On the effectiveness of loan-to-value regulation in a multiconstraint framework

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[1] The views expressed in this presentation are solely the responsibility of the author and should not be interpreted as reflecting the views of the Sveriges Riksbank

Research question

Does the existence of multiple constraints affect our conclusions about the effectiveness of loan-to-value (LTV) regulation?

Motivation

- Macroprudential measures increasingly important

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- Mortgage market in Sweden: rising house prices and household indebtedness

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- DSTI (discretionary income) and LTV
- Also in other advanced and emerging countries
- Swedish micro-data: Existence of borrowers at both constraints

Empirical evidence of multiple constraints

Table: The contemporaneous usage of explixit LTV and DSTI limits in different countries

Country	LTV-limit	DSTI-limit
Canada	95%	39-44%
China	70%	50%
Cyprus	80%	35%
Estonia	85%	50%
Hong Kong	70%	50%
Hungary	80%	10-60%
Israel	75%	50%
Korea	50-70%	50-60%
Lithuania	85%	40%
Netherlands	100%	10-38%
Singapore	80%	60%
Slovenia	80%	50%

Empirical evidence of multiple constraints

- Banking practice to assess capacity to settle loan installments along with downpayment: Brasil, France, Colombia, Malaysia, Thailand
- Discretionary income calculations along with LTV assesment: Sweden, Latvia, Poland, Romania, Slovakia, Czech Republic

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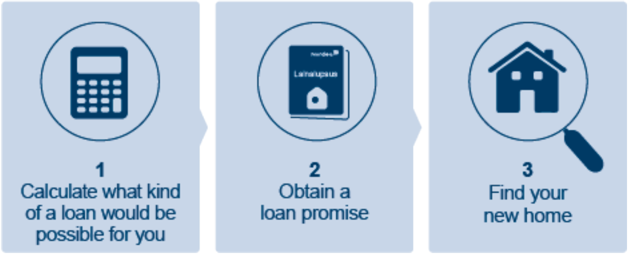
- Discretionary income calculations along with LTV assesment: Sweden, Latvia, Poland, Romania, Slovakia, Czech Republic
- Sweden: guideline for LTV limit of 85% (FI, 2010)
- guideline for assesment of repayment capacity (FI, 2004), KALP ("kvar att leva på"): 'discretionary income' limit - defines the upper loan amount given borrowers' salary and expenditures (see Li and van Santen, 2017)

$$
\begin{aligned}
DiscretionaryIncome = {} & DisposableIncome - LivingCosts \\
& - MortgageInterestExpenses - Amortization \\
& - HousingMaintenanceCosts
\end{aligned} \tag{1}
$$

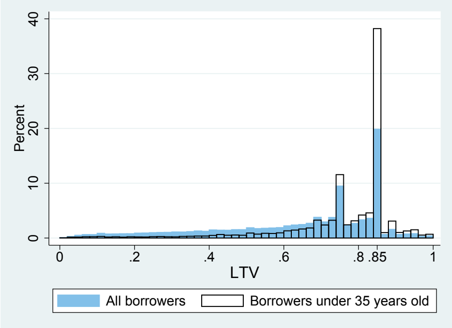
KALP

Mortgage process in Sweden

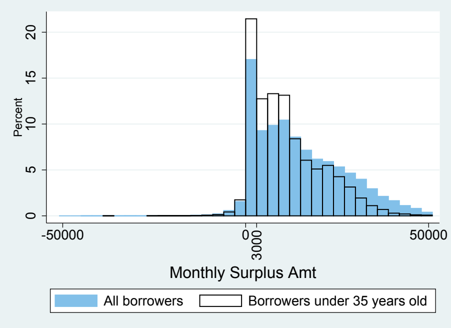


Source:https://www.nordea.fi/en/personal-customers/loans/buying-a-home/loan-promise.html

