Real-Financial Linkages: Policy Models at the Bank of Canada

Economic and Financial Crisis: Lessons from the Past and Reforms for the Future

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Outline

1. A generation of Bank of Canada models
2. Recent literature
3. Lessons from the crisis
4. Recent model development at the Bank of Canada
5. Conclusion

Traditional View of the Canadian Monetary Policy Transmission Mechanism (1)

- At the Bank of Canada the mainstream paradigm is articulated around three major sets of linkages (Thiessen 1995):
  1. From the overnight rate to other financial variables (term structure of market interest rates, rates on deposit and loans at financial institutions , equity prices, and the exchange rate).
  2. From financial variables to aggregate demand and the output gap.
  3. From the output gap, the exchange rate, and inflation expectations to inflation.

Traditional View of the Canadian Monetary Policy Transmission Mechanism (cont.)

- Financial factors (such as financial frictions and time-varying premiums) in the transmission mechanism have not received as much attention.

Generation of Bank of Canada Models

Small Annual Model (SAM)

- Small Annual Model (SAM) differed from its predecessors
  - Well-defined steady-state; complete wealth accounting; a supply side; explicit energy market; economic behaviour was derived using the same framework; expectations were partly model consistent
- SAM featured multiple financial assets: government bonds, net foreign assets, physical capital (equity) and money
  - Asset prices were determined by model-based fundamentals; valuations affected by interest rates
- Monetary policy controlled base money supply

SAM (cont.)

- Household demand was influenced by financial wealth and the real interest rate
  - Excess real money balances also played an important role in influencing consumption
- Business investment was affected by short-term interest rates and equity prices
- Real exchange rate affects the trade balance

Quarterly Projection Model (QPM)

- Quarterly Projection Model (QPM) was the Bank staff's workhorse projection model over the (1993-2005) period

- Built on lessons learned from SAM; shared a similar philosophy including a top down focus and an important role for expectations, supply –side, stock-flow equilibria

- QPM also featured multiple financial assets: long and short-tem government bonds, net foreign assets, physical capital (equity); No money
  - Asset prices were determined by model-based fundamentals

QPM (cont.)

- Monetary policy set the short-term risk free rate (target overnight rate)
- Household spending was linked to the **slope of the yield curve** and financial wealth
  - QPM includes “hand-to-mouth” consumers who don’t have access to credit markets
- Business investment spending was linked to real short and long-term risk-free interest rates + risk premium on capital
- Exchange rate influenced by interest rate differentials
- Net exports are linked to the real exchange rate
- Exogenous risk premiums on interest rates associated with capital, government debt, and the exchange rate

Terms of Trade Economic Model (ToTEM)

- ToTEM builds on the advances of QPM
- Unlike QPM, however, ToTEM incorporates optimizing behaviour on the part of firms and households, both in and out of steady state
- ToTEM is a fully specified multi-sector model; good for terms-of-trade shocks
- Multiple financial assets (held in the form of government bonds, physical capital and net foreign assets)
  - Prices are endogenously determined but determined by model-based fundamentals

ToTEM (cont.)

- Monetary policy set the overnight rate
- Household expenditures and business investment are influenced by the current overnight rate but more importantly by model consistent expectations of future overnight interest rates + risk premium over the government debt rate
  - Includes “hand-to-mouth” consumers who don’t have access to credit markets
- Exchange rate influenced by expected interest rate differentials and by the degree of foreign indebtedness
- Net exports are a function of the exchange rate

Recent Literature: Brief Review

Recent Literature

- There has been progress in building and estimating DSGE models that fit quarterly data well by standard econometric criteria.

- In practice these models abstract from details of financial markets and interaction with real economy.

- A common presumption: asset markets passively reflect fluctuations in standard shocks and contribute little to propagation and amplification.

Recent Literature: Findings

- Shocks that originate in the financial sector account for a significant portion of business cycle fluctuations.

- The Fisher debt-deflation channel has a substantial impact on propagation.

- The bank capital channel greatly amplifies and propagates the effects of shocks (due to procyclicality).

Lessons from the Recent Crisis

Lessons from the Recent Crisis

- The crisis has clearly illustrated that financial factors can have a very strong effect on the transmission mechanism.

- In addition, time-varying term, liquidity and risk spreads have been shown to be empirically relevant for explaining real activity, as have non-price terms for credit.

Lessons from the Recent Crisis (cont.)

