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Hong Kong:

A Bridge Connecting Mainland China and the International Market

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16 May 2014

EGC Report No: 2014/06

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Hong Kong: a bridge connecting mainland China and the international market

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Version: May 16, 2014

Chow et al. (2011) apply three time-varying parameter methods to investigate the relationship between the stock markets of Shanghai and New York and find that the mutual influence between the two markets has increased since 2002. We reconsider their approaches and find that two suffer from parameter underidentification and all three from underspecification of the parameter variation. We include Hong Kong in an analysis based on standard and partial correlations over a running window in order to depict the change in the mutual relationships between these three markets. It is found that the observed increasing co-movement between Shanghai and New York is mainly due to the channel of Hong Kong. So Hong Kong appears to connect mainland China with the global market.

Keywords: China; Co-movement, Globalization; Specification analysis, Stock markets

JEL Classifications: C29, C58, G14

1. INTRODUCTION

Mainland China joined the WTO at the end of 2001, which accelerated its progress of integration into the international market. As a consequence, cross-correlation or co-movement between stock markets of mainland China and international financial centres such as New York becomes increasingly apparent. For the integration of mainland China into the international market, Hong Kong plays an important role due to its status as a financial and commercial centre. The role of Hong Kong was further enhanced after its political reversion to China, followed by a series of policies enhancing the economic integration between mainland China and Hong Kong. The purpose of this paper is to study the co-movement relationship of the price indices of stocks traded in Shanghai (mainland China), Hong Kong and international financial centres represented by the New York Stock Exchange.

There is a vast literature on the relationships among various financial markets. Huang et al. (2000) find unidirectional Granger causality from US to Hong Kong and no Granger causality between Hong Kong and Shanghai using daily data from 1992 to 1997. Li (2007) uses the GARCH BEKK model and finds unidirectional volatility spillover from the stock market of Hong Kong to Shanghai while no direct linkage between Shanghai and the US could be established. Zhang et al. (2009) apply the MVGARCH model and find return spillover from the preceding transaction day of Hong Kong to Shanghai, but not in reverse. The majority of the studies employ the GARCH model and its extensions to study the spillover effect in return and volatility between markets. Moreover, they all just include lags of the return of other markets in the mean equation and therefore cannot conclude on any co-movement or concurrent cross-correlation between the markets. Chow et al. (2011) propose three time-varying parameter methods to shed light on this issue, based on: (a) simple correlations over sub-samples, (b) dynamic regressions over sub-samples, and (c) state-space time-varying coefficient regressions. They use weekly data of the stock markets of Shanghai and New York to study the co-movement of the two markets and conclude that their mutual influence has increased and became statistically significant, especially after mainland China entered the WTO.

However, as we shall demonstrate, their approaches (b) and (c) suffer from underidentification and at the same time all three approaches seem too restrictive. Since Chow et al. (2011) do not discuss whether any co-movement between the stock markets of Shanghai and New York is due to direct or indirect effects, which could well be the case given the complexity of the financial world in which individual stock markets are all inter-connected, we will refine their method (a), by comparing simple and partial correlations over moving overlapping subsamples, upon incorporating the stock market of Hong Kong into the analysis.

A partial-correlation coefficient quantifies the remaining correlation between two variables after taking out the correlation with a third mediating variable. Baba et al. (2004) present a theoretical discussion of partial-correlation. Shapira et al. (2009) utilize partial-correlation to study the cohesive effects of DJIA, S&P and the Tel Aviv Stock Exchange. Kenett et al. (2012) use partial-correlation to study the intra-correlations of individual stocks for the six most important world markets. Partial-correlation is useful in the inter-connected world to measure the residual correlation between two variables and to reveal distinctions between direct and indirect channels of market influence. As Hong Kong is correlated to both mainland China and the US, it may serve as a mediating variable for the interaction between mainland China and the US. The use of partial-correlation can unveil whether the co-movement between mainland China and the US is primarily through a direct channel or an indirect one.

The purpose of this paper is to examine our concerns regarding the approaches in Chow et al. (2011). In addition, by including the Hong Kong stock market, we will use partial cross-correlation to verify the channel of co-movement between the stock markets of Shanghai and New York. It is found that the co-movement between Shanghai and New York does not increase, even after mainland China entered the WTO, when the effect of Hong Kong is removed. The observed increasing co-movement between Shanghai and New York is due to the increasing co-movements between Shanghai and Hong Kong as well as Hong Kong and New York. The market integration of Shanghai and New York is through the indirect channel of Hong Kong, which serves as a bridge connecting the two markets.

