Two-Factor Decomposition Analysis for Correlation between Mainland China and Hong Kong Stock Markets*

KENT WANG, LI MIAO AND JIAWEI LI
WISE, Xiamen University, Xiamen, China

ABSTRACT

We analyzed the correlation between mainland China and Hong Kong stock markets based on cash flow (CF) news and discount rate (DR) news instead of considering market return as a whole. We decomposed stock return into CF news and DR news following Campbell and Vuolteenaho. Then, the VAR-BEKK-GARCH method was used to investigate the time-varying correlations of CF news and DR news in the two markets. We ensured robustness by using the structural break test from Bai and Perron to estimate the structural break points during the sample period. The results show that CF news and DR news in the mainland China market is more volatile than in the Hong Kong market, and DR news correlation is usually negative when the mainland China market is undergoing some reform. The estimated structural break points were matched to important events in the mainland China market and the two markets become increasingly correlated.

I. INTRODUCTION

Investors in different markets face more than one kind of market volatility risk; therefore, investigation of the correlations between different markets is essential for investment decisions and risk management. According to portfolio theory, investors can reduce risk by diversifying investments into lowly correlated assets. Hence, the performance of a portfolio depends not only on the return and risk of its individual assets, but also on the correlations between these assets. The lower the correlation, the more risk is reduced. This theory also applies across countries. If stock markets in two countries are less correlated, then diversifying investment over these two markets reduces risk. Consequently, research on return correlations of different assets or of different stock markets has flourished.

* We wish to thank the Associate editor of IRF, an anonymous referee, Guo Hui, Kai Li, Michael O’Neil, Yongmiao Hong, seminar participants in CCER, Peking U, SWUFE, Dalian Commodity Exchange (DCE), and the 2012 SMU ‘Asset Price Bubble’ Summer Institute for helpful comments. Wang wish to acknowledge financial support of NSFC #71101122. This article is an independent research which represents only the authors’ personal views. All remaining errors are our own.

© 2012 The Authors. International Review of Finance © International Review of Finance Ltd. 2012. Published by Wiley Publishing Asia Pty Ltd
Early research about the comovements of stock markets in different countries tested whether holding investment portfolios in different countries was more beneficial than investing in a single country. Grubel (1968) developed a model with internationally diversified portfolios from 11 industrially developed countries to analyze this. He found that an internationally diversified investment can, indeed, lead to welfare gains for individual investors because of the low correlations between selected countries’ stock markets. Errunza (1977) and Lessard (1973) extended the work of Grubel (1968) to include both developed and developing countries. Their empirical results showed that diversification can result in higher benefits. Later literature estimates the comovements of different stock markets by directly analyzing the return spillover effect and volatility spillover effect across stock markets. Hamao et al. (1990) constructed an ARCH model to estimate the comovements between the New York, London, and Tokyo stock markets, and found that price and price volatility have a strong spillover effect. Karolyi (1995) estimated the comovements between the New York and Toronto stock markets using a multivariate GARCH (MVGARCH) model, and concludes that volatility correlation between the two markets is time-varying. Moreover, Karolyi (1995) determined that the spillover effect from the American market to the Canadian market decreases in the late 1980s. Similar studies are also found in Richards (1995) and Hsin (2004).

Previous literature indicate that diversifying investments in both developed countries and developing countries can bring a higher return because of low correlation (Bekaert and Harvey 1995; Harvey 1995). However, over time, the opening of capital markets in developing countries has changed the structure of international return correlations. Gerard et al. (2003), Forbes and Rigobon (2002), and Fujii (2005) found that correlations between developing stock markets and developed stock markets increased over time. Carrieri et al. (2007) investigated the comovements among eight developing stock markets and developed stock markets. They found that correlations become stronger although developing markets are still affected more by local information. Moreover, they showed how using stock market indices as research objectives was questionable, because these indices cannot fully reflect integrated market information.

In recent studies, Chiang et al. (2007) used the DCC-GARCH model to study nine Asian stock markets. Empirical results verified the contagion effect among these markets, especially after the Asian financial crisis. Arouria et al. (2010) found similar results by analyzing the dynamic conditional correlations between six emerging Latin American stock markets. The DCC-GARCH model was applied to estimate time-varying volatility correlation and the Bai and Perron (2003) structural break test was employed to analyze structural change in the markets. Their results showed that correlations among these markets have increased, especially since 1994. This increase was attributed to regime change, according to the structural break test results. Moreover, the comovements during the financial crisis period are significantly stronger than for other
periods. Chen et al. (2002) also find that developing markets in Latin America have increasing correlations over time, thus limiting the benefits of international diversification.

