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A Study on Volatility Dynamics and Inter-Sectoral Spillovers Originating from Banking Sector: The Case of Karachi Stock Exchange

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Abstract
The study was conducted to investigate the spillover effects originating from the Banking sector and directionality of these effects on various sectors of Pakistan. The sectors under study were Banks, Oil and Gas, Construction, Chemical, Food Producer, Fixed Line Telecommunication, Electricity sector and Personal Goods sector. Daily data of 251 companies was considered and the time period studied was from 2008 to 2012. We investigated the spillover effects originating from Banking sector and whether they differ across different sector but also examined whether correlation of Banking sector with other sector varies over time. We used BEKK parameterization as used by (Engle & Kroner, 1995) to detect volatiltity transmission among Banking and all other sectors. We also conducted Granger Causality test on weekly portfolio returns, volatility and conditional standard deviation to have a better understanding. The results of daily data showed returns of banking sector significantly impacted returns in Oil and Gas sector, Chemical and Electricity Sector Returns in Construction and Chemical sector impacted return in banking sector. We tested Granger Causality, on weekly portfolio returns, volatility and conditional standard deviation and then ran the GARCH model on weekly and monthly data set. We concluded that banking sector did play a crucial role in impacting various sectors of the economy but it was also evident from the results that few sectors did impact the Banking sector too.
Keywords: Volatility, GARCH Model, Portfolio returns, Banking Sector

1. Introduction

For economic growth of any country a sound financial sector is important. Banking sector of Pakistan has played a pivotal role in the growth of country's economy. The study is confined to investigate on spillover effects originating from the Banking sector and directionality of these effects. We were interested in understanding whether banking sector was leading other sectors or it was other sectors leading the Banking sector. To test these relationship GARCH model has been used widely in finance literature.

The most popular method to measure volatility was by ARCH model developed by (Engle, 1982) which was then generalised by (Bollerslev, 1986) to Generalised Autoregressive Conditional Heteroscedasticity GARCH model measuring volatility of high frequency data. To study the volatility spillover among different markets and sector the most widely used model has been Multivariant Generalised Autoregressive Conditional Heteroscedasticity (MGARCH).

With reference to GARCH models, it has been widely accepted that Vector GARCH (VEC) specifications suggested by (Bollerslev, Engle, & Wooldridge, 1988) are extremely difficult to handle while working with more than two variables due to the large number of parameters required.

Keeping in view these constraints we decided to use BEKK specification (acronym for Baba, Engle, Kraft and Kroner) proposed by (Engle & Kroner, 1995).

We used BEKK parameterization (acronym for Baba, Engle, Kraft and Kroner) as used by (Engle & Kroner, 1995) to detect volatiltity transmission among Banking and Oil and Gas, Food Producers, Chemicals, Personal Goods, Construction and Materials, Electricity and Fixed Line Telecommunication as well as the persistence of volatility with in each series.

The basic objective to use multivariate GARCH was to extract the time varying conditional covariance and correlation between different sectors returns and Banking sector return in Karachi stock exchange.

We concluded, in our daily analysis that returns in Banking sector were significantly impacting the returns of Oil and Gas sector, Electricity sector and Chemical sector whereas returns in Construction sector, Chemical sector and Personal Goods sector impacted Banking sector. We ran GARCH model on our weekly data and found return in Banking sector positive and significantly impacted Oil and Gas sector, Chemical and Personal Goods and negatively impacted Construction sector and Fixed Line Telecommunication. Food producer, Fixed Line Telecommunication and Electricity impacted Banking sector positively and significantly whereas Oil and Gas impacted the Banking sector negatively. Lastly the monthly data GARCH model results depicted return in banking sector significantly and positively impacted Construction, Chemical, food producer and Electricity sector. Whereas Oil and Gas and Fixed Line Telecommunication impacted the Banking sector.

Considerable research on volatility spillover has been conducted in developed countries. In Pakistan there has been no such study conducted so far which examines whether Banking sector originates volatility in other sectors or vice versa. So this left us with ample room to carry out this research.

This would assist in deriving important implications for economic policies. Furthermore, in case where some non-financial sectors are more sensitive to contagion from financial sector, policy makers gain information on where to allocate scarce resources. The study will add to the growing literature on volatility spillover for developing countries. After this study we will be able to comment on the extent to which Banking sector originates volatility spillover in other sectors and whether the Banking sector functioned as engine of growth.

The study can be of interest for financial markets participants who are more and more interested in knowing how shocks and volatility transmission mechanism works across markets over time. It can also grab interest of the policy maker in making economic policies helping them understanding how to allocate their limited resources once the transmission mechanism of volatility spillover of banking sector with that of other sector is known.

The remaining paper is as follows: Section II will present a detailed literature review on the Volatility Spillover and GARCH models; Section III will explain the data used methodology of the research followed by Section IV providing conclusion and policy implications.

2. Literature Review

There has been a lot of literature on how different sectors and markets interact over time for developed countries. There are various reasons that explained the significance of transmission mechanisms between the returns and volatilities of different stocks. These explicit and implicit reasons were discussed by (Harris & Pisedtasalasai, 2006). Firstly, transmission mechanisms helped explaining market efficiency. Presence of spillover effecting returns depicted evidence against efficient market hypothesis which meant exploitable trading strategy may exist to benefit from profits. In addition, the knowledge of spillover effects may be valuable in asset allocation and help in portfolio management. Lastly, volatility spillover effects understanding was of significant importance in financial applications that rely on conditional volatility, such as portfolio optimization, value at risk, option pricing, and hedging. Guarda & Rouabah (2011) investigated the sectoral outgrowth in Luxembourg and its correlation with other sectors the empirical findings suggested that financial service sectors functioned as engine of growth and led the other sectors in Luxembourg.

Ewing (2002) argued that it is important that investors comprehend the interrelationships among different indexes and whether or not to include in a portfolio depends on a number of reasons including how, and to what extent, are various sectors related. This study examined five major sector of S&P stock market which comprises of capital goods, financials, industrial, transportation and utilities using monthly data from 1988 to 1997. It used generalized forecast error variance decomposition technique and found that unanticipated news in one sector did have a significant impact on another sector returns.

