Weathering financial crisis in China: The role of global market integration

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Abstract

We test the hypothesis that the integration of China into the global financial system, as a consequence of domestic market reforms, reduced the effectiveness of intervention efforts during the stock market crises. Using an event study methodology in tandem with the DCC GARCH and Markov Regime Switching models, we investigate whether the interventions were able to address the decline in market returns and volatility during the 2008 and 2015 stock market collapses. Results show that the 2015 measures were ineffective compared to the 2008 ones and that the increasing global integration of the Chinese market played a significant role in their failure. This study is the first of its kind and the results have important implications for policymakers, given the vital position of China in the international economy.

Keywords: Event Study, Market Intervention, Markov Regime Switching Model, Dynamic Conditional Correlations, China, Equity Markets, Market Reforms.

JEL Classification: F36, G14, G15, G18.

1. Introduction

China has emerged as a significant economic power in recent years, with its exports dominating the international markets. The increasing trade relationships and expanding global outlook has increased China's linkages with other equity markets (Burdekin and Siklos, 2012; Zhou *et al.,* 2012). Furthermore, the market reforms have increased the pace of China's integration with the international financial eco-system (Li, 2012). While the process of financial integration eliminates barriers and lowers transaction costs and, therefore, enhances efficiencies and liquidity (Yellen, 2003), it can also attract spillover or contagion effects from other markets (Kearney and Lucey, 2004; Fry-McKibbin, 2014; Gofman, 2017). Theoretically, macroeconomic policies directed at stemming domestic crisis events can improve market returns. However, as markets become integrated, they pose challenges to policymakers during times of crisis (Angkinand *et al.,* 2009; Boubaker *et al.,* 2016). Global event risks can impact investors in integrated markets, resulting in the rapid flow of capital due to them overreacting by overweighting current information. This process can sway stock prices due to the aim of market participants in achieving equilibrium based on underlying economic fundamentals (DeBondt and Thaler, 1985). These factors can hinder localised intervention policies during times of market crisis (IMF, 2011ab).

We test the hypothesis that increasing globalisation impacted the effectiveness of Chinese interventions by examining the results during the 2008 and 2015 market crises. China provides a valuable natural laboratory to examine this hypothesis since the government has been loosening its hold on the domestic financial sector over the years due to market reforms (Bendini, 2015). While the diminishing role of the government improves the integration of the markets and makes them more efficient, it also increases the exposure to global contagion shocks. Evidence during the global financial crisis (GFC) in 2008 shows that intervention efforts succeeded in China. The decline in markets during this period was mainly because of the asset bubble formed by the lottery-like behaviour of predominantly individual investors (Bendini, 2015; Liang and Zhang, 2016; Liu *et al.,* 2016). Nevertheless, the authorities had tighter control over the financial system, which, along with the predominance of state-owned enterprises (SOE) was effective in shielding the market from global volatility transmission (Xiaoyi, 2011). However, the dynamics have evolved since then, as the government started several liberalisation measures directed at integrating the markets with the global system. These far-reaching reforms aimed at improving efficiency also meant lesser control and higher linkages with international markets.

Our study uses several novel methods to assess the effectiveness of the intervention policies in China in light of the increasing global integration of its markets. To judge the success of the interventions, we apply an event study method and analyse the behaviour of abnormal market returns and volatility during and after the event periods. We also examine the volatility of the market based on the Markov Regime Switching (MRS) model. The dynamic conditional correlations (DCC) measure the connections between the Chinese and the global financial markets. Lastly, a regression model tests the impact of international

linkages and market interventions on their effectiveness, controlling for confounding variables. The results show contrasting impacts of the policies during the two interventions. While the abnormal returns responded positively to the policies in 2008, such was not the case in 2015, where the efforts failed to address the volatility and the decline in equity returns. The market reforms and the increasing integration with the global markets likely led to the failure in the later period.

The motivation to study China's intervention efforts is due to its growing influence on international economic and financial systems. Along with the impact on the financial market, the failure of the interventions can have implications for China's export-oriented economy, leading to a profound worldwide impact. Furthermore, the transmission of volatility from China can export negative sentiments to other indices. We offer two major contributions. First, to the best of our knowledge, this is the first study to investigate the effectiveness of policy interventions in the Chinese stock markets using two market events. While a few studies such as Cheng *et al.* (2000) and Su *et al*. (2002) measures the impact of policy interventions in the equity markets, they do so only during the financial crisis in Asia. Khan and Battaeu (2011) investigate the success of market interventions in Russia, but they confine their scope to the GFC event. Our study provides an in-depth and broader investigation by comparing two market interventions that allow us to compare their success in the two periods. By comparing two crisis periods, we can assess the impact of changing domestic financial controls and the resulting linkages on the intervention efforts. Second, the insights can aid policymakers and regulators in strengthening policies. Evidence suggests that intervention policies not only drain national reserves but can also disrupt market efficiencies, thus requires discretion in its implementation. For example, the G-20 countries collectively spent $700 billion on fiscal stimulus in 2009, with a significant portion attributed to the US, China, and Japan (Prasad and Sorkin, 2009). Global policy coordination can be effective against volatility spillovers, given the increasing integration of the economy with the world financial system. For instance, the 2015 Chinese crisis spread to other Asian markets such as Hong Kong, Japan, Korea, Singapore, and India, signifying the embedded connections of China's economy and its financial system with the world economy (Jayasuriya, 2011; Zhou, 2012; Fang and Bessler, 2018). The results have an important implication on policy reforms and the need for global coordination in market intervention efforts. We take motivation from the "globalization hypothesis," which states that the integration with the international markets is likely to increase the vulnerability of the domestic policymakers in dealing with significant shocks (See Bakaert *et al.*, 2011; Bayoumi *et al.,* 2014). Countries plagued with imperfections such as capital controls are vulnerable to crisis transmission when they attempt to liberalise their markets (Schmukler 2004). Thus, we can also expect that as China becomes increasingly integrated with the global financial sector, the efficiency of its domestic market intervention policies decreases.

The rest of the paper is structured as follows. In Section 2, we review the literature and offer a comparison of the two market interventions in Section 3. Section 4 describes the methodology and data used in the paper. The empirical results are presented in Section 5, while Section 6 provides the conclusion.

2. Literature review

The literature cites several reasons behind increasing relationships between global stock markets such as the decrease in trade barriers, cross-listing of stocks, advancement in trading technology and the emergence of multinational banks and investors (Bekaert *et al*., 2005; Chambet and Gibson, 2008; Arouri *et al.,* 2010). Shen *et al.* (2015) use the interdependence theory to point to real linkages between financial as the channels for shocks transmitting between global markets. Although the Chinese equity markets have a short history of existence, a few studies demonstrate their deepening integration with other international indices.[1] Burdekin and Siklos (2012) detect higher levels of linkages between Shanghai and other markets, along with contagion effects during the 2008 financial crisis. Similarly, Wang *et al.* (2011) use a time-varying copula method to highlight China's strengthening ties with Japan and other Pacific markets. Zhou *et al.* (2012) note similar results along with an increase in volatility from China since 2005 to the adjacent markets of Hong Kong and Taiwan.

Along with increasing integration, the Chinese equity markets have undergone several rounds of regulatory reforms. Li (2012) uses a GARCH-BEKK model to find an increase in the interdependence between China and other regional markets because of market liberalisation and institutional reforms. He *et al.* (2014) identifies the Qualified Foreign Institutional Investor (QFII) and the foreign exchange liberalisation measures as factors behind the increase in interdependence with international financial markets. Yao *et al.* (2018) use the stochastic discount factor (SDF) approach to support the positive relationship between reforms and linkages. They detect a significant impact of QFII along with Qualified Domestic Institutional Investor (QDII) and Renminbi Qualified Foreign Intuitional Investor (RQFII) on the cross border integration of China with other markets.

With increasing globalisation, a few studies identify the negative impact of the increasing market integration on the efficacy of localised intervention efforts. Fry-McKibbin *et al.* (2014) conclude that financial linkages increase crisis transmission, which can be problematic for smaller economies. Such observation is supported by Bernake (2015), who states that the "monetary policy autonomy" is increasingly eroding from smaller economies because of the global market turbulence and the ensuing interventions in significant markets. The rapid flight of capital due to the interconnected financial system can further exaggerate the market declines and import volatility. For example, Claessens and Forbes (2004) attribute the connections between internationally traded financial assets as a leading cause of

[1] The Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) opened in 1990 and 1991, respectively (See Mok and Yao, 1993).

financial contagion. Another study by You *et al.* (2014) uses the economic integration index (EII) to measure China's integration with the world economy over the period 1991-2011 and find an increase in correlations during crisis events, resulting in financial contagion. A lack of developed financial and legal structure in integrated markets also adds to the risk of contagion (Boyd and Smith, 1992; IMF, 1998). Bayoumi *et al.* (2014) state that global economies have no choice but to engage in international policy coordination to deal with crisis events.

