

The Spillover Effects of Major Chinese Macro-Economic Announcements on Regional Stock
Markets

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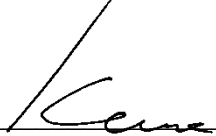
Abstract

The advancement of the Chinese economy into the world's second largest advocates a need to better understand how macro-economic events flow onto interconnected regional economies. This research aims to investigate the announcement spillover effects of Chinese economic indicators on major stock indices in the Asia–Pacific region from January 2011 to December 2017. Using intraday financial data, official Chinese macro-economic announcements and Bloomberg analyst market consensus data, this study examines the extent of interconnectivity between China and surrounding nations. More specifically, announcements are divided into five groups based on release time, and regional index futures markets include Japan, Australia, Korea, Hong Kong, Taiwan and Thailand. Empirical results reveal that the release of gross domestic product, industrial production, exports and imports cause corresponding movements in regional index futures markets. Due to China's recent economic transition from manufacturing to the service industry, the economic significance of the manufacturing Purchasing Managers' Index on regional stock markets is also decreasing.

Keywords: Chinese economy, Cumulative Average Return, macro-economic announcement, spillover effect

Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

(Signed)  _____

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1. Introduction

In the past few decades, fuelled by a rapid and continuous economic growth, China became the second largest economy in the world and has a dominant position as a global exporter and importer. This indicates a need to better understand how Chinese economic news influences stock markets in the Asia–Pacific region, especially economies with a significant trading partnership with China. This study examines the potential spillover effects of 12 scheduled Chinese macro-economic announcements, and provides insights into China’s economic relationship with six neighbouring economies from 1 January 2011 to 31 December 2017. The 12 scheduled macro-economic announcements and corresponding market estimates are categorised into five groups based on release time, and regional index futures markets include Japan, Australia, Korea, Hong Kong, Taiwan and Thailand. Empirical results suggest that gross domestic product (GDP), industrial production (INP), exports and imports induce a conditional mean jump of index futures markets, while the other macro-economic announcements investigated have less contemporaneous intraday effects. Furthermore, due to the underlying transition of structural economic growth (i.e., from manufacturing to service), the manufacturing Purchasing Manager Index (PMI) has a decreasing influence on regional markets and appears to be of little interest to investors more recently.

The efficient market hypothesis (EMH) asserts that financial markets reflect all available information completely, instantaneously and rationally (Fama, 1970). By implication, markets receive both public and private news, and impound all relevant information into asset prices. Private information, by definition, is not accessible to all market participants, and is impossible to monitor and gather in all cases. Therefore, prior literature has dedicated research into investigating the linkage between asset prices and economic fundamentals. The main driving forces of financial market movements are the fundamentals of the corresponding economies, and the changes that are typically

represented by macro-economic announcements, such as GDP or the Consumer Price Index (CPI) or PMI.

A rich body of literature examines how publicly available fundamentals are incorporated into price movements. Prior studies initially focused on the information transmission between the news of one country and one asset class, and has extended to connections between multiple countries and multiple asset classes.¹ With the increasing globalisation of economies, there is growing interest from researchers into investigating the relationships between multiple countries across various asset classes.

The phenomenon of fundamental information flowover from a country across borders is commonly known as a spillover effect. This describes how the country-specific information transfers to the financial markets of another country. Prior literature that examines the spillover effect has traditionally focused on developed countries, such as the United States (US). For example, Harju and Hussain (2011) examine the dominant and instantaneous influence of US announcements on European stock markets, while Gurgul and Wójtowicz (2014) analyse the reaction of Polish indices at the time of US news announcements, such as the CPI, Producer Price Index (PPI) and non-farm payroll. Despite being the world's second largest economy, there are limited studies on the spillover effect that originates from China. This topic is of growing importance as the amount of bilateral trade between China and regional countries continues to expand and their economies are increasingly entwined. This thesis contributes to the literature by examining the effect of major Chinese macro-announcements on regional exchanges *ex post* becoming the world's second largest economy.

¹ One market to one source refers to the reaction of one market to one macro-economic announcement (e.g., US S&P 500 Index response to US CPI announcement). Multiple markets to one source refers to the reactions of multiple markets to one macro-economic announcement; these are markets from different countries (e.g., US S&P 500 and UK Financial Times Stock Exchange 100 Index [FTSE 100] response to US CPI announcement). Multiple assets to multiple sources refers to the reaction of multiple assets to multiple macro-economic announcements; these assets are from different economies and macro-economic announcements are undertaken by different authorities (e.g., European equity indices response to various US news release and European regional news releases).

According to the World Bank (2018), China is the second largest economy in the world as of 2011 and also the largest contributor to the world economic growth after the 2008 financial crisis. Since the Chinese market reforms in 1978, the average GDP growth is around 10%, which is ‘the fastest sustained expansion by a major economy in history’(World Bank, 2018). This is driven predominately by industrialisation, urbanisation and demographic dividend. Additionally, the privatisation of state-owned enterprises, entry into the World Trade Organization (WTO) and government fiscal stimulus all provided sustained economic growth over the past few decades.

Trade ties and financial linkage between China and surrounding countries have strengthened dramatically. Changes in the Chinese economy affect the regional economic outlook and the risk appetite of global investors. Therefore, regional countries are interested in Chinese macro-economic announcements and would adjust policies in response to Chinese economic change. To the best of our knowledge, this is the first study that seeks to examine the spillover effect of China after becoming the second largest economy in the world.

By employing multivariate regressions, this thesis extends the literature on spillover effect in two ways. The research seeks to first identify which of the 12 scheduled Chinese macro-economic announcements affects regional index futures markets. By investigating the qualitative aspects of each announcement, we also provide economic explanations of the empirical results. This study uses a standardised measurement ‘surprise’ to represent the magnitude of the unexpected component of the news. Such a ‘surprise’ is defined as the difference between the actual announced figure and the median of analyst consensus across all observations. As all macro-economic announcements have different units, the use of

‘surprise’ scales the announcement shock to a comparable measurement across all macro-economic announcements.²

This thesis further contributes to the literature on the relationship between the sign of the index return and the sign of the news ‘surprise.’ The news of fundamentals could be categorised as ‘good’ news and ‘bad’ news to financial markets. Good news (positive ‘surprise’) refers to the information that is in favour of the economic progress and bad news (negative ‘surprise’) indicates a deterioration of the economy. However, the good news of economy changes is not always interpreted as good news to the financial markets; those that increase price level could be interpreted as either involving higher future demand or possible future tighter policies. Thus, positive ‘surprise’ could create a positive return or a negative return in the spillover recipient markets. Prior literature has discussed that the response of price movement could reverse when entering a new business cycle, but consensus has not been reached (e.g., Andersen, Bollerslev, Diebold & Vega, 2007; Baum, Kurov & Wolfe, 2015; Flannery & Protopapadakis, 2002; McQueen & Roley, 1993; Wongswan, 2006). The relationships documented in this thesis is consistent with the claims of Baum et al. (2015) that the positive surprise of Chinese announcements induce positive indices return in regional markets and vice versa.

Additionally, this study conducts time-variant analysis on the market response of the official manufacturing PMI, and results reveal that investors appear less interested in this indicator. One possible explanation of such change is the transition of the underlying Chinese economic structure from manufacturing to service. Excess industrial output capability and financial market vulnerabilities became the new issue in China and have contributed to the slowing of economic growth, which is expected to decrease to an average of 6.2%. Chinese leaders decided to conduct economic structure reform in 2004 (Lardy,

² For example, GDP is in percentage, PMI is an index and imports is in USD billion. With various units, 1% of GDP cannot be compared to 1 index unit of PMI and to USD 1 billion for imports.

2006) and initiated *the Silk Road Economic Belt and the 21st-Century Maritime Silk Road* (the Belt and Road or B&R) (OECD Development Centre, 2018). Results suggest that the Chinese economy has successfully experienced a transition from the secondary sector (industry) to the tertiary sector (service), and private consumption and investment became the new anchor of growth.

From a research perspective, a better understanding of the information transmission and interaction between financial markets helps regulators conduct proficient surveillance to ensure the fairness, efficiency and integrity of their jurisdiction. More specifically, since Chinese macro-economic announcements were criticised regarding data fabrication and leaks, understanding information transmission mechanisms helps Chinese authorities to prevent information leaks and allows for the release of information more clearly and effectively.

Regarding decision-making, the empirical results from the spillover effect provide an investor overview of the economy to the regulators and helps them conduct future policies. However, investors can develop trading strategies based on the understanding of information flow. For example, investors whose trading strategy is event driven can focus on the indicator with the largest influence on the index, and can develop trading strategy based on the price pattern and volume pattern created by the spillover effect.

The rest of the thesis proceeds as follows: Chapter 2 provides a review of the literature; Chapter 3 discusses the hypotheses development; Chapter 4 explains the data used in this research, including the macro-economic indicators and indices; Chapter 5 presents the methodological framework and model specifications; Chapter 6 outlines the empirical results; and Chapter 7 concludes the thesis. Appendix A lists the calculation of each announcement and Appendix B provides robustness tests on macro-economic announcement Group 5.

2. Literature Review

This section provides an overview of the literature relevant to this thesis. Two streams of literature are first reviewed, including the relationship between asset pricing and fundamental factors, and market co-movement. Based on the understanding of these two strands of literature, studies on spillover effect are reviewed.

2.1 Asset Pricing by Fundamental Factors

The EMH developed by Fama (1970) explains the financial market response to information completely, instantaneously and rationally. As there is no monopolistic access to all information that moves price (strong-form efficiency), semi-strong-form efficient markets (where price adjusts efficiently to publicly available information and technical analysis) are commonly observed. Scheduled macro-economic announcements are the most frequent forms of publicly available information.

$$P_t = E \left[\sum_{\tau=1}^{\infty} \frac{D_{t+\tau}}{1 + r_{t,t+\tau}} | \Omega_t \right] \quad (1)$$

McQueen & Roley (1993) propose a model to explain the relationship between stock price and news (see Equation 1). Where P_t is the stock price at time (t), $E[\cdot | \Omega_t]$ is the expected price based on the information set Ω at time t, r denotes the discount rate during t to $t + \tau$, and D is the corresponding dividend. The information set Ω contains macro-economic announcements that show the previous state of the economies, current situation and prospects. For example, the monthly CPI indicates the price level of last month while the PMI is an estimate of the future demands of products from the perspective of purchasing executives. Therefore, macro-fundamentals are essential information sources for investors and are the most important origin of price changes in financial markets. The model specification (see Equation 1) and macro-economic announcements will be discussed in the following sections.

2.2 Linkage Between Markets

Another stream of literature explores the concept of market linkage. Nations are not isolated from each other, and economies are integrated within various aspects due to the development of logistics and communication devices. With these advancements, global financial markets are tightly bound. At the regional level, integration among such markets occurs more rapidly due to the formation of free trade associations and currency union.

To explain the market co-movement phenomenon, Solnik (1974) presents a hypothesis that, under the single world market concept, security price is consistent. His equilibrium model illustrates that common fundamental factors are the causes of market linkage. Meanwhile, to explain the market crash in October 1987, King and Wadhwani (1990) argue that even if fundamental factors of various markets differ widely, security prices still move in the same direction. Therefore, the co-movement of financial markets is sometimes due to exogenous variables (Baele, 2005; Calvo & Mendoza, 2000; Chen, Roll & Ross, 1986; Taşdemir & Yalama, 2014).

Nevertheless, the market linkage cannot solely be explained by exogenous variables that affect all financial markets simultaneously. Johnson and Soenen (2003) examine the linkage between the Latin American equity markets and the US, illustrating that the increasing stock market co-movement is due to the high number of trading activities between these countries and the US. Calvo and Mendoza (2000) argue that institutional investors with marginal costs higher than marginal returns tend to mimic their portfolio in other countries.

2.3 Spillover Effect and Spillover Channels

A large body of literature examines the information transmission mechanism across borders. They use the term ‘spillover effect’, which is the shock transmission from one economy’s market to others. Such economic innovation may be a real shock, pure financial shock, or a mixture of both.

A real shock is news about economic prospects, which indicates future growth, while pure financial shock is fundamental economic change, such as interest rates. Moreover, the transferred information should be economy specific rather than common factors that move markets together (Abiad, Furceri, Kalemli-ozcan & Pescatori, 2013; Arslanalp, Liao, Piao & Seneviratne, 2016; Baele, 2005; Dungey & Martin, 2007). This study examines the scheduled macro-economic announcements that are real economic shocks.

Recent research reveals that the spillover effect occurs through both economic and financial channels, and that these channels are either direct and indirect (Arslanalp et al., 2016; Mathews, 2016; Shu, He, Dong & Wang, 2018).³ The direct economic channel, which is the most observable one, involves international trades. A manufacturing company exports merchandise abroad and then this company's earnings are subject to the demands of foreign markets and the exchange rate. Thus, a company's trading performance determines its share price. Government statistical announcements demonstrate the aggregate demand and supply change, and also affect the foreign exchange rate. Therefore, direct economic channels between two countries, particularly those highly depending on trade, would influence the stock price performance.

Chinese merchandise trade shows a steeper upward trend compared to other countries, as described in Figure 1. Although China's share of merchandise declined in 2016 (for the first time since 1996) from 12.2% to 11.8%, China was still ranked the fifth exporter and the second-largest importer in the world (World Trade Organization, 2017).

Arslanalp et al. (2016) claim that international trade is the most substantial spillover channel, and China's growing international trade explains the increasing correlation between the Chinese asset price and other asset prices in the Asia-Pacific region. Mathews

³ Regarding the economies examined in this study, Arslanalp et al. (2016) note that Australia, Korea, Taiwan and Thailand have strong direct economic links with China, Australia has an indirect economic link with China, Korea and Taiwan have direct financial links with China and Japan has an indirect financial link with China.

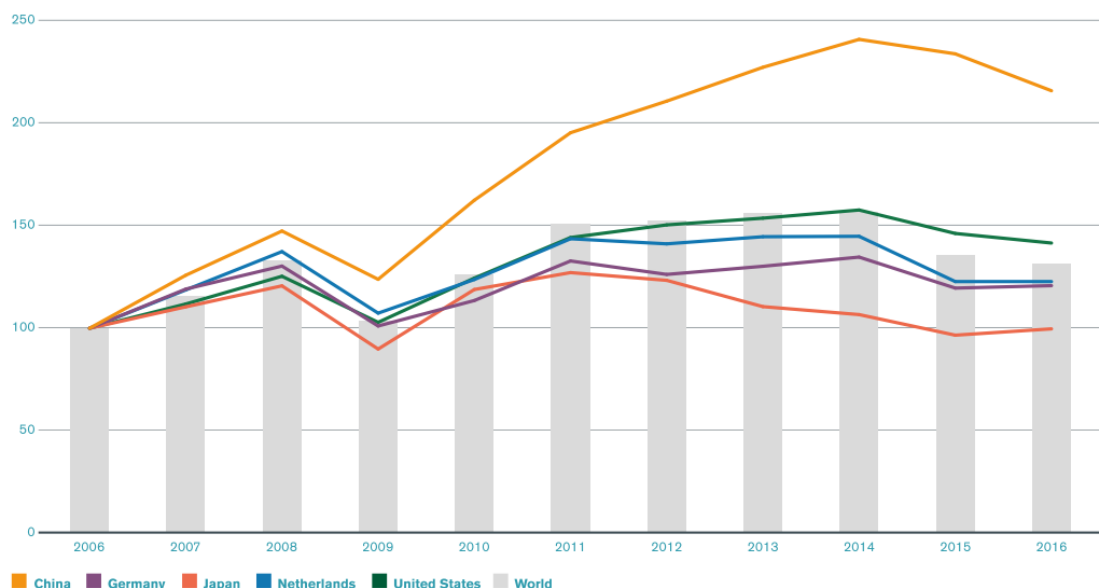
(2016) notes that Australian markets are influenced by China's economy directly as China accounts for 30% of Australian exports.

The direct financial channel refers to foreign investment or capital flows. This channel is not restricted to the institutional levels, such as the opening of a new factory overseas, but also includes individuals purchasing stock shares in another country. Under the process of financial market reform, China has partially opened equity markets to overseas investors and is gradually shifting the exchange rate towards a market-determined regime. Such policy changes are incorporating the Chinese stock market into the international financial system. The direct financial linkage between China and other Asian countries is now multiplying (Chow, 2017; Shu et al., 2018).

Even if countries have no direct trading partnership, their respective financial markets could still move in synchrony if they are both exposed to common factors, such as commodity prices. In contrast to a direct economic spillover channel (direct trading partnership), this information transmission process is an indirect economic spillover channel. According to the law of one price, identical products are perfectly arbitrated. Ordinary international buyers and arbitragers will rule out the inequivalent commodity price level, and consolidate the global markets, at least in the long term. As a large contribution to international trade, China has an influential power on commodity prices (Baum et al., 2015; Ma, Yang, Xu & Wang, 2018).

The last spillover effect transmission is the indirect financial channel, which involves major economies having indirect financial effects on other nations. The improvement of large economies results in the higher confidence and positive sentiment of investors globally, and such confidence in investors increases risk appetite. A positive Chinese economic prospect could induce optimistic revisions for the regional economics that are highly exposed to China.