A.Al-Fayoumi, Khamees, & A.Al-Thuneibat (2009) used Vector Error Correction (VECM) model to examine the interdependences of Jordan stock markets indices. Dynamic interactions among the daily returns of Amman Stock Exchange (ASE) indices from September 2000 to August 2007 were studied for general, financial, industrial and service sectors. The results depicted that sectors showed co movement among each other which meant price fluctuation in one sector could be determined to an extent using information provided by other sector.

According to various authors (Susmel & Engle, 1994) and (Bae & Karolyi, 1994) asymmetries need to incorporate in the model to prevent any erroneous conclusion from volatility transmission models. GARCH model has been the most popular to integrate asymmetries, other methodologies also have the asymmetric version. (Harvey & Shephard, 1996) used the asymmetric version of Stochastic Volatility models.

In the study by (Xia & Dhesi, 2010) examined the volatility spillover and dynamic conditional correlations between US and European equity market. The BEKK model was used for volatility spillover effect and DCC model to estimate the dynamic conditional correlations. It was also found that US equity market S&P500 was the main transmitter for the time period of 2004 till 2009 between European and US stock market whereas UK was the main transmitter with the European market.

A study conducted in Pakistan by (Qayyum & Kemal, 2006) investigated the volatility spill over between stock and foreign exchange market. The main aim was to examine and scrutinize the relationship between the stock market and the foreign exchange market. To study this relation it used time series approach. (Engle & Granger,1987) two steps approach to test for the co-integration relation between stock market prices and exchange rates using weekly data from 1998 to 2006 from Karachi Stock Exchange (KSE-100) and exchange rate data from State Bank of Pakistan. The results depicted that there is no long run relationship between the two markets in case of co-integration analysis whereas the volatility result showed the both the stock market and foreign exchange markets were inter connected.

3. Methodology

3.1 Data and Sample Criteria

In this study, we used time series data for the firms under consideration to study the spillover effect of banking

sector on other sector and vice versa with the help of daily price and market capitalization data obtained from KSE index. We required the average returns of selected sectors which were not available due to the absence of sectoral indices, therefore, we constructed, by using portfolio returns methodology, returns for each selected sector. The data set consisted of daily sectoral price indices of Karachi stock market from Janurary1, 2008 through December 31, 2012.The daily data enabled to capture all possible interactions which can be ignored by using weekly or monthly data. In our view that stock markets reacts promptly to news and thus low frequency would fail to capture such dynamics eight sectors were selected based on market capitalization and turnover shown in Table 1. In banking sector we considered 21 banks, 12 Oil and Gas companies, 23 Construction companies, 25 Chemical companies, 46 food producer, 4 Fixed Line Telecommunication companies, 13 companies in Electricity sector and 107 in Personal Goods sector.

3.2 Our Model

We used BEKK parameterization as used by (Engle & Kroner, 1995) to detect volatiltity transmission among Banking and Oil and Gas, Food Producers, Chemicals, Personal Goods, Construction and Materials, Electricity and Fixed Line Telecommunication as well as the persistence of volatility with in each series.

For the calculation of conditional correlation, however, we also relied on the calculations provided by Eviews which uses Diagonal VECH specifications to estimate variance equations particularly for weekly and monthly data. It has also been recognized that correlation does not ensure the presence of causation in any meaningful sense and there could still be a possibility of spuriously identified relationship between two sectors on the basis of strong correlation coefficient. To minimize the possibility of any such spurious relationship we also ran granger causality tests extensively to ensure the robustness of any possible relationship as well as direction between Banking sector and other sectors of KSE.

The basic objective to use multivariate GARCH was to extract the time varying conditional covariance and correlation between different sectoral returns and Banking sector return in Karachi stock exchange. With reference to GARCH models, it has been widely accepted that VEC specifications suggested by (Bollerslev, Engle, & Wooldridge, 1988) are extremely difficult to handle while working with more than two variables due to the large number of parameters required$\left[\frac{N(N+1)(N(N+1)+1)}{2} = 78\ for\ N = 3\right]$. (Bollerslev, Engle, & Wooldridge, 1988) proposed Diagonal VEC (DVEC) model which allows conditional variance depending only on its own lag and on the lagged values of cross product of errors $(\boldsymbol{\epsilon_{it}\epsilon_{jt}})$ thus restricting the number of parameters up to$\left[\frac{N(N+5)}{2} = 12\ for\ N = 3\right]$. Nonetheless even in diagonal VEC representation it is extremely difficult to ensure the positivity of conditional variance covariance matrix (H_t) unless we impose strong restrictions on the parameters (Bauwens, Laurent, & Rombouts, 2006). Keeping in view these constraints we decide to use BEKK specification (acronym for Baba, Engle, Kraft and Kroner) proposed by (Engle & Kroner, 1995) to calculate dynamic conditional correlations between individual sector's stock returns and Banking sector's returns. We assume that $\psi(t-1)$ is the information field generated by the past values of ϵ_t and that H_t is the conditional variance-covariance matrix of the k-dimensional random vectorϵ_t. We also assume that H_t is measurable with respect to past information set$\psi(t-1)$; in that case the structure of multivariate GARCH would be as

$$(\epsilon_t|\psi(t-1) \sim N(0, H_t))$$

$$H_t = C + \sum_{i=1}^{q} A_i' \epsilon_{t-i} \epsilon_{t-i}' A_i + \sum_{i=1}^{p} G_i' H_{t-i} G_i$$

Equation 0.1

Where$C$,A_i and G_i are $k \times k$ parameter matrices.

