Public Policy, Household Finance and the Macroeconomy

Jakob Almerud

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Abstract
The thesis contains four separate essays, spanning questions of the interaction between public policy, household finance and the macroeconomy. How does public policy affect macroeconomic outcomes, and the choices and welfare of households, and what are households' optimal financial responses to changes in macroeconomic environments? Furthermore, the thesis includes a development of a method, which is helpful to answer questions like the ones stated above.

The first essay, Optimal Public Policy in a Multi-Sector Economy with Asymmetric Shocks, shows how fiscal policy can complement monetary policy. It is shown that fiscal policy can be used to improve macroeconomic outcomes and make the economy more efficient. Since fiscal policy, in general, includes more instruments than monetary policy, it is possible to neutralize several frictions in the economy simultaneously. This is shown in a general equilibrium model with dynastic households, where firms face monopolistic competition, sticky prices, productivity shocks and cost-push shocks.

The second essay, On the Design of Mortgage Default Legislation, asks how different types of mortgage contracts interact with different types of mortgage default policies regarding the probability of a default on home-owner's mortgage. The different types of mortgage contracts analyzed are fixed rate annuity mortgages, adjustable rate amortized mortgages and adjustable rate non-amortized mortgages. The mortgage default policies span from non-recourse (where the mortgage lender takes all the default risk) to full recourse (where the borrower takes all the default risk). It is shown that a "borrower friendly" non-recourse policy is, as the one implemented in many parts of the United States, not necessarily borrower friendly due to its effect on the risk premium. This is investigated in a model with finitely lived households and an endogenous risk premium.

The third essay, On The Empirical Relevance of Cointegration Between Stock Market Returns and Labor Income on Optimal Portfolio Choice, investigates how finitely lived households optimally choose a portfolio consisting of risk-free bonds and risky equity, and how this choice is affected by the long-run correlation between risky (cumulative) equity returns and stochastic labor income. More specifically, I investigate if the empirical cointegration (long-run correlation) between the two variables is strong enough to affect the optimal portfolio choice. It is shown that it is not. Cointegration exists between the two variables, but the speed-of-adjustment back to the cointegration equilibrium is to slow to have a significant effect on the households' optimal portfolios.

The fourth essay, Solving Dynamic Programming Problems Using Stochastic Grids and Nearest-Neighbor Interpolation, describes a new computational method, which is used in the second and third essays. The method is developed to solve models with finitely lived households who face a complex economic environment. Post-state decision rules for the households are used together with simulated stochastic grids over the exogenous variables. By simulating the grids it is possible to reduce the number of grid points that the model is solved for, thereby making it significantly faster to solve models with many exogenous state variables. It is shown that it is possible to solve non-linear life-cycle models including at least eight state variables relatively quickly on a standard desktop computer.

Keywords: Public policy, household finance, macroeconomics, numerical models, housing finance.

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Till Liv och Alva
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Sammanfattning på svenska

Denna avhandling innehåller fyra uppsatser, som tillsammans spänner över ämnena penning- och finanspolitik, bolånereglering och hushållets finansiella val. Sammantaget diskuteras de olika val som den offentliga sektorn och hushållet gör och bör göra.


I den tredje uppsatsen utreds hur hushållets optimala val mellan två typer av tillgångar, obligationer med en fast ränta samt en aktieindexfond, påverkas av att det finns en langsiktig korrelation mellan avkastningen på aktier och löneökningarna i ekonomin. Om en sådan korrelation finns så kan det betyda att hushållet bör spara betydligt mindre i aktier än

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1 Here, I think it is appropriate to mention that one could probably randomly re-shuffle all scenes in the movie Shark Exorcist without in any significant way changing the movie experience.
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Jakob Almerud
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Introduction

