DOI: 10.20472/ES.2015.4.3.001

LINKAGE BETWEEN US MONETARY POLICY AND EMERGING ECONOMIES: THE CASE OF KOREA'S FINANCIAL MARKET AND MONETARY POLICY

CHAN-GUK HUH, JIE WU

Abstract:

This study offers empirical evidence on the linkage between the US monetary policy and Korean financial market volatilities, and the efficacy of Korea's' monetary policy in the past decade and a half. First, we find evidence showing significant effects of interest spreads between short and long term interest rates of Korea and the US, and other US variables on the volatility of won-dollar exchange rate as well as Korean stock market index. Second, we find evidence that suggests that capital inflow into Korea might have weakened the efficacy of its monetary policy since the mid-2000s, a period notable for the increased accession by foreign investors to the Korean bond market and the US quantitative easing (QE) policy. A distinct change in the propagation mechanism of monetary policy, in which short term policy rate affects long term interest rates, is observed in Korea since the mid-2000s. In the latter sample period, US monetary policy appears to have had more influence on Korean market interest rates than Korea's policy rate. In addition, we examine structural issues of the balance sheet of Korea's' central bank in view of recent rise in interests in the financial health of central bank balance sheets and monetary policy credibility in the wake of QE policies in advanced economies.

Keywords:

Monetary policy, International transmission, Volatility, Central bank balance sheet.

JEL Classification: C13, C32, E44

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Citation:

CHAN-GUK HUH, JIE WU (2015). Linkage between US monetary policy and emerging economies: the case of Korea's financial market and monetary policy. International Journal of Economic Sciences, Vol. IV(3), pp. 1-18., 10.20472/ES.2015.4.3.001

We benefited from comments by participants in seminars in Korea, and the IISES 16th International Academic Conference in Amsterdam in May 2015. We also would like to acknowledge two anonymous referees for helpful comments and suggestions. Any remaining errors are our own.

I. Introduction

The policy interest rate of United States is expected to rise from the near zero level for the first time since the onset of the global financial crisis (GFC) in 2008, and it has already presented a challenging new monetary policy environment to many advanced and emerging countries. This study offers a case study of the related issues for the important emerging economy of Korea, whose dependency on external demand has remained high like many other emerging economies that have been affected by the drop-off in global economic growth. Korea is also notable for its liquid and open financial markets. Some studies have found that capital inflows and outflows in Korea to have been more mobile than in other emerging economies during the past decade or so, partly due to its liquid securities markets.[1]

This study examines sequentially three issues that are important to Korea's monetary policy deliberations in the coming period of normalization of the hitherto unconventional monetary policy of the US Federal Reserve (Fed). The first is the linkage between the Fed's monetary policy and Korea's financial market volatility. Rapid capital flows are expected to affect Korea's foreign exchange and stock market volatility. This paper offers an explicit empirical examination of whether there has been a statistically significant linkage between the US monetary policy and Korean financial market volatility in the pre-GFC period. To the extent that financial market stability is a part of the central bank mandate, the Bank of Korea (BOK) should take this relationship into consideration in policy deliberations. For analysis, we estimate a simple single equation regression model consisting of financial market and monetary policy variables of the United States and Korea for both won-dollar exchange rate and Korean stock market index.

The second issue is the impact of capital inflows on the efficacy of Korea's monetary policy, especially during the post-2008 US quantitative easing (QE) period. The broad topic of global capital flow and monetary policy independence has been discussed by many in the wake of the 2008 GFC (for example, Rey, 2013; Bruno and Shin, 2013). The impact of US QE on the effectiveness of monetary policy in the emerging Asian economies has been of interest to many researchers (Jain-Chandra and Unsai, 2012; Miyajima, Mohanty, and Yetman, 2014). This paper offers results of empirical examinations of the case of Korea.[2] Using a cointegration framework due to Johansen (1991) a distinct change in the propagation mechanism of monetary policy, in which short term policy rates affect long term interest rates, is observed in

[1] For example, see Park, Lee, and Chung (2013). Some observers go as so far as to describe Korea as "the ATM of emerging markets" for international investors. This view points to the depth and liquidity of the stock, bonds and foreign exchange markets in Korea that allows foreign financial capital to flow in and out of the country with ease.

[2] This topic has special relevance to the monetary policies of Korea owing to the high indebtedness of households that has grown steadily over the past decade, even during the period immediately following the 2008 GFC, when deleveraging was common in advanced economies. A large stock of household debt with relatively short maturity and variable interest payments could work as a weight restraining any upward movement in policy interest rate.

Korea since the mid-2000s. In the latter sample period, US monetary policy variables appear to have more influence on Korean market interest rate than Korea's policy rate.

Finally, an observation is made on the financial health of the Korean central bank in terms of balance sheet size and composition, and on how they could affect the deliberations of the course of monetary policy actions going forward. This topic deserves attention in light of recent academic as well as policy–oriented discussions, namely, of the central bank's financial health issues implied by the composition of its assets/liabilities, and policy credibility. Researchers have adopted two types of "carry trade" to describe the modality of how assets on a central bank's assets are financed. The first modality may be called "foreign carry trade" since it is related to how foreign reserve assets, with low returns, are financed by domestic currency denominated central bank liabilities, with high costs, in many Asian economies (Filardo and Grenville, 2012). What has been happening to the Swiss National Bank since 2011 with the installation of the exchange rate peg of the Swiss franc to euro is an apt example. The second modality, could be called "domestic carry trade" and relates to the enlarged marketable domestic security holdings on the asset side (of the Fed), matched by commercial bank reserves as a consequence of QE (Goodfriend, 2014).[3] Korea belongs to the first category. If the BOK's loss entails onerous consequences such as further diminution of central bank independence, monetary policy deliberations could be encumbered by the central bank's profit/loss implications of policy changes. Thus, this is an important issue that deserves further attention.

