How does Loan-to-Value Policy Strengthen Banks' Resilience to Property Price Shocks: Evidence from Hong Kong

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The views and analysis expressed in this presentation are those of the presenter and do not necessarily represent the views of the Hong Kong Monetary Authority

Research question and main findings

- What should be the optimal target of LTV policy (i.e. limiting LTV caps) in pursuing banking stability?
  - Property prices
  - Household leverage
  - Credit growth

- Main Findings:
  - Very limited policy transmission through property markets
  - The main policy impact is transmitted through household leverage rather than credit growth

Road map

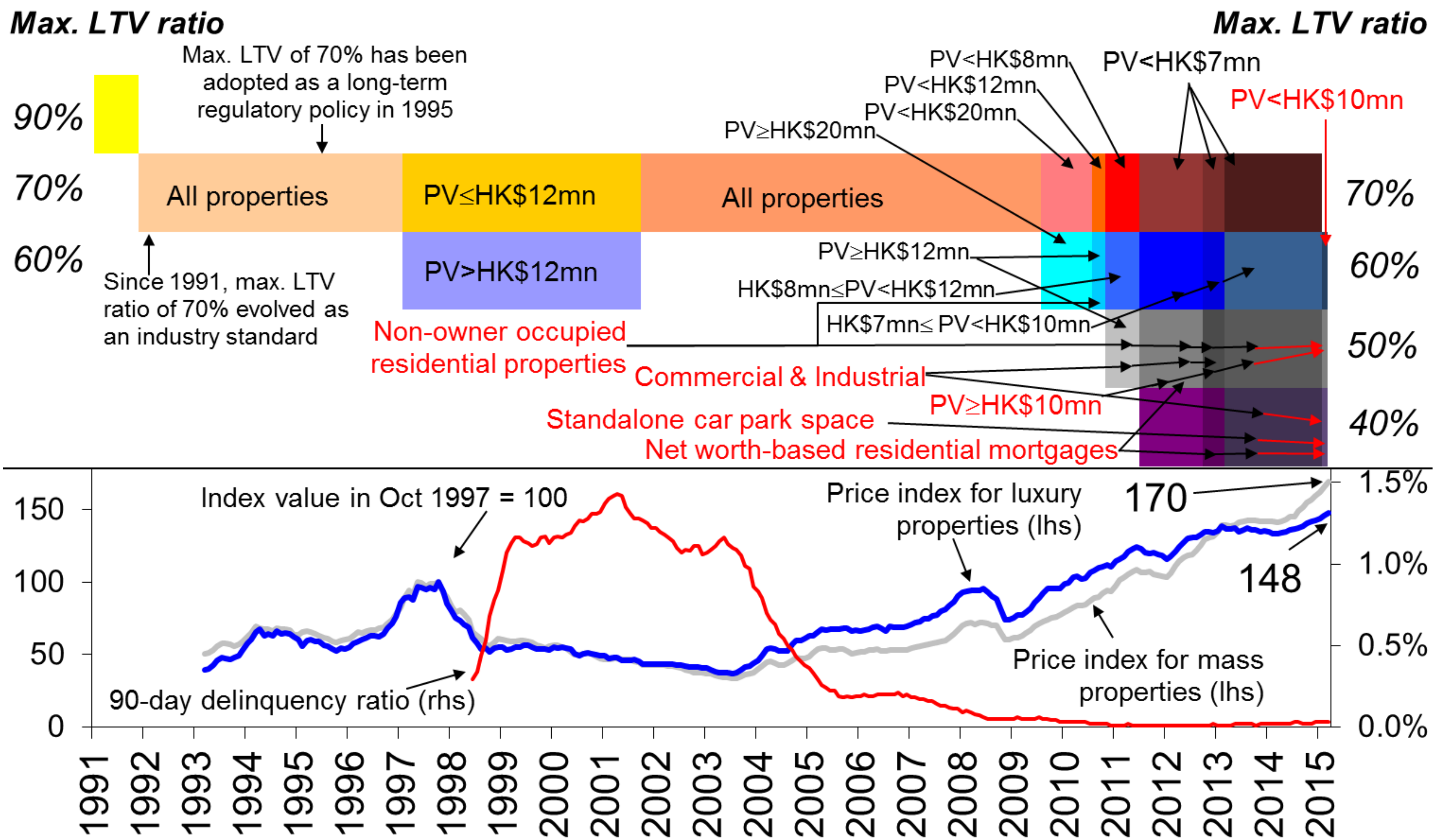
- A brief overview of MPPs in HK
- Effectiveness of LTV policy from a historical perspective
- The impact of LTV policy on property prices
- The impact of LTV policy on household leverage (direct impact) and credit growth (indirect impact)
  - Econometric evidence
  - Actual scenario (with LTV policy tightening) and Counterfactual scenario (without tightening)
  - Default risk of two scenarios under severe macro stress
  - The contributions of the direct and indirect impacts