In this article, we investigate the comovements between mainland China and Hong Kong stock markets. We choose these two markets as Hong Kong’s stock market has close proximity to mainland China stock market. It is an important market for Chinese investors because Chinese investors’ limits to investing in the Hong Kong market are fewer than the limits to investing in other countries. At the same time, hundreds of companies from mainland China are listed in the Hong Kong market; companies from Hong Kong also invest in the mainland China market. The financial environments strongly influence each other. However, for historical reasons, the financial systems of mainland China and Hong Kong are independent. Information channels are not exactly the same, thus the same information may result in different reactions in each market. The pairing of these two markets provides a good platform for international correlation research.

Poon and Fung (2000) use a multivariate EGARCH-M model and find that red chip stocks, H-share stocks, and mainland China stocks have significant return and volatility spillover effects. Similar results are also found in Sun and Tong (2000). As more and more companies from mainland China issue stocks in the Hong Kong market, the two markets become increasingly correlated.

The existing literature only consider market information in its entirety to investigate return or volatility spillover. Campbell and Shiller (1988), Campbell (1991), and Campbell and Vuolteenaho (2004) show that excess return on assets can be decomposed into two parts: cash flow (henceforth, CF) news and discount rate (henceforth, DR) news. CF news relates more to company fundamentals, such as dividend, book value, etc., which reflects long-term information, while DR news relates more to return or investors’ risk aversion, which reflects short-term information. Naturally, investment decisions depend equally on both long- and short-term information. So it is meaningful to analyze the correlations among different stock markets by CF news and DR news separately.

In this article, we employed the vector autoregressive regression (VAR) model used in Campbell and Vuolteenaho (2004) to decompose excess return into CF news and DR news. We constructed the four state variables used by Campbell and Vuolteenaho (2004), i.e., the excess market return ($R$), the yield spread between long- and short-term bonds ($TY$), the market’s smoothed price-earnings ratio ($PE$), and the small-stock value spread ($VS$), in both the Hong Kong and the Chinese markets for return decomposition. The BEKK-GARCH

1 As of February 2011, there were 596 mainland companies listed in the Hong Kong market (including the mainboard and the Growth Enterprise Market). Source: HKEX Monthly Market Highlights 2011.
2 Red chips are Chinese background companies in Hong Kong that are listed on the HKEX. H shares are Chinese companies in mainland China that are listed on the HKEX. Compared with red chips, H shares issuers are subject to the additional requirements.
model is then used to test the time-varying CF news correlation and DR news correlation in the two markets. Finally, the Bai and Perron (1998, 2003) structural break test is applied to test for break points that provides a robust test of the news decomposition.

Using a sample from 2002 to 2010, we found that CF news correlation between Hong Kong and China markets was more volatile after 2007 and gets into negative range when there are major financial events in the mainland China market, while DR news correlation was positive with only a few exceptions. This negative correlation decreases over time, indicating that the Hong Kong market has become more and more sensitive to information transmitted from the mainland China market. We predict that future comovements between the mainland China and Hong Kong markets will be even stronger. According to the structural break test, DR news correlation has several structural breaks coinciding with major financial events of mainland China while CF news correlation has no structural break.

Compared with previous correlation literature, our method has the following advantages. First, we consider the GARCH effect in the VAR model when decomposing CF news and DR news from the market return. This accounts for the volatility dynamics in the VAR estimation and yields consistent decomposition results. Second, the news decomposition allows us to separately estimate the time-varying CF news correlation and DR news correlation in the two markets, which gives us more information than just considering market return as a whole. Third, a structural break test was used to test if CF news correlation or DR news correlation has a structural break, thus providing a robust test of the news decomposition. The current work is one of the few that take a decomposition approach in estimating dynamic correlation structure between two connected markets. Given the special relationship between China and Hong Kong, such examination is well motivated and yields consistent results that have economic meanings. In the study, we extended the Campbell and Vuolteenaho (2004) methodology to correlation study and proved its feasibility. The current study also employed a VAR-BEKK-GARCH integrated econometrical framework, which is innovative and robust.

