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Republic of Korea: Selected Issues

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INTERNATIONAL MONETARY FUND

REPUBLIC OF KOREA

Selected Issues

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Approved by the Asia and Pacific Department

July 14, 2011

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I. FORMALIZING FINANCIAL STABILITY CONSIDERATIONS IN THE CONDUCT OF MONETARY POLICY IN KOREA

The recent global financial crisis has exposed the limitations of a conventional inflation targeting (IT) framework in insulating an economy from all shocks it may face, and demonstrated that its rigid application may aggravate the effect of shocks on output and inflation. Accordingly, we investigate possible refinements to the inflation targeting framework in Korea by taking into account developments in the financial sector. The findings indicate that incorporating financial stability considerations can help smooth business cycle fluctuations, by mitigating the buildup of factors that lead to subsequently large fluctuations in output and inflation.

A. Introduction

1. **The recent global financial crisis has demonstrated that strong underlying economic fundamentals cannot insulate an economy from all possible shocks.** The crisis, while originating in the subprime segment of the U.S. mortgage market, quickly spread through financial and real channels, and severely affected many economies, even those that did not have any major exposures to the assets at the heart of the crisis. Korea's economy too was hit hard by the global financial crisis due to the sudden drying up of liquidity and the collapse of global trade despite having strong macroeconomic fundamentals before the outbreak of the crisis.

2. **A key factor in determining the impact of the global crisis on individual economies was the extent to which underlying vulnerabilities had interacted with the shock and amplified its effect on the financial system and the overall economy.** For example, and as has been well-documented by now, the buildup of leverage, rapid house price appreciation or excessive credit growth have all been found to lead to larger economic downturns when an economy is hit by a financial shock.² This highlights the role of balance sheet vulnerabilities in the dynamics of an economy when it is subject to shocks. Moreover, it raises the question of the role of inflation targeting frameworks in the run-up to the crisis, and whether they can contribute to creating the pre-conditions that better insulate an economy from shocks through improved balance sheets, thereby supporting the mandate of the monetary authority to maintaining price stability and minimizing output volatility.

3. **A conventional IT framework generally ignores financial (in)stability considerations despite the effects that monetary policy itself has on the financial system.** For instance, when a central bank lowers its policy rate, it reduces the cost of external (i.e., not from own cash reserves) financing for the nonfinancial sector and increases the demand for such financing. A greater volume of external funds does not just increase aggregate investment and consumption,

² See Cardarelli et al. (2009) and Shin (2010).

but also raises the leverage of firm and household balance sheets. This may lead to the buildup of systemic vulnerabilities in the economy if, for example, monetary loosening is in the context of an already highly indebted nonfinancial sector. Since the impact of many types of shocks on real activity depends on the degree of leverage in balance sheets, monetary policy could potentially play a role in limiting the system-wide buildup of leverage, and the subsequent evolution of prices and output when shocks hit an economy.

4. **A conventional IT framework typically does not respond to financial shocks until the effects are apparent in the standard indicators of output and prices.** These frameworks focus only on the usual channels of monetary policy transmission, excluding the underlying balance sheet conditions. Hence a central bank adopting a conventional IT framework would not react to a financial shock until it has a visible impact on the indicators that are closely linked to output and prices. Given that financial shocks are usually transmitted to the real economy with a lag, a conventional IT framework can respond to some shocks, including financial ones, only partially and with a lag, rather than preemptively.³ This was also seen during the run-up to the global financial crisis when monetary policy remained largely agnostic to the buildup of balance sheet vulnerabilities.

5. **This paper has been motivated by recognition that financial sector developments play a role in the economy.** In particular, we review the appropriateness of an IT framework under the conventional wisdom that monetary policy should remain solely limited to achieving the inflation target, to the exclusion of all other considerations such as financial stability that may affect the dynamics of output and prices over the cycle.

6. **We propose alternative inflation targeting rules that incorporate financial stability indicators.** In our alternative policy rules for inflation targeting incorporating financial stability (ITFS), a central bank monitors systemically relevant financial stability indicators in addition to the usual developments in inflation and output. Under the ITFS rules, a central bank reacts to the deviations of financial indicators from their desirable/equilibrium levels by changing its policy rate, weighted by the importance that it assigns to financial stability indicators in its policy function. We then examine the performance of these alternative policy rules in achieving the central bank's objectives in minimizing the deviations of prices and output from their desired/potential level.

³ Of course, most central banks have room for discretion and do not adhere mechanically to the rule implied by the prevailing framework. This was evident in the crisis response of most central banks, but largely only once the economic impact of the financial crisis started becoming evident, rather than in the run-up.

7. **We consider four systemically important financial stability indicators that have direct implications on private sector balance sheets:**⁴

- i. *Nonfinancial sector borrowing spread*: This indicator would be expected to increase along with the rise in the leverage of the nonfinancial sector. This is a systemically important indicator since excessive leverage in households and firms can easily transform into undesirable balance sheet problems, and result in severe economic distress. High nonfinancial sector leverage played a role in Korea during the 1997 Asian crisis and 2003 credit card crisis.⁵
- ii. *Banks' foreign exchange leverage*: This indicator captures foreign exchange leverage of the banking sector, a source of vulnerability for many banking systems when faced with an external liquidity squeeze. During the 2008 crisis, Korean banks faced a "sudden stop" of short-term capital inflows which required large scale liquidity injections to prevent rapid deleveraging in the financial sector.
- iii. *Credit Volume*: Past experience has shown that developments in the credit market have important implications for the real economy. While credit supports economic activity, excessive credit growth, particularly when the recipients have already weak balance sheets, may exacerbate financial vulnerabilities.
- iv. *Asset Prices*: In particular, we examine the role of house prices as relevant financial indicators. In Korea, housing constitutes more than 70 percent of the households' wealth, and rapid increases in house prices may incentivize these agents to engage in risky building up of leverage, while sharp declines in house prices may leave them exposed to financial difficulties.

8. **In line with this reappraisal, we propose a small open economy dynamic stochastic general equilibrium (DSGE) model.** This model is based on Bernanke, Gertler, Gilchrist (1998), and the frictions in this model are price stickiness, investment delays, and financial frictions. Financial frictions are captured by explicitly incorporating a housing sector and entrepreneurs. Frictions in these sectors are modeled using the financial accelerator framework, which captures the amplifying effect of financial shocks on the macroeconomy. The model is calibrated to capture the economic characteristics of Korea during 2001–07.

