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**BOK-KIEP-PIIE Conference**

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# **Estimating the Effects of FX- Related Macroprudential Policies in Korea**

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THE BANK OF KOREA

# Contents

**I**

**Introduction**

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**II**

**Econometric Methodologies**

---

**III**

**Empirical Evidence**

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**IV**

**Concluding Remarks**

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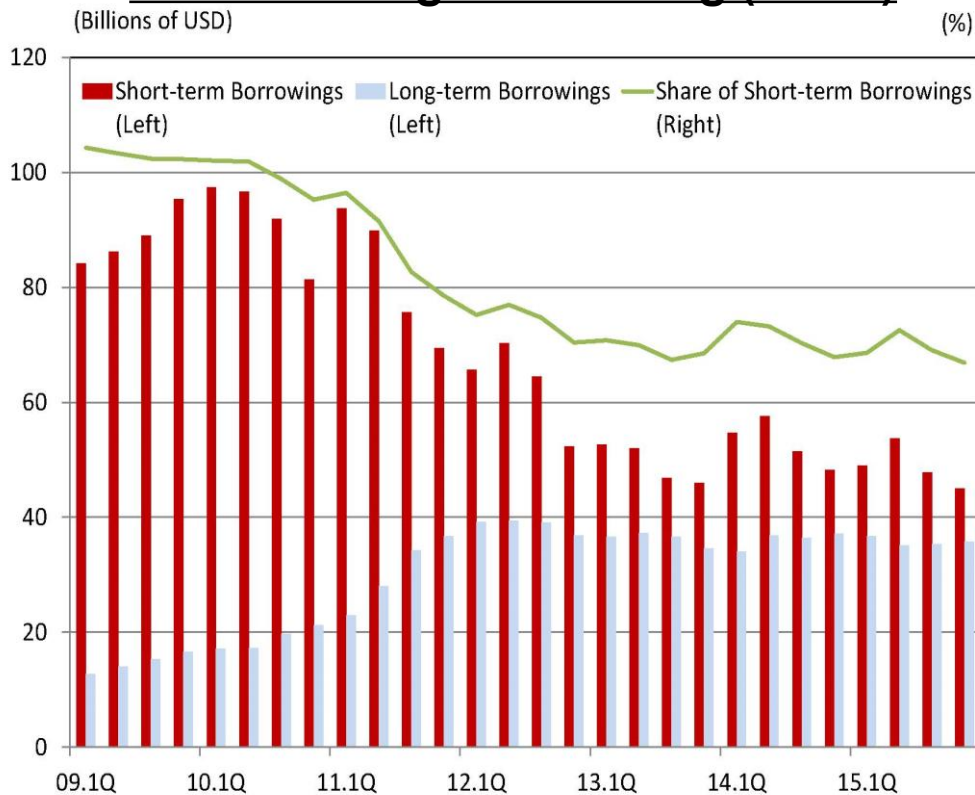
# Introduction



# 1. Background

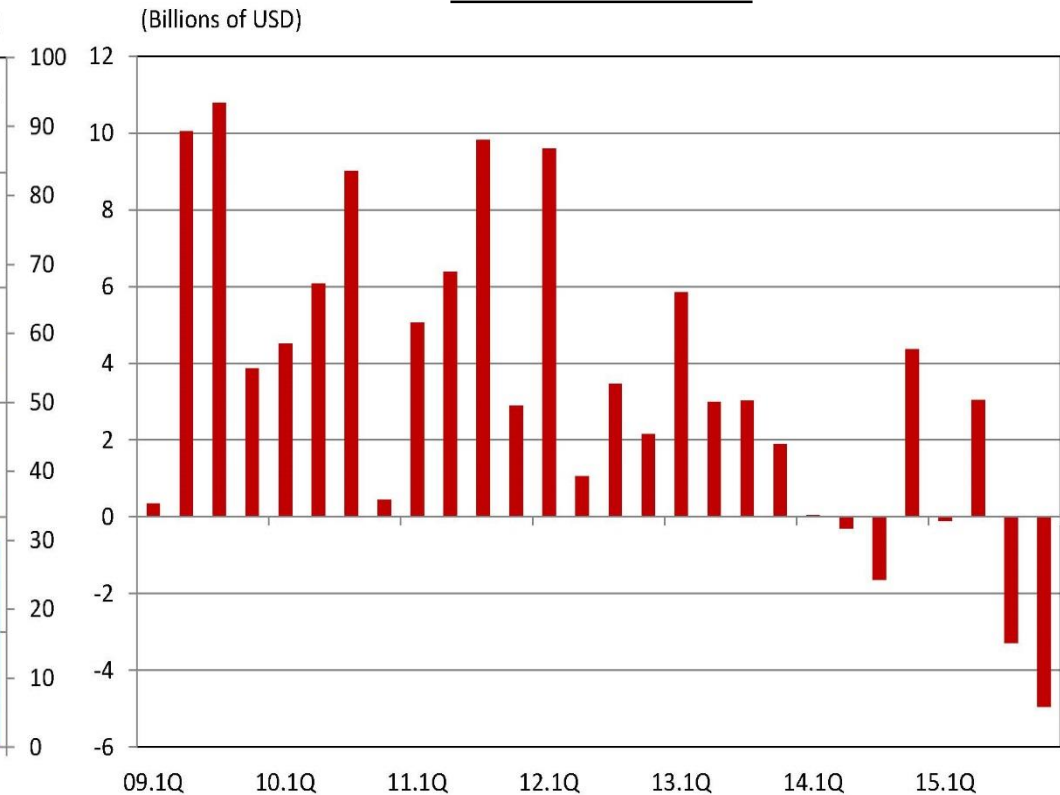
- ◆ Before and after Asian financial crisis (1997) or GFC (2008): **Large swings** in capital inflows
- ◆ **Large capital inflows** until Oct. 2010: A series of FX-related macroprudential policy measures

## Banks' Foreign Borrowing (stock)



Source: The Bank of Korea

## Bond Inflows



Source: The Bank of Korea

## 2. FX-Related Macroprudential Measures Since 2010

- ◆ FX-Related Macroprudential Policies since 2010
  - **Leverage caps** on FX forward position / macroprudential **stability levy** / **resumption of the taxation** on foreigners' bond investment / regulations on foreign currency **loan use**

Table 1: Dates of FX-Related Macroprudential Policies

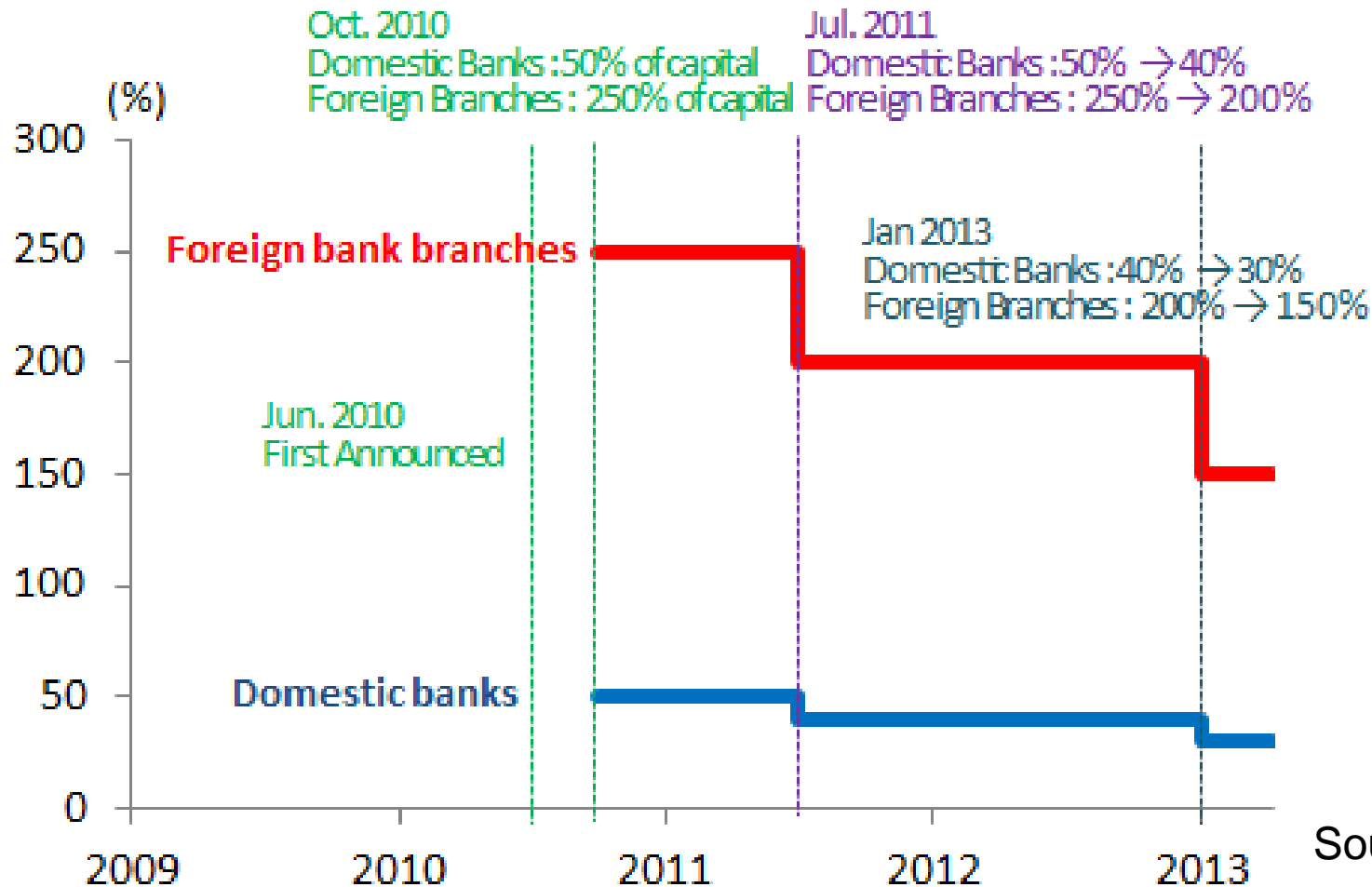
Date	Policy Content	Category
2010:06	Introducing New Macroprudential Measures	Announcement
2010:07	Regulations on Foreign Currency Loan Use	Effective
2010:10	New Ceilings on FX Forward Positions	Effective
2010:11	Interest Income Taxes for Foreign Bond Investors	Announcement
2010:12	Macroprudential Stability Levy	Announcement
2011:01	Interest Income Taxes for Foreign Bond Investors	Effective
2011:04	Macroprudential Stability Levy	Announcement
2011:05	Tightening Caps on FX Forward Position	Announcement
2011:07	Tightening Caps on FX Forward Position	Effective
2011:08	Macroprudential Stability Levy	Effective
2012:11	Tightening Caps on FX Forward Position	Announcement
2013:01	Tightening Caps on FX Forward Position	Effective

