Monetary and Macroprudential Policy in a DSGE Model for Sweden

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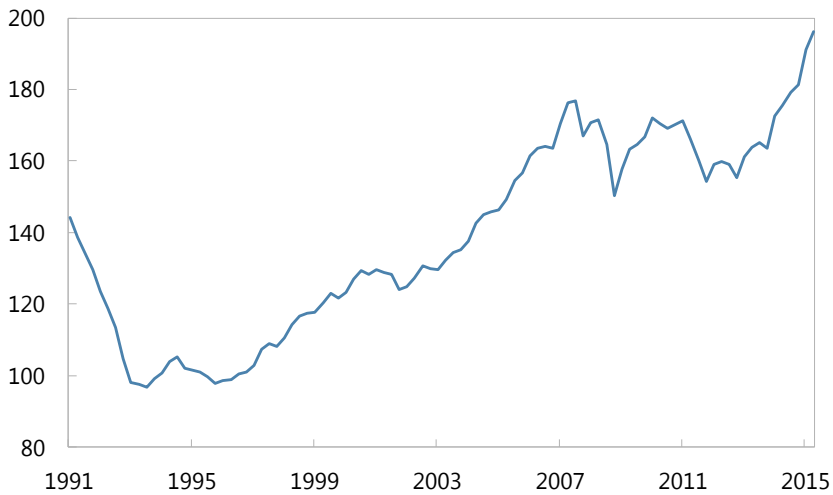
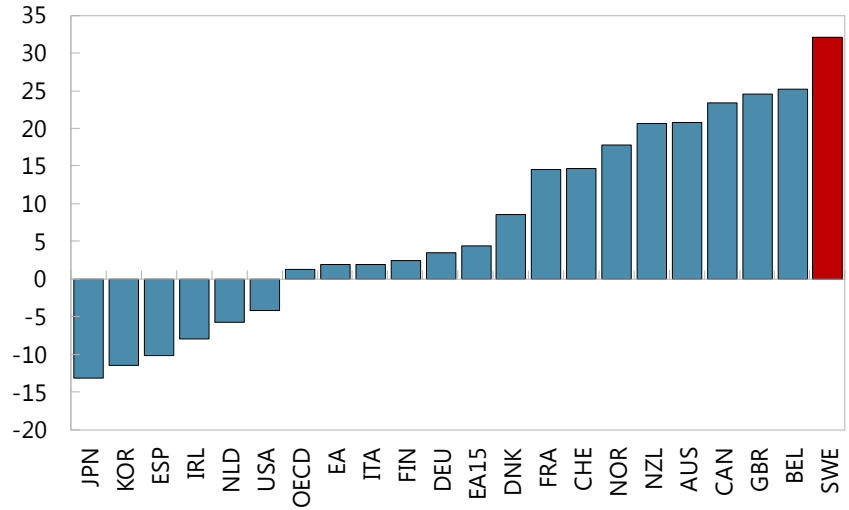
Houses in Sweden are becoming increasingly expensive

House Price to Disposable Income Per Capita
(Index, 1995=100)



Sources: Statistics Sweden, Sveriges Riksbank, Valueguard, and Fund staff calculations.

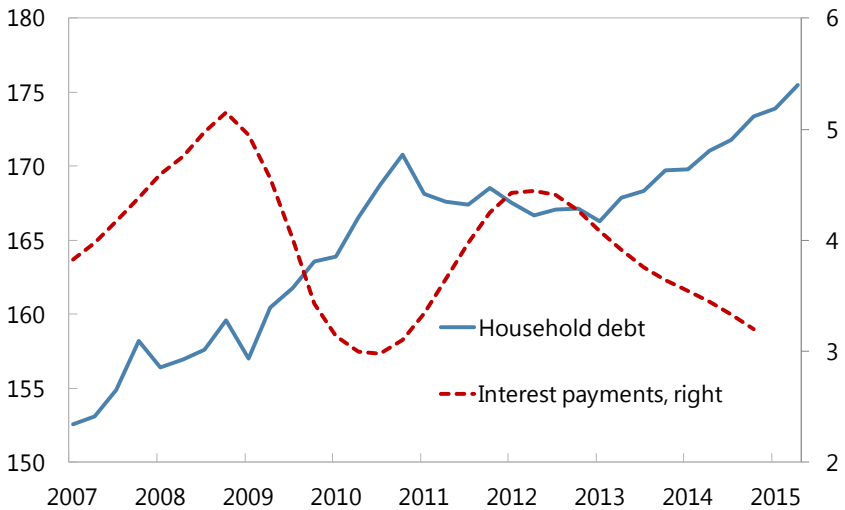
House Price to Disposable Income Per Capita
(Percent deviation from 20 year average)



Sources: OECD and Fund staff calculations.

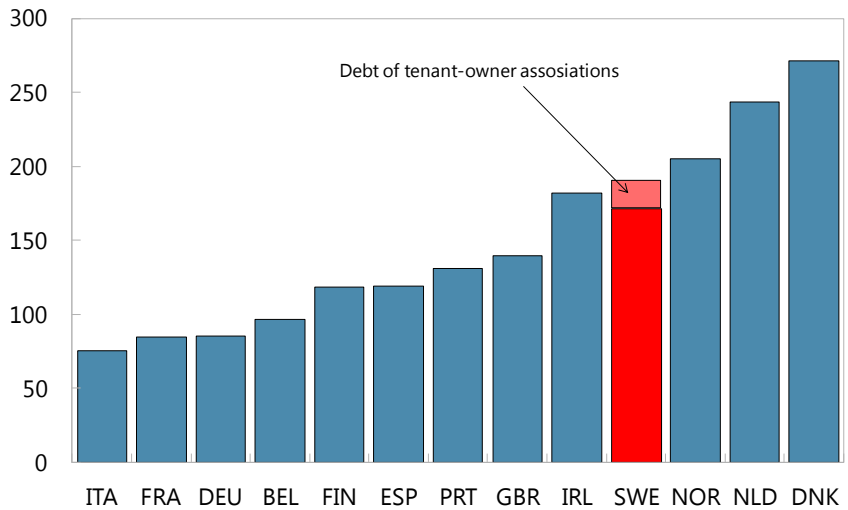
High house prices are driving up household indebtedness

Household Debt and Interest Payments
(Percent of disposable income)



Sources: Sveriges Riksbank and Fund staff calculations.

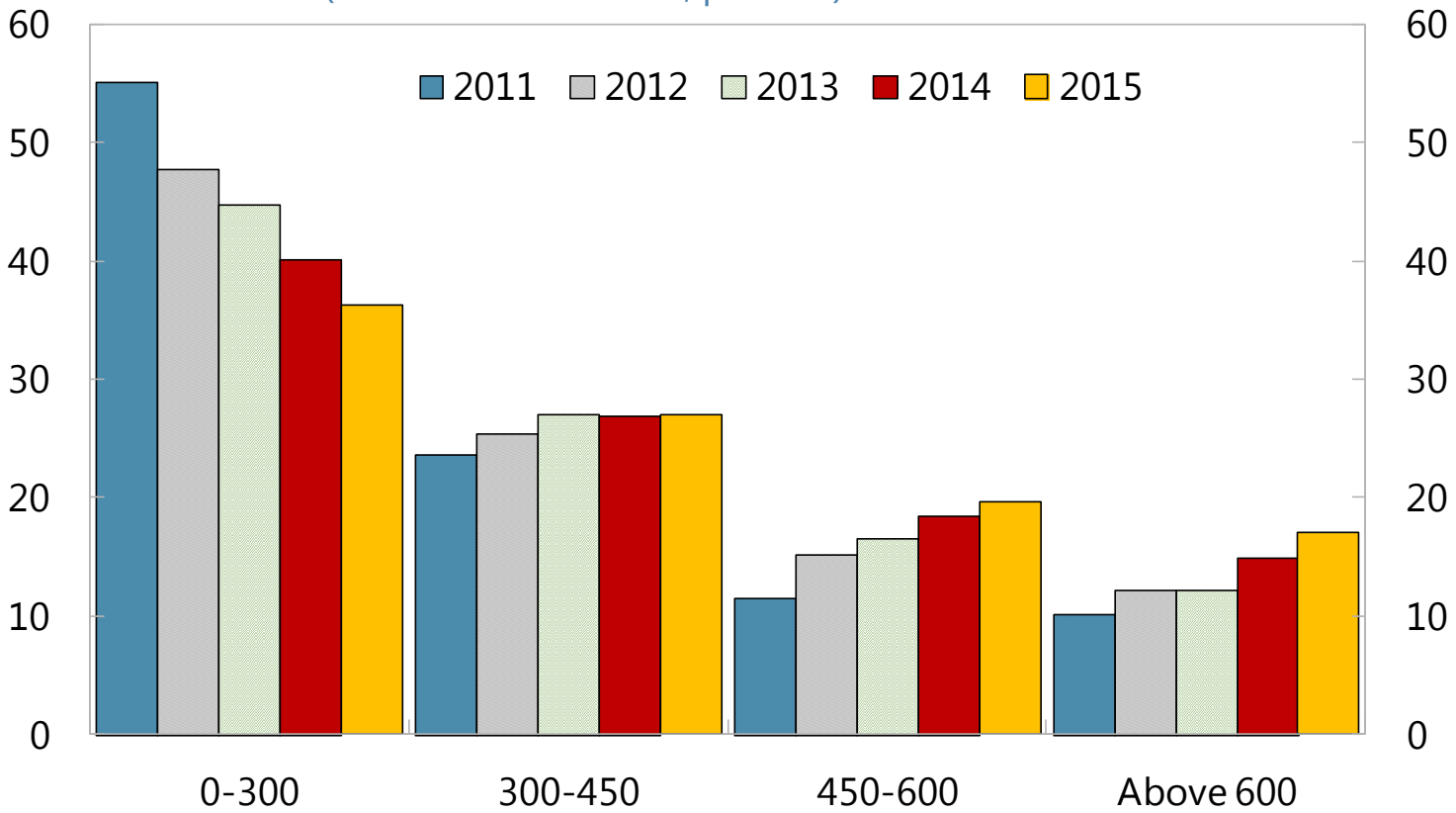
Household Debt, 2014Q4 or latest available
(Percent of disposable income)



Sources: Statistics Sweden, and Fund staff calculations.