For bivariate GARCH (1, 1) the structure can be represented as follows.

$$H_t = \begin{bmatrix} c_{11} & c_{12} \\ c_{12} & c_{22} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}' \begin{bmatrix} \epsilon_{1,t-1}^2 & \epsilon_{1,t-1}\epsilon_{2,t-1} \\ \epsilon_{2,t-1}\epsilon_{1,t-1} & \epsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix}' H_{t-1} \begin{bmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{bmatrix}$$

We maximize the following log-likelihood function for multivariate GARCH model, written without a constant term;

$$\ell = -\frac{1}{2} \sum_{t=1}^{T} [log|H_t| + \epsilon_t' H_t^{-1} \epsilon_t]$$

Equation 0.2

To calculate sectoral returns we will first calculate continuously compounded returns of each individual firm by using following equation

$$CCR_{j,t} = \left(lnP_{j,t} - lnP_{j,t-1}\right) \times 100$$

Equation 3.3

After segregating each firm according to the sector, we will calculate the weight of each firm by dividing its base date market capitalization with the total market capitalization of the sector to which a firm belongs on the same date.

$$W_{j,t} = Market\ Cap_{j\ Firm} / Market\ Cap_{i\ Sector}$$

Equation 3.4

This weight would not be constant for the whole sample period rather it will be updated after each six months period which is the usual frequency to update market indices. Sum of weights belongs to all firm in each sector must be 1 and individual weights will be applied to the previously calculated returns of all firms in a sector to obtain weighted average sectoral return.

$$r_{i,t} = \sum_{j=1}^{n} W_{j,t}.CCR_{j,t}$$

Equation 3.5

Where j is the number of firms identified in i sector and the process will be repeated for all selected sectors. For banking sector we will calculate the sectoral returns exactly in the manner described above which will be denoted as

$$r_{BNK,t} = \sum_{j=1}^{n} W_{j,t}.CCR_{j,t}$$

Equation 3.6

We decide to model mean equations as Vector Auto regression (VAR) and their structure would be like following;

$$\boldsymbol{r_{i,t} = \beta_{10} + \beta_{11} r_{i,t-1} + \beta_{12} r_{BNK,t-1} + \epsilon_{i,t}}$$

Equation 0.7

$$\boldsymbol{r_{BNK,t} = \beta_{20} + \beta_{21} r_{i,t-1} + \beta_{22} r_{BNK,t-1} + \epsilon_{BNK,t}}$$

Equation 0.8

Where $r_{i,t}$ is the sector i's index return which depends on its own lagged value as well as the lagged value of Banking sector return $R_{BNK,t}$ is the Banking sector index return which depends on its own lagged value as well as the lagged value of sector i's index return.

By incorporating the setting of mean equations mentioned above, the final model becomes the VAR (1)-GARCH (1, 1) with the structure of Variance-Covariance equations given below;

$$\boldsymbol{H_{(i.i),t} = c_{11} + a_{11}^2 \epsilon_{i,t-1}^2 + 2a_{11}a_{21}\epsilon_{,t-1}\epsilon_{BNK,t-1} + a_{21}^2 \epsilon_{BNK,t-1}^2 + g_{11}^2 H_{(i.i),t-1} + 2g_{11}g_{21} H_{(i.BNK),t-1} + g_{21}^2 H_{(BNK.BNK),t-1}}$$

Equation 0.9

$$\boldsymbol{H_{(i.BNK),t} = c_{12} + a_{11}a_{21}\epsilon_{i,t-1}^2 + (a_{21}a_{12} + a_{11}a_{22})\epsilon_{i,t-1}\epsilon_{BNK,t-1} + a_{21}a_{22}\epsilon_{BNK,t-1}^2 + g_{11}g_{12} H_{(i.i),t-1} + (g_{21}g_{12} + g_{11}g_{22}) H_{(i.BNK),t-1} + g_{21}g_{22} H_{(BNK.BNK),t-1}}$$

Equation 0.10

$$\boldsymbol{H_{(BNK.BNK),t} = c_{22} + a_{12}^2 \epsilon_{i,t-1}^2 + 2a_{12}a_{22}\epsilon_{i,t-1}\epsilon_{BNK,t-1} + a_{22}^2 \epsilon_{BNK,t-1}^2 + g_{12}^2 H_{(i.i),t-1} + 2g_{12}g_{22} H_{(i.BNK),t-1} + g_{22}^2 H_{(BNK.BNK),t-1}}$$

Equation 0.11

H_t is the conditional variance-covariance equation of Banking sector and sector i error terms ϵ_t.Equation 3.9 depicts the impact of Banking sector on sector i. $\boldsymbol{a_{11}^2}$ is the coefficient of past squared residuals $\boldsymbol{\epsilon_{i,t-1}^2}$ and capture the news impact within sector on the volatility. Sector i volatility is also caused by the news impact in the Banking sector in time period (t-1) $\boldsymbol{\epsilon_{BNK,t-1}^2}$ can be identified by looking at co-efficient$\boldsymbol{a_{21}^2}$. Lastly the most important term is the spillover term from the Banking sector$\boldsymbol{g_{21}^2\ H_{(BNK.BNK),t-1}}$, which shows how much strongly banks are transmitting their volatility towards i sector.

Equation 3.11 depicts the impact of sector i on Banking sector. $a_{12}^2 \epsilon_{i,t-1}^2$Showed that variance in the error term is caused by news impact in sector i.$a_{22}^2 \epsilon_{BNK,t-1}^2$Showed the volatility in banking sector is also cause by banking sector error term in the time period (t-1). The spillover of sector i was depicted by$g_{12}^2 H_{(i.i),t-1}$.

4. Result and Analysis

4.1 Descriptive Statistics of Portfolio Returns

The table 1 summarizes the descriptive statistics of all the sectors i.e. Banks, Oil and Gas, Construction, Chemicals, Food Producers, Electricity, Fixed Line Telecommunication and Personal Goods. The sector that outperformed all other sector was Food Producer (Mean=0.000301) during 2008 to 2012. And highest volatility was seen is Fixed Lined Telecommunication (S.D=0.021856) followed by Electricity (S.D=0.021087).As seen in the above table data was not normally distributed. Normal distribution is characterized by 0 skewness and kurtosis of 3 which was absent in the entire eight sector under our study. The kurtosis test indicated that sectoral return series were leptokurtic which meant it was thick tailed. Leptokurtosis can be explained by Volatility clustering – period of high and low volatility followed by another large high or low volatility period. It is modeled as Auto regressive conditional heteroscedasticity. Jarque-Bera null hypothesis is rejected by combining the evidence of excess kurtosis and skewness at the significance level of 1%.

4.2 Test on Daily Returns of all sectors with Banking Sector

We ran the daily data on SAS to check the relationship of returns of Banking sector with that of other sector and also relationship of volatility of Banking sector with other sectors.