Sources: Ministry of Strategy and Finance, the Bank of Korea, and Financial Services Commission

## 2. FX-Related Macroprudential Measures Since 2010

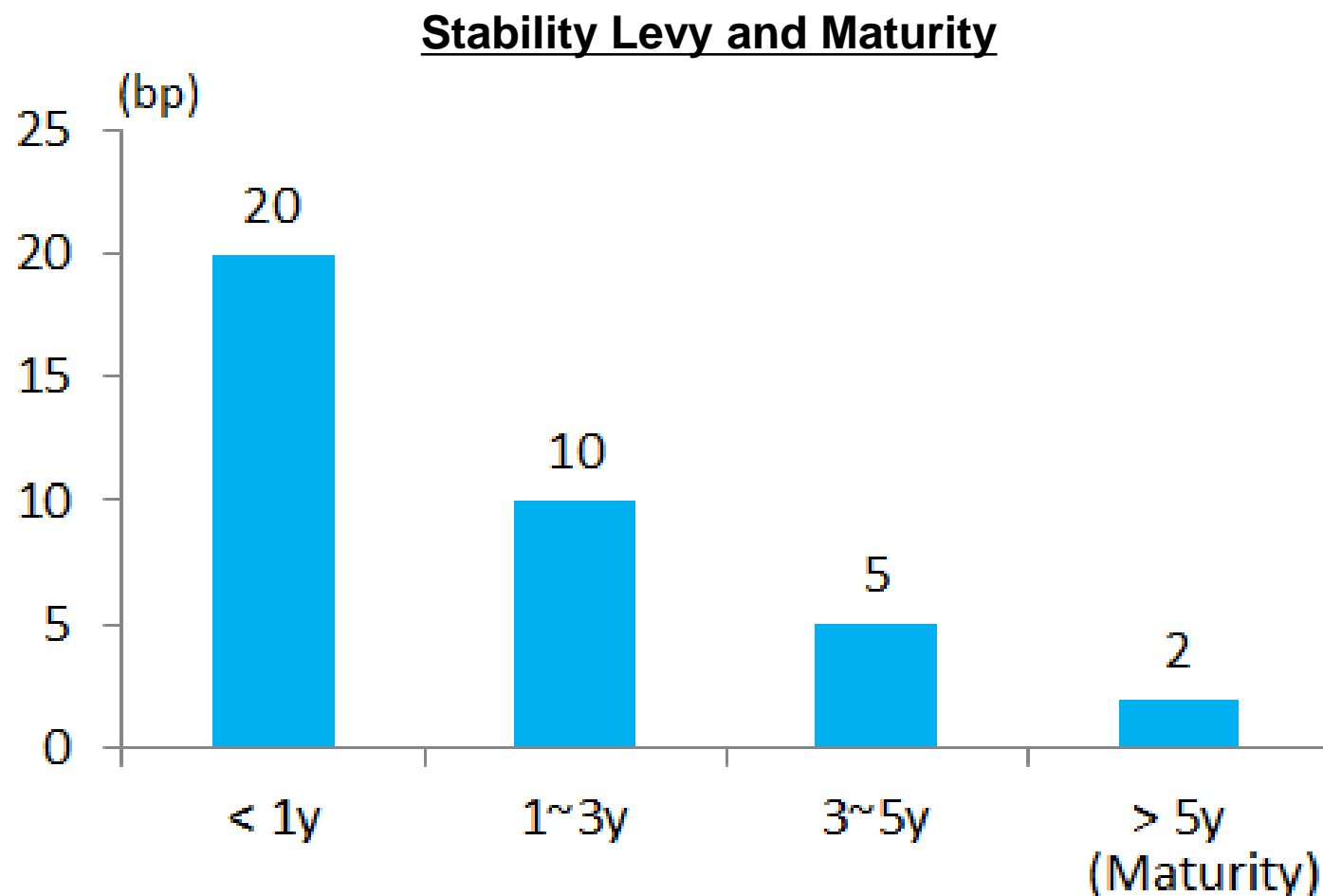
### ◆ **Leverage caps** on FX derivatives position

- limit the excessive enterprises' **net FX forward selling** and the resulting increase in banks' **short-term overseas borrowings**



## 2. FX-Related Macroprudential Measures Since 2010

- ◆ Macroprudential Stability **Levy** (2011.8)
  - curb the excessive increase in banks' **short-term non-core (non-deposit) liabilities**



## 2. FX-Related Macroprudential Measures Since 2010

- ◆ **Resumption of the taxation** on foreigners' bond investment (2011.1)
  - limit speculative capital inflows
  - re-impose a 14% tax on interest income and a 20% tax on capital gains
  
- ◆ Reinforcing regulations on **foreign currency loan use** (2010.7)
  - control an excessive increase in foreign currency loans for use in purchasing domestic facilities
  - foreign currency financing must be for overseas use only.
  
- ➔ **Overall effectiveness?**
- ➔ **Individual policy's effectiveness?**

# 3. Related Literature

## ◆ Taxonomy of Macroprudential Measures (Ostry et al, 2012)

	Capital flow management measures (CFMs)		Other prudential measures (domestic focus)
	Capital controls	FX-related prudential measures	
Basis	Residency	Currency	-
Examples	Limits on borrowing from abroad, Restrictions on the maintenance of accounts abroad, Differential treatment(asset requirements, interest rates, credit controls)	Limits on local lending in foreign currency, Limits on purchase of locally issued securities denominated in foreign currency, Limits on open foreign exchange positions, Levy on foreign currency denominated liabilities	LTV cap, Reserve requirements on local currency liabilities, Limits on credit concentration to specific sectors

# 3. Related Literature

- ◆ Previous literature focuses on quantifying macroprudential policies and investigating the impact of these policies.
  - Ahmed and Zlate (2014) : 12 EMEs, 2002-2013
  - Ostry et al. (2012) : 51 EMEs, 1995-2008
  - Forbes et al. (2015) : 60 countries, 2009-2011
  - Bruno et al. (2016) : 12 Asia-Pacific economies, 2004-2013
  
- ◆ “There is **mixed evidence** on relation between the introduction of controls and the pace of capital inflows. -- Capital controls are likely to be most effective when they target short-term investment and foreign-currency lending.” (Engel, 2015)

### 3. Related Literature

- ◆ There have been **a few empirical studies** on the impact of FX-related macroprudential measures **in Korea** since 2010.
  - Choi (2014) : **Counterfactual analysis**
    - These measures have contributed to boosting resilience in the banking system, in that they reduced mainly banks' short-term foreign borrowings.
  - Bruno and Shin (2014) : **Panel study**
    - Capital inflows became less responsive to global factors after the adoption of these measures.
  - Huh and An (2014): **Dummy variable analysis**
    - Leverage caps have a significant dampening effect on debt securities and short-term loans
- cf. Kim and Yang (2012): **Capital control / liberalization index**
- ➔ Promising **Qualitative VAR**: the overall policies' effects
- ➔ **Counterfactual analysis** in a different way: policy/bank/maturity



# Econometric Methodologies

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# 1. Tools of Empirical Analysis

## ◆ Qualitative VAR

- **Latent policy stance variable** from binary policy variable
  - **Binary obs.** of various policies (Table1) w/ other variables → **continuous latent policy stance** (truncated Normal w/ MCMC)
  - Latent policy stance + other variables: **Standard IRF**

## ◆ Counterfactual analysis using Bayesian VAR

- BVARs are **separately estimated** (i) for periods before and after policy adoption (**leverage caps, levy**), (ii) for different bank types (**DB, FBB**) and (iii) for different maturities (**S-T, L-T**)
- Control environmental variables to be equal across regimes and compare **conditional forecasts** at the same periods
- Interpret their **differences** as policy effects
  - By nature, **no causal interpretation**
  - But, some policies like a **regulation**, can be considered as **most exogenous**

## 2. Qualitative VAR

- ◆ Qualitative VAR (Qual VAR) : Dueker (2005), Tillmann (2015)
  - Unlike conventional monetary policy, macroprudential policy has multi-dimensional nature and multiple measures.
  - The Qual VAR can reveal **the latent propensity for macroprudential policy** from actual policy events (Table 1) and other variables related to capital flows.
  - We assume that **binary policy variables** come from **unobserved policy stance** that follows **truncated normal**.

$$y_t = \begin{cases} 0 & \text{if } y_t^* \leq 0 \\ 1 & \text{if } y_t^* > 0 \end{cases}$$

$$y_t^* = \rho y_{t-1}^* + \mathbf{X}_{t-1} \boldsymbol{\beta} + \epsilon_t, \quad \epsilon_t \sim N(0, 1)$$

## 2. Qualitative VAR

- ◆ Markov Chain Monte Carlo (MCMC) estimation
  - VAR coefficients are normally distributed with the mean and variance given by the OLS estimates.
  - Covariance matrix  $\Sigma$  is sampled from an inverted Wishart distribution.
  - The latent variable follows a **truncated Normal distribution** where  $y_t^*$  is positive whenever  $y_t$  is equal to 1 and negative otherwise
  - We run 10,000 iterations and discard the first 5,000 iterations.