⁴ Some of these indicators are also used in the earlier research done on monetary policy and financial stability, such as Taylor (2008), and Curdia and Woodford (2010).

⁵ The limitation of this indicator is that spreads can also be affected by factors such as the availability of liquidity or a general decline in risk aversion.

9. **Our results show that by incorporating financial stability, a central bank can improve on its objectives compared with implementing a conventional IT framework.**⁶ The effect is particularly important if the source of the shock is from the supply side limiting the investment/consumption activities of the agents, such as a rise in the borrowing spreads of the nonfinancial sector, as opposed to a demand-side shock.⁷ For the latter, the performance of the ITFS is similar to that of a conventional IT framework.

10. **Performance of alternative ITFS rules differs in terms of attaining the objectives of price stability and output volatility.** Some financial stability indicators perform better than a conventional IT rule in smoothing the volatility of both output and prices. However, others may lead to higher inflation in the short run, while outperforming the conventional IT rule in smoothing business cycle volatility, reflecting a tradeoff that the monetary authority will need to weigh. For instance, monitoring house prices as a financial stability indicator can perform better than a conventional IT framework, in terms of both price and output stability, when the economy is exposed to a shock that raises the nonfinancial sector's borrowing spreads. However, the ITFS incorporating nonfinancial-sector leverage may lead to higher short-term inflation even though it does a better job in smoothing the deviations of output from its potential. The appropriateness of the indicator depends on the characteristics of the economy and financial system, and the types of shocks it commonly faces.

11. **Our results show that within the ITFS framework, a central bank could stabilize output and price volatility better by discouraging the excess use of credit.** We look at this issue since there is a lack of consensus in the literature regarding the role of credit. Within the ITFS framework, we use credit volume under two financial stability considerations: a central bank ensures financial stability by (i) encouraging credit to the nonfinancial private sector, and (ii) by discouraging credit. The ITFS rule incorporating the level of credit shows that a central bank can do better by curbing excess credit than promoting rapid credit to the private sector.⁸

⁶ One could argue that introducing financial stability into a conventional monetary policy framework would create tradeoffs between the objectives of a central bank. In some circumstances, such tradeoffs may exist; however, such conflicts between the objectives of a central bank do not differ from those of a central bank that targets only price and output stability: for instance, as experienced in some circumstances, by showing more tolerance to the deviations of inflation than otherwise in order to stabilize output. However, we are not proposing an expansion of the mandate of the central bank; instead, we propose incorporating financial stability considerations in the conduct of an inflation targeting framework where price stability remains the mandate.

⁷ We should note that in practice, it may be difficult for a central bank to detect the sources of a shock. Nevertheless, the finding that an ITFS performs either better than or similar to (and no worse) the benchmark inflation targeting (ITB) rule would be of comfort for central bankers implementing this new IT framework.

⁸ This finding is also striking given that there is no consensus in the literature whether a central bank should limit financial risk-taking or encourage credit growth. For instance, Curdia and Woodford (2010) argue that a monetary policy response to credit would not help to stabilize the economy, since it is not clear whether encouraging or discouraging credit to the private sector helps to smooth the nature and persistence of disturbances in the economy.

12. **The roadmap for the paper is as following.** The next section is on the impact of the global crisis on the Korean economy, and it aims to provide a context to our analysis. Then we present the benchmark model. Next, we introduce the ITFS rules and our numerical experiments for a nonfinancial sector risk premium shock, external demand shock, and technology shock. The final section concludes the paper.

B. The Impact of the Global Crisis on the Korean Economy

13. **Given the characteristics of its financial system and economy, Korea was vulnerable to the disruptive effects of an unanticipated external shock.** Macroeconomic performance in the years leading up to the global crisis was strong, and the banking system was adequately capitalized and with little exposure to securities at the heart of the crisis. However, balance sheet vulnerabilities had been building up in other parts of the economy, making the Korean economy susceptible to shocks. Short-term foreign currency debt of the banking system, and household and small- and medium-enterprise (SME) debt had risen sharply in the years leading to the global crisis.

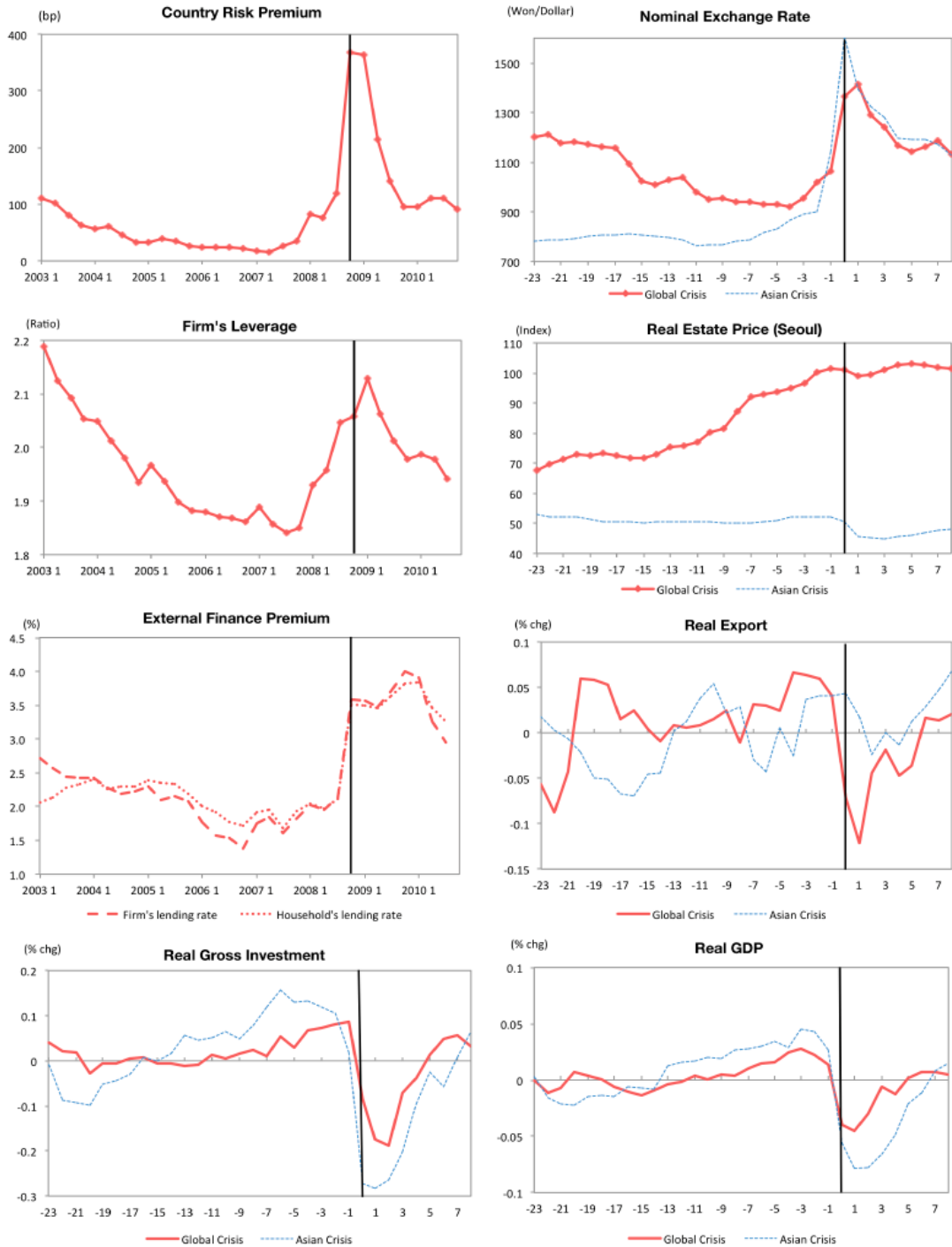
14. **Despite the strong macroeconomic fundamentals, the interaction of the external shock with underlying financial vulnerabilities had a sizable impact on the Korean economy.** The transmission of the financial shock, as well as the sharp contraction in global trade, contributed to an economic downturn in Korea during 2008–09 that was sizable even when compared with the 1997 Asian crisis (Figure 1).