- Another insight from the crisis is that broader **procyclical** dynamics in money, asset and credit markets have important implications for the real economy and hence monetary policy (see the work of the CGFS).

- These lessons point to the need for models that can address financial frictions (balance sheet considerations), incorporate more than one interest rate, and include non-price (liquidity/credit) constraints.
  - Increasing volume of research is now being produced by academics and central bank researchers including those at the Bank of Canada.

Recent Model Development at the Bank of Canada

Recent Model Development at the Bank of Canada

- To deal with the financial crisis and the ZLB, the Bank of Canada staff adapted the main policy model (ToTEM).
- Bank staff also models balance sheets of banks in DSGE models with financial frictions:
  - Meh and Moran (2009, forthcoming *JEDC*)
  - Dib (2009)
- Bank staff also introduces credit and banking into Global Economy Model (GEM).

Modified ToTEM during the Crisis

- Multiple interest rates are included in a fully structural way (long- and short-term rates).
- Short- and long-term government bonds
  - long-term interest rates depend on expected short-term rates plus a liquidity premium
  - Long-term rates differ from expected short-term rates;
  - Monetary policy can affect long-term rates that are independent of expectations of short-term rates

Modified ToTEM during the Crisis (cont.)

- Allows to differentiate between the effects of a change in long-term rates that is caused by a shift in expectations of future short-term rates from one that comes about from a change in the liquidity premium.
- This is key for getting a grip on the potential impacts of **unconventional monetary policy**. (In the case of the Bank of Canada: conditional statements, credit easing and quantitative easing)
- Households and firms face short- and long-term borrowing rates:
  - includes exogenous risk premiums over risk-free rates

Modeling Balance Sheets of Banks in DSGE

The Bank of Canada is at the frontier in this area.

Standard DSGE models augmented with:

- Banking and bank capital

➢ Meh and Moran (2009): Bank capital mitigates an asymmetric information problem between a bank and its creditor (investor).

  – higher bank capital signals higher quality of bank

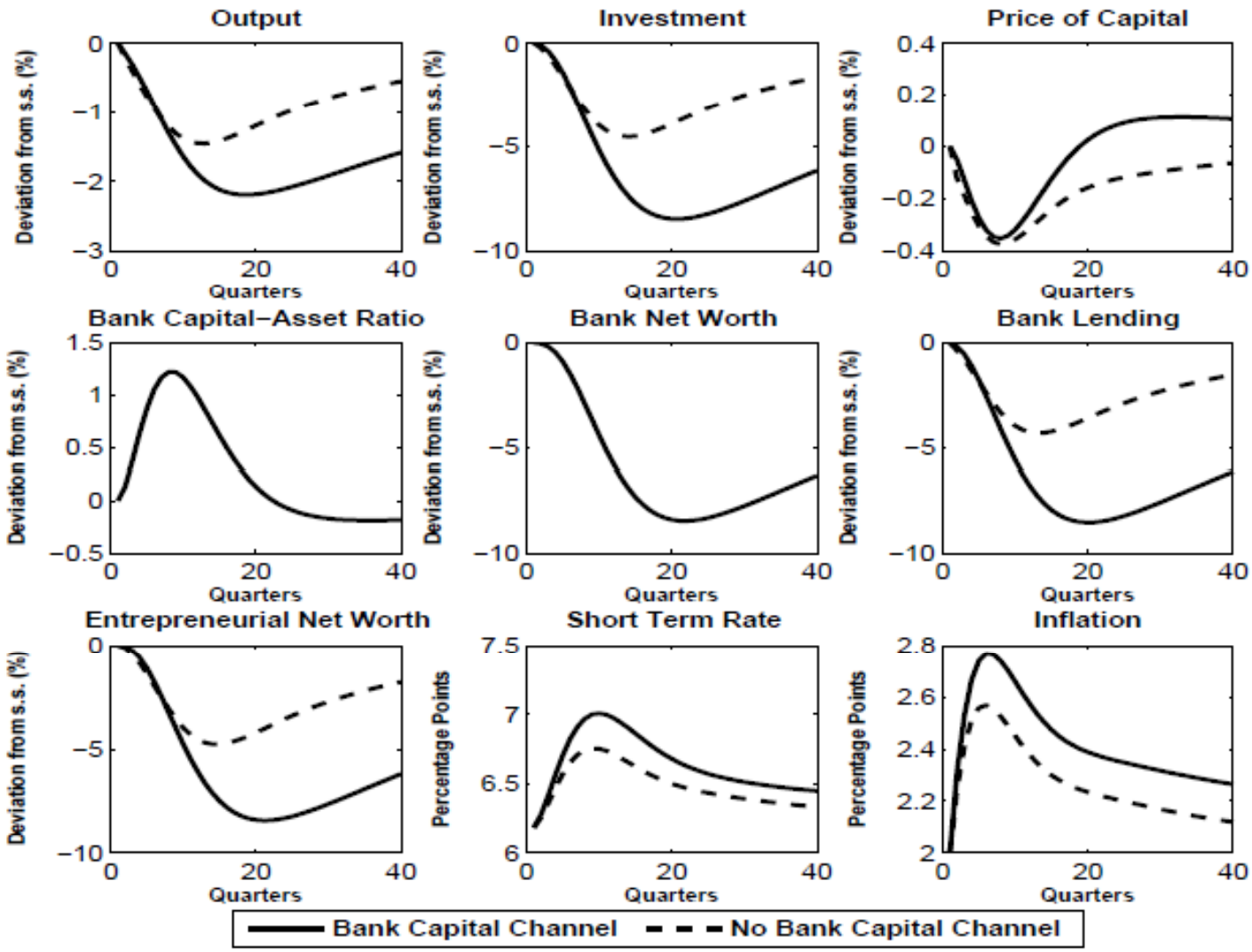
➢ Dib (2009): banks hold bank capital because of capital requirement.