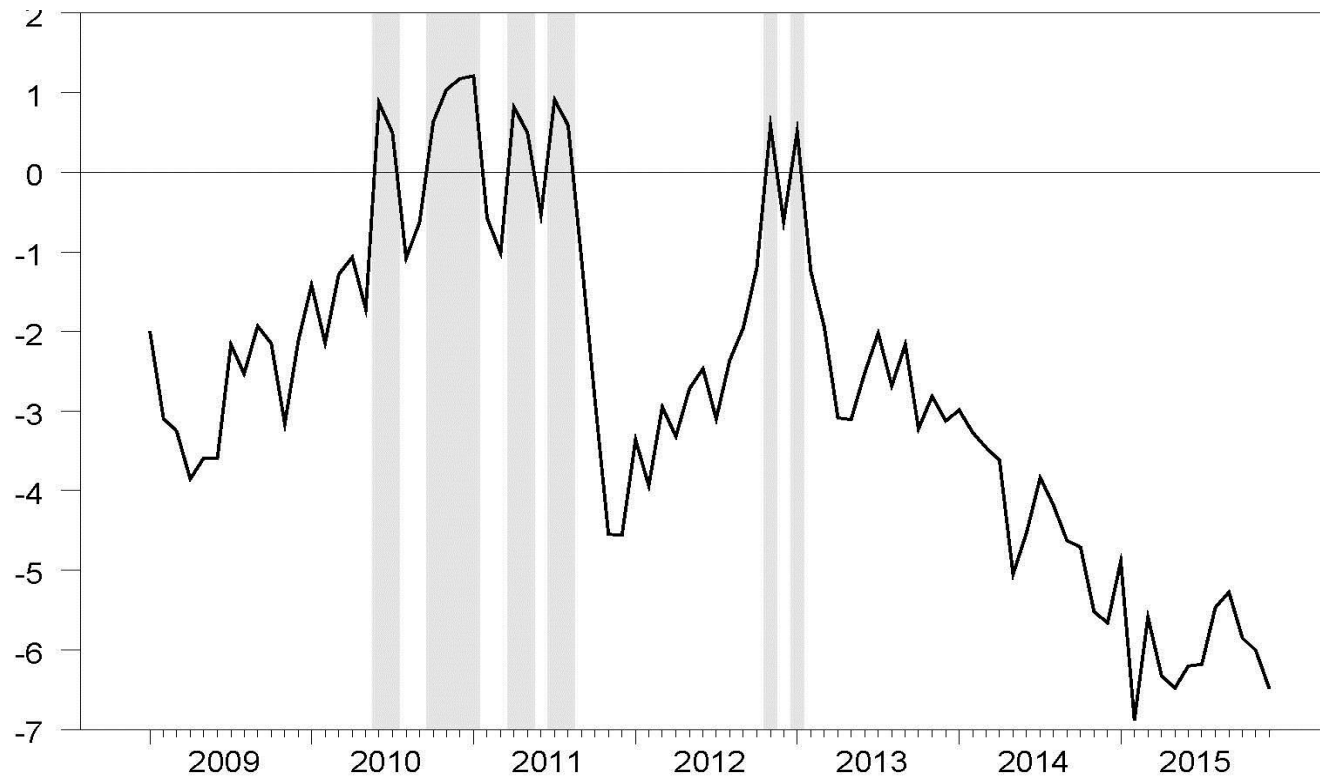
## 2. Qualitative VAR

- ◆ Sample period : Jan. 2009 to Dec. 2015
  
- ◆ Capital inflow measures (as a share of nominal GDP)
  - **Gross capital inflows** (BOP liabilities) : net purchases of domestic assets by non-residents, or
  - Change in banks' stock of **foreign borrowing**, or
  - **Bond inflows** (BOP liabilities)
  
- ◆ Other variables
  - Growth rate of **global liquidity**
  - **VIX** Index
  - Growth rate of **industrial production**
  - **Latent variable** constructed by policy actions

## 2. Qualitative VAR

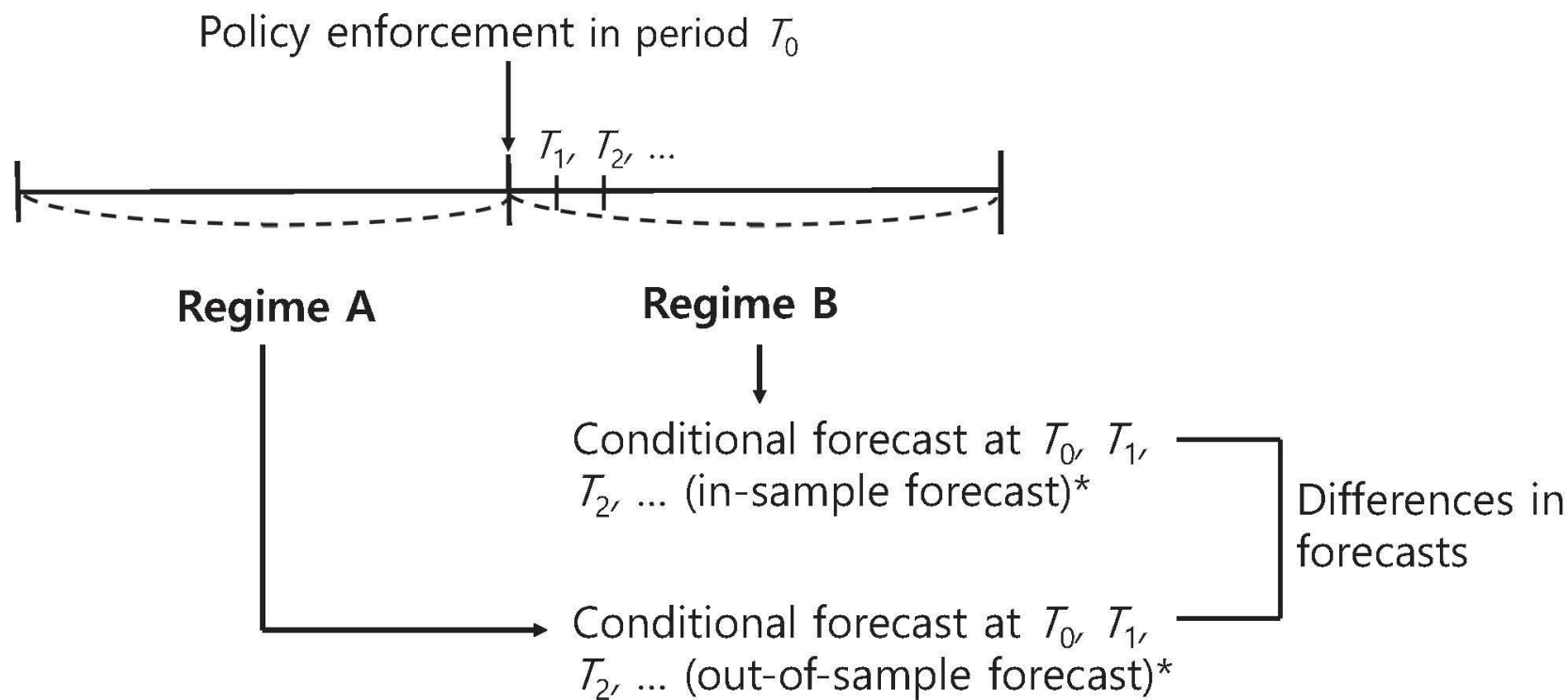
- ◆ VAR identification
  - Cholesky decomposition : Liquidity, VIX, IP, CF (or foreign borrowing),  $y_t^*$  w/ lag =1
- ◆ Latent propensity to FX-related macroprudential policies

### Latent Policy Stance Variable



# 3. Counterfactual Analysis Using Bayesian VAR

## Counterfactual Experiments Using Conditional Forecasts



\* Excepting variables of interest, each variable is constrained to follow the same future path across regimes

# 3. Counterfactual Analysis Using Bayesian VAR

- ◆ Data (monthly: Sept. 2006 ~ Dec. 2015)
  - Baseline five-variable model (Extended model: S-T and L-T)
    - **Global liquidity**
    - Baltic exchange dry index (**BDI**)
    - **Foreign borrowing** of banks (% of annual GDP)
    - The ratio of **FX derivative position** to capital
    - Short- or long-term **arbitrage** (or **borrowing spread**)
  
- ◆ Bayesian VAR in Giannone, Lenza and Primiceri (2015)
  - Informative prior under hierarchical structure: Suited for short time series in Korea
  - Separately estimate VAR coefficients before and after 2010.10M, i.e. implementation date of leverage caps
  
- ◆ Counterfactual experiments

# 3. Counterfactual Analysis Using Bayesian VAR

- ◆ Unconditional forecasts for each regime / same forecasting points
  - Regimes based on **leverage caps** and **stability levy**
- ◆ Conditional forecasts for each regime / same forecasting points
  - Control **all other variables** excepting those of interest to follow **the same future paths across regimes**
- ◆ Interpretation of the difference in forecasts
  - By nature, **causal interpretation is not allowed**
  - However, leverage caps are a kind of **regulation**
  - Whatever endogenous relationship among variables, leverage caps were kept by banks (by means of adjusting other variables) due to the macroprudential policy
  - Interpret the **difference** across regimes as **policy effects**

# 3. Counterfactual Analysis Using Bayesian VAR: Some Issues

- ◆ **Classification of two regimes:** Before and after 2010.10M
  - **Leverage caps has changed** since 2010.10M: hence we compute a kind of average effects of different caps
  - **The date of stability levy** does not exactly coincide that of leverage caps.
- ◆ To measure the effects of stability levy, we add an additional assumption
  - Assume that banks have an incentive to keep the **profitability**, especially with respect to the rate of return, **equal across regimes**
  - Define the effects as **endogenous changes in foreign borrowing** (and FX deriv. position) which ensure **the same actual rate of return** (levy costs are considered) across regimes

