Policy Analysis of the First-Time Homebuyer Tax Credit

Master Seminar:
Incomplete Markets

Summer Semester 2023

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Munich, 20.06.2023

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I. Referee Report: “Consumption Dynamics During Recessions”

The Great Recession is an important motivation to gain a better understanding of the behavior of durable goods in business cycles, because more than half of the decline in GDP in the U.S. can be explained by a decrease in vehicle and home sales (Berger & Vavra, 2015). Therefore, the U.S. government has been forced to counteract with a durable demand-stabilizing fiscal policiy (Berger & Vavra, 2015). At the same time, there are reasonable doubts about the effectiveness of these economic stimuli, which lead Berger & Vavra (2015) to precisely address these issues. Hence, the authors research the responsiveness of the aggregated durable consumption to various shocks, including policy shocks, and whether the state of the economy matters for the responsiveness. Moreover, the question of the relationship between household-level decision-making for the durable consumption adjustment and its impact at the aggregate level is extensively discussed in the paper, focusing on a micro-based explanation.

The paper presents a simple heterogenous-agent incomplete market model, which distinguishes between non-durable and durable consumption[1] and includes fixed costs for durable adjustments. Thereby, the estimation procedure of the model relies on the gap-based indirect inference method in order to assess the relevant parameters. The paper concludes by revealing three main results after testing the model on the micro-level and macro-level with the estimated parameters. Firstly, the model can explain a large share of the variation in microeconomic adjustment patterns observed in the data of the Panel Survey of Income Dynamics (PSID). Secondly, the aggregated durable consumption is responding procyclically to the induced shocks. Therefore, the same shock on aggregated durable consumption has a lower effect during a recession compared to an expansion period. The final finding of the paper concerns the question of how the fixed costs of durable adjustment give rise to this procyclical pattern. Thereby, the authors argue that this pattern is caused by a reduction of durable stock adjustments on the household-level during an economic decline. Overall, Berger & Vavra (2015) conclude that governments have to expect a lower effectiveness of demand-stabilizing policies during recessions compared to periods of expansions.

[1] Berger & Vavra (2015) uses the broad definition of durable holdings, which is the sum of housing and vehicles sales.

1. Statistical and Argumentative Strategy

"Consumption Dynamics During Recession" by Berger & Vavra (2015) is a comprehensive and well-argued paper presenting the results of its incomplete market model with fixed costs of durable adjustment. In the following, the argument is advanced that the straightforward structure proceeding from the micro- to macro-level evidence, the extensive provision of statistical test and inducing shocks in the partial and general equilibrium lead to a result of high credibility. Thus, there is little criticism possible that could cast doubt on the main results of the procyclical responsiveness of durable consumption and the relevance of the fixed costs of durable adjustment to explain this procyclical nature. In next paragraph, the argument is presented in more detail, using examples from the paper, whereby the order of the above-mentioned results is followed.

The presentation of evidence for the procyclical behavior of durable consumption, depending on the state of the economy in Berger & Vavra (2015), is clearly structured. The paper starts by showing that the incomplete market model at the microeconomic-level has the ability to predict various important dimensions of household consumption dynamics from the data. To arrive at this result, the authors have used numerous different statistical tests, such as the R-Squared value for evaluating the global fit of the model's hazard distribution relative to the empirical hazard, while additionally providing a local measure for the distribution of hazard. Moreover, the paper compares the model distribution of different durable expenditure patterns with their data equivalents. Thus, the paper achieves to demonstrate that the incomplete market model is able to successfully predict household consumption behavior.

The authors proceed with the evaluation of the macroeconomic implications of fixed costs on aggregate durable expenditures in the partial equilibrium. Thereby, the authors calculate the impulse response function (IRF) of durable consumption on all aggregated shocks relevant to the business cycles. In order to visualize the results of the procyclical behavior of durable expenditures, the IRF is plotted over a time interval with the recession period being marked. Furthermore, the response of durable expenditures to a one percent shock is presented in a graph for a boom and recession phase. Moreover, the paper shows that the same findings can be discovered in a structural General Equilibrium (GE). One possible shortcoming of the paper is that it would have been beneficial to also establish a technological shock in the partial equilibrium to allow for a qualitative comparison with the GE results, since it is not possible to induce income, wealth and policy shocks in the GE.