A significant share of households has high debt

Distribution of Debt-to-Income Ratios for New Mortgage Borrowers (Share of households, percent)

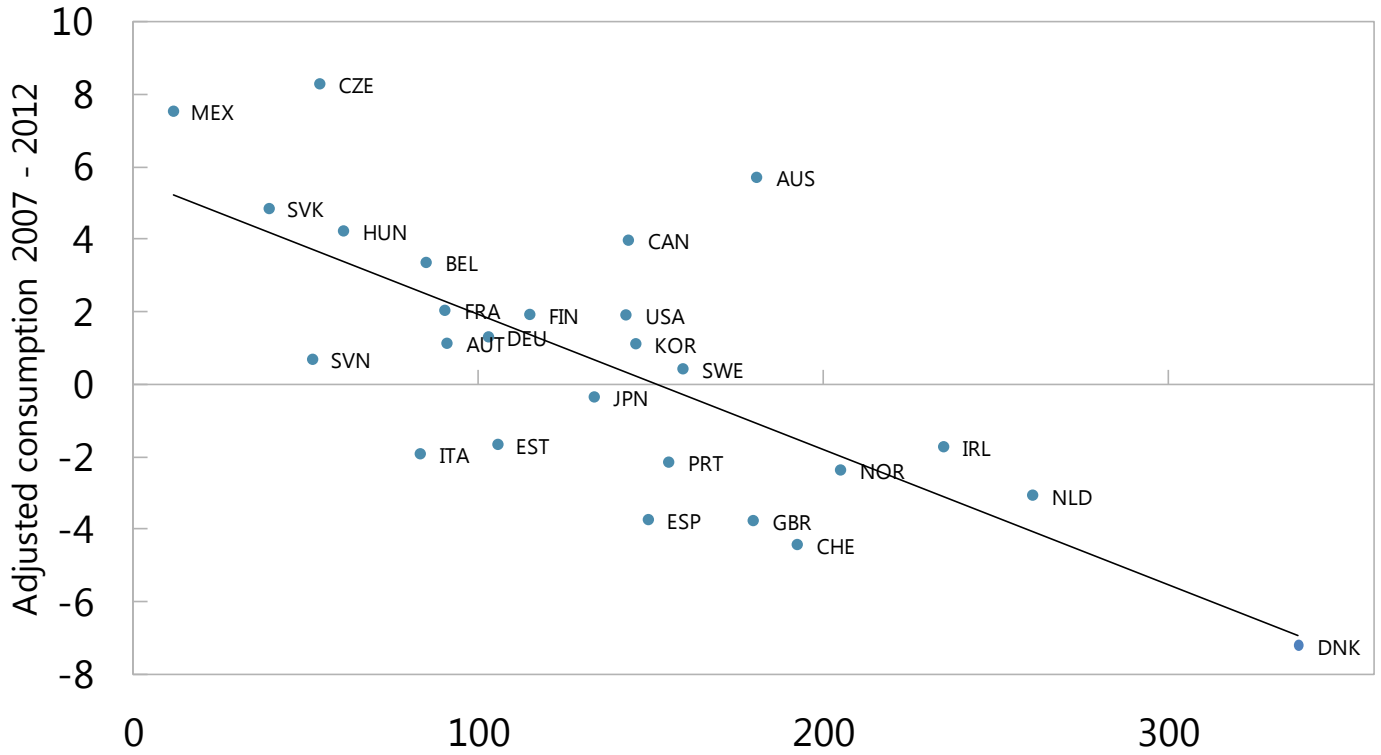


Sources: Finansinspektionen and Fund staff calculations.

Note: The figure shows debt-to-income ratios based on households' total debt.. Ratio based on disposable income, i.e., after tax.

High debt makes the economy vulnerable to shocks

Relationship Between Debt-to-Income Ratio and Consumption Growth between 2007 and 2012 1/



Sources: Severige Riksbank.

1/ Adjusted consumption growth has been calculated following Floden (2014).

Considerations for macroprudential policy

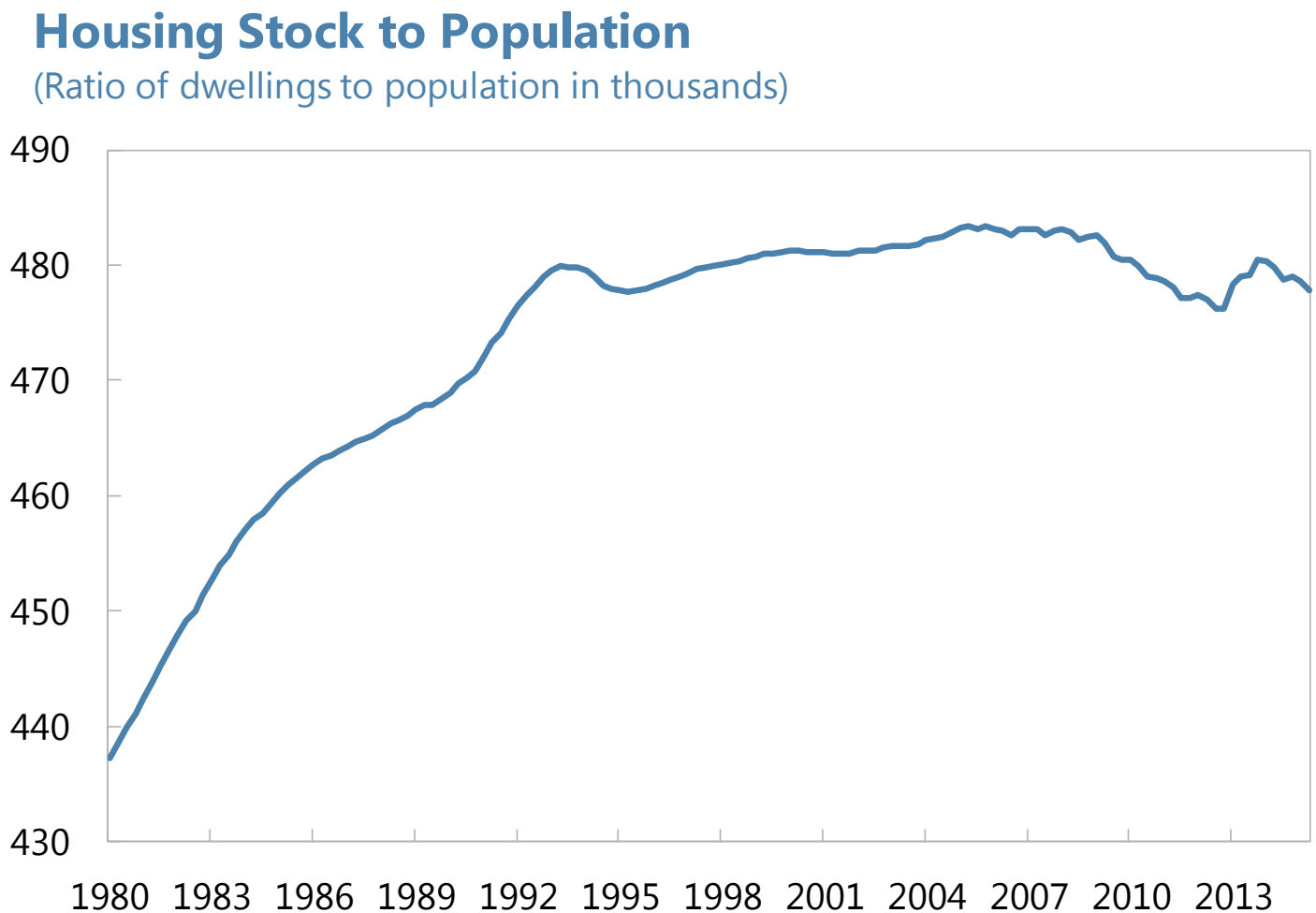
- Assess impact on:
  - riks factors: household debt, house prices
  - "spillovers" to the macroeconomy
- Method: a small open economy DSGE model akin to Gerali et al. (2010):
  - modified the model to assess a range of macroprudential measures in a general equilibrium framework, important to capture household incentives (substitution, and wealth effects)
  - estimated the model with the Swedish data
  - simulation exercise and welfare analysis