The rest of this paper is organized as follows. We discuss briefly the data in Section 2. In Section 3 we examine the results in Chow et al. (2011). Section 4 applies partial-correlation analysis over moving windows in order to investigate the dynamics in any co-movement channels between the stock markets of Shanghai, Hong Kong and New York. Section 5 concludes the paper.

2. DATA

This paper uses the same data and time frame as Chow et al. (2011), but includes the Hong Kong market. We obtained weekly data of the Shanghai Composite Index (sh), the NYSE Composite Index (ny) and the Hang Seng Index of Hong Kong (hk) from Yahoo finance. Using the weekly closing price p_t^i of stock market i at week t, the weekly return of the stock market r_t^i is given by

$$r_t^i = \ln p_t^i - \ln p_{t-1}^i, \text{ for } i \in \{sh,\ ny,\ hk\}. \tag{1}$$

The sample period is from 1992-01-27 to 2010-12-27.

3. EXAMINATION OF EARLIER RESULTS

Method (b) of Chow et al. (2011) estimates the equations

$$\left.\begin{array}{l} r_t^{ny} = \beta_0 + \beta_1 r_t^{sh} + \beta_2 r_{t-1}^{ny} + \beta_3 r_{t-1}^{sh} + \varepsilon_t^{ny} \\ r_t^{sh} = \gamma_0 + \gamma_1 r_t^{ny} + \gamma_2 r_{t-1}^{sh} + \gamma_3 r_{t-1}^{ny} + \varepsilon_t^{sh} \end{array}\right\} \tag{2}$$

over two subsamples by ordinary least-squares, where ε_t^{ny} and ε_t^{sh} denote disturbance terms. Apparently, in order to obtain consistent estimators for all the coefficients, these disturbances have been assumed to be such that

$$\left.\begin{array}{l} E[\varepsilon_t^{ny}(1, r_t^{sh}, r_{t-1}^{ny}, r_{t-1}^{sh})] = (0,0,0,0) \\ E[\varepsilon_t^{sh}(1, r_t^{ny}, r_{t-1}^{sh}, r_{t-1}^{ny})] = (0,0,0,0) \end{array}\right\} \quad (3)$$

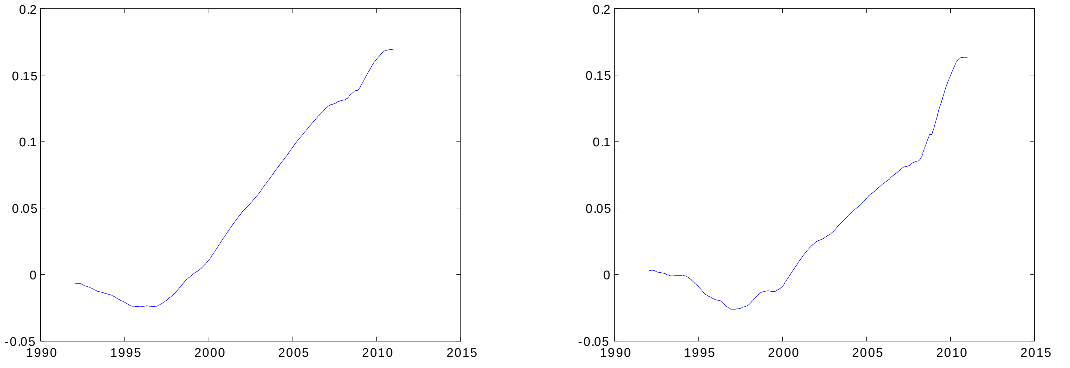
This, however, cannot be the case, due to the implied joint dependence of r_t^{ny} and r_t^{sh}. More seriously, however, without further restrictions on the coefficients, these two equations form the prototypical example of an under-identified two-equation dynamic simultaneous system. Note that when $\beta_1 \neq 0$, the first equation implies

$$r_t^{sh} = -\beta_1^{-1}\beta_0 + \beta_1^{-1} r_t^{ny} - \beta_1^{-1}\beta_2 r_{t-1}^{ny} - \beta_1\beta_3 r_{t-1}^{sh} - \beta_1^{-1}\varepsilon_t^{ny}, \quad (4)$$

which shows that the two equations are inherently indistinguishable. This result is also reflected by the equivalent t-ratios of the OLS coefficient estimates of β_1 and γ_1 (see Table 3 of Chow et al. (2011)) for each of the three sample periods. In addition, equation (4) shows that r_t^{sh} is correlated with ε_t^{ny}, which undermines (3). So, there is no meaningful interpretation of the results obtained by method (b) possible, unless some empirically unverifiable identification restrictions will be adopted which annul the symmetry between the two equations.