The rest of this article is organized as follow: Section I explains our methodology for decomposing the return into CF news and DR news. Section II discusses the data and the construction method for the VAR state variables. Section III presents the empirical results of the dynamic correlations of CF news and DR news in the two markets, and Section IV tests the robustness of the results. Section V concludes.

II. METHODOLOGY

A. Stock return decomposition

Following Campbell and Shiller (1988) and Campbell (1991), we obtained a log-linear approximate decomposition of returns as
An Empirical Study

\[ r_{it+1} - E_i[r_{it+1}] = (E_{t+1} - E_i) \left[ \sum_{j=0}^{\infty} \rho^j \Delta d_{it+1+j} \right] - (E_{t+1} - E_i) \left[ \sum_{j=1}^{\infty} \rho^j r_{it+1+j} \right] \]

\[ = N_{i,CF,t+1} - N_{i,DR,t+1}, \]

where \( r_{it} \) is the log stock return at time \( t+1 \), \( d_{it} \) is the log dividend paid by the stock \( i \) at time \( t+1 \), \( \Delta \) denotes a one-period change, and \( \rho \) is the discount coefficient, which was assumed to be 0.95 per year as in Campbell and Vuolteenaho (2004). Future CF news was denoted by \( N_{i,CF,t+1} = (E_{t+1} - E_i) \left[ \sum_{j=0}^{\infty} \rho^j \Delta d_{it+1+j} \right] \) which reflected future company fundamentals such as dividends; future DR news was denoted by \( N_{i,DR,t+1} = (E_{t+1} - E_i) \left[ \sum_{j=1}^{\infty} \rho^j r_{it+1+j} \right] \), which reflected market information such as returns.

Equation (1) shows that changes in unexpected stock returns are associated with changes in expectations of future CFs or DRs. Given a dividend stream, higher future returns can only be generated by a future price increase from a low current price. Thus, if investors have a decrease in expected future CFs or an increase in expected future DRs, there will be a capital loss today.

To decompose returns into CF news and DR news, we used a VAR model following Campbell and Vuolteenaho (2004). The decomposition process started assuming that the data were generated by a first-order VAR process:

\[ Z_{t+1} = a + AZ_t + u_{t+1}. \]

where \( Z_{t+1} \) is an \( m \)-by-1 state vector with \( r_{Mt+1} \) as its first element, \( \alpha \) is an \( m \)-by-1 constant vector, \( A \) is an \( m \)-by-\( m \) coefficient matrix, and \( u_{t+1} \) is an \( m \)-by-1 vector of shocks following an independent and identically distributed process.

Based on the data generation process of equation (2), we can get a linear function that relates CF news and DR news to the shock vector:

\[ N_{CF,t+1} = eY(I - \rho A)^{-1} u_{t+1} = [eY + eY \rho A(I - \rho A)^{-1}] u_{t+1} \]

\[ = eY \rho A(I - \rho A)^{-1} u_{t+1}, \]

where \( eY = [1 \ 0 \ L]_{m \times 1} \). Now, VAR shocks were mapped into CF news and DR news using \( \rho A(I - \rho A)^{-1} \). The greater the absolute value of the top row of \( A \), the greater the weight the variable received in the DR news formula.

We estimated \( A \) and \( u_{t+1} \) through the VAR model, and then equations (3) and (4) were used to derive CF news and DR news. This method was easy to implement, but the choice of state variables in the VAR model was extremely important, as they determine the precision of the decomposition. Campbell and Vuolteenaho (2004) determine four robust state variables for us to refer to. They are the excess market return (\( R \)), the yield spread between long- and short-term

3 Campbell and Vuolteenaho (2004) links \( \rho \) to the average consumption-wealth ratio.
bonds (TY), the market’s smoothed price-earnings ratio (PE), and the small-
stock value spread (VS).

There are several reasons we choose these four state variables. First, our
decomposition object was excess market return, thus, excess market return must
be included as one of the state vectors. Second, the yield spread between long-
and short-term bonds tracks the business cycle, while stock market was corre-
lated with business cycle. Third, as the price–earnings ratio was determined by
market price and earnings, a high price–earnings ratio implies low future
expected returns at a given constant growth in expected earnings. Fourth,
small-stock value spread was chosen based on intertemporal capital asset
pricing model (ICAPM) theory. ICAPM claims that a higher return of small
growth stocks predicts lower future expected market return, while a higher
return of small value stocks predicts higher future expected market return. Thus,
the value spread between them also influences market return. Another expla-
nation is that small-stock value spread can be related to market-wide DRs
because prices of small growth stocks are more sensitive to changes in DRs.