Outline

- The Swedish Housing Market
- Model: an overview
- Model Properties
- Estimated Impacts of Macroprudential Tools
- Welfare Analysis
- Conclusion

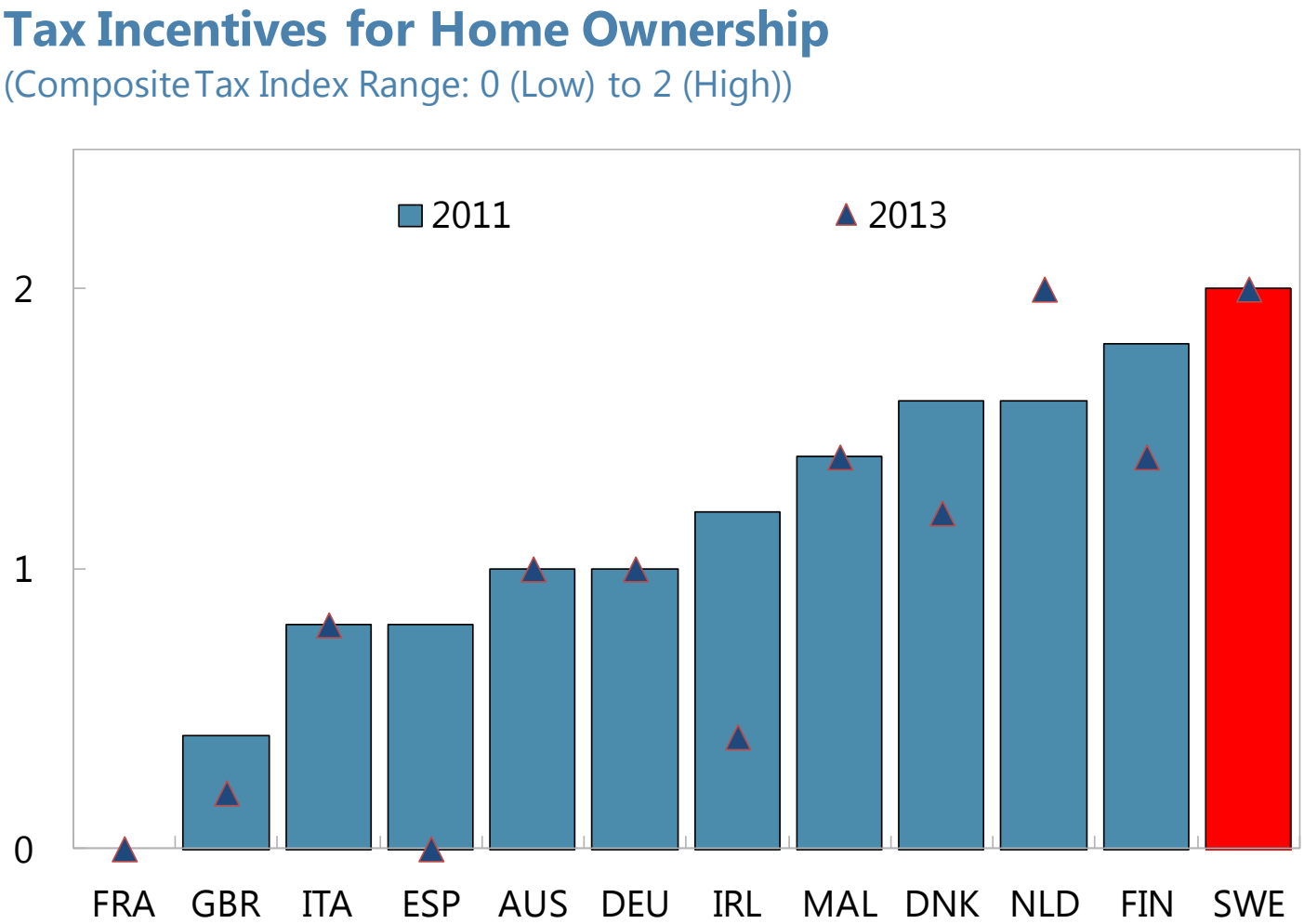
The Swedish Housing Market

Housing supply as share of population remains largely unchanged



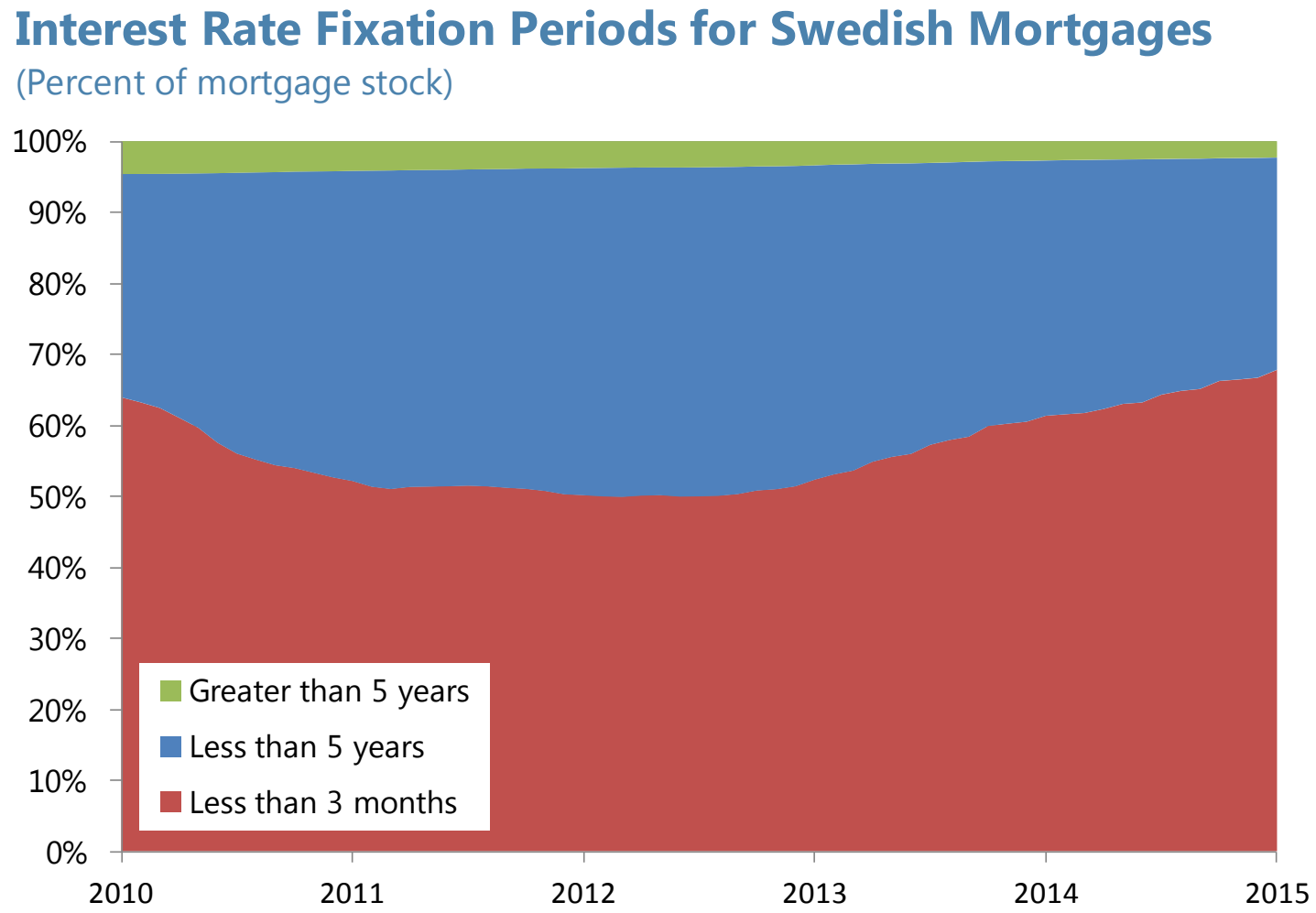
Sources: Statistics Sweden and Fund staff calculations.