It is evident from the previous description of the stringent structure in Berger & Vavra (2015) that a lot of effort went into ensuring that the model predicts the observations in the data, and that the procyclical outcome of the durable expenditures does not disappear due to GE effects.

In doing so, the authors applied a large number of relevant statistical tests and accounted for all possibilities, including any relevant aggregated shocks. The structure of the argument concerning the fixed costs of durable adjustment, which is responsible for the procyclical pattern is similarly extensive and supports the argument of this critical assessment of Berger & Vavra (2015).

2. Estimation Method: Indirect Inference Procedure

The estimation of the full-structural joint density of the variable in the model is a high-dimensional entity, which is impossible to assess (Berger & Vavra, 2015). Therefore, it is important to concentrate on specific moments of the distribution in order to simplify the estimation procedure. In the literature, two different concepts of the indirect inference procedure have emerged and are promising convincing estimators of the structural parameters. Therefore, the following paragraph explains the gap-based and the Gaussian Objective Function-based indirect inference procedure and assesses their characteristics.

Berger & Vavra (2015) opted for the gap-based indirect inference procedure, which allows to match the parameters of the model's distribution of gaps and the adjustment hazard to those of the data as adequately as possible. Thereby, the gap is defined as the difference between the inherited durable holdings in the beginning of the period and the desired durable holdings at the end of the period (Berger & Vavra, 2015). The first step of the gap-based indirect inference procedure is to estimate the gap of the model with the auxiliary model, which is restricted through the characteristics of the structural model and conditioned to a given set of parameters. As a second step, the gap of the data is estimated with the same auxiliary model that was used in the previous step. Once both of these gaps are estimated, the corresponding distribution and the adjustment hazard can be calculated for the model and the data. These steps are repeated for different parameters until the sum of the squared differences of the distribution of gaps and hazard between the model and the data is minimized. After finishing this procedure, the results are the point estimates of the parameters. Overall, Berger & Vavra (2015) are able to state convincing results of the parameters, as they can predict the adjustment probability and the distribution of the gap in the data with their dynamic model.

Despite the undoubted success of this estimation procedure, a rivalry indirect inference estimation method has emerged parallel to the gap-based alternative. The indirect inference procedure based on the Gaussian objective function is worthwhile to implement in order to allow for a comparison of the results as a robustness check of the estimated parameters. Instead of calculating the distribution of the gap and hazard, it estimates the parameters according to Guvenen & Smith (2014) in the following way. First, the Gaussian objective function based on real data is maximized and the resulting parameters are inserted again into

the objective function. It is important to mention that this Gaussian objective is a function of the error term of the auxiliary model. Secondly, the Gaussian objective function of the simulated data is calculated. In order to receive the estimated parameters[2], the distance of the first and the second Gaussian objective function must be minimized subject to the restrictions imposed by the structural model. The results are the point estimates of the parameters, which reduce the distance between the model and the data. Moreover, Guvenen & Smith (2014) provides evidence that this procedure delivers consistent estimators, which are close to the corresponding true parameters in the data.

Overall, it can be concluded that both methods are estimating reliable parameters for the model, although the approach of the estimation strategy is different. Nevertheless, it is of great interest to prove that the gap-based estimators are robust, and therefore the credibility of the estimated parameters would increase if the indirect inference procedure based on the Gaussian objective function would be additionally performed.