15. **Triggered by a flight-to-safety, the country risk premium of Korea rose sharply while its currency depreciated abruptly.** Korea's country risk premium had been rising gradually during 2008 along with the depreciation of its exchange rate, reflecting the rise in global risk aversion. Following the bankruptcy of Lehman Brothers, Korea's risk premium reached about 400 basis points and the won lost around half of its value, similar to the magnitude of depreciation during the Asian crisis.

16. **The crisis also worsened household and firm balance sheets, and led to an increase in their borrowing costs.** The deterioration on the firms' side was much larger, since these companies were exposed both financially and economically through their dependence on exports.⁹ The worsening of the nonfinancial sector's balance sheet was reflected in its cost of borrowing, and the external financing premium rose by about 200 basis points during the crisis. Higher funding costs worsened the nonfinancial sector's balance

⁹ Also, households' balance sheet worsened less, since housing, which constitutes the majority of the household wealth, is highly regulated in Korea.

Figure 1. The Korean Economy



Source: Bank of Korea.

Note: Zero in the x-axis denotes the peak crisis period: 2008Q4 for the global crisis and 1998Q1 for the Asian crisis. Country risk premium is the exchange equalization fund spread; firm's leverage shows average asset-to-equity ratio; real estate price is an index variable; external finance premium is the difference between nonfinancial sector's borrowing and lending rate. All real aggregate variables are the log-deviations from the HP-filtered trend.

sheet even further by lowering its net worth, and hence led to an even higher borrowing spread for this segment.

17. **Overall, the global financial crisis had a very strong impact on the Korean economy.** The developments in the financial indicators affected the real aggregate variables with a lag, and the rise in borrowing costs of the nonfinancial sector and the fall in overall exports contributed to the contraction in investment and output during 2008–09.¹⁰ The impact of the global financial crisis on the Korean economy and the accumulated and lagged effects of financial instability on macroeconomic variables suggest that an IT framework incorporating financial stability indicators could be more preemptive and better insulate the Korean economy from such external shocks.

C. The Benchmark Model

18. **The benchmark model is a small open economy DSGE model following Aydin and Volkan (IMF Working Paper, forthcoming).**¹¹ This setting makes it feasible to study alternative inflation targeting frameworks and compare them with the benchmark model where the central bank adopts a conventional IT framework. The basic structure of our model is outlined in Figure 2.

19. **The agents in our model can be grouped under five categories:** (i) consumers, (ii) nonfinancial sector, (iii) financial sector, (iv) government, and (v) the external sector.

20. **Consumers are infinitely-lived risk-averse agents: they work, consume, and save.** In every period, they work for the wholesale goods producers for a wage income and decide how much of disposable income (i.e., after taxes) to consume and how much to save. They consume by purchasing tradable goods from domestic and foreign retailers and by renting housing services from homeowners. They save in the form of bank deposits which pay a risk-free interest rate.