High tax incentives for debt financed housing ownership



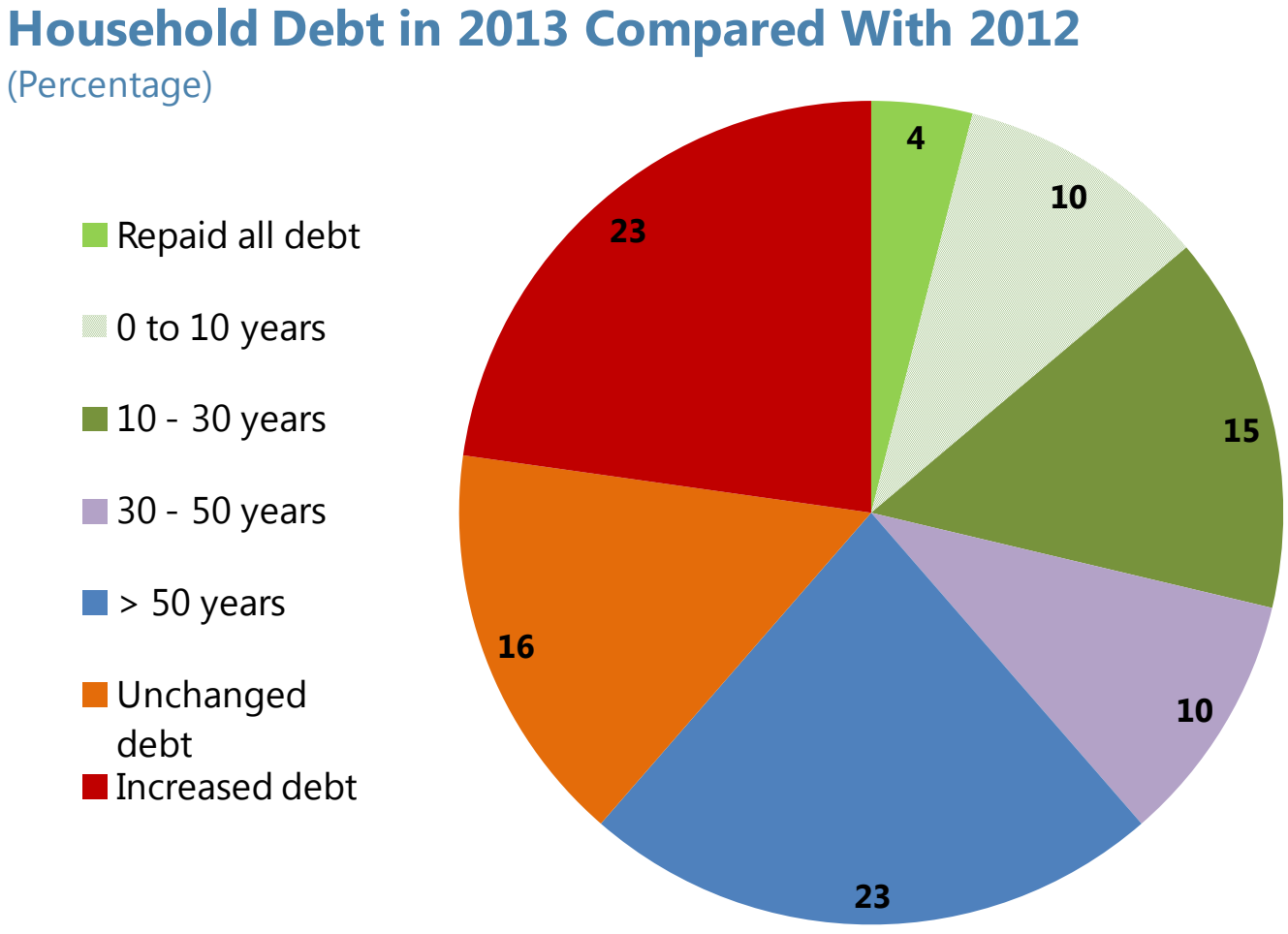
Sources: European Commission and Fund staff calculations

High share of variable rate mortgages



Sources: Statistics Sweden and Fund staff calculations.

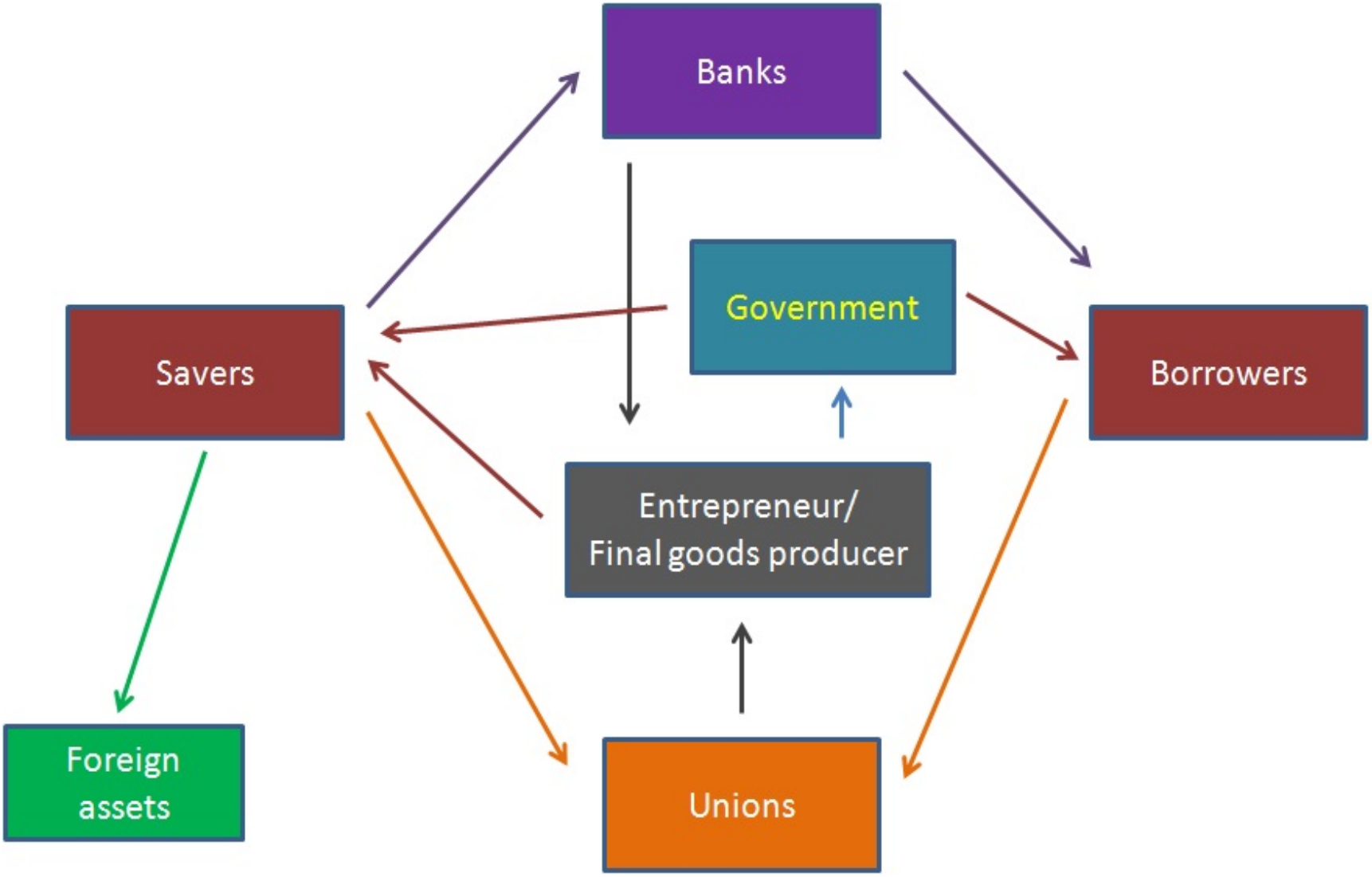
Very low amortization rate



Sources: Sveriges Riksbank.

The Model and Estimation Results

An overview: key elements of the model



Model description: households' problem

- **Households**: savers and borrowers
  - Borrowers' problem
    - choose consumption, housing investment, and labor supply
    - subject to a budget constraint: tax deductibility
    - and a borrowing constraint: LTV cap and amortization requirement
  - Savers' problem
    - choose consumption, housing investment, and labor supply
    - save in domestic and foreign assets

Model description: overview

- **Other sectors**:
  - **Banks**: set lending rates
    - funded from wholesale market/deposit, set deposit rates with adjustment costs
    - issue loans to households and firms, set lending rates with adjustment costs
    - max profits by setting the rates, but subject to a risk weighted capital constraint
  - **Entrepreneur**: hire labor, borrow from the banks for capital investments, subject to a borrowing constraint
  - **Government**: balanced budget
    - consumes, subsidizes household mortgage payments
    - collect taxes

Borrower's problem

$$\max \; E_0 \sum_{t=0}^{\infty} \beta_l^t \left[\epsilon_t^z (1-\alpha^l) log(c_t^l(i) - \alpha^l c_{t-1}^l) + \epsilon_t^h log h_t^l(i) - \frac{(l_t^l)^{1+\phi}}{1+\phi} \right]$$

subjects to:

$$\text{B.C.} \qquad c_t^l(i) + q_t^h \Delta h_t^l(i) + \left((1 + r_{t-1}^{bH}(1-\tau_t^h)) \frac{b_{t-1}^l(i)}{\pi_t} \right.$$
$$\leq w_t^l l_t^l(i) + b_t^{bH}(i) + T_t^l$$

$$\text{LTV} \qquad b_t^l(i) \leq (1-\rho_t^A) \frac{b_{t-1}^l(i)}{\pi_t} + m_t q_t (\Delta h_t^l)$$

Reasonable steady state values

Estimate model using data between 1996Q1 - 2014Q4

- 13 data series: GDP, consumption, house prices, mortgage rates, etc...