Figure 1. Leading traders and world exports of merchandise trade, 2006–2016 (Indices, 2006 = 100) Source: World Trade Organization (2017).



One sub-strand of literature regarding the spillover effect focuses on different asset classes. Most studies concentrate on the equity market (Diebold & Yilmaz, 2009; King & Wadhvani, 1990). Researchers also investigate bond markets, commodities markets and currency markets (Andersen & Bollerslev, 1998; Andersen, Bollerslev, Diebold & Vega, 2003; Felices, Grisse & Yang, 2007). Some literature examines multiple asset classes, including equity, bond and currency (Andersen et al., 2007; Balduzzi, Elton & Green, 2001; Baum et al., 2015; Dungey & Martin, 2007).

Identifying spillover originators and receivers is another sub-strand of literature. The information transmission process contains the source of information (originator) and the response markets (receiver). Developed economies have a dominant power on the price movement, and serve as the centre of the information in most studies. For example, Harju and Hussain (2011) and Louzis (2015) study the spillover effect among developed economies. Meanwhile, some literature explores the reaction of emerging markets to the news of developed economies (Johnson & Soenen, 2003; Lahrech & Sylwester, 2011; Leung, Schiereck & Schroeder, 2017; Liu & Pan, 1997; Wongswan, 2006).

In recent years, emerging markets became a new starter in the information transmission process, and the developed markets become the destinations (Taşdemir & Yalama, 2014; Yilmaz, 2010). Some studies are explicitly concerned with the spillover effect from China. Investigating the daily return and the spillover channel, Arslanalp et al. (2016) claim that the relationship between the Chinese stock market and regional stock markets is increasing. Baum et al. (2015) employ 5-minute interval data from 30 September 2009 to 31 December 2013 to test which announcement had an effect on the indices, foreign exchange futures and commodity prices. They find that Chinese PMI, GDP and INP had significant effects on these financial markets. Shu et al. (2018) argue that Chinese financial markets (except for bonds markets) have an essential effect on regional markets, close to the level of the US during tranquil periods. With the internationalisation of currency, the Chinese Yuan and China currency regime have an increasing effect on regional and global currency systems (Fratzcher & Mehl, 2014; McCauley & Shu, 2018).

2.4 Information Proxy

Several studies examine the spillover effect using sophisticated models, such as VAR, GARCH and extensions (Balduzzi et al., 2001; Hou & Li, 2016; Kim, Kim & Lee, 2015; Leung, Schiereck & Schroeder, 2017; Li, 2007; Louzis, 2015; Yilmaz, 2010). Wongswan (2006) argues that using volatility innovations from financial models to represent information may fail to be recognised in the comparing market. Volatility innovations induced by fundamental material news could be treated or disguised as noise and thus neglected by models. Hence, some previous literature uses macro-economic announcements as a proxy for information to explain price variation in the recipient market.

Early research used actual announcement figures as the information proxy to test the reaction of the price series. Results using the actual announcement number only are dispersed and even contradictory (Asprem, 1989; Cutler, Poterba & Summers, 1989; Kaul, 1987). Although the actual news figure offers insight into the economy, it is an incomplete

information set with which for investors to trade and, according to the predictions of rational expectations theory, the financial markets only respond to unexpected sharing of new information.

Over the past two decades, financial institutions such as Bloomberg began reporting the market expectations of the macro-economic announcement figure, and this consensus data provides a better information proxy for academia. While analyst estimates of macro-economic announcements outline the overall opinion of the markets, the analyst estimates also guide investors' corresponding actions. More precisely, analyst expectations of the upcoming announcement have already affected the asset price, and this figure is the old information in the last information set Ω_{t-1} (see Equation 1).

The new information proxy combines both the expected figure and the actual figure into a standardised formation, which is 'surprise.' This surprise is the difference between these two figures, which is then divided by the standard deviation of all the sample differences (see Equation 5). Positive surprise refers to good news and negative surprise refers to bad news (Andersen et al., 2007; Baum et al., 2015; Harju & Hussain, 2011; Rangel, 2011; Wongswan, 2006).

2.5 Sign and Size of Spillover Effects

It is intuitively evident that positive surprises or good news would have a positive effects on the market return, and negative ones would drive the market down. More specifically, a positive surprise of one economy is expected to raise the external demand of other economies and increase equity markets. However, a positive surprise sometimes implies upcoming tight monetary and fiscal policies, which reduces the external demand of other economies. For example, a positive surprise of INP, which refers to higher output than expected, is a sign of unexpected higher aggregate demand from both domestic and overseas markets. Thus, the stock price of manufacturing companies increases due to higher earnings. In contrast, unexpected good news raises investors' concerns of an overheating

economy, and potential tighter economic government policies. Therefore, ‘surprise’ can be both negative and positive related to contemporaneous stock returns.

Wongswan (2006) claims that the effects of the announcements on returns are unpredictable. He explains that macro-economic announcements have an inexplicit effect on economic and financial variables, such as international trades, capital flows, and foreign exchange rates. Hence, the aggregate effect on equity return is ambiguous and direct examination of the effect of announcements on returns may not always produce implied results.

The empirical results on the direction of returns are extensive, but inconsistent, and prior literature tries to explain the results from many perspectives. One explanation regarding the unpredictability of returns based on macro-economic announcements is straightforward: that the expectation and position of investors vary for each announcement, and that the return is unpredictable after they adjust positions.

Financial markets’ price movements reflect fundamentals; however, during a varying economic state, the price movement may move in the opposite direction and at a different magnitude. McQueen and Roley (1993) claim that when using the constant estimate model, the fundamental surprise has different implications across business cycles. Flannery and Protopapadakis (2002) argue that the effect of the announcement is time variant, and the announcement innovation will exhibit different levels of influence on equity returns. Wongswan (2006) notes that the state of the business cycle or corresponding monetary and fiscal policy are reasons for the variation of the spillover effect. Furthermore, Andersen et al. (2007) explain that, in the contraction and expansion period, cash flow and discount factor dominant the stock price respectively. They find that positive surprises from US macro-economic announcements cause negative returns in expansion and positive returns in extraction.

This idea from Andersen et al. (2007) can be explained by Equation 1. The discount rate $r_{t,t+\tau}$ and cash flow $D_{t+\tau}$ altogether determine the asset price. As discussed above, a positive surprise means an improvement in the economy and greater company earnings. During the expansion phase, while unexpected good news appears, investors are more concerned about potential tight policy, and the discount rate dominates the asset price rather than cash flow. At the time of contractions, as governments are less likely to conduct tight policies, a positive surprise indicates greater cash flow and raises stock prices.

The size of the spillover effect is determined by three factors: 1) the size of the standardised surprise—for example, the larger the innovation, the larger the market response; 2) the level of the linkage of markets through those four channels—the higher the linkage, the higher the magnitude of response; and 3) the openness, vulnerabilities and policy space of the receiving markets (Arslanalp et al., 2016; Elder, Miao & Ramchander, 2012).

3. Hypotheses Development

3.1 Hypothesis Regarding the Existence of the Spillover Effect

Based on prior literature, the integration of economies can cause co-movements of financial markets, especially among regional markets that are open simultaneously. Financial markets respond to the unexpected economic news, which is a ‘surprise’. The economic information about one country could create price adjustments in another country. This information transmission process mainly originates from developed economies, which means that major economies dominate other financial market movements (Harju & Hussain, 2011; Johnson & Soenen, 2003; Lahrech & Sylwester, 2011; Leung et al., 2017; Liu & Pan, 1997; Louzis, 2015; Wongswan, 2006). However, little literature focuses on how economic shock from developing economies affects developed financial markets (Taşdemir & Yalama, 2014; Yilmaz, 2010).

After successive and rapid economic growth, China became the second largest economy in 2011. The growing linkages of China with the regional nations through spillover channels are generally recognised (Arslanalp et al., 2016; Baum et al., 2015; Shu et al., 2018). Therefore, while China is still a developing country, any ‘surprise’ in relevant scheduled macro-economic change would affect regional stock indices, creating a spillover effect. This leads to Hypothesis 1.

H1: Scheduled macro-economic announcements that contain ‘surprises’ have spillover effects on regional indices.

This study examines the five macro-economic announcement groups and adopts a multivariate regression analysis to identify the particular event(s) that affect regional indices .

There are 12 scheduled macro-economic announcements and six indices assessed in this study, which means that this hypothesis can be extended to 72 sub-hypotheses. It is necessary to understand each macro-economic announcement before proceeding to the

empirical analysis. The methodology used in calculating each indicator is listed in Appendix A.

3.1.1 The manufacturing PMI

The manufacturing PMI is the official indicator released by the China Federation of Logistics and Purchasing (CFLP) and the China National Bureau of Statistics (NBS), while the non-official PMI indicators are called the Caixin PMI.⁴ A reading of 50 refers to no change in the overall economic situation, a reading below 50 means the deterioration or contraction of the economy (a lower level of new orders and output) and a reading over 50 means an improvement in the manufacturing sector. From 2011 to 2017, both the official manufacturing and non-manufacturing PMI were mostly above 50, indicating improvement in the Chinese manufacturing and non-manufacturing sectors.

The PMI figures are released on the first day of the month, making it the first example of economic change from the past month. This figure is crucial to regulators, and the CFLP reports the survey details to the National Development and Reform Commission, Ministry of Finance, and other government departments monthly (Orlik, 2011). China's manufacturing industry is one of the highest demanders of raw materials, such as copper and iron core, and countries such as Australia that are highly dependent on the export of commodities have a relationship with Chinese manufacturing activities.

China has experienced an economic transit from the secondary sector to the tertiary sector. The fast-growing economy in China is associated with vast investment in manufacturing and infrastructure. Manufacturing sector used to composite half of GDP, while the service sector has been accelerating and account for half of the Chinese economy nowadays. The fast-growing service sector in China underpins this economic growth, and reinforces the view that Chinese economic growth is slowing gradually (Orlik, 2011;

⁴ Formally known as the HSBC Markit PMI. It has a smaller sample and allocates greater weight to the small and private companies compared to the official release (Orlik, 2011). Non-official PMI is not assessed in this study as the analyst consensus data are unavailable in the Bloomberg database.

Reuters, 2018a, 2018b). The readings of the non-manufacturing PMI surpass the manufacturing PMI (see Figure 2), with the contribution to the Chinese GDP of the tertiary sector surpassing the secondary sector in 2013 (see Figure 3).

Figure 2 outlines the actual released figures of the official manufacturing PMI, official non-manufacturing PMI, non-official Caixin China PMI Service and Caixin China PMI Manufacturing. The data range for the official PMI is from 1 January 2011 to 31 December 2017, while the data for non-official PMI is from March 2015. The macro-economic announcements data are from Bloomberg, which are also used in empirical analysis.

Figure 2. Purchasing Manager Index.



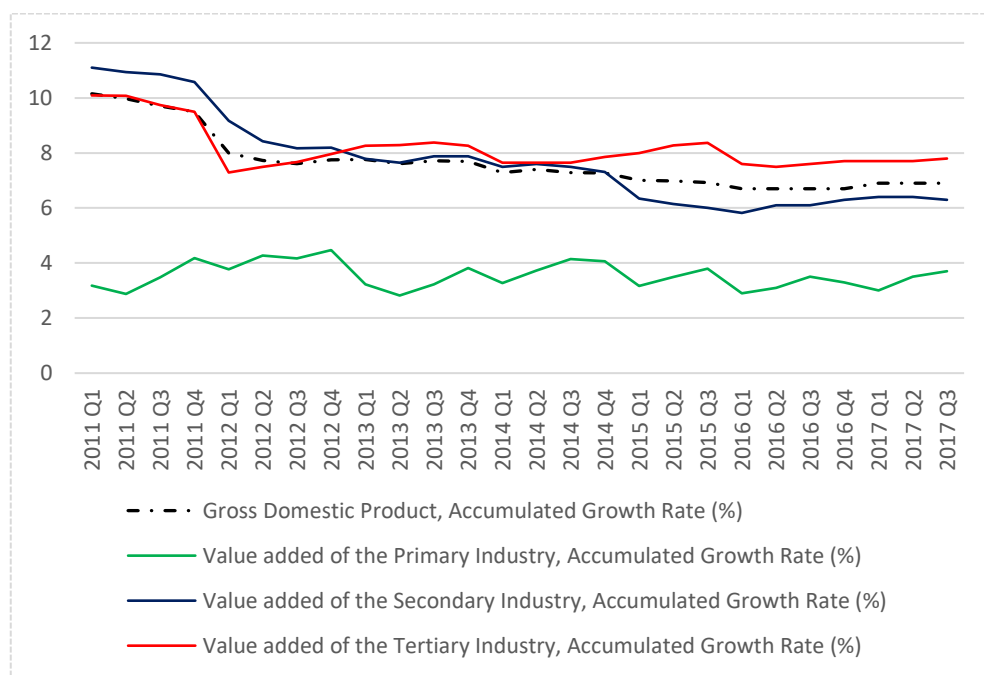
3.1.2 GDP, INP, Retail Sales, Fixed Asset

INP, retail sales and fixed asset investment (FAI) data are released simultaneously on the 11th of each month (January and February data are release together), and they are

delayed to coincide with the GDP data release on 15th of January, April, July and October. The GDP growth rate describes the size and growth of the economy quarterly, INP reports the industrial value-added output monthly, RES reports the retail sales situation of the last month, and the FAI describes the investment on fixed assets.

Figure 3 describes the actual released accumulated growth rate of GDP and three compositions of GDP from the first quarter 2011 to the third quarter 2017. The primary sector is agriculture industry, the secondary sector is mainly industry (manufacturing, mining, electricity) and the tertiary sector is mainly service. Due to data availability, the fourth quarter of 2015 and 2017 are not presented.

Figure 3. China GDP Growth from 2011 to 2017. Source: China National Bureau of Statistics (2018)



Based on Figure 3, the Chinese GDP growth rate witnessed a dramatic drop from a two-digit rate since the first quarter 2011 to around 8% in the first quarter 2012, which brought about the debate regarding the Chinese's economy 'hard landing'. After this, the Chinese economic growth rate still decreased gradually, but remains stable. According to Figure 3, the growth rate of the Chinese primary industry, which is mainly agriculture,

fluctuated around 3–4%. The secondary sector is responsible for most of the slowing growth rate. Regarding the tertiary sector, after the drop in 2011, the Chinese service sector now hovers around 8%. The other three indicators of fundamentals announced simultaneously with GDP (INP, RES and FAI) have all declined during the sample period (see Figure 4).

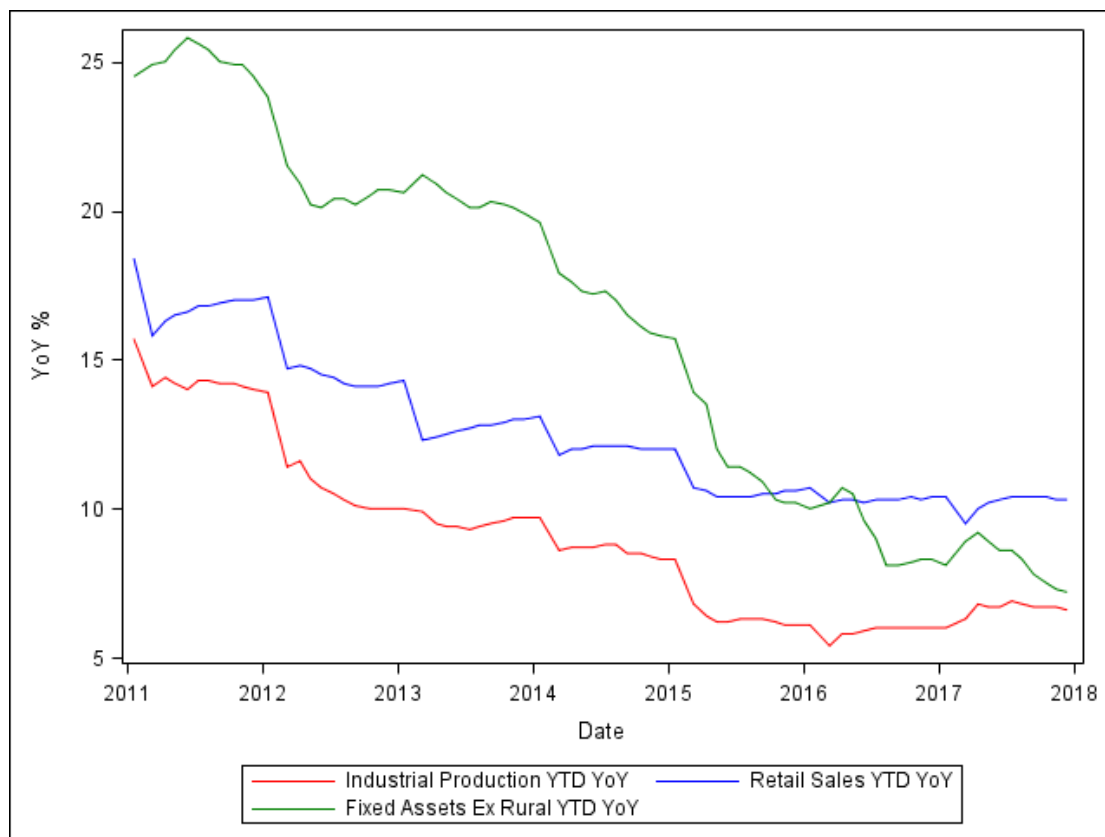
The Chinese GDP growth rate is the most significant economic indicator for several reasons. First, other timely economic indicators released monthly provide a sub-perspective of the status of the economy, such as the trades, PMI, and INP. While the GDP growth rate is released quarterly, it still provides a comprehensive view of the Chinese economy. Second, the Chinese GDP growth rate is the government performance indicator and also provides the implications regarding future Chinese policy. Third, the expectation about the Chinese GDP is mostly in line with the actual figure, because it is broadly estimated and sometimes leaked before the official announcement. Therefore, a surprise in the GDP is an extraordinary shock to the financial markets (Orlik, 2011).