The remainder of this paper is organized as follows. Section II presents observations on the linkage between the US monetary policy and Korean financial market volatility. Section III presents empirical results of influences of US QE on the efficacy of Korea's monetary policy. Section IV discusses the financial health issues of the BOK and how they might influence monetary policy deliberations. Section V concludes with a brief discussion of policy implications of evidence and observations.

II. Korean Financial Market Volatility and the US Monetary Policy

Financial markets first respond to actual as well as anticipated monetary policy changes. In the current globalized financial markets with fluid financial capital flows, the international transmission of US monetary policy action, significant even before 2008, has become more visible during the post–2008 GFC period with the advent of various unconventional monetary policy measures such as QE.

Despite exhibiting exemplary scores on dimensions such as current account balances, the size and the maturity composition of external liabilities, the inflow and outflow of capital in Korea has been volatile. Regardless of whether Korea can be considered as the "ATM of emerging markets," the country seems to experience bouts of financial market volatility that roughly coincides with notable events in the US and other key financial markets. Thus, financial market volatility is a matter of concern to monetary policy makers to the extent that the stability of financial markets

[3] See Rudebusch (2011), Carpenter et al. (2013), and Hall and Reis (2013) for more detailed discussions of issues of the Fed.

is a part of the central bank's mandate. This section empirically investigates the linkage between the US monetary policy and Korean financial market volatility.

Our strategy is to estimate simple regression models with the measures of financial market volatility as the dependent variable on two sets of explanatory variables: the US monetary policy related variables, and the Korean real economic activity variables that influence financial market volatility. There has been multitude of research on modelling financial market volatility variables for forecasting purposes as their key role as a measure of risks (see Poon and Granger, 2003).

Our interest lies not in designing a forecasting model but an empirical model that can be used to examine the international repercussion of the US monetary policy. Our approach is similar to the MIDAS approach (Ghysels, Santa-Clara, and Valkanov, 2006; Alper, Fendenglu, and Saltoglu, 2008), in that data with different frequencies (daily and monthly) are utilized. But our use of daily data in the monthly model is limited to using them to calculate the volatilities of exchange rate and stock market index within a calendar month. We have to add that the regression results by themselves do not yield information about the causality between the model variables. Any such interpretation will be based on the assumption that Korea is a small open economy, whose financial markets also act as a price taker vis-à-vis the changes in the US monetary policy and financial market prices.

First, monthly volatility of foreign exchange and stock markets series are created using the standard deviations of daily observations; *vol(ex)*, for the exchange rate, and *vol(stk)*, the stock market index. The initial group of explanatory variables includes: two interest rate spreads of the short–term (*sspread*), and the long–term (*lspread*) interest rate spreads of the US and Korea[4]; KRW/USD exchange rate (*ex*). In addition, to account for the US financial market risk, the Chicago Board Options Exchange Volatility Index, the Vix (*vix*) is included[5]. The baseline model (I) is as follows:

$$vol(ex)_t = \alpha + \beta_1 sspread_t + \beta_2 lspread_t + \beta_3 ex_t + \beta_4 vix_t + \sum_{i=1}^{k} \gamma_i vol(ex)_{t-i} + \varepsilon_t \quad \cdots\cdots\cdots\cdots\cdots\cdots \text{(I)}.$$

In the model (I), *sspread*, which is the spread between short term interest rates of the US and Korea, is the explanatory variable most relevant to the US monetary policy. It is implicitly assumed that this variable is exogenous to the dependent variable, *vol(ex)*. Justification is as follows. The monetary policy changes in terms of the policy interest rate changes had been far more frequent in the Unite States than in Korea by approximately a ratio of two to one in the 2000-2008 period. Furthermore, the possibility of feedback from the Korean won's exchange rate volatility to the US

[4] A typical interest parity relationship involves a change in an exchange rate and either short or long term interest rate spreads of the two countries. We rely upon this theoretical motivation for the inclusion of the interest rate spreads.

[5] The sources for the Korean and US variables are respectively the Ecos of the BOK and the FRED of St. Louis Fed. For *sspread*, differences between the 3–month USD LIBOR (US) and 3–month CD (Korea) rate are used. For *lspread*, differences between the yields on 5-year US Treasury (US) and 5-year Korean government bonds are used. Logged series are used with linear smoothing adjustments (adding a constant positive number to a series to make it positive).

short term monetary policy rate should be negligible. Similar reasoning applies to the case of the long term interest rate spread (*lspread*) and the Vix, and thus the contemporaneous terms are included in (I). However, the lagged dependent variable on the right hand side could give rise to the endogeneity problem. For this reason, we utilize the Generalized Method of Moments estimation.[6] Estimation results for the exchange rate and stock price index models are shown in <Table 1> and <Table 2> respectively for the sample period from January 1999 to December 2009.[7]

The first column of <Table 1>[8] shows the estimation results for (I). The model seems to explain the won/dollar exchange rate fairly well, given that the adjusted R^2 of 0.53. The result shows that all explanatory variables are significant except *sspread*. It is interesting to note the long term interest rate spread remains consistently significant. The (widening of) long term interest rate spread, the (rise of) won/dollar exchange rate, and the (rise in) the US financial market volatility (*vix*) are found to have added to the exchange rate volatility in Korea.