3. Extension of the Model

Berger & Vavra (2015) primarily explains the procyclical pattern of durable expenditures induced by fixed costs in their adjustment. Some strict assumptions were made in order to allow for an accurate analysis of the model, but in many aspects, they deviate strongly from economic reality. Therefore, it is important to relax the following assumption of Berger & Vavra (2015) to allow for a more accurate analysis of policies, since different durable goods require different institutions:

1. Durable expenditures are the sum of vehicle and housing values
2. No collateralized lending
3. No differentiation in durable ownership (i.e., there is no renting out possible and no change in the ownership situation, e.g., going from owning a house to renting a house)
4. No differentiation in quality of the durable goods
5. No direct channel for fiscal policy and monetary policy

The heterogenous-agent incomplete market model in Berger & Vavra (2015) (equivalent to the term "basis model") has a great potential for the abovementioned extension, due to the important role of the durable expenditures in recession, as it is argued in the paper itself. As it can been seen in the following two papers, there have already been several extensions of the basis model in order to allow for specific policy analysis. The first paper to mention is Gavazza & Lanterni (2021), which studies the Car Allowance Rebate System of the U.S.

[2] The estimated parameters are those, which reduce the distance between the model's distribution of gaps and hazard and the data's distribution of gaps and hazard (Berger and Vavra, 2015).

Government during the Great Recession. For this purpose, the authors consider that goods may differ in quality and may be sold on a secondary market. In doing so, they succeed in developing a model that can predict important patterns in car sales observed in the data during the Great Recession. A second example of how the basis model can be extended is McKay & Wieland (2021). In this case, the paper implements a central bank that can influence the demand for durable goods through monetary policy. Thereby, this model succeeds in predicting the low interest rate after the Great Recession and matches the observations in the data.

After a brief introduction of the existing extensions for the incomplete market model in Berger & Vavra (2015), it might be of interest to extend the model with respect to the First-Time Homebuyer Tax Credit. For this purpose, it is necessary to make some additional assumptions for the basis model to allow for a targeted fiscal policy on first-time homebuyers. Therefore, the central new assumption of housing choices is in line with De Francisco (2021). Moreover, a mortgage market with collateralized borrowing and lending a fraction of the future income is implemented in order to be able to buy a house, which is designed according to De Francisco (2021). Additionally, the mortgage rate and the risk-free interest rate are assumed to be different from each other. Thus, households must compare the costs and the benefits of buying a house in each period when they make the decision to keep, sell, or rent a house. This create the possibility to model households to transit from being a renter to a homeowner. Therefore, the model is promising for a more in-dept analysis of the First-Time Homebuyer Tax Credit.

II. Policy Analysis of the First-Time Homebuyer Tax Credit

1. Introduction

The decrease in housing demand after the burst of the bubble in the year 2008 led to the need for measures to stabilize the demand, due to the great importance of the housing market for the U.S. economy with a homeowner share of approximately 70% (DeFrancisco, 2021). Therefore, several fiscal policy measures have been taken to prevent the continued decline in the housing demand, either by assisting highly indebted households to secure homeownership or by increasing the housing demand among those who never owned a house (Hembre, 2018). The first-mentioned fiscal policy is formally known as the Home Affordability Modification and Refinancing Program and is analyzed with an incomplete market model in Kaplan et al. (2020). The second one is known as the First-Time Homebuyer Tax Credit (FTHC) and was active between the years 2008 and 2010 (Hembre, 2018). Thereby, the FTHC has proven to be an effective tool to increase the housing demand among first-time homebuyers by 16% as Hembre (2018) states in the empirical study. Thus, this fiscal policy succeeded in increasing housing sales and has contributed to stabilize the demand for houses (Hembre, 2018).

Despite the proven effectiveness of the FHTC, there is no research available for a structural modeling approach to assess this specific fiscal policy in an incomplete market. Therefore, the research question of this research proposal is how to model a housing market and the FHTC with housing adjustment costs. Moreover, the focus lays on providing a clear mechanism that explains the shift of current renters to become first-time homebuyers.

This research proposal develops a heterogenous-agent incomplete market model based on Berger & Vavra (2015) by extending it with housing choices and a mortgage market inspired by De Francisco (2023) and additionally models mortgage payments. Thereby, the central role of determining whether the household decides to buy a house depends on the costs of a mortgage and the benefits of owning a house. When additionally extending this model to the First-Time Homebuyer Tax Credit, the success of this fiscal policy relies on the amount of the subsidy in order to counteract the costs of the mortgage payments since they are a fundamental factor of the decision-making process of the household.

