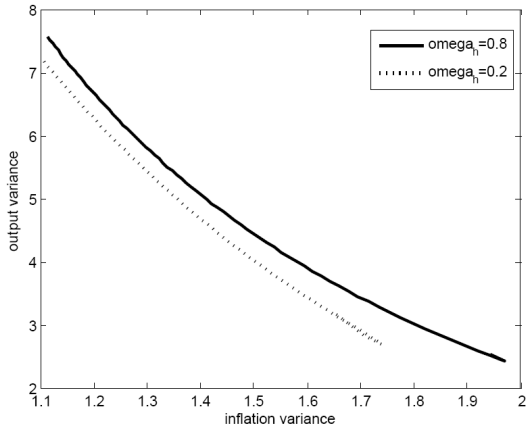

Figure 5: Policy frontier. High versus low preference for owner-occupied housing

whereas in the other one subsidies benefit rentals. We see that, in this case, monetary policy is more efficient when house purchases are subsidized. On the one hand, subsidizing rentals makes the economy less dependent on housing price movements, as in the previous case. However, subsidizing home purchases makes that changes in house prices are effectively smaller because the subsidy represents a reduction in the real housing price. Then, a change in real house prices coming from a change in monetary policy affects less the economy and therefore increases stability.

Figure 7 is similar to figure 5, in the sense that the scenario in which the rental market share is larger provides a more stable situation. The argument here is also similar. In a situation in which it is easier to derive housing services from rentals, borrowers substitute mortgaged housing by rentals. Therefore, changes in house prices coming from monetary policy do not produce destabilizing collateral effects.

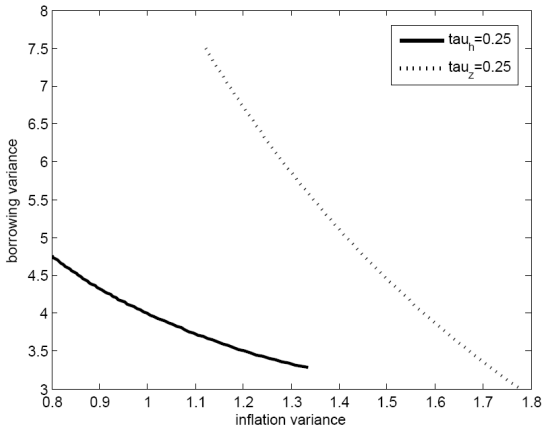

Figure 6: Policy frontier. Favorable fiscal treatment to owner-occupied housing versus rentals

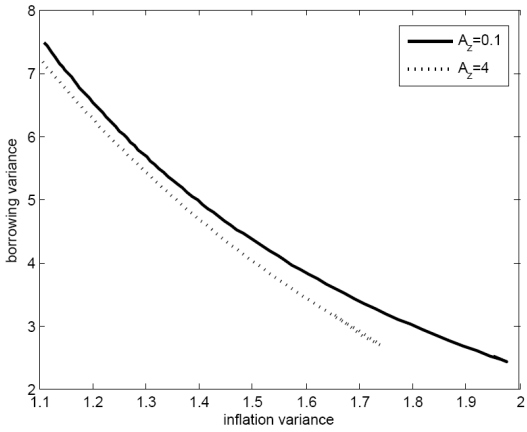

Figure 7: Policy frontier. More versus less efficient institutions

6 Optimal Monetary Policy

So far, we have seen that, for given monetary policy, a change in the interest rate is transmitted differently depending on the structural parameters that affect rental and owner-occupied housing markets. Furthermore, the efficiency of monetary policy is also affected by these structural and fiscal factors. In this section, we study the optimality of monetary policy for each case. I restrict the analysis to simple, linear rules in which interest rates respond to output and inflation. In particular, for each situation, we search for the combination of reaction parameters in the Taylor rule (both for output and inflation), that maximize total welfare.