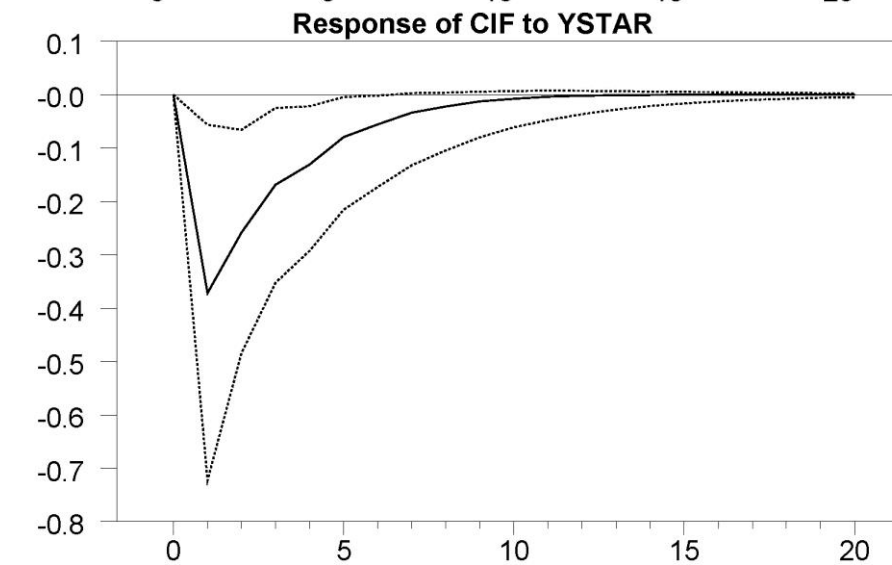
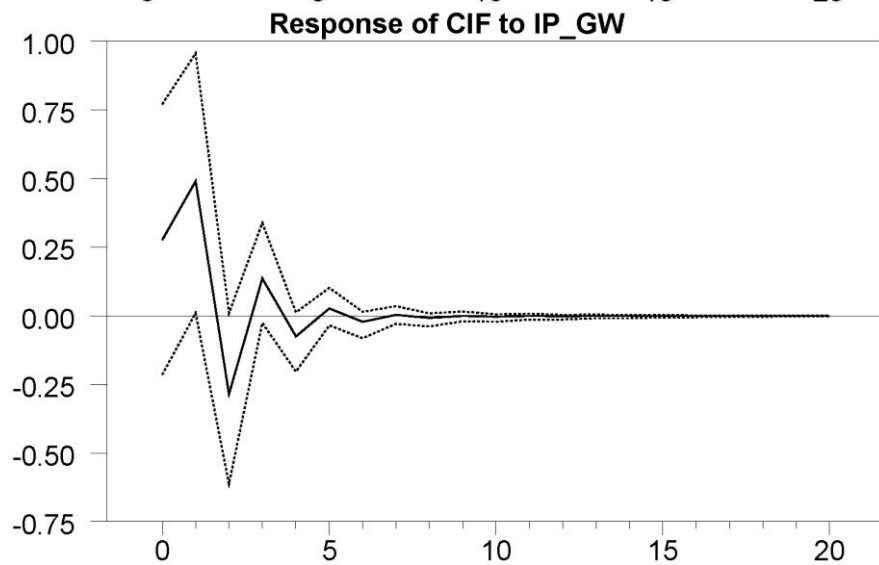
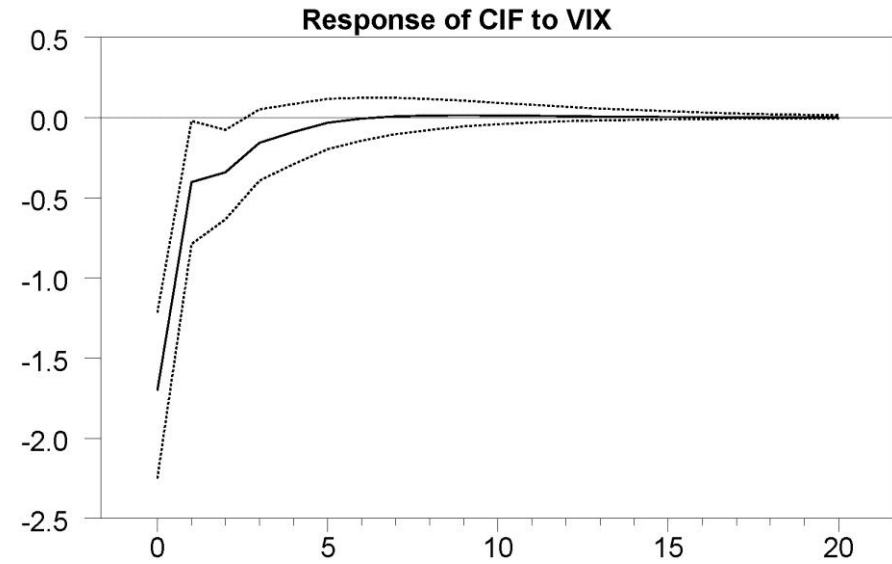
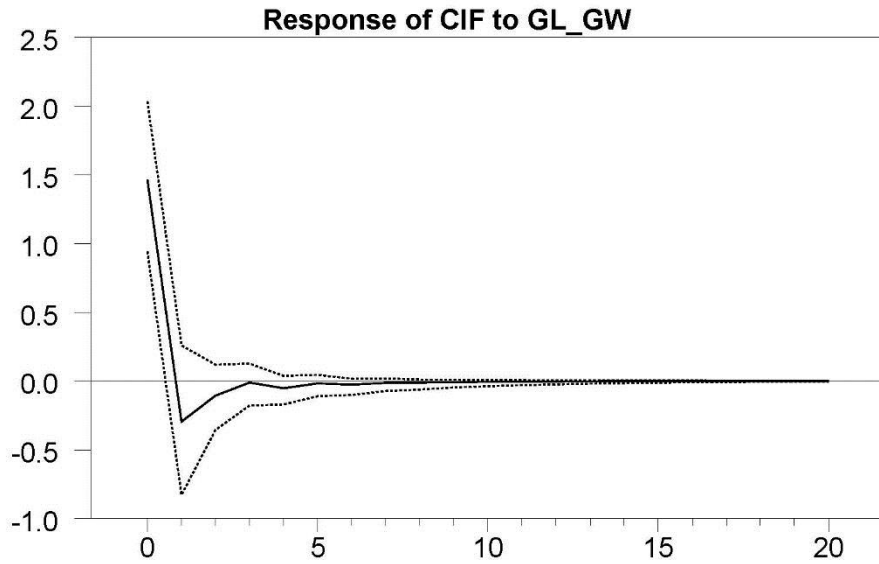


## **Empirical Evidence**

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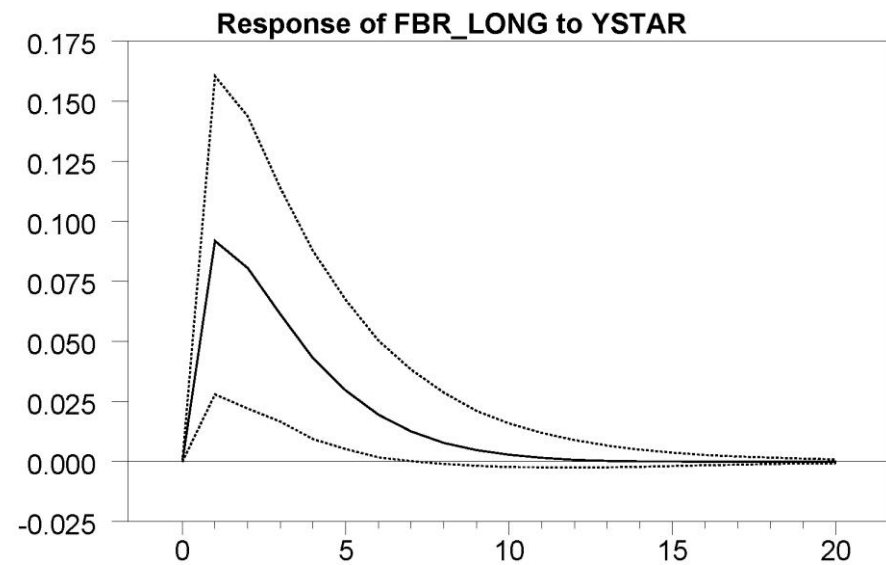
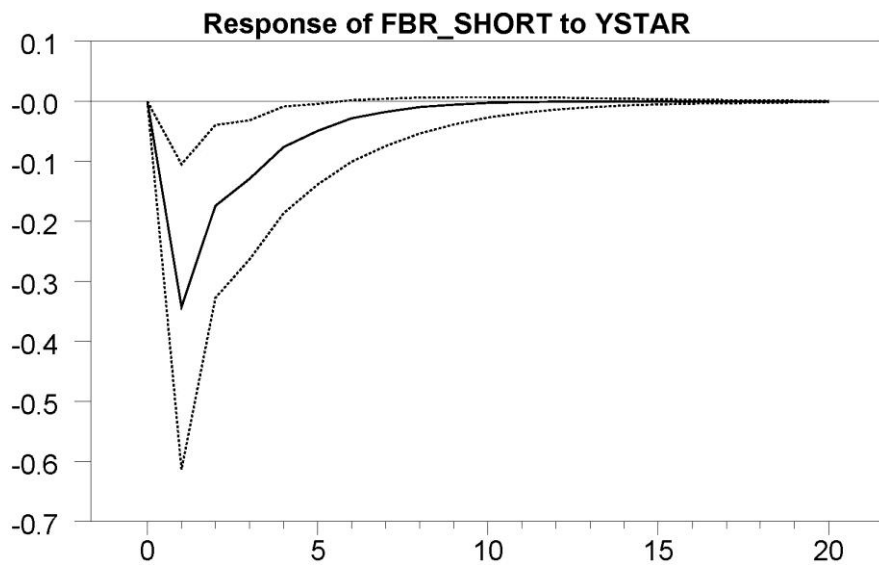
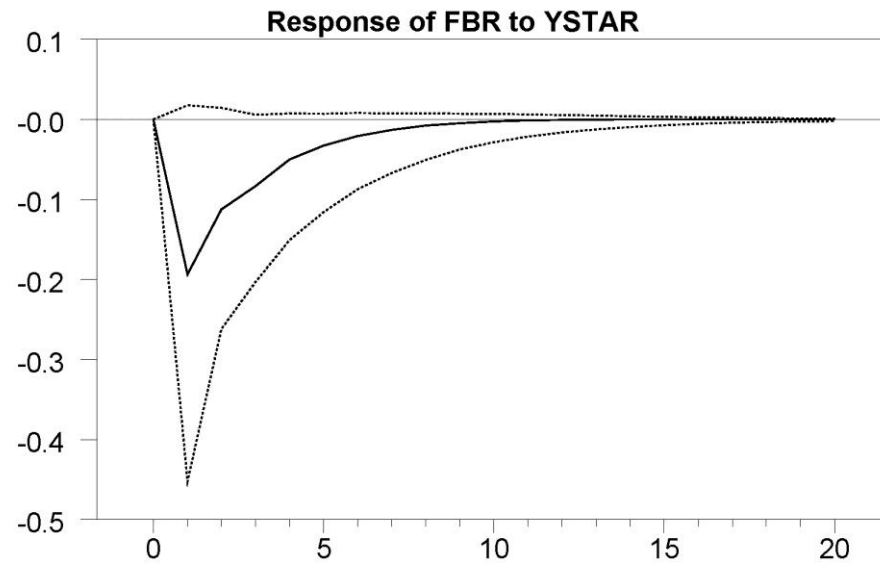
# 1. Qualitative VAR: Total Capital Inflows