By definition, both changes in the US as well as Korean monetary policy could cause movements in the short term interest rate spread, *sspread*. We further investigate a channel through which the changes in the US monetary policy, not those of Korea, could affect the Korean foreign exchange market volatility. For this we constructed an index variable, to be called $intval_t$, that measures the number of months since the last change in the US monetary policy by using the federal funds rate change data provided by the Federal Reserve Board. A non-zero entry of this index on a particular month conveys two pieces of information. One is the date of the US monetary policy change, and secondly, the number of months that has passed since the last change.

We add this variable interacted with the short term interest rate spread, *sspreadt*intvalt*, to the model and create a variant model (I-1). The reasoning behind this approach is to bring a sharper focus to the changes in the short term interest rate spreads that are caused specifically by changes in the US monetary policy. In addition, this interacted variable could capture the potential difference in the effects of frequent changes in the policy (i.e., low value of *intval*) vs. infrequent changes (i.e., high values of *intval*). The estimation results are shown in the second column of <Table 1>.

All the coefficient estimates remain stable, compared to those of the model (I). The

[6] GMM makes use of the orthogonality conditions of instrumental variables to provide an unbiased and robust estimator within the presence of endogenous explanatory variables (Hansen, 1982). We use the second and the third lags of the dependent variable as instruments for the lagged dependent variable ($vol(ex)_{t-1}$).

[7] The start date of the sample was chosen as large repercussions of the 1997-98 financial crisis had dissipated by then. The end date was chosen as it was the last year that the Korean policy interest rate was lowered since the Lehman Brothers' collapse in the previous year. The BOK started to increase the policy rate in late 2010.

[8] Either level or first differenced series are used depending on the Augmented Dick-Fuller (ADF) unit root test results. The first differenced series is used if the series is found to have a unit root. First–differenced *lspread, sspread, exch, cpid*, *kip and exp* are used for both models.

coefficient for the crossed variable (β_5) is significant at 5 percent level even though that of the *sspread* continues to be insignificant. We offer two interpretations. One, changes in the spread between short term interest rates of Korea and the United States caused by the changes in the US monetary policy do affect Korean FX market volatility. Two, the negative sign of the coefficient suggests that large *intval* tends to lower the exchange rate volatility. That is, a change in the US monetary policy that occurs after a relatively longer period of inaction tends to reduce the volatility of the won-dollar exchange rate.

An intuitive explanation for this observation is as follows. Uncertainty about the future monetary policy in the United States, which adds to the exchange rate volatility, tends to rise as more time lapses since the last change, ceteris paribus. Once a change in the US policy does occur, it reduces the uncertainty and hence offers a period of stability in the foreign exchange market, at least in the short run. Three, the positive signs of β_3 and β_4 the exchange rate depreciation (e.g., bigger *ex*), and instability of the US financial market add to the volatility in foreign exchange as well as stock markets.

In the Model (I-2), we add some non-financial variables to capture any significant effects those variables might have on the exchange rate volatility. The variables are: the difference between the US and Korean CPIs (*cpid*), and the monthly growth rates of two Korean macroeconomic variables of industrial production (*kip*) and exports (*exp*) to account for the real sector developments. For all three variables of the model (I-2), one-month lagged variables are used. The results are shown in the third column of <Table 1>.

Inclusions of these macroeconomic variables seem to have had little effect on the estimation results. The adjusted R^2 of the model (I-1) and model (I-2) are the same. They are all insignificant at conventional significance level. Furthermore, there is almost no perceptible change in the coefficient estimates of the variables of the model (I-1).

Next, we carry out an identical analysis using the volatility of monthly stock market price index KOSPI as the dependent variable. The monthly $vol(stk_t)$ is calculated using the standard error series of daily KOSPI index for the sample period from January 1999 to December 2009. The same sets of explanatory variables are employed in the models (II) through (II-2), comparable to the model (I) through (I-2). The estimation results are shown in <Table 2>.

In general, the estimation results show a different pattern compared to those of <Table 1>. The short and long term interest rate spreads as well as the Vix are not significant while the won-dollar exchange rate, the short term interest spread interacted with the US monetary policy interval variable, and Korea's export are significant. Of the three variables that involve US interest rates, only the ($sspread_t$*$intval_t$) term remains significant. As in the earlier exchange rate volatility case, this indicates that changes in the short term interest rate spread caused by changes in the US monetary policy do affect the Korean financial market volatility.