This thesis contains four self-contained essays. The essays span different topics, but share the common feature that all questions in the thesis are analyzed using computational applied theoretical simulation models. The first two essays investigate how different public policies affect welfare, and how to conduct policy in an optimal fashion. In the first essay, I investigate how fiscal policy can be used in complement with monetary policy to improve macroeconomic outcomes. In the second essay, the focus is shifted away from the macroeconomy to individual households and their financial decisions. In the essay, which is co-authored with Roine Vestman and Anders Österling, we investigate how different types of mortgage default policies interact with different types of mortgage contracts regarding the households' choice to default on their mortgages. Even though the focus is not directly on the macroeconomy, a macroeconomic environment is still present. A change in that macroeconomic environment directly affects the households' financial decisions. The third and fourth essays also investigate the households' financial decisions. In the third essay, I investigate how households optimally choose between risky equity and risk-free bonds in their asset portfolios if there is a long-run correlation between the returns to equity and the wage income that they receive. I also investigate if the empirical long-run correlation is strong enough to matter for the households' financial decisions. In the fourth essay, which is written together with Anders Österling, we develop a method to solve computational economic models such as the ones used in the second and third essays in a more efficient way than has previously been done. As the computational efficiency increases, it becomes easier for the computer to solve the models, which has as a consequence that it is possible to build more complex and realistic models, being more similar to the world that the models are built to investigate. Below follows a more detailed descriptions of the four essays.

Essay No 1: Optimal Public Policy in a Multi-Sector Model with Asymmetric Shocks:

Academics have studied, and policy makers have conducted, monetary and fiscal policy (public policy) as tools for stabilizing the economy at least since the days of John Maynard Keynes. Since the welfare loss of economic recessions is seen as larger than the welfare gains of booms, it is possible to improve the general welfare by conducting counter-cyclical public policy to reduce size of the swings in output around its growth-trend.

A modern view of stabilization policy is, however, that it might not be possible to improve welfare by stabilizing economic output completely around its trend. Such a policy could lead to the economy acting in a less efficient manner, thereby reducing welfare. Instead, it is recognized that the economy is affected by different frictions (for example matching frictions, informational frictions and price frictions). The goal of public policy in such an economy
should then be to (as far as possible) neutralize the negative effects of those frictions, thereby pushing the economy closer to its frictionless counterfactual self.

One commonly used framework which is used to analyze how to conduct policy given different frictions, especially price frictions, is the New Keynesian framework. In such a framework, it is commonly assumed that firms are not able to react immediately to changes in the economic environment, which means that the price level can not adjust optimally to such changes. Within the framework, the use of monetary policy as a policy tool has been analyzed extensively. Fiscal policy as a tool to achieve similar outcomes is, however, less frequently analyzed (with Correia et al. (2008) and Correia et al. (2013) as two notable exceptions).

In the essay, I try to fill (a portion of) that gap. I investigate how state-dependent fiscal policy, i.e. a fiscal policy that responds to changes in the economic environment, for example, an economy that goes into a recession, can be used to reduce, or under some conditions completely neutralize, the negative effects of the frictions that distort the economic outcomes.

The analysis builds on an idea presented by Correia et al. (2013), who show that state-dependent fiscal policy can be used as a tool when monetary policy is constrained by the zero-lower bound on the nominal interest rates. An economy at the lower bound is, however, not the only potentially case for fiscal policy as a useful tool. The usefulness depends on the structure of the economy. To show this, I build a New Keynesian model that includes several different types of production goods, where the sectors that produce the goods are hit by shocks which are not correlated between sectors. The firms in each sector are subject to monopolistic competition and price stickiness. In such an environment, it is not possible to reach the first-best outcome, i.e. the outcome where all negative effects of the frictions are neutralized, with only monetary policy as a tool. However, by introducing the appropriate fiscal instruments it is possible to reach the first-best. This does, however, hinge on that the fiscal authority is able to respond immediately after a shock has hit the economy. In reality this might be difficult, since it is often the case that changes in fiscal policy have to go through a time-consuming political process. Therefore, it is also investigated how to conduct policy when fiscal policy is restricted by an implementation lag. It is shown that it is still beneficial to conduct state-dependent fiscal policy if such a lag is included.