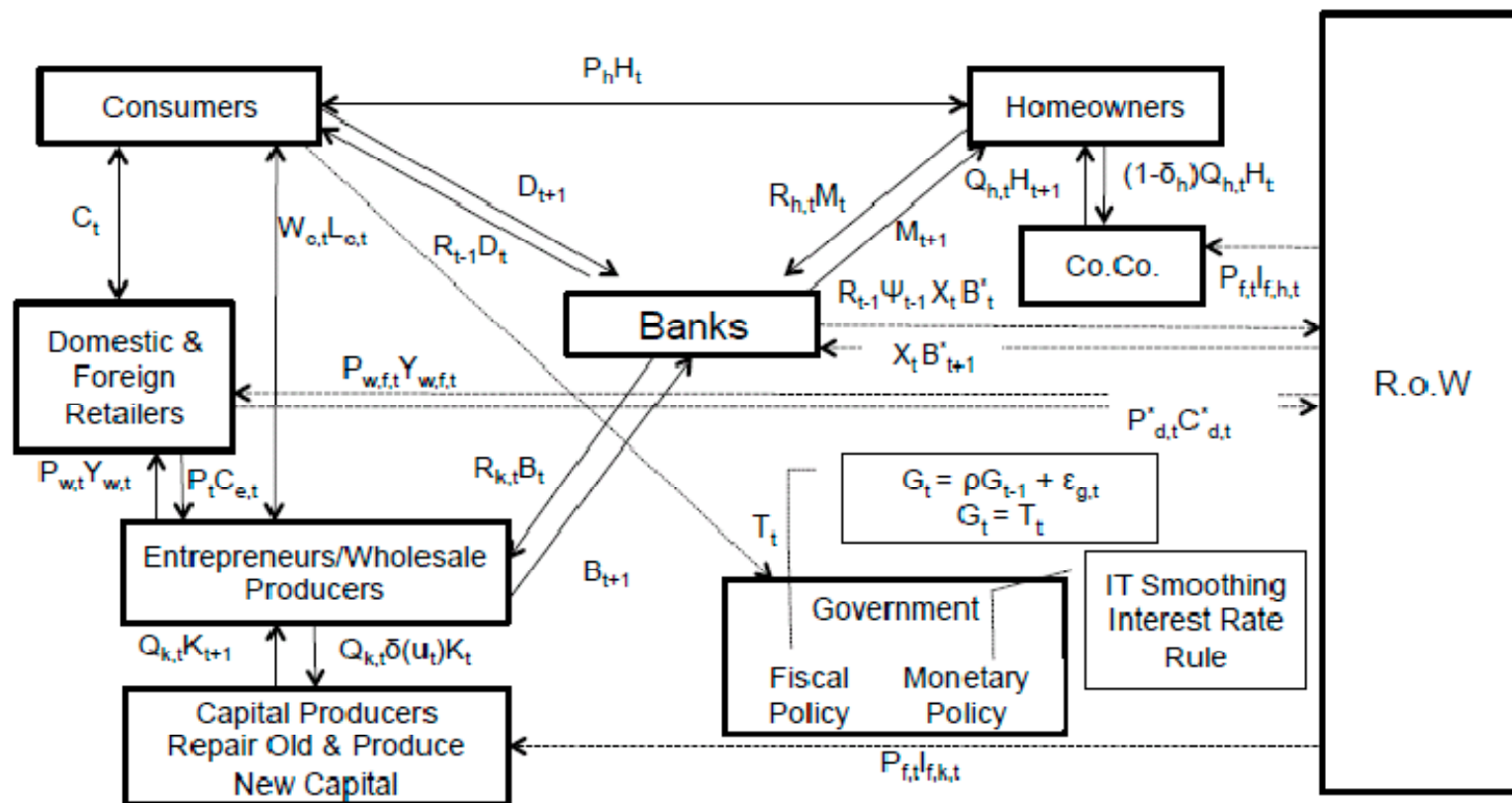
21. **The nonfinancial sector includes the real estate and the real sector.** The real estate sector comprises homeowners and construction companies, while the real sector includes entrepreneurs/wholesale producers, capital producers, and retailers.

- a. **Homeowners own the entire housing stock.** Their main source of income is the rental payment received from consumers. In each period, as part of their investment decision, they adjust their holdings of housing stock by purchasing

¹⁰ Trade is a very strong channel for Korea, and its importance during the 2000s was on an increasing trend. The share of imports and exports rose from around 55 percent of its GDP in 2001 to almost 90 percent in 2007.

¹¹ This section provides the basic set up of the benchmark model. For details of the model, see Aydin and Volkan (forthcoming) IMF Working Paper.

Figure 2. Setup of the Model



new homes from construction companies. Homeowners finance their housing investment through a down payment and a one-period mortgage loan extended by the bank.

- b. ***Construction companies (Co. Co.) repair old houses and build new housing stock.*** For production, they use old housing stock purchased from homeowners and domestic and foreign investment goods.
- c. ***Entrepreneurs/wholesale producers manage the production of wholesale goods.*** Wholesale goods are produced in every period using capital and labor. Entrepreneurs demand labor contemporaneously, whereas their demand for capital is a decision made one-period ahead, taking into account entrepreneurs' expectations of the returns and the cost of capital. Capital is purchased from capital producers, and the cost is financed partly by the entrepreneurs' net worth and partly by one-period corporate loans extended by banks.
- d. ***Capital producers use the existing capital stock to produce investment goods.*** The investment good is composed of domestic and foreign goods. Similar to entrepreneurs, capital producers also make their production plans one period in advance, helping the model to capture the delayed investment response to economic shocks as observed in the data.
- e. ***Retailers are monopolistically competitive firms owned by consumers.*** They buy wholesale goods, repackage them, and sell them to consumers as final consumption goods. All retailers have sticky price-setting rule a la Calvo, allowing the introduction of nominal rigidities into the model.

22. ***The financial sector is comprised of banks.*** Banks extend corporate and mortgage loans to the nonfinancial sector by relying on their own net worth, consumer deposits, and borrowings from international financial markets. On the liabilities side, banks pay a risk-free interest rate to consumers; for foreign borrowing, they pay an external financing premium, which increases proportionally with banks' external liabilities relative to net worth. On the asset side, banks sign loan contracts with homeowners and entrepreneurs to ensure that they receive an average return free of risk. Accordingly, the loan rate contains an external finance premium to cover for the default risk of a borrower, and it is directly linked to the borrower's leverage ratio.¹²

¹² This setup is the key aspect of the financial accelerator mechanism which was developed in Bernanke, Gertler, Gilchrist (1998). The setup links the balance sheets of the nonfinancial sector to that of the financial sector, and is key in capturing the amplifying effect of economic fluctuations.

23. ***The government is comprised of the fiscal and monetary authorities.*** Fiscal authorities follow the fiscal rule of a balanced budget, and the monetary authorities, referred to as the central bank, apply an inflation targeting framework. In the baseline model, the central bank follows a conventional IT framework, named as the benchmark rule, which targets price and output stability through an interest rate smoothing rule. Inflation targeting policy is key to our analysis for studying the effectiveness of monetary policy against macrofinancial shocks. Next section introduces the ITFS framework, and compares model outcomes under the ITB and ITFS frameworks.

24. ***The external sector constitutes the economy's trade with the rest of the world.*** The trade balance consists of the country's exports and imports of consumption and investment goods. Trade is conducted in domestic currency, and the nominal exchange rate is defined as the price of foreign wholesale good in domestic currency over the price of foreign goods in foreign currency. This definition allows the model to capture temporary deviations from the law of one price. In addition, it also captures the incomplete exchange rate pass-through observed in reality as the retailers of foreign goods also have a sticky price setting rule.

D. Incorporating Financial Stability in an IT Framework

25. ***We compare the "benchmark" interest rate rule to four alternative ITFS rules.*** In the alternative interest rate rule, price stability is the main objective of the central bank, and along with output stability, the central bank also reacts to financial stability considerations. The experiments are simulated for an unanticipated financial shock, external demand shock, and technology shock.