Empirical evidence from Sweden



(a) The distribution of LTV 2011-2015



(b) The distribution of KALP 2011-2015

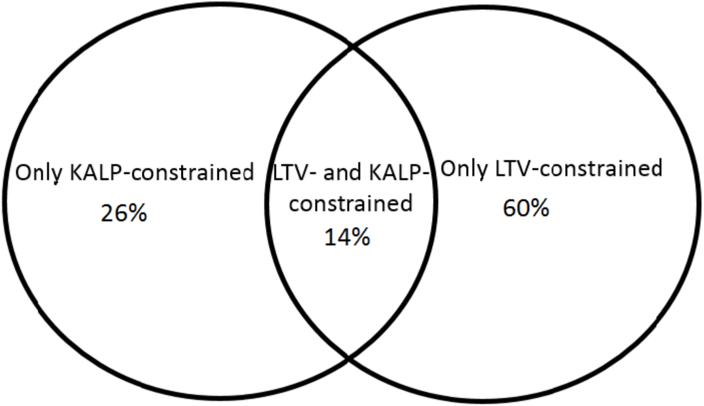
Figure: Distributions of constraints for new borrowers in Sweden, 2011-2015

Notes: The distributions are based on the data from the Mortgage Survey conducted annually by Finansinspektionen in Sweden.

*If KALP is at 0, it means that a person maximized its loan amount, if positive - it still has some margin.

Empirical evidence from Sweden

Figure: The distribution of constrained borrowers in Sweden among the LTV and the KALP-constraint, 2011-2015



This paper

- Micro-evidence from the Swedish mortgage market
- Simple real business cycle model with one-period debt and two borrowing constraints: DSTI and LTV
- New-Keynesian model with long-term debt and two borrowing constraints: DSTI and LTV
- Long-run and short-run comparison of different macroprudential measures
- Occasionally binding constraints

Main results

- Theoretically, it cannot be excluded that both DSTI and LTV bind at the same time.

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- Changing the LTV limit may not affect the debt to GDP/income ratio at all in equilibrium in the extreme case.
- Given actual distribution of borrowers across constraints, stricter LTV policies are less effective in lowering indebtedness than what has been previously shown.
- LTV policies have a large short-run and long-run effect on house prices, so if we aim at lower indebtedness without negative effect on house prices, other measures are preferable.

Literature

- Iacoviello (2005), AER: "House Prices, Borrowing Constraints and Monetary Policy in the Business Cycle"
- - Guerrieri and Iacoviello (2015), JME, "Occbin: A Toolkit to Solve Models with Occasionally Binding Constraints Easily" and
  - Guerrieri and Iacoviello (2017), JME, "Collateral Constraints and Macroeconomic Asymmetries"
- - Finocchiaro, Jonsson, Nilsson, Strid (2016), Riksbank Economic Review, "Macroeconomic effects of reducing household debt",
  - Chen and Columba (2016), IMF Working Paper, "Macroprudential and Monetary Policy Interactions in a DSGE model for Sweden"
- Greenwald, 2016, SED WP, "The Mortgage Credit Channel of Macroeconomic Transmission"

RBC Model with One-Period Debt

- Savers - borrowers framework à la Iacoviello (2005)
- Both savers and borrowers own housing, but only borrowers are credit constrained
- Firms are profit maximizers, use labor for production
- The housing stock is fixed

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- Firms are profit maximizers, use labor for production
- The housing stock is fixed
- This model exemplifies the main mechanism in a setup with no difference between the stock and flow of debt.

Model with one period debt - the borrower's problem

- Impatient households have the following utility function:

$$\max_{b_t^B, h_t^B, L_t^B} E_0 \sum_{t=0}^{\infty} \beta^{B,t} \left(\log c_t^B + j_t \log h_t^B - \frac{{l_t^B}^{\eta^B}}{\eta^B} \right) \tag{2}$$

- Borrowing is subject to a typical LTV constraint (as in Iacoviello, 2005):

$$R_t b_t \leq E_t(m^B q_{t+1} h_t^B) \tag{3}$$

- In addition, the borrowing is limited by a DSTI constraint:

$$R_t b_t \leq DSTI w_t^B l_t^B \tag{4}$$

- The budget constraint of the impatient household is:

$$c_t^B + q_t(h_t^B - h_{t-1}^B) + R_{t-1} b_{t-1} = b_t + w_t^B l_t^B, \tag{5}$$