Method (c) of Chow et al. (2011) extends the two-equation simultaneous dynamic system by embedding it partly into a state-space model over the whole sample, upon allowing for time-varying coefficients of the current (and when included also the lagged) effect of the other stock market, while imposing time-constancy for the intercept (and when included the lagged dependent variable). By applying maximum likelihood to the two equations separately, again the implied simultaneity is neglected, and too are the implications of the two equations for each other, being that all coefficients should in fact be taken as time-varying. Then again though, due to abstaining from identifying coefficient restrictions, a sensible interpretation of the estimated parameters is impossible.

So, neither specification (b) nor its extension (c) satisfy as structural models. That (c) does not satisfy either as a coherent description of the observed stochastic data processes can be illustrated as follows. Adopting the simplest specification (as the more general ones involve insignificant additions, according to the Chow et al. (2011)), so describing the return



$\hat{\beta}_t^{ny}$ $\hat{\beta}_t^{sh}$

FIG. 1 Plot of estimated time-varying coefficients

of market i in terms of the return of market j by

$$\left.\begin{array}{l} r_t^i = \alpha + \beta_t^i r_t^j + e_t^i,\ e_t^i \sim IIN\left(0, \sigma_{e^i}^2\right) \\ \beta_t^i = \beta_{t-1}^i + u_t^i,\ u_t^i \sim IIN\left(0, \sigma_{u^i}^2\right) \end{array}\right\} \tag{5}$$

where β_t^i is the time-varying coefficient and u_t^i its white-noise change $\Delta\beta_t^i$, we obtain by EViews (standard errors in parentheses):

$$r_t^{sh} = \underset{(0.002)}{0.002} + \hat{\beta}_t^{ny} r_t^{ny} + \hat{e}_t^{sh},$$

$$r_t^{ny} = \underset{(0.001)}{0.001} + \hat{\beta}_t^{sh} r_t^{sh} + \hat{e}_t^{ny}$$

The series of estimates $\hat{\beta}_t^{ny}$ and $\hat{\beta}_t^{sh}$ are plotted in Fig.1. Although their magnitudes are clearly different from those plotted in Fig. 1 of Chow et al. (2011), they do exhibit a similar rising pattern for both β_t^{ny} and β_t^{sh}, which in that study is interpreted as: the mutual influence between Shanghai and New York enhanced over time.

However, these time-varying regressions become suspicious when we examine the estimated increments of their time-varying coefficients (the state disturbances)

$$\hat{u}_t^i = \hat{\beta}_t^i - \hat{\beta}_{t-1}^i,\ i \in \{ny, sh\},$$

plotted in Fig. 2. From these it is obvious that it is hard to believe that they correspond to series u_t^i, which were assumed to establish zero mean normal white-noise processes. Formal (asymptotic) statistical tests confirm their non-zero means, non-normal distributions and