## Responses of Total Capital Inflows to Various Shocks



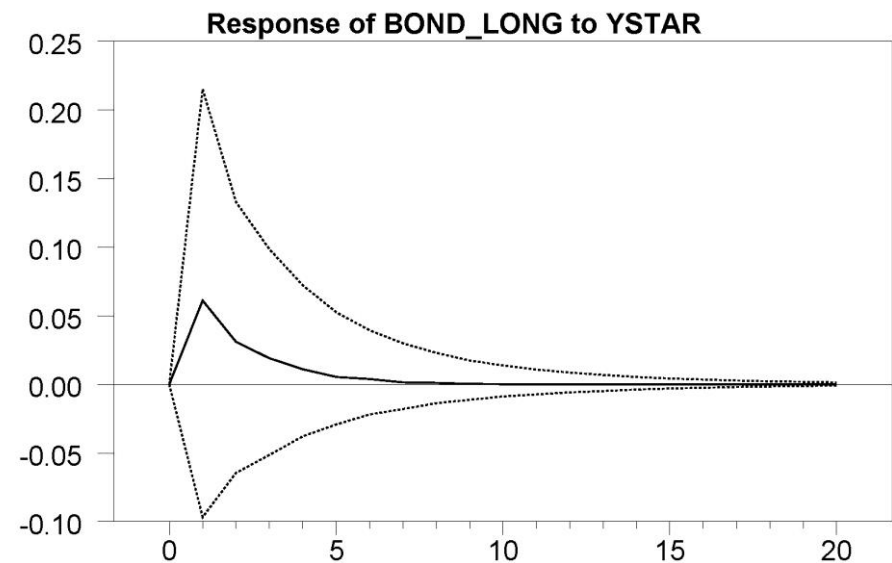
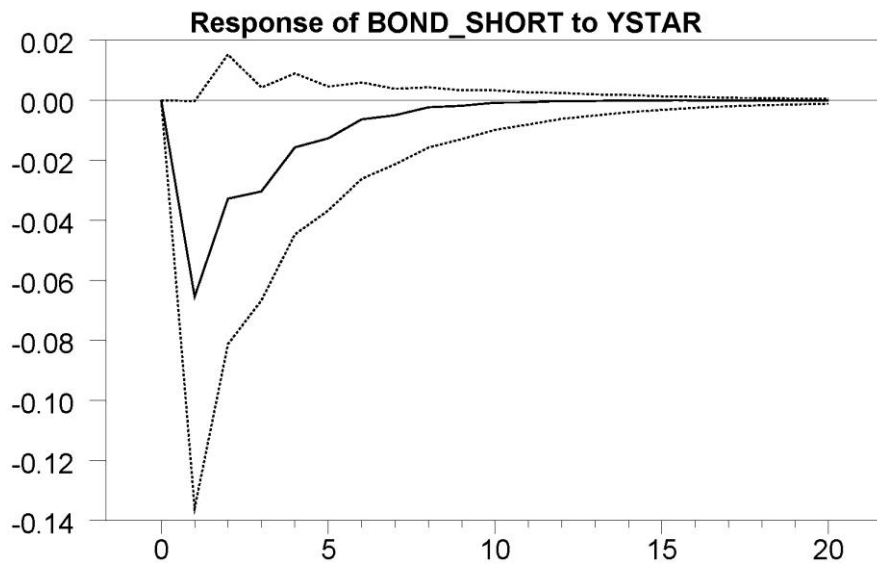
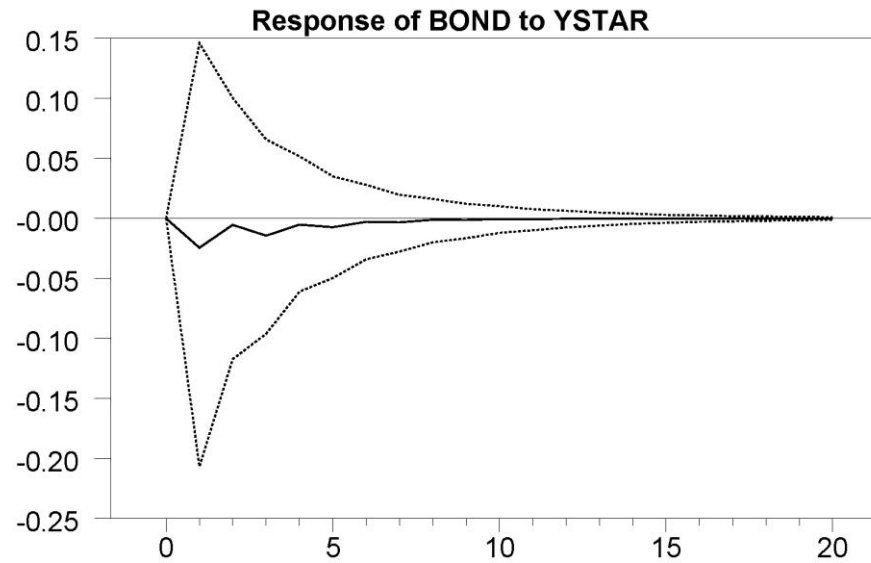
# 1. Qualitative VAR: Banks' Foreign Borrowing

## Responses of Banks' Foreign Borrowing to Policy Shock



# 1. Qualitative VAR: Bond Inflows

## Responses of Bond Inflows to Policy Shock

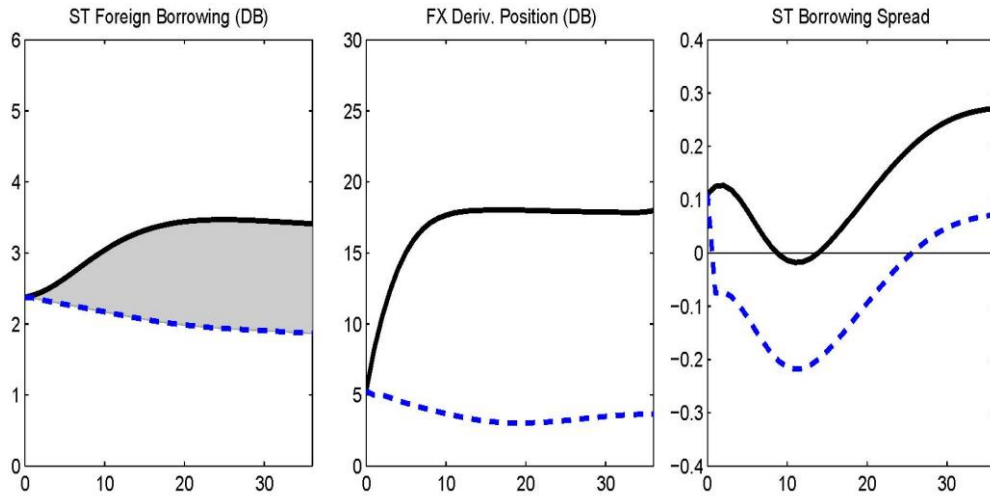


# 1. Qualitative VAR: Summary

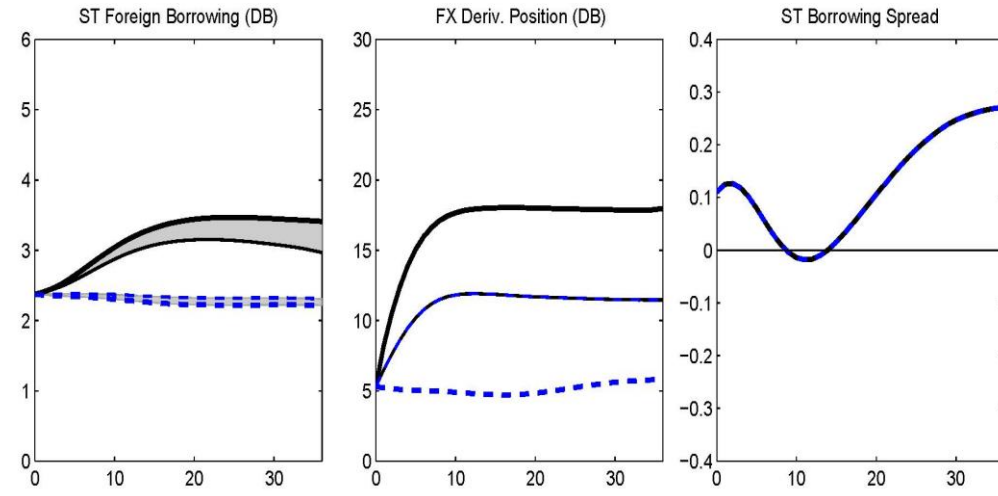
- ◆ Korea's recent FX-related macroprudential measures have been effective in **curbing excessive capital inflows**.
- ◆ In particular, these measures have contributed to mitigating FX market vulnerability by **extending the maturity of foreign borrowing** at the banking sector.
- ◆ The effects on **short-term bond inflows** are weaker than those on **short-term foreign borrowing**
  - Macroprudential measures focus on short-term foreign borrowing
  - Korea's sound economic fundamentals relative to other EMEs, induce steady inflows of portfolio investment