- Both firms and banks are financially constrained.

Modeling Balance Sheets of Banks in DSGE: Findings

- Bank capital-asset ratio or leverage ratio is procyclical in terms of amplification of shocks.
- Well-capitalized banks are better able to absorb adverse shocks than less-capitalized ones.
- Bank capital requirement leads to an “attenuation” effects of financial shocks.
- Unexpected decrease in bank capital can lead to a prolonged recession.

Figure 1: Response to Technology Shocks
Source: Meh and Moran (2009)



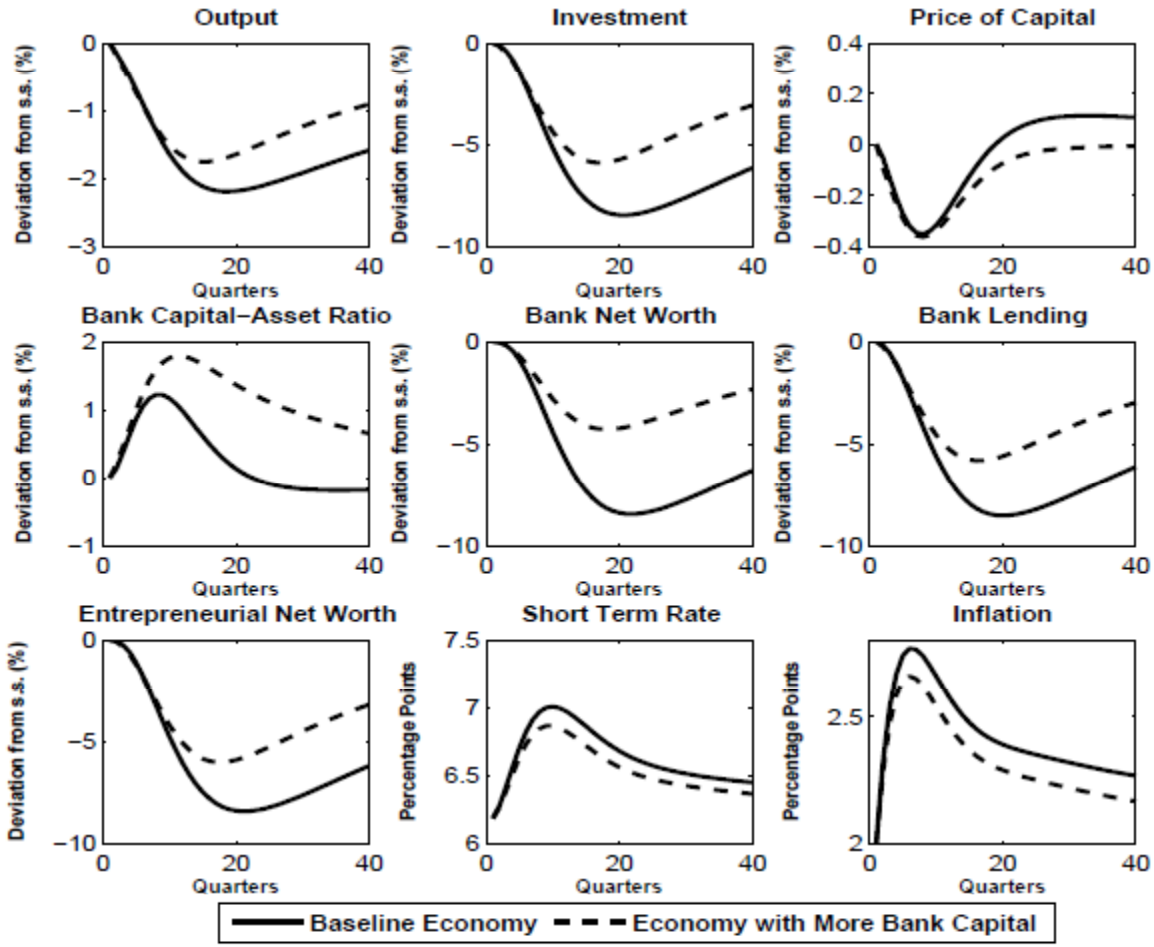
Intuition for Figure 1

- **Results: Presence of bank capital transmission channel amplifies and propagates shocks.**
- One-standard deviation negative productivity (supply) shock in 2 economies.
- No bank capital channel economy: banks do not need bank capital to make loans but firms still use net worth to borrow.
- Negative shock reduces the demand of capital goods and this leads to a decrease in price of capital goods.
- As expected, banks cut lending, and investment and output decrease. Inflation increases.

Intuition for Figure 1 (cont.)

- Bank capital channel economy (Baseline): The 2 economies are similar except that now banks need bank capital to lend.
- Since returns on investments fall after the shock, the incentives of banks to screen firms decrease. Such risk-taking behaviour increases the probability of default of banks.
- Market knowing this requires banks to hold more bank capital per unit of loan and this increases capital-asset ratios.
- Since bank capital cannot be raised readily (here, bank capital is accumulated from bank profits), bank lending falls in order to satisfy market-determined capital ratio (deleveraging).
- This effect makes investment and output fall more than the "no bank capital channel economy".

Figure 2: Response to Technology Shocks---Well- vs. Less-Capitalized Banks
Source: Meh and Moran (2009)



Intuition for Figure 2

- **Results: Well-capitalized banks are better able to absorb shocks (when banks need bank capital to make loan)**
- Note: In this experiment, banks in the two model economies need bank capital to obtain funds and thus make loans.
- In the economy with more bank capital (provided exogenously), the capital-asset ratio is higher.
- Because this model economy is well-capitalized, banks do not cut loans as much relative to the baseline economy (which has a lower capital-asset ratio).
- As a result, investment and output decrease less.