<Table 1> Estimation results for exchange rate volatility models

Sample period	January 1999~December 2009.		
Model	(I) [a]	(I-1) [b]	(I-2) [c]
Explanatory variables			
α	-0.60* (0.36)	-0.61* (0.35)	-0.54 (0.35)
β_1	-16.44 (15.62)	13.57 (20.97)	15.20 (22.61)
β_2	32.51** (13.85)	31.05** (14.13)	31.06** (12.99)
β_3	4.46** (2.00)	4.26** (1.80)	4.43** (1.93)
β_4	0.50** (0.20)	0.49** (0.20)	0.47** (0.19)
β_5		-49.29** (21.26)	-49.43** (21.56)
γ_1	0.44** (0.17)	0.45** (0.17)	0.44*** (0.15)
γ_4	0.13* (0.07)	0.14** (0.07)	0.15* (0.08)
δ_1			9.97 (12.71)
δ_2			-0.73 (1.60)
δ_3			0.27 (0.56)
Adjusted R^2	0.53	0.54	0.54
P-value of J-statistic[3]	0.75	0.78	0.89

a. $vol(ex)_t = \alpha + \beta_1 sspread_t + \beta_2 lspread_t + \beta_3 ex_t + \beta_4 lvix_t + \sum_{i=1}^{k} \gamma_i vol(ex)_{t-i} + \varepsilon_t$

b. Model (I) + $\beta_5 sspread_t * intval_t$

c.. Model (I-1) + $\delta_1 cpid_{t-1} + \delta_2 kip_{t-1} + \delta_3 exp_{t-1}$

1. Numbers in () are standard errors and ***, **, * denote significant cases at 1%, 5%, and 10% levels.

2. J-statistic is to test the validity of our choice of multiple instruments variables in the GMM estimation under the null hypothesis that the over-identifying restrictions are satisfied. These figures show that our use of multiple IV variables is acceptable.

<Table 2> Estimation results stock market rate volatility models

Sample period	January 1999~December 2009.		
Model	(II) [a]	(II-1) [b]	(II-2) [c]
Explanatory variables			
α	0.73* (0.38)	0.70* (0.39)	0.63 (0.42)
β_1	3.80 (9.86)	28.53 (18.38)	22.59 (18.89)
β_2	-0.80 (14.21)	-2.59 (14.14)	-0.021 (12.84)
β_3	3.52* （1.87）	3.18** (1.51)	3.52** (1.57)
β_4	0.11 (0.35)	0.14 (0.12)	0.15 (0.12)
β_5		-40.93** (18.98)	-35.27* (8.50)
γ_1	0.15* (0.08)	0.14* (0.08)	0.16* (0.08)
γ_2	0.53** (0.22)	0.52** (.22)	0.50** (0.20)
δ_1			9.15 (8.89)
δ_2			2.08 (1.35)
δ_3			0.88*** (0.32)
Adjusted R^2	0.25	0.27	0.32
P-value of J-statistic	0.66	0.86	0.86

a. $vol(stk)_t = \alpha + \beta_1 sspread_t + \beta_2 lspread_t + \beta_3 ex_t + \beta_4 lvix_t + \sum_{i=1}^{k} \gamma_i vol(stk)_{t-i} + \varepsilon_t$

b. Model (II-1): Model (II) + $\beta_5 sspread_t * intval_t$

c. Model (II-1) + $\delta_1 cpid_{t-1} + \delta_2 kip_{t-1} + \delta_3 exp_{t-1}$

1. Numbers in () are standard errors and ***, **, * denote significant cases at 1%, 5%, and 10% levels.

2. J-statistic is to test the validity of our choice of multiple instruments variables in the GMM estimation under the null hypothesis that the over-identifying restrictions are satisfied. These figures show that our use of multiple IV variables is acceptable.

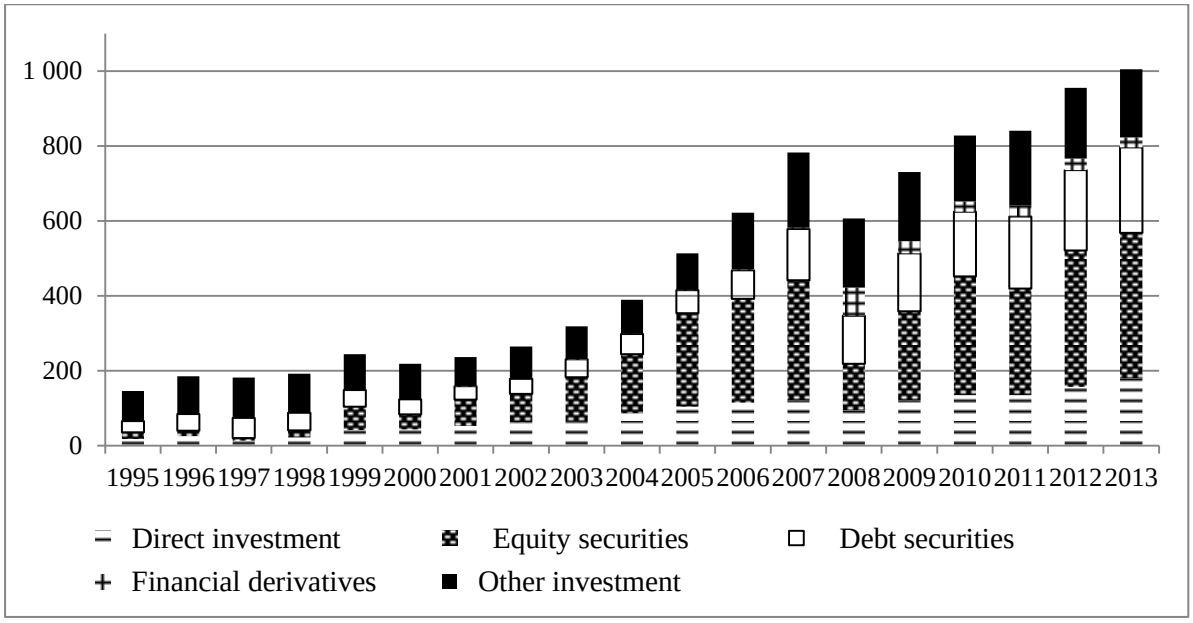
All in all, the results show that volatility of both won-dollar exchange rate and Korean stock market is sensitive to the US financial market as well as monetary policy developments. However, the former appears more sensitive to the US

developments than the latter.