Although industrial output is no longer dominant in the Chinese economy, the implication of INP still has influential power towards financial markets. Furthermore, given that PMI is the leading indicator which is an anticipation of the industrial output by business executives, INP is the actual output number, and thus this output figure is well-estimated by market participants. To conclude, any surprise of the industrial output would introduce high volatility to the markets.

To understand retail sales in China, the contribution of GDP to counterparties should be investigated. As shown in Figure 6.1 and 6.2, the contribution of final consumption to GDP is above 80% in the US, around 75% in Japan and less than 55% in China. Meanwhile, capital formation contribution to the GDP is around 23% in the US and Japan as well as the worldwide average while, in China, the share is around 45%. This

unbalanced economic growth structure is unsustainable, and the Chinese government has taken action that will be discussed in the following sections.

Figure 4. INP, RES and FAI. Chinese INP, retail sales and FAI YTD YoY from January 2011 to December 2017.

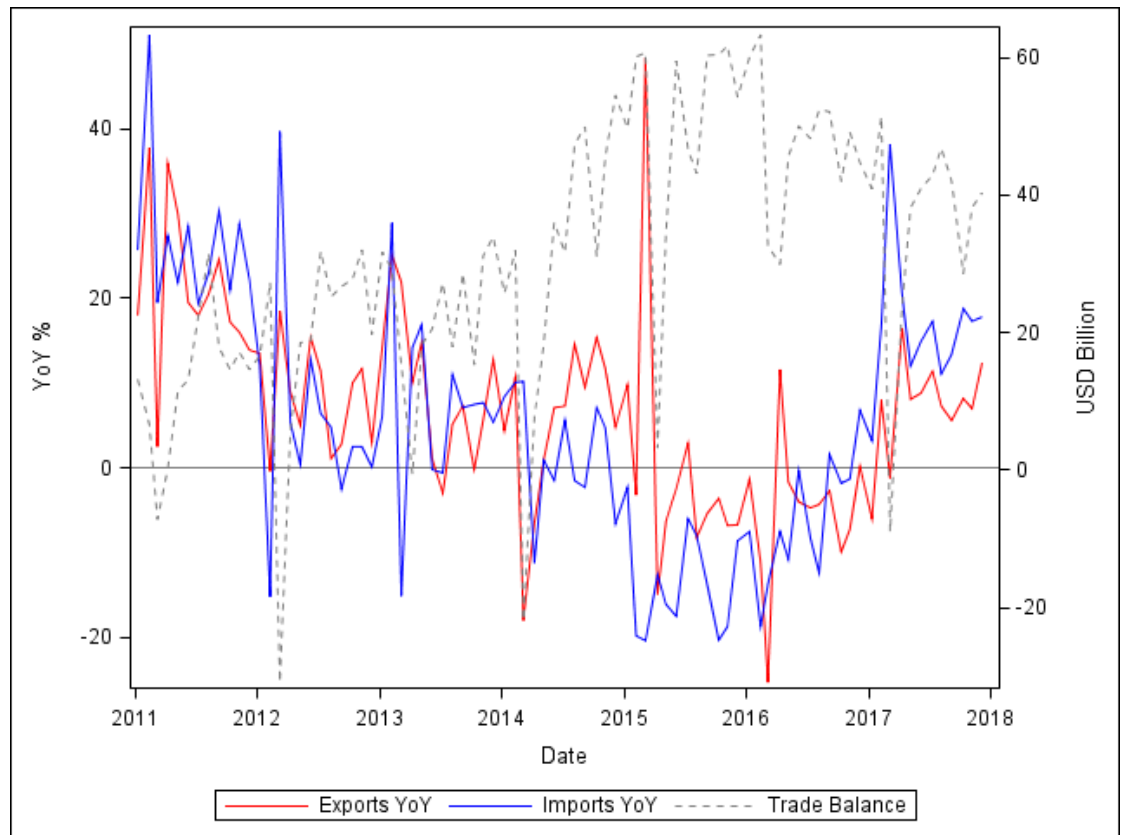


Regarding FAI, China employs a similar growth model to Japan and Korea, encouraging saving and increasing investment. The FAI Ex Rural announcement is released along with the sub-category of investment, indicating potential industrial output.

3.1.3 Exports and Imports

China is a large goods producer and a giant consumer. According to Figure 5, for the last seven years, Chinese exports and imports have increased (despite a decrease in 2015 and 2016), and the trade balance remains positive in most quarters. While the contribution of exports of goods and services to the GDP is decreasing overall, exports are still one of the main driving force in the Chinese economy (see Figures 6.3).

Figure 5. Chinese International Trades. Chinese Exports YoY, Imports YoY and Trade Balance in USD billion from January 2011 to 2017.



After joining the WTO, China was exporting low value-added products, such as textiles and toys; however, high value-added products are now flooding the world markets. For example, China is the largest exporter of machinery and mobile phones (Orlik, 2011). The low cost of labour, capital, raw material, facilities, and energy are the fundamental supports to China's export industry, along with the undervalued Chinese Yuan. China is a resource-poor country and its economy is resource intensive. Therefore, China has a close relationship with exporters and importers and, subsequently, their domestic financial markets.

Figure 6.1. Final consumption expenditure (% of GDP). Source: World Bank (2018).

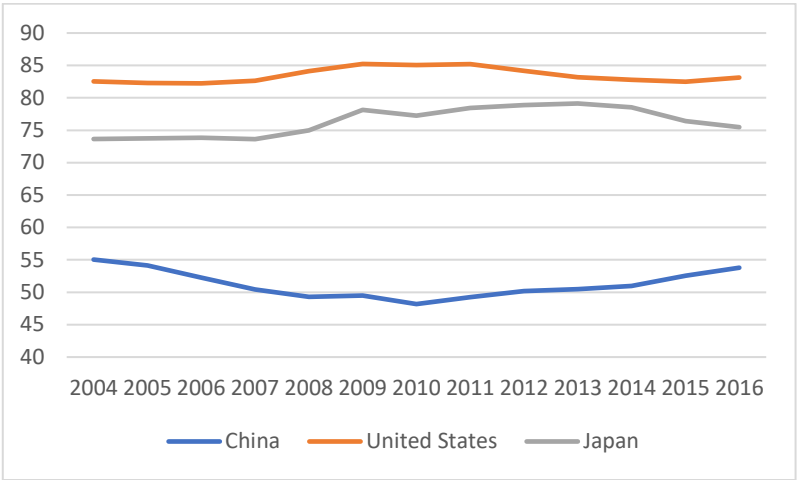


Figure 6.2. Gross capital formation (% of GDP). Source: World Bank (2018).

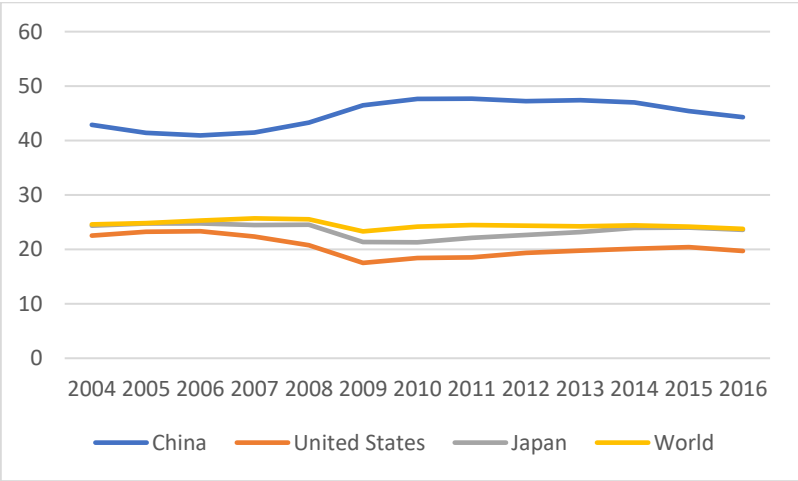
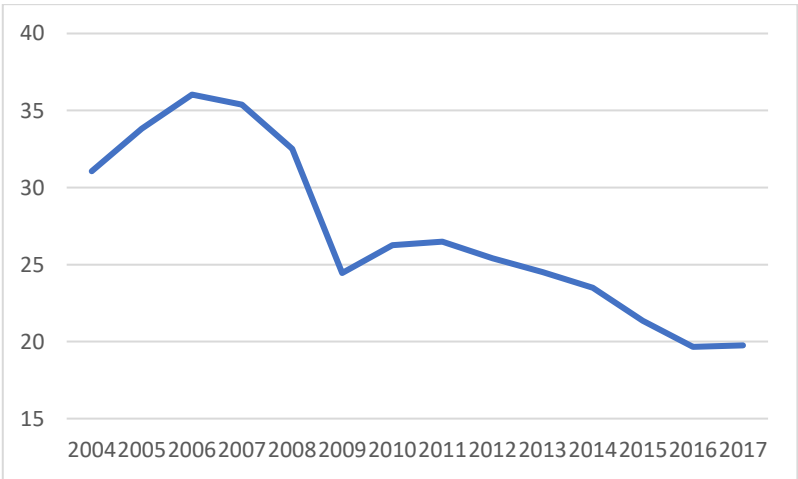


Figure 6.3. Chinese exports of goods and services (% of GDP). Source: World Bank (2018).



In 2013, China presented the B&R, which is an economic reform strategy. As of 2018, this project includes 65 countries, two-thirds of the world's population and one-third of its GDP. The initiative promotes trade and investment both in Asia and Europe, aiming to enhance integration, connectivity and co-development (OECD Development Centre, 2018). Until the end of 2016, China has accounted for an average of 19% exports for Australia, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand, and accounts for 11% of global trade (Shu et al., 2018).

3.1.4 CPI and PPI

China's CPI is relative stable compared with the PPI (see Figure 7). The CPI is typically controlled by the government via multiple governmental instruments and policies. For instance, the objective of the European Central Bank is to keep the CPI below, but close to, 2%. Despite China having no explicit inflation target, the People's Bank of China (PBOC, China Central Bank) can adjust the money supply, bank reserve ratio and issue bonds to control the price level. The Chinese government takes a hawkish and smooth step towards inflation, and also conducts forward-looking methodology, achieving low and stable inflation (Girardin, Lunven & Ma, 2014).

Regarding the PPI, Andersen et al. (2003) note that the CPI and PPI are related. Although the PPI has no direct effect on households or policymaking, it still indicates the potential price level. The effect of the CPI and PPI on financial markets is indistinct or contradictory in many cases. Inflation in China is driven by property prices and health care and lowered by food prices (OECD Development Centre, 2018). A high and volatile CPI in favour of financial markets may introduce stringent fiscal and monetary policies in the future that will dampen investor expectations. An increasing PPI reading can be interpreted as a soaring profit of the industrial company and increasing stock prices. However, it is also a sign of overheating, resulting in tighter government policies.

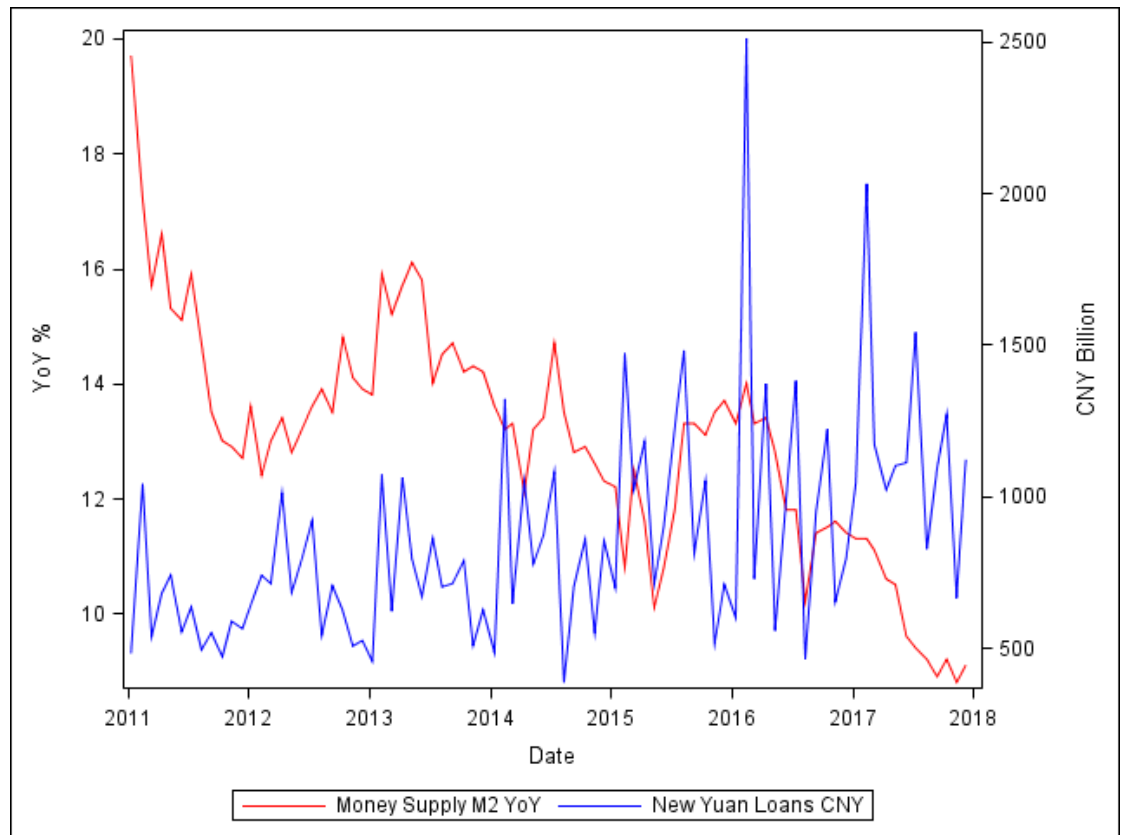
Figure 7. The CPI and PPI. Chinese CPI YoY and PPI YoY from January 2011 to December 2017.



3.1.5 Money Supply M2, New Yuan Loans and Foreign Exchange Reserve

As explained above, the Chinese economy was driven by investment and export, and the Money Supply M2 (M2), New Yuan Loans (NYL), and foreign reserves (FRS) highlight the status of inflation, investment and exports (see Figure 8.1-8.2). Continuous huge net exports result in the current account surplus and capital account deficit; however, the current account surplus contributes to the inflation and stresses the money supply, while the capital account deficit accumulates in FRS.

Figure 8.1. M2, NYL and FRS. The released Chinese Money Supply M2 YoY and New Yuan Loans in CNY billion.



These three financial indicators are highly monitored and frequently adjusted by key institutions. Chinese authorities, including the PBOC and State Administration of Foreign Exchange, have actively participated in managing the money supply, new loans and FRS to strike a balance with stable inflation, economic growth, sufficient financial reserves (a buffer against financial turmoil) and a stable foreign exchange rate. Strategies employed by government departments include open market operations and adjustment of RMB deposit reserve ratio (Orlik, 2011).

Figure 8.2. M2, NYL and FRS. The released Chinese foreign reserves in USD 100 million.



3.2 Hypothesis Regarding the Surprise Sign and the Spillover Effect

Previous literature discusses the relationship between the sign of the surprise and the corresponding stock return as based on the business cycle (Flannery & Protopapadakis, 2002; McQueen & Roley, 1993). Andersen et al. (2007) claim during the expansion phrase, a negative relationship prevails while, during a contraction period, the relationship is positive. Meanwhile, Baum et al. (2015) argue that good economic news regarding China during expansion increases the financial markets of other economies. As this study examines the spillover effect in the context of China, the following hypothesis is tested:

H2: Positive ‘surprises’ for scheduled macro-economic announcements lead to positive returns in regional indices and vice versa.

4. Data

4.1 Macro-Economic Announcements Data

4.1.1 The integrity and credibility of macro-economic announcements

To enable high-quality research that uses macro data from China, it is useful to recognise prior issues surrounding its integrity and credibility. The issue of data reliability and information leaks before official announcements is well-documented by Cai (2000), Holz (2004, 2008) and Rawski (2001). However, more recent research, such as Baum et al. (2015) and Orlik (2011), have affirmed the integrity and credibility of Chinese macro-economic announcement figures from 2011 onwards.

There were two main issues regarding Chinese macro-economic announcements: data fabrication and data leaks. According to Orlik (2011), the macro-economic indicators were controlled by the government. During the Great Leap Forward era, which occurred approximately 60 years ago, production data were not reflective of reality; instead, they were designed to produce good news to support the morale of the society. Rawski (2001) claims that Chinese GDP figures were exaggerated from 1997 to 2001, and also speculates that the real cumulative GDP was no more than one-third of the official release.