The research proposal first gives an overview of the existing literature. Afterwards, the model extension with the corresponding assumptions and the infinite household problem are presented. In the following section, the mechanisms are explained intensively. Finally, the conclusion consists of a summary of the research proposal and an outlook on the research possibilities is given.

2. Overview of Existing Literature

The heterogenous-agent incomplete market model with adjustment costs for housing includes housing choices, a mortgage market and the First-Time Homebuyer Tax Credit. This research proposal aims to contribute to a larger set of research to understand households' housing consumption in combination with adjustment costs. Thereby, numerous papers have provided insights on this topic and often tried to match the dynamics during the Great Recession.

The first paper to be mentioned in this literature overview is Kaplan, Mitman and Violante (2020) in which an infinite life-cycle incomplete market model is accomplished by numerous financial institutions to analyze the housing bubble. Particularly notable is the inclusion of households' expectations of house price developments in the model. Thereby, the performance of the model in terms of matching the housing bubble in 2008 is highly successful and shows that a large part of the house price fluctuations is explained by a change of the expectations. As opposed to the approach in this research proposal, Kaplan et al. (2020) analyzes the implication of the Debt Forgiveness Program of the U.S. government in the developed model during the Great Recession, while the First-Time Homebuyer Tax Credit is not included in this policy analysis. Moreover, Bajari, Chan, Krueger & Miller (2013) incorporates 60 life-cycles in an incomplete market model with house prices. This large number of life-cycles allows the authors to match housing demand patterns across different age groups and explain how young and old households behave towards changes in their housing stock, if house price and income shocks are induced. The next influential paper is Kaplan and Violante (2014), which combines a Baumol-Tobin model with a life-cycle incomplete market model and adds mortgages without collateralized lending. In doing so, the paper is designed to provide a general policy recommendation with respect to their results on the responsiveness of wealthy and poor hand-to-mouth households to tax rebates. On the other hand, this research proposal attempts to develop a model, which directly targets first-time homebuyers can, while allowing for collateralized lending and focusing on the implications for the extension of Berger & Vavra's (2015) baseline model. Another paper with a realistic modeling approach for housing choices is Garriga and Hedlund (2020) by taking it one step further and adding a sophisticated mortgage market and housing prices. In addition, they analyze tightening credit limits and their effect on ownership. Thereby, they identify the reduction in the mortgage rate as a possible stabilizing policy tool. In contrast to this research proposal, Garriga and Hedlund (2020) does not provide a simple model and no concrete analysis of the First-Time Homebuyer Tax Credit, while this research proposal aims to contribute to the research of policy analysis.

3. Model

The model presented in this research proposal is based on the basis model of a heterogeneous-agents incomplete market framework with fixed costs of housing adjustments by Berger & Vavra (2015). In this research proposal, the term "basis model" is used to refer to the model in Berger & Vavra (2015). The proposed extension is inspired by De Francisco (2021), which extended by housing choices and mortgages with the possibility of collateralized lending. Moreover, this research proposal adds mortgage payments for each period based on the mortgage rates r_m. Furthermore, a government budget to finance the first-time homebuyer tax credit is added to provide an analysis of the fiscal policy. In the following section, the basis model as well as housing choices, the technicality of the mortgage market and the government budget are explained in detail. The final step is then to state the dynamic programming problem of the infinite households.

3.1 Utility Function

The isoelastic utility function (1) of the household is adopted from Berger & Vavra (2015) and the explanation of the notation is provided in the following paragraph. The households are gaining utility from consuming non-durable consumption goods c and housing services h, whereby v represents the weights of the non-housing consumption goods (Berger & Vavra, 2015). Moreover, the γ represents the inverse intertemporal elasticity of consumption (Berger & Vavra, 2015).