B. Modeling time-varying correlation

Financial time series usually have characteristics like a fat tail and cluster, and
the ARCH model of Engle (1982) catches up well with the characteristics
mentioned earlier. The further extension of the ARCH model to the GARCH
model by Bollerslev (1986) has a more general application because it appears to
more successfully describe the properties of stock returns and volatility. In order
to find the correlation of multiple series, Bollerslev et al. (1988) extend the
GARCH model into a MVGARCH model. Pagan (1996) and Bauwens et al.
(2006), among others, illustrate the wide application of the GARCH and
MVGARCH models in financial research.

In this study, we used the BEKK-GARCH model developed by Engle and
Kroner (1995) to estimate the time-varying correlations of CF news and DR
news between mainland China and Hong Kong stock markets. This model was
suitable here because it avoids the information loss that the DCC-GARCH
model was susceptible to.

We first write $N_{CF,t}$ and $N_{DR,t}$ as $N_t$, and write $H_{CF,t}$ and $H_{DR,t}$ as $H_t$; to arrive at
a stochastic vector, $n_t = (m_{1t}, K n_{kt})'$, which is a $k$-by-1 vector; $n_t = \mu_t + \varepsilon_t$, where
$\varepsilon_t = H_t^{1/2}z_t$; $H_t^{1/2}$ is a $k$-by-$k$ positive matrix, and $z_t$ is a $k$-by-1
vector.

We assume that $E(z_t) = 0$, $\text{Var}(z_t) = I_k$, where $I_k$ is a $k$-order identity matrix.
Thus, the conditional variance of $n_t$ is
\[
\text{Var}(n_t | I_{t-1}) = \text{Var}_{t-1}(\varepsilon_t) = H_t.
\]
(5)

In the BEKK (1, 1, 1)-GARCH model, $H_t$ is written as:
\[
H_t = \Omega'\Omega + \Gamma'\varepsilon_{t-1}\varepsilon_{t-1}'\Gamma + B'H_{t-1}B.
\]
(6)

If there are only two series of data, $\Omega$ is a 2-by-2 upper triangular matrix, and $\Gamma$
and $B$ are both $2 \times 2$ coefficient matrices. We denote $w_{ij}$, $y_{ij}$, and $\beta_{ij}$ as the $(i,j)$
element of matrices \( \Omega, \Gamma, \) and B separately. Through testing, whether non-diagonal elements of \( \Gamma \) and B are significantly different to zero or not, we can determine the volatility spillover effect.

We used maximum likelihood method to estimate this BEKK-GARCH model, hence the log-likelihood function can be written as:

\[
L_T(\theta) = -\frac{T N}{2} \log(2\pi) - \frac{1}{2} \sum_{t=1}^{T} \log[H_t] - \frac{1}{2} \sum_{t=1}^{T} (y_t - \mu_t)' H_t^{-1} (y_t - \mu_t)
\]

We obtain estimates of \( w_{ij}, y_{ij}, \) and \( \beta_{ij} \) by maximizing \( L_T(\theta) \).

Additionally, the GARCH process was integrated into the VAR model for news decomposition. That is, we assumed the shock term in the VAR model follows a GARCH process.

### III. DATA

Given the availability of data in Hong Kong and China markets, we use monthly data from June 2002 to September 2010. The data selection and state variables’ constructions are conducted in the following way.

The excess log return on the market \( (R_{Me}) \) is the difference between the log market return and the log risk-free rate. In this article, we do not choose either the Shanghai Composite Index or the Heng Seng Index to represent the price of the two markets. It is not precise to use a price index as the market price because the Shanghai Composite Index or the Heng Seng Index alone only represents part of the stocks. Our research objective is the whole set of stocks listed in both markets, so we calculate the value-weighted stock return for all listed stocks. Excess return data for the mainland China market comes from the CSMAR database of Shenzhen GTA Company. Return and market value data for the Hong Kong market is from DATASTREAM. The risk-free rate data of Hong Kong is constructed by the Hong Kong Monetary Authority from Treasury bills with a 1-month maturity. Until September 2010, the DATASTREAM database indicates that there were 1484 stocks in the Hong Kong market and the CSMAR database gives 2008 stocks in the mainland China market.