Regarding leaks, officials who have access to information may leak data to friends or relatives for profit. Even senior government officials have broken the rules regarding information release. For example, in March 2010, the Chinese premier revealed the expected trade deficit of CNY 8 billion several weeks before the official announcement to a group of foreign company executives, which was a rare reading and signalled a new trend. However, official data could be reasonably estimated before the official announcement based on the publicly available information (Orlik, 2011).

The process of publishing official announcements is also questionable. Orlik (2011) notes that before GDP is made public, journalists can obtain the figures 10–15 minutes ahead and can communicate this information to others. However, according to Baumohl

(2012), in the US, a journalist can only access the data before the official release while in a locked room and cannot communicate this information to others.

Baum et al. (2015) state that China took actions to protect the integrity of news releases and prevent data leaks, such as by shortening the time between finalising the data and publishing it and limiting the number of officials with access to unreleased data. However, in 2011, five officers from several government departments were investigated for data leaks, such as regarding GDP and the CPI (Xinhua, 2011). Furthermore, the Chinese government established a law enforcement unit to protect against data fabrication, and also makes official statements, including that they have a zero tolerance towards fabricating economic data as well as the importance of authentic data in decision-making.

It is worth highlighting that this current research uses data from 2011 onwards after China became the second largest economy in the world and does not include the bias period.

4.1.2 Five groups of macro-economic announcements

This study examines the 12 major scheduled Chinese macro-economic announcements from 1 January 2011 to 31 December 2017. The sample period starts after China is acknowledged as the second largest economy in the world.⁵ The announcements data are obtained from the Bloomberg database, which includes the actual figure, median of the analyst consensus number, release time and date. The 12 macro-economic announcements include national output, investment, household sectors, international trade, price and financial indicators. However, they are categorised into five groups based on release time. Specifically, announcements scheduled to be released simultaneously are grouped together as shown in Table 1.

⁵ There is no official time when China became the second largest economy in the world. According to Barboza (2010), it was in the second quarter of 2010, while the World Bank's (2011) annual GDP figure indicates that it was after 2010. To avoid ambiguity, this study uses 2011. The third quarter of 2011 (1 July 2011) to the end of 2017 has also been investigated, and no significant difference was found when compared to the period used. Moreover, during the examined period, no crisis occurred; therefore, the contagion effect, which is an intense spillover effect, is not examined in this study.

Table 1 summaries the Chinese macro-economic announcements. The announcements listed have both the actual released figure and the median of the analyst expectations. The manufacturing PMI in Group 1 is released individually and announcements in Groups 2 to 4 are scheduled to be release simultaneously. Three indicators in Group 5 are released together prior to September 2015; Group 5 is divided into sub-groups in Appendix A. The GDP and FRS are released quarterly in January, April, July and October. Money Supply M0, Money Supply M1 and Trade Balance are excluded from the study, as they are highly correlated with M2 and imports and exports, respectively (Baum et al., 2015).

The rest of the macro-economic announcements not included in this study either have no market analyst expectations collected or are less important, based on the Bloomberg importance rankings.

Table 1

Summary of Chinese Macro-Economic Announcement

Announcement	Abbreviation	Category	Frequency	Unit	Release Authority
Group 1					
Manufacturing PMI	PMI	National Output	Monthly	Index	CFLP and NBS a
Group 2 (1 July 2011 to 31 December 2017)					
Real Gross Domestic Product YoY	GDP	National Output	Quarterly	%	NBS
Industrial Production YTD YoY	INP	National Output	Monthly b	%	NBS
Retail Sales YTD YoY	RES	Household	Monthly	%	NBS
Fixed Assets Investment Ex Rural YTD YoY c	FAI	Investment and Real Estate	Monthly	%	NBS

Group 3					
Exports YoY	EXP	Trade	Monthly	%	GAC
Imports YoY	IMP	Trade	Monthly	%	GAC
Group 4 (1 July 2011 to 31 December 2017)					
Consumer Price Index YoY	CPI	Prices	Monthly	%	NBS
Producer Price Index YoY	PPI	Prices	Monthly	%	NBS
Group 5 (1 January 2011 to 31 August 2015)					
Money Supply M2 YoY	M2	Financial Indicator	Monthly	%	PBOC
New Yuan Loans CNY	NYL	Financial Indicator	Monthly	CNY billion	PBOC
Foreign Reserves	FER	External	Quarterly	100 million USD	PBOC

^a China Federation of Logistics and Purchasing (CFLP), China National Bureau of Statistics (NBS), General Administration of Customs (GAC), People's Bank of China (PBOC).

^b INP, retail sales and FAI are announced monthly; in March, June, September and December, they are released together with GDP. Their January and February data are released together.

^c FAI Ex Rural YTD YoY: FAI (Excluding Rural Households) YTD YoY.

The manufacturing PMI is released individually, while GDP, INP, retail sales and FAI were released mostly at the same time, with a few exceptions.⁶ The third group, which is regarding trade data, comprised exports and imports. While they are scheduled to be announced simultaneously, according to the Bloomberg database, export and import data were released several minutes apart in some cases. As the method used in this research is to examine the 20-minute window effect, which is relatively larger compared to the

⁶ For example, on 9 August 2011, INP and FAI were released at 15:40 local time, while RES was announced 30 minutes later at 16:10; such outliers were removed from the sample.

announcement gap, this study uses the latter time as the simultaneous announcement time.⁷ Announcements in Groups 2 and 4 were released at the same time before July 2011, so these data were also removed from the sample. Announcements in Group 4 are for the CPI and PPI. Group 5 is regarding three simultaneously released indicators: M2, NYL and FRS.

8

4.2 Index Futures Data

4.2.1 Six index futures markets

The index futures data used in this study are from Thomson Reuters Tick History, which is provided by the Securities Industry Research Centre of Asia–Pacific. Index futures markets include Japan, Australia, Korea, Taiwan, Hong Kong and Thailand (see Table 2). Due to the data available, other index futures markets are not assessed in this study; these include Singapore, New Zealand, Indonesia, Philippines and Vietnam. Intraday last trade price and trading volume within a 1-minute interval are used to construct 5-minute price and volume windows to analyse the effect of Chinese news release on regional markets.⁹

Table 2 summaries the instruments examined in this study. The futures contract specifications listed are from the official websites of exchanges, and the high-frequency data used in this research adjusts for the local trading hour changes and removes off-hour trading data. The local trading hours were found on the official stock exchange websites. Due to the availability of data, other Asia–Pacific index futures are not included in this research: Singapore Straits Times Index Futures, New Zealand index futures (NZX 20 Index Futures launched on 16 June 2014), Indonesian index futures (including MSCI Indonesia Index Futures), SGX-PSE MSCI Philippines Index Futures (launched on 25

⁷ For example, on 13 July 2017, Exports YoY was released at 11:20 China local time, while Imports YoY was released at 11:22 local time; therefore, 11:22 is used as the simultaneous release time, and the examined return is from 11:12 to 11:32. This study uses 1-minute-interval trading data to build the 5-minute interval based on the actual release time.

⁸ Due to changes to the announcement time, Group 5 is split into four sub-groups (see Appendix B).

⁹ The 5-minute interval has been built using 1-minute intervals, rather than 5-minute interval data because the announcement does not always occur as scheduled at 5-minute intervals.

November 2013) and Vietnam index futures (VN 30 Index Futures launched on 10 August 2017).

Table 2

Summary of Index Futures Market

Instruments	Ticker Symbol	Exchange	Local Trading hours
Japan Nikkei 225 Futures	NK	SGX ^a	07:45–14:25, 14:55–04:45 07:30–14:25, 14:55–04:45 (after 11 July 2016)
Australian SPI 200 Futures	AP	SFE	5.10 pm to 7.00 am, 9.50 am to 4.30 pm (during US daylight saving time) 5.10 pm to 8.00 am, 9.50 am to 4.30 pm (during US non-daylight saving time)
Korean KOSPI 200 Futures	KS	KRX	09:00–15:35
Taiwan (China) TAIEX Futures	TX	TAIFEX	08:45–13:45, 15:00–05:00
Hong Kong (China) Hang Seng Futures	HSI	HKFE	09:45–12:30, 14:30–16:15 09:15–12:00, 13:30–16:15 (Effective 7 March 2011) 09:15–12:00, 13:00–16:15 (Effective 5 March 2012) 09:15–12:00, 13:00–16:15, 17:00– 23:00 (8 April 2013) 09:15–12:00, 13:00–16:15, 17:00– 23:45 (Effective 3 November 2014) 09:15–12:00, 13:00–16:30, 17:15– 23:45 (Effective 25 July 2016) 09:15–12:00, 13:00–16:30, 17:15– 01:00 (Effective 6 November 2017)
Thailand SET 50 Futures	S50	TFX	09:45–12:30, 14:30–16:55

^a Singapore Exchange (SGX), Sydney Futures Exchange (SFE), Korea Exchange (KRX), Taiwan Futures Exchange (TAIFEX), Hong Kong Futures Exchange (HKFE), Taiwan Futures Exchange (TFE).

Index futures data were used instead of spot stock market data because the trading hours of index futures are longer compared to that of the stock index, and the futures market tends to lead the spot market. Regarding price discovery, futures markets typically serve a dominant price discovery function (Andersen et al., 2007; Chu, Hsieh & Tse, 1999). Furthermore, the price and volume of nearby futures contracts are assessed in this analysis and, as maturity approaches, the nearest futures contract become less liquid. The next maturity contract is used instead when its daily trading volume surpasses the nearby futures contract.

This research employs high-frequency data that are processed from intraday tick-by-tick transaction records to analyse, identify and document the real-time effects that can occur immediately in response to new information. Prior studies that have used intraday high-frequency data, suggest that lower frequency data, such as daily or weekly data, revealed no or weak evidence of a connection between scheduled news and market. The rationale is that fundamentals are incorporated into markets in a short time (Andersen & Bollerslev, 1998; Andersen et al., 2007; Christie, 1982; Elder et al., 2012; Gurgul & Wójtowicz, 2014; Harju & Hussain, 2011). However, Andersen et al. (2007) suggest that if the sampling is too frequent, random market microstructure effects may affect the results; conversely, if sampling is too infrequent, vague price reactions can occur. Therefore, to identify a suitable time frame, the study starts by examining tick-by-tick transactions, followed by 1-minute intervals and eventually settled on 5-minute intervals, which appear to provide an optimal balance regarding the frequency.

4.2.2 Removing the contemporaneous effect and excluding Chinese index futures

Given the spillover effect of country-specific shocks, it is essential to distinguish the spillover effect of macro-economic announcements from exogenous factors that can cause contemporaneous market co-movements. Nevertheless, this is not applicable in this research, due to the features of the Chinese markets.¹⁰

The first reason is that the Chinese government plays a vital role in market intervention. The Chinese stock market soared up since mid-2014, started to decline in June 2015, and then returned to stable volatility after 2015 (Han & Pan, 2017; Sornette, Demos, Zhang, Cauwels & Zhang, 2015). This growth of Chinese stock was exceptional as it occurred at the time when the Chinese real estate market, along with the overall economy, were cooling significantly. Chinese regulators blames the futures market as the source of the crash, and harsh restrictions were placed on the futures market to curb market turbulence, resulting in a huge trading volume decline in the futures market as well as the stock market.¹¹ However, during the same period, other Asia–Pacific stock markets did not experience the same rollercoaster dynamics that the Chinese financial markets experienced, which means that there was a disconnection among stock markets. Moreover, prior literature also notes that the Chinese stock market has a weak linkage with other stock markets with low correlations (Li, 2007; Lin, Menkveld & Yang, 2009; Long, Tsui & Zhang, 2014).

The second reason is that the Chinese stock market is quite isolated from other markets because of large barriers to avoid foreign investors actively participating in the Chinese stock market. According to the Heritage Foundation (2018), China is among the

¹⁰ Consistent with Baum et al. (2015) and Mathews (2016).

¹¹ The China Securities Regulatory Commission (CSRC) intervened with several restrictive measures in the futures markets. The restrictions included increasing trading curbs, raising margin requirements for non-hedging purposes, imposing higher transaction fees, placing limits on same-day trading and suspending trading in various companies. This accounted for nearly 40% of the market capitalisation. Additionally, the CSRC announced a high-profile investigation into the trading activities of the top 50 traders in the equity index futures and introduced a string of state-led bailout measures for the stock market. Moreover, since the restrictions in 2015, the Chinese index futures market has almost been unfunctional (Maio, Ramchander, Wang & Yang, 2017).

‘mostly unfree’ economies with a freedom score of 57.8. More precisely, the Chinese economy ranked the 110th freest in 2018 and was 24 out of 43 Asia–Pacific countries.

The third reason is that the dominant participants in the Chinese stock markets are individual investors, who are less informed and are more sentimental compared to their counterparts: institutional investors (Maio, Ramchander, Wang & Yang, 2017). The last reason is that the Chinese foreign exchange rate and market rate are highly regulated, resulting in them being less integrated with the other financial markets. Therefore, this study does not consider the exogenous factors that move markets together.

5. Methodology

5.1 Cumulative Average Return

This section examines the price movement pattern at the time of news release, and also provides evidence for a return time frame used in the multivariate regression. Investigation of the price movement to the sign of surprise is performed through the Cumulative Average Return (CAR) (Baum et al., 2015; Ma, Rao & Sears, 1989). The distribution of CAR across all news observations describes the average response of the asset price on the release of the announcement. The CAR analysis only demonstrates positive and negative surprises, regardless of the magnitude of the surprises. Since the manufacturing PMI is the only announcement that is released individually, the price movement pattern can be easily distinguished from positive and negative PMI surprises. As the rest of the announcements are released in groups, the direction of the price movement cannot be exactly identified from the sign of the indicator's surprise, and only the manufacturing PMI is examined using CAR.

$$AR_t = \sum_{i=1}^n R_{i,t}/n \quad (2)$$

AR_t is the average return at time t . The price reaction pattern examined using CAR_t is 30 minutes before and 1 hour after the announcement ($t \in \{-30 \text{ min} \dots 60 \text{ min}\}$). Where $R_{i,t}$ is the continuous compounded return, the first difference of log price at a 5-minute interval is time t and $i \in \{1 \dots n\}$ is each announcement observed.

$$CAR_t = \sum_{j=1}^t AR_j \quad (3)$$

As shown in Figure 9, a positive manufacturing PMI surprise increases the CAR after the announcement, and a negative surprise decreases the CAR only for the first few minutes. These are less significant patterns compared to Baum et al. (2015).¹² The pattern

¹² This study extends the sample period; the price movement pattern is consistent with Baum et al. (2015).

shows that, when the positive manufacturing PMI is announced, the Japanese, Australian and Korean index futures markets tend to increase; when lower than expected figures are released, the price level tends to remain stable and then increases afterward, suggesting weak guidance for the surprise signs in relation to the price movement direction.

The negative surprise pattern is counterintuitive and contrary to previous literature; altogether, this indicates a rejection of Hypothesis 2. The cause of such a pattern is that investors are not interested in the PMI, especially after 2016. This study's sample period is from 2011 to 2017. During the first half of the period, the manufacturing PMI was still valued by investors, but it was not valuable in trading decision-making afterward. The price movement in the later period is a stochastic process, rather than a conditional mean adjustment.¹³ This is further corroborated in Section 6.6.

Figures 9.1 to 9.3 outline the CAR approximately 30 minutes before and 1 hour after the release of the manufacturing PMI announcements for the Nikkei 225, SPI 200 and KOSPI 200.

¹³ The exact date of when the manufacturing PMI is insignificant to the investor cannot be identified. Thus, the CAR patterns are not separately investigated based on time to explore the change.

Figure 9.1. CAR around manufacturing PMI release (Nikkei 255 Index Futures).

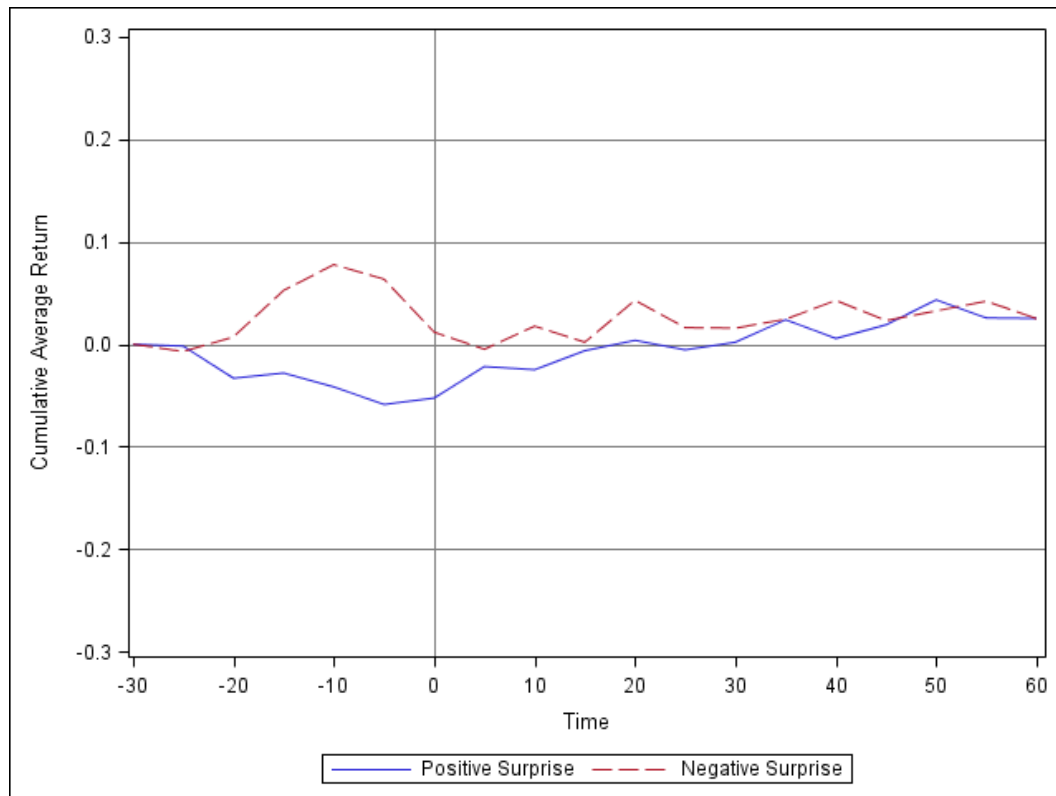


Figure 9.2. CAR around manufacturing PMI release (SPI 200 Index Futures).