Model with one period debt - the borrower's problem

- The first order conditions of this problem are:
  w.r.t. b_t

$$\frac{1}{c_t^B} = \beta^B E_t\left(\frac{R_t}{c_{t+1}^B}\right) + R_t\lambda_t^{LTV} + \lambda_t^{DSTI} R_t \qquad (6)$$

w.r.t. h_t^B

$$\frac{q_t}{c_t^B} = \beta^B E_t\left(\frac{q_{t+1}}{c_{t+1}^B}\right) + \frac{j_t}{h_t^B} + E_t(\lambda_t^{LTV} m^B q_{t+1}), \qquad (7)$$

w.r.t. l_t^B

$$w_t^B = l_t^{B^{\eta^B - 1}} c_t^B - \lambda_t^{DSTI} DSTI w_t^B c_t^B, \qquad (8)$$

The bindingness of borrowing constraints

- $$\lambda^{\bar{LTV}} = \frac{\bar{q}\bar{h}^B - \beta^B \bar{q}\bar{h}^B - \bar{j}\bar{c}^B}{m^B \bar{q}\bar{h}^B \bar{c}^B}. \tag{9}$$

  $$\lambda^{\bar{DSTI}} = \frac{1 - \beta^B \bar{R} - \bar{R}\lambda^{\bar{LTV}} \bar{c}^B}{\bar{R}\bar{c}^B}. \tag{10}$$

- The Kuhn-Tucker conditions, necessary for an optimum in a model with inequality constraints, require the nonnegativity of Lagrangian multipliers.
- For standard parameter values, the multiplier on the DSTI constraint will be always binding in this model, and the sign of the multiplier on the LTV constraint depends mostly on the level of impatience of borrowers and their preference for housing.

Model with one period debt - debt to GDP

- When both LTV and DSTI constraint bind, in equilibrium we have:

$$DSTI\bar{w^B}\bar{l^B} = \bar{m^B}\bar{q}\bar{h^B}, \tag{11}$$

and so

$$DSTI = \frac{\bar{m^B}\bar{q}\bar{h^B}}{\bar{w^B}\bar{l^B}}. \tag{12}$$

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- $\frac{\bar{m^B} \bar{q} \bar{h^B}}{\bar{w^B} \bar{l^B}}$ is the debt to GDP or debt to income ratio of this economy.

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- $\frac{\bar{m^B}\,\bar{q}\,\bar{h^B}}{\bar{w^B}\,\bar{l^B}}$ is the debt to GDP or debt to income ratio of this economy.
- Changes in LTV do not influence the debt to GDP at all, only changes in DSTI do!

Model with long-term debt - the borrower's problem

- $$\max_{c_t^B, h_t^B, l_t^B, sb_t} E_0 \sum_{t=0}^{\infty} \beta^{B,t} \left(\log c_t^B + j_t \log h_t^B - \frac{{l_t^B}^{\eta^B}}{\eta^B} \right) s.t. \tag{13}$$

s.t.

$$sb_t \leq (1-\kappa) sb_{t-1} + m^B q_t (h_t^B - (1-\delta_h) h_{t-1}^B) \tag{14}$$

$$sb_t (R_t + \kappa - 1) \leq DSTI w_t^B l_t^B, \tag{15}$$

$$c_t^B + q_t (h_t^B - (1-\delta_h) h_{t-1}^B) + \frac{R_{t-1} sb_{t-1}}{\pi_t} = sb_t + w_t^B l_t^B. \tag{16}$$

$$sb_t = \frac{(1-\kappa) sb_{t-1}}{\pi_t} + b_t \tag{17}$$

$$b_t (R_t + \kappa - 1) \leq DSTI w_t^B l_t^B \mu_t, \tag{18}$$

where $\mu_t = \frac{b_t}{sb_t}$.

$$c_t^B + q_t (h_t^B - (1-\delta_h) h_{t-1}^B) + \frac{(R_{t-1} - 1 + \kappa) sb_{t-1}}{\pi_t} = b_t + w_t^B l_t^B. \tag{19}$$