III. Effects of capital inflow on Monetary Policy Efficacy in Korea[9]

Capital inflows into Korea started to grow briskly in the mid-2000s, as shown in <Figure 1>. A sharp fall in 2008, caused by a steep drop-off in equity investment, turned out to be temporary as the inflow resumed thereafter. One noticeable trend in the composition of capital inflow since 2007 is the discrete increase in inflow to the bond market, especially into the government debt market. This reflects both supply and demand factors. The government bond issuances had started to grow in the 2000s and efforts were made to bolster the market by providing longer maturity issues. At the same time, demands for Korea's government and central bank debts steadily grew as the perceptions about the stability of Korea's economy by global institutional investors had improved. Foreign investment in debt securities did not fall, even in 2008, when equity investment more than halved from the 2007 level, and has continued to grow.

<Figure 1> Composition of foreign investment (billion USD, 1995-2013)[1]



1. 'Other investment' includes bank lending. Source: Ecos, The Bank of Korea.

Typically, monetary policy actions are believed to influence economic activities via changes in short–term policy interest rates that propagate to long–term market interest rates. This section's investigation focuses on the monetary policy transmission mechanism short–term to long–term interest rates. An empirical model is employed to check the stability of the estimated monetary policy transmission

[9] This section is based on the first author's earlier research paper titled "Korea's Monetary Policy Challenges in the Wake of the U.S. Quantitative Easing and its Tapering" (2014, in Korean).

mechanism over different sample periods. Jain-Chandra and Unsai (2012) and Miyajima, Mohanty and Yetman (2014) examined this issue for different Asian economy groups by using a slightly different empirical methodology.

We implement an empirical investigation of the extent of the influences of the US monetary policy on Korea's monetary policy transmission mechanism using cointegration relationship–based vector error correction model (VECM) as follows.

$$\Delta \boldsymbol{Z_t} = \sum_{i=1}^{k} \Gamma_i \Delta \boldsymbol{Z}_{t-i} + \boldsymbol{\Pi}\, \boldsymbol{Z}_{t-1} + \boldsymbol{C} + \boldsymbol{\psi}\mathbf{D} + \epsilon_t. \quad (2)$$

Here letters in capital and bold represent vectors: **Z** represents interest rates, exchange rate, and inflation; Δ is a difference operator; **Γ**, **Π** and **Ψ** are coefficient matrices; **C** and **D** represent constant and dummy variables; **ε** represents a vector of residual terms with multivariate normal distribution. Johansen (1991) cointegration test is about whether a linear combination of elements of **Z** with stochastic trends could be found.

Two models, each with different sets of **Z** are estimated using the US and Korean monthly series. Model MP-1 include the call market interest rate (the Korean counterpart of the US federal funds rate, CALL), the KRW/USD exchange rate (KORUS), the yield on 3-year Korean Treasury bonds (KT3), and the consumer price index (INF). Model MP-2 is constructed by adding the 10-year US Treasury bond yields (UST10) to MP-1.

First, we investigate whether the variables of the model MP-1 have a stable cointegration relationship throughout the sample period from January 2000 to December 2013 by using the VAR based Johansen (1991) test. A stable cointegration relationship for the full sample period is not found, but two separate cointegration relationships are found for the two sample periods of 2000-2008 and 2007-2013. The results are shown in <Table 3> and <Table 4>. In the following, we dub the MP-1 estimated from the first and the second samples (shown in <Table 3>), as the pre-GFC MP1 and the post-GFC MP1, respectively.

In contrast to MP-1, MP-2 shows a stable cointegration relationship for five variables for relatively longer sample periods from 2005 as shown in <Table 4>. There are couple interesting points. First, while no stable cointegration relationship is found in a set consisting of only Korean monetary and financial variables in the full sample period, two distinct ones from two almost disjoint samples are found, suggesting a structural shift in the relationship between those variables in the vicinity of 2007 and 2008. Second, US monetary policy seems to have had a measurable influence on Korea's monetary/financial variables even before the 2008 global financial crisis because the cointegration relationship of the variables of Model 2 started in 2005. This finding can be explained by the observation that capital inflows started to grow in the mid-2000s, as shown in <Figure 1>.