The table 2 depicted the relationship of returns of Banking sector and other sector and vice versa. $\boldsymbol{\beta} \quad r_{BNK,t-1}$ Showed the impact of returns in banking sector on the returns of respective sector and $\boldsymbol{\beta} \quad r_{i,t-1}$ showed the impact of returns of the same sector on the returns of banking sector.

In our daily analysis we found out that return in banking sector was significantly impacting the returns of Oil and Gas sector (p-value= 0.0001), Electricity sector (p-value=0.0008) and Chemical sector (p-value=0.0445) whereas Returns in Construction sector (p-value=0.102) and Chemical sector (p-value=0.0825) impacted Banking sector.

ARCH terms depicted the news impact of banking sector on Oil and Gas, Construction, Chemical, food producer, Fixed Line Telecommunication, Electricity and Personal Goods. Banking sector was significantly impacting Oil and Gas (p-value=0.0002), Chemicals (p-value=0.001), Electricity (p-value=0.0002) and personal good (p-value=0.004).See table 3

GARCH terms of banking sector impacting all other sector depicted the volatility transmission. The volatility of Banking sector was transmitted in Oil and Gas sector (p-value=0.0357), Electricity sector (p-value=0.0357) and Personal Goods (p-value=0.0086).See table 4

4.3 Ganger Causality Test on Weekly Portfolio Returns

We ran Ganger Causality test in order to check the impact of weekly portfolio returns of Banking sector on other sectors weekly portfolio returns and vice versa. To have a better understanding we ran test from 1 to 10 lag. The table 5 summarizes the granger test ran on weekly portfolio returns of each sector with Banking sector.

According to the first hypothesis we tested that banking sector weekly portfolio returns did not impact weekly portfolio returns of Oil and Gas sector. At lag=1 there was no impact on portfolio returns of Oil and Gas sector, at lag=2 and 3 Banking sector impacted Oil and Gas sector at 1% and 5% significance level respectively. Then at lag= 4 and 5 no impact was seen and it was at lag= 6 till 10 weekly portfolio returns of Oil and Gas sector got impacted at a significance of 1%. The next hypothesis tested was weekly portfolio returns of Oil and Gas sector did not impact weekly portfolio returns of banking sector. It was found that weekly portfolio return failed to impact banking sector till lag 3. It was at lag=4 and 5 Banking sector returns got impacted at 5% and 1% significance level respectively. Then again at lag= 6 Banking returns had no impact and it was from lag 7 to 10 Banking sector weekly portfolio returns were impacted at 1% significance level.

Then we tested for weekly portfolio returns of banking sector did not affect weekly portfolio returns of Construction Sector. It was found that null hypothesis was rejected and from lag=1 till 10 were highly significant bringing us to the conclusion that weekly portfolio returns of Banking sector did impact weekly portfolio returns of Construction sector. Furthermore we tested that weekly portfolio returns of Construction sector did not impact Banking sector. The results showed that at lag 1 and 2 weekly returns of Banking sector did get affected by the weekly portfolio returns of Construction sector but it was after lag 2 no impact was seen on weekly portfolio returns of the Banking sector till lag=8. It was at lag=9 and 10 the impact was seen on weekly portfolio returns of the Banking sector at significance level 5%.

Granger test on weekly portfolio returns of Banking sector impacting Chemical sector showed that weekly portfolio returns of Banking sector didn't impact weekly portfolio returns of Chemical sector till lag 5.It

was from lag=6 till 10 that weekly portfolio returns of Chemical sector got impacted. Whereas when we tested the hypothesis that weekly portfolio returns of Chemical sector did not impact weekly portfolio returns of banking sector. We had to reject the null hypothesis meaning Chemical sector returns did impact Banking sector from lag=1 to 10 mainly at 1% significance level.

As far as the food producer sector weekly portfolio returns were concerned the results showed that neither Banking sector weekly portfolio returns affect food producers nor food producer weekly portfolio returns impacted Banking sector. In short in both the cases we failed to reject the null hypothesis.

Banking sector weekly portfolio returns when tested to find the impact on weekly portfolio returns of Fixed Line Telecommunication the results came out to be interesting. Banking sector impact the returns significantly at lag 1 and then the impact was seen from lag 5 till 10. Whereas when Fixed Line Telecommunication weekly returns impact was tested on Banking sector weekly portfolio returns the result showed that from lag=1 to 10 the impact was significant at 1%. This meant that returns of fixed line communication could impact returns of banking sector.

Next hypothesis we test was Banking sector weekly portfolio returns did not impact Electricity sector weekly portfolio returns. And we found Banking sector returns impacted Electricity returns at lag=1, 3 and from lag 6 till 10. Whereas hypothesis tested Electricity sector weekly portfolio returns impacting Banking sector was highly significant from lag 1 till 10. Returns in Electricity sector were impacting returns of Banking sector.

Lastly we tested the hypothesis that weekly returns of Banking sector did not impact weekly portfolio returns of Personal Goods sector. We rejected the null hypothesis as returns of banking sector were significantly impacting returns of Personal Goods. We then tested for impact of returns of Personal Goods on banking sector returns. We didn't not find significant impact on Banking sector expect at lag =5 and 6 at 5% and 10% significance level respectively.

4.4 Ganger Causality Test on Weekly Volatilities

We then ran the granger Causality test on weekly volatility on all the sectors the table 7 summarizes the results. The first hypothesis stated that volatility in banking sector does not lead to volatility in Oil and Gas. We ran the test on lag= 1 to 10 and found that Banking sector significantly impacted the volatility in Oil and Gas sector at 1% significance level. The next hypothesis we tested was whether volatility in Oil and Gas sector impacted volatility in banking sector. At lag=1 we failed to reject the null hypothesis meaning volatility in Oil and Gas did not impact volatility in Banking sector. The impact of volatility was seen in lag=2 where volatilities in Oil and Gas sector affected the volatilities in Banking sector. Furthermore no impact was seen at lag= 3 to 4 and then it became evident at lag=4 till 10.

We then tested for our next sector Construction sector. First we wanted to test the impact of volatility of banking sector on volatility of Construction sector. At lag=1 volatility in Banking sector did not impact volatility in Construction sector. Whereas from lag=2 till 10 volatility in Banking sector significantly impacted volatility in Construction sector. Whereas when we tested the impact of volatility in Construction sector on volatility in Banking sector we found that Construction sector did have a significant impact on Banking sector from lag=1 till lag=10.