A brief overview of MPPs in HK

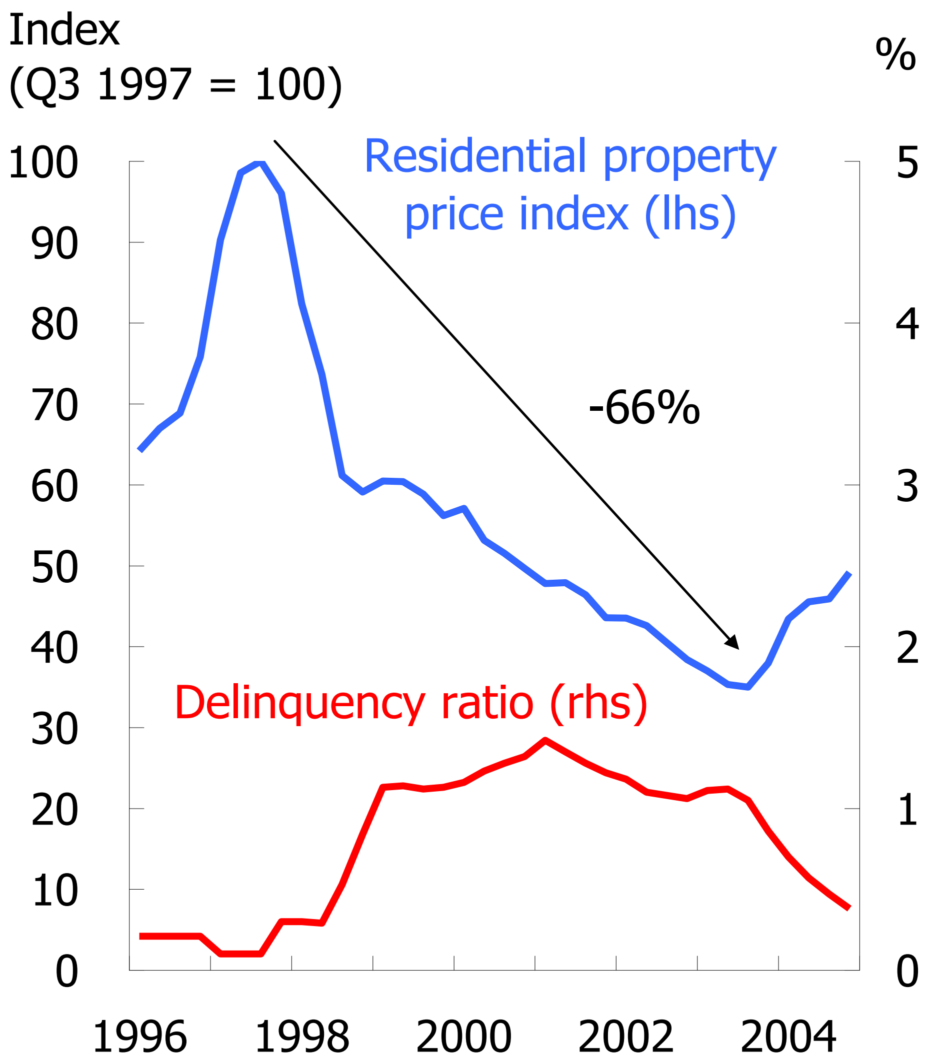
1. By HKMA
    1. LTV ratio caps since 1991
    2. Debt-serving ratio (DSR) limits, and stress-testing DSRs
    3. Maximum tenor of 30 years for mortgage loans
    4. A risk-weight floor of 15% for mortgage loans for banks adopting IRB
    5. Regulatory reserves
    6. Stable funding requirement since 2014

2. By HKSAR government
    1. Special stamp duties (SSD) since Nov 2010
    2. Buyer stamp duties (BSD) since Oct 2012
    3. Double stamp duties (DSD) since Feb 2013