The term yield spread \( (TY) \) is computed as the yield difference between 10-year constant-maturity government bonds and 1-year maturity government bills, in percentage points. We choose 1-year bills instead of 1-month bills because of the availability of Chinese bond data. Data for both markets are provided by DATASTREAM.

The price-earnings ratio \( (PE) \) is constructed as a share-weighted PE. Our construction method is different from Campbell and Vuolteenaho (2004) because of the data availability of the mainland China market. Because the RESSET database provides share-weighted PE values for the mainland China market, we also use this kind of PE values for the Hong Kong market. The ratio is log transformed.
The small-stock value spread (VS) is constructed by referring to Campbell and Vuolteenaho (2004). The portfolios are constructed at the end of each June, and are the intersections of two portfolios sorted according to size (market value or MV) and three portfolios formed based on the ratio of book-to-market value (BE/ME). The size breakpoint for year $t$ is the median market value of all stocks at the end of June of year $t$. BE/ME for June of year $t$ is the book value divided by the market value for December of $t-1$. The breakpoints for BE/ME are the 30th and 70th percentiles among the small stocks sorted before. At the end of June of year $t$, the small-stock value spread is constructed as the difference between the log (BE/ME) of the small high book-to-market portfolio and the log (BE/ME) of the small low book-to-market portfolio. From July to May of each year, the small-stock value spread is constructed by first adding the cumulative log return (from the previous June) on the small low book-to-market portfolio to the small stock value spread at the end of June, and then subtracting the cumulative log return on the small high book-to-market portfolio from it.

**IV. EMPIRICAL RESULTS**

We report and interpret the results obtained from the empirical estimation. Statistics description of data is given first, and then we present extracted CF news and DR news. Finally, we investigate and interpret the time-varying conditional correlations of CF news and DR news in the two markets.

**A. Statistics description**

Descriptive statistics and stochastic properties of four VAR state variables in each market are presented in Table 1.

Compared with the Hong Kong market, the mainland China market return has higher return and risk. This is consistent with most research results in the literature. Skewness is mostly negative and kurtosis is above 3 for the Hong Kong market. The null hypothesis of no autocorrelation of order 12 is rejected for both markets, which suggests the use of a VAR model is appropriate. The Engle (1982) test for conditional heteroskedasticity rejects the null hypothesis of no ARCH effect for both the mainland China and the Hong Kong market. This provides support for us to use a GARCH model to estimate the time-varying correlation.

From Table 2, we see that under the 10% significance level, the excess market return series rejects the hypothesis of existing unit roots in both the mainland China and Hong Kong markets. However, TY in the mainland China market, and TY and VS in the Hong Kong market have unit roots, indicating non-stationarity. Despite this, we continue to use these eight state variables in our empirical tests because we need to use the VAR model in a given form to extract
<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std-Dev</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>J-B Test</th>
<th>Q(12)</th>
<th>ARCH(12)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mainland China</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R$</td>
<td>0.010039</td>
<td>0.092651</td>
<td>-0.26457</td>
<td>0.33175</td>
<td>1.62517</td>
<td>26.4799</td>
<td>27.27238</td>
</tr>
<tr>
<td>$TY$</td>
<td>1.3247</td>
<td>0.72163</td>
<td>-0.15520</td>
<td>-1.2688</td>
<td>7.10877</td>
<td>377.8840</td>
<td></td>
</tr>
<tr>
<td>$PE$</td>
<td>3.5579</td>
<td>0.27659</td>
<td>0.17455</td>
<td>-0.43170</td>
<td>1.28429</td>
<td>305.5120</td>
<td></td>
</tr>
<tr>
<td>$VS$</td>
<td>0.49673</td>
<td>0.057849</td>
<td>0.21007</td>
<td>-0.90073</td>
<td>4.11601</td>
<td>325.4218</td>
<td></td>
</tr>
<tr>
<td><strong>Hong Kong</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R$</td>
<td>-0.01106</td>
<td>0.079528</td>
<td>-0.274396</td>
<td>4.340375</td>
<td>13.37334</td>
<td>18.899</td>
<td>25.86700</td>
</tr>
<tr>
<td>$TY$</td>
<td>1.812922</td>
<td>1.126675</td>
<td>0.120729</td>
<td>1.98934</td>
<td>6.875669</td>
<td>982.83</td>
<td></td>
</tr>
<tr>
<td>$PE$</td>
<td>2.928207</td>
<td>0.238440</td>
<td>-0.692756</td>
<td>3.723452</td>
<td>15.57430</td>
<td>422.31</td>
<td></td>
</tr>
<tr>
<td>$VS$</td>
<td>2.001593</td>
<td>0.279345</td>
<td>-0.202669</td>
<td>3.143588</td>
<td>1.178844</td>
<td>953.64</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** J-B test is the Jarque–Bera test for normality based on excess skewness and kurtosis. Q (12) is the Ljung Box test for autocorrelations of order 12. ARCH (12) is the test for conditional heteroskedasticity from Engle (1982). $R$, market return; $TY$, yield spread between long- and short-term bonds; $PE$, price–earnings ratio; $VS$, small-stock value spread.
CF and DR news from the excess market return, and the existing regression methods cannot solve this non-stationary problem of the state variables.4