Model with long-term debt - the borrower's problem

- The FOCs are :

  w.r.t. sb_t

$$\frac{1}{c_t^B} = \beta^B E_t\left(\frac{R_t}{c_{t+1}^B \pi_{t+1}}\right) + \lambda_t^{LTV} - E_t \frac{\beta^B \lambda_{t+1}^{LTV}(1-\kappa)}{\pi_{t+1}} + \lambda_t^{DSTI}(R_t + \kappa - 1) \quad (20)$$

  w.r.t. h_t^B

$$\frac{q_t}{c_t^B} = \frac{j_t}{h_t^B} + \beta^B E_t\left(\frac{(1-\delta_h)q_{t+1}}{c_{t+1}^B} - (1-\delta_h)\lambda_{t+1}^{LTV} m^B q_{t+1}\right) + \lambda_t^{LTV} m^B q_t \quad (21)$$

  w.r.t. L_t^B

$$w_t^B = L_t^{B^{\eta^B - 1}} c_t^B - DSTI c_t^B w_t^B \lambda_t^{DSTI} \quad (22)$$

The bindingness of borrowing constraints

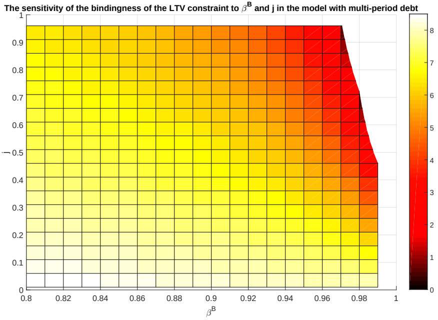
The steady state expression for λ^{LTV}, denoted by the barred variable, can be found from equation 21:

$$\bar{\lambda}^{LTV} = \frac{\bar{q}\bar{h}^B - \beta^B \bar{q}\bar{h}^B(1-\delta_h) - \bar{j}\bar{c}^B}{m^B \bar{q}\bar{h}^B \bar{c}^B - \beta^B(1-\delta_h)m^B \bar{q}\bar{h}^B \bar{c}^B}. \tag{23}$$

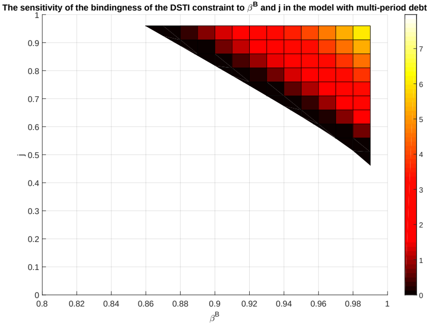
The steady state expression for λ^{DSTI}, denoted by the barred variable, can be found from equation 20:

$$\bar{\lambda}^{DSTI} = \frac{1 - \beta^B \bar{R} - \bar{\lambda}^{LTV} \bar{c}^B + \beta^B \bar{\lambda}^{LTV} \bar{c}^B (1-\kappa)}{(\bar{R} + \kappa - 1)\bar{c}^B}. \tag{24}$$

The bindingness of borrowing constraints



(a) λ^{LTV} as a function of β^B and J^B



(b) λ^{DSTI} as a function of β^B and J^B

Figure: The sensitivity of the bindingness of borrowing constraints in the model with long-term debt

Calibration

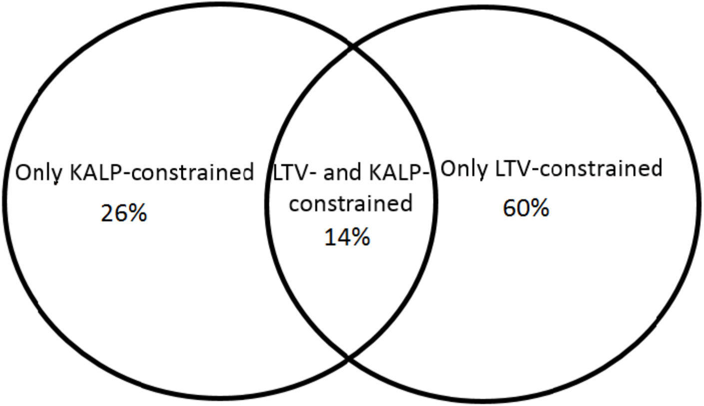
	Parameter	Value	Source/Target
β^S	savers' discount factor	0.99	4% annual int. rate
β^B	borrowers' discount factor	0.93	high impatience level of borrowers
δ_h	housing depreciation rate	0.0076	average LTV of 65%
m^B	LTV ratio for new loans	0.85	Swedish FSA guideline
$DSTI$	DSTI ratio for households	0.25	with κ debt-to-GDP of 62%
κ	quarterly amortization rate	0.01	25 years amortization
α	savers' wage share	0.8	borrowers earn 20% of wage income
η'	savers' labor supply aversion	2	Frisch labor supply elasticity of 1
η''	borrowers' labor supply aversion	2	Frisch labor supply elasticity of 1
J'	savers' weight on housing	0.2	Finocchiaro et al. (2016)
J"	borrowers' weight on housing	0.8	debt/GDP 62% in the LTV model
θ	degree of price stickiness	0.75	duration of price of 1 year
X	price markup	1.01	4% annual markup
ρ_R	interest rate inertia	0.833	Adolfson et al. (2013)
ρ_π	central bank's response to infl.	1.733	Adolfson et al. (2013)
ρ_y	central bank's response to GDP	0.051	Adolfson et al. (2013)