History of LTV policy in HK

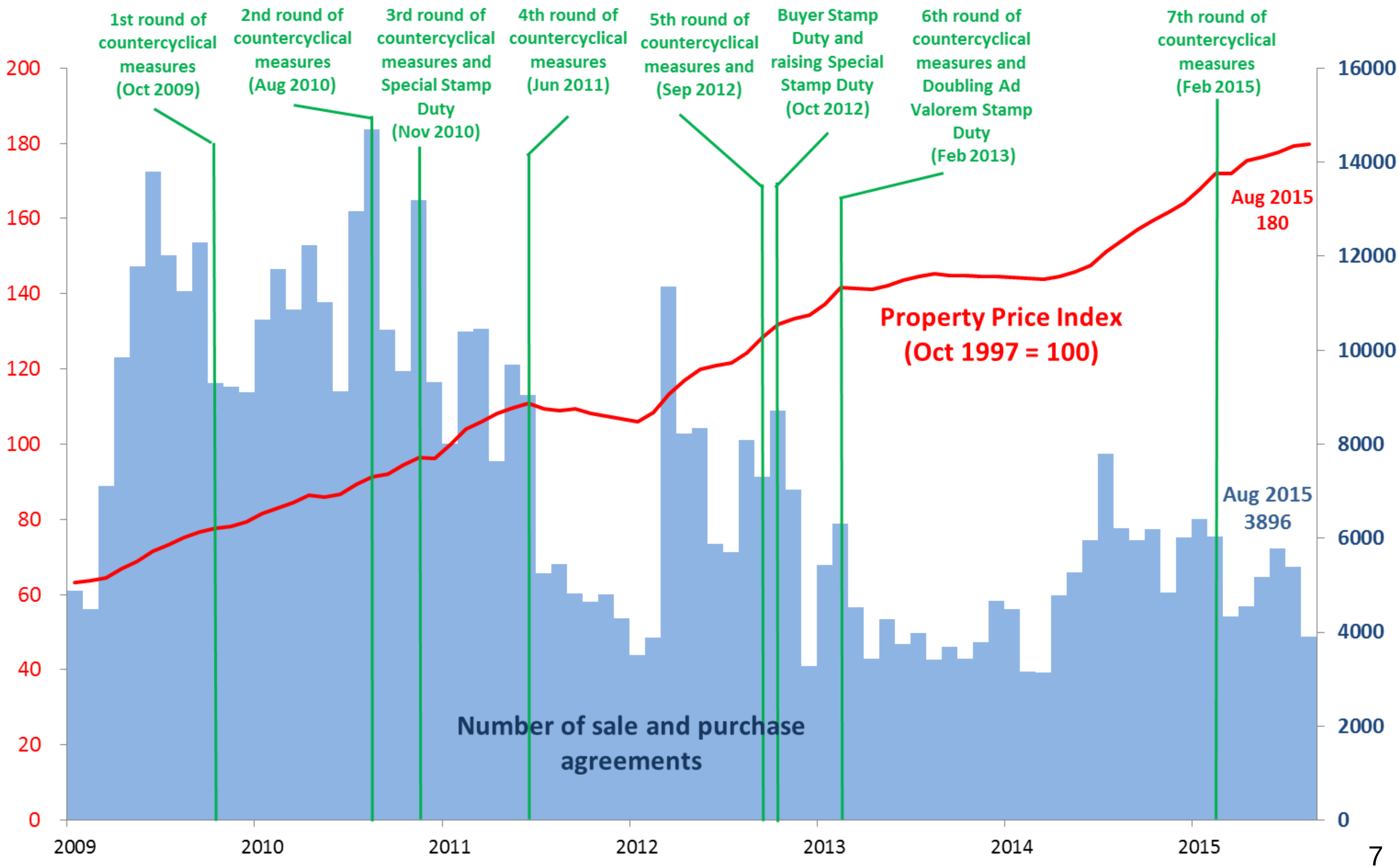


Effectiveness of LTV policy in past episode of property market downturn

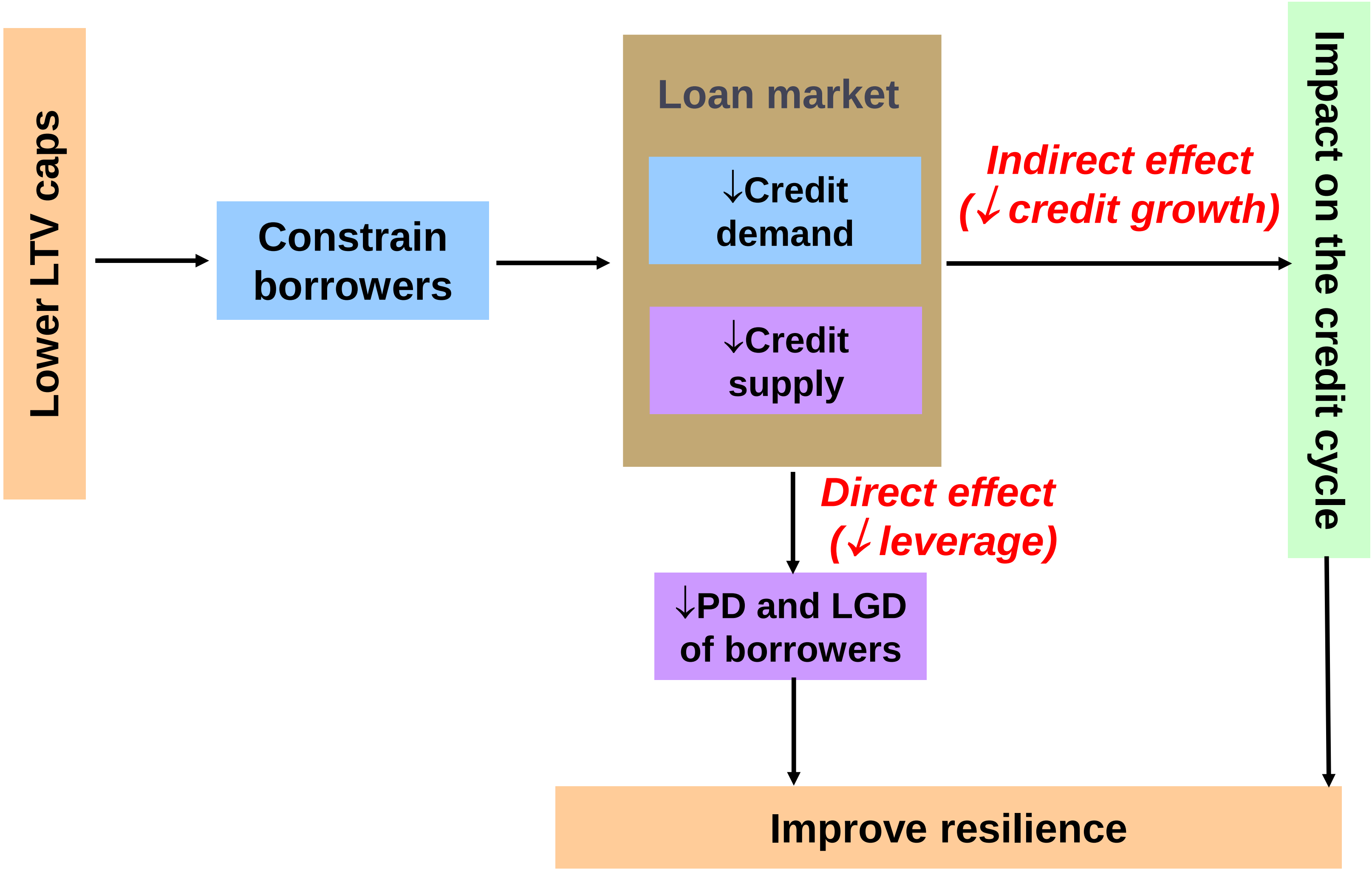


Note: Delinquency ratios are computed based on those past due 30 days or more.
Sources: HKMA and Rating and Valuation Department

How far the LTV policy is transmitted through the property market?



Transmission Channels of LTV policy



Source: A simplified version of graph 3.3. from CGFS (2012), "Operationalising the selection and application of macroprudential instruments", CGFS Paper no. 48