A few studies evaluate interventions during market collapses. Cheng *et al.* (2000) evaluate the impact of interventions on the Hong Kong index and futures market during the Asian Financial Crisis (AFC). They state that a spike in market volatility during and after the crisis distorted price movements resulting in higher arbitrage gains and standard deviations. Su *et al.* (2002) find that the interventions reduced the volatility and reversed the market decline, in particular, owing to the unconventional direct share repurchase by the government. They also detect a broader positive impact on segments of the market not targeted by the intervention policies. Burdekin *et al.* (2012) state that the capital controls helped to mitigate the effects of the AFC in China. Similarly, Agusman *et al.* (2014) find that the positive outcome of government measures during the Indonesian financial crisis involved the injection of liquidity into banks, changes in capital requirements and introduction of deposit insurance. Fiordelisi and Galloppo (2018) measure the reactions to monetary and fiscal policy measures based on twelve equity indices from 2007 to 2012. They discover that while the industry indices' reactions to interventions vary, the markets react more in the initial stages of the financial crisis to intervention policies than in the later stages.

The intervention efforts during the GFC led to mixed results. IMF (2009) uses an event study of policy announcements in thirteen countries to conclude that the liquidity support measures were highly effective during the early stages of the crisis, while recapitalisation of bank assets and asset purchases by regulators helped in the later stages. However, the results were not conclusive on the long-term effectiveness of the policy measures. Aizenman *et al.* (2016) provide reasons policymakers struggled to stem the market collapse and the ensuing negative economic implications. They state that given the globalized domestic economies, the localised policy responses aggravated the crisis by transmitting volatility from major markets such as the US to the smaller economies. Others also find that an increase in volatility directly affected returns through the liquidity channel (Ang *et al*., 2009; Chung and Chuwonganant, 2018; Ma *et al.,* 2018). Khan and Battaeu (2011) investigate market interventions in Russia during the GFC and find they did not impact the abnormal returns due to their ad hoc nature. However, a fundamental weakness of this study is that it limits its scope to the GFC only. Our study overcomes this weakness by examining the 2008 and 2015 market turbulence.

Research on the effectiveness of interventions in China remains scarce, although a few studies investigate the reasons behind the 2015 stock index crash. Liu *et al.* (2016) blame the overreaction of the Chinese investors to monetary and fiscal policy announcements as a cause of the equity bubble leading up

to the correction. Besides, Hsu (2016) finds that the real estate crash in 2014 led to the diversion of investment capital to the equity markets, which contributed to the asset bubble. Xia (2018) highlights the missed opportunity by the Chinese government to reform the banking sector after the 2008 market collapse, which contributed to the asset price bubble. There was also an increase in systematic risk in the financial system, especially among the banking institutions before the crisis (Wang *et al.,* 2018). While these studies provide some of the reasons behind the crisis event in China, the literature, in general, indicates a critical gap in research on the efficacy of interventions considering China's growing connections with other global financial markets. We aim to bridge this gap in this study.

3. Market dynamics: A brief backgrounder

3.1. Market interventions in 2008

During the GFC, the Chinese equity returns declined by 30% over the pre-event period (Figure A1, Appendix). The market events in 2008 were the result of not only the global crisis but also due to the asset bubble formed by the speculative and lottery-like behaviour of the individual investors (Bendini, 2015; Liang and Zhang, 2016; Liu *et al.,* 2016). The policymakers were not only concerned about the fall in the stock market but also with the risk of the possible economic recession. Estimates show that close to 20 million migrant workers in China became unemployed in 2008 (Morrison, 2009). There was also the risk of a collapse in the export sector, a critical component of the economy. The authorities were concerned about the impact of the market correction on individuals as they formed most of the investors, leading to possible social unrest (Liu *et al.,* 2016). Thus, the policymakers embarked on a broad set of intervention efforts to stabilise the financial market and to provide confidence to the other sectors of the economy. The authorities intervened using both indirect and direct methods, mainly over the period September 18 to November 9. Other than the measures listed in Table 1, indirect measures involved several SOEs releasing bullish press releases reaffirming confidence in the market and pledges not to sell shares.[2]

Table 1: Intervention measures (2008)

Sep 15, 2008	Reduction in the interest rate from 7.47% to 7.20% by the People's Bank of China.[3]
Sep 18, 2008	Initiation of direct purchase of shares of three big lenders (Commercial Bank of China, Bank of China and China Construction Bank) by Central Huijin Investment Co. Ltd., a government investment firm.[4]
Sep 18, 2008	Reduction in the stamp duty on share purchase.[5]
Oct 8, 2008	Reduction in the interest rate from 7.20% to 6.93% by the People's Bank of China.[6]
Oct 9, 2008	Suspension of IPOs by the Chinese Securities Regulatory Commission (CSRC). [7]
Oct 29, 2008	Reduction in the interest rate from 6.93% to 6.66% by the People's Bank of China.[8]
Nov 9, 2008	Injection of the stimulus of $586 billion to stabilize the market.[9]

[2] SOEs have a major footprint in the Chinese economy. There are 51,000 SOEs in China employing over 20 million people and valued at US$29.2 trillion (OECD, 2017).
[3] Source: https://www.investing.com/economic-calendar/pboc-interest-rate-decision-1083, accessed January 8, 2019.
[4] Source: http://www.china-briefing.com/news/china-cancels-stamp-duty-on-stock-purchases, accessed January 8, 2019.
[5] *Ibid.*
[6] *Ibid.*
[7] Source: https://www.investing.com/economic-calendar/pboc-interest-rate-decision-1083, accessed January 8, 2019.
[8] *Ibid.*
[9] Source: https://www.economist.com/asia/2008/11/10/china-seeks-stimulation, accessed January 8, 2019.

3.2. Market interventions in 2015

The market crash of 2015 was profound in magnitude as the Shanghai Composite Index lost 40% between June and August (Figure A.2, Appendix). The risk of the financial market crisis translating into an economic recession was immense, as early signs showed a weakening outlook for the economy and negative pressure on the currency.[10] The Chinese interventions mainly took place over the period June 27-July 8 aimed at improving market confidence and investor confidence (Table 2). The total state-sponsored direct bailouts in China amounted to US$144 billion, along with US$322 billion to the state financial institutions.[11]

Table 2: Intervention measures (2015)

June 27, 2015	Reduction in the required reserve ratios (RRR) by 50 basis points.[12]
June 27, 2015	Reduction in the People's Bank of China interest rate from 5.10% to 4.85%.[13]
June 29, 2015	Permission to pension funds managed by local governments to invest in the stock market with a potential investment of $161 billion.[14]
July 1, 2015	Reduction of 30% in the securities transaction fee by Shanghai and Shenzhen stock exchange with an implementation date of Aug 2015.[15]
July 2, 2015	Relaxation in the margin trading rules by the China Securities Regulatory Commission– reduction in the threshold for individual investors and expansion of brokerage funding channels.[16]
July 3, 2015	Suspension of 19 brokerage accounts by China Financial Futures Exchange (CFFEX) from short-selling for one month.[17]
July 4, 2015	Investment of $19.3 billion in the market by 21 top securities brokerages.[18]
July 4, 2015	Suspension of IPOs by 28 Chinese firms.[19]
July 5, 2015	Announcement of purchase of Exchange Traded Fund (ETFs) by the state-owned Central Huijin Investment Ltd to support the market and along with the injection of liquidity by the Chinese Securities Regulatory Commission into the state-owned margin finance company.[20]
July 8, 2015	Announcement by Chinese regulators of several support measures such as raising the margin requirements for short positions against the small-cap CSI500 Index and loosening the restrictions on insurers in purchasing blue-chip stocks.[21]
July 8, 2015	Trading halted by 1300 firms representing 45% of the stock market.[22]

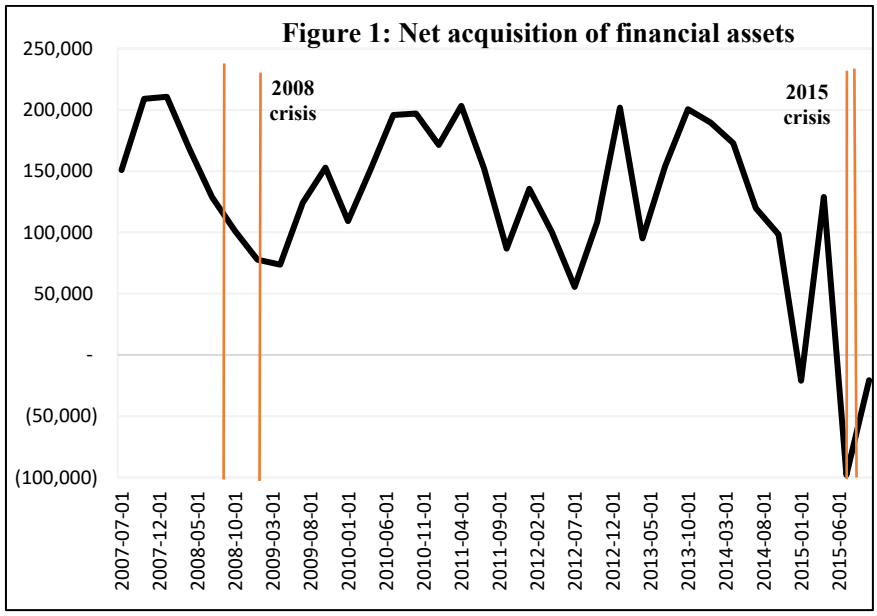
3.3. Comparison of the 2008 and 2015 market interventions