As a measure of welfare, we solve the model using a second-order approximation to the structural equations for given policy and then evaluating welfare using this solution. As in Mendicino and Pescatori (2007), we take this latter approach to be able to evaluate the welfare of the two types of agents

separately.[12] The individual welfare for savers and borrowers, respectively, as follows:

$$W_{s,t} \equiv E_t \sum_{m=0}^{\infty} \beta_s^m \left[\log C_{s,t+m} + j \log H_{s,t+m} - \frac{(N_{s,t+m})^{\eta}}{\eta} \right], \tag{22}$$

$$W_{b,t} \equiv E_t \sum_{m=0}^{\infty} \beta_b^m \left[\log C_{b,t+m} + j \log \widetilde{H}_{b,t+m} - \frac{(N_{b,t+m})^{\eta}}{\eta} \right], \tag{23}$$

Following Mendicino and Pescatori (2007), we define social welfare as a weighted sum of the individual welfare for the different types of households:

$$W_t = (1 - \beta_s) W_{s,t} + (1 - \beta_b) W_{b,t}. \tag{24}$$

Each agent´s welfare is weighted by her discount factor, respectively, so that the all the groups receive the same level of utility from a constant consumption stream.

Table 6 presents the values for the Taylor rule parameters that maximize welfare, as defined above.

Table 6: Optimal values for Taylor Rule Parameters

	$(1 + \phi_\pi^*)$	ϕ_y^*
Benchmark	1.1	0.001
Low rental share		
$\omega_h = 0.8$	1.1	0.005
$\tau_h = 0.25$	1.11	0
$A_z = 0.1$	1.1	0.060
High rental share		
$\omega_h = 0.2$	1.19	0
$\tau_z = 0.25$	1.19	0
$A_z = 4$	1.19	0

I first compute the optimal parameters for the benchmark case, the one in which the preferences for owner-occupied housing and rentals are equal, there are no subsidies in the housing markets and the rental efficiency parameter is normalized to one. In this case we see that the optimal interest rate

[12] We used the software Dynare to obtain a solution for the equilibrium implied by a given policy by solving a second-order approximation to the constraints, then evaluating welfare under the policy using this approximate solution, as in Schmitt-Grohe and Uribe (2004). See Monacelli (2006) for an example of the Ramsey approach in a model with heterogeneous consumers.

response to output is very small relative to the inflation response. However, we see that for the three cases in which the rental share is high, since the collateral effect is less strong, it is optimal to respond more aggressively against inflation but the output response is negligible in this case. For the cases in which $\omega_h = 0.8$ and $A_z = 0.1$, it is optimal to increase the response of the interest rate to output. The argument is similar, since the collateral effects are stronger in this case, it is optimal to cut this effects by responding to output more strongly. As we have seen, the case in which $\tau_h = 0.25$ is a special one because even though the rental share is low in this case, and this should increase the collateral effects, the economy's exposure to changes in house prices is softened by the subsidy making monetary policy more efficient. Therefore, monetary policy does not need to be as aggressive both for inflation and for output in order to stabilize the economy.

7 Conclusions

Rental markets present clear differences across countries, both in its size and its efficiency and dynamism. This heterogeneity responds to different factors: consumer preferences, cultural factors, fiscal treatment of housing purchase versus rental, institutional framework or the financial market development, among others. In order to illustrate these issues, I propose a dynamic stochastic general equilibrium model, which features a housing market, in which borrowers face credit constraints and use their housing as collateral. The model generates impulse responses which are in line with economic theory, in which an increase in the interest rate contracts the economy and decreases owner-occupied housing in favor of rentals. Within this theoretical framework, the preference or cultural factor which affects the proportion of rentals with respect to purchases is reflected by the parameter associated to the weight of house purchases in the utility function. The model generates a steady state in which the higher this parameter, the more agents are indebted and the less rentals. The fiscal treatment of the housing market is reflected by a subsidy to house purchases and a subsidy to rentals. The subsidy to purchases decreases the proportion of rentals while debt increases. The subsidy to rentals has the opposite effect. Regarding the efficiency of the institutions with respect to rental markets, this is proxied by the efficiency parameter in the rentals production function. The more efficient this market is, the more agents rent and therefore less borrow. This setting, based on the model by Iacoviello (2005) is able to reflect the basic points which determine the difference among the rental markets across countries. It also reflects a fundamental concept in housing markets, wealth effects derived from collateral constraints. Therefore, it is a valid

framework to make comparative analysis of different economic policies to modify the relative weight of house purchases versus rentals.