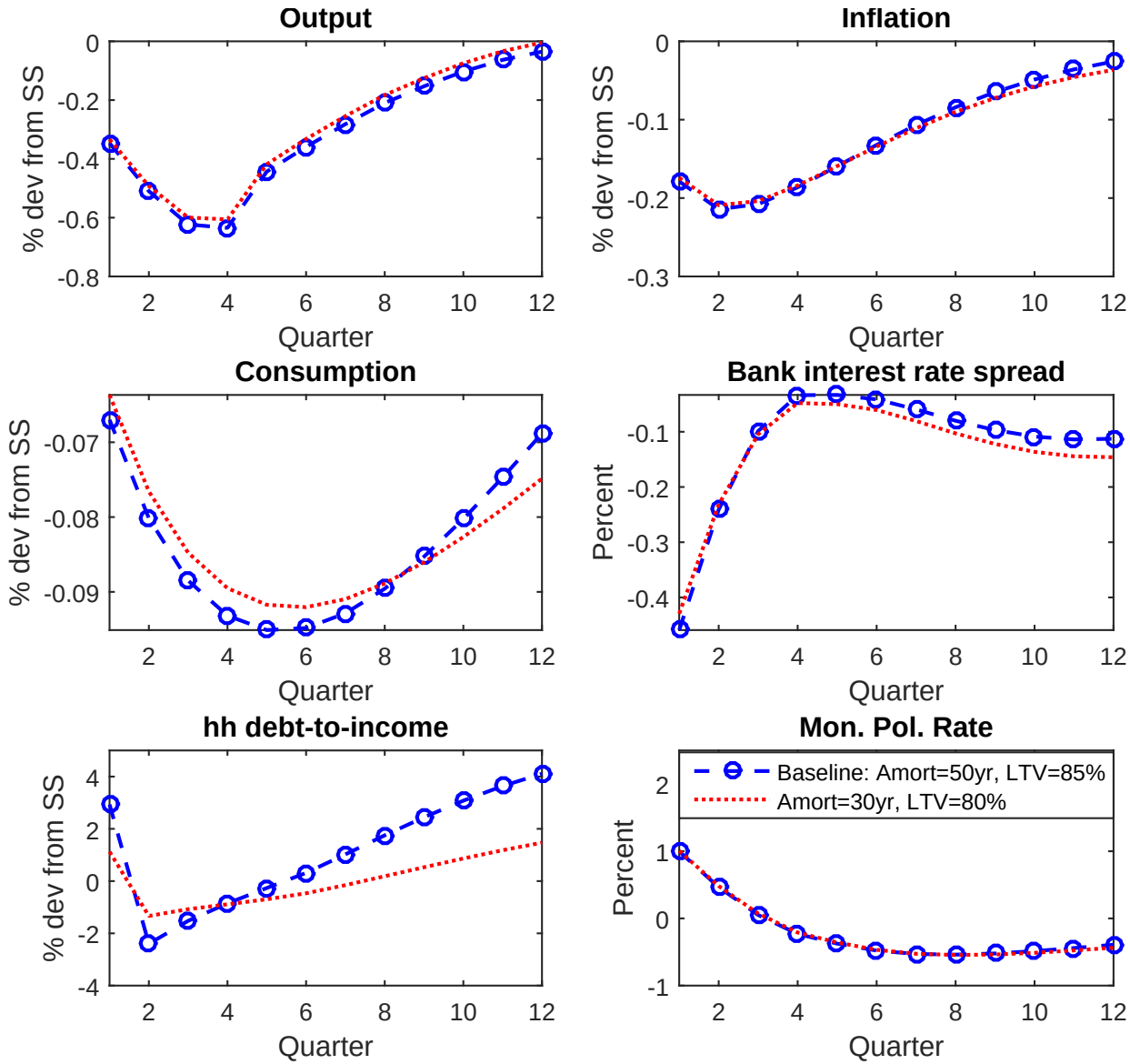
Table: **Steady state ratios**

Variable/Interpretation	Model	Data
Ratio of consumption to GDP	0.55	0.45
Ratio of investment to GDP	0.21	0.22
Ratio of government consumption to GDP	0.25	0.28
Disposable income to GDP	0.47	0.44
Ratio of bank credit to households and firms to GDP	1.2	1.02
Share of loans to households over corporate loans	1.3	1.2
Borrower's debt-to-disposable income	1.4	1.3
Mortgage to GDP ratio	0.7	0.6
Average LTV for mortgage stock	0.68	0.67

Model Properties

Monetary policy shock

Figure: 1 percentage point increase in repo rate



Estimated impact of macroprudential policy

Figure: LTV cap: 85percent $\rightarrow$ 80percent

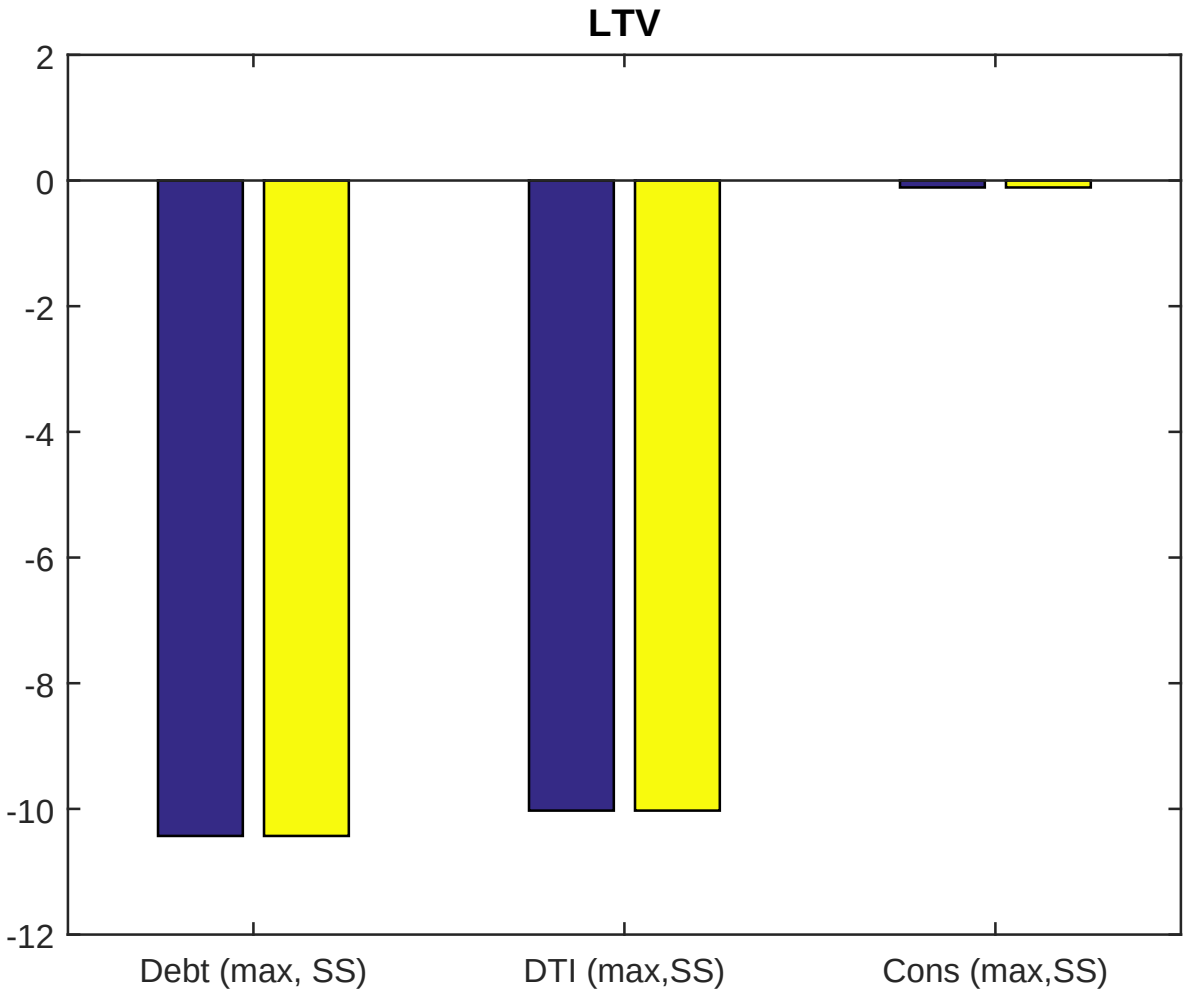


Figure depicts maximum impacts on household mortgage debt, debt-to-income(DTI) and consumption(Cons) following a permanent reduction in loan-to-value (LTV) ratio from 85 to 80 percent. And changes in the three variables in the new steady state (LTV= 80) compared with the baseline (LTV= 85).