Long-run experiments in the model with long-term debt

Variable/Model	Benchmark model	DSTI-only model	LTV-only model
		LTV $\downarrow$ 5%	
Debt to GDP/income	0%	0%	-7.88%
House prices	+1.07%	0%	-2.12%
Borrowers' housing stock	+3.59%	0%	-3.61%
Output	-0.54%	0%	-0.17%
		DSTI $\downarrow$ 5%	
Debt to GDP/income	-5%	-6.88%	0%
House prices	-1.50%	+0.09%	0%
Borrowers' housing stock	-3.41%	+1.27%	0%
Output	+0.15%	-0.37%	0%
		$\kappa \uparrow$ 5%	
Debt to GDP/income	-2.43%	-2.97%	-4.22%
House prices	+0.58%	+0.09%	-0.16%
Borrowers' housing stock	+1.74%	+0.37%	+0.02%
Output	-0.12%	-0.17%	-0.03%

Empirical evidence from Sweden

Figure: The distribution of constrained borrowers in Sweden among the LTV and the KALP-constraint, 2011-2015

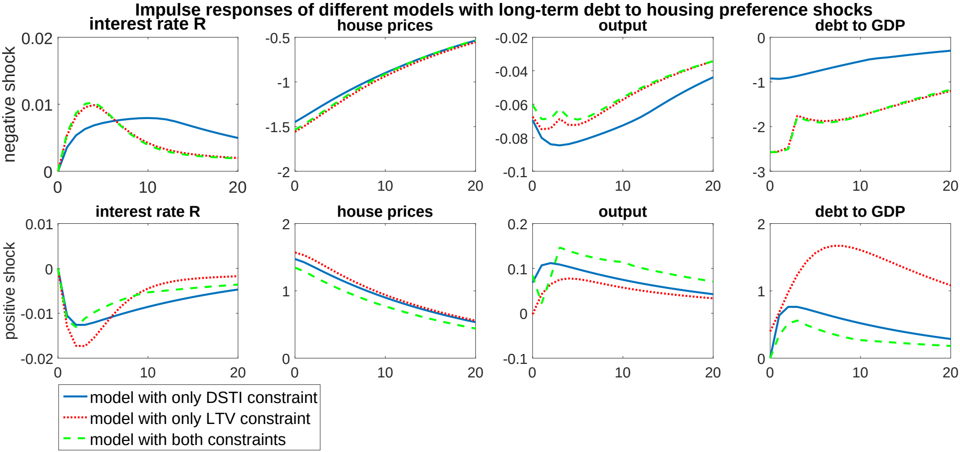


Long-run experiments in the model with long-term debt

Variable/Model	Benchmark	DSTI-only	LTV-only	'Swedish economy'
		LTV $\downarrow$ 5%		
Debt to GDP/income	0%	0%	-7.88%	-3.06%
House prices	+1.07%	0%	-2.12%	-3.17%
Borrowers' housing stock	+3.59%	0%	-3.61%	+0.50%
Output	-0.54%	0%	-0.17%	+0.09%
		DSTI $\downarrow$ 5%		
Debt to GDP/income	-5%	-6.88%	0%	-3.09%
House prices	-1.50%	+0.09%	0%	-0.21%
Borrowers' housing stock	-3.41%	+1.27%	0%	-2.60%
Output	+0.15%	-0.37%	0%	-0.07%
		$\kappa \uparrow$ 5%		
Debt to GDP/income	-2.43%	-2.97%	-4.22%	-5.80%
House prices	+0.58%	+0.09%	-0.16%	-0.16%
Borrowers' housing stock	+1.74%	+0.37%	+0.02%	+6.09%
Output	-0.12%	-0.17%	-0.03%	-0.08%

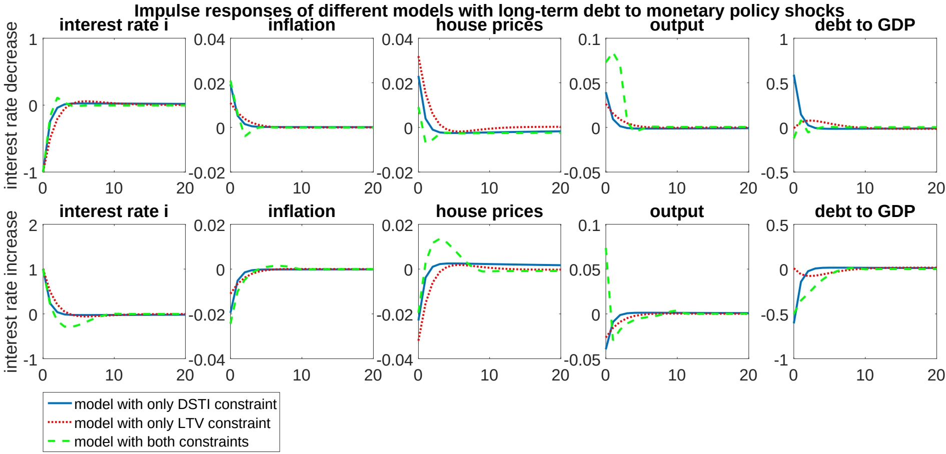