Essay No 2: On the Design of Mortgage Default Legislation:
This essay is co-authored with Roine Vestman and Anders Österling. We investigate how different types of mortgage contracts interact with different types of mortgage default policies regarding the probability of a default on a home-owner’s mortgage, and which is the best policy-combination from the home-owner’s perspective.

The legislation regulating the consequences of a home-owner defaulting on his or her mortgage differs significantly between countries and between different states within the United States (U.S.). On one end of the spectrum lies for example many U.S. states, having so-called non-recourse regimes, meaning that the mortgage lender has no ability to claim any
outstanding debt that is left after a forced sale of the home (the underlying security of the mortgage). On the other end lies for example Sweden, where the mortgage lender has the right to claim all of the home owner's assets to cover their loss. Which policy that is optimal from the home-owner's perspective is however uncertain. Furthermore, it might depend on the type of mortgage contract.

To be able to answer that question, we develop a model consisting of home-owners who are modeled from the year that they buy their home and to the end of the duration of the mortgage contract. The home-owners choose how much to consume, save, and how much to work. Furthermore, every year they choose if they should stay in their home, sell it to become renters, or if they should default on their mortgage.

The mortgage default policies span from non-recourse to full recourse. With non-recourse policy, the mortgage lender takes all the default risk since there is no cost for the household (except for the mortgage lender claiming the house) to default on their mortgage. With full recourse, the mortgage lender is able to claim all of the defaulting household's assets and income, up to the difference between the value of the mortgage and the value of the home. Hence, the households bear all the risk of the default.

The different types of mortgage contracts that we consider are fixed rate annuity mortgages (FRM), adjustable rate amortized mortgages (ARM) and adjustable rate non-amortized mortgages (IO). Households with FRM mortgages have a fixed nominal interest rate, and do therefore face inflation risk. If inflation is high the real interest rate of the mortgage decreases. Simultaneously, the mortgage levels decrease in real terms since the mortgage contract is written in nominal terms. The real interest rates of households that have ARM and IO mortgages are not affected by inflation, but are instead affected by changes in the real short-term interest rate. Increased inflation does however decrease the mortgage levels in real terms also for households with ARM and IO mortgages.

Due to the differences in household behavior given different policies and different types of mortgages, the home-owners face a different risk premium for every default legislation/mortgage type combination. The main result in the essay that a "borrower friendly" policy, as the non-recourse policy implemented in many states in the United States, is actually not borrower-friendly due to its effect on the risk premium. Households that do not default on their mortgages pay for the households that do default via a higher risk premium. Therefore, households prefer recourse to non-recourse, since it leads to reduced interest rate payments on their mortgages. Furthermore, we show that households prefer mortgages including amortization if the default cost is low, since the amortization reduces the probability of default, thereby decreasing the risk premium. However, if the cost of default is high, the households instead prefer IO mortgages.

Essay No 3: On the Empirical Relevance of Cointegration Between Stock Market Returns and Labor Income on Optimal Portfolio Choice

In the third essay, I investigate how the optimal choice of an asset portfolio that consists of
risk-free bonds and risky equity is affected by long-run correlation, or so-called cointegration, between cumulative equity returns and aggregate labor income. This is important because it has implications on for example how pension funds should be allocated, so as to minimize the risk of the household loosing both labor income and future pensions. It does also have implications for how the household should allocate their savings “for a rainy day” (so-called precautionary savings). Assume that there is a long-run correlation between equity income and labor income, and that there is a sharp decline in stock market prices, i.e. a stock market crash. If this, because of the cointegration, is followed by labor income decreasing drastically, the assets that was hold for a rainy day is not worth much when that rainy day arrives.