When we tested the hypothesis volatility in Banking sector did not impact volatility in Chemical sector. Volatility in Banking sector significantly impacted volatility in Chemical sector from lag=2 till lag= 10. Whereas in volatility in Chemical sector failed to impact volatility in Banking sector at any lag.

The next Granger Causality test was ran on volatilities of Food Producer sector and Banking sector. In case on volatility in Banking sector impact on volatility in Food producer and also impact of volatility in Food Producer on volatility in Banking sector, in both the scenario the impact was significant at lag=1 which meant both the sectors were impacted each other at lag=1. No significant impact was found from lag=2 to 10.

Banking sector weekly volatility when tested to find the impact on weekly volatility of Fixed Line Telecommunication the results came out to be interesting. Volatility in Banking sector impacted volatility of Fixed Line Telecommunication significantly at lag 2, 3 and 6. Whereas when Fixed Line Telecommunication weekly volatility impact was tested on Banking sector weekly volatility the result showed that from lag=1 to 10 the impact was significant at 1%. This meant that volatility in fixed line communication could impact volatility in banking sector.

Next hypothesis we tested was volatility in banking sector did not impact volatility in Electricity sector. And we found volatility in Banking sector impacted volatility in Electricity returns at lag=1, 2, 3, 4 and 10 mainly at 5% significance level. Whereas hypothesis tested volatility in Electricity sector impacting volatility in Banking sector was highly significant from lag 1 till 10 at 1% significance level. Volatility in Electricity sector was impacting volatility in Banking sector.

Lastly we tested for volatility in Banking sector and Personal Goods. The results clearly showed that volatility in Banking sector was impacting volatility in Personal Goods sector at all the lags at a significance of 1% except for lag=1. Whereas when tested for the impact of volatility in Personal Goods on volatility in Banking

sector. We failed to reject the null hypothesis which meant that volatility in Personal Goods sector did not impact volatility in banking sector.

4.4 Granger Causality Test on Weekly Conditional Standard Deviation

Lastly we ran granger causality test on weekly conditional standard deviation. The results are summarized in the table 9. The test was run in similar way as for returns and volatility data. The results came out to be interesting.

According to the first hypothesis we tested that banking sector weekly conditional standard deviation did not impact weekly conditional standard deviation of Oil and Gas sector. The results clearly showed that conditional standard deviation of Banking sector was impacting conditional standard deviation of Oil and Gas sector at all the lags at a significance of 1%. The next hypothesis tested was weekly conditional standard deviation of Oil and Gas sector did not impact weekly conditional standard deviation of banking sector. It was found that weekly conditional standard deviation of Oil and Gas failed to impact banking sector. We failed to reject the null hypothesis.

We also tested the hypothesis that Banking sector weekly conditional standard deviation did not impact weekly conditional standard deviation of Construction sector. The results depicted that Banking sector significantly impacted Construction sector at the significance level of 1% from lag=1 to 10. Whereas when we tested the impact of Construction sector on Banking sector we found the impact on lag=2, 3, 4 and 9 and 10 at significance level 5% to 10%. No impact of Construction sector was seen on Banking sector at lag=1, 5, 6, 7 and 8.

When we tested the hypothesis weekly conditional standard deviation in Banking sector did not impact weekly conditional standard deviation in Chemical sector. We found that Banking sector was impacting Chemical sector at lag=1, 2 at significance level of 5% and at lag=3 it impacted at the significance level of 10%. No impact was seen at lag=4 and 5. The impact became evident again from lag=6 till 10. We then tested weekly conditional standard deviation in Chemical sector did not impact weekly conditional standard deviation in Banking sector. The results showed Chemical sector had no impact on Banking sector from lag=1 till 4 and it was from lag=5 till 10 Chemical sector significantly impacted Banking sector at the significance level of 1%.

As far as the food producer sector weekly conditional standard deviation were concerned the results showed that neither Banking sector weekly conditional standard deviation affect food producers nor food producer weekly conditional standard deviation impacted Banking sector. In short in both the cases we failed to reject the null hypothesis.

Banking sector weekly conditional standard deviation when tested to find the impact on weekly conditional standard deviation of Fixed Line Telecommunication the results depicted that Banking sector significantly impacted the Fixed Line Telecommunication from lag=1 to 10 at 1% significance level. When tested for weekly conditional standard deviation of telecommunication sector impact on weekly conditional standard deviation of Banking sector we found no significant impact from lag=1 and 2 but then the impact became significant from lag=3 till 10.

As far as the Electricity sector weekly conditional standard deviation were concerned the results showed that neither Banking sector weekly conditional standard deviation affect Electricity nor Electricity weekly conditional standard deviation impacted Banking sector. In short in both the cases we failed to reject the null hypothesis.

Lastly we tested for weekly conditional standard deviation in Banking sector and Personal Goods. The results showed that weekly conditional standard deviation in Banking sector was impacting weekly conditional standard deviation in Personal Goods sector from lag=6 till 10 significantly. Whereas when tested for the impact of weekly conditional standard deviation in Personal Goods on weekly conditional standard deviation in Banking sector. Personal Goods sector impacted Banking sector at lag= 4, 5 and 6 at significance level of 10%. Remaining lags had insignificant impact.

4.5 GARCH Model on Weekly Data

We ran GARCH model on our weekly data set of 2008-2012 in order to find the relationship of different sectors with banking sector as seen in table 11.

When we ran the data to find the impact of Oil and Gas sector with Banking sector we found Banking sector was significantly impacting Oil and Gas sector (p-value=0). Similarly, Oil and Gas sector also impacted Banking sector significantly but negatively (p-value=0).

When we ran to check the impact of Banking sector on Construction sector we found a significant but negative impact on Construction sector (p-value=0). Whereas Construction sector did not have a significant impact on Banking sector (p-value=0.135).

For Chemical sector, Banking sector was significantly impacting the Chemical sector (p=0.002) also Chemical sector impacted on Banking sector significantly (p-value= 0.0279).