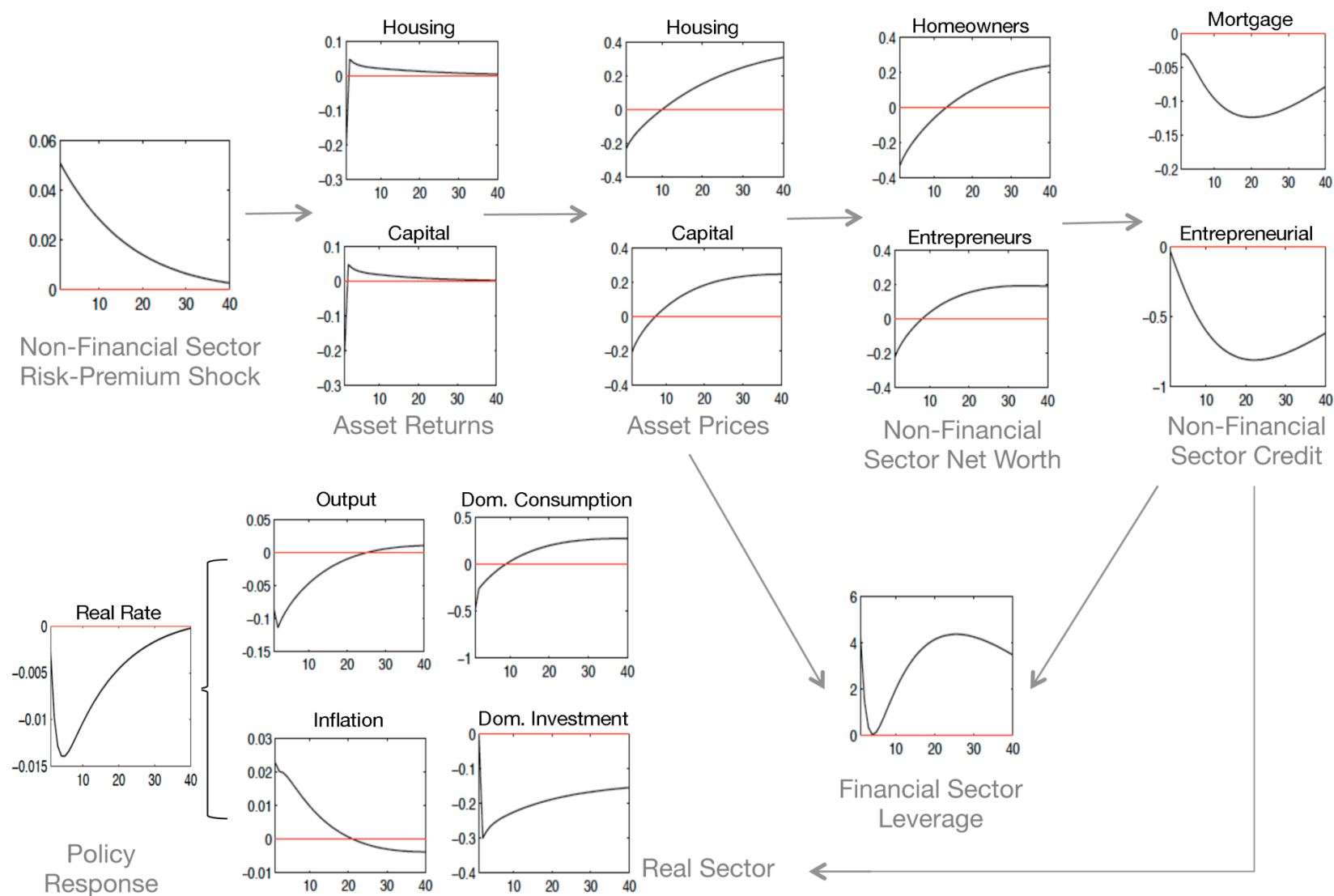
An Adverse Shock to Nonfinancial Sector Risk Premium

26. ***First, we analyze the economy under the benchmark and ITFS frameworks when a financial shock hits the economy.*** The financial shock is a 5 percent rise in the risk premium of the nonfinancial sector loans. Even though the magnitude of the shock is much smaller in the model, the nature of the shock was quite similar to what the Korean economy has experienced during the global financial crisis and is thus appropriate for demonstration.

27. ***The financial shock raises borrowing spreads of the nonfinancial sector immediately; however, the impact on the real aggregate variables come with a lag.*** Figure 3 presents the transmission of a 5 percent financial shock under the benchmark model.¹³ The shock affects the borrowing spreads of the nonfinancial sector immediately. However, its adverse impact on the borrowing spreads dies out slowly, as experienced in Korea in the aftermath of the global financial crisis. The shock's transmission to real

¹³ The shock follows an autoregressive process with a persistence parameter of 0.95.

Figure 3. Transmission Mechanism in the Benchmark Model under a Nonfinancial Sector Risk Premium Shock



aggregate variables operates with a lag. Because of this lag between the time of the shock and the time that it passes on to the real aggregate variables, the central bank's reaction under the benchmark rule comes with a lag.

28. **We compare the benchmark interest rate rule to the alternative ITFS when the economy is exposed to an adverse risk premium shock.** The purpose of this exercise is to demonstrate how the central bank's reaction function, and output and price dynamics can vary across different ITFS rules and different weights on the financial stability indicators. These four ITFS rules are presented under the following scenarios:

29. **Scenario 1 incorporates "nonfinancial sector's risk premium" into the central bank's monetary policy rule.** This is a risk indicator which increases along with the rise in the leverage of the nonfinancial sector. This indicator is particularly important since excess leverage in households and firms can easily be triggered by an unexpected shock and result in a severe economic downturn. In our experiments, the weight of the nonfinancial sector risk premium is taken as -0.5 and -1. The coefficients suggest that at times of financial distress, during which the model predicts higher default rates in the nonfinancial sector, the central bank should reduce the base interest rate to ease the pressure on repayment cost of loans.

30. **Scenario 2 incorporates banks' foreign exchange denominated leverage into the central bank's reaction function.** In our model, banks have two sources of funding, namely deposits and foreign capital through banks' issuance of bonds. Even though deposits are safer, they are limited by consumers' savings decisions. On the other hand, foreign capital is available to banks to channel liquidity to the nonfinancial sector, but the costs rise as banks rely more on global financial markets. Foreign investors charge a higher risk premium as banks' bond issuance increases because excess leverage makes banks more financially vulnerable. Similarly, a central bank also pays attention to the foreign exchange leverage in the financial sector, as excess foreign currency funding may lead to a sudden stop in the financial system in times of liquidity squeeze, as experienced by Korea during the global financial crisis. Therefore, the central bank lowers interest rate, to ease the pressure on the banks' debt servicing capacity. Similar to scenario 1, the weight of the financial sector risk premium in the ITFS rule is taken as -0.5 and -1.