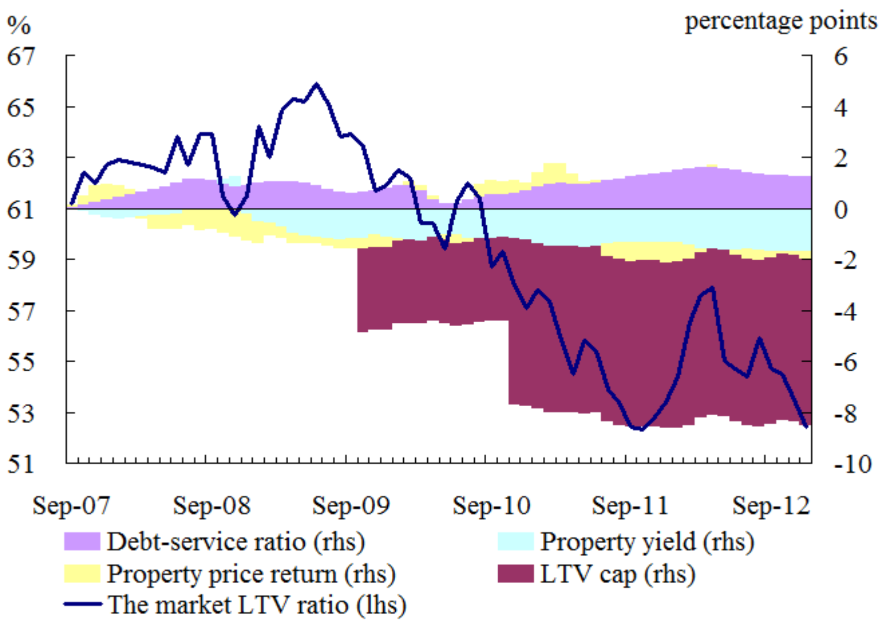
Econometric evidence of the direct effect: How do LTV caps reduce the average LTV ratio in the market

Long-run determinants of the market LTV ratio

$$\Pi_t^{LTV} = LTV_t - (0.605 + 0.326 * LTVcap_t + 0.285 * Proreturn_t + 1.436 * Proyield_t$$
$$[14.3] \quad [16.2] \qquad [2.91] \qquad [6.11]$$
$$- 0.696 * DSR_t)$$
$$[-6.83]$$

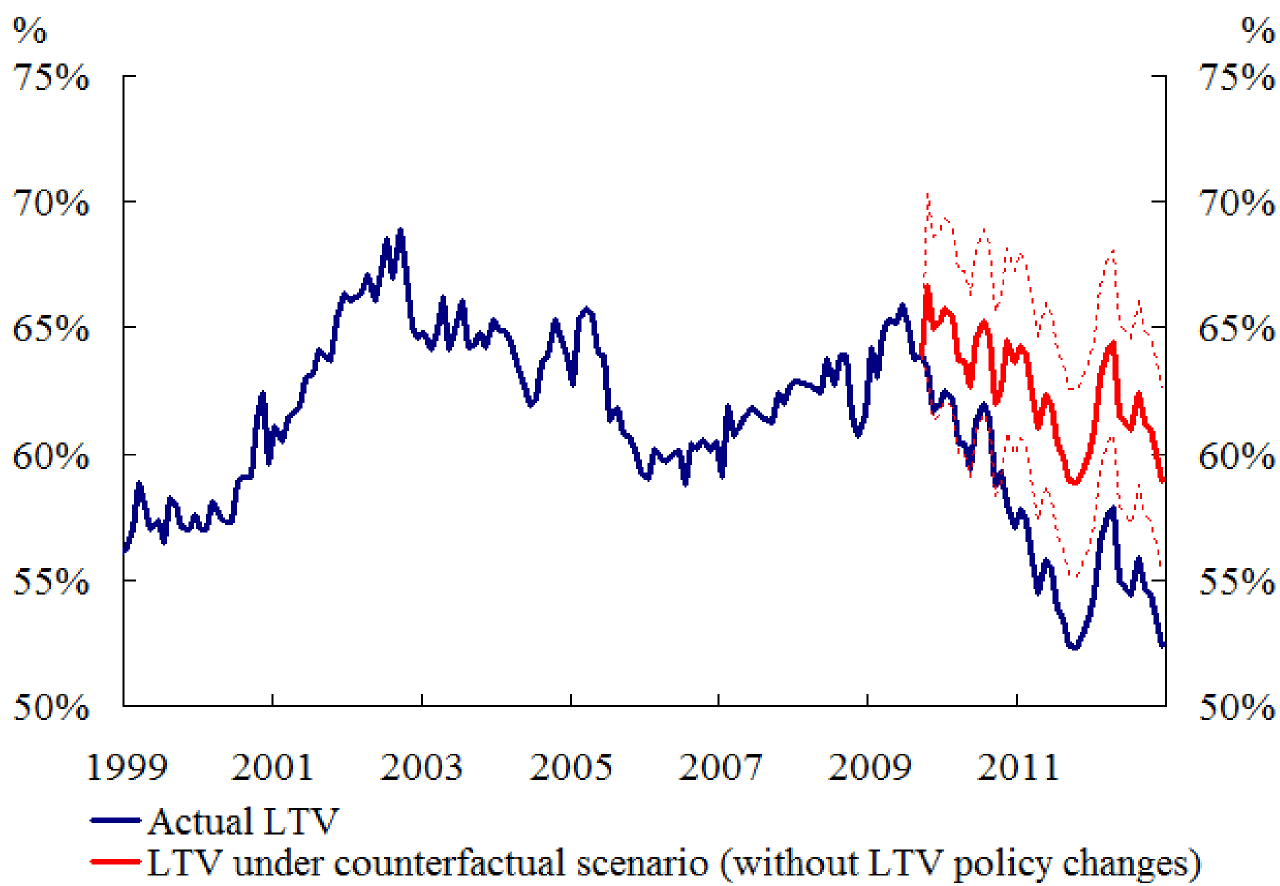
$$Adj.\ R^2 = 0.77$$

Contribution of main factors to change in the market LTV ratio



LTV ratios under the actual and counterfactual scenarios

The market LTV ratio under the actual and counterfactual “no policy” scenarios



An econometric model for the indirect effect

1. Model characteristics
   a) Allowing for disequilibrium (standard assumption, Stiglitz and Weiss, 1981)
   b) Demand and supply models (as LTV policy may affect both the demand and supply of mortgages)
   c) Relevant MPP variables are included in the equations as control variables
2. Estimation results
   a) Q^D = f(LTV, r, special stamp duties, DSR limit, unemployment rate)

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   b) Q^S = f(LTV, RAROC(r), house price growth, deposit growth, ↓DSR limit)