$$u(c,h) = \frac{[c^v h^{1-v}]^{1-\gamma} - 1}{1-\gamma} \tag{1}$$

3.2 Fixed Costs of Housing Stock Adjustment

Alongside the utility function of the basis model, the adjustment costs of housing are incorporated into the research proposal's model. Thereby, the household has to take into account possible adjustment costs, when deciding to change the current housing service. Berger & Vavra (2015) define that durable adjustment costs consist of two parts. The first important cost factor is proportional fixed costs F^has for example realtor fees. The second cost factor is time costs F^t representing the fact that searching for a new house takes time in which the household could earn additional income. The new assumption proposed in this research proposal, is that mortgage payments are not included anymore in the proportional fixed costs F^h in order to allow an assessment of the First-Time Homebuyer Tax Credit. The adjustment costs equation $A(h', h)$ is determined by the following dummy equation:

$$A(h, h_{-1}) = \begin{cases} 0, \ if \ h = [1 - \delta_h(1 - \chi)]h_{-1} \\ F^h(1 - \delta_h)h_{-1} + F^t \omega h \eta_t^i, \ otherwise \end{cases} \quad (2)$$

with χ representing the maintenance costs, δ_h representing the depreciation of housing.

Thereby, the adjustment costs equation (2) reflects the fact that either the household adjusts the housing stock and pays the adjusting costs or the household does not adjust and only bears the maintenance costs χ.

3.3 Housing Choices and Decision Options

The first assumption concerns the variety of housing services inspired by De Francisco (2021) and differentiates between renters and homeowners. This is a simpler assumption on housing services compared to the one advanced in De Francisco (2021). Therefore, renters consume housing service h_r and homeowners consume the housing service h_o. Moreover, the value of housing services for homeowner $h_o$is greater than for renter h_r.

$$h = \{h_o, h_r\} \ with \ h_o > h_r$$

Another assumption is imposed on the current homeowners in this model stating that once a household owns a house, the house will not be sold by the homeowner and only an adjustment of the housing stock is possible. This allows to reduce the number of different options during the household's decision-making process to four instead of five different household options in De Francisco (2021)[3] and simplifies the mechanism of the model. Thereby, these two households' decision options are the same on as in Berger & Vavra (2015). The decision-making process of the household is represented in the value functions in chapter 3.6.

The following paragraph explains the two new households' decision options added to the basis model, which are introduced by the two above-mentioned options. The first option is that households can decide to rent a house in the current period and rent a house in the next period, as it is done in the supplement of Berger & Vavra (2015). The second option enables the household to change from renting a house in the current period to owning a house in the next period, which is inspired by De Francisco (2021). This last household decision option represents the first-time homebuyer (FTHB) and allows to introduce an economic stimulus.

[3] Thereby, the households' decision options can be stated as follows: the current homeowners can choose to not adjust their housing stock, to adjust their housing stock but don't sell it completely or to sell their complete housing stock. On the other side, households renting a house choose between staying a renter or buying a house.

3.4 Mortgage Market

The next step is to explain the mortgage market, which is slightly extended in this research proposal compared to De Francisco (2021) by including the mortgage payments for each period. The first thing to introduce is the exogenous credit limit $\bar{m}_c(h)$, which is explained in the spirit of De Francisco (2021) but matches the notation of Berger & Vavra (2015). This credit limit can be interpreted as the mortgage of the model and consists of the sum of lending a certain fraction λ of the future labor income and the collateralized borrowing. Thereby, the household collateralizes the house they are buying in the current period.

$$\bar{m}_c(h) = \lambda\omega' h'\eta' + (1 - \mathbb{I}_{rent}) * (1 - \theta)h_o \tag{3}$$

$$\text{With } \mathbb{I}_{rent} = \begin{cases} 1, & if\ houshold\ is\ renting \\ 0, & otherwise \end{cases}$$

Thereby, ω' is the income of the next period, h' is the fixed working hours of the next period, η' is the income shock for the next period, $\mathbb{I}_{rent}$ indicates whether the household is renting or not and θ is the minimum down-payment requirement for buying a house. The parameter θ is set to $\theta = 0.2$ implying that households can collateralize 80% of their house as suggested in De Francisco (2021) and Berger & Vavra (2015). This research proposal contributes to De Francisco (2021) by adding mortgage payments for each period of $r_m * \bar{m}_c(h)$.