31. **Scenario 3 incorporates credit into the IT framework.** Since there is no consensus in the literature on whether the central bank should promote or discourage credit to the nonfinancial sector to support financial stability, in this scenario, we provide reaction functions both with a positive and a negative coefficient. Therefore, we choose the weight of credit volume as -0.1 and 0.1.

32. **Scenario 4 incorporates house prices into the monetary policy rule.** Assessing whether asset prices are overvalued or not is a formidable challenge. However, the purpose of incorporating asset prices in the ITFS framework is not to judge the equilibrium level of these prices but rather to assess whether the positions taken by leveraged households pose a financial risk to the system. In the Korean context, house prices are particularly important,

since around 70 percent of total household wealth is invested in housing. We incorporate the volatility in house prices into the ITFS rule by choosing a weight of 0.5 and 1.5.

33. Results indicate that ITFS rules do a better job in smoothing business cycle volatility. When the economy is exposed to a rise in the risk premium of the nonfinancial sector's borrowing spread, the central bank responds by more under the ITFS rule than under the ITB framework (Figure 4). As a result, the deviations of real economic indicators, such as output, investment and consumption are smaller in this framework compared to the ITB (Figure 5).¹⁴

34. However, the performance of financial stability indicators varies (Table 1). While financial stability indicators targeting nonfinancial sector risk premium and credit volume perform better in smoothing the business cycle, they produce higher inflation in the short run. However, the ITFS rule with house prices improves both on output and price stability, since house prices also affect overall consumer inflation.

An Adverse Shock to Technology and External Demand

35. As a final exercise, we analyze the transmission of shocks when an adverse supply or external demand shock hits the economy. ITFS rules produce similar results when there is an adverse technology shock (Table 1). Indeed, a financial shock can be classified as a supply side shock, since it limits the agents' ability to invest and/or consume. However, under a demand shock, this shock is transmitted at the same speed as to the real and financial stability indicators. Therefore, a central bank applying a conventional IT framework does not respond differently from a central bank applying an ITFS framework. Hence, the deviation of output and inflation under ITB and ITFS are similar when a demand shock hits the economy.

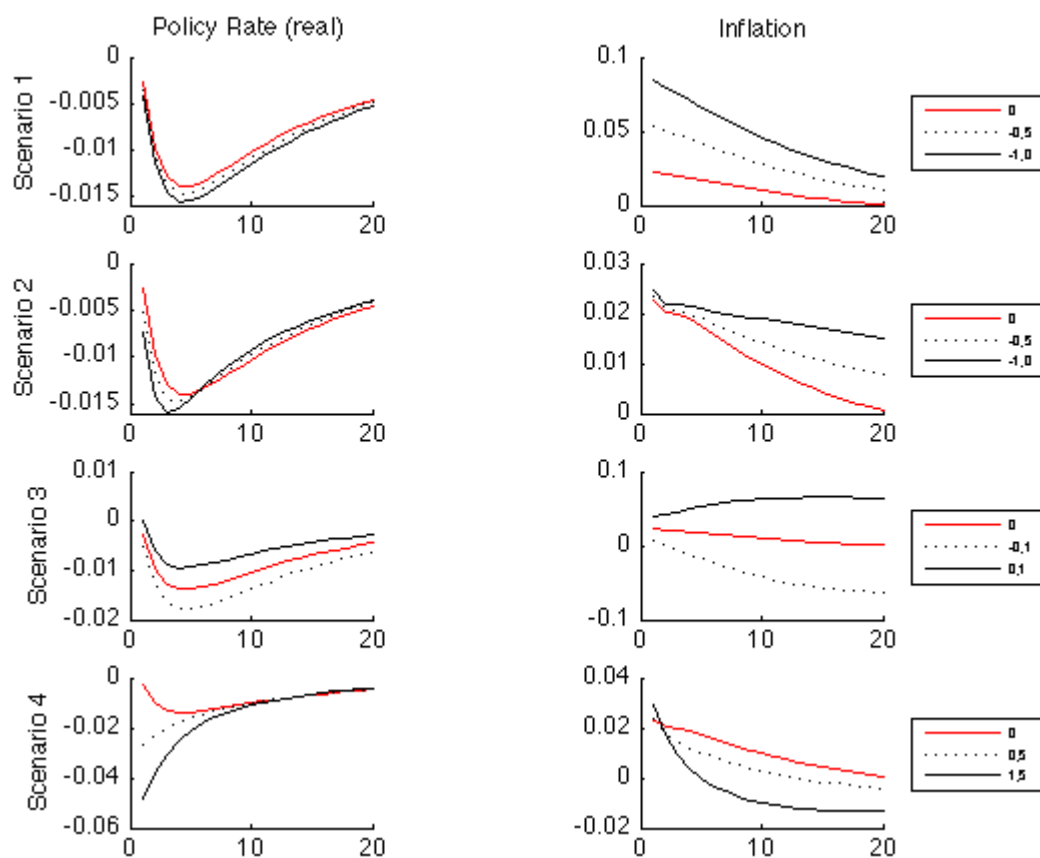
Table 1. Comparing the Alternative ITFS Rules to the Benchmark IT Rule

Financial Stability Indicator, Weight on Indicator	Output Volatility	Inflation Volatility
Financial Premium Shock		
Non-Financial Sector Risk Premium, -0.5	✓	
Non-Financial Sector Risk Premium, -1.0	✓	
Financial Sector Risk Premium, -0.5		
Financial Sector Risk Premium, -1.0		
Non-Financial Sector Credit Volume, -0.1	✓	
Non-Financial Sector Credit Volume, 0.1		✓
House Price Volatility, 0.5	✓	✓
House Price Volatility, 1.5	✓	✓
Technology Shock		
Non-Financial Sector Risk Premium, -0.5		
Non-Financial Sector Risk Premium, -1.0		
Financial Sector Risk Premium, -0.5	✓	✓
Financial Sector Risk Premium, -1.0	✓	✓
Non-Financial Sector Credit Volume, -0.1	✓	✓
Non-Financial Sector Credit Volume, 0.1		
House Price Volatility, 0.5	✓	✓
House Price Volatility, 1.5	✓	✓
External Demand Shock		
Non-Financial Sector Risk Premium, -0.5		
Non-Financial Sector Risk Premium, -1.0		
Financial Sector Risk Premium, -0.5		
Financial Sector Risk Premium, -1.0		
Non-Financial Sector Credit Volume, -0.1		
Non-Financial Sector Credit Volume, 0.1		✓
House Price Volatility, 0.5		
House Price Volatility, 1.5		

Checkmarks mean the policy improves volatility relative to ITB.