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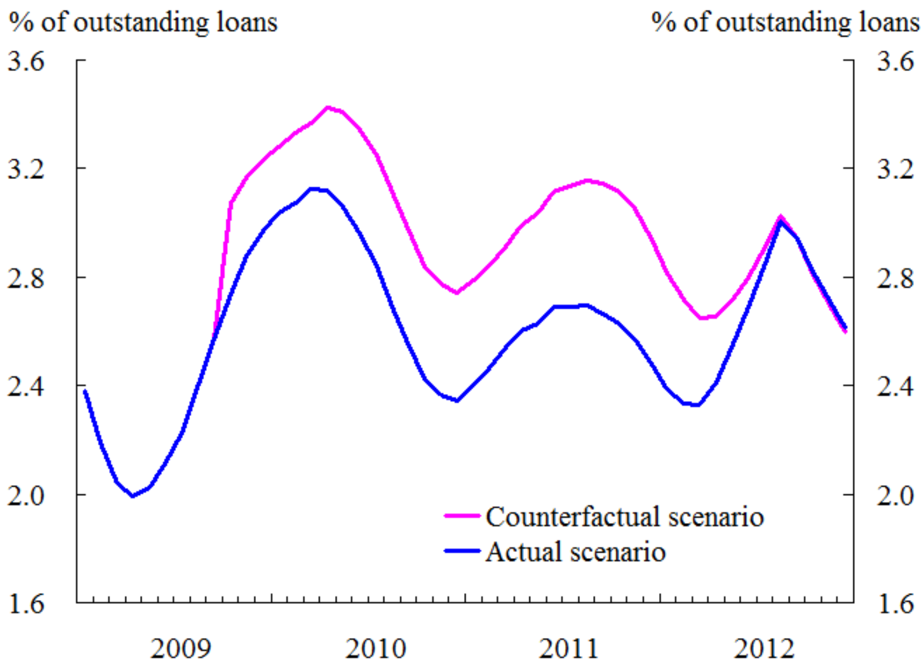
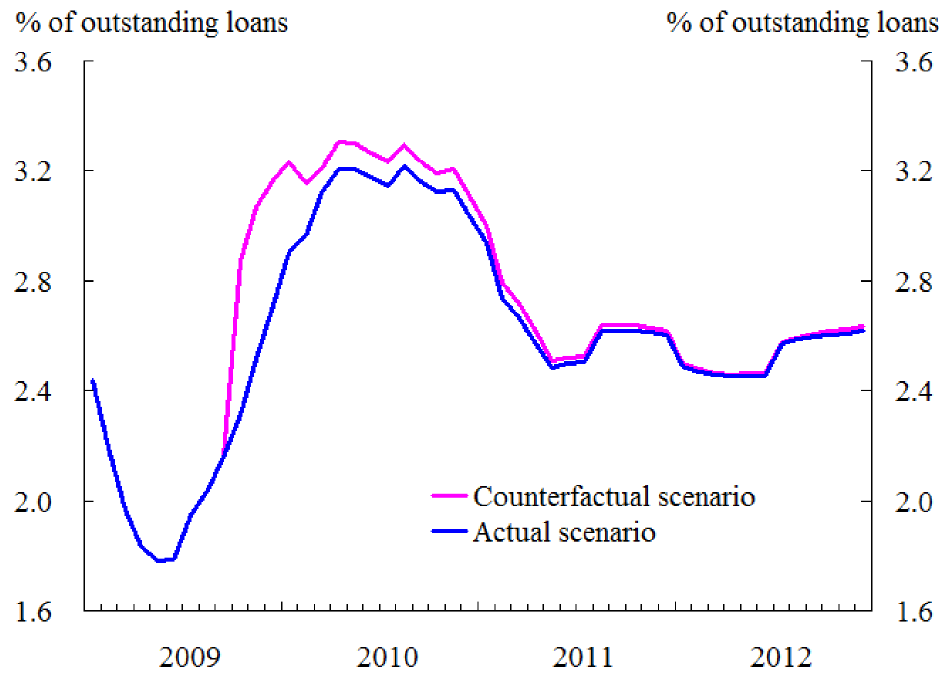
Indirect effect: quantifying the impact on supply and demand