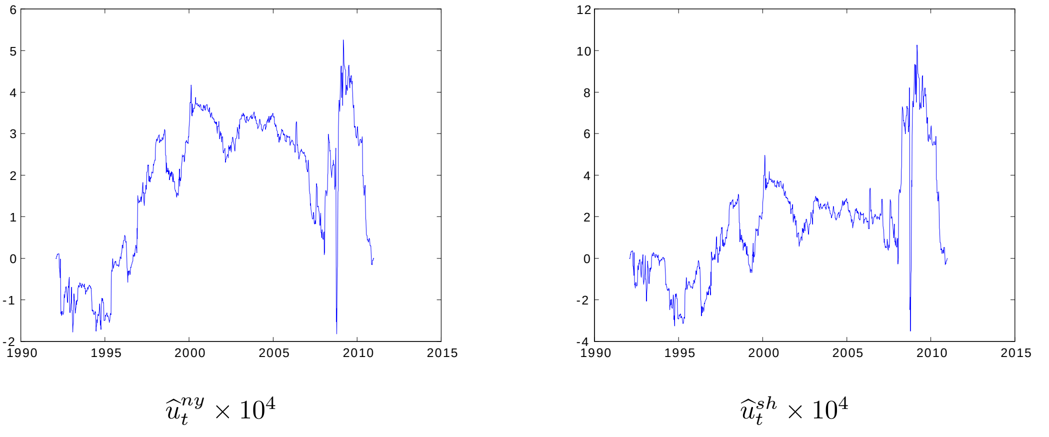


FIG. 2 Plot of estimated state disturbances

serious serial correlation. Hence, these time-varying coefficient regressions do not pass basic diagnostic tests.

4. A CHANNEL FOR MARKET CO-MOVEMENT

To determine the co-movement between the Shanghai and New York stock markets and the degree of market opening and integration, we make a running window analysis for both the pair-wise simple correlations and the partial correlations between the observed returns at the Shanghai, New York and Hong Kong stock markets. We will use a window of 52 weeks, hence of one full year, where the first window covers weeks 1 through 52, the second one weeks 2 through 53, and so on.

Assuming that the returns at the stock markets i and j are available for the weeks $t = 1, 2, ..., T$, where $T \gg 52$, their simple sample correlations are calculated over the moving windows $w = 1, 2, ..., T - 51$ by Pearson's correlation coefficient according to

$$\hat{\rho}_w(i,j) = \frac{1}{51\left|\hat{\sigma}_w^i \hat{\sigma}_w^j\right|} \sum_{s=1}^{52} (r_{w+s-1}^i - \bar{r}_w^i)(r_{w+s-1}^j - \bar{r}_w^j), \qquad (6)$$

where

$$\bar{r}_w^i = \frac{1}{52} \sum_{s=1}^{52} r_{w+s-1}^i, \; \hat{\sigma}_w^i = \sqrt{\frac{1}{51} \sum_{s=1}^{52} (r_{w+s-1}^i - \bar{r}_w^i)^2}.$$

The sample partial correlation for the moving window w between the markets i and j, excluding their correlations with market k, is given by

$$\hat{\rho}_w(i,j;k) = \frac{\hat{\rho}_w(i,j) - \hat{\rho}_w(i,k)\hat{\rho}_w(j,k)}{\sqrt{[1-\hat{\rho}^2_w(i,k)][1-\hat{\rho}^2_w(j,k)]}}. \tag{7}$$

In an inter-connected financial world, markets may be linked through direct connections or also by indirect ones via other markets. Existence of a positive indirect connection during weeks $t \in \{t_1, ..., t_2\}$ between the markets i and j, which stems from market k, should in principle give rise to a partial-correlation $\hat{\rho}_w(i,j;k)$ which is smaller than the simple correlation $\hat{\rho}_w(i,j)$ over the windows $w \in \{t_1, ..., t_2\}$ or a subset of these. Positive simple sample correlations indicate co-movement, while positive sample partial-correlations reveal a certain degree of direct market integration.

The reason to include Hong Kong in our analysis is that Hong Kong has played a role for mainland China as a corridor to connect with the external world, helped by its established status as a financial centre. The pair-wise concurrent simple and partial correlations are plotted in Fig. 3. It is shown that the simple correlations between the three markets have fluctuated around a positively sloping trend, especially during the first decade of the new millennium. The positively trending simple correlations express the tendency of increased co-movement among the three markets. Reasonable similarity for markets i and j with the corresponding partial-correlation series excluding market k would reveal that this co-movement is mainly due to the direct channel of market integration of i and j, whereas much more modest partial-correlations suggest existence of an indirect effect through the third market k. The partial-correlations between Shanghai and Hong Kong and between New York and Hong Kong both match well with the corresponding simple correlations both showing an upward trend, indicating the closer market integration of mainland China and Hong Kong and of Hong Kong and New York. In contrast, the partial correlation between Shanghai and New York does not notably increase over time, but seems stable over the whole sample period. That means that the market integration of mainland China and the international market does not progress substantially. The increasing simple correlation between Shanghai and New York is because of the increasing market integration of mainland China and Hong Kong, which at the same time also sees increasing market integration with New York. Hence, the increasing mutual influence between Shanghai and New York observed in the market is mainly due to the indirect channel of Hong Kong. Our conclusion is similar to Sun and Zhang (2009) who employ GARCH models and conditional correlation to study the interactions of the three markets.