We then ran the GARCH model on Food producer sector to understand whether it's the Banking sector

impacting the food producers or is it food producers impacting the Banking sector. The results showed Banking sector was not impacting the food producers (p-value=0.279) neither food producer sector impacted Banking sector (p-value=0.32).

We also tested for Fixed Line Telecommunication and Banking sector. The results showed that Banking sector was significantly but negatively impacting Fixed Line Telecommunication (p-value=0.006) and also Fixed Line Telecommunication was impacting Banking (p-value=0.081).

Banking sector impacted Electricity sector significantly (p-value=0.0103) and also Electricity sector impacted Banking sector significantly (p-value=0).

Lastly we tested for Personal Goods and Banking sector. Banking sector was significantly impacting Personal Goods sector (p-value= 4.E-04). But Personal Goods sector did not significantly impact Banking sector (p-value= 0.641).

Policy Implication

The study could be of vital importance for monetary, financial and regulatory authorities as it explored the volatility spillover that the Banking sector in Pakistan is capable of transmitting towards other sectors while market is in operation. We conducted an extensive research on Oil and Gas, Construction, Chemical, Food Producer, Fixed Line Telecommunication, Electricity and Personal Goods sector in order to find out the effect of Banking sector on these sector and vice versa.

This would assist in deriving important implications for economic policies. Furthermore, in case where some non-financial sectors are more sensitive to contagion from financial sector, policy makers gain information on where to allocate scarce resources. The study will add to the growing literature on volatility spillover for developing countries. After this study we will be able to comment on the extent to which Banking sector originates volatility spillover in other sectors and whether the Banking sector functioned as engine of growth.

The study can be of interest for financial markets participants who are more and more interested in knowing how shocks and volatility transmission mechanism works across markets over time. It can also grab interest of the policy maker in making economic policies helping them understanding how to allocate their limited resources once the transmission mechanism of volatility spillover of banking sector with that of other sector is known.

5. Conclusion

In our daily analysis we found out that return in Banking sector was significantly impacting the returns of Oil and Gas sector, Electricity sector and Chemical sector whereas Returns in Construction sector and Chemical sector impacted Banking sector.

In weekly data analysis when we ran granger causality test on portfolio returns, volatility and conditional standard deviation from lag 1 to 10 we found some interesting results. In case of portfolio returns of banking sector impacted Oil and Gas, Construction, Fixed Line Telecommunication, Electricity portfolio returns and Personal Goods. Whereas Oil and Gas, Chemical, Fixed Line Telecommunication and Electricity portfolio returns impacted portfolio returns of banking sector. Weekly volatility results depicted that volatilities in Banking sector impacted volatilities in Oil and Gas, Construction, Chemical, Electricity and personal good sector. On the other hand, volatilities in Oil and Gas, Construction, Fixed Line Telecommunication and Electricity significantly impacted volatilities in banking sector. Lastly the results of weekly conditional standard deviation showed Banking sector was impacting Oil and Gas, Construction, Chemical and Fixed Line Telecommunication and Personal Goods whereas conditional standard deviation in Construction, Chemical and Fixed Line Telecommunication impacted conditional standard deviation of Banking sector in almost all lags.

To have a better understanding we divided the research into two parts daily and weekly analysis.We found significant spillover effect from Banking sector to other sectors, hence financial and monetary authorites will be in a better position to formulate policies and strategies not only to protect against crisis originating from Banking sector but also to utilize the same spillover by injecting growth in other sectors through a Banking channel. It will also help authorities to understand whether the influence of Banking sector over other sectors has changed over time or not and what are the dynamics of that change. Banks can also utilize this study in understanding what are the sectors that can hurt the performance of Banking sector due to their idiosyncratic and indiginous problems and to what extent banks should expose themselves to those sectors.

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Tables

Table 1- Descriptive Statistics of Portfolio Returns from 2008-2012

Sector	Banks	Oil and Gas	Construction	Chemical	Food Produce	Electric	Fixed Line Telecommunication	Personal Goods
Mean	-0.00119	-7.08E-05	-0.00119	-0.00090	0.000301	-0.00070	-0.001391	-0.001407
Median	-0.00011	0	0	0	0	0	-6.73E-06	-4.45E-05
Max	0.08711	0.093245	0.061575	0.082158	0.04931	0.131134	0.094585	0.065464
Mini	-0.09439	-0.35429	-0.230045	-0.11883	-0.04691	-0.23262	-0.137822	-0.091175
Std. Dev.	0.01768	0.019816	0.015683	0.016929	0.01280	0.021087	0.021856	0.013035
Skewness	-0.15845	-5.50431	-2.97392	-0.75315	-0.01597	-1.54296	-0.214770	-0.414789
Kurtosis	5.54137	101.2751	47.16129	8.127098	4.689354	25.23725	6.406400	6.357868
Jarque-Bera	284.771	425240.6	86373.45	1235.052	124.8061	21882.79	512.7810	517.9190
Probability	0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.00

Table 2- Test on Daily Return of all sectors with Banking Sector

Sectors	**Parameter**	**Estimate**	**Pr > |t|**
PRT_02OAG	$\beta_{12} r_{BNK,t-1}$	0.11917	0.0001
	$\beta_{21} r_{i,t-1}$	0.04517	0.9741
PRT_03CON	$\beta_{12} r_{BNK,t-1}$	-0.03275	0.3568
	$\beta_{21} r_{i,t-1}$	-0.09997	0.0102
PRT_04CH	$\beta_{12} r_{BNK,t-1}$	0.08406	0.0445
	$\beta_{21} r_{i,t-1}$	0.07861	0.0828
PRT_05FP	$\beta_{12} r_{BNK,t-1}$	-0.00815	0.7198
	$\beta_{21} r_{i,t-1}$	-0.01244	0.7723
PRT_06FTL	$\beta_{12} r_{BNK,t-1}$	-0.00213	0.9488
	$\beta_{21} r_{i,t-1}$	0.00508	0.9741
PRT_07E	$\beta_{12} r_{BNK,t-1}$	0.06509	0.0082
	$\beta_{21} r_{i,t-1}$	-0.0846	0.3226
PRT_08PG	$\beta_{12} r_{BNK,t-1}$	0.04509	0.1182
	$\beta_{21} r_{i,t-1}$	-0.06469	0.2226