The total financial assets z are defined as the sum of the liquid assets a of the current period and the households' mortgage $\bar{m}_c(h)$ of the previous period according to De Francisco (2021). In order to include this proposition into the budget constraint, this equation is solved for the liquid asset and is substituted into a' and a of the budget constraint of the basis model. The reasoning of this can be easily understood with equation (5). The liquid assets a in the beginning of the period t are the savings from the last period $t-1$ for which the household gets risk-free interest rate in period t. Thereby, the savings from last period are the difference between the total amount of the financial assets in period t minus the amount of income loaned from period t into period $t-1$.

$$z = a + \bar{m}_c(h^{-1}) \tag{4}$$

$$\Leftrightarrow a = z - \bar{m}_c(h^{-1}) \tag{5}$$

3.5 Government

The government budget allows to interact with the housing market by determining the labor income tax rate τ_l and setting the First-Time Homebuyer Tax Credit by inducing a subsidy S. Thereby, the government is allowed to finance the demand-stabilizing fiscal policy by a budget deficit but cannot roll over debt infinitely. Moreover, the Ricardian Equivalence is

given such that neither the government debt nor the deficit has a significant effect on the households.

$$\tau_l \omega h \eta_t^i + b \geq g + r b_{-1} \tag{6}$$

with b being the debt of the government in period t and g being expenditures of government on the subsidies.

3.6 Infinite Horizon Problem

The last step of presenting the model is to state the infinite housing problem given the above-mentioned extensions and assumptions. Thus, the following recursive infinite household problem is a combination of Berger & Vavra (2015), an alternated version of De Francisco (2021) and some contributions of this research proposal:

$$V(a_{-1}, h_{-1}, \eta) = \max [V^{AdjustHousing}(a_{-1}, h_{-1}, \eta), V^{NoAdjustHousing}(a_{-1}, h_{-1}, \eta),$$

$$V^{Rental}(a_{-1}, h_{-1}, \eta), V^{FTHB}(a_{-1}, h_{-1}, \eta)]$$

With

$$V^{AdjustHousing}(a_{-1}, h_{-1}, \eta) = \max_{c,h,a} \frac{[c^v h_o^{1-v}]^{1-\gamma}}{1-\gamma} + \beta E_\varepsilon V(a, h_o, \eta') \tag{7}$$

Subject to

$$c + [z' - \bar{m}_c(h_o)] + h_o + A(h_o, h_o^{-1}) + r_m \bar{m}_c(h_o) = (1 - \tau_l)\omega h \eta + (1 - r)[z - \bar{m}_c(h_o^{-1})]$$

$$c \geq 0$$

$$z' \geq 0$$

$$z' = a' + \bar{m}_c(h)$$

$$\log \eta' = \rho_\eta \log \eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon)$$

with η being the shock on idiosyncratic labor earnings and β being the discount factor

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$$V^{NoAdjustHousing}(a_{-1}, h_{-1}, \eta) = \max_{c,h,a} \frac{[c^v h_o^{1-v}]^{1-\gamma}}{1-\gamma} + \beta E_\varepsilon V(a, h_{o,-1}(1 - \delta_d(1 - \chi), \eta') \tag{8}$$

Subject to

$$c + [z' - \bar{m}_c(h_o)] + \delta_d \chi h_o^{-1} + A(h_o, h_o^{-1}) + r_m \bar{m}_c(h_o) = (1 - \tau_l)\omega h \eta + (1 - r)[z - \bar{m}_c(h_o^{-1})]$$

$$c \geq 0$$

$$z' \geq 0$$

$$z' = a' + \bar{m}_c(h)$$

$$\log \eta' = \rho_\eta \log \eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon)$$

$$V^{Rental}(a_{-1}, h_{-1}, \eta) = \max_{c,h,a} \frac{\left[c^v h_r^{1-v}\right]^{1-\gamma}}{1-\gamma} + \beta E_\varepsilon V(a, 0, \eta) \quad (9)$$