LTV: declining house prices reinforces LTV cap

- directly constraints households' ability to borrow $\rightarrow$ lower hh debt $\rightarrow$ borrowers' housing stock declines. In addition, falling house prices $\rightarrow$ reinforces the LTV constraint
  - lower borrowers' consumption in the *short run* $\rightarrow$ but as debt declines, consumption increases $\rightarrow$ in the new *steady state*, borrower's consumption could be higher
- savers' consumption falls: declining bank profit $\rightarrow$ lower deposit rates $\rightarrow$ savers receive less income
- aggregate consumption increases in the *long run*, varies according to the strength of the wealth effect

Estimated impact of macroprudential policy

Figure: Amortization requirement: 50years $\rightarrow$ 45years

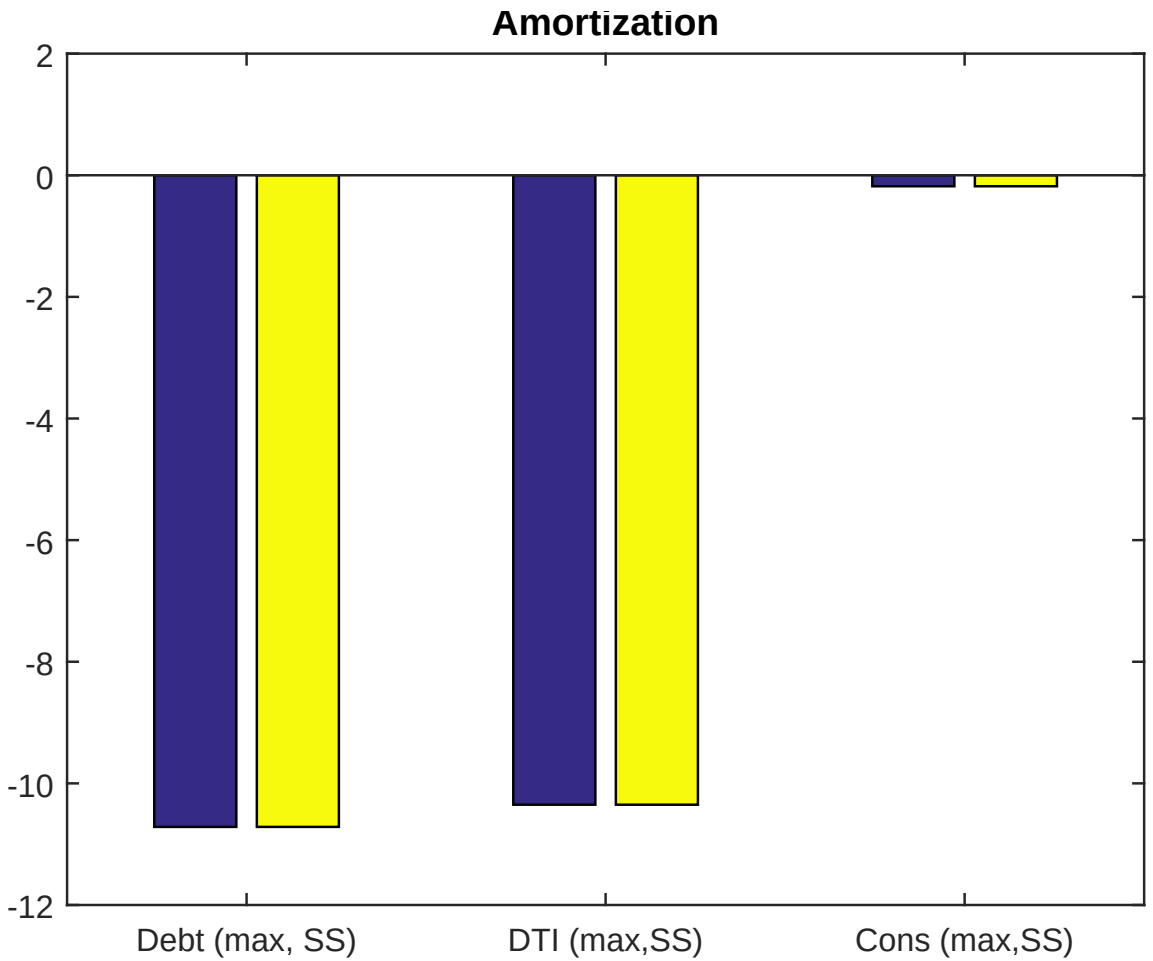


Figure depicts maximum impacts on household mortgage debt, debt-to-income(DTI) and consumption(Cons) following a permanent reduction in amortization requirement from 50 to 45 years. And changes in the three variables in the new steady state (Amortization= 45years) compared with the baseline (Amortization= 50years).

Amortization: reduces debt burden for "tomorrow"

- forces borrower to repay larger portion of debt each period
- household debt equals to PV of future incomes over the amortization period $\rightarrow$ debt falls
- more restricted budget constraint $\rightarrow$ fall in consumption in short term
- but borrowers can refinance up to the LTV cap, if needed
- Importantly, borrowers are more "flexible"

Estimated impact of macroprudential policy

Figure: Mortgage tax deductibility: 30percent $\rightarrow$ 25percent

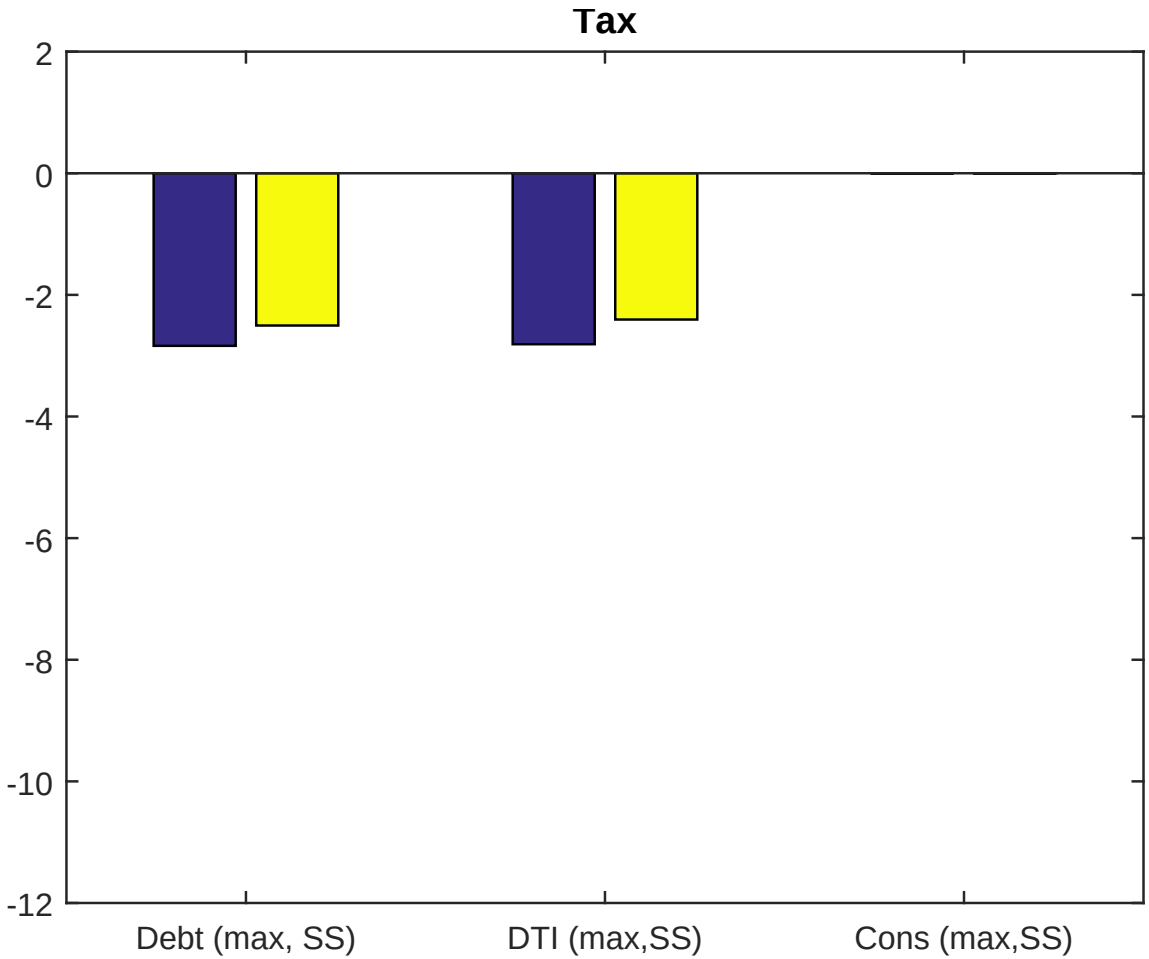


Figure depicts maximum impacts on household mortgage debt, debt-to-income(DTI) and consumption(Cons) following a permanent reduction in mortgage tax deductibility from 30 to 25 percent. And changes in the three variables in the new steady state (tax= 25) compared with the baseline (tax= 30).