A critical factor that differentiates the two crisis events is the rapid expansion of the Chinese economy and markets and the targeted policy reforms (highlighted in Section 3.2). These factors increased the pace of integration of China with the global financial markets. While China was relatively segmented from the global markets during the 2008 crisis (Brooks *et al.* 2009), the later period saw increasing

[10] Source: https://www.economist.com/news/2015/08/24/the-causes-and-consequences-of-chinas-market-crash, accessed January 8, 2019.
[11] Source: https://www.ft.com/content/ec29a8b2-3bf8-11e5-8613-07d16aad2152, accessed January 8, 2019.
[12] Source: https://www.scmp.com/news/article/1828162/china-cuts-interest-rates-reserve-ratio, accessed January 8, 2019.
[13] Source: https://www.investing.com/economic-calendar/pboc-interest-rate-decision-1083, accessed January 8, 2019.
[14] Source: https://www.reuters.com/article/us-china-stocks-factbox/timeline-of-chinas-attempts-to-prevent-stock-market-meltdown-idUSKCN0PI0RC20150708?feedType=RSS&feedName=topNews, accessed January 8, 2019.
[15] *Ibid.*
[16] *Ibid.*
[17] *Ibid.*
[18] Source: https://www.reuters.com/article/china-markets-idUSL3N0ZL03520150705, accessed January 8, 2019.
[19] *Ibid.*
[20] Source: https://www.reuters.com/article/us-china-stocks-factbox/timeline-of-chinas-attempts-to-prevent-stock-market-meltdown-idUSKCN0PI0RC20150708?feedType=RSS&feedName=topNews, accessed January 8, 2019
[21] Source: https://www.reuters.com/article/us-china-stocks-factbox/timeline-of-chinas-attempts-to-prevent-stock-market-meltdown-idUSKCN0PI0RC20150708?feedType=RSS&feedName=topNews, accessed January 8, 2019.
[22] Source: https://www.france24.com/en/20150708-almost-half-chinese-firms-suspend-trading-market-dives, accessed January 8, 2019.

interconnectedness among its institutions leading up to the 2015 crisis (Wang *et al.* 2018; Fang *et al.* 2018). Furthermore, the likely outcome of these trends was the shift in the investor base from being predominantly individuals in 2008 to a higher proportion of institutions in 2015. Other than the policy reforms, other factors such as the increase in financial leverage, lackluster corporate earnings, unsustainable corporate debt and overvaluation in equity pricing meant that the bubble in the Chinese market leading to the correction in 2015, was not sustainable (Bendini, 2015; Liang and Zhang, 2016; Liu *et al.,* 2016). Furthermore, the Chinese regulators suffered from overconfidence from the previous success in resolving the 2008 crisis and did not initiate far-reaching adjustments to domestic macro-economic disequilibrium and structural deficiencies (Xia, 2008).

Capital outflow can also accompany turbulence, which can spread negative sentiments in the general economy and pose severe problems to policymakers (Stanley, 2018). The evidence in China shows that while the net acquisition of financial assets declined during 2008, it remained positive, pointing to the success in financial controls in stemming the outflow. However, this was not the case in 2015, where the flow of capital despite interventions remained negative during the post-event period. Thus, 2015 was making a "perfect storm" for China – not only were its financial markets much more integrated with the global economy, loosening the grip of domestic regulators, but the frictions and the inefficiencies in the financial systems also remained deeply entrenched.



Note: The figure depicts the Balance of Payment: Net capital flow from China (US$), not seasonally adjusted
Source: OECD/FRED

4. Methodology and data

To test the effectiveness of intervention policies in China during the 2008 and 2015 stock market correction, we follow these steps. First, we gauge the success of these measures by applying an event study method, from the seminal work of Brown and Warner (1980), to analyse the behaviour of abnormal market returns (AR) and its volatility during and after the intervention. Second, we examine the volatility of the market based on the Markov-Regime Switching (MRS) model to identify the association of the post-event period with regimes of high or lower volatility. Third, we then determine the extent of integration of China with the global market by applying cointegration tests and the dynamic conditional correlation model. Finally, a regression model assesses the impact of the dynamic conditional correlations and market interventions on abnormal returns, controlling for confounding variables. Our study uses market indices data from the *FactSet* database. The *MSCI China* and *MSCI World* index are priced in the Renminbi (RMB) and US$, respectively. In order to check the robustness of these results, we also repeat our analysis by using the same currency (US$) for both indices.

4.1. Event study: Abnormal returns and their conditional volatility

In order to determine the effectiveness of China's policy interventions during the 2008 and 2015 stock market crises, we use event methodology, which is widely used in the finance literature to measure impacts after a key event (Draper and Paudyal, 2008; Gregory and O' Donohoe, 2014; Fiordelisi and Galloppo, 2018). This entails analysing the behaviour of AR and cumulative abnormal returns (CAR) and their volatilities before the interventions, during the interventions and post-interventions. If the abnormal returns are higher (lower) and their conditional volatility is lower (higher) during and after interventions, then this indicates the success (failure) of the interventions.

The periods (or windows) for the event study are:

2008 market crisis

(Estimation window)	(Pre-event)	(Event)	(Post-event)
Sep 20, 2007-June 23, 2008	June 24-Sep 17, 2008	Sep 18, 2008-Nov 9, 2008	Nov 10, 2008-Feb 6, 2009

2015 market crisis

(Estimation window)	(Pre-event)	(Event)	(Post-event)
July 1, 2014-April 1, 2015	April 2, 2015-June 26, 2015	June 27, 2015-July 8, 2015	July 9, 2015-Oct 1, 2015

Note: The event period corresponds to the market decline and the intervention efforts. The estimation, pre-event and the post-event period comprises of 60, 30, and 30 days, respectively.

Abnormal Returns and Cumulative Abnormal Estimation

We use three methods to estimate abnormal returns (AR): (a) Market Model (MM)[23] (b) Market Adjusted Return Model (MAR) (c) GARCH (1,1). AR is defined as the excess of realized or actual returns over expected or predicted returns. Based on the Market Model of MacKinlay (1997), the AR is expressed as *ex-post* return of the market index less the normal return of the event window, depicted as:

$$AR_{x,t} = R_{x,t} - \beta R_{m,t} - \alpha \quad (1)$$

where $AR_{x,t}$ = abnormal returns at time *t*; *x* = *MSCI China* index; β = linear regression estimate for the pre-event period; $R_{x,t}$ = realized returns; α = constant; $R_{m,t}$ = world market return at time *t*; *m* = *World MSCI* index.

As a robustness check and following several studies that use abnormal returns (Kutan *et al.,* 2012; Madsen and Zachariah, 2015; Fiordelisi and Galloppo, 2018), we use the Market Adjusted Return (MAR) model along with the Market Model. Under the MAR model, the AR is simply the difference between the realized return and the world market return, where the β in equation (1) is equal to 1 and the constant α is set to 0. According to Fuller *et al.* (2002), such a model might be useful when policy measures might overlap during the event period.

The cumulative abnormal return (CAR) or the aggregated abnormal returns take into account the overall influence of the event, estimated as:

$$CAR\ (t_1, t_2) = \sum_{t=t1}^{t2} AR_{i,t} \quad (2)$$

where the event window comprises 2 days starting from $t_1 = -1$ and $t_2 = 0$.

Volatility of Abnormal Returns

We apply the Generalised Autoregressive Conditional Heteroscedasticity or the GARCH (1,1) model of Bollershev (1987) to analyse the conditional volatility of AR. This method overcomes the estimation issues with the Ordinary Least Squares (OLS) due to heteroscedasticity because of extreme tail events in the data[24] – in particular, the variation in volatility across the time period can have a severe impact on beta. This involves estimating first the conditional mean of AR by:

$$\overline{AR_t} = \rho AR_{t-1} + \epsilon_t \quad (3)$$

[23] The Market Model remains a popular choice in the literature to measure the equity market's efficiency over other methods of expected returns such as the Capital Asset Pricing Model (CAPM) introduced by Treynor (1961), Fama and French (1996) three-factor model and the Carhart (1997) four-factor model. CAPM was commonly used as a method for abnormal returns in the past. However, evidence shows deviations from the CAPM that casts doubt on its validity of the restrictions that can be relaxed using the Market Model (Cambell *et al.,* 1997). For example, a major criticism of the CAPM model stems from the uncertainty of the relationship between market betas and the stock returns (Fama and French, 1992, 1996; MacKinlay, 1997). The other alternatives, such as the multi-factor models such as Fama and French and Carhart model, adds unnecessary complexity to the event study methodology and offer no advantage over unrestricted models such as the Market Model (Cambell *et al.,* 1997; Ahern, 2009). A study by Cable and Holland (1999) tests the choice of model for normal returns in event studies and finds that the Market Model outperforms the other models such as the CAPM and the Mean Adjusted Returns Model. Dyckman *et al.* (1984) also confirm the advantage and simplicity of the Market Model when comparing event study methodologies.

[24] The JB test of normality and skewness and kurtosis indicate extreme tail events in the data.

where ρ = abnormal return coeffiecient and $\epsilon_t \sim (0, \sigma_t^2)$

The conditional volatility of AR is estimated as:

$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \quad (4)$$

where ω = constant term; α_1 = ARCH term; α_2 = GARCH term; σ_t^2 = conditional volatility of the AR. Furthermore, we estimate the cumulative GARCH CAR, which is the sum of all abnormal returns.[25] Before estimating the conditional volatility of AR, we test the data using the Jarque-Bera test – see Table 1 in the Appendix and reject normality conditions. Secondly, we test for heteroscedasticity conditions using ARCH-LM test and detect the presence of ARCH effects (Table A.1, Appendix).