Estimated supply of mortgage loans



Estimated demand for mortgage loans

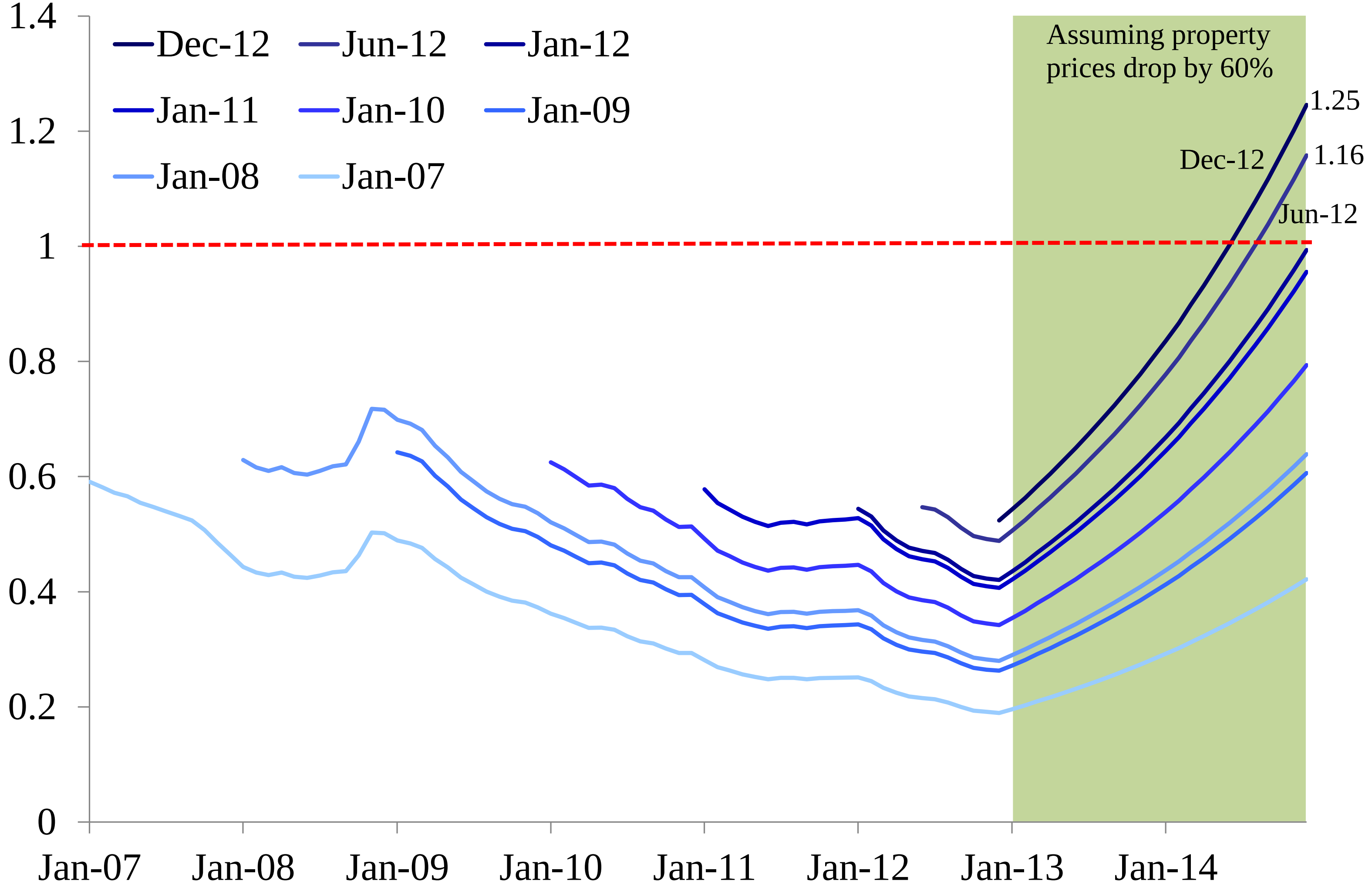


Default risk analysis

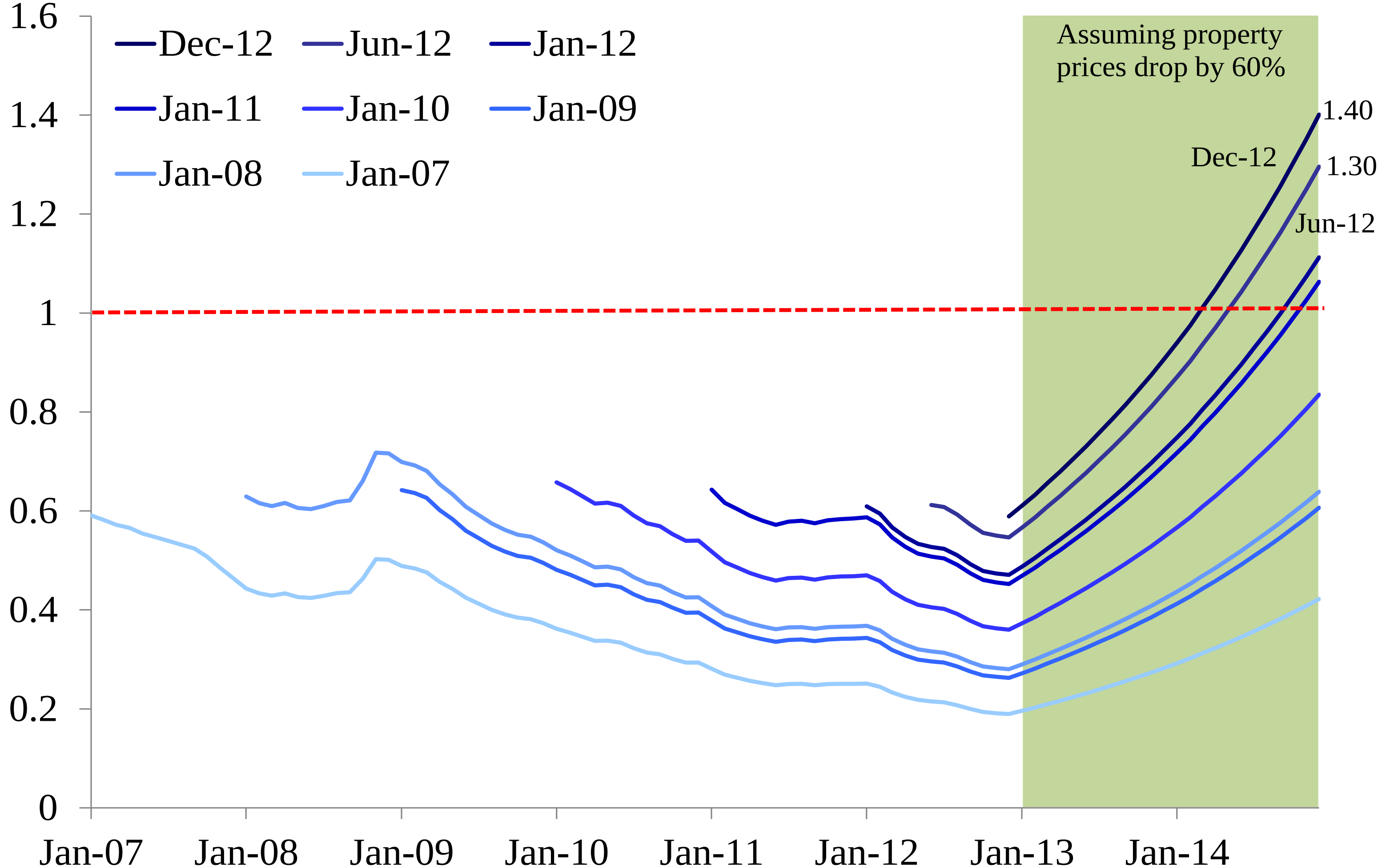
1. **Actual scenario**: actual data of LTV and new mortgage loans
2. **Counterfactual scenario**: based on the estimated LTV and new mortgage loans assuming no LTV policy tightening
3. Comparing the default risk under the two scenarios with the following macro shocks
   1. Mortgage interest rates increase by 300 basis points
   2. Property prices drop by 60%
   3. Household income decreases by 20%
   4. Unemployment rate increases to 8.5%