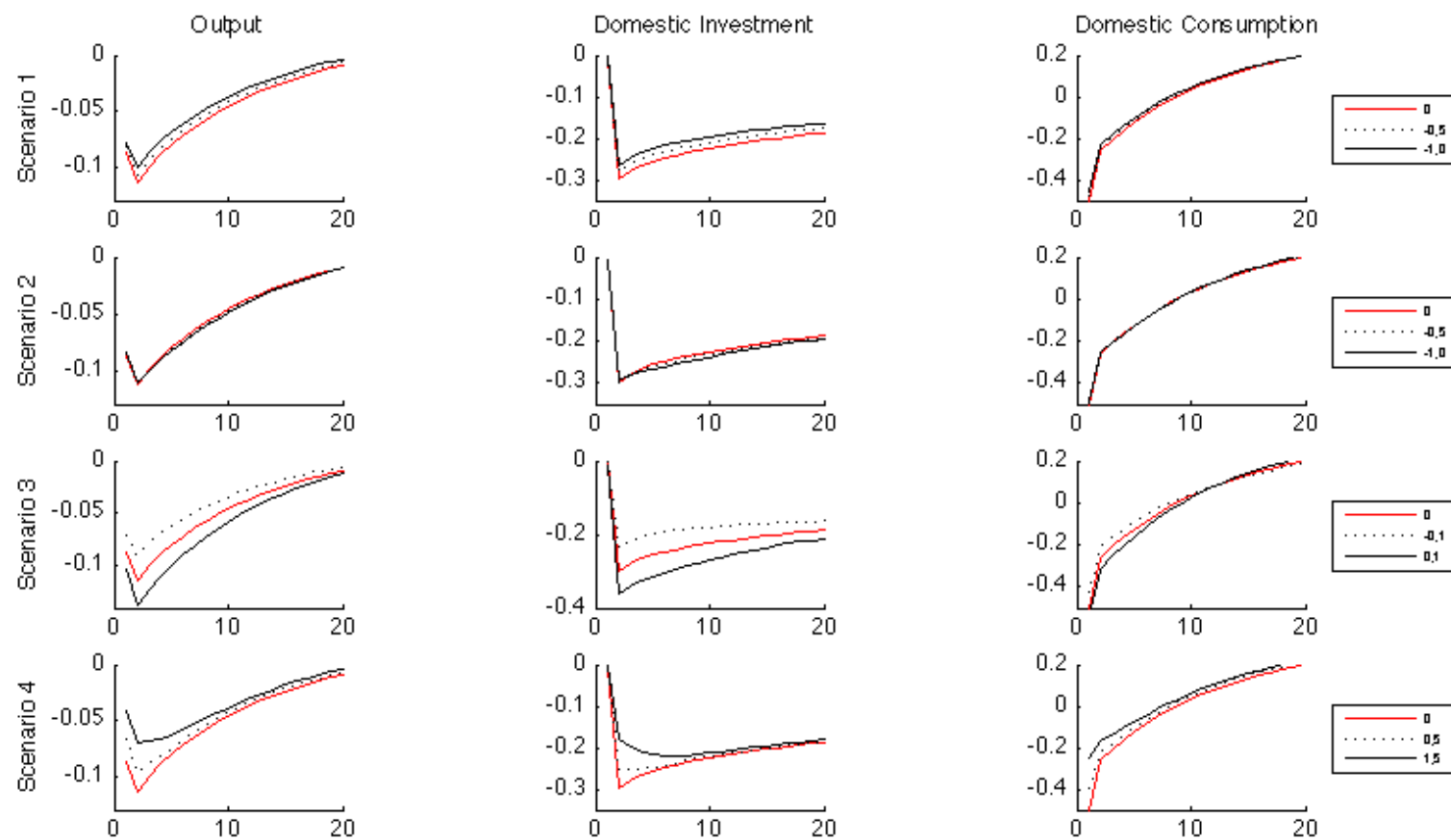
¹⁴ In all ITFS rules, except the one under scenario two, output volatility is smaller than how it would be under the benchmark case. Scenario two produces similar results as that of ITB.

Figure 4. Impulse Response of Interest Rate and Inflation to a Nonfinancial Sector Risk Premium Shock



Note: The legend shows the weight of the financial stability indicator under each ITFS rule, and a weight of zero is equivalent to the benchmark IT rule.

Figure 5. Impulse Response of Output, Investment and Consumption to a Nonfinancial Sector Risk Premium Shock



Note: The legend shows the weight of the financial stability indicator under each ITFS rule, and a weight of zero is equivalent to the benchmark IT rule.

E. Conclusion

36. **The global financial crisis has once again demonstrated that despite strong fundamentals, economies cannot be fully insulated from exogenous shocks.** Moreover, financial vulnerabilities that have accumulated in balance sheets during the cycle can amplify the effect of these exogenous shocks on the real economy.

37. **This paper examines the role that refinements in the IT framework can play in strengthening policy frameworks, and proposes alternative IT rules for a central bank that incorporates financial stability indicators.** These monetary policy rules focus on systemic vulnerabilities in the financial and nonfinancial sector, which may interact with unanticipated shocks in destabilizing the economy. Under our proposed alternative policy rules, a central bank monitors the level of risk in the nonfinancial sector's borrowing spread, bank leverage, credit volume, or house prices, and reacts by changing its policy rate whenever these indicators deviate away from their desired level.

38. **Incorporating financial stability into a central bank's policy rule should not be seen as a substitute for a more comprehensive macrofinancial framework.** An ITFS is a complementary part of this framework. Since the scope of interest rate policy is limited by its objectives, a more comprehensive macrofinancial framework is essential to limit the undesirable effects of sectoral risks affecting the overall economy, such as by monitoring sectoral and systemic risk indicators and using macroprudential tools, consistently within the macrofinancial framework, to avoid any buildup of systemic risks.