4.2 Further Analysis of the Volatility of Returns - Markov Regime Switching Model

The MRS model of Hamilton (1989) can determine if the high or low volatility regimes followed market interventions. Several studies use this model to assess volatility, market sentiments and correlation switching regimes (Ang and Bekaert, 2002; Gravelle *et al*., 2006; Kasch and Caporin, 2013). The model is estimated:

$$y_t = \alpha_i + \beta_i x_{i,t} + \epsilon_t \quad (5)$$

$$\epsilon_t \sim N(O, \sigma_{s_t}^2) \quad (6)$$

where y_t = time series generated with regime switching variance; β_i = coefficient; i = Chinese equity index

$\sigma_{s_t}^2$ = variance of the state s_t; The state s_t is based on N-state Markov chain and the transitional probabilities are calculated as:

$$P(s_t = i \mid s_{t-1} = j, s_{t-2} = q \ldots.) = p_{ij} \quad (7)$$

4.3. Linkage between China and Global Markets - Dynamic Conditional Correlations

The DCC estimates the linkages between China and other international markets. Engle (2002) prefers this method to unconditional correlations, which can suffer from heteroscedasticity issues. The model is constructed as:

$$H_t = \sqrt{D_t} \sqrt{D_t} R_t \quad (8)$$

$$R_t = diag\ (Q_t^{-1/2})\ Q_t\ (Q_t^{-1/2}) \quad (9)$$

$$Q_t = (1 - a - b)\bar{Q} + aZ_{t-1}\, Z'_{t-1} + bQ_{t-1} \quad (10)$$

[25] Further robustness to the measure is provided by calculating the t-test to observe if H0: $CAR\ (t_1, t_2) = 0$; $t_{CAR} = \frac{CAR}{S_{CAR}}$; where S_{CAR} is the standard deviation of the CAR in the estimation period.

where H_t = time-varying multivariate conditional covariance; D_t = diagonal matrix of conditional variances; R_t = matrix of conditional quasi correlations; Q_t = time-varying covariance matrix; $\bar{Q} = \{\overline{q}_{ij}\}$ the unconditional covariance matrix of Z_t.

According to the theory of pure contagion, the likelihood of a high correlation during the market crisis period is higher than that during other times (Masson, 1999). Such occurrences are likely due to the prevalence of panic, risk-aversion and negative sentiments amongst market participants (Shen *et al.,* 2015). Furthermore, herding behaviour amongst investors can increase such linkages between markets (Khan and Park, 2009). Empirical studies such as Mollah *et al.* (2016) documents the spread of contagion from the US to other markets during the GFC.

4.4. Policy Interventions and China's Global Market Linkages - Regression model

We test the impact of China's global market linkages on the success of its policy interventions during the 2008 and 2015 crises using a regression model. In this model, we use AR as a proxy variable for the effectiveness of policy interventions and DCC as a proxy for linkages. We then test the relationship between the two, along with other control variables. A negative relationship between the two variables will imply that increasing global integration negates the potency of market intervention measures. The regression model is specified as follows:

$$Y = f\ (x_i);\ \forall\ i = (1, \dots, 5) \qquad (11)$$

where Y = GARCH CAR = 1 if positive or 0 otherwise. To provide further robustness, we repeat the model by taking the absolute value of GARCH *CAR*. Table 3 describes the independent variables (x_i).

Table 3: Regression variables

Variable	Description	Expectation of the sign	Data source
x_1	correlation between the Chinese and the world equity index	Negative	Calculated by the authors
x_2	univariate conditional variance in the Chinese equity index (Equation 4)	Negative (Schwert, 1989; Ang *et al*., 2009; Chung and Chuwonganant, 2018); Ma *et al.*, 2018)	Calculated by the authors
x_3	volume in the Chinese market index	Positive / Negative (Lee and Rui, 2002; Patra and Poshakwale, 2006)	FactSet
x_4	change in the Chinese industrial production index	Positive (Hosseini *et al.*, 2011; Mahedi, 2012)	OECD
x_5	market intervention (1 if Yes, 0 if No)	Positive	Calculated by the authors

5. Empirical Results

5.1. Effectiveness of market interventions

5.1.1 Abnormal returns and conditional volatility

We proxy the effectiveness of market intervention by estimating the CAR before, during, and after the event period using all the three methods – Market Model, Market Adjusted Return Model and the

GARCH(1,1) Model. If the CAR increases after the event period, then it signals the success of the measures and vice versa. During the 2015 crisis, the Chinese market suffered declines in half of the trading days during the pre-event period leading to the intervention or the event period. The event period experienced an average daily decline of over 2%, with stocks declining 1%, 6%, 3% and 6% on July 2, 6, 7 and 8, respectively (Figure A2, Appendix). The post-event period started with an uptick in the stock market. However, the declines continued with 34 trading period losses during this period (Table 4). The abnormal returns confirm the lackluster impact of interventions during the 2015 crisis. While 53% of the trading days in the pre-event period reported negative ARs, the results were even worse during the post-event period, with almost 57% reporting negative values. The average abnormal returns also remained negative during the post-event period, confirming that the market did not respond positively to the interventions. Also, while the CAR responded positively during 2008, they depicted a negative trend in the post-event period during the 2015 crisis (Figures 2a and 2c). In order to confirm the robustness of these results, we repeat the analysis using only US$ as the currency (Figures 2b and 2d). We find no significant changes in trends in CAR arising out of this additional analysis.

The stock market volatility is synonymous with the scale of turbulence – higher volatility means higher variations in returns and vice-versa. Volatility is likely to accompany periods of market correction (Claessens and Forbes, 2004; Kearney and Lucey, 2004; Zhou, 2012; Fry-McKibbin, 2014; Gofman, 2017). Results show that the volatility in the Chinese market continued to spike in August and September after the event period in 2015, whereas the volatility fell during a similar period in 2008 (Figures 3a and 3b). Unlike 2008, the interventions during the 2015 crisis could not calm the spikes in the volatility, i.e., the measures did not have a lasting and sustainable impact. Thus, the intervention policies reduced the volatility in 2008 but failed to do so in 2015. Notably, the trends in volatility remain the same when pricing the index in local currency and US$

Table 4: Abnormal returns

	2008 market crisis					**2015 market crisis**				
	Positive AR		Average AR			Positive AR		Average AR		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	# of days	%	Market Model	MAR Model	GARCH(1,1)	# of days	%	Market Model	MAR Model	GARCH(1,1)
Pre-event	25	42%	-0.0023	-0.0032	-0.0026	28	47%	0.0000	**0.0006**	0.0000
Event	17	45%	0.0044	0.0032	0.0042	1	14%	-0.0225	**-0.0191**	-0.0223
Post-event	31	52%	0.0026	0.0042	0.0024	26	43%	-0.0012	**-0.0223**	-0.0012

Notes: For each of the market crisis:

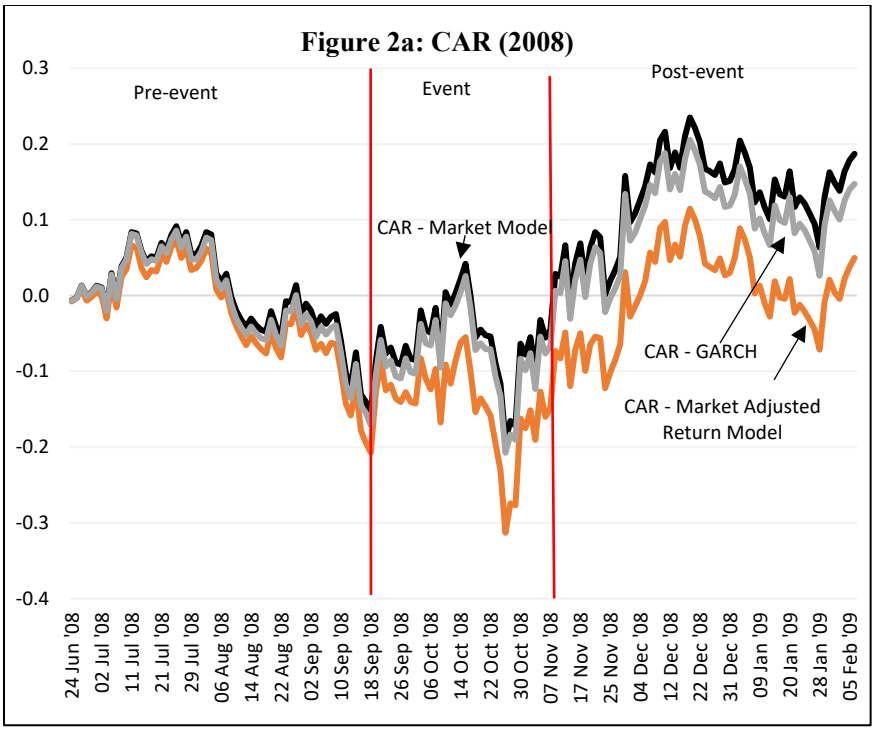
(1) The columns (1), (2), (6) and (7) display the number of days and percentage of days with positive AR in each period. The results were the same for all three methods.