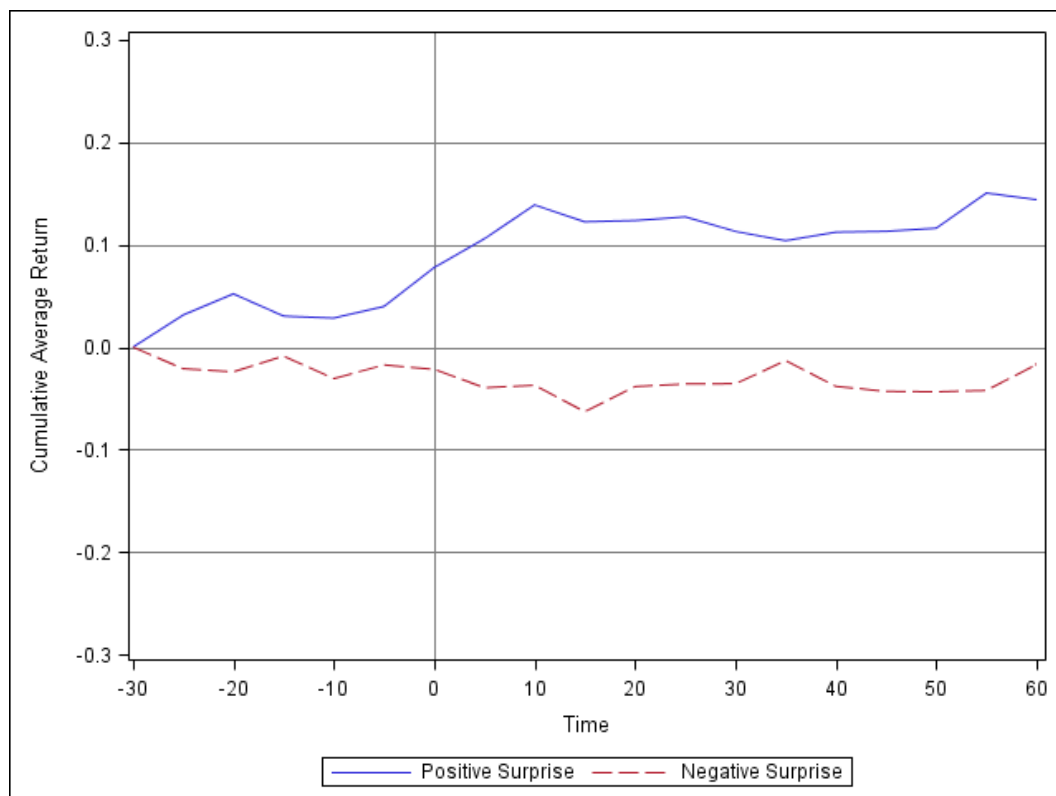


Figure 9.3. CAR around manufacturing PMI release (KOSPI 200 Index Futures).

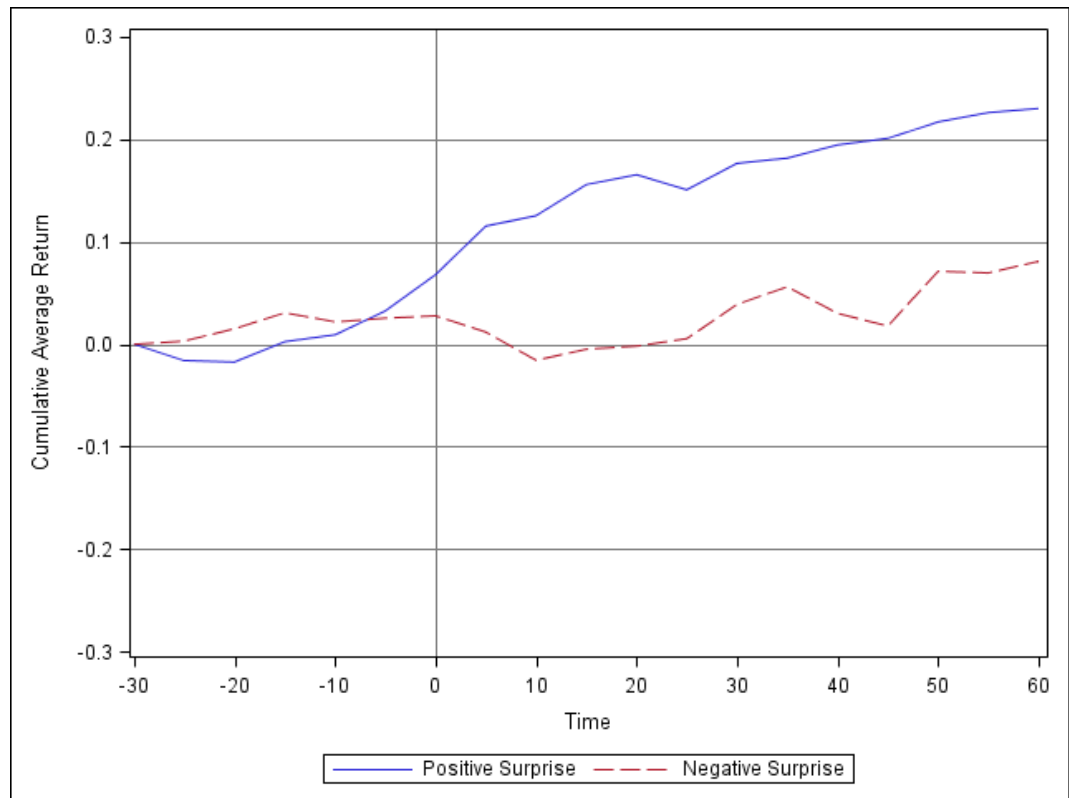


Table 3 reports the number of positive, negative and zero surprises investigated in the CAR figure. Announcements released on the weekend of Beijing Time were removed from the sample. If the futures market did not trade 30 minutes before and 1 hour after the announcement, the data were removed from the sample to obtain the complete price movement pattern. The TAIEX, Hang Seng and SET 50 were excluded from the analysis, as only some observations were found during their continuous trading hours.

Table 3

Number of Positive, Negative and Zero Surprises Investigated in the CAR Figures

Instrument	Negative Surprise	Positive Surprise	Zero Surprise
Nikkei 225	26	25	5
SPI 200	25	25	5
KOSPI 200	20	21	5

5.2 Trading Volume Around Announcements

As the examination of the continuously compounded return using CAR shows ambiguous results, this study investigates the volume response to the release of macro-economic announcements. The investigation of volume directly shows the reactions of investors' activities, regardless of whether it is a good or bad news. Even for a zero surprise announcement release—which means the actual figure is equal to the median of the analyst expectations—analyst opinions towards the actual figure could be extremely dispersed. The large dispersion of the market participants' opinions would create a large trading volume when investors adjust positions, but price movement could be random (Wongswan, 2006).

Figure 10. Trading volume around manufacturing PMI announcement.

This figure outlines the average trading volume per minute, 30 minutes before and 1 hour after the announcements release (positive, negative and zero surprises), regarding manufacturing PMI. The index futures markets that continuously traded at the time of release were the Nikkei 225, SPI 200 and KOSPI 200.

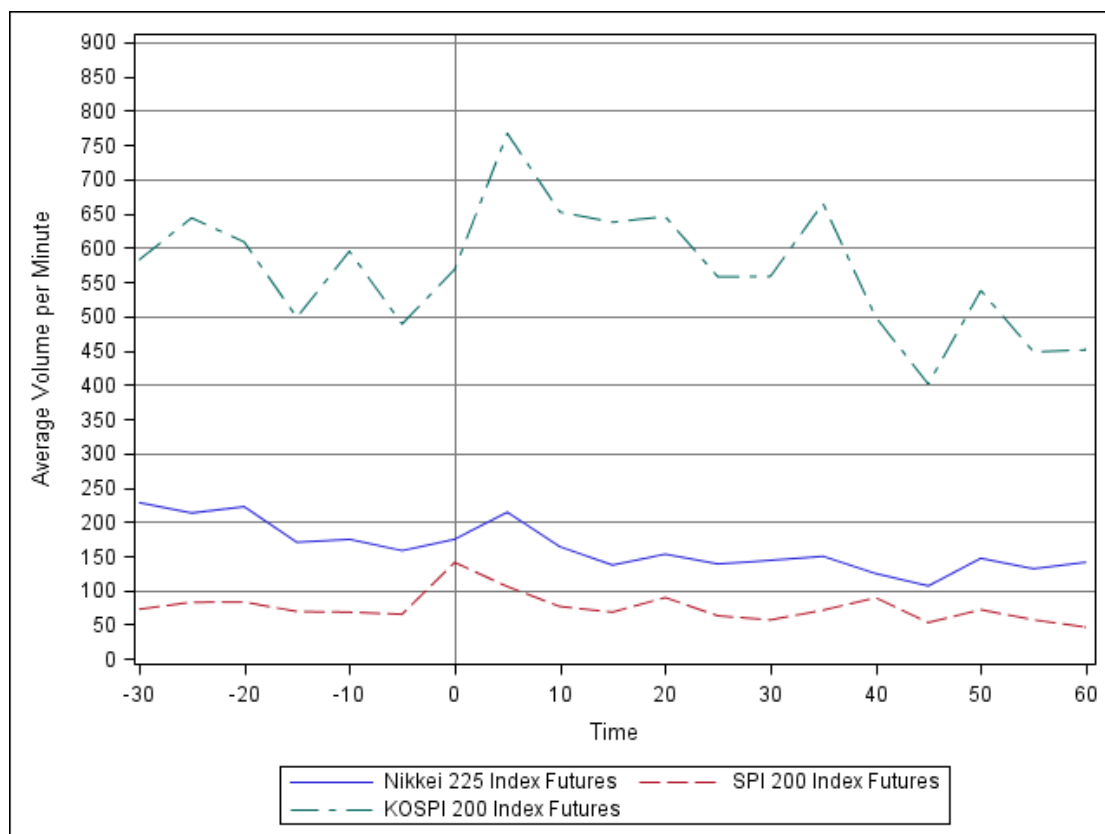


Figure 11. Trading volume around GDP, INP, RES and FAI announcements.

This figure outlines the average trading volume per minute, 30 minutes before and 1 hour after the announcement releases (positive, negative and zero surprises), regarding GDP, INP, RES and FAI. The index futures markets that continuously traded at the time of release were the Nikkei 225, SPI 200, KOSPI 200, Hang Seng and TAIEX.

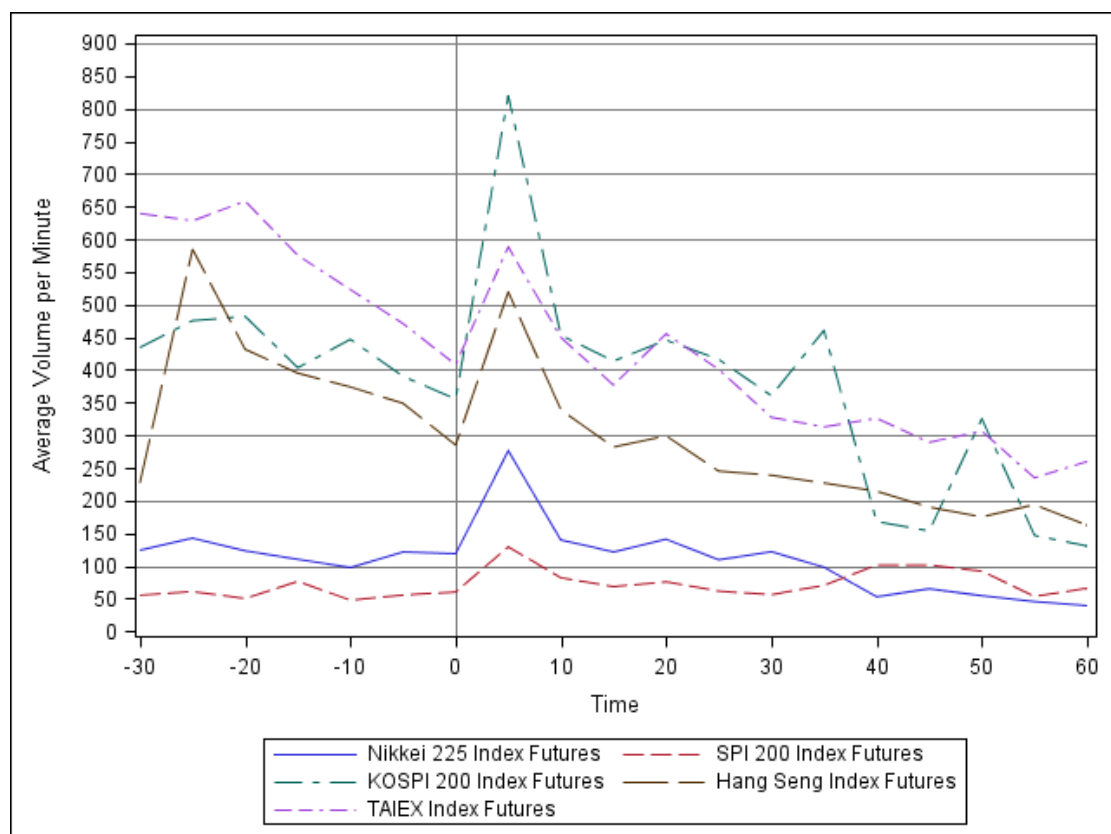


Figure 12. Trading volume around exports and imports announcements.

This figure outlines the average trading volume per minute, 30 minutes before and 1 hour after the announcements release (positive, negative and zero surprises), regarding export and import announcements. The index futures markets continuously trading at the time of release were the Nikkei 225, SPI 200, KOSPI 200, Hang Seng, TAIEX and SET 50.

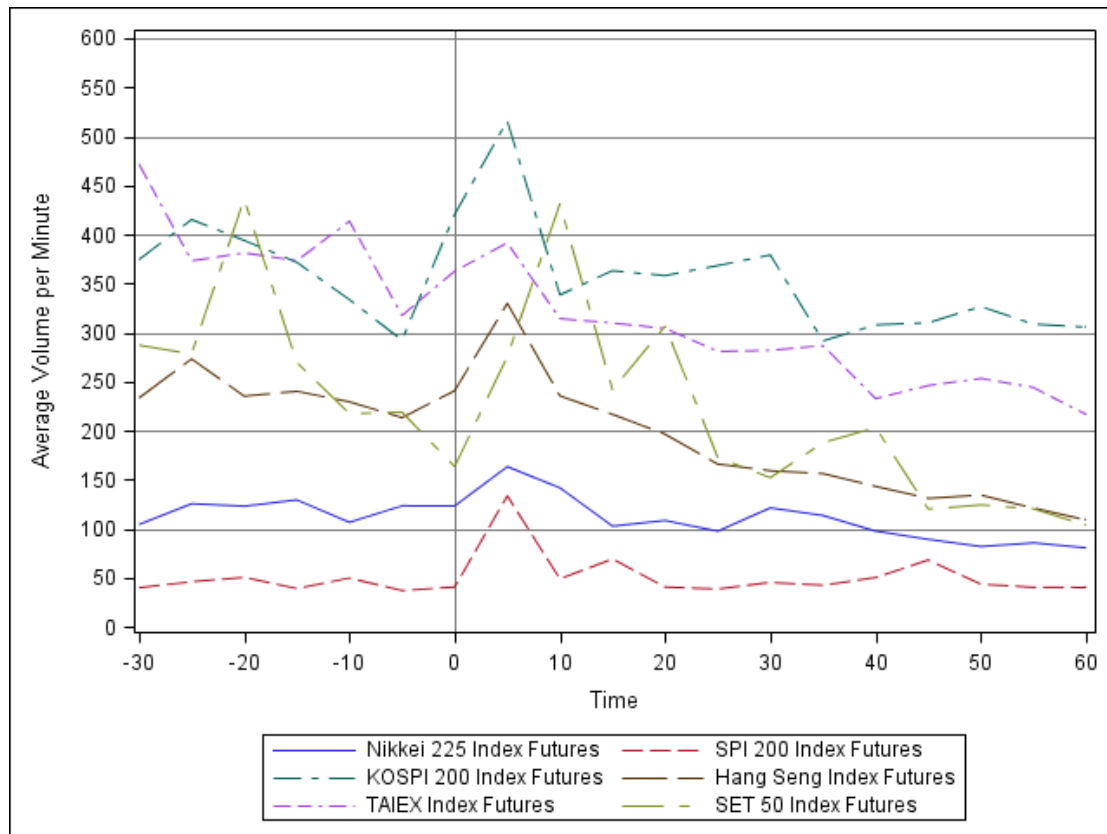


Figure 13. Trading volume around the CPI and PPI announcements.