39. **Our simulations show that a central bank can do much better by incorporating financial stability into its IT framework, in particular should the distortions come from the supply side.** For other distortions affecting the demand side of the economy, an inflation targeting rule with or without financial stability is comparable.

40. **Even though interest rate rules incorporating financial stability smooth output volatility much better than a conventional interest rate rule, for some alternative rules, there are tradeoffs between output gains and inflation convergence to the target.** Some ITFS rules, such as the one targeting house prices, can outperform a conventional IT rule both in price and output stability; however, others may lead to tradeoffs between output gains and inflation in the short term.

41. **The ITFS rules in this paper should be interpreted as indicative of the slant of monetary policy rather than for precise estimates of the gains.** In this paper, we do not estimate the optimal weights on the ITFS rule or the optimal financial stability indicator. Instead, we analyzed the performance of various financial stability indicators relative to that of a conventional interest rate rule. The purpose of the analysis was to demonstrate the directional impact of interest rate rules when an economy is exposed to unanticipated shocks, and to demonstrate that an ITFS rule can improve on an ITB. Future work is aimed at deriving the optimal monetary policy rule incorporating financial stability which is best suited for minimizing both output and price volatility. Of course, arriving at an operational IT rule would require further work along these lines and other dimensions.

REFERENCES

- Alexandre, Fernando, John Driffill, and Fabio Spagnolo, 2002. "Inflation targeting, Exchange Rate Volatility and International Policy Coordination." *The Manchester School*, Vol. 70, No. 4, pages 546-569.
- Angelini, Paolo, Stefano Neri, and Fabio Panetta, 2010. "Monetary and Macroprudential Policies." unpublished, Bank d'Italia-Economic Outlook and Monetary Policy Department.
- Aoki, Kosuke, James Proudman, and Gertjan Vlieghe, 2002. "House Prices, Consumption, and Monetary Policy: A Financial Accelerator Approach." *Bank of England Working Papers*, No. 169.
- Aydin, Burcu, and Engin Volkan, forthcoming, "Incorporating Financial Stability into an Inflation Targeting Framework" *IMF Working Paper*. (Washington: International Monetary Fund).
- Baxter, Marianne, and Dorsey D. Farr, 2005. "Variable Factor Utilization and International Business Cycle." *Journal of International Economics*, Vol. 65, pages 335-347.
- Benita, Golan. 2007. "Policy Factors and Exchange Rate Volatility: Panel Data versus a Specific Country Analysis." *International Research Journal of Finance and Economics*, Issue 7.
- Bernanke, Ben, Mark Gertler, and Simon Gilchrist, 1998. "The Financial Accelerator in a Quantitative Business Cycle Framework" *C.V. Starr Center for Applied Economics, Economic Research Reports*, No. 98-03.
- Brunnermeier, Markus K., and Yuliy, Sannikov, 2011. "A Macroeconomic Model with a Financial Sector" Unpublished. Princeton University.
- Caballero, Ricardo J., and Arvind Krishnamurthy, 2004. "Exchange Rate Volatility and the Credit Channel in Emerging Markets: A Vertical Perspective." *NBER Working Paper*, No. 10517.
- Calvo, Guillermo, 2010. "Controls on Cyclical Capital Inflows - Some Skeptical Notes." A note for the XXXI Latin American Network of Central Banks and Finance Ministries, IADB.
- Calvo, Guillermo, 1983. "Staggered Prices in a Utility-Maximizing Framework." *Journal of Monetary Economics*, 12, pages 383-398.
- Cardarelli, R., S. Elekdag, and S. Lall, 2011, "Financial Stress and Economic Contractions," *Journal of Financial Stability*, Elsevier, Vol. 7(2), pp. 78-97.

- Carlstorm, Charles T., and Timothy S. Fuerst, 1997. "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis." *American Economic Review*, 87, pages 893-910.
- Christiano, Lawrence J., Cosmin Ilut, Roberto Motto, and Massimo Rostagno, 2007. "Monetary Policy and Stock-Market Boom-Bust Cycles," unpublished, Northwestern University.
- Curdia, Vasco, and Michael Woodford, 2010. "Credit Spreads and Monetary Policy," *Journal of Money, Credit and Banking*, Blackwell Publishing, Vol. 42(s1), pages 3-35, 09.
- Curdia, Vasco, and Michael Woodford, 2009. "Credit Frictions and Optimal Monetary Policy," BIS Working Paper, No. 278.
- DeFiore, Fiorella, and Oreste Tristani, 2011. "Credit and the Natural Rate of Interest." *Journal of Money, Credit and Banking*, Vol. 43, No. 2-3, pages 407-440.
- Dooley, Michael, Rudiger, Dornbusch, and Yung Chul, Park, 2002. "A Framework for Exchange Rate Policy in Korea." Korea Institute for International Economic Policy, Working Paper, No. 02-02.
- Gertler, Mark, Simon Gilchrist, and Fabio M. Natalucci, 2007. "External Constraints on Monetary Policy and the Financial Accelerator." *Journal of Money, Credit and Banking*, Vol. 39, No. 2-3.
- Gertler, Mark, and Peter Karadi, April 2010. "A Model of Unconventional Monetary Policy." Working Paper.
- Greenwood, Jeremy, Zvi Hercowitz, and Gregor W. Huffman, 1988. "Investment, Capital Utilization, and the Real Business Cycle." NBER Working Paper. No. 8905.
- Hausmann, Ricardo, Ugo, Panizza and Roberto Rigobon, 2004. "The Long-Run Volatility Puzzle of the Real Exchange Rate." NBER Working Paper. No. 10751.
- Ostry, Jonathan. D., Atish R., Ghosh, Karl, Habermeier, Marcos, Chamon, Mahvash S., Qureshi, and Dennis B.S., Reinhardt, 2010. "Capital Inflows: The Role of Controls." IMF Staff Position Note.
- Shin, Hyun Song, 2010, "Risk and Liquidity," Clarendon Lectures in Finance, Oxford University Press.
- Taylor, John B, 2008. "Monetary Policy and the State of the Economy." Testimony before the Committee on Financial Services, U.S. House of Representatives.
- Wicksell, Knut, 1898. "Interest Rates and Prices," Royal Economic Society 1936, Macmillan, London. Reprinted New York: Augustus M. Kelley 1978