<Table 3> Cointegration test results of Korea's monetary policy transmission model consisting of only Korean domestic variables

(Model MP-1: CALL–KORUS–KT3–INF)

Johansen cointegration test						
	Trace statistic			Max eigenvalue statistic		
H_0	$r = 0$	$r = 1$	$r = 2$	$r = 0$	$r = 1$	$r = 2$
H_1	$r = 1$	$r = 2$	$r = 3$	$r = 1$	$r = 2$	$r = 3$
Full sample (October 2000~December 2013) [1]						
	41.34 (47.86)	16.71 (29.80)	8.69 (15.49)	24.63 (27.58)	8.02 (21.13)	4.44 (14.26)
Pre-2008 version (October 2000~December 2008)						
	59.87***	22.36	9.88	37.52***	12.48	7.59
Post-2008 version (January 2007~December 2013)						
	61.05***	12.47	4.45	48.58***	8.01	4.25

***, **, * denote significant cases at the 1%, 5%, and 10% confidence level, respectively.

1. The top figures are test statistics and ones in parentheses are the 5%critical values as provided in *Eview 7*. These indicate that there is no cointegrating relationship in the full sample.

<Table 4> Cointegration test results of Korea's monetary policy transmission model consisting of US and Korean domestic variables

(Model MP-2, UST10–CALL–KORUS–KT3–INF)

Sample period: January 2005~December 2013[2]						
	Trace statistic			Max eigenvalue statistic		
H_0	$r = 0$	$r = 1$	$r = 2$	$r = 0$	$r = 1$	$r = 2$
H_1	$r = 1$	$r = 2$	$r = 3$	$r = 1$	$r = 2$	$r = 3$
	83.95***	36.68	13.45	47.26***	23.23	7.17

1. Notations are the same as in <Table 2>.

<Table 5> Variance decompositions of Pre-GFC and post-GFC MP-1 (%)

Pre-GFC MP-1

Variance Decomposition of (KT3):

Month	CALL	KORUS	KT3	INF
1	8.9	4.0	87.1	0.0
6	38.1	1.6	59.4	1.0
12	46.8	2.7	47.1	3.5

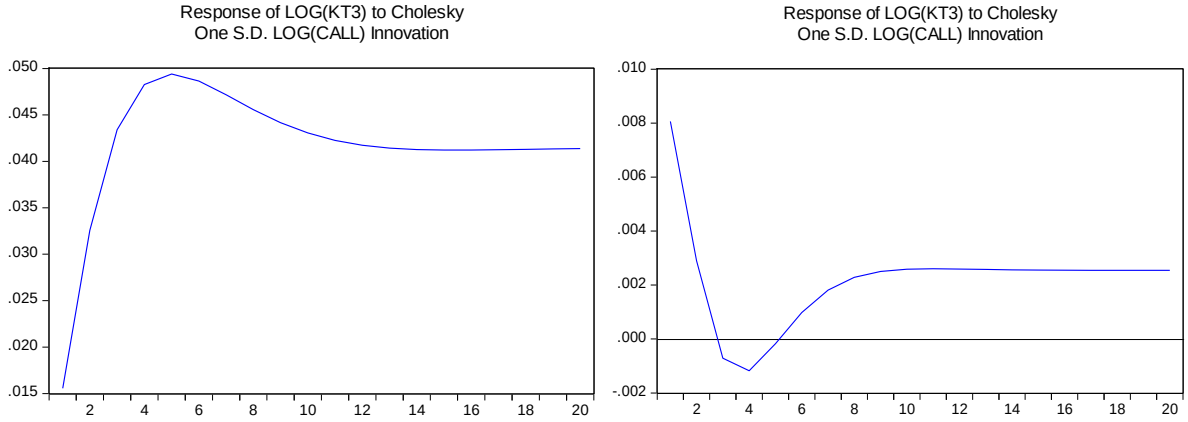
Post-GFC MP-1

Variance Decomposition of (KT3):

Month	CALL	KORUS	KT3	INF
1	3.4	0.2	96.4	0.0
6	0.4	1.0	98.2	0.3
12	0.3	1.2	96.6	1.9

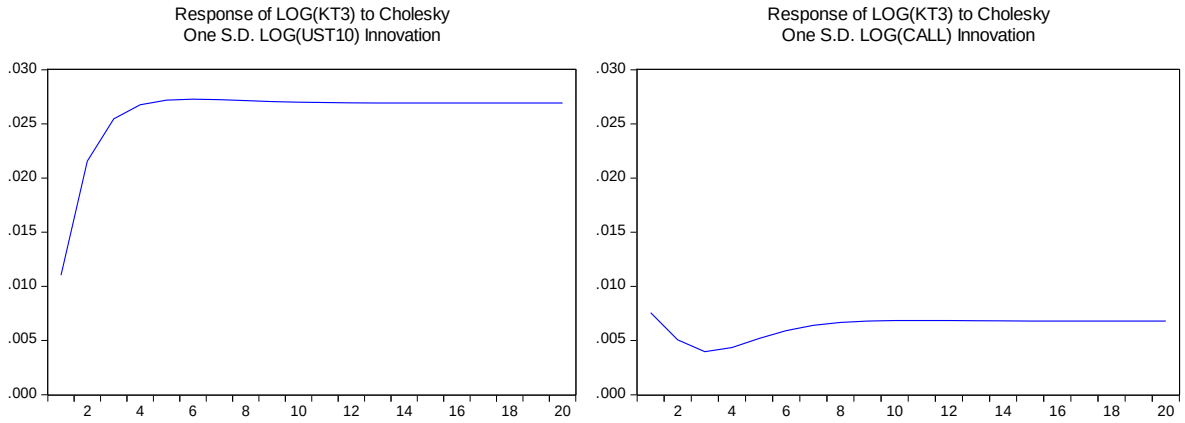
<Figure 2> Responses of Korea's long term interest rate (KT3) to policy rate shock, MP-1