This figure outlines the average trading volume per minute, 30 minutes before and 1 hour after the announcements release (positive, negative and zero surprises), regarding the CPI and PPI announcements. The index futures markets continuously trading at the time of release were the Nikkei 225, SPI 200, KOSPI 200, Hang Seng and TAIEX.

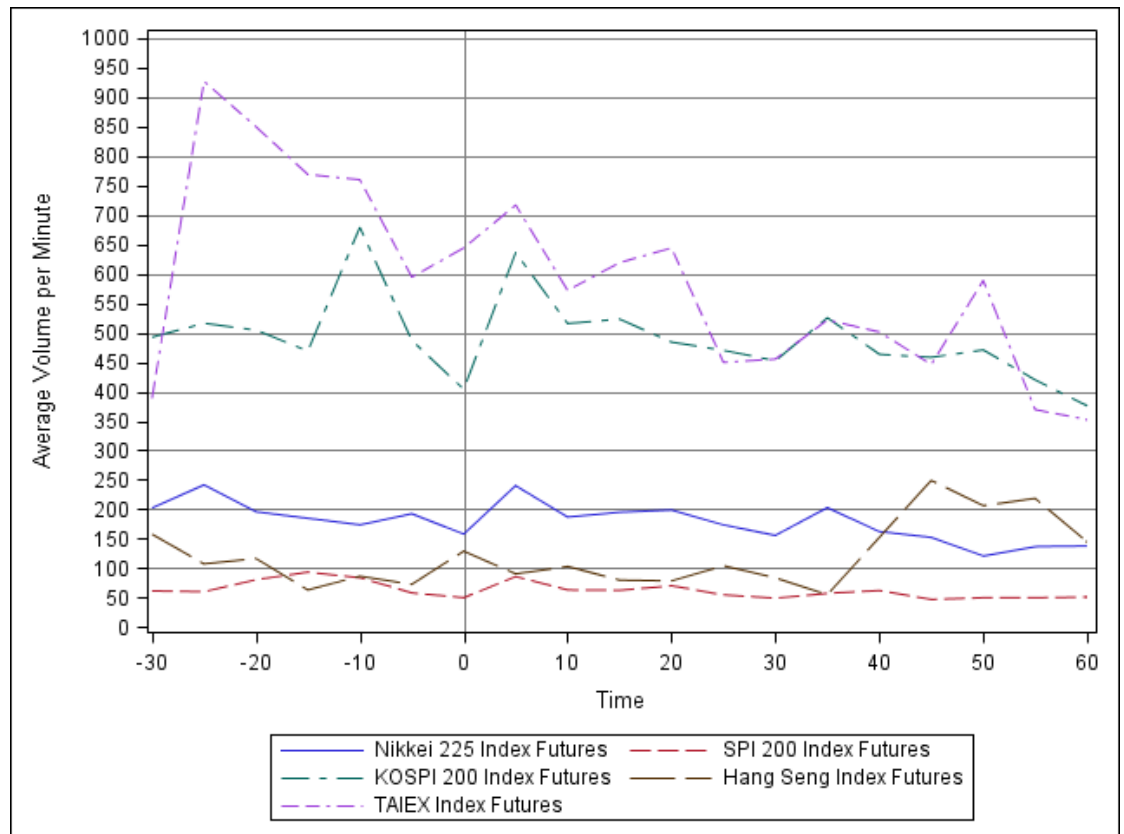


Figure 14. Trading volume around M2, NYL and MER announcements.

This figure outlines the average trading volume per minute, 30 minutes before and 1 hour after the release of announcement (positive, negative and zero surprises), regarding the M2, NYL and FRS announcements. The index futures markets continuously trading at the time of release were the Nikkei 225, SPI 200, KOSPI 200, Hang Seng, TAIEX and SET 50.

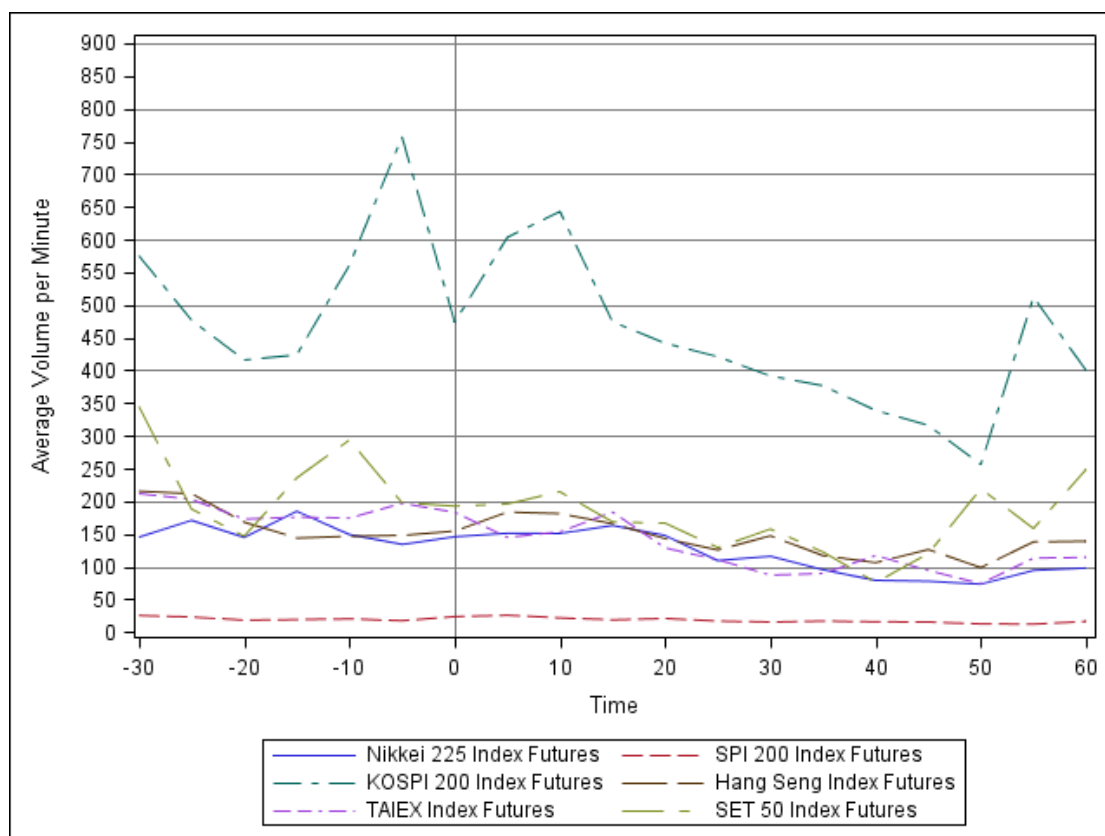


Figure 10 to Figure 14 present the average trading volumes for each group of the announcement release. For the first four groups of announcements, the trading volume of each market witnessed spiked around 5 minutes after the announcement, while the M2, NYL and FRS had little effect on the markets. Such abnormal trading volume patterns show that most of the trading volume happens within the first 5 minutes after the announcement release, and the volume rebound vanished approximately 10 minutes after the announcement. The abnormal trading volume pattern provides evidence that the macro-economic information leaks in China have been controlled well.¹⁴

¹⁴ The abnormal trading volume before the announcement is mainly due to the opening effect.

5.3 Multivariate Regression

This study uses methods in line with prior literature (Balduzzi et al., 2001; Hou & Li, 2016; Kim et al., 2015; Leung et al., 2017; Li, 2007; Louzis, 2015; Yilmaz, 2010). The multivariate regression examines the relationship between a 20-minute asset return with the surprise of the macro-economic announcement. For multiple macro-announcements (Group 2-4), this regression approach distinguished the individual effect of each simultaneously released news.

$$R_{kt} = \alpha + \sum_{i=1}^I \beta_i S_{i,t} + \varepsilon_t \quad (4)$$

As discussed above, the surprise S_t is calculated as:

$$S_{i,t} = \frac{A_{i,t} - E_{i,t}[A]}{\sigma} \quad (5)$$

Where $S_{i,t}$ denotes the ‘surprise’ of an announcement i announced at time t . $A_{i,t}$ is the actual figure, $E_{i,t}[A]$ is the median of the analyst expectations, and σ is the standard deviation of all differences. A standardised surprise provides a comprehensive comparison across various macro-economic indicators. Moreover, as the standard deviation is constant across all the ‘surprise’ measurements, such a ‘surprise’ has no statistically significant effect on the regression coefficient nor on the fit of the regression. The regression coefficient is estimated using White's (1980) heteroskedasticity consistent covariance matrix, and ε_t is an i.i.d. error term, representing that the data release is irrelevant to the return. For the joint model purpose, the GDP surprise for those not in the following month of each quarter is set to zero (Baum, 2015).

Where return R_{kt} denotes percentage return of futures market k , and this return uses the last trade price of the futures contract in the intraday 20-minute event window around the announcement.¹⁵

$$R_{kt} = (\text{Log}(P_{t-10}) - \text{Log}(P_{t+10})) * 100\% \quad (6)$$

Since the Chinese PMI is announced individually, the approach is reduced to a univariate regression as follows:

$$R_{kt} = \alpha + \beta S_t + \varepsilon_t \quad (7)$$

The statistical significance of the coefficient estimates β_i in Equations 4 and 7 suggest whether a macro-economic announcement S_i has an effect on the index futures market k (Hypothesis 1). The sign of the significant coefficient is used to test Hypothesis 2. The positive sign of the parameter estimated suggests the acceptance of Hypothesis 2, while the negative sign suggests its rejection.

¹⁵ Balduzzi et al. (2001) use an event window of 5 minutes before and 30 minutes after; Baum et al. (2015) use an event window of 10 minutes before and 10 minutes after. According to the CAR and volume patterns in the following section, asset price remains stable after 10 minutes of the announcement and the abnormal volume occurs within this time frame.

6. Empirical Results

This section presents the empirical results based on the macro-economic announcement groups; the proposed hypotheses are also discussed.

6.1 The Manufacturing PMI

This is a survey from business managers that conveys information about new orders, production and inventories. An index of 50 refers an unchanged condition with the last month, a reading above 50 means an optimistic opinion of the industrial output in the coming month and a reading below 50 indicates a worsening economy (see Table 4).

Table 4

The Response of Futures Returns to PMI Announcements

This table reports estimated response of futures returns on the standardised announcement surprises for the manufacturing PMI. The futures return was calculated as the first difference of the logarithm price 10 minutes before and 10 minutes after the announcement. The ordinary least squares (OLS) regression was estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The Hang Seng and SET 50 were excluded from the analysis because these futures contracts are not continuously traded during the announcements. Most PMI announcements for the TAIEX are 15 minutes before opening, so there was no cumulative return chart; rather, empirical results 10 minutes before to 10 minutes after the price are available and continuously trading. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	PMI (t-stat)	R^2
Nikkei 225	57	0.05741 (2.05)**	0.0652
SPI 200	55	0.09382 (2.63)**	0.1304
KOSPI 200	46	0.10539 (2.94)***	0.2155
TAIEX	50	0.08300 (2.02)**	0.0958
Standard Deviation of Surprise		0.47538	

The PMI announcement had a spillover effect on regional stock index futures across the whole examined period (see Table 4). The parameter estimates in the third column relate to how much one standard deviation of PMI positive surprise can bring to the index price change. For example, one standard deviation of positive China PMI could increase the Nikkei 225 Index Futures price by 0.057% in the 20-minute event window. Positive coefficients suggest the information regarding a strong Chinese economy is translated into a price level increase in the regional index futures markets. These results are not entirely consistent with prior literature. Baum (2015) examines the effect of Chinese macro-economic announcements on index futures from 30 September 2009 to 31 December 2013 and discovered that the Chinese PMI wields the most substantial influence on financial markets. However, their results show that PMI has no effect on the Japan Nikkei 225 Index Futures, which is the opposite of the results outlined in Table 4.

6.2 GDP, INP, Retail Sales, Fixed Asset

While there is some discussion regarding the credibility of Chinese GDP figures in earlier years, GDP provides the most comprehensive insight into Chinese economy conditions compared to other fundamental news. As shown in Table 5, GDP exerts the most significant influence on index futures markets and the magnitude of the response estimates are the largest across all the indicators. The positive sign indicates that better than expected economic growth increases the markets and vice versa. Previous literature also finds that GDP is a vital variable for stock markets (Baum et al., 2015; Birz & Lott, 2011). There are two reasons GDP wields such a great influence: 1) it is well-estimated by the public and 2) the Chinese government establishes the GDP range, reasserts the target and tries to accomplish this goal, leaving little room for variations. Therefore, any unexpected GDP release would shock financial markets. Furthermore, the model specification also leads to the large magnitude of the response coefficient, as the surprise is set to zero when GDP is not released. However, zero surprise is also economically important information.

Table 5***The Response of Futures Returns to GDP, INP, RES and FAI Announcements***

This table reports estimated response of futures returns on the standardised announcement surprises of GDP, INP, Retail Sales and FAI, which are released simultaneously. The futures return was calculated as the first difference of the logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression was estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The SET 50 was excluded from the analysis because this futures contract was not continuously traded during the announcement. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	GDP	Industrial Production	Retail Sales	Fixed Asset Investment	R^2
Nikkei	57	0.09024	0.06769	0.01691	−0.02678	0.2782
225		(2.84) ***	(2.41) **	(0.54)	(−1.08)	
SPI 200	46	0.15103	0.08424	0.01804	0.02364	0.4047
		(4.03) ***	(3.17) ***	(0.28)	(0.53)	
KOSPI	57	0.10596	0.03209	−0.03062	−0.07833	0.1878
200		(2.70) ***	(1.11)	(−0.83)	(−2.78) ***	
Hang	56	0.19457	0.08226	0.01858	−0.04020	0.3784
Seng		(4.21) ***	(2.05) **	(0.40)	(−1.00)	
TAIEX	56	0.09825	0.04849	−0.02327	−0.07045	0.2366
		(4.04) ***	(1.52)	(−0.66)	(−1.89) *	
Standard Deviation of Surprise		0.15516	0.71310	1.04196	0.48950	

INP, retail sales and FAI are released together every month; INP explains greatly the price change while the other two indicators contribute less (see Table 5). INP provides a comprehensive assessment of output; details of each sector and products are released along with the growth rate.

Despite retail sales providing the best available information about China's domestic consumption, it only contains information about goods, not services; thus, it provides

incomplete information about China's new economic landscape. Meanwhile, FAI implies long-term investment and momentum of future output; such uncertainty makes it less important compared to the current output situation (Baum et al., 2015; Orlik, 2011).

6.3 Exports and Imports

Although exports are not the main driving force of the Chinese economy, both imports and exports surprisingly explain the drive price movement of some index futures. For example, China is the largest international trade partner of Australia. Australia, as an export-oriented economy, exports raw materials to China, especially iron core; this makes Chinese imports figures sensitive to Australian mining companies. Furthermore, the mining industries constitute a large share of the Australian stock index.

The surprise of Chinese exports indicates two economic conditions regarding trading partners. Positive Chinese export growth rates cause current account deficits for the importing economy, damaging its financial markets. However, higher than expected exports represent a higher demand for this economy, which favours investors (Baum et al., 2015). The positive signs in Table 6 suggest that the Chinese exports growth rate demonstrates high demands that dominate regional economies.

Arslanalp et al. (2016) note that China's imports account for more than 4% of the GDP of Australia, Korea, Taiwan and Thailand, which means that a 10% decline in China's imports would cause 0.4% of write-offs in economic growth. Baum et al. (2015) discover that Chinese trades data from 2009 to 2013 were important for the US and Hong Kong index futures markets, but not for Japan, Australia and Taiwan. This is contrary to the results in Table 6. After splitting the data sample, they found that the response increased both in magnitude and significance. With the same methodology, the results in Table 6 explain what occurred after 2011. As discussed above, Chinese B&R Initiatives facilitate international trade and such trade partnerships are expected to increase as new free trade zones are established, with the Chinese government intending to increase high value-added

exports. Therefore, the spillover effect of exports and imports are now of interest to investors and this is expected to grow.