Subject to

$$c + [z' - \bar{m}_c(h_r)] + r^h h_r + r_m \bar{m}_c(h_r) = (1 - \tau_l)\omega h \eta + (1 - r)[z - \bar{m}_c(h_r^{-1})]$$

$$c \geq 0$$

$$z' \geq 0$$

$$z' = a' + \bar{m}_c(h)$$

$$\log \eta' = \rho_\eta \log \eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon)$$

$$V^{FTHB}\left(a_{-1}, h_{r,-1}, \eta\right) = \max_{c,h,a} \frac{\left[c^v h_o^{1-v}\right]^{1-\gamma}}{1-\gamma} + \beta E_\varepsilon V(a, h_0, \eta) \quad (10)$$

Subject to

$$c + [z' - \bar{m}_c(h_o)] + h_o + A(h_o, h_r^{-1}) - S + r_m \bar{m}_c(h_o) = (1 - \tau_l)\omega h \eta + (1 + r)[z - \bar{m}_c(h_r^{-1})]$$

$$c \geq 0$$

$$z' \geq 0$$

$$z' = a' + \bar{m}_c(h)$$

$$\log \eta' = \rho_\eta \log \eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon)$$

4. Mechanism

After introducing the model of this research proposal, the basic mechanism of the incomplete market model with added mortgages and housing choices is explained in order to understand households' decision-making process on taking out mortgages and buying a house. Subsequently, the final step is to explain the impact of FHTC on this model and the proposed mechanism that leads first-time homebuyers to purchase a home.

4.1 Basic Mechanism

The model introduces mortgages $\bar{m}_c(h)$ for households according to De Francisco (2021), which they take out when buying a house. Thereby, the mortgage consists of loaning future labor income into today's period and collateralized borrowing against a house (De Francisco, 2021). Moreover, the lending of future income is bound to a fixed share λ and the minimum downpayment requirement is equal to 20% (De Francisco, 2021). At the same time, the households have to pay their mortgage payments every period which depends on the mortgage rate r_m, as it is newly introduced in this research proposal. Moreover, the mortgage rate is unequal to the risk-free interest rate on liquid assets $r_m \neq r$. Consequently, the mortgage rate and saving rate for which the household borrows and saves are different. In this research proposal, it is argued that introducing a mortgage market with mortgage payments entails new dynamics in the decision-making process of households. In the following, the mechanism of this decision process is explained in detail.

The households have to make every period the decision if they want to change their housing stock, which is especially of interest for renters since they would gain greater utility from a greater housing service. Thereby, this decision is strongly influenced by the level of the mortgage rate. In general, a rising mortgage rate makes it less attractive for potential homebuyers to take out a mortgage and, thus, they are more likely to postpone their investment decision. On the other hand, sinking mortgage rates encourage potential homebuyers to take out a loan in order to buy a house.

However, the households' decision is more complicated because every household compares the returns of capital r on today's savings and the costs of mortgage payments when buying a house in order to get a greater housing service h_o. To make the decision process more comprehensible, the households compare the costs with the benefits of buying. Thereby, this research proposal defines the costs of buying a house with mortgage payments and opportunity costs of missing out on return on capital. Moreover, the benefit of buying a house is the greater housing service h_o, which the homeowners enjoy.

If the households observe $r_m > r$, the costs of taking out a mortgage are greater than the benefits of buying a house. Therefore, the households are more likely to decide to not take out a mortgage and would become a saving household, which benefits from the risk-free interest rate on their savings. On the other hand, if the households observe $r_m < r$, the costs of the mortgage payments are relatively small, and the households are more likely to decide that they want to benefit from housing service h_o. This has the consequence that they benefit less from the return on capital on savings since they become net borrowers and reduce their savings.

After stating the mechanism of the research proposal's model, it is important to place it into the context of the recursive infinite household problem from the subchapter 3.6. The value function (7) states the decision of the homeowner to adjust their housing stock after already owning a house. While the value function (8) states the decision of the homeowner to not adjust their housing stock and to continue consuming h_o. The value function (9) represents the decision of the renting households to continue consuming the housing service h_r. Furthermore, the value function (10) represents the decision-making process of the households of changing from renting a house to becoming a homeowner and is of great interest for this research proposal since it allows to analyze the First-Time Homebuyer Tax Credit. In the next subsection, the description and the mechanism of the tax credit is explained and presented.