   From 2013Q1 to 2014Q4
4. Analysis the contribution of the direct and indirect impacts

Estimated LTV ratios for selected vintage months under the actual scenario with property price shocks



Estimated LTV ratios for selected vintage months under the counterfactual scenario with property price shocks



Contribution of direct and indirect effects

$$P_t^{NE} = \frac{\sum_{k=1}^{t} N_k \overline{L}_{k,t} I(\overline{ltv}_{k,t} > 1)}{\sum_{k=1}^{t} N_k \overline{L}_{k,t}}$$

- P_t^{NE} = Proportion of mortgage loans with negative equity (NE)
- N_k = Number of mortgage loans underwritten at time k
- $\overline{L}_{k,t}$ = Average loan amount outstanding at time t for those that were underwritten at time k
- $I(\overline{ltv}_{k,t} > 1)$ = Indicator function for LTV ratio > 1 (i.e NE) at time t for those underwritten at time k
- *The direct impact will be captured by a smaller number of time points with NE*
- *The indirect impact will be captured by a lower $N_k \overline{L}_{k,t}$ during the upcycle of property markets.*

Linking the NE indicator to default risk

$$\ln(Ploan_t) = \alpha_0 + \alpha_1 P^{NE} + \alpha_2 (U + (1-U) * P^{DSR}) + \varepsilon$$

- $Ploan_t$ = Delinquency and rescheduled ratios for mortgages at t
- U = Unemployment rate
- P^{DSR} = Proportion of mortgage loans with DSR > 0.6

$$\ln(Ploan_t) = -6.803 + 6.293 * P_t^{NE} + 2.317 * (U_t + (1-U_t) * P_t^{DSR})$$

$$[-55.8] \quad [16.2] \qquad [9.73]$$

$$Adj.\ R^2 = 0.63 \qquad \text{Sample: Jun 1998 - Dec 2012}$$

[Figures in brackets are t-statistics]

Decomposition of the direct and indirect impacts

Table 2: Estimated non-performing ratio of mortgage loans with a hypothetical severe property price shock

Estimated non-performing loan ratio at end-2014 (%)	
Actual scenario (A)	0.95%
Counterfactual "no policy" scenario (B)	2.32%
(A) - (B)	-1.37%

Decomposition analysis	**Estimated non-performing loan ratio at end-2014 (%)**
1) Actual scenario (both the direct and indirect effects)	$d_A = 0.95$
2) Only the direct effect	$d_{NI} = 0.98$
3) Only the indirect effect	$d_{ND} = 2.03$
4) Counterfactual "no policy" scenario	$d_C = 2.32$

References:

- *Wong, T. C., Fong, T., Li, K. F., & Choi, H. (2011). Loan-to-Value Ratio as a Macroprudential Tool - Hong Kong's Experience and Cross-Country Evidence, HKMA Working Paper (no. 01/2011).*

- *Wong, T.C., Tsang, A., & Kong, S. (2016). How Does Loan-To-Value Policy Strengthen Banks' Resilience to Property Price Shocks – Evidence from Hong Kong. International Real Estate Review, 19(1) 120-149.*

Appendices

Indirect effect: An empirical study

$$DD_t = \alpha_0 + \boldsymbol{\alpha_1 X_{1t}^D} + \alpha_2 r_t + \mu_t^D$$

$$SS_t = \beta_0 + \boldsymbol{\beta_1 X_{1t}^S} + \beta_2 r_t + \mu_t^S$$

$$Q_t = \min\left(DD_t, SS_t\right)$$

$$\Delta r_{t+1} = \gamma\left(DD_t - SS_t\right)$$

$$Q_t = \alpha_0 + \boldsymbol{\alpha_1 X_{1t}^D} + \alpha_2 r_t - \frac{\Delta r_{t+1}^+}{\gamma} + \mu_t^D \quad \text{where} \quad \Delta r_{t+1}^+ = \begin{cases} \Delta r_{t+1}, & \text{if } r_{t+1} > r_t \\ 0, & \text{otherwise} \end{cases}$$

$$Q_t = \beta_0 + \boldsymbol{\beta_1 X_{1t}^S} + \beta_2 r_t - \frac{\Delta r_{t+1}^-}{\gamma} + \mu_t^S \quad \text{where} \quad \Delta r_{t+1}^- = \begin{cases} -\Delta r_{t+1}, & \text{if } r_{t+1} < r_t \\ 0, & \text{otherwise} \end{cases}$$