Pre-GFC version (left), and post-GFC version (right)



<Figure 3> Responses of Korea's long term interest rate (KT3) to shocks, MP-2

UST10 shock (left), and CALL shock (right)



The dynamics of the models are summarily compared using variance decompositions and impulse responses of the variables of interest. First, <Table 5> shows the variance decompositions of the KT3 from the pre- and post-GFC model MP-1. In the pre-GFC case, the CALL and KT3 each accounts for about half of the

forecast variance of the KT3 over 12 month horizon. However, we observe a complete shift in this pattern as almost all of the forecast error variances of KT3 is accounted for by itself in the post-GFC

The patterns of how the Korean long-term interest rate responded to a Korean monetary policy shock in the two sample periods are compared in <Figure 2>. The left and right hand side figures are impulse responses of the KT10 to one standard deviation shock in the CALL respectively from the pre-GFC and post-GFC versions of the model MP-1. They offer strong evidence of a shift in the efficacy of monetary policy in Korea around the 2008 GFC. The pre-GFC pattern conforms to the general expectation of how a change in short-term policy interest rate leads to a similar change in long-term interest rate. However, we observe quite a different pattern in the post GFC sample. The responses shown in the right panel suggest that the positive effect of a CALL rate increase completely dissipates within three months.

Next, <Figure 3> shows the response patterns of KT3 to shocks in the US long–term interest rate (UST10) and the Korean policy rate (CALL) from MP-2. However, there are significant differences between the effects of a UST10 shock and a CALL shock. Korea's long-term interest rate (KT3) responds noticeably to the shock of UST10, but we do not see comparable responses to shock of CALL. The pattern of how KT3 responds to a UST10 shock is very similar to that seen in the pre–GFC version of MP-1, whereas the response pattern of KT3 to a CALL shock is perceptibly subdued, similar to that seen in the post–GFC version of MP-1. It appears that since the mid–2000s, the US interest rate has played the role of the Korean policy interest rate vis-à-vis the Korean long–term interest rate for the 2000–2008 sample.

These results together suggest that the interest rate channel of the BOK has changed since the late 2000s and that the influences of the exogenous inflows of capital captured by the US long–term interest rate have grown in the same time frame. This observation is broadly consistent with the findings of related studies such as Jain-Chandra and Unsai (2012) and Miyajima, Mohanty and Yetman (2014).

IV. Central Bank Financial Health

The preceding sections offer empirical evidence on the extent of the influences of the US monetary policy on Korea’s key financial variables such as long term interest rate and volatilities of exchange rate and stock market. Given such a linkage between the US monetary policy changes and financial market conditions of Korea, the monetary authority of Korea, the Bank of Korea (BOK) faces potentially significant challenges ahead as changes in the US monetary policy stance, in terms of rising of the policy interest rate, are expected to take place soon. Thus, in this section we examine an important structural issue regarding the financial health of the central bank that might affect the BOK’s policy options going forward. The BOK showed accounting losses for several years during the past decade and a half, as can be seen in <Table 6>. According to Archer and Moser-Boehm (2013), “Central banks exist for different purposes than commercial banks. … Their financial results

are often a poor guide to their success."[10] While it is not rare for a central bank to incur losses (see Kluh and Stella, 2008, for Latin American cases, and Sweidan, 2011, for Asian cases), such losses are rare in advanced economies. This is because "financial results may be important for a central bank even though it can always create money to pay its bills, cannot be declared bankrupt by a court, and does not exist to make profits. Losses or negative capital may raise doubts – however erroneous – about the central bank's ability to deliver on policy targets, and expose it to political pressure."[11] [12]

According to its annual report for 2013, the BOK conducts "… sterilization policy whereby excess liquidity supplied through the overseas sector is absorbed chiefly by issuing Monetary Stabilization Bonds (MSBs). Accordingly, its assets are largely made up of foreign-currency assets including foreign currency securities and due from banks. Its liabilities …are mostly composed of MSBs issued and foreign-currency deposits." [13] Thus, the won–denominated profit/loss of the BOK is determined by interest rates receives on its US Treasuries holdings, interest rate it pays to MSBs and on the liquidity control–related deposits, and the KRW/USD exchange rate.

<Table 6> Key factors affecting the financial health of the Bank of Korea (2003~2011)[1]

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
2-year US Treasury (%)	1.65	2.38	3.85	4.82	4.36	2.01	0.96	0.70	0.45
2-year MSB (%)	4.59	4.09	4.24	4.83	5.33	5.47	3.84	3.67	3.71
KRW/USD	1191.9	1144.7	1024.3	955.5	929.2	1102.6	1276.4	1156.3	1108.1
BOK profit/loss[2]	2,175.0	-150.2	-1,877.6	-1,759.7	-444.7	3,402.9	2,865.5	3,513.3	3,135.0
BOK Assets/ GDP (%)[3]	27.1	28.9	29.5	31.4	31.0	28.3	31.6	30.3	34.2

1. Loss making years are shaded. 2. Billion KRW.

3. Sources: FRED, St. Louis Fed, and Ecos, and Annual Reports, BOK.

[10, 11] Page 4, Archer and Moser-Boehm (2013). Similar points are made by Stella (2008).