5. CONCLUSION

Chow et al. (2011) investigate the mutual influence between stock markets of Shanghai and New York, especially the concurrent returns. They claim that they have established the mutual relationships between the two markets and conclude that the mutual influence between the two markets has intensified significantly after mainland China entered the WTO. We demonstrate that their coefficient estimates cannot be interpreted due to identification problems and also to model specification problems associated with lack of both flexibility and generality. This is revealed by allowing a role for the stock market of Hong Kong and by using a method that puts less restrictions on the time-variability of the co-movements of the stock markets.

By a running window study of both simple and partial correlations, we find that simple bivariate correlations among the three markets are increasing over time, confirming the observed tendency of enhanced co-movement among the three markets. However, the three partial correlations, show similar patterns in only two cases. The partial correlation between Shanghai and New York, has been stable over the whole sample of data. This highlights the special role of Hong Kong. Apparently market integration between Shanghai and Hong Kong as well as between Hong Kong and New York have been enhanced, while it did not improve between Shanghai and New York. The observed increasing correlation between Shanghai and New York is mainly through the channel of Hong Kong as Hong Kong serves as a bridge between mainland China and the global market, even after China joined the WTO already more than 10 years ago.

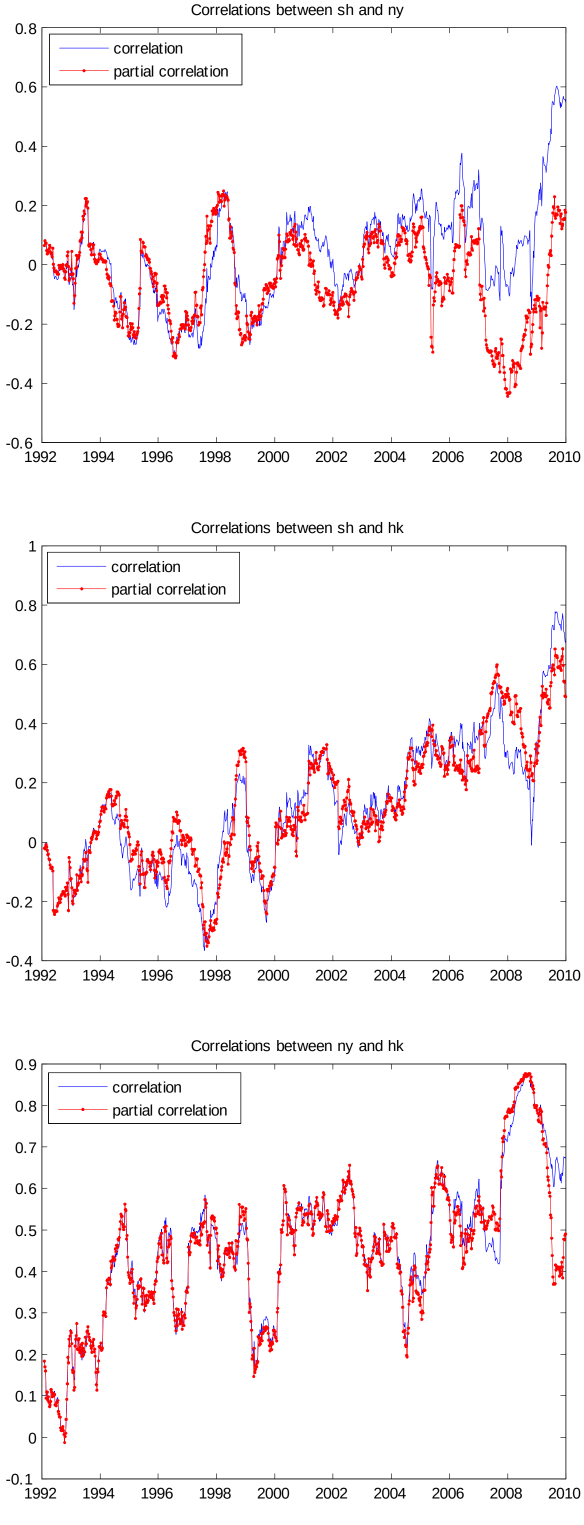


FIG. 3 Plots of correlation and partial correlation.

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