Reduction in tax deductibility: makes consumption more attractive

- tighter budget constraint for borrowers $\rightarrow$ reducing consumption and demand for housing
- BUT, a reduction in tax deductibility **tilts** household preferences toward consumption
- in the *short run* borrowers' consumption increases, with larger fall in housing demand
- balanced budget implies government redistribute the "savings" to households

Estimated impact of macroprudential policy

Figure: Mortgage Risk Weight: 25percent $\rightarrow$ 30percent

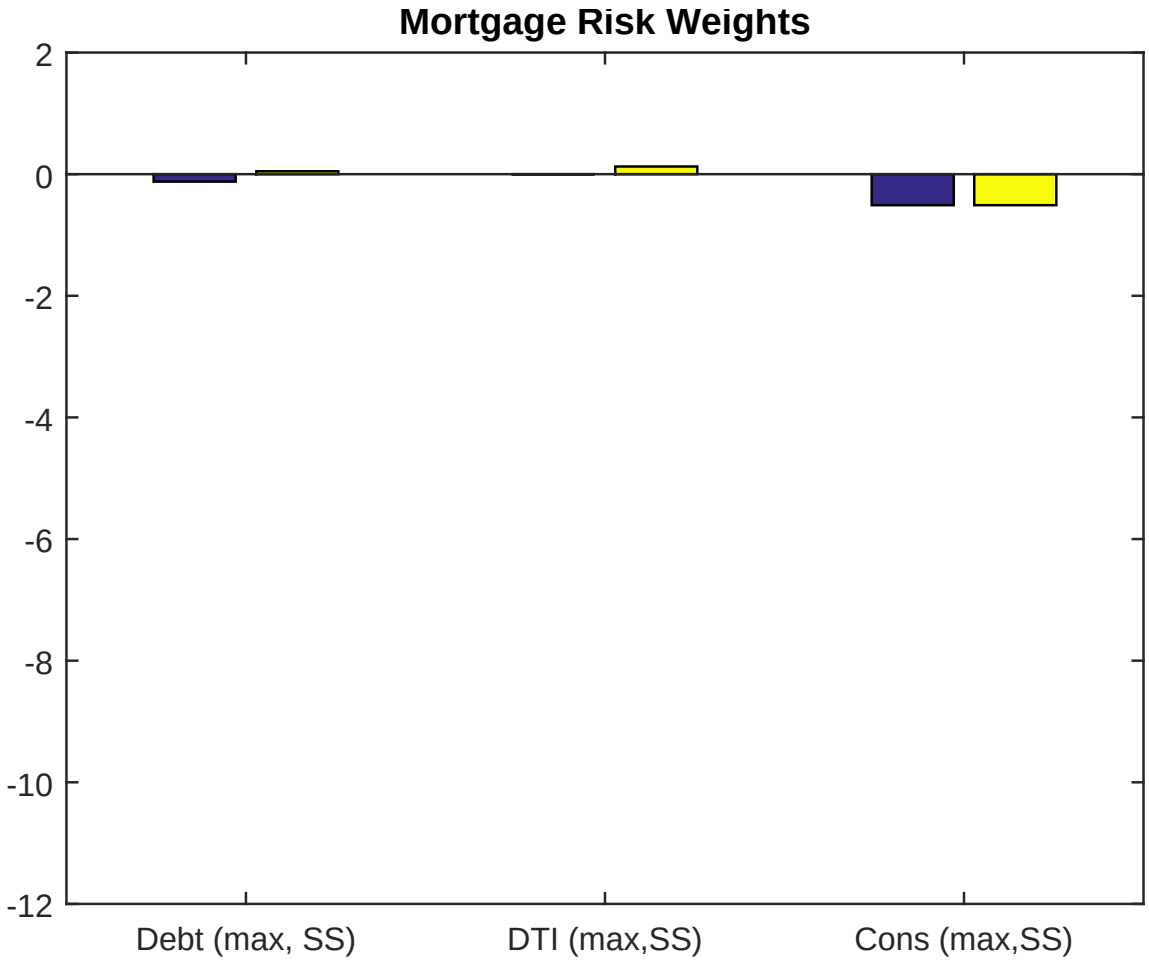


Figure depicts maximum impacts on household mortgage debt, debt-to-income(DTI) and consumption(Cons) following a permanent increase in mortgage risk weights from 25 to 30 percent. And changes in the three variables in the new steady state compared with the baseline .

Mortgage risk weights: makes debts more costly

- mortgage rate raises $\rightarrow$ debt and consumption fall
- bank's capital requirement constraint becomes tighter $\rightarrow$ higher corporate lending rates $\rightarrow$ firm profits fall $\rightarrow$ savers' consumption declines too
- BUT model can not capture the impact of making banking sector more resilient.

Welfare Analysis

We consider two measures of welfare:

1. Schmitt-Grohe and Uribe (2007): a second-order approximation to models equilibrium conditions, simulating the model subject to stochastic shocks and report mean of welfare
2. Sum of agents' utilities in steady states

Welfare I

Figure: Interaction between amortization requirements and LTV

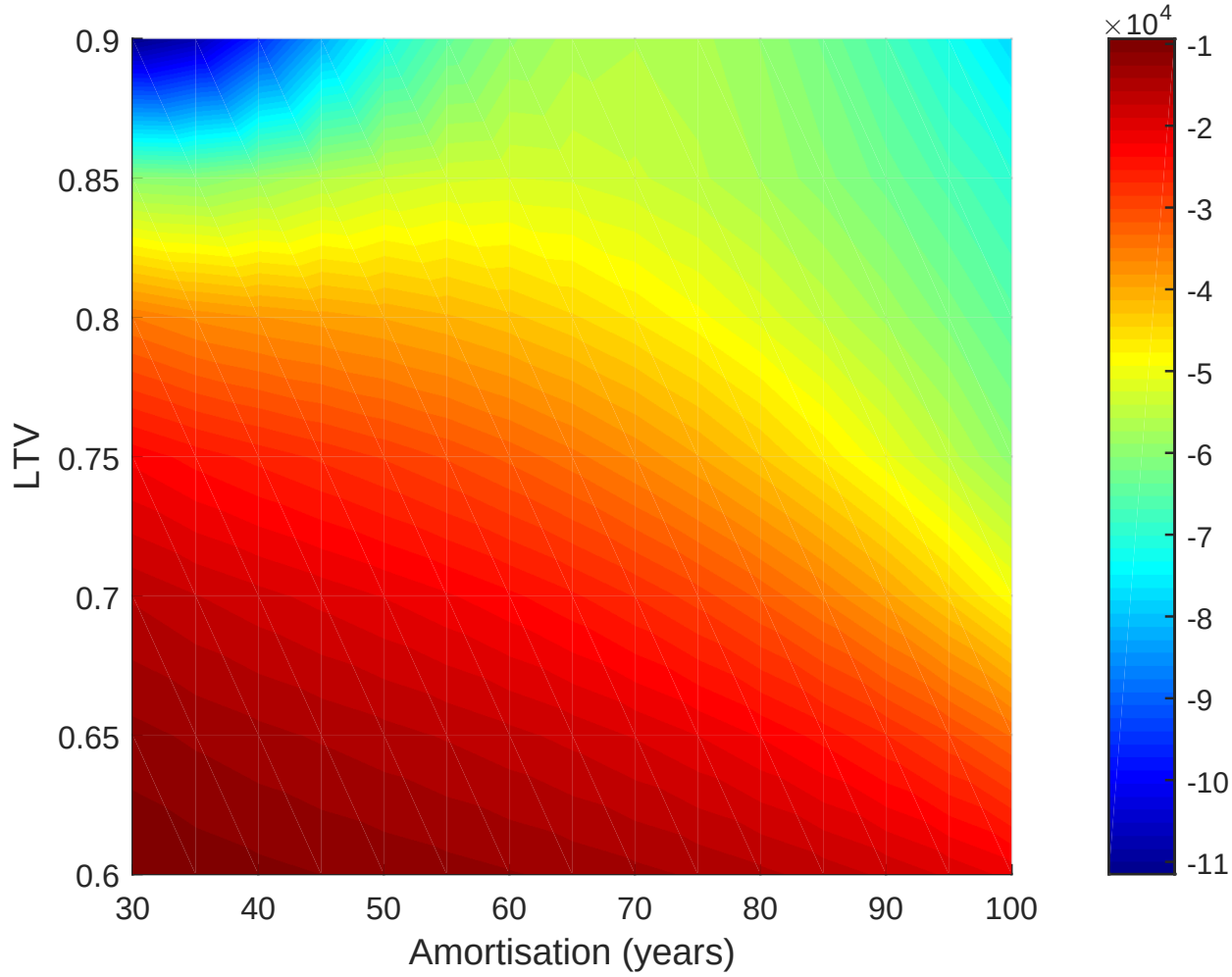


Figure depicts welfare over a combination of amortization requirements and loan-to-value (LTV) ratios. The dark red color corresponds to the highest level of welfare, and dark blue represents the opposite. The scale is displayed by the vertical bar on the right.