(2) The columns (3) and (8) report the average AR using the Market Model.

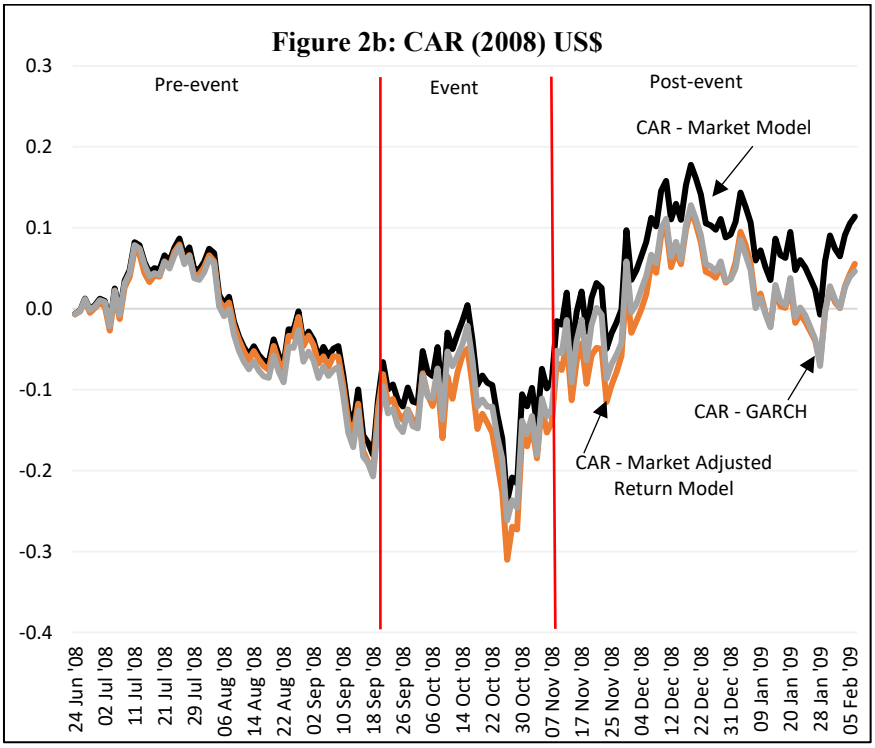
(4) The columns (4) and (9) report the average AR using the Market Adjusted Return Model.

(5) The columns (5) and (10) report the average using the GARCH(1.1) model.

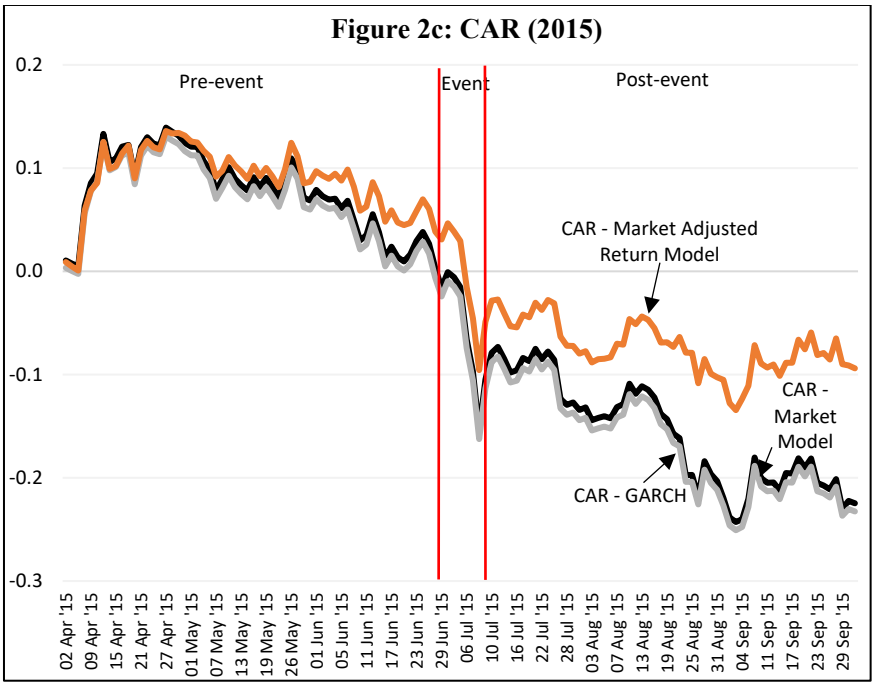
(5) The t-test is used to test if H_0: $CAR\ (t_1, t_2) = 0$, with results showing rejection of the null hypothesis for most event days – due to space constraints, the test results are not presented.



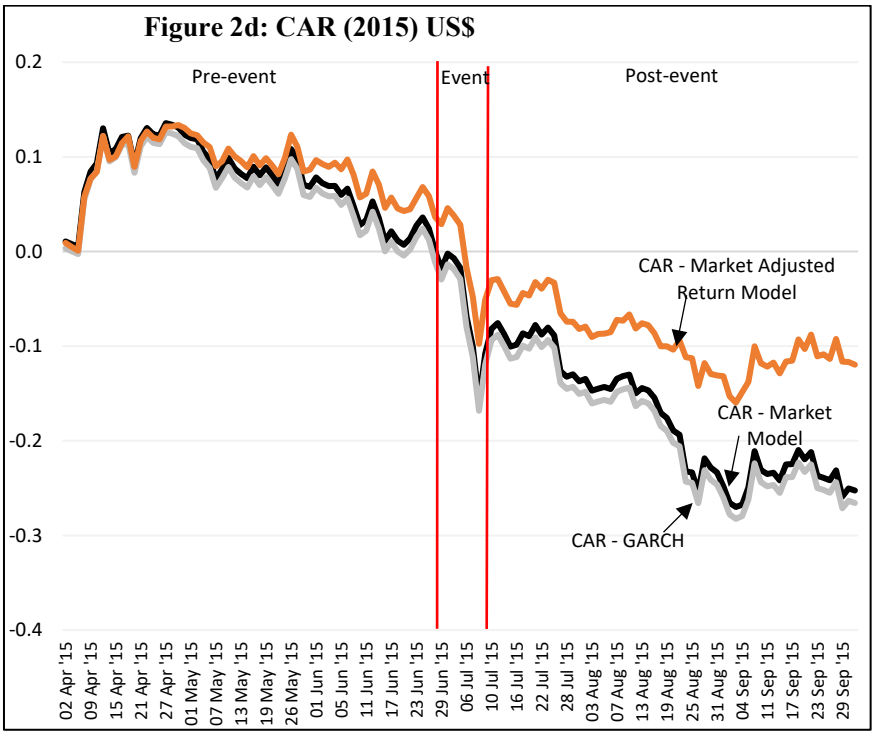
Note: The figure depicts the cumulative abnormal returns for the *MSCI China* index using GARCH (1,1), Market Model and the Market Adjusted Return Model. The increase in the CARs during the post-event confirms the success in the interventions in reversing the negative trend observed during the pre-period.
Source: FactSet



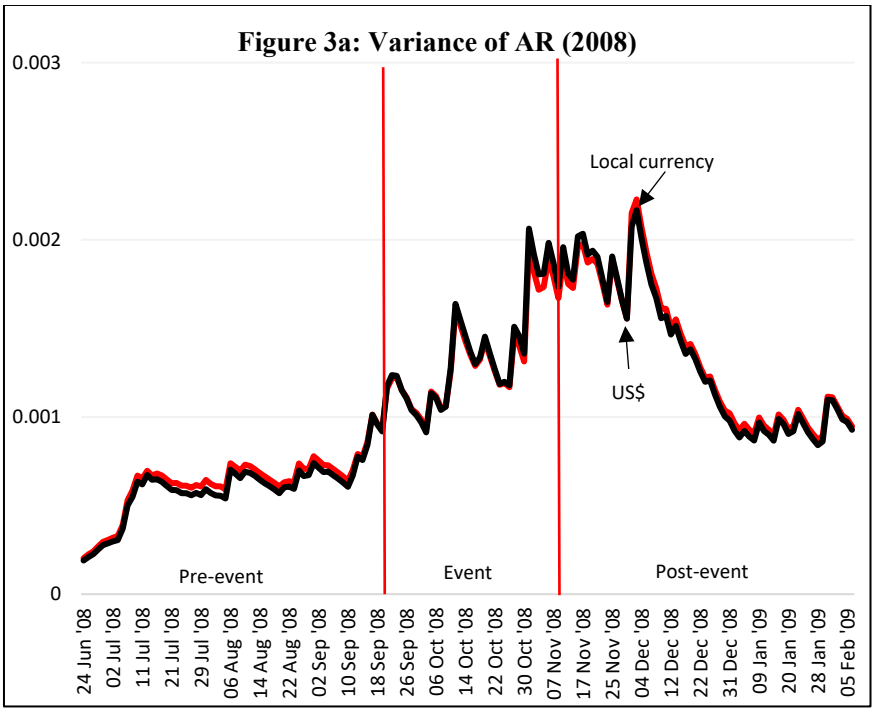
Note: The figure depicts the cumulative abnormal returns for the *MSCI China* index using GARCH (1,1), Market Model and the Market Adjusted Return Model using US$. The trends remain the same as in Figure 2a.
Source: FactSet