In order to complete the study, I present impulse responses to a monetary policy shock under the different structural settings. Simulations show that monetary policy is transmitted in a different way through the housing market depending on the relative size of rentals versus properties. These structural and fiscal differences have also implications for the efficiency of monetary policy. Results show that when the relative size of the rental market is larger, monetary policy is more stabilizing than in the benchmark scenario. However, when the government subsidizes house purchases, the link between monetary policy and house prices is weaker and this creates an even more stable scenario. An optimal monetary policy analysis suggests that when the rental market relative size is large, monetary policy should respond more aggressively to inflation and disregard output, since the financial accelerator effects are stronger in this case.

For future research, it would be interesting to look at the implications of all these factors for financial stability.

Appendix

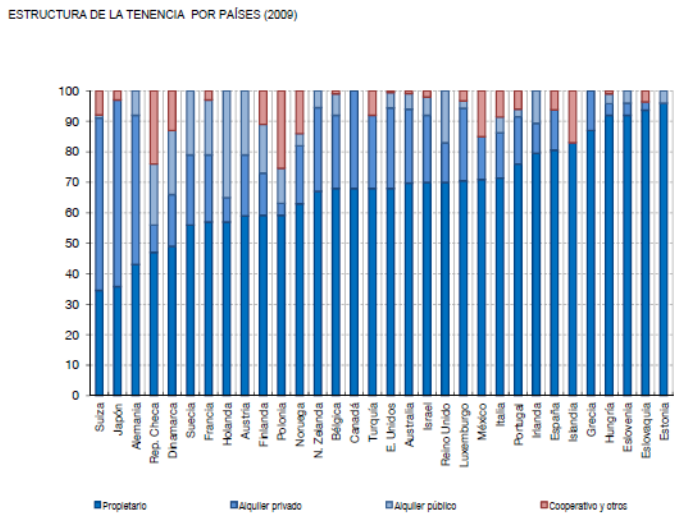

Table 3 Housing market-related taxation

(2008)

	Tax on imputed rent[1]	Tax deductibility of interest payments	Capital gains tax: On selling own home after 10 years	Capital gains tax: Different treatment financial – housing assets?	Capital gains tax: Maximum tax rate applicable	Inheritance tax: On own (principal) home[3]	Inheritance tax: Different treatment financial – housing assets?	Wealth tax	Real estate/ property tax	Transaction tax/fees/ stamp duties
Belgium	yes[4]	yes	no	no	16.5%	yes	no	no	no	yes
Germany	no	no	no	yes	45%	yes	yes	no	yes	yes
Ireland	no	yes	no	yes	20%	yes	no	no	no	yes
Greece	no	yes	yes[2]	no	n.a.	no	no	no	yes	yes
Spain	no	yes	yes[2]	yes	18%	yes	yes	yes	yes	yes
France	no	yes	no	yes	16%	yes	no	yes	yes	yes
Italy	no	yes	no	yes	20%	yes	yes	no	yes	yes
Cyprus	no	no	yes	yes	20%	no	no	no	yes	yes
Luxemburg	yes (4%)[5]	yes	no	yes	38.95%	yes	no	no	yes	yes
Malta	no	no	yes	yes	12%	no	no	no	no	yes
Netherlands	yes (0.6%)	yes	no	no	n.a.	yes	yes	no	yes	yes
Austria	no	yes	no	no	50%	yes	yes	no	yes	yes
Portugal	no	yes	yes[2]	yes	42%	no	no	no	yes	yes
Slovenia	no	no	no	yes	20%	yes	yes	no	no	yes
Finland	no	yes	no	no	28%	yes	no	no	yes	yes

Sources: NCBs and International Bureau of Fiscal Documentation (2007).
1) Tax rate on imputed rent is given in brackets.
2) No taxation if capital gains has been or will be reinvested in another permanent residence, within certain time limits.
3) Depending on the degree of kinship.
4) 30% to 50% of the rateable index-linked value.
5) 6% of the unit value exceeding EUR 3,800.

Justice is	Slow	not affordable	does not enforce decisions	a great obstacle
France	47,0%	16,3%	2,1%	4,1%
Germany	20,6%	18,6%	4,2%	8,0%
Italy	62,4%	43,8%	8,9%	16,3%
Spain	41,2%	13,5%	4,2%	12,2%
UK	17,3%	18,2%	1,0%	2,0%
US	23,2%	25,3%	7,1%	2,2%

Table A1: Enforcement contracts indicators (World Business Environment) Source: Mora-Sanguinetti 2010

Table A2

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