Welfare I

Figure: Interaction between mortgage tax deductility and LTV

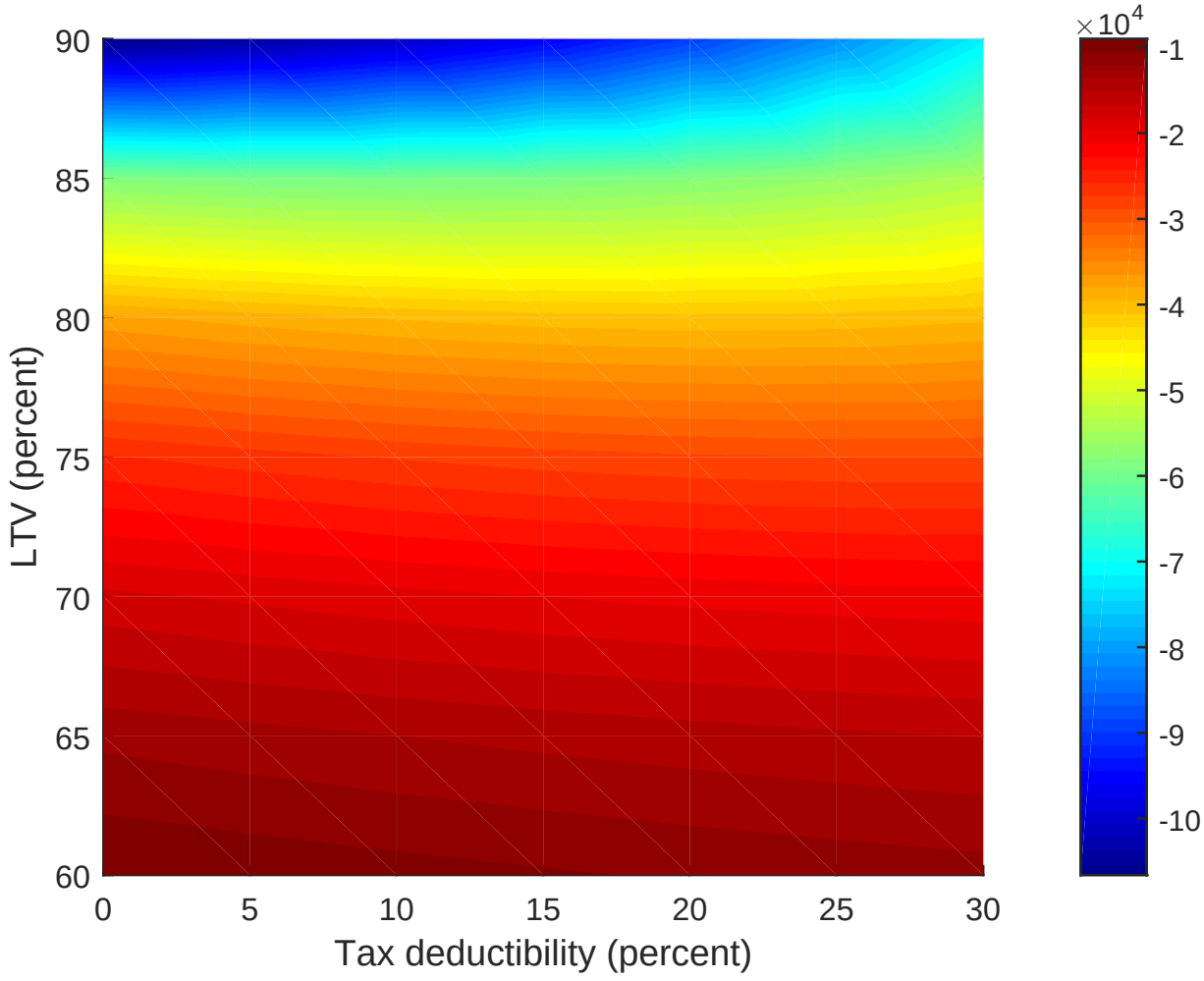


Figure depicts welfare over a combination of mortgage tax deductibility and loan-to-value (LTV) ratios. The dark red color corresponds to the highest level of welfare, and dark blue represents the opposite. The scale is displayed by the vertical bar on the right.

Welfare II

Figure: Interaction between amortization requirements and LTV

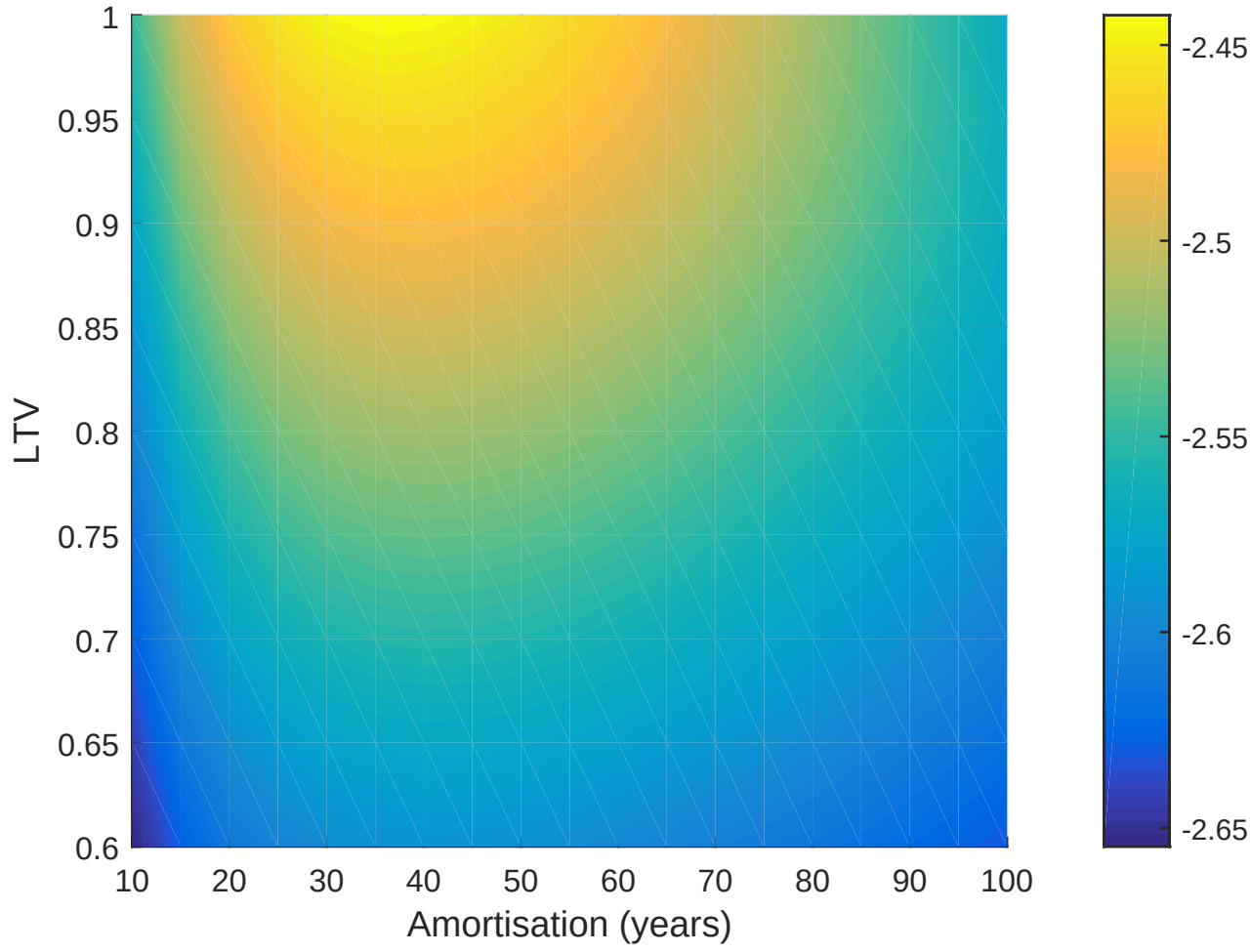


Figure depicts the sum of saver's and borrower's utilities in different steady states that are characterized by a combination of amortization requirements and loan-to-value caps. The light yellow color corresponds to the highest level of utility.

Conclusion I

- Macroprudential policies have strong effects on households debt, with limited impact on consumption
  - *short run* reduce consumption
  - *long run* wealth effects from lower debt allow borrowers to spend more
  - yet, savers may reduce consumption due to lower bank profitability

Conclusion II

- Tightening macroprudential policies may improve welfare
  - tighter LTV requirements on new mortgages and higher mortgage risk weights improve welfare, yet with diminishing returns
  - a mix of macroprudential measures studied is needed to deliver the maximum level of welfare
  - the sequence with which macroprudential measures are introduced matters
- Importantly, tighter macroprudential policies lead to a more muted response of the economy to banking sector shocks

Conclusion III

- Model limitations and future work
  - improve model fit
  - introduce construction sector
  - add debt-to-income ratio with occasionally binding constraints