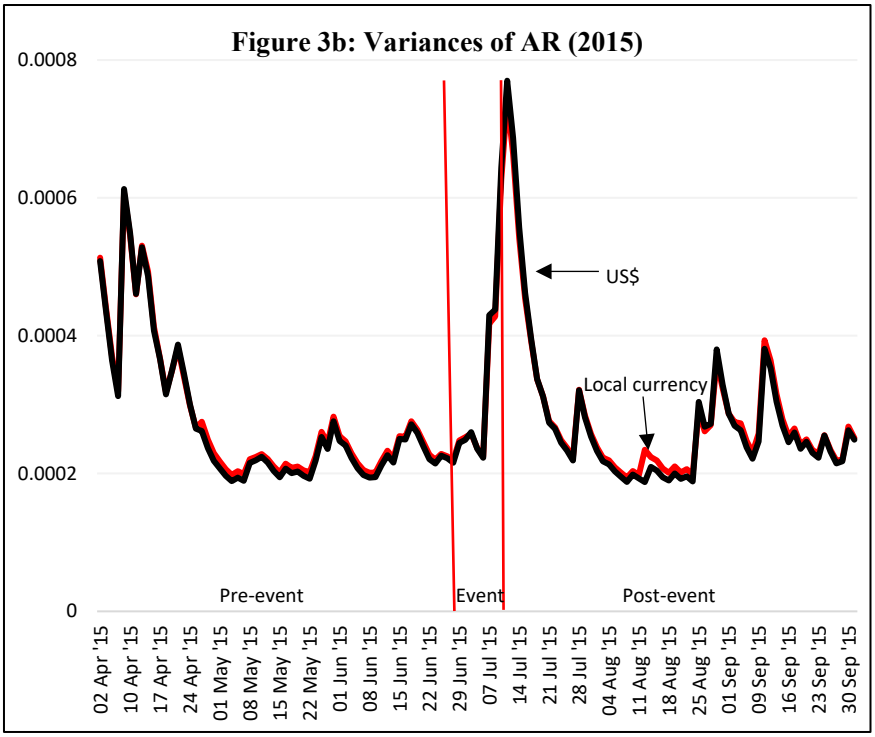
Note: The figure depicts the cumulative abnormal returns for the *MSCI China* index using GARCH (1,1), Market Model and the Market Adjusted Return Model. The decreasing CARs during the post-event show that the interventions were unsuccessful in reversing the declining trends noticed during the pre-event and the event periods.
Source: FactSet



Note: The figure depicts the cumulative abnormal returns for the *MSCI China* index using GARCH (1,1), Market Model and the Market Adjusted Return Model using US$. The trends remain the same as in Figure 2c.
Source: FactSet



Note: The figure depicts the variances in the abnormal returns for the *MSCI China* index - the noticeable declines in the post-event period show the success of the interventions.
Source: FactSet



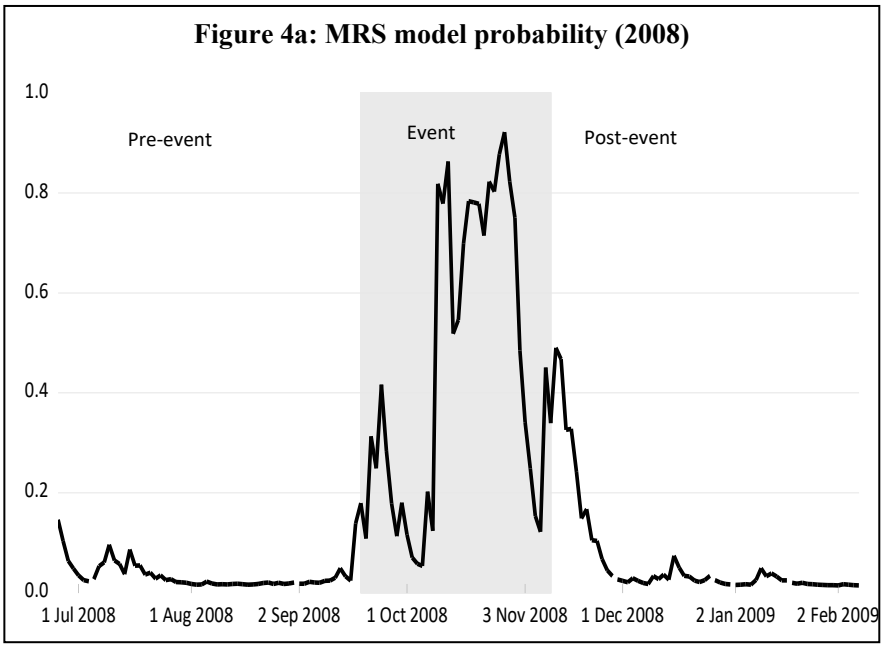
Note: The Figure 3b depicts the variances in the abnormal returns for the *MSCI China* index. While the peak subsides in the event period, several spikes occur during the post-event period.
Source: FactSet

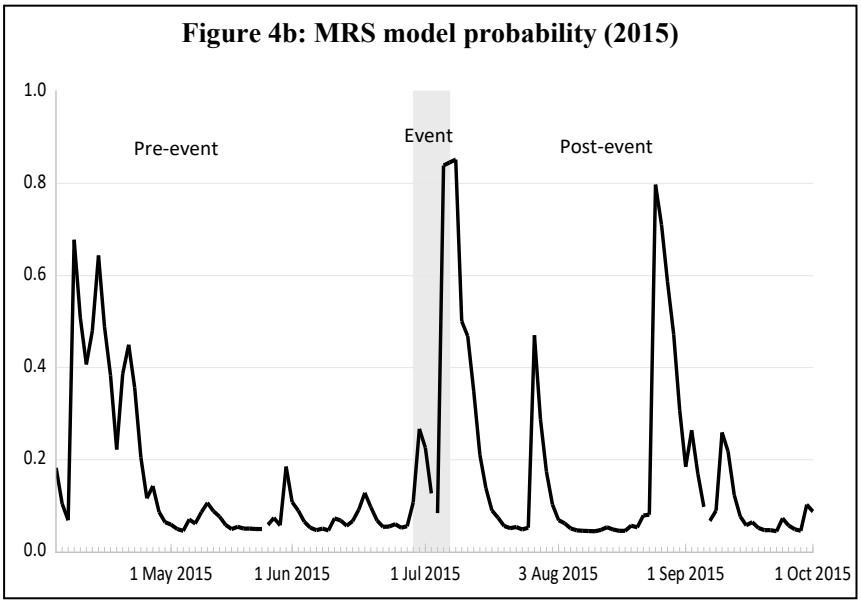
5.1.2 Markov Regime Switching Model

The MRS model provides further evidence of volatility after the end of the market turbulence. The results can aid in answering the following question: *after the event period, was the market associated with a high or a low probability regime?* It is crucial to estimate the probability of volatility as it can hurt stock market returns (Chung and Chuwonganant, 2018; Ma e*t al.,* 2018). Thus, if high volatility is evident in the post-event period, markets are likely still struggling, depicting a failure of the intervention efforts.

Figures 4a and 4b plot the probabilities of the high volatility regime (Regime 2) for the 2008 and 2015 market crises, respectively. During the 2008 crisis, the probability of the regime of high volatility was at its peak in October, but fell after the event period, i.e., the interventions reduced market volatility. However, the probability of high volatility remained elevated during the post-event period, during the 2015 crisis, as noted by significant peaks. Thus, the MRS results provide further evidence that the interventions in 2015 failed to reduce market volatility as they likely suffered from poor timing and were not extensive enough to calm the market.

Figure 4a: MRS model probability (2008)





Note: The Figures 4a and 4b depict the regime of high volatility

5.2. The extent of China's global market linkages

We test for long-run linkages between China and the global equity index using cointegration tests and find no evidence of such relationships (Table A.2, Appendix). However, the ongoing market reforms in China and its growing role in global trade is likely to increase its relationships with other equity indices, at least in the short run, which can be measured by estimating the DCC GARCH (1,1) conditional correlations between China (*MSCI China* index) and the global market (*MSCI World* index).[26] The shocks from the international equity index were more likely to influence *China* index than vice versa since $\alpha_{China,\ World} < \alpha_{World}$ (Table 5). However, volatility transmission from the Chinese market was more likely to impact other world markets than vice versa ($\beta_{China,\ World} > \beta_{World}$) The results support the theory of pure contagion, which indicates that irrationality, herding and negative sentiments increase amongst global investors during times of market crisis (Masson, 1999; Khan and Park, 2009; Shen *et al.*, 2015).