Table 6

The Response of Futures Returns to Exports and Imports Announcements

This table reports estimated response of futures returns on the standardised announcement surprises of exports and imports, which are released simultaneously. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression was estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. If an announcement release occurred several minutes apart, then the latter time was used as the simultaneous announcement time. For example, on 13 July 2017, Exports YoY was released at 11:20 China local time, while Imports YoY was released at 11:22 local time; therefore, 11:22 was used as the simultaneous time with the examined return being from 11:12 to 11:32. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	Exports	Imports	R^2
Nikkei 225	62	0.05581 (1.80)*	0.01396 (0.49)	0.0843
SPI 200	62	0.01651 (0.93)	0.04357 (2.23)**	0.1228
KOSPI 200	59	0.04003 (1.68)*	0.03143 (1.80)*	0.2113
Hang Seng	61	0.07870 (1.76)*	0.04461 (1.67)	0.1668
TAIEX	60	0.02993 (1.18)	0.02142 (1.12)	0.0652
Thailand SET	25	0.14746 (1.70)	0.04607 (0.80)	0.1577
50				
Standard Deviation of Surprise		7.18875	7.32204	

6.4 CPI and PPI

Despite the CPI's importance to domestic index futures markets—and Figure 10 shows volume spike soon after the announcement release—this has no spillover effect on regional stock markets (see Table 7). Chen, Liu, Lu, & Tang (2016) used the Baidu Search

Index to show that the CPI is the most searched indicator; they found that the CPI is the only indicator with a significant effect on the China Securities Index (CSI) 300 futures in the short term, showing volatility and trading liquidity.¹⁶

Table 7

The Response of Futures Returns to the CPI and PPI

This table reports estimated response of futures returns on the standardised announcement surprises of the CPI and PPI, which are released simultaneously. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression was estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The SET 50 was excluded from the analysis because this futures contract is not continuously traded during the announcement. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

	N	CPI	PPI	R^2
Nikkei 225	62	−0.00998 (−0.59)	0.02693 (1.42)	0.0204
SPI 200	61	−0.01418 (−0.87)	0.00169 (0.12)	0.0158
KOSPI 200	63	−0.00631 (−0.27)	−0.01704 (−1.03)	0.0048
Hang Seng	60	−0.04114 (−0.93)	−0.00637 (−0.20)	0.0173
TAIEX	61	−0.01274 (−0.41)	−0.03904 (−1.19)	0.0206
Standard Deviation of Surprise		0.21712	0.30219	

There are potential explanations regarding why the CPI has no spillover effect. First, Baum et al. (2015) argue that the median of the consensus data creates noise as an information proxy. Second, the composition of the CPI is not disclosed by the NBS. Third, the change in the CPI cannot be clearly distinguished from a real price change and the calculation method, despite detailed weights of the index components being disclosed in

¹⁶ They investigate five announcements: CPI, PPI, RES, INP and FAI. Baidu is the largest search engine in China.

most countries (Orlik, 2011). Fourth, inflation is managed well by the government, leaving fewer opportunities for real shocks to financial markets.

Although the CPI has an insignificant influence on the stock market, the negative response coefficient of the CPI in Table 7 is still consistent with prior research. Geske and Roll (1983) explain that a stock return can be negatively related to an unexpected CPI announcement. A positive CPI surprise could be interpreted by investors as tightening monetary policies, such as interest rate hikes, in the future. This prospect would decrease asset prices. Furthermore, the negative coefficient responses in Table 7 suggest investor belief in Chinese anti-inflationary policies (Baum et al., 2015; Girardin et al., 2014).

6.5 Money Supply M2, New Yuan Loans and Foreign Reserves

With some exceptions, news regarding M2, NYL and FRS leave most financial markets unaffected (see Table 8). These results are consistent with Figure 14. Abnormal volume indicates that only the KOSPI 200 shows a slight response. As discussed, these are controlled by the authorities, indicating the future economic prospects from the perspective of government.

Table 8

The Response of Futures Returns to M2, NYL and FRS Announcements

This table reports estimated response of futures returns on the standardised announcement surprises of the M2, NYL and FRS, which are released simultaneously. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression was estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimates coefficient denotes the percentage of return within one standard deviation of surprise. The sample period is from 1 January 2011 to 31 August 2015. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	Money Supply	New Yuan	Foreign	R^2
		M2	Loans	Reserves	

Nikkei	41	0.07915	−0.02422	−0.01679	0.0658
225		(1.13)	(−0.63)	(−0.63)	
SPI 200	46	0.00633	−0.00008881	−0.01529	0.0130
		(0.31)	(−0.00)	(−0.52)	
KOSPI	17	0.13476	−0.06460	−0.01768	0.3006
200		(2.02)*	(−1.25)	(−0.24)	
Hang	39	0.05458	−0.00158	−0.03204	0.0642
Seng		(1.12)	(−0.02)	(−0.48)	
TAIEX	13	0.15703	−0.04782	−0.07684	0.3337
		(1.79)	(−0.63)	(−0.73)	
Thailand	26	−0.09692	0.08292	−0.01385	0.2158
SET 50		(−2.48)**	(1.56)	(−0.71)	
Standard		0.73377	204.88	56.768	
Deviation of					
Surprise					

6.6 Conclusions of Hypotheses

Therefore, the release of Chinese GDP, INP, exports and imports announcements has a comprehensive spillover effect on regional index futures. The parameter estimates in Table 4 to Table 8 indicate that macro-economic announcements that have a spillover effect on the stock market. The sub-hypotheses generated from Hypothesis 1 can be verified accordingly. Therefore, the results suggest an overall acceptance of Hypothesis 1.

The significant positive response signs of PMI, GDP, INP, exports and imports show that good news about the Chinese economy increases the regional stock markets when the Chinese economy is expanding, which leads to acceptance of Hypothesis 2. Unlike other developed countries, China has a strong resistance to recession (Wen & Wu, 2018). Furthermore, to promote sustainable economic advancement, the Chinese government implement multiple policies, and the economy structure of China has successfully transferred from being led by investment to consumption. Since Chinese GDP growth remains positive, the Chinese unemployment rate is decreasing, and inflation is decreasing

but stable, the Chinese economy has not contracted from 2011 to 2017.¹⁷ These results add to the literature that explains the signs of response, especially during a different stage of the business cycle. This supports Baum et al. (2015) but contrasts with Andersen et al. (2007) and Boyd, Hu and Jagannathan (2005). One feasible explanation is that the nature and characteristics of the business cycle between developing countries and developed countries are different.¹⁸

6.7 Further Analysis

Since the PMI is released individually and the number of observation is large, it allows for an examination of the changing spillover effect. This study investigates the rolling response estimates. The rolling regression is the same as it is for Equation 7 and the rolling window is 30 observations. For example, the available number of observations on the Nikkei 225 is 57, and the first response estimate is the regressing asset return on the first 30 manufacturing PMI surprises as ended on October 2014. The next estimates plotted for November 2014 is the regressing asset return on the latest 30 PMI surprises. Compared with the upward trend across all markets found by Baum (2015), the response coefficients show a consistent downward trend, suggesting that the effect of the manufacturing PMI on regional index futures is decreasing.¹⁹ As Figures 15 to 18 demonstrate, the official Chinese manufacturing PMI data had an effect on the regional market in the first half of the examined period; however, since October 2016, the effect has vanished across all four index futures markets.

¹⁷ Andersen et al. (2007) define contractions as three consecutive monthly decreases of NFP employment.

¹⁸ Rand and Tarp (2002) discuss the different business cycles of both developing and developed countries.

¹⁹ Baum (2015) examines the rolling parameter with 17 observation windows. This research extends the investigation period; the rolling window corresponds to Baum's work and almost identical estimates patterns were found.

Figure 15. The rolling coefficient estimate for the manufacturing PMI on the Nikkei 225.

This figure outlines the changing estimated response of futures returns on the standardised announcement surprises of the manufacturing PMI. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The rolling OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. Each plot of the coefficient in the figure is estimated from the previous 30 observations and the next parameter estimates are also estimated on the latest 30 observations. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The grey dashed lines are the heteroscedasticity consistent 95% upper and lower confidence bands. The red triangle represents the confidence level of each rolling estimate at 90%, 95% or 99%. The confidence levels of 90%, 95% and 99% correspond to the significance levels 10%, 5% and 1%, respectively.

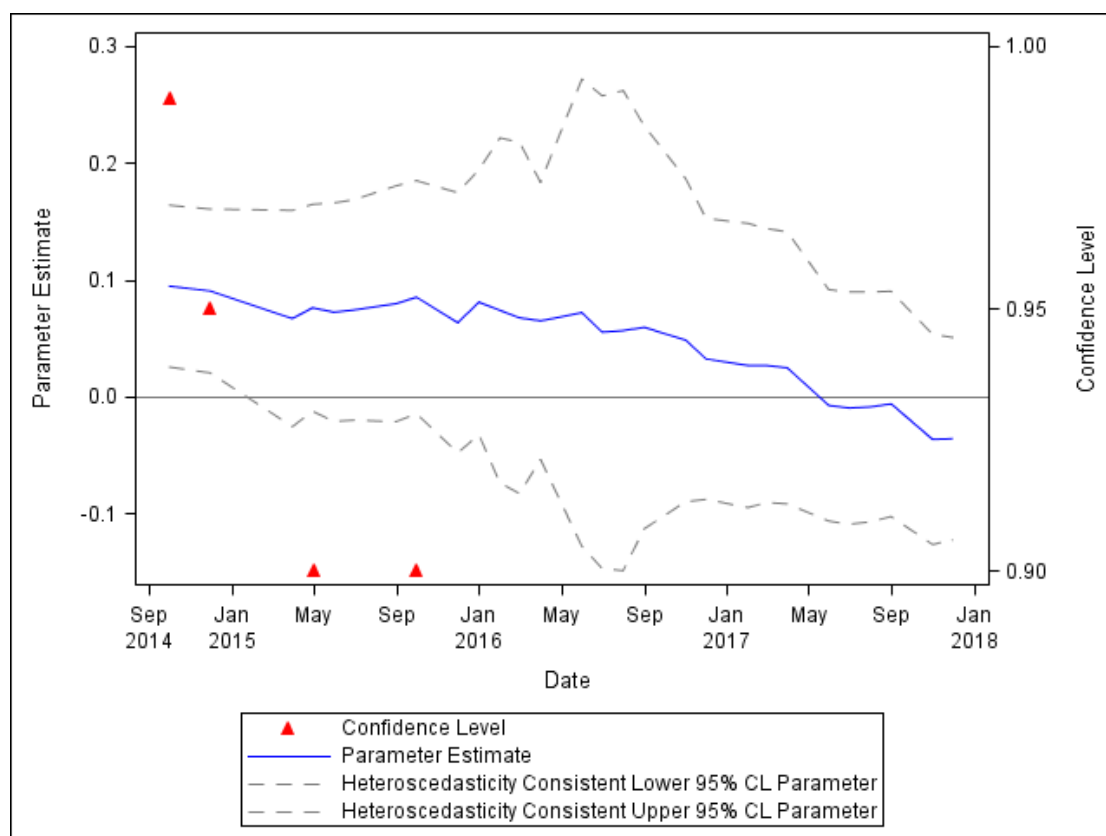


Figure 16. The rolling coefficient estimate for the manufacturing PMI on the SPI 200.

This figure outlines the changing estimated response of futures returns on the standardised announcement surprises of the manufacturing PMI. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The rolling OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. Each plot of the coefficient in the figure is estimated from the previous 30 observations and the next parameter estimates are also estimated on the latest 30 observations. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The grey dashed lines are the heteroscedasticity consistent 95% upper and lower confidence bands. The red triangle represents the confidence level of each rolling estimate at 90%, 95% or 99%. The confidence levels of 90%, 95% and 99% correspond to the significance levels 10%, 5% and 1%, respectively.

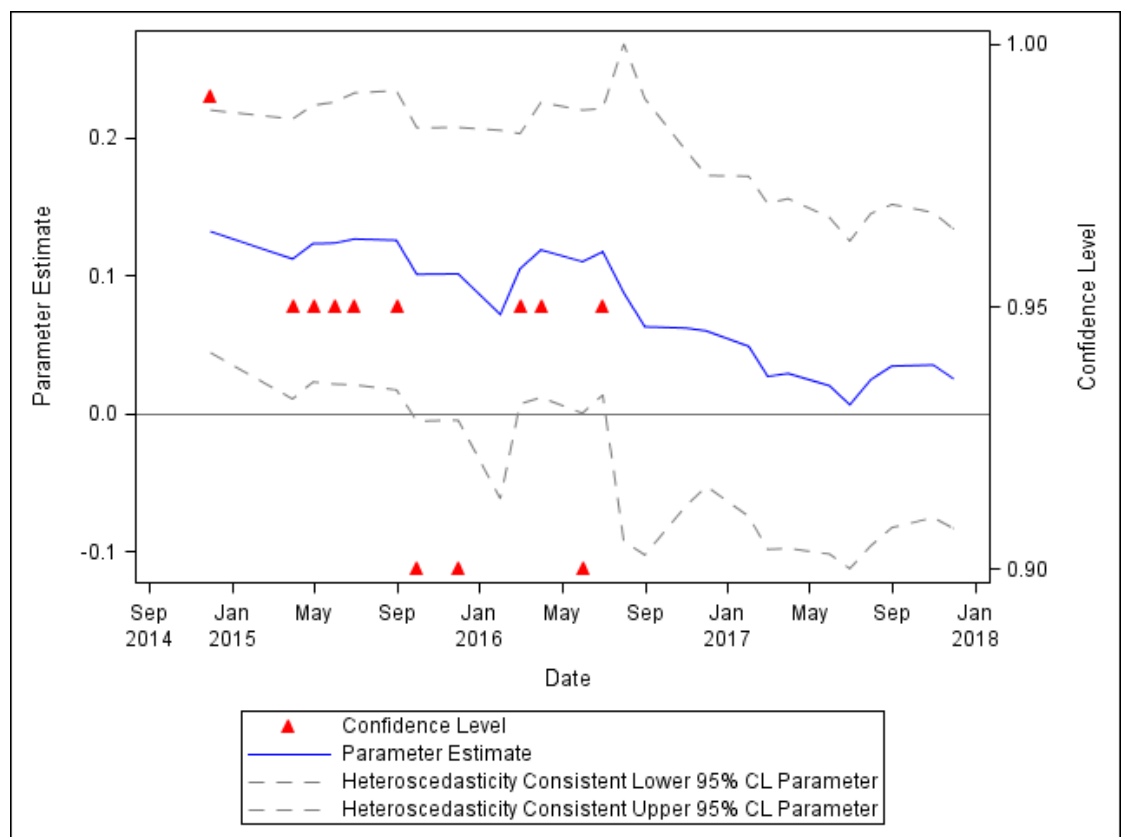


Figure 17. The rolling coefficient estimate for the manufacturing PMI on the KOSPI 200.

This figure outlines the changing estimated response of futures returns on the standardised announcement surprises of the manufacturing PMI. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The rolling OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. Each plot of the coefficient in the figure is estimated from the 30 prior observations and the next parameter estimates are also estimated on the latest 30 observations. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The grey dashed lines are the heteroscedasticity consistent 95% upper and lower confidence bands. The red triangle represents the confidence level of each rolling estimate at 90%, 95% or 99%. The confidence levels of 90%, 95% and 99% correspond with the significance levels 10%, 5% and 1%, respectively.