Indirect effect: Model specification

Demand equation:

$$Q_t = \alpha_0 + \alpha_1 \Delta LTV_t + \alpha_2 ROE_t(LTV_t, r_t) + \alpha_3 ROE_t(LTV_t, r_t) * (SSD_t) +$$

$$\alpha_4 DSR10_t + \alpha_5 DSR12_t + \alpha_6 U_t + \alpha_7 CNY_t - \frac{\Delta r_{t+1}^{+}}{\gamma} + \mu_t^D$$

where

$$ROE = \frac{(V * GPR - L * r)}{E} = \frac{1}{1 - LTV}(GPR - LTV * r)$$

Supply equation:

$$Q_t = \beta_0 + \beta_1 \Delta LTV_t + \beta_2 RAROC_t(r_t) + \beta_3 PPG_t + \beta_4 CD_t +$$

$$\beta_5 DSR10_t + \beta_6 DSR12_t - \frac{\Delta r_{t+1}^{-}}{\gamma} + \mu_t^S$$

where

$$RAROC = \frac{(1-t) * (r - c)}{k}$$

Indirect effect: Estimation result

Table 1: Estimation results for the demand and supply of mortgage loans

	Model 1	Model 2	Model 3
Demand Equation			
Constant	0.030 ***	0.031 ***	0.031 ***
	[9.376]	[9.930]	[10.247]
ΔLTV	0.0005	-0.0012	
	[0.035]	[-0.084]	
ROE(LTV,r)	0.013 ***	0.013 ***	0.013 ***
	[6.427]	[6.425]	[6.659]
*ROE(LTV,r)*SSD*	-0.015	-0.009	-0.011 **
	[-1.344]	[-1.503]	[-2.148]
DSR10	0.003		
	[0.732]		
DSR12	-0.004	-0.004	
	[-0.708]	[-0.746]	
U	-0.153 ***	-0.168 ***	-0.166 ***
	[-2.830]	[-3.137]	[-3.166]
CNY	-0.007 ***	-0.007 ***	-0.007 ***
	[-2.902]	[-2.958]	[-2.918]
$-\Delta r_{t+1}^{+}$ (i.e., $1/\gamma$)	3.138 **	3.069 **	3.041 **
	[2.428]	[2.449]	[2.354]
Adjusted R^2	0.323	0.345	0.348

Indirect effect: Estimation result

Table 1: Estimation results for the demand and supply of mortgage loans

	Model 1	Model 2	Model 3
Supply Equation			
Constant	0.017 ***	0.017 ***	0.016 ***
	[10.273]	[11.843]	[9.921]
ΔLTV	0.085 ***	0.073 ***	0.081 ***
	[3.761]	[3.453]	[3.579]
RAROC(r)	0.011	0.011 **	0.017 ***
	[1.445]	[2.081]	[2.674]
PPG	0.021 ***	0.023 ***	0.022 ***
	[3.375]	[3.696]	[3.513]
CD	0.070 ***	0.067 ***	0.068 ***
	[5.427]	[5.330]	[5.286]
DSR10	0.003		
	[0.991]		
DSR12	-0.013 **	-0.010 **	-0.013 **
	[-2.561]	[-2.139]	[-2.468]
$-\Delta r_{t+1}^{-}$ (i.e., $1/\gamma$)	3.138 **	3.069 **	3.041 **
	[2.428]	[2.449]	[2.354]
Adjusted R^2	0.134	0.142	0.133

Sample period: June 1999 - December 2012
[Figures in brackets are t-statistics]

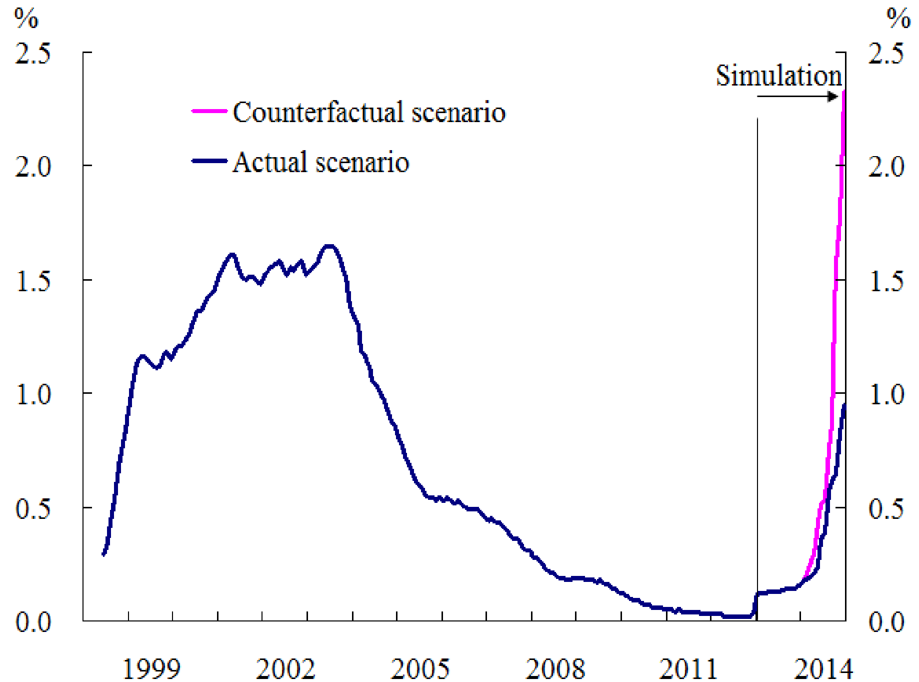
Contribution of direct and indirect effects

$$P_t^{DSR} = \frac{\sum_{k=1}^{t} N_k \overline{L}_{k,t} I(\overline{DSR}_{k,t} > 0.6)}{\sum_{k=1}^{t} N_k \overline{L}_{k,t}}$$

- P_t^{NE} = Proportion of mortgage loans with DSR > 0.6
- N_k = Number of mortgage loans underwritten at time k
- $\overline{L}_{k,t}$ = Average loan amount outstanding at time t for those that were underwritten at time k
- $I(\overline{DSR}_{k,t} > 0.6)$ = Indicator function for DSR ratio > 0.6 at time t for those that were underwritten at time k
- *The indirect impact will be captured by a lower* $N_k \overline{L}_{k,t}$ *during the upcycle of property markets.*

Contribution of direct and indirect effects

Estimated **stressed** delinquency ratio for mortgage loans under the actual and counterfactual scenarios



Scenarios	Estimated problem loan ratio at end-2014 (%)
1) Actual (both the direct and indirect effects)	$d_A = 0.95$
2) Only the direct effect	$d_{NI} = 0.98$
3) Only the indirect effect	$d_{ND} = 2.03$
4) Counterfactual ("No policy")	$d_C = 2.32$