Table 5: DCC GARCH (1,1) estimates

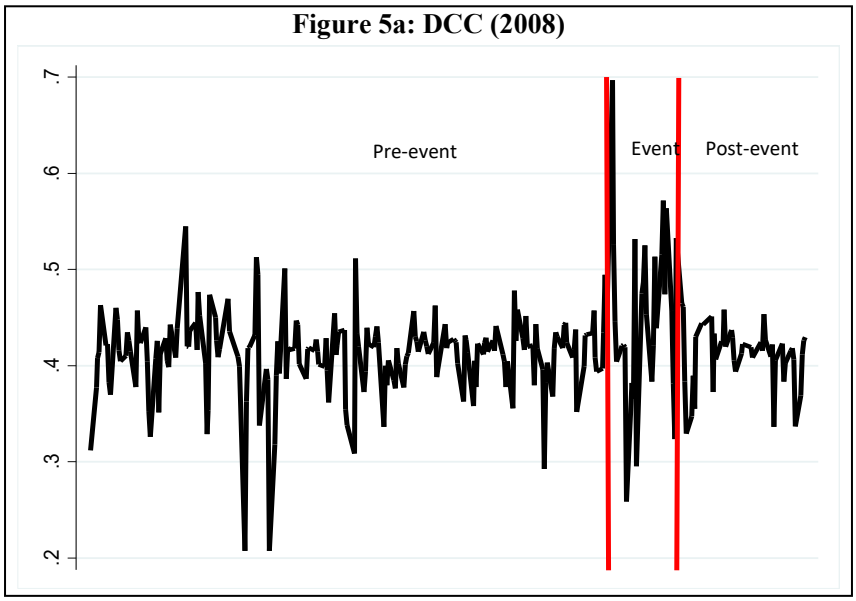
	2008	**2015**
$\alpha_{China,\ World}$	0.0743	0.1289
α_{World}	0.0871	0.2272
$\beta_{China,\ World}$	0.8937	0.8144
β_{World}	0.4539	0.5841
ω_{China}	0.0000	-0.0013
Ω_{World}	0.0001	0.0000
Likelihood	4563.9390**	777.8455***
Conditional correlations	-0.0183	0.4493***

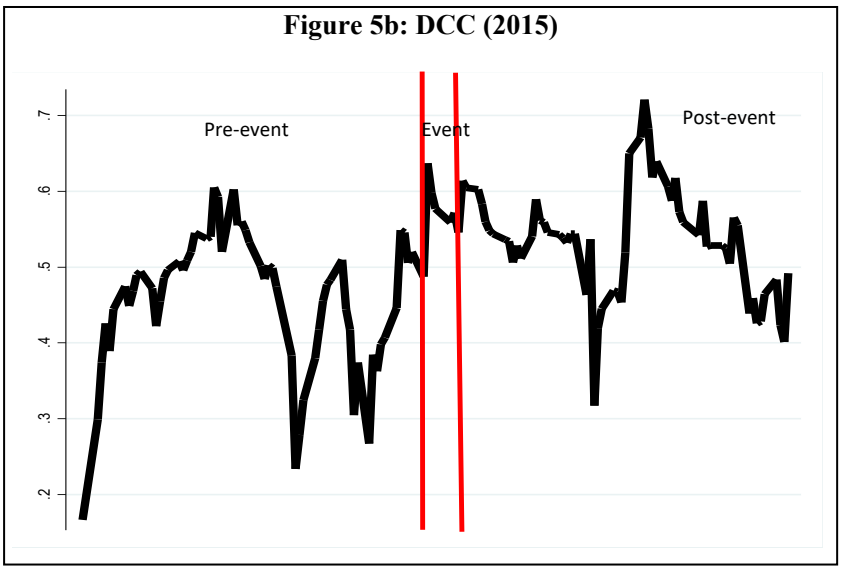
Notes: (1) ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.
(2) $\alpha_{China,\ World,}$ and α_{us} refer to the ARCH effect.
(3) $\beta_{ChinaA,\ ChinaB,}$ and β_{us} refer to the GARCH effect.

[26] To provide robustness, ARCH LM test rule out any remaining ARCH effects in the residual. Because of the space limitation, we do not present the results in the paper.

Time-variant connections are likely to increase during times of a market crisis (Bekaert, 2005; Caporale *et al.,* 2005; Kizys and Pierdzioch, 2009). King *et al. (*1994) document the increasing interconnectedness in developed, and Bekeart, and Harvey (1997) in the emerging markets. Our results indicate that the linkages between the Chinese and the global equity index were much higher during the time-period related to the 2015 crisis compared to the earlier event. The average conditional correlation estimates were negative during the 2008 event but positive in 2015, displaying tighter linkages (Table 5). Interestingly, the time-variant correlations between China and the global equity market increased in the pre-event and the event in 2008 but declined in the period after (Figures 5a and 5b). However, this was not the case for the 2015 crisis, where the conditional correlations continued to increase in the post-event period. The results exemplify the phenomenon that the increasing integration of China with the international economy increased stock market linkages, and support studies such as Burdekin (2012), which find that despite capital controls, the Shanghai index experienced an increasing level of integration with other regional and global markets.

Figure 5a: DCC (2008)





Note: Figures 5a and 5b depict the dynamic conditional correlations between the *MSCI China* and *MSCI World* index (the red lines depict the event period). The 2008 market crisis display a relatively flat trend in the correlations, whereas a noticeable increasing trend occur over the three event periods in 2015.
Source: FactSet

5.3. Globalisation of China's financial markets

The globalisation of China's equity markets is a by-product of its increasingly dominant role in international trade and the significant scale of its domestic economy. In order to delineate the impact of internationalisation on intervention efforts, it is beneficial to illustrate the ongoing reforms. The intentions of the market liberalisation initiatives, which sped up post-2008, were to facilitate China's integration with the global financial system and improve efficiencies.

5.3.1 Market reforms

The changing dynamics of the Chinese financial market due to targeted policy reforms preceded the 2015 stock collapse. For example, during the 2013 Third Plenum, President Xi Jinping laid out his commitment to making the financial markets more open and transparent, supported by a reform agenda called the *Decision on Major Issues Concerning Comprehensive and Far-Reaching Reform* (Bendini, 2015). During the period before the crisis event, the government started several policy measures to liberalise the market and increase its integration with the global economy (Table 6).

Table 6: Financial market reform measures

2002	Qualified Foreign Institutional Investors (QFII) scheme allows foreign institutional investors who met specific qualifications to invest in select cross-border securities products.
2010	Approval of short sale and equity margin trading (Feng *et al.,* 2017).
2011	Approval under QFII to invest in stock index futures.
2011	RMB Qualified Foreign Institutional Investors (RQFII) scheme permits the Hong Kong subsidiaries of domestic fund management companies and securities companies to invest in the domestic Chinese securities market with funds raised in Hong Kong.[27]
2012	RMB exchange rate reform of increasing the daily fluctuation of the currency spot exchange rate against US$ by up to 1% (Xiaoyi, 2011; Yao *et al.,* 2018).
2012	Increase in the quota for the RQFII scheme US$80 billion.[28]
2013	Increase in quota for the RQFII to US$150 billion. [29]
2013	Third Plenum of the Chinese Communist Party National Congress declaration to allow the market to play a prominent role in the economy.[30]
2014	Increase in the daily fluctuation of the currency spot exchange rate against the US$ to 2% (Xiaoyi, 2011; Yao *et al.,* 2018).
2014	Launch of the "Shanghai-Hong Kong Stock Connect" mutual market access program to allow mutual investment2 of shares between the two exchanges[31] - a significant step in the liberalisation of China's capital account and bridged the gap in pricing between A shares on exchanges in the mainland and B shares in Hong Kong (BIS, 2014).
2015	Increase in the daily fluctuation of the currency spot exchange rate against US$ to 3% (Xiaoyi, 2011; Yao *et al.,* 2018).
2015	Stock listing reform to permit bourses to be responsible for IPO approval instead of the CSRC.[32]
2015	Permission to local financial institutions to invest in the Hong Kong stock markets (Bendini, 2015).

Although the financial market liberalisation started with the QFII initiative in 2002, allowing limited foreign investment in the domestic securities in 2002, the pace of the reforms increased from 2010. The intent of these measures, along with foreign exchange rate reforms, was to improve efficiency and to bring China closer to the international markets. The QFII and RQFII played a vital role in integrating China into the global financial systems (Yao *et al.,* 2018). However, some of these measures led to unintended negative consequences. For example, approving the short sale and equity margin trading along with increased borrowing through official and unofficial channels such as "changwaipeizi" contributed to a rapid increase in the stock market bubble (Jing, 2015). This policy reform dramatically increased average market volume reaching a peak on June 18, 2015, contributing to equity mispricing, which led to the 2015 crisis (Liu *et al.*, 2016).

Over time, China also pushed towards loosening its control over its currency, making it vulnerable during equity market turbulence (Stanley, 2008). Other than the reform initiatives by the government, a differentiator in 2015 was the rapid development of financial markets. For example, by 2014, the Federal Stability Board (FSB) included Chinese financial institutions such as the Agricultural Bank of China, Bank of China, Industrial and Commercial Bank of China Limited in the list of systematically critical

[27] Source: http://english.sse.com.cn/investors/qfii/what/, accessed January 8, 2019.
[28] Source: http://www.csrc.gov.cn/pub/csrc_en/newsfacts/release/201308/t20130815_232696.html, accessed January 8, 2019.
[29] *Ibid.*
[30] Source: https://www.chinabusinessreview.com/the-third-plenum-of-the-18th-chinese-communist-party-congress-a-primer/, accessed January 8, 2019.