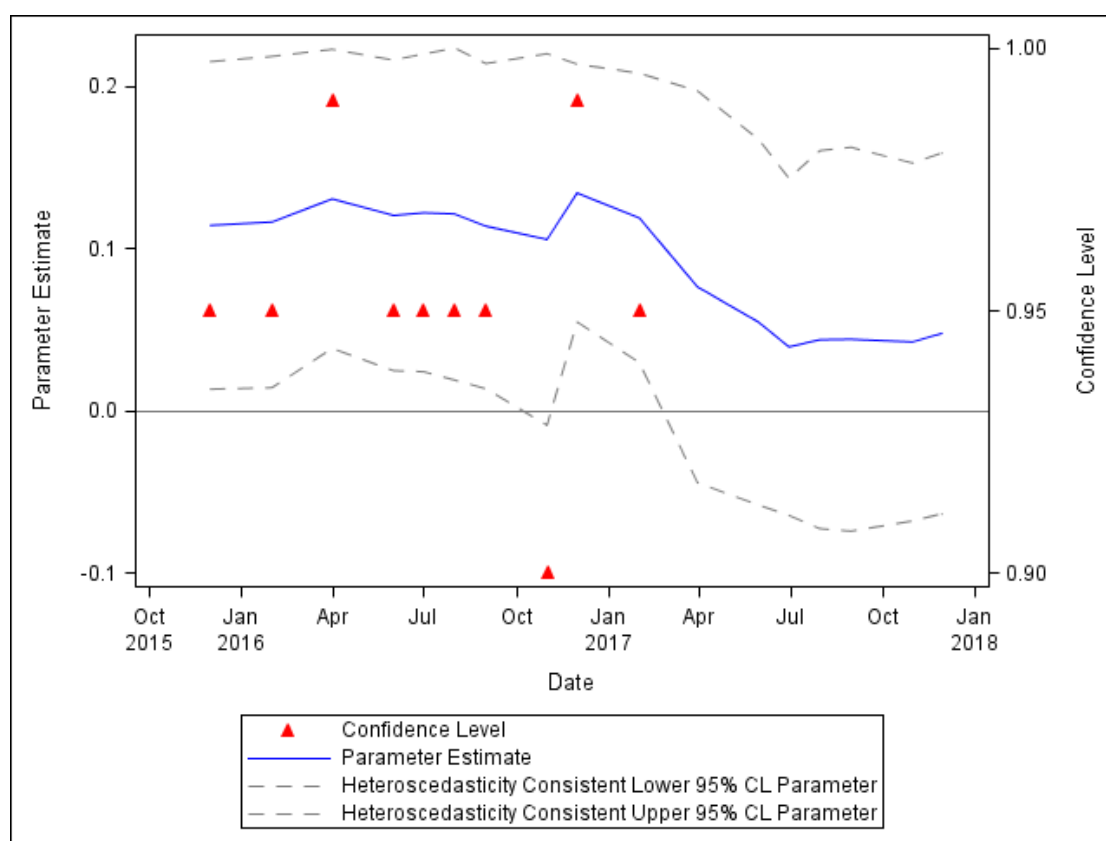
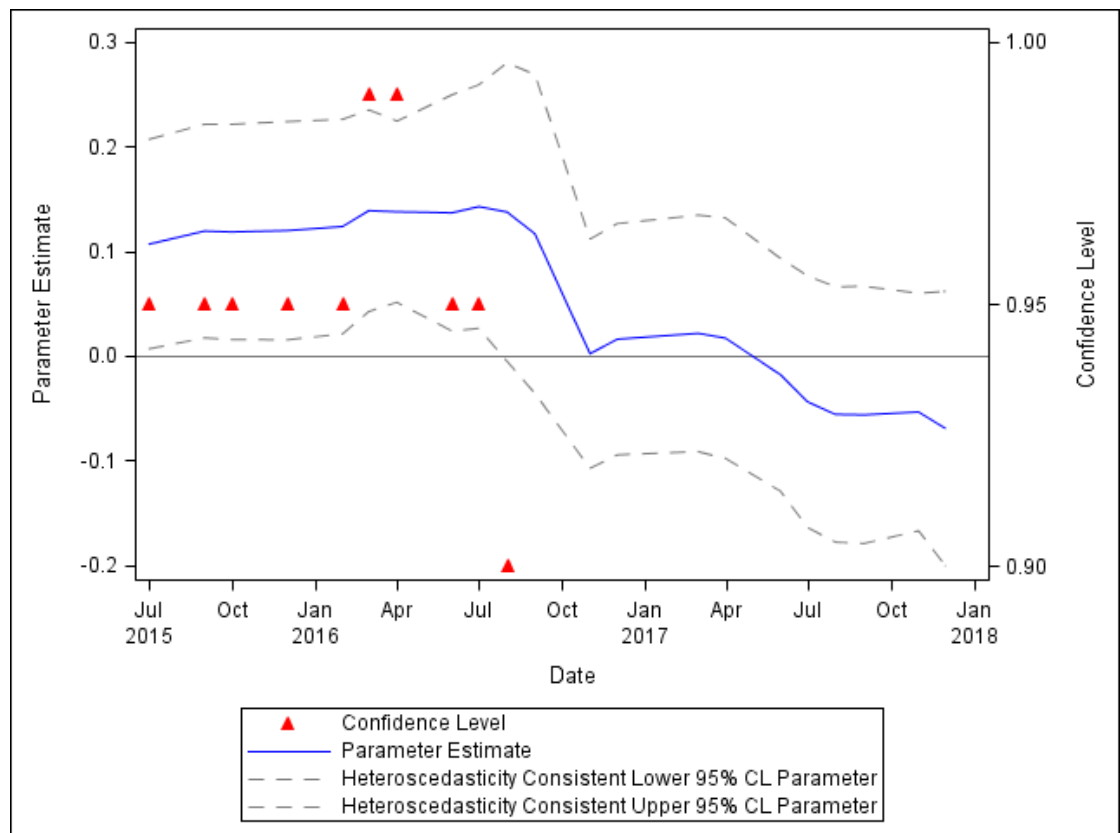


Figure 18. The rolling coefficient estimate for the manufacturing PMI on the TAIEX.

This figure outlines the changing estimated response of futures returns on the standardised announcement surprises of the manufacturing PMI. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The rolling OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. Each plot of the coefficient in the figure is estimated from the previous 30 observations and the next parameter estimates are also estimated on the latest 30 observations. The estimates coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The grey dashed lines are the heteroscedasticity consistent 95% upper and lower confidence bands. The red triangle represents the confidence level of each rolling estimate at 90%, 95% or 99%. The confidence levels of 90%, 95% and 99% correspond with the significance levels 10%, 5% and 1%, respectively. Most PMIs were announced for the TAIEX 15 minutes before the opening, so there is no cumulative return chart; however, empirical results 10 minutes before to 10 minutes after the price are available and continuously trading.



The diminishing influence of the manufacturing PMI on the stock markets may be attributable to several reasons. Since December 2004, the Chinese government decided to alter the Chinese fundamental strategy from one driven by investment and exports to one driven by domestic consumption (Lardy, 2006). In 2013, China proposed the B&R as another strategic decision for economic reform. The Chinese economy had been transitioning from being a manufacturing economy to service economy, with the growth rate in the tertiary sector surpassing the secondary sector in the fourth quarter of 2012. Currently, services contribute to half of the Chinese GDP. Therefore, investors have identified an economic transition in the Chinese market and are less interested in the Chinese manufacturing PMI announcements.²⁰ This pattern also explains the reason behind the low guidance ability of the manufacturing PMI to the price movement direction in Section 5.1.

Another possible reason that PMI is of less interest to investors is the feature of this indicator. The manufacturing PMI is a leading indicator that collects the estimates of business executives (see Section 3.1.1 & Appendix A). The collection is in the middle of the last month, and reports on the first day of the next month, losing timeliness. Although it provides information regarding the estimates of INP, it is not the accurate measurement of output. Since INP is estimated well by the PMI release and reveals actual output, INP is more interesting to investors. The final reason is the existence of competitors. Caixin PMI, the private indicator, weakens the position of official Chinese indicators in explaining the Chinese economy.

²⁰ Analyst consensus data on the non-manufacturing PMI and Caixin China PMI service data are not available in the Bloomberg database; therefore, the effect of service PMI is not examined in this study.

7. Summary and Conclusion

Despite being a developing country, China became the second largest economy in the world as of 2011. Prior studies that examine macro-economic announcements have focused mainly on the spillover effect that originates from the major developed economies, such as the US and European countries. With the growing affluence and scale of the Chinese economy, this study contributes to the literature by exploring the interconnectivity between Chinese macro-economic announcements and Asia–Pacific index futures markets. This study extends the understanding of the information transmission mechanism from a large emerging country with unique features to surrounding economies that have close trading ties, and includes both emerging and developed financial markets. A better understanding of these complex relationships is likely to assist regulators in conducting effective market surveillance and help investors develop their trading strategies.

Based on prior literature, this study develops and tests two hypotheses: 1) scheduled macro-economic announcements that contain ‘surprises’ have spillover effects on regional indices and 2) positive ‘surprises’ for scheduled macro-economic announcements lead to positive returns in regional indices and vice versa.

This thesis first extensively discussed each macro-economic announcement and its qualitative importance to the stock market. Then a method was used to convert the median of the analyst consensus regarding the announcement and the actual readings into a standardised format that represents the information content of the macro-economic announcement. Announcements are classified as a positive, negative or zero surprise. Positive surprises refer to the actual figures being higher than expected, which also imply an unexpected improvement in the economy. Negative surprises are bad news to the stock markets and zero surprises are neutral. Macro-economic announcements are also categorised into five groups based on release time, which means that announcements in one group are released simultaneously.

The research also examines market response in terms of price movement patterns and volume patterns using CAR and volume per minute. As the manufacturing PMI (Group 1) is the only announcement released individually, CAR is performed on this indicator based on the sign of the surprise. The price movement shows an ambiguous result, which lead to the further analysis of the manufacturing PMI. The volume response patterns show that stock markets have an abnormal trading volume at the time of the announcements release, except for Group 5 (M2, NYL and FRS). Additionally, the volume pattern also suggests that regional indices respond within the first few minutes of a news release.

This study employs multivariate regressions to test five groups of Chinese macro-economic announcement effects on six indices (Japan, Australia, Korea, Hong Kong, Taiwan and Thailand), using tick-by-tick data. Empirical results suggest acceptance of both hypotheses: GDP (Group 2) has a broad significant effect on all regional index futures markets, while INP (Group 2) and exports and imports (Group 3) are essential to some stock markets (INP influences the indices of Japan, Australia and Hong Kong; trades influence the indices of Japan, Australia, Korea and Hong Kong). More specifically, Chinese GDP announcements wield the most substantial influence on regional indices as they provide the most comprehensive view of the Chinese economy. Industrial output and international trades constitute a large portion of the Chinese economy, making INP and Trades (exports and imports) the second and third most important indicators, respectively. Although indicators regarding price level, the CPI and PPI (Group 4), induce abnormal volumes, these two macro-economic announcements have no effect on stock market returns. The main reason is that the change in these indicators cannot be clearly distinguished from real price changes, and the calculation method as the composites of the indices are not disclosed to the public. The empirical results, along with the volume pattern, show that announcements in Group 5 are less important to the stock market.

Since the manufacturing PMI is released individually and the number of observations is large, this allows for further analysis of the spillover effect across time. The time-variant responses of the stock markets to the Chinese manufacturing PMI are consistent and demonstrate a persistent downward trend. At the end of the sample period, this indicator has no influence on the regional stock markets. The most likely explanation is that the Chinese economic structure has transferred from growth that is driven by investment and exports to growth that is driven by domestic consumption. The industrial outputs are no longer dominant in the Chinese economy.

Furthermore, empirical results reveal that a positive economic shock of these macro-economic announcements creates a positive return in these indices and vice versa. This contributes to the literature by illustrating that, during the expansion period in a large developing country, the sign of the surprise and stock return are positively correlated. In a theoretical context, in developing countries, cash flow, rather than discount rates, dominate the asset price during the expansion period.

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Appendix A: Methodology of Calculation Indicators

The Manufacturing PMI

The calculation methodology for the Chinese manufacturing PMI used by the CFLP is based on the US Institute of Supply Management; the data are from anonymous business managers and this bypasses the local government. The survey is conducted in the middle of each month, with the weighting varying across 11 areas.

GDP

The methodology for GDP calculation is commonly known as three approaches: expenditure, income and production. Chinese GDP figures use the production approach, which is the sum of the value added across all sectors. The figures for the expenditure approach are also released annually.

Industrial Production

The sampled companies used to calculate value-added INP have kept changing. Until 2011, the sampled companies with an annual operating income over CNY 20 million were included. The largest 40,000 firms report to the China NBS directly, while the remained report to the local government, leaving room for the local government to manipulate the data. Along with INP, the details of industrial output are also released according to sector and product.

Retail Sales

Companies are divided into three groups according to annual operating income. The first group is the largest (5000 enterprises), which report retail data directly to the China NBS. The second group of companies (annual operating income of wholesalers above CNY 20 million, retailers above CNY 5 million and hotels and restaurant above CNY 2 million) report to the local government. The data from the small firms are from a sample survey.

Fixed Assets Investment (Excluding Rural Households)

FAI is also divided into two groups: real estate and others. Large real estate developers report to the China NBS headquarters while small developers report to the local government. Regarding other fixed investment, CNY 5 million is the reporting threshold.

Exports and Imports

Trades data are collected and reported by China's General Administration of Customs.

Consumer Price Index

The CPI is from the survey of household consumption throughout the nation. The survey team, spread over 50,000 locations and 500 towns, compile the prices of eight groups of household goods, monthly, weekly or daily, depending on the type of goods. The weightings of the eight components change annually.

Producer Price Index

The PPI is the average of two collections of data conducted on the 8th and 18th of each month, including 11,000 products from 50,000 firms in 430 cities. Different weightings are allocated to each product according to their share in the output.

M2 and New Yuan Loans

M0	Notes and coins actually in circulation
M1	M0 + demand deposits
M2	M1 + short-term deposits

Collected by the PBOC.

Foreign Reserves

The China State Foreign Exchange Administration calculates the FRS in line with the International Monetary Fund's Balance of Payment Manual. However, details of the calculation are still undisclosed.

Source: China National Bureau of Statistics (2018) and Orlik (2011)

Appendix B: Sub-Groups of the M2, NYL and FRS

Before September 2015, M2, NYL and FRS were announced together; however, after this, FRS was released individually. Group 5A and Group 5B examine M2 and NYL, and FRS respectively after the change of schedule. As the FRS are released quarterly and the other two monthly, Group 5C and Group 5D are designed to distinguish the individual effect of the FRS and the grouped effect of M2 and NYL throughout the whole period (see Table 9).

Table 9

Sub-Groups of the M2, NYL and FER

Announcement	Abbreviation	Category	Frequency	Unit	Release Authority
Group 5-A (1 September 2015 to 31 December 2017)					
Money Supply M2 YoY	M2	Financial Indicator	Monthly	%	PBOC
New Yuan Loans CNY	NYL	Financial Indicator	Monthly	CNY billion	PBOC
Group 5-B (1 September 2015 to 31 December 2017)					
Foreign Reserves	FRS	External	Quarterly	USD 100 million	PBOC
Group 5-C (1 January 2011 to 31 December 2017)					
Money Supply M2 YoY	M2	Financial Indicator	Monthly	%	PBOC
New Yuan Loans CNY	NYL	Financial Indicator	Monthly	CNY billion	PBOC
Group 5-D (1 January 2011 to 31 December 2017)					
Foreign Reserves	FRS	External	Quarterly	USD 100 million	PBOC

Group 5A: Response of Futures Returns to M2, NYL (1 September 2015 to 31 December 2017)

Table 10

The Response of Futures Returns to the M2 and NYL Announcements, 1 September 2015 to 31 December 2017

The estimated response of futures returns on the standardised announcement surprises of the M2 and NYL, which are released simultaneously. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimated coefficient denotes the percentage of return within one standard deviation for the surprise. The KOSPI 200 is excluded from the analysis because only four observations were continuously traded during the announcement. *, ** and *** are the significance levels 10%, 5%, 1%, respectively.

	N	Money Supply M2	New Yuan Loans	R^2
Nikkei 225	24	0.00161 (0.05)	0.07431 (3.47) ***	0.4421
SPI 200	26	-0.00265 (-0.05)	0.02909 (1.47)	0.1209
Hang Seng	20	0.12637 (2.19) **	0.04184 (1.38)	0.3103
TAIEX	10	0.07689 (0.50)	0.00220 (0.05)	0.1202
Thailand SET 50	17	0.01876 (0.28)	0.02395 (0.85)	0.0416

Group 5B: Response of Futures Returns to the FRS Announcements (1 September 2015 to 31 December 2017)

Table 11

The Response of Futures Returns to the FRS Announcements, 1 September 2015 to 31 December 2017

The estimated response of futures returns on the standardised announcement surprises of FRS. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimated coefficient denotes the percentage of return within one standard deviation for the surprise. The KOSPI 200 is excluded from the analysis because only two observations were continuously traded during the announcement. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	Foreign Reserves	R^2
Nikkei 225	22	0.15856 (1.67)	0.2885
SPI 200	22	0.13448 (2.88) ***	0.2876
Hang Seng	17	0.11843 (1.26)	0.1276
TAIEX	8	-0.35200 (-4.69) ***	0.6611
Thailand SET 50	19	0.07045 (1.25)	0.0314

Group 5C: Response of Futures Returns to the M2 and NYL Announcements

Table 12

The Response of Futures Returns to the M2 and NYL Announcements

The estimated the response of futures returns on the standardised announcement surprises of the M2 and NYL, which are released simultaneously and do not coincide with the FRS. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimated coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	Money Supply M2	New Yuan Loans	R^2
Nikkei 225	55	0.06019 (0.94)	0.04154 (1.64)	0.0989
SPI 200	61	-0.00212 (-0.11)	0.01759 (1.28)	0.0315
KOSPI 200	14	0.10130 (1.28)	0.01315 (0.22)	0.3144
Hang Seng	51	0.06304 (1.47)	0.03834 (1.04)	0.1448
TAIEX	53	0.04182 (1.42)	-0.00151 (-0.13)	0.0790
Thailand SET 50	40	-0.05813 (-1.59)	0.01463 (0.41)	0.0635

Group 5D: Response of Futures Returns to the FRS Announcements

Table 13

The Response of Futures Returns to the FRS Announcements

The estimated response of futures returns on the standardised announcement surprises of the FRS, which are released individually. The futures return was calculated as the first difference of logarithm price 10 minutes before and 10 minutes after the announcement. The OLS regression is estimated using a heteroskedasticity consistent covariance matrix (White, 1980) with an intercept term. The estimated coefficient denotes the percentage of return within one standard deviation for the surprise. The sample period is from 1 January 2011 to 31 December 2017. The KOSPI 200 was excluded from the analysis because only five observations were continuously traded during the announcement. *, ** and *** are the significance levels 10%, 5% and 1%, respectively.

Instrument	N	Foreign Reserves	R^2
Nikkei 225	26	0.11511 (1.56)	0.2350
SPI 200	26	0.09868 (2.49)**	0.2389
Hang Seng	20	0.06904 (0.88)	0.0453
TAIEX	12	-0.00423 (-0.14)	0.0012
Thailand SET 50	20	0.05028 (0.73)	0.0149