4.2 First-Time Homebuyer Tax Credit

The First-Time Homebuyer Tax Credit was introduced by the U.S. government during the Great Recession in order to stabilize the sinking housing demand in the year 2008 (Berger et al., 2020). Thereby, this program had great success in stimulating housing sales by targeting first-time homebuyers, which two recent empirical studies confirmed (Berger et al., 2020; Hembre, 2018). Thus, it is of great interest to include this fiscal policy in the previously explained model and to analyze it regarding changes in the model.

The first step is to define and understand the First-Time Homebuyer Tax Credit in order to be able to represent it in this research proposal. The tax credit is a certain amount of money, which all eligible households receive form the government after handing in their tax files (Berger et al., 2020). Hence, this research proposal suggests to model the tax credit is by a subsidy S, which is only incorporated in the value function (10) where the household changes from renting a house to owning a house. Therefore, the first-time homebuyers are targeted in order to convince them to buy a house instead of continuing to rent. This would mimic the First-Time Homebuyer Tax Credit and increase the number of sold houses and, thus, lead to the desired effect of a greater demand for the housing stock.

The second step explains the basic mechanism of the subsidy for first-time homebuyers given that the mortgage rate is significantly higher than the risk-free interest rate. In the case without subsidy, households are more inclined to invest into liquid assets rather than taking out a mortgage, due to the high mortgage payments. The subsidy functions as a reduction in the mortgage payment and thus reduces the costs of taking out a mortgage. If the subsidy is high enough, the costs of the mortgage relative to the benefit of the housing service h_o is small and the first-time homebuyers are more likely to buy a house. Thus, this mechanism has

the potential to describe the effect of the First-Time Homebuyer Tax Credit, which would lead to a stabilization of the housing demand by an increased number of first-time homebuyers.

Overall, it can be stated that the introduction of the First-Time Homebuyer Tax Credit seems to have the intended stimulating effect in the model and, thus, increases the probability of households to adjust their housing stock. The further statistical assessment of this fiscal stimulus must be calculated with the impulse response function according to Berger & Vavra (2015). Thereby, the same procyclical patterns in the aggregated housing expenditures are expected within the framework of the research proposal as in Berger & Vavra (2015). This would support the policy implication of a lower effectiveness of a fiscal stimulus during a recession and would make an effective usage of this mechanism expensive.

5. Conclusion

This research proposal develops a heterogenous-agent incomplete market model with housing choices, a mortgage market and fixed costs for the housing stock adjustments based on Berger & Vavra (2015) in order to analyze the mechanism of the First-Time Homebuyer Tax Credit. Thereby, the housing choices are inspired by De Francisco (2021), and the mortgage market of the same paper is completely incorporated into the research proposal's model and extended by mortgage payments. In addition, a central decision must be made by the households whether to save into risk-free liquid assets or to take out a mortgage in order to buy a house induced by the difference between the borrowing rate and the risk-free interest rate. This modeled mechanism would enable to generate a framework that allows to study the First-Time Homebuyer Tax Credit and help to understand the outcome of this fiscal stimulus. Especially the effectiveness of the stimulus is an interesting aspect to evaluate in this model since Berger & Vavra (2015) suggest lower responsiveness of durable expenditures to shocks.

In the continuation of this research, another suggested action would be to further adjust the model by relevant institutions for the European economy in order to analyze a European fiscal stimulus version of the First-Time Homebuyer Tax Credit. This is interesting as the same procyclical behavior of durable goods is observed in the European economies and this implies the need for a policy analysis model to evaluate the response of the economies to a stimulus (European Central Bank, 2020). However, the main challenge of the further extension towards the European area would be to find useful and accessible data.

6. References

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Munich, 20.06.2023 Alexander Vapf

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