B. VAR-BEKK-GARCH result

Tables 3 and 4 contain the parameter estimates for the VAR-BEKK-GARCH model. Table 3 gives the VAR estimates while the GARCH estimates are in Table 4.

Table 3 shows that the estimated coefficients of the VAR state variables are significantly different from zero. Once we have this coefficient matrix, the CF news and DR news in both markets can be derived. We plot them in Figures 1 and 2.

From the Figures 1 and 2, we find that during the sample period, CF news and DR news generally show a similar trend. The time-varying correlation between mainland China and Hong Kong stock markets is our concern, so we show the time-varying correlation of CF news in the two markets in Figure 3, the time-varying correlation of DR news in the two markets in Figure 4.

From Figure 3, we find that CF news correlation appears to be more volatile after 2007. Because CF news represents long-term information, this pattern indicates that after 2007, long-term information became more important than short-term information for mainland China investors. From Figure 4, we also see some interesting patterns in DR news. First, most of the time, the correlation of DR news during the sample period is positive. Second, we can map the negative correlation points to several big financial events in China, For instance, the Qualified Foreign Institutional Investor (QFII) in December 2002, the non-tradable stocks reform commencing from May 2005, the increase of stamp duty in May 2007, the announcement of ‘through-train’

4 We also test the stationarity of the VAR state variables of Campbell and Vuolteenaho (2004), and find their TY and VS are not stationary either. To our best knowledge, so far, there is no other way in the existing literature to address this problem.

Table 2  Unit root tests (Phillips–Perron)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Option</th>
<th>PP statistic</th>
<th>10% critical value</th>
<th>Stationarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainland China</td>
<td>R</td>
<td>NI &amp; NT</td>
<td>-8.815977</td>
<td>-1.614596</td>
</tr>
<tr>
<td>TY</td>
<td>I</td>
<td>-2.227767</td>
<td>-2.582514</td>
<td>No</td>
</tr>
<tr>
<td>PE</td>
<td>I</td>
<td>-2.643193</td>
<td>-2.582514</td>
<td>Yes</td>
</tr>
<tr>
<td>VS</td>
<td>I</td>
<td>-2.535928</td>
<td>-2.582514</td>
<td>No</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>R</td>
<td>NI &amp; NT</td>
<td>-9.449126</td>
<td>-1.615316</td>
</tr>
<tr>
<td>TY</td>
<td>I</td>
<td>-1.884179</td>
<td>-2.576939</td>
<td>No</td>
</tr>
<tr>
<td>PE</td>
<td>I</td>
<td>-2.689945</td>
<td>-2.576939</td>
<td>Yes</td>
</tr>
<tr>
<td>VS</td>
<td>I</td>
<td>-2.242260</td>
<td>-2.576939</td>
<td>No</td>
</tr>
</tbody>
</table>

Notes: I denotes intercept option, T denotes trend option, NI denotes no intercept option and NT denotes no trend option. R, market return; TY, yield spread between long- and short-term bonds; PE, price–earnings ratio; VS, small-stock value spread.