Table 3 Arch Term

Sectors	Parameter	Estimate	Pr > |t|
Oil and Gas	a^2_{21}	-0.0125	0.0002
Construction	a^2_{21}	-0.074	0.5669
Chemicals	a^2_{21}	0.0003	0.001
Food Producer	a^2_{21}	0.00101	0.9992
Fixed Line Telecommunication	a^2_{21}	-0.0085	0.789
Electricity	a^2_{21}	0.04254	0.0002
Personal Goods	a^2_{21}	0.003	0.004

Table 4 GARCH Terms

Sectors	Parameter	Estimate	Pr > |t|
Oil and Gas	g^2_{21}	-0.02766	0.0357
Construction	g^2_{21}	-0.14827	0.6659
Chemicals	g^2_{21}	0.41408	0.678
Food Producer	g^2_{21}	0.00030	0.8895
Fixed Line Telecommunication	g^2_{21}	-0.36462	0.9986
Electricity	g^2_{21}	0.02766	0.0357
Personal Goods	g^2_{21}	0.0432	0.0086

Table 5- Ganger Causality Test on Weekly Portfolio Returns

	B ⇏ OAG	OAG ⇏ B	B ⇏ Con	Con ⇏ B	B ⇏ Ch	Ch ⇏ B	B ⇏ FP	FP ⇏ B	B ⇏ FTL	FTL ⇏ B	B ⇏ E	E ⇏ B	B ⇏ PG	PG ⇏ B
Lags	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic
1	5.65892	0.63681	10.7594***	2.75567*	0.01104	7.81458***	1.23881	0.32458	7.04032***	24.6434***	7.1963***	40.9102***	15.8053***	1.48326
2	5.15666***	1.73851	11.0150***	4.21122**	1.56454	4.32217**	0.96170	1.03914	1.13941	10.2092***	2.19339	16.6819***	17.3739***	1.27861
3	2.64570**	1.73441	6.38545***	1.85796	1.01898	2.98893**	0.49998	0.46821	0.19623	12.1435***	3.03889**	9.24881***	10.3080***	0.54210
4	1.89524	2.47208**	4.68667***	0.98800	0.20784	4.21003***	0.37721	0.64763	0.16687	11.2757***	1.59160	6.55378***	7.71425***	1.71863
5	1.37141	3.22821***	4.05264***	0.79617	0.29879	6.21295***	0.47189	0.44178	1.88097*	8.92832***	0.86537	5.40565***	5.95508***	2.3559**
6	3.67604***	0.91221	5.48192***	1.72335	2.70359**	3.68033***	0.34237	1.07813	2.76466**	4.26261***	3.3319***	6.41379***	11.0980***	2.04229*
7	3.28481***	2.42337**	4.99275***	0.88970	2.15697**	3.24986***	0.20854	1.42306	2.25571**	3.39823***	1.76130*	5.25250***	10.0398***	1.55244
8	2.86001***	2.25264**	4.59213***	0.90879	2.39712**	2.93415***	0.25783	1.41605	2.88403***	2.99250***	1.74475*	4.60013***	8.78510***	1.31024
9	2.58598***	2.01007**	4.16263***	2.39467**	2.44317***	2.69012***	0.24913	1.26150	2.55675***	2.67734***	2.11800**	4.34086***	8.08652***	1.15899
10	2.58571***	1.97079**	3.84896***	2.17847**	2.17218**	2.51294***	0.29234	1.17618	2.60242***	2.46245***	2.14234**	4.45841***	7.53942***	1.07763

Notes: *, **, and *** indicate statistical significance at 90%, 95% and 99% level of significance, respectively.

Notes: *, **, and *** indicate statistical significance at 90%, 95% and 99% level of significance, respectively.

Table 6 Categorized Results of Granger Causality Test between weekly returns of Bank and other sectors

	Bank impacting the Sector	**Sector impacting the bank**
Oil & Gas	Highly Significant	Moderately Significant
Construction	Highly Significant	Insignificant
Chemical	Moderately Significant	Highly Significant
Food Producer	Insignificant	Insignificant
Fixed Line Telecommunication	Highly Significant	Highly Significant
Electricity	Highly Significant	Highly Significant
Personal Goods	Highly Significant	Insignificant

Note: These results are based on the frequency of occurrence of significant wald statistics at less than 10 percent level, reported in Table 5. We categorize the results according to the following criteria:
Highly Significant= More than 70 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.
Moderate Significant= 50 percent to 70 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.
Insignificant= Less than 50 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.

Table 7 - Ganger Causality Test on Weekly Volatilities

	B ⇏ OAG	OAG ⇏ B	B ⇏ Con	Con ⇏ B	B ⇏ Ch	Ch ⇏ B	B ⇏ FP	FP ⇏ B	B ⇏ FTL	FTL ⇏ B	B ⇏ E	E ⇏ B	B ⇏ PG	PG ⇏ B
Lags	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic
1	13.3616***	1.20196	0.97948	6.718***	1.78043	1.44756	4.8189**	3.9325**	0.01235	8.15797***	6.66959**	36.4579***	0.33673	0.07329
2	14.2493***	3.05785**	6.90656***	5.6627***	7.35756***	1.90513	1.90763	0.77642	4.42839**	12.1069***	6.73334**	26.4264***	9.44031***	1.57577
3	9.71093***	1.87950	6.03870***	3.00513**	5.71728***	1.15915	1.26752	0.73427	3.69607**	7.76982***	2.69920**	12.5043***	13.1867***	0.51506
4	5.87370***	1.87667	3.96690***	3.7957***	4.10243***	1.33949	0.94785	0.76848	1.80933	7.73758***	2.02524*	9.28520***	9.90727***	1.39906
5	4.63027***	1.89601*	3.33720***	2.75126**	2.77380**	1.20566	1.06163	0.81679	1.59701	6.71728***	1.61727	7.76357***	7.81026***	1.30140
6	3.40997***	2.42377**	4.74356***	2.37200**	2.20234**	0.99623	1.18462	0.66696	1.86868*	5.54488***	1.67160	6.31476***	6.52182***	1.00814
7	3.05119***	2.19677**	4.63498***	2.07813**	2.90524***	0.92745	1.14205	0.61312	1.70982	4.76153***	1.52582	5.46690***	5.94622***	1.01481
8	2.68839***	1.83695*	4.48638***	2.04292**	2.59438***	0.80927	1.02491	0.79740	1.51585	4.25497***	1.31004	5.20487***	5.39612***	0.87010
9	3.04124***	1.78556*	4.19838***	1.66319*	2.37809**	0.76156	0.91562	0.75797	1.58170	4.04209***	1.29394	4.43106***	5.23869***	0.93994
10	3.23698***	2.40142***	3.91192***	2.10970**	2.25697**	0.97722	1.04161	0.72438	1.56086	3.73511***	1.68277*	4.18275***	4.76545***	0.89447

Notes: *, **, and *** indicate statistical significance at 90%, 95% and 99% level of significance, respectively.