[12] Article 100 (Compensation for Losses) of the Bank of Korea Act says the following. "Losses accruing during a fiscal year of the Bank of Korea shall be compensated from reserves, and if reserves are insufficient, they shall be compensated by the Government as prescribed by the State Finance Act."

[13] Page 129, *The Bank of Korea Annual Report (2013)*.

<Table 6> seems to confirm the importance of the interest rates paid to MSBs and the KRW/USD rate on the BOK profit/losses. The shaded years are when the BOK recorded operating losses. The interest income on foreign securities must not fluctuate much because fixed coupon payments make up a big part of the receipts. The exchange rate change seems to dominate the profit/loss outcome of the BOK rather than the changes in interest rates of foreign securities (asset) and the MSB (liability). A similar point was made by Filardo and Grenville (2011) and Cook and Yetman (2012). The latter estimated the sterilization costs of interest rate changes as well as the exchange rate appreciation of the East Asian economies.[14]

The extent to which the profit/loss of the BOK is a sensitive political issue is likely to be a factor influencing the BOK's monetary policy, a point made by many economists with regards to central banks in general (e.g., Stella, 2008; Archer and Moser-Boehm, 2013; Goodfriend, 2014). Higher domestic interest rates in relation to those of the US and stronger KRW/USD exchange rates are factors that can tip the BOK into the red. The extent of the bias that these facts may cause on the BOK's mode (slow and infrequent vs. prompt and frequent) as well as the direction of policy making are not clear.[15]

It might be reasonable to assume some influences on previous decision makers as one hears the critical comments made by Korean observers that the BOK tends to be sluggish in its policy interest rate decisions. For example, a simple comparison of the frequency of policy interest rate changes and the range of rates for the period 2000–2008 for the US and Korea offers some evidence. The Fed changed the policy interest rate 43 times (20 increases and 23 decreases), whereas the BOK changed the rate 23 times (11 increases and 12 decreases). The US federal funds rate ranged between 6.5% and 0.25%, while the same period for the BOK's rate ranged between 5.25% and 3.0%.[16] These differences stand out, given the patterns of CPI inflation rates in both countries were quite similar in terms of highs and lows and variability.

The bottom line of <Table 6> shows the ratio of total BOK assets to nominal GDP. A large asset size means commensurate MSBs and deposits employed for liquidity control purposes, meaning higher costs in terms of interest payments on these balance sheet liability items for the central bank. The relative ratio of GDP to BOK asset size is larger than that of the central banks of advanced economies whose asset size has grown rapidly since 2008 as a consequence of domestic central bank carry trades. For example, the ratios for the Federal Reserve, Bank of England, and European Central Bank remain below 30% as of 2014, the Bank of Japan is an exception–their quantitative easing measures in recent years have pushed the ratio close to 50%. The degree to which the financial health of a central bank becomes an issue could be expected to be roughly commensurate with its asset size.

[14] Table 13, page 61, Cook and Yetman (2012).
[15] The concern is "that poorly-capitalized central banks are often constrained in their policy choices or, even when not so constrained, sometimes loosen policy to avoid large losses for reputational or political economy reasons." (page 4, Stella, 2008).
[16] The lowest federal funds rate target before 2008 was 1%, reached in June 2003. This relatively narrow range of policy rate in Korea might be a case in point of Asian economies with large foreign exchange reserves that "do not seem to able to use the interest rate setting vigorously enough to impinge on the demand for credit when it is growing rapidly." (page 101, Filrado and Grenville, 2012)

IV. Conclusion and Policy Implications

This paper offers some empirical evidence that changes in the US monetary policy affect Korean financial market volatility and the efficacy of the BOK's policy interest rate to market long–term rate channel of monetary policy since 1999, with special attention on the post–2008 GFC period. In addition, we reviewed some structural issues related to the financial health of the Korean central bank's balance sheet. The results indicate perceptible influences of the unconventional US monetary policies since 2008, such as QE. In addition, the results suggest that the inflow of capital weakened the BOK's interest rate policy efficacy especially after 2008, offering evidence of an incomplete sterilization. Although not discussed in this paper, the expanded domestic liquidity due to capital inflows appears to have contributed to the trend of steady growth of household indebtedness in Korea which has become a key challenge to the promulgation of monetary policy.

Major changes can be expected in the external environment for monetary policy decisions in Korea in the near future, following the upward drift of the US policy interest rate after staying near zero for 6 years. In addition to the unconventional accommodating monetary policy continuing in Japan, similar measures were implemented by the European Central Bank on March 2015. Moreover, conditions such as developing crisis in Greece exist for unusual turbulences in global capital flows.

In addition to near term policy responses to address external shocks, measures to bolster the financial condition of the central bank should help monetary policy credibility in the future. Accordingly, it might be desirable for the government to grant more autonomy to the BOK in utilizing its operating profits to build up its capital reserves so that the central bank would not be encumbered by potential operating losses when pondering policy actions.[17] Such a change would bolster the efficacy of monetary policy by enhancing its credibility in the medium term.

Conducting the volatility model analysis done in the first part of this paper using daily frequency data along the lines of the MIDAS approach might yield more illuminating results on the international repercussions of the US monetary policy. We leave that as our future research task.

[17] The Bank of Korea Act was revised to increase the proportion of net profit to be allocated to the legal reserve from 10% to 30%.

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