# 2. Counterfactual Analysis: DB, S-T Borrowing

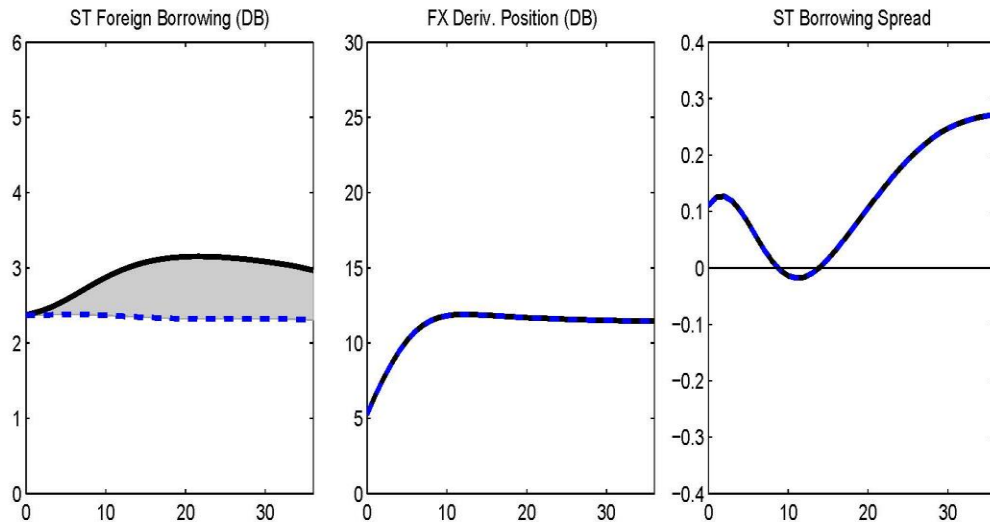
## Overall Effect on Domestic Banks



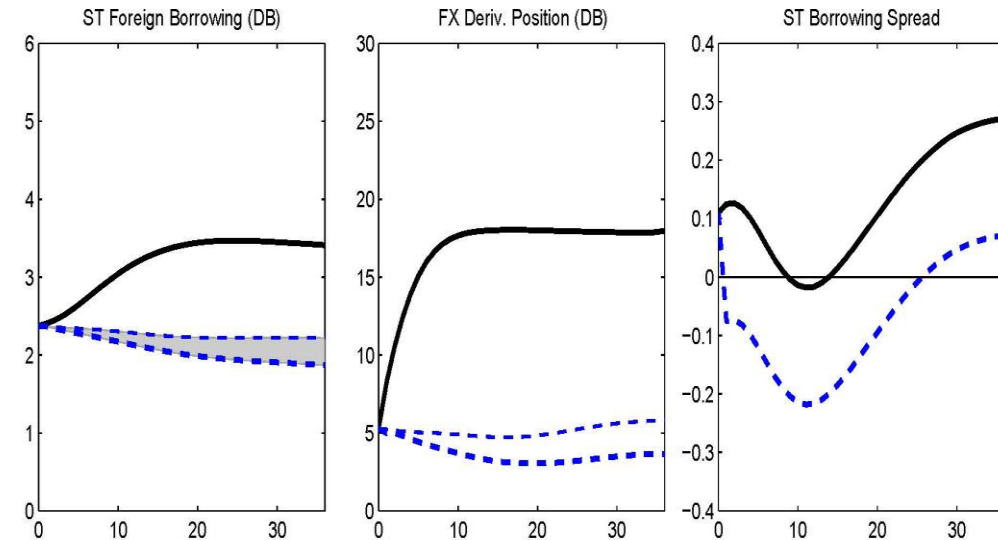
## (2) Effect of Leverage Caps Only



## (1) Non-Separable Mixed Effect

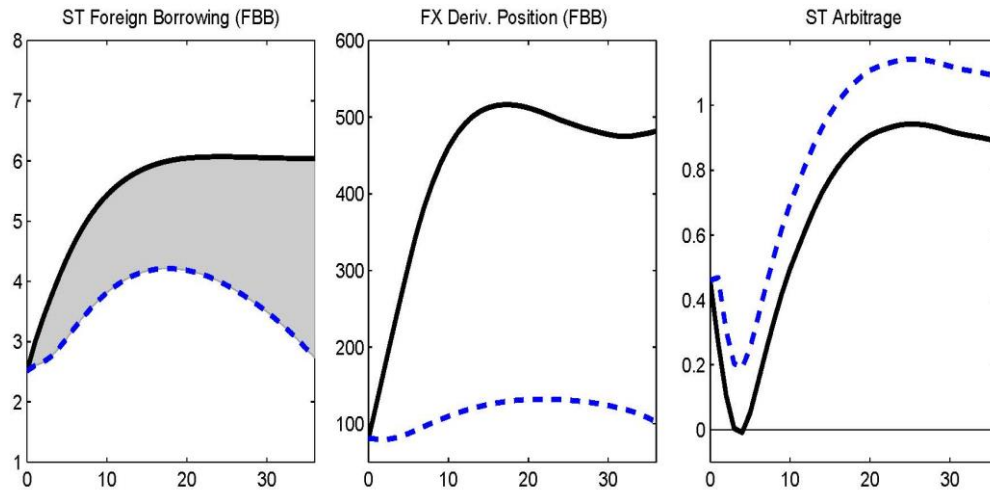


## (3) Effect of Stability Levy Only

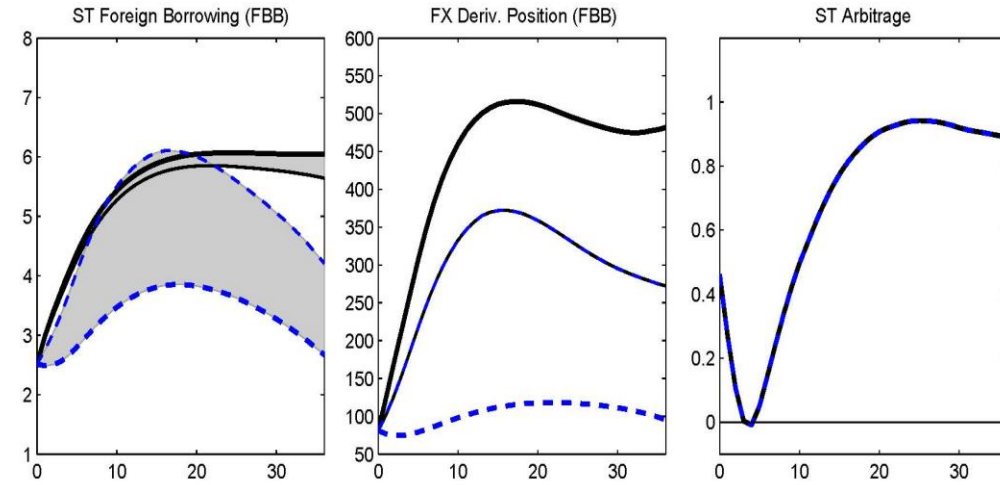


# 3. Counterfactual Analysis: FBB, S-T Borrowing

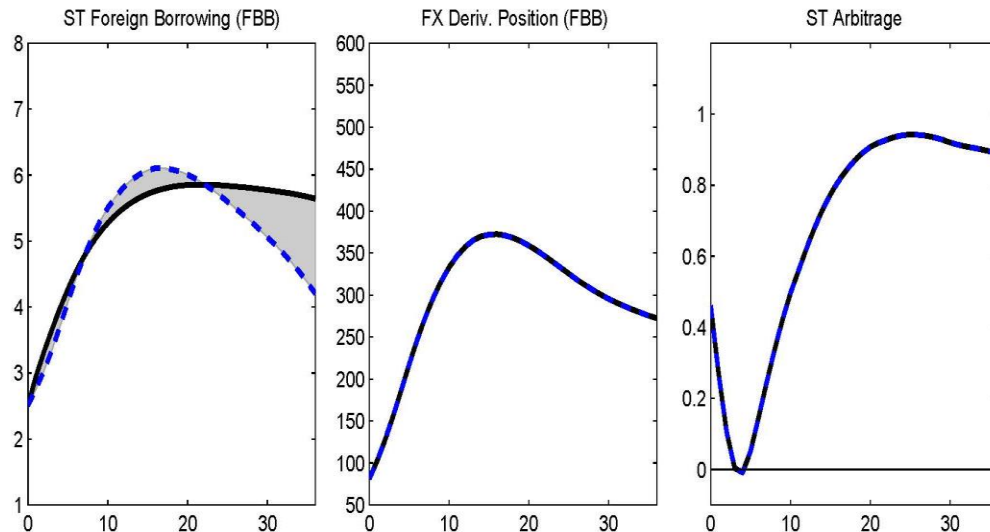
## Overall Effect on Foreign Bank Branches