Table 8 Categorized Results of Granger Causality Test between weekly volatilities of Bank and other sectors

	Bank impacting the Sector	**Sector impact on bank**
Oil & Gas	Highly Significant	Moderately Significant
Construction	Highly Significant	Highly Significant
Chemical	Highly Significant	Insignificant
Food Producer	Insignificant	Insignificant
Fixed Line Telecommunication	Insignificant	Highly Significant
Electricity	Moderately Significant	Highly Significant
Personal Goods	Highly Significant	Insignificant

Note: These results are based on the frequency of occurrence of significant wald statistics at less than 10 percent level, reported in Table 7. We categorize the results according to the following criteria:
Highly Significant= More than 70 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.
Moderate Significant= 50 percent to 70 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.
Insignificant= Less than 50 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.

Table 9- Ganger Causality Test on Weekly Conditional Standard Deviation

	B ⇏ OAG	OAG ⇏ B	B ⇏ Con	Con ⇏ B	B ⇏ Ch	Ch ⇏ B	B ⇏ FP	FP ⇏ B	B ⇏ FTL	FTL ⇏ B	B ⇏ E	E ⇏ B	B ⇏ PG	PG ⇏ B
Lags	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic	F-statistic
1	11.6676***	0.73826	13.6887***	2.37728	6.75528**	2.07817	0.64502	0.82468	11.9304***	0.81703	0.18622	8.28945	1.59509	0.02652
2	5.83782***	0.35995	6.73587***	3.65280**	3.27846**	1.17344	1.38478	0.78427	6.13865***	0.89752	0.81352	7.99601	1.06587	0.38025
3	4.84651***	0.36858	4.69973***	2.47650*	2.20944*	1.58947	1.02021	0.57200	4.80421***	7.37737***	0.35259	5.96716	1.45392	1.57863
4	4.07417***	0.32279	3.18759**	1.98766*	1.65233	4.54665***	1.06924	1.15770	4.81030***	5.59011***	0.38636	5.07565	1.03992	2.04593*
5	4.51162***	0.68110	2.83231**	1.53703	1.51968	3.93900***	1.08513	1.63615	3.98080***	4.79669***	0.21969	4.53660	1.30187	1.97657*
6	6.33306***	1.10069	4.27424***	1.49091	1.91088*	2.91776***	0.88882	1.30509	3.68239***	3.32721***	0.58409	3.58339	2.15919**	1.82113*
7	5.30894***	1.08026	4.61800***	1.58612	2.83898***	2.93658***	1.09214	1.32193	2.94875***	2.60089**	0.56021	3.21248	2.21604**	1.56100
8	4.38332***	0.89407	5.33586***	1.45885	2.20886**	2.47598**	1.09404	1.22200	2.82618***	2.27384**	0.51714	2.90686	1.88044*	1.34523
9	4.02318***	0.88176	4.80820***	1.66570*	2.08359**	2.35282**	0.98957	1.11505	2.57674***	2.08835**	0.47205	3.15032	1.90780**	1.32785
10	3.52846***	1.06157	4.24884***	1.91954**	1.83753*	3.14271***	0.90100	1.00541	2.67712***	2.20932**	0.61280	3.01551	1.71122*	1.41177

Notes: *, **, and *** indicate statistical significance at 90%, 95% and 99% level of significance, respectively.

Table 10 Categorized Results of Granger Causality Test between weekly Conditional Standard Deviation of Bank and other sectors

	Bank impacting the Sector	**Sector impact on bank**
Oil & Gas	Highly Significant	Insignificant
Construction	Highly Significant	Moderately Significant
Chemical	Highly Significant	Highly Significant
Food Producer	Insignificant	Insignificant
Fixed Line Telecommunication	Highly Significant	Highly Significant
Electricity	Insignificant	Insignificant
Personal Goods	Moderately Significant	Insignificant

Note: These results are based on the frequency of occurrence of significant wald statistics at less than 10 percent level, reported in Table 9. We categorize the results according to the following criteria:
Highly Significant= More than 70 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.
Moderate Significant= 50 percent to 70 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.
Insignificant= Less than 50 percent times wald statistic is significant at less than 1 percent, from 1 to 10 lags.

Table 11 GARCH Model on weekly returns

Sectors		**Co-efficients**	**Prob**
Oil & Gas	$\beta_{12} r_{BNK,t-1}$	0.192183	0
	$\beta_{21} r_{i,t-1}$	-0.083467	0
Construction	$\beta_{12} r_{BNK,t-1}$	-0.149809	0
	$\beta_{21} r_{i,t-1}$	0.029201	0.135
Chemical	$\beta_{12} r_{BNK,t-1}$	0.055566	0.002
	$\beta_{21} r_{i,t-1}$	0.019299	0.0279
Food Producer	$\beta_{12} r_{BNK,t-1}$	0.007901	0.23
	$\beta_{21} r_{i,t-1}$	0.027361	0.32
Fixed Line Telecommunication	$\beta_{12} r_{BNK,t-1}$	-0.055317	0.006
	$\beta_{21} r_{i,t-1}$	0.024789	0.081
Electricity	$\beta_{12} r_{BNK,t-1}$	0.031004	0.0103
	$\beta_{21} r_{i,t-1}$	0.088196	0
Personal Goods	$\beta_{12} r_{BNK,t-1}$	0.041096	4E-04
	$\beta_{21} r_{i,t-1}$	-0.006704	0.641

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