Some Policy Implications from Modeling Balance Sheets of Banks

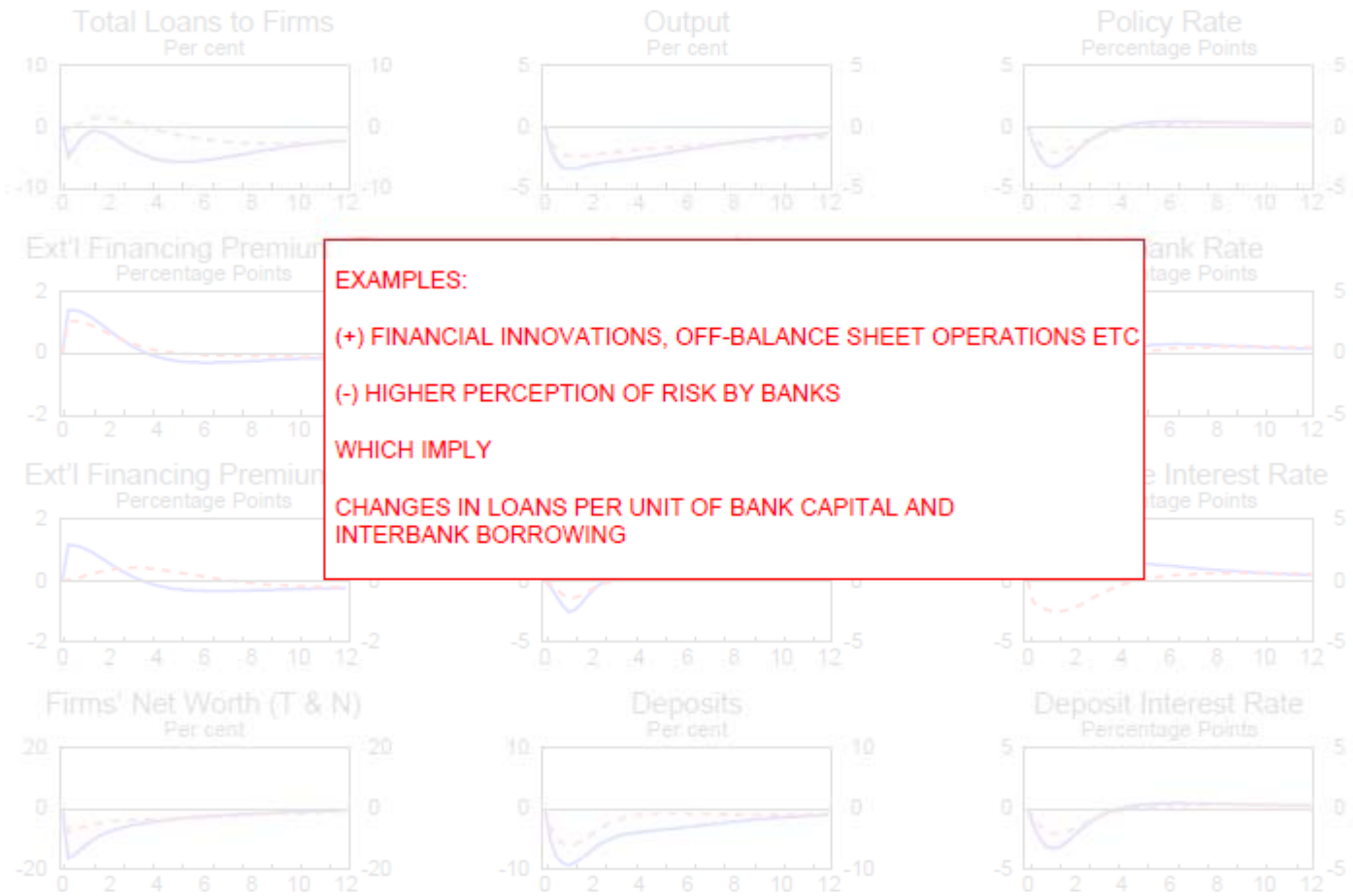
- bank capital channel amplifies and propagates shocks.
- additional amounts of bank capital help attenuate shocks.
- help assess use of countercyclincal capital buffers to address procyclicality (work underway at Bank of Canada).

Global Economic Model (BoC-GEM)

- BoC-GEM is a 5 region and 5 sector DSGE open economy model.
- Introduce credit markets and banking into the BoC-GEM (to become BoC-GEM-FIN):
  - Based on banking model of Dib (2009)
  - cross-border lending: firms borrow from domestic and foreign banks
  - Domestic and foreign financial shocks: intermediation, riskiness and probability of interbank default.

Figure 3: Temporary 5% Fall in U.S. Loan Supply

(Deviation From Control; Years)
(Blue = United States; Red = Canada)



EXAMPLES:

(+) FINANCIAL INNOVATIONS, OFF-BALANCE SHEET OPERATIONS ETC

(-) HIGHER PERCEPTION OF RISK BY BANKS

WHICH IMPLY

CHANGES IN LOANS PER UNIT OF BANK CAPITAL AND INTERBANK BORROWING

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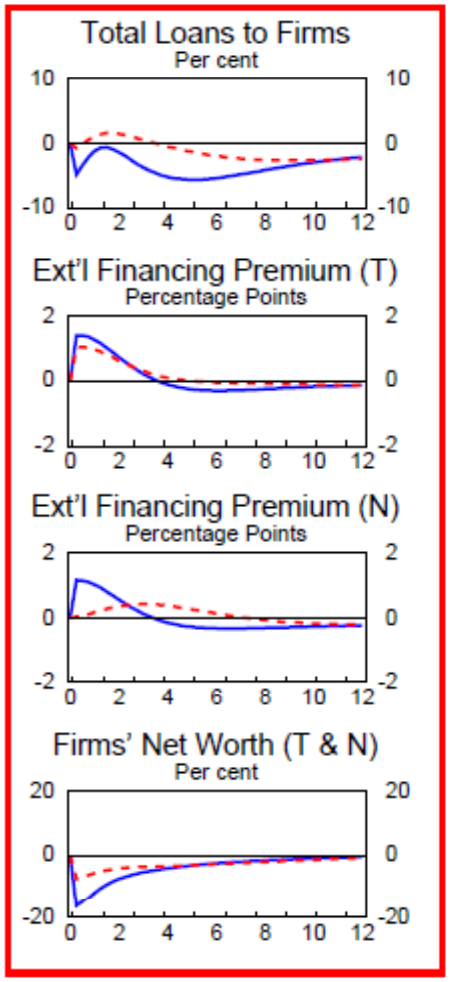

LOWER SUPPLY OF LOANS:

FOR THE SAME RISK, BANKS ARE LESS WILLING TO MAKE LOANS

HIGHER FINANCIAL COST FOR ENTREPRENEUERUS

REDUCTION IN NET WORTH

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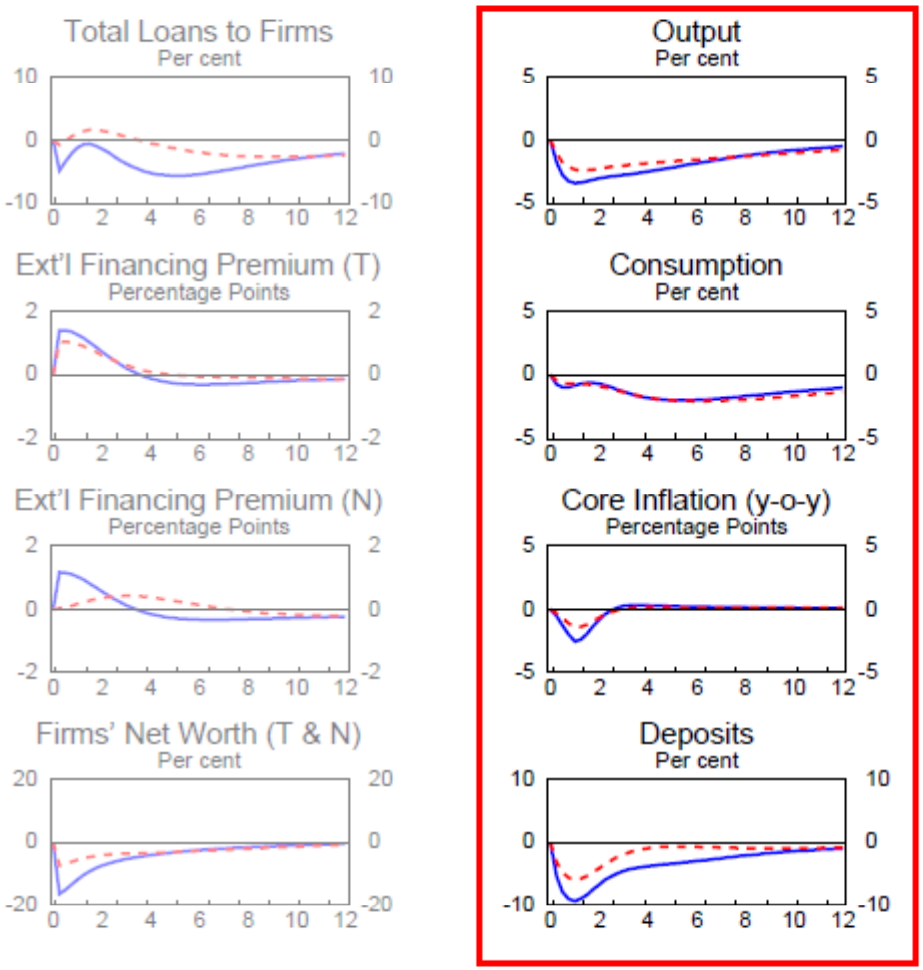


LOWER SUPPLY OF LOANS:

FOR THE SAME RISK, BANKS LESS WILLING TO MAKE LOANS

HIGHER FINANCIAL COST FOR ENTREPRENEUERUS

REDUCTION IN NET WORTH

FALL IN ECONOMIC ACTIVITY AND INFLATION (REINFORCES REDUCTION IN NET WORTH AND INCREASE IN RISK PREMIUM)