International Review of Finance © 2012 The Authors
## Table 3  Vector autoregressive regression parameter estimates

<table>
<thead>
<tr>
<th></th>
<th>Hong Kong</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Constant</td>
<td>$R_{M,t}$</td>
<td>$TY_{t+1}$</td>
<td>$PE_{t+1}$</td>
<td>$VS_{t+1}$</td>
</tr>
<tr>
<td>$R_{M,t+1}$</td>
<td>-0.0535 (-0.1920)</td>
<td>-0.2175 (-1.6713)</td>
<td>0.0309 (0.2662)</td>
<td>-0.0064 (-0.1378)</td>
<td>0.1108 (0.4149)</td>
<td></td>
</tr>
<tr>
<td>$TY_{t+1}$</td>
<td>1.7877 (15.4506)</td>
<td>0.0111 (0.1674)</td>
<td>0.8012 (10.6397)</td>
<td>-0.3320 (-12.1745)</td>
<td>-0.6280 (-5.6948)</td>
<td></td>
</tr>
<tr>
<td>$PE_{t+1}$</td>
<td>0.4574 (1.2511)</td>
<td>-0.1985 (-1.0871)</td>
<td>0.0136 (0.1020)</td>
<td>0.8663 (13.2224)</td>
<td>0.0068 (0.0203)</td>
<td></td>
</tr>
<tr>
<td>$VS_{t+1}$</td>
<td>0.1518 (2.7122)</td>
<td>-0.0078 (-0.1142)</td>
<td>-0.0009 (-0.0526)</td>
<td>-0.0257 (-2.1989)</td>
<td>0.8822 (9.2091)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mainland</td>
<td>Constant</td>
<td>$R_{M,t}$</td>
<td>$TY_{t+1}$</td>
<td>$PE_{t+1}$</td>
<td>$VS_{t+1}$</td>
</tr>
<tr>
<td>$R_{M,t+1}$</td>
<td>0.1405 (0.5847)</td>
<td>0.3238 (3.0491)</td>
<td>-0.0082 (-0.4889)</td>
<td>-0.0553 (-1.6986)</td>
<td>0.0168 (0.1922)</td>
<td></td>
</tr>
<tr>
<td>$TY_{t+1}$</td>
<td>0.1874 (2.6017)</td>
<td>0.5110 (4.7382)</td>
<td>0.9509 (36.1811)</td>
<td>0.0374 (1.9118)</td>
<td>-0.0965 (-9.3579)</td>
<td></td>
</tr>
<tr>
<td>$PE_{t+1}$</td>
<td>0.4883 (1.3748)</td>
<td>0.3425 (2.9975)</td>
<td>-0.0164 (-0.6216)</td>
<td>0.8447 (13.1518)</td>
<td>0.0036 (0.0384)</td>
<td></td>
</tr>
<tr>
<td>$VS_{t+1}$</td>
<td>0.3008 (0.9691)</td>
<td>-0.0401 (-0.1473)</td>
<td>0.0139 (0.2799)</td>
<td>-0.0455 (-0.6839)</td>
<td>0.9061 (9.4834)</td>
<td></td>
</tr>
</tbody>
</table>

*R*, market return; $TY$, yield spread between long- and short-term bonds; $PE$, price–earnings ratio; $VS$, small-stock value spread.
Table 4  BEKK-GARCH (1,1) estimates

<table>
<thead>
<tr>
<th></th>
<th>CF_Mainland</th>
<th>CF_HK</th>
<th>DR_Mainland</th>
<th>DR_HK</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Omega$</td>
<td>0.0167 (0.4674)</td>
<td>-0.0143 (-0.5128)</td>
<td>0.0354 (5.0626)</td>
<td>0.0022 (0.1665)</td>
</tr>
<tr>
<td>$\Gamma$</td>
<td>0.3725 (1.2138)</td>
<td>0.0967 (0.6620)</td>
<td>0.5034 (2.5367)</td>
<td>-0.5458 (-3.2169)</td>
</tr>
<tr>
<td></td>
<td>-0.2980 (-1.4420)</td>
<td>0.0438 (0.1335)</td>
<td>-0.0511 (-0.6521)</td>
<td>-0.2611 (-2.3859)</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.8850 (3.6033)</td>
<td>-0.1378 (-0.5725)</td>
<td>0.3481 (2.0109)</td>
<td>-0.4698 (-1.6168)</td>
</tr>
<tr>
<td></td>
<td>0.3075 (1.8346)</td>
<td>0.8293 (5.6346)</td>
<td>-0.3971 (-1.6403)</td>
<td>-0.5824 (-1.6314)</td>
</tr>
</tbody>
</table>

| Eigen values | 0.9258 | -0.6077 |
|             | 0.6824 + 0.2768i | 0.5807 |
|             | 0.6824 - 0.2768i | 0.6892 |
|             | 0.8214 | -0.5487 |

| Log likelihood | 256.0190 | 331.7685 |

Notes: $t$-statistics in the parentheses.
An Empirical Study

Figure 1  Cash Flow (CF) News.