[31] Source: https://www.hkex.com.hk/news/news-release/2014/141117news?sc_lang=en, accessed January 8, 2019.
[32] Source: http://www.china.org.cn/business/2015-12/27/content_37406429.htm, accessed January 8, 2019.

international banks.[33] China's financial markets also experienced a tremendous increase in scale – it ranked second in terms of global market capitalization, with its global share increasing from 1.5% in 2003 to 10.5% in 2016.[34]

5.3.2 Impact of increased globalisation on the effectiveness of market interventions

The regression model represented by Equation 11 assesses if the increase in linkages affected the efficiency of policy interventions, controlling for other confounding factors. The VIF test rules out multicollinearity amongst the independent variables (Table 7). The time-varying correlations had a negative and significant impact on abnormal returns during both events (Table 8). Thus, the increasing globalisation of the Chinese equity markets reduced the efficacy of the interventions. However, the impact was higher in 2015, due to the bigger coefficient. Market interventions had a positive coefficient in 2008 but a negative one in 2015, confirming that they were not effective in the later period. The results are similar to other studies, which find that integrated markets pose challenges to intervention efforts (Angkinand *et al.,* 2009; Boubaker *et al.,* 2016). With China, the global crisis event and the lottery-like behaviour of the predominant investor base led to the stock market correction in 2008. However, the decline in the equity index in 2015 resulted from asset bubble correction and the imperfections in the market, which, despite the reforms, were well entrenched in the financial eco-system. Previous studies such as Bendini (2005) and the detailed discussion of the reforms in Section 5.3.1 support the changing market dynamics in China. These reforms, essential and well-intended, while not enough to remove the inefficiencies in the market, were counterproductive and did not correct declines. For example, the shadow banking in China and other inefficiencies in the capital markets were a likely contributor to the asset bubble before the crisis in 2015 (Wang *et al.* 2018; Xia, 2018). Studies such as Boyd and Smith (1992) and IMF (1998) also support the relationship between market imperfections and higher volatility during crisis events. Furthermore, the overreaction of Chinese investors, coupled with lesser capital controls, affected the efficiency of the interventions supporting evidence provided by Liu *et al.* (2016). Overall, the results support the hypothesis that increasing linkages between China and global equity markets, an outcome of reforms, reduced the success of intervention efforts during times of crisis. We lend support to the "globalization hypothesis," which states that the international integration process increased the vulnerability of the domestic markets (Bakaert *et al.*, 2011).

[33] Source: http://www.fsb.org/wp-content/uploads/r_141106b.pdf, accessed January 8, 2019.
[34] Source: http://www.businessinsider.com/world-stock-market-capitalizations-2016-11, accessed January 15, 2019.

Table 7: Multicollinearity test

Independent variables	2015	2008
x_1 (conditional correlation)	3.090	1.1159
x_2 (volatility)	2.030	1.4467
x_3 (volume)	2.461	2.0683
x_4 (industrial production)	2.741	1.3910
x_5 (market intervention)	2.731	2.5833

Note: The Variance Inflation Factor (VIF) test is used to detect multicollinearity, with a value higher than 4 indicating multicollinearity.

Table 8: Regression model results

Independent variables	2015	2008
x_1 (conditional correlation)	-0.7295***	-0.6063***
	(-2.44)	(-2.65)
x_2 (volatility)	80.6622	-589.6294***
	(0.87)	(-2.35)
x_3 (volume)	-0.0035*	0.0000***
	(-1.81)	(3.50)
x_4 (industrial production)	0.0428	-0.0012
	(0.43)	(-0.48)
x_5 (market intervention)	-0.8752***	0.4927***
	(-16.83)	(5.97)
c	-3.1545	0.8775*
	(-0.30)	(1.98)
R^2	0.7740	0.4417
Adjusted R^2	0.7646	0.4233
F-statistic	82.8645***	24.0468***
Wald F-test	179.1882***	39.6547***

Notes: (1) ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.
(2) The regression model uses Huber-White-Hinkley (HC1) heteroscedasticity-consistent standard errors.
(3) The t-statistics are in brackets.

6. Conclusion

The financial crisis remains a key risk for policymakers, given the impact on the broader economy and the possibility of negative sentiments and volatility transmission to other global markets. The concern has become critical as China experiences regulatory reforms and an increase in linkages with other markets, a consequence of growing intercontinental trade. The GFC crisis of 2008 and the 2015 market turbulence tested the strength of the intervention policies in China, with the latter event failing to deliver favourable results. We test the hypothesis that China's growing integration with global financial markets impacts the effectiveness of local interventions using an event study method combined with dynamic conditional correlation (DCC GARCH) and MRS models.

The results support our hypothesis. We find a contrast between the two interventions – while the actions in 2008 led to a positive reaction from the market; such was not the case in 2015. The abnormal returns respond positively to efforts in 2008 with the variances in return subsiding, leading to reversals in volatility spikes and negative sentiments in the market. However, the post-event abnormal returns in 2015 stay negative with the spikes in variances occurring after the end of the intervention. Noticeably, unlike 2008, the time-varying DCC correlations were higher during 2015, showing an increasing trend, with no reduction in the post-event period. Unlike 2008, the MRS model finds that the interventions in 2015 did

not correspond to the probability of high volatility and that such volatility was likely to occur in the post-event period. The regression model reinforces the support for our hypothesis as we detect conditional correlations to be a significant and negative determinant of abnormal returns, with a higher impact in 2015. We attribute the failure in the later crisis event to increasing integration with global markets and ongoing reductions in controls in the Chinese financial systems. Although the structural reforms made the domestic market closely aligned with the international market, it likely hurt the success of the interventions. Thus, China was the victim of its own making and perhaps did not have a choice, as its export-oriented economy needs its financial markets to assume a global character.

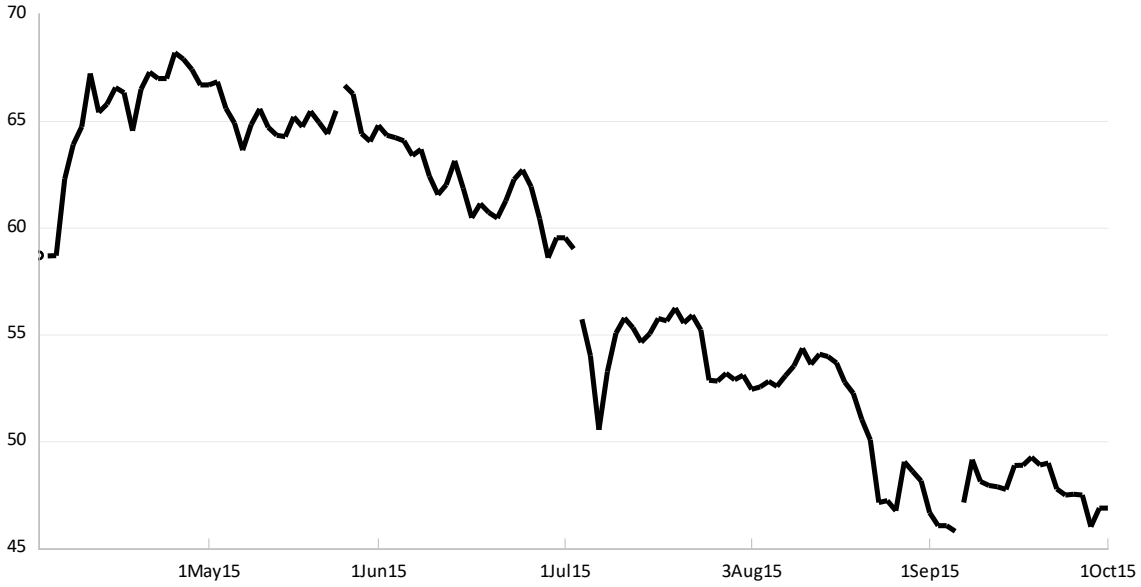
The impact of growing financial linkages between China and the global economy on its local market interventions is critical to assess as its success or failure can have worldwide implications. China has not only emerged as the second-biggest economy in the world with its stock market capitalization rivaling that of the biggest global financial market, the US. Any fallout from a financial crisis in China can not only disrupt the 'global factory' and the intertwined networks of trade and supply chain; it can also export volatility to other international indices. Our results have important implications. Given the increasing integration between China and the global financial system and the required reforms, policymakers cannot continue to use localised interventions to stem the future market crisis. A much more globally coordinated intervention effort needs to follow any crisis event not only to restore stability in the interlinked financial market participants and agents but also to reduce any volatility spillovers. There is also an increasingly important role of multilateral organizations such as the IMF to lead such global initiatives.

Declaration of interest: none

Appendix

Figure A.1: MSCI China index (2008)

Figure A.2: MSCI China index (2015)



Source: Factset

Table A.1: Residual Tests

	2008	2015
Heteroscedasticity (ARCH –LM) F-statistic	10.1739***	24.2581***
JB Test of Normality	36.8894***	17.4773***
Skewness	0.5418	0.0245
Kurtosis	5.1046	4.8167

Note: Both ARCH-LM and JB Test are significance at the 1% level

Table A.2: Cointegration Tests

	2008	2015
Engle-Granger Test	-1.7813	-2.4490
Johansen Cointegration Rank Test:		
None (trace statistics)	4.8659	8.9056
At Most 1 (trace statistics)	0.8586	2.5339

Note: The Engle Granger test (Engle and Granger, 1987) shows no evidence of cointegration as we fail to reject the null hypothesis of no cointegration. Furthermore, using the Johansen test (Johansen, 1995), we fail to detect any cointegration equations.

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