LESS DEPOSITS (LOWER SAVINGS)

Figure 3: Temporary 5% Fall in U.S. Loan Supply

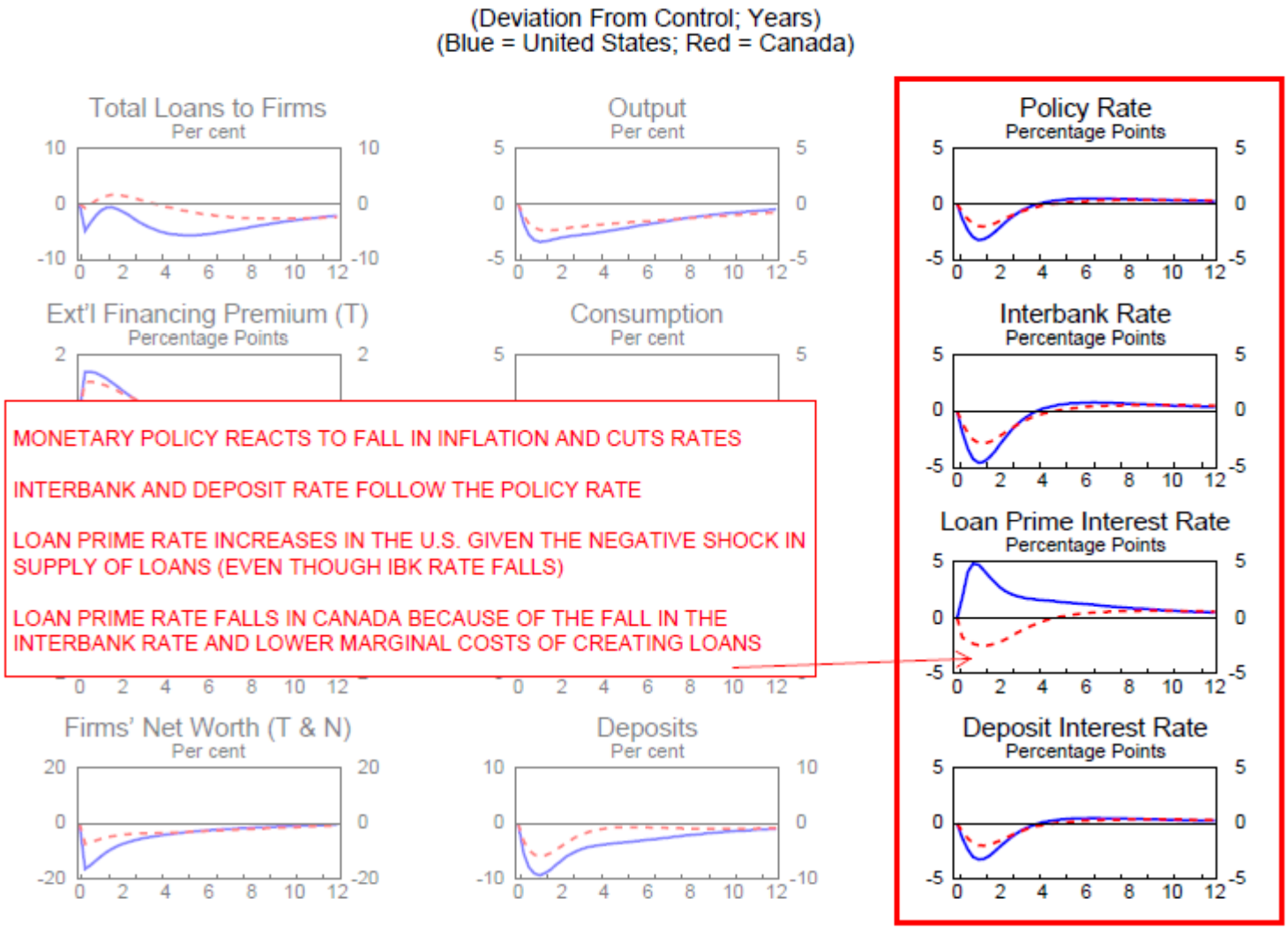
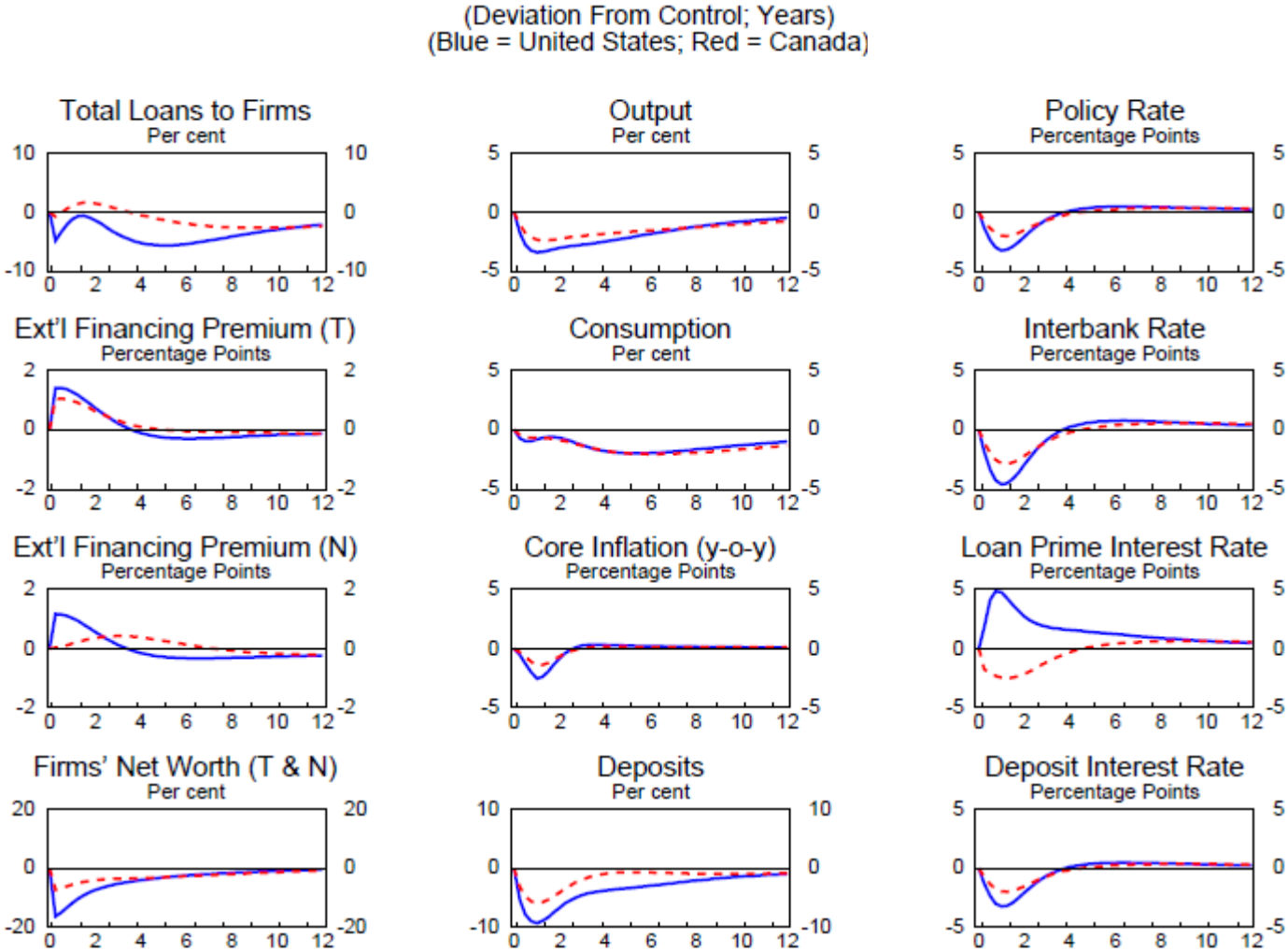


Figure 4: Temporary 5% Fall in U.S. Loan Supply



Conclusion

- The crisis underscores the need to understand linkages between financial system and macro-economy
  - Macroeconomic effects of financial crises
  - Role of financial system in transmitting macro shocks and monetary policy
  - Using financial information to guide monetary policy.

Work in progress

- ToTEM 2 (second generation)
  - Include imperfect substitute financial assets
  - Housing (but non-collateral effects)
  - Expected to enter in projection mode in 2011 Q1.
- Introduce banking and financial accelerator into ToTEM.
- Introduce international interbank market into Global Economic Model.