Figure 2  Discount Rate (DR) News.
policy in mid-2008,\(^5\) and the introduction of the mainland stock index futures in April 2010. Third, if the Hong Kong market does not care about the mainland China market, then for big events in mainland China, its reaction should be different from the mainland China market, and the DR correlation should be negative. Therefore, the negative points along with big events reflect the different reactions of the two markets during big events in China markets. Fourth, we find that since 2008, the correlation becomes more positive than negative. Such observation may indicate it is possible that Hong Kong market does not care too much about mainland China market in the early periods; however, since 2008, the announcement of the ‘through-train’

\(^5\) ‘Through-train’ policy allows mainland investors to invest in Hong Kong market to some extent.
policy induces the Hong Kong market to start to notice more about the mainland China market, and consequently this is reflected in a more positive correlation of the DR news after 2008.

V. STRUCTURAL BREAKS TESTS

Although the negative correlation points of DR news can be mapped to several important events, further evidence is required to show the robustness of our decomposition. Because CF news reflects long-term information, given our limited sample, the events happening in the market should not affect the structure of CF news; on the contrary, DR news reflects the short-term information and should have structural change during the sample period.

In order to test the precision of our news decomposition, we investigate whether any structural changes occur in the conditional correlations between mainland China and Hong Kong markets during the estimation period. We apply the structural break test of Bai and Perron (1998, 2003) to detect the structural break points in CF news and DR news conditional correlations.

6 Please refer to Bai and Perron (1998) for detailed statistics computation.
Tables 5 and 6 present the results, where the $supF$ and $Dmax$ tests determine whether or not there are break points.

In the Table 5 shows the break test for CF news assuming three break points, while Table 6 shows the break test for DR news assuming three break points as well. For CF news conditional correlation, both the $supF$ and $Dmax$ tests statistics are insignificant, suggesting the null hypothesis of stability is accepted, while for DR news conditional correlation, the null hypothesis of stability is rejected, which indicates that there are three break points. The results show that during the sample period, CF news conditional correlation does not have any structural change, while DR news conditional correlation has structural break points that coincide with big financial events such as the non-tradable shares reform, the ‘through-train’ policy and the introduction of mainland stock index futures. Therefore, this test provides evidence that the decomposition is appropriate.

VI. CONCLUSION

This study tries to investigate the dynamic correlation between mainland China and Hong Kong stock markets based on news decomposition perspective instead of considering market return as a whole. It is a new exploration of dynamic correlation structures in connected financial markets. Specifically, we analyze the CF news comovements between the mainland China and Hong Kong stock markets, as well as the DR news comovements between these two markets. The sample period is from June 2002 to September 2010.

We find CF news correlation becomes more volatile after 2007. Because CF news relates more to long-term information, we conclude that investors in the mainland China market have become more concerned about long-term information, and that this concern leads to the fluctuating correlation. As demonstrated by our empirical findings, DR news mainly shows positive correlations except for some points that can be associated with important stock market events such as the QFII of December 2002, the non-tradable stocks reform of May 2005, the increase in stamp duty in May 2007, the announcement of the ‘through-train’ policy in mid-2008, and the introduction of mainland stock index futures in April 2010. However, we see that after 2008, the correlations become more positive than negative. Although correlations become negative again from mid-2010, the degree of negativity is significantly less than before. We believe that this corresponds to the change in the relative relationship of the two markets. It suggests that the Hong Kong market comprehends the importance of the mainland China market and is consequently is influenced more by the changes in the mainland China market. In addition, the structural break test shows that there are no structural breaks for CF news correlation, but that there are three breaks for DR news correlation. This further supports our news decomposition for correlation examinations. Our method proposed in the current study provides a new perspective for information linkage analysis by looking at
DR and CF news (and consequently, the short- and long-term market information) correlations separately and can surely be applied to beyond Hong Kong and China markets.

Kent Wang  
WISE  
Economics Building  
Xiamen University  
Xiamen 361005  
China  
kentwang@xmu.edu.cn

REFERENCES