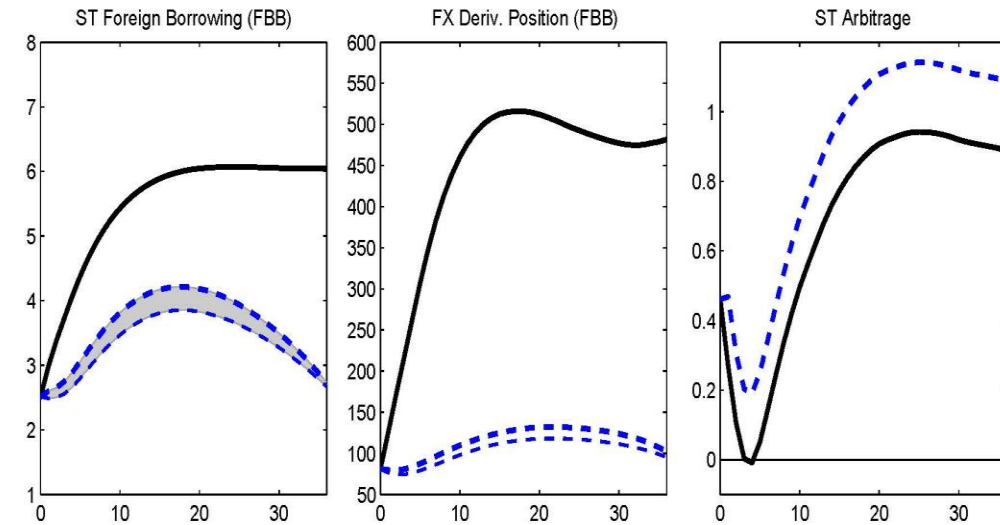
## (2) Effect of Leverage Caps Only



## (1) Non-Separable Mixed Effect



## (3) Effect of Stability Levy Only



# 3. Counterfactual Analysis: S-T Borrowing

- ◆ Policy effects on short-term foreign borrowing
  - **Overall effect on FBBs** is larger than that on DBs
  - For DBs (FX demander), **leverage caps and stability levy** work in decreasing foreign borrowing / **behavior change**
  - For FBBs (FX supplier), **only leverage caps** have large negative effects / **no behavior change** (←mixed effect)

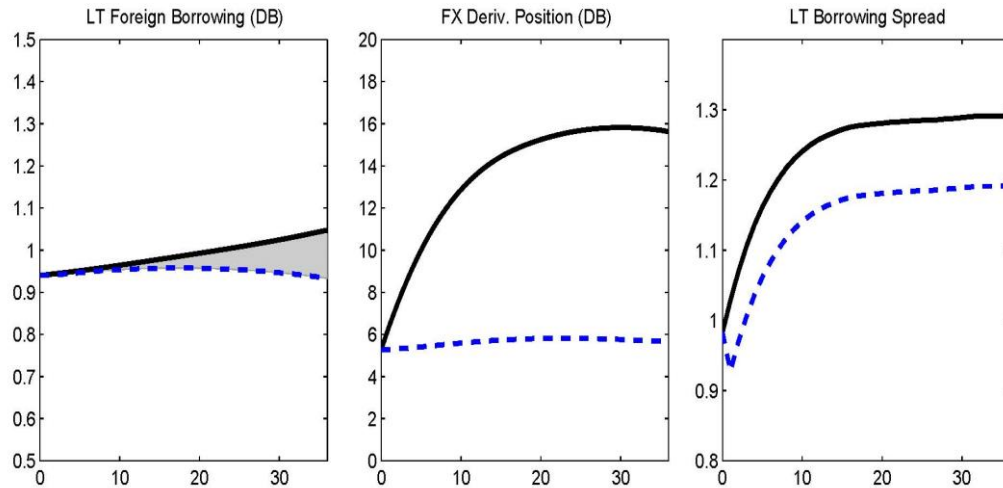
Table 2: Decomposition of the Policy Effects on Short-Term Foreign Borrowing

Bank	Decomposition	Months after policy implementation					
		6	12	18	24	30	36
Domestic banks	Overall	-0.47	-1.05	-1.39	-1.52	-1.54	-1.54
	Mixed	<b>-0.25</b>	<b>-0.61</b>	<b>-0.80</b>	<b>-0.82</b>	<b>-0.76</b>	<b>-0.66</b>
	Leverage caps only	-0.13	-0.28	-0.37	-0.43	-0.47	-0.53
	Stability levy only	-0.08	-0.15	-0.22	-0.27	-0.32	-0.35
Foreign bank branches	Overall	-1.43	-1.66	-1.79	-2.07	-2.56	-3.31
	Mixed	-0.10	0.32	0.27	-0.15	-0.72	-1.44
	Leverage caps only	<b>-1.61</b>	<b>-2.33</b>	<b>-2.42</b>	<b>-2.24</b>	<b>-2.06</b>	<b>-1.94</b>
	Stability levy only	0.28	0.36	0.36	0.32	0.22	0.06

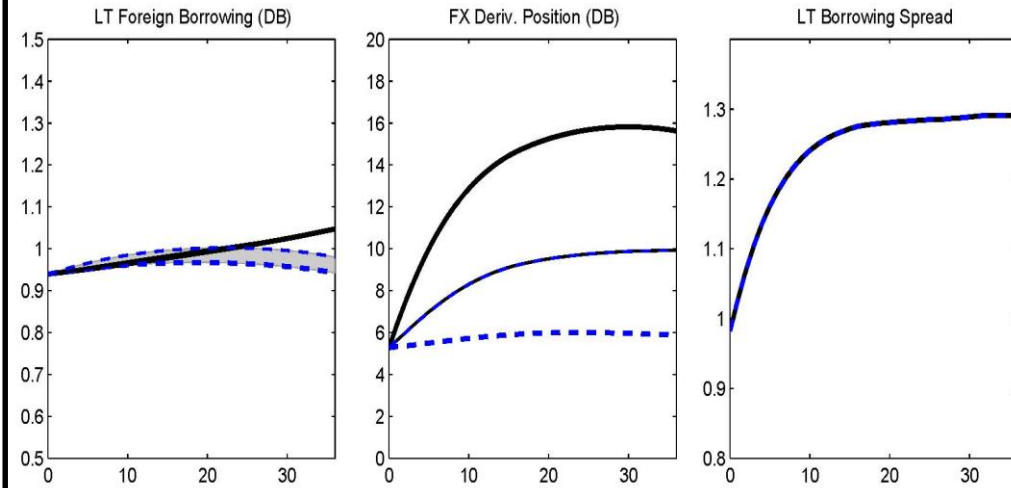
Note: 1) All numbers are in unit of percentage point.