The standard optimal portfolio choice result found in the finance literature, which disregards such long-run correlation, states that households should invest heavily in equity when young, and then reduce their equity share as they grow older. However, that result is at odds with empirical observations of how households act, giving rise to a so-called puzzle that has caught the interest of many researchers. One study where this result has been reversed is Benzoni et al. (2007). They study the cointegration between aggregate labor income and equity dividends. Finding such a cointegration, they continue by making the assumption that the total return on equity perfectly follows the evolution of dividend payouts, and show that the cointegration between the two variables leads to dramatic effects on the optimal portfolio choice compared to the standard result in the literature. Instead of investing heavily in equity, households should invest nothing in equity when young. Furthermore, they should increase, rather than decrease, the equity share in their portfolio as they grow older.

The assumption of total returns being perfectly correlated with dividend payouts is however at odds with the data, as shown by for example Shiller (1981) and Shiller (1987). Furthermore, investors rather care about total returns than only about dividends. Therefore I estimate a type of cointegration model, a Vector Error Correction (VEC) model, using data on the United States aggregate labor income and cumulative total equity returns. The estimated values in the VEC model are then used in a theoretical model where households solve a portfolio problem between the ages 20 and 64 (after which they are assumed to retire, thereby no longer caring about labor income). The portfolio consists of a risk-free bond and an stock market index fund. In contrast to Benzoni et al. (2007), the households do not choose to save only in bonds when young. Instead their behavior lies much closer to the standard result. Hence, I do not find any evidence for the long-run correlation between the two variables being important enough for the households to take it into account when choosing how to save for the future.

Essay No 4: Solving dynamic programming problems using stochastic grids and nearest-neighbor interpolation

The fourth essay is co-authored together with Anders Österling, and is a pre-requisite for the
The real world, and the actions taken by the inhabitants in it, is a very complex place. Economists try to understand it by reducing the world into something more manageable. When doing this, a large part of it have to be abstracted from, and it is the economist's job to include the relevant elements needed to answer the question that he or she is studying, and to abstract from the rest. When doing this, the economist creates a small, manageable model economy. As the power of computers have exploded during the last decades, these model economies have become more complex, introducing more elements from the real world into them.

Another way of being able to introduce more elements is by increasing the efficiency of the solution methods used to solve the economic models. This is done in the paper. We develop a method that can be used to computationally solve economic simulation models. With the method, it is possible to solve a certain class of economic models more quickly, and using less computational power, than before. This means that it is possible to include more elements to the model, making it more realistic than if those elements would be excluded.

With the method, we are able to solve so-called life-cycle models, where the economic agents live for a certain amount of periods and then die, with many exogenous disturbances (for example several different shocks to a household's labor income together with an uncertain interest rate and uncertain future inflation) using a standard personal computer. This has been hard to do before, which means that answers to questions including these features have become more accessible to the economist.

We build on a method to solve an economic consumption/savings problem of a finite live household, introduced by Carroll (2006) to solve the kinds of models. On top of that, we introduce a number of economic shock processes that affect the household's labor income. These shock processes are called exogenous state variables. The standard way of solving a model with such state variables is to introduce a deterministic discrete space that includes values which the process can take, on which the model is then solved. If there are several shock processes, every shock has its own discrete space, and the model is solved for each combination of elements in those discrete spaces. Instead of using that approach, we simulate paths of the shock processes beforehand, solving the models on the simulated paths instead of on deterministic grids. This way, we are able to reduce the number of points that the model is solved for significantly, thereby increasing the solution speed of the model.

Furthermore, we make use of nearest neighbor interpolation to find policy functions where the economic environment is similar to the economic environment for which the model is solved. We show that it is possible to solve non-linear life-cycle models including at least eight exogenous state variables relatively quickly on a standard desktop computer.

We then apply the method to a consumption/savings problem in a life-cycle setting, where agents face a much more complicated wage earnings process than the one commonly assumed in the the kind of model framework we are using. The process that we use was estimated by Guvenen et al. (2015), and lies much closer to what we see in actual data than the one...
that is commonly used. We compare the patterns of consumption and savings to those of a model using the standard process.

References


Shiller, R. J. (1981). Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?