Note: The 'Swedish economy' calibration differs slightly from the remaining three models in order to maintain the same debt-to-GDP ratio in equilibrium.

Short-run effects of housing preference shocks



Short-run effects of monetary policy shocks

Figure: Impulse responses of models with long-term debt to monetary policy shocks



Conclusion

- Contary to our standard model world, borrowers often face multiple constraints and can be bound by them at the same time.
- In a model with DSTI and LTV constraint present, the effectiveness of LTV in influencing debt to GDP ratios is reduced.
- When both constraints bind, the debt to GDP and debt to income ratio are fixed at the level of DSTI.
- The existence of multiple occasionally binding constraints amplifies the asymmetry in the short run responses to positive and negative shocks, even for shocks of small size.

Thank you for your attention!

KALP vs DSTI

- KALP:

$$(1-\tau_l)W_iL_i + TR - C - (I(1-\tau_h) + SR + \kappa)SB_i - HE = 0, \quad (25)$$

$$SB_i = \frac{(1-\tau_l)W_iL_i + TR - C - HE}{I(1-\tau_h) + SR + \kappa}, \quad (26)$$

$$\mathbf{SB_i} = \frac{(\mathbf{1}-\tau_\mathbf{l})\mathbf{W_iL_i}}{\mathbf{I}(\mathbf{1}-\tau_\mathbf{h}) + \mathbf{SR} + \kappa} + \frac{\mathbf{TR} - \mathbf{C} - \mathbf{HE}}{\mathbf{I}(\mathbf{1}-\tau_\mathbf{h}) + \mathbf{SR} + \kappa} \quad (27)$$

- DSTI:

$$\frac{(I(1-\tau_h) + \kappa)SB}{(1-\tau_l)W_iL_i} = DSTI, \quad (28)$$

$$\mathbf{SB_i} = \mathbf{DSTI}\frac{(\mathbf{1}-\tau_\mathbf{l})\mathbf{W_iL_i}}{\mathbf{I}(\mathbf{1}-\tau_\mathbf{h}) + \kappa}, \quad (29)$$

Return