# 3. Counterfactual Analysis: DB, L-T Borrowing

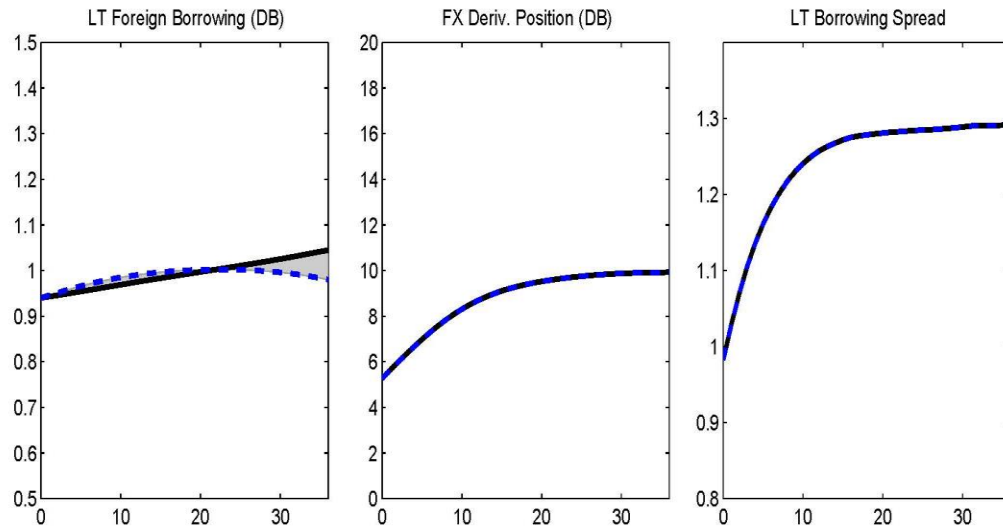
## Overall Effect on Domestic Banks



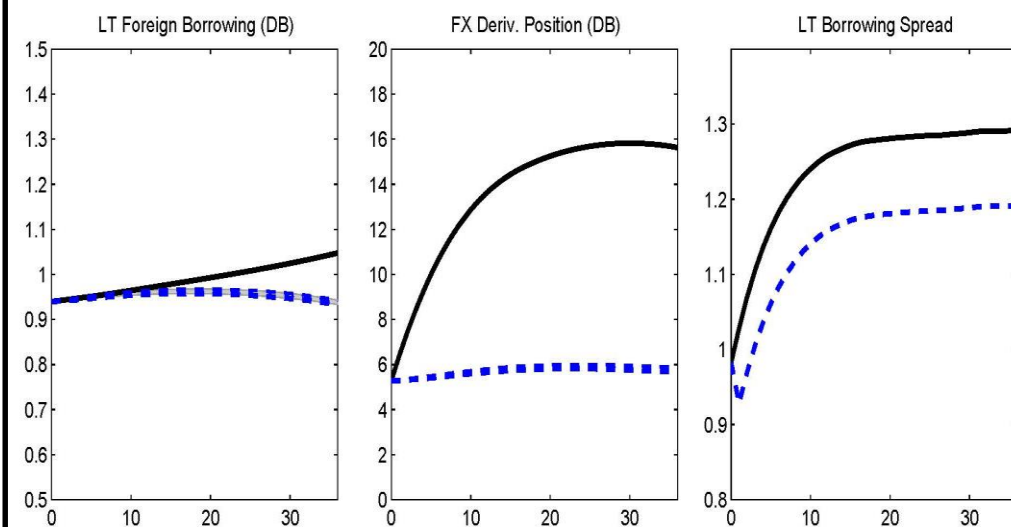
## (2) Effect of Leverage Caps Only



## (1) Non-Separable Mixed Effect

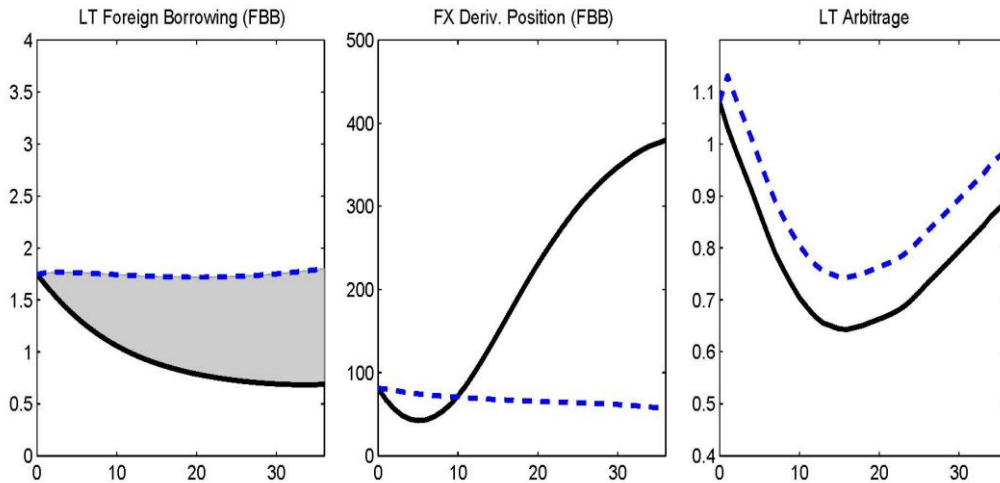


## (3) Effect of Stability Levy Only

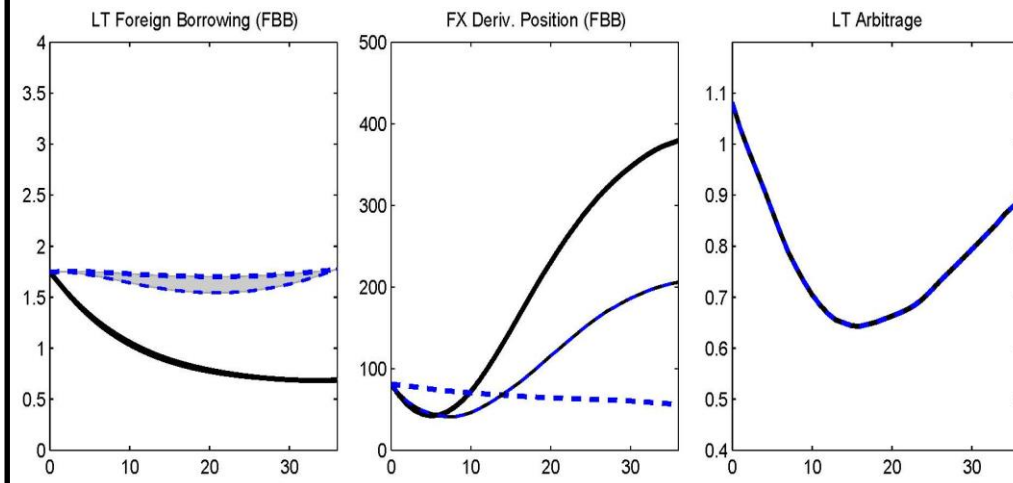


# 3. Counterfactual Analysis: FBB, L-T Borrowing

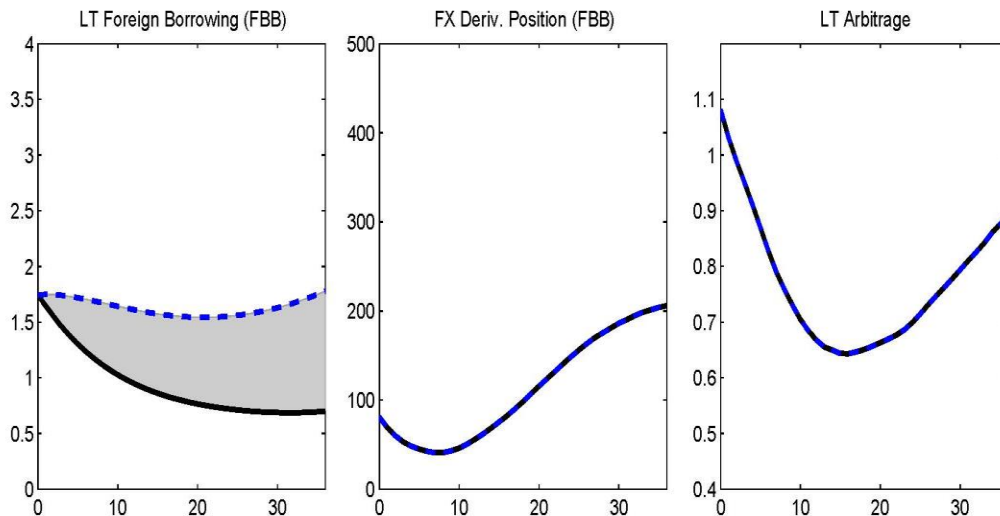
## Overall Effect on Foreign Bank Branches



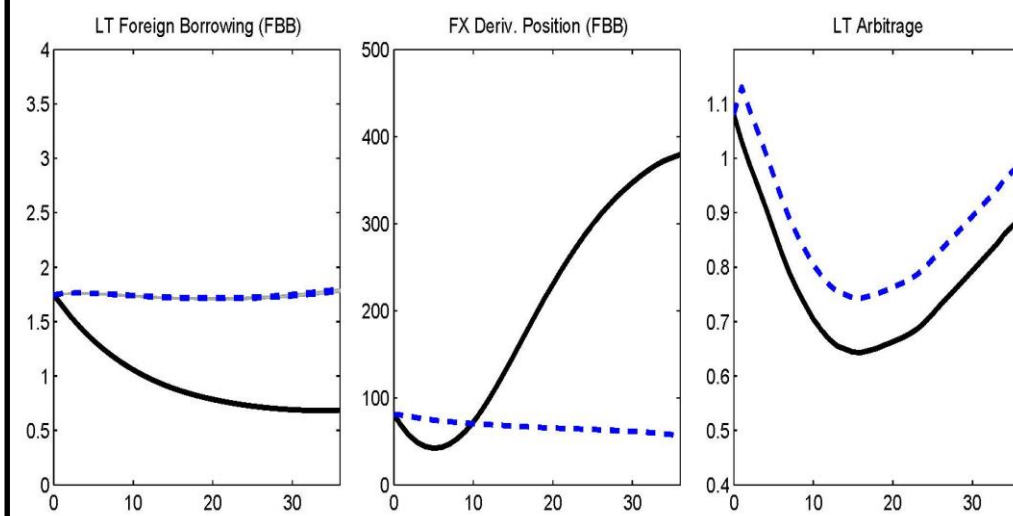
## (2) Effect of Leverage Caps Only



## (1) Non-Separable Mixed Effect



## (3) Effect of Stability Levy Only



# 3. Policy Effects: L-T Borrowing

- ◆ Policy effects on long-term foreign borrowing
    - **Overall effect on FBBs** is prominent (L-T borrowing ↑)
    - These may be due to **changes** in the behavior of FBBs w.r.t. **asset management due to leverage caps**
      - Asian bank branches: L-T borrowing ↑ (to match maturity) & FX lending ↑  
→ no change in FX deriv. position
- c.f. American or European bank branches

Table 3: Decomposition of the Policy Effects on Long-Term Foreign Borrowing

Bank	Decomposition	Months after policy implementation					
		6	12	18	24	30	36
Domestic banks	Overall	-0.01	-0.01	-0.03	-0.05	-0.08	-0.11
	Mixed	0.01	0.02	0.01	-0.01	-0.03	-0.06
	Leverage caps only	<b>-0.01</b>	<b>-0.02</b>	<b>-0.03</b>	<b>-0.03</b>	<b>-0.04</b>	<b>-0.04</b>
	Stability levy only	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Foreign bank branches	Overall	0.49	0.75	0.90	0.99	1.06	1.11
	Mixed	<b>0.47</b>	<b>0.66</b>	<b>0.75</b>	<b>0.83</b>	<b>0.94</b>	<b>1.08</b>
	Leverage caps only	0.01	0.08	0.13	0.14	0.10	0.01
	Stability levy only	0.01	0.01	0.01	0.02	0.02	0.03

Note: 1) All numbers are in unit of percentage point.



## **Concluding Remarks**

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- ◆ We assess the effects of Korea's FX-related macroprudential measure by using a Qual VAR model and a counterfactual analysis
- ◆ Korea's recent macroprudential measures have been effective in mitigating FX market vulnerability
  - Reduces banks' **short-term foreign borrowings** and extends their **average maturity**
  - Seems to dampen **portfolio investment inflows** over the sample period

- ◆ The effects of macroprudential policies are quite different depending on policy type, bank type and maturity
  - **Leverage caps** have relatively larger dampening effects on **short-term foreign borrowing of FBBs** and lead to an increase in long-term foreign borrowing of FBBs
  - **Macroprudential stability levy** works as a device to limit **short-term foreign borrowings of DBs**, but not of FBBs
  
- ◆ There are a few cautions in interpreting the results
  - Multi-dimensional nature and various types of policy tools
  - Measures were implemented in response to the sharp rise in capital inflows

# Thank you

