Financial Constraints and Household Heterogeneity in the Macroeconomy

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GFC	Great Financial Crisis
HA	Heterogeneous Agent
HANK	Heterogeneous Agent New Keynesian
LTV	Loan-to-Value

Abstract

Abstract goes here.

1 Introduction

Households face limits to borrowing. In the real world, these limits take various forms and vary across households and asset types. For example, mortgage debt might be limited by regulatory prescriptions on loan-to-value ratios (LTV).

Such constraints play an important role for individuals as well as for the aggregate economy. In the absence of complete insurance markets, the presence of borrowing limits constrains households in their ability to smooth shocks to consumption. Moreover, borrowing limits combined with idiosyncratic income risk induce precautionary savings, i.e. a build-up of assets in order to prevent running into the borrowing constraints. Both of these aspect have implications for the behaviour of the economy as a whole.

The following question arises: how does time-variation in those limits affect the economic outcomes on aggregate and household levels? To answer this question, this thesis follows and extends the work by Guerrieri and Lorenzoni (2017) and analyses shocks to the household-level borrowing limits in a heterogeneous agent New Keynesian model (HANK).

This limit to borrowing is usually much harsher than the so-called natural borrowing limit, which is commonly defined as the expected net present value of an individual's income stream.

Since at least the Great Depression economists have aknowledged the importance of debt. The Great Financial Crisis (GFC) was a vivid reminder of how developments in finance, including credit and limits to credit, affect households and the macroeconomy.

A heterogeneous-agent (HA) model naturally lends itself to the analysis of household-level borrowing limits for at least two reasons. First, unlike their representative-agent counterparts, prototypical HA models explicitly incorporate borrowing limits. Second, HA models speak to the differential effect of borrowing constraints across the distribution of households.

I further include some financial constraints on the side of the firms and banks as done in Chiang and Zoch (2022).

The model and its dynamics are solved with the Python package `Econpizza` by Boehl (2023) and the methods therein.

Outline

The remainder of this thesis is structured as follows. Section 2 reviews the related literature. Section 3 lays down the macroeconomic model, the numerical implementation and calibration of which is discussed in section 4. Thereafter, section 5 presents the results and section 7 concludes.

2 Related Literature

This section reviews the two strands of the literature which this thesis is most closely related to. I focus first on the macroeconomic literature revolving around household inequality and constraints to household finance. Second, I dwell on the most prominent works on financial

constraints and the macroeconomy, where constraints are usually placed in the firm or bank sectors.

2.1 Household Heterogeneity in the Macroeconomy

Guerrieri and Lorenzoni (2017) build a household-focused incomplete-markets model and find that a permanent tightening in the household-level borrowing constraint evokes deleveraging and increased precuationary savings. Combined, these two effects depress output and interest rates in the economy. The recession is aggravated and the economy falls into a liquidity trap when the model is augmented with nominal wage rigidities and the zero lower bound.

2.2 Financial Constraints in the Macroeconomy

In the real world, it is not only households who face financial constraints. Other agents, such as firms and financial intermediaries, can be subject to limits to their borrowing capacity.

BG and BGG are among the earliest and most widely used approaches to the study of financial constraints on the firm side.

GK focus on the economy's financial intermediaries. In their framework, banks are limited in the amount of leverage they can hold because of the possibility of banks' owners to liquidate the business.

3 Model

3.1 Households

The household side is modeled following the standard incomplete-markets approach, initiated *inter alia* by. In this framework, households are ex-ante identical but heterogeneous ex-post as they are subject to idiosyncratic, i.e. household-level, income risk. Markets are incomplete and thus, households can only self-insure by saving and borrowing in a one-period, rsik-free bond. This bond is the only asset in the economy and is perfectly liquid, i.e. there are no costs involved when purchasing or selling bonds. The bond is to be understood as unsecured borrowing.[1]

Households have utility function U, which is strictly increasing in household consumption c_i. Households choose consumption, labour and asset holdings so as to maximise their utiliy, given the prices they face in the economy.

The bond is supplied by households and by the government.

A note on the asset structure is in order. The one-asset framework seems to be in contradiction to what we find in reality, where households can choose from a variety of assets to self-insure. What is more, there is government insurance and insurance from employers, see Heathcote et al.

[1] Secured borrowing would be collateralised.

Kaplan et al. (2018) provide an insightful critique of the one-asset structure.

Note that in incomplete markets models it is required that the interest rate times the discount fatcor is smaller than one.

3.2 Banks

Heterogeneous banks are modeled in the paper Bewley banks by.

3.3 Firms

3.4 Fiscal and Monetary Policy

3.5 Equilibrium

4 Implementation and Calibration

The grid is not allowed to change over time as this mimeo notes. Otherwise, the interpolation would be between repeatedly different grid points, making the comparison of over time inaccurate.

5 Results

5.1 Comparison of Steady States

Variable	Initial Steady State	Terminal Steady State	Rel. Change
B	3.0000	3.0000	0.00
beta	0.9700	0.9700	0.00
C	1.0000	1.0000	0.00
D_o_Y	0.9699	0.4819	-50.31
div	0.1000	0.1000	0.00
lower_bound_a	-2.0000	-1.0000	-50.00
MPC	0.2481	0.1143	-53.93
N	1.0000	1.0000	0.00
pi	1.0000	1.0000	0.00
R	1.0158	1.0144	-0.14
Rn	1.0158	1.0144	-0.14
Rr	1.0158	1.0144	-0.14
Rstar	1.0158	1.0144	-0.14
tax	0.0473	0.0431	-8.88
Top10A	0.8162	0.7231	-11.41
Top10C	0.1908	0.1897	-0.58
w	0.9000	0.9000	0.00
y	1.0000	1.0000	0.00
y_prod	1.0000	1.0000	0.00
z	1.0000	1.0000	0.00

5.2 Transitional Dynamics

6 Sensitivity Analyses

7 Conclusion

References

Boehl, G. (2023). Robust Nonlinear Transition Dynamics in HANK. Retrieved 1st May 2023, from https://ssrn.com/abstract=4433585.

(Cited on page 1)

Chiang, Y.-T. & Zoch, P. (2022). *Asset Supply and Liquidty Transformation in HANK* (Working Paper No. 2022-038). St. Louis Fed. Retrieved 20th April 2023, from https://research.stlouisfed.org/wp/more/2022-038.

(Cited on page 1)

Guerrieri, V. & Lorenzoni, G. (2017). Credit Crises, Precautionary Savings, and the Liquidity Trap. *The Quarterly Journal of Economics*, *132*(3), 1427–1467. https://doi.org/https://doi.org/10.1093/qje/qjx005.

(Cited on pages 1, 2)

Kaplan, G., Moll, B. & Violante, G. L. (2018). Monetary Policy According to HANK. *American Economic Review*, *108*(3), 697–743.

(Cited on page 3)

Appendices

A Description of Computer Codes

B The Case of a Shock to Income Risk

Statement of Authorship

I hereby confirm that the work presented has been performed and interpreted solely by myself except for where I explicitly identified the contrary. I assure that this work has not been presented in any other form for the fulfillment of any other degree or qualification. Ideas taken from other works in letter and in spirit are identified in every single case.

Andreas Koundouros
Bonn, the 25th August 2023