Developing Stock Markets and the Real Economy: investigating Chinese stock market turbulences in the past 18 years

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***Abstract*— This study investigates the relationship between developing stock markets and the real economy by examining the effect of stock market crashes on macroeconomic variables in China in recent years. I determine periods of stock market crashes in China and estimate a panel Vector Autoregression model to assess the impulse responses of provincial GDP, interest rate, consumer confidence index and consumer price index to stock market crash shocks. The impulse response functions reveal a statistically insignificant response of GDP to stock market crashes, yet significant negative responses of consumer confidence index to stock market crashes. A robustness check indicates a positive reaction of fixed investment to crash shocks. I speculate that as the Chinese economy is investment-driven, it is resilient to wealth effects while the increase in fixed investment in response to financial crash offsets consumption changes to produce an overall insignificant net effect in GDP.**

I. Introduction

As their economies undergo significant growth in the past decades, numerous developing countries have experienced a simultaneous rapid development in their financial and capital markets. China in particular witnessed a marked expansion of its financial markets, in particular its stock market, within the past 15 years; the Shanghai Stock Exchange (SSE) Composite Index experienced an increase as much as nearly 4000 from just above 2000 in 2002 to a peak of over 6000 in 2007. With the large-scale development nevertheless come stock market turbulences and crashes. The SSE Index suffered several minor turbulences as well as massive drops, in particular one following the 2007-2008 global financial crisis and, after a period of recovery, another steep decline in June 2015. Despite such slumps in stock market performance, in contrast to other developed countries whose economies often underwent pronounced declines due to capital market crashes, the real economies of developing countries whose financial markets have a relatively short history appear to experience rather little, if any, effect from declines in stock market performances. China in particular seemed not to have suffered any significant declines recently as a consequence of the countrys stock market turbulences. Not only is the Chinese stock market a less share of its GDP compared to developed countries such as the United States, its stock market also possesses distinct differences from developed, and even some similarly under-developed countries: a large number of Chinese stock market investors are small individual retail investors focused on short-term gains rather than professional or institutional investors as in the case of the United States and other Western countries. Furthermore, Chinese stock markets experience frequent policy interventions from the government. Given these differences, it has thus come into interest whether Chinese stock market turbulences would have any adverse effects at all on macroeconomic variables. Whilst numerous literatures suggest that stock markets affect the real economy both in the short run and in the long run, such papers often cite evidence from mainly developed stock markets with characteristics dissimilar to Chinas. There has not been recent literature conducting an in-depth study of the relation between financial markets and the macroeconomic variables for the case of China. This study hence seeks to determine whether there existed real impacts of historical and recent stock market turbulences on the economy, and if yes, to what extent. This study will rely upon data sets of the SSE Index and China macroeconomic variables from December 1998 to December 2016. First, I will estimate the change in Chinas quarterly GDP by province, Consumer Confidence Index, interest rate and Consumer Price Index associated with turbulences in the Chinese stock market. I will then examine the effect of Chinese stock market crashes on individual provinces GDP, in particular those with most advanced economic and financial development to determine how the level of influence varies among regions. I estimate a panel Vector Autoregression Model (VAR) to analyze the data. Stock market booms and busts are first identified in order to determine periods of stock market crash using both the algorithms of Bry and Boschan (1971) and the framework of Bord *et al.* (2008). A Vector Autoregression (VAR) model is then constructed to investigate the reactions of the real economic variables to stock market turbulences through the impulse response functions (IRF). The main findings do not support my research hypothesis and the theory proposed by many studies that stock market crashes have a real effect on the GDP. Nevertheless, other variables do show statistically significant responses to stock market crashes. The Consumer Confidence Index is found to negatively react to a stock market crash, and there is also a statistically significant negative response of the Consumer Price Index to stock market turbulences. I speculate that since the Chinese economy is investment-driven, it is rather resilient to declines in consumption, whereas any declines in stock market investment are offset by increases in fixed asset investment as small investors withdraw their stock investments and turn to other forms. As robustness checks, I examine the existence of

influence of stock market turbulences on different sectors of the GDP and on major financially developed regions through IRF to determine if significant results come up. The paper is organized as the following: I review relevant literatures on the relation between stock markets and macroeconomic variables in section 2, and describe my identification strategy, data sources and econometric methods in section 3. In section 4, I report my findings and results of my robustness checks. Section 5 concludes the study.

II. Literature Review

A. Chinese Stock Market Crashes or Variables and the Real Economy

While evidence has attested to the large-scale effect stock market crashes and financial crises can have on macroeconomic variables in developed economies, this effect does not apply in China according to Wangs research (2010). Wang investigated the time-series relationship between stock market volatility and macroeconomic volatility in China from 1992 to 2008. Exponential generalized autoregressive conditional heteroskedasticity and lag-augmented Vector Autoregressive (VAR) models were employed to estimate the relationship between Shanghai Composite Index and real economic variables. The study found no causal relationship between GDP volatility and stock returns volatility but only a causal relationship between stock market volatility and inflation volatility. This result departs from the conception that stock market price changes would affect real GDP through wealth effects. Wang suggested that since the stock market in China is primarily determined by government orders, small investors focus on short-term gains. Hence, Chinas stocks are less correlated with real, longer-term economic growth. In addition, most Chinese firms are financed through commercial bank loans, hence the weaker role of the stock market. This study however only employed data up to 2008 and investigates volatility rather than specific crashes. The real estate market is a significant component of the Chinese economy. Nevertheless, changes in stock market variables also appear to have no effect on real estate markets in China, as seen in the research by Lin and Lin (2011). This study used the co-integration approach and the Granger causality test to study integration and causal relationships between stock and real estate markets. The authors found that Chinas real estate market is only fractionally integrated with its stock market, and found no causal relationship between its stock and real estate markets. Similar to Wang (2010), Lin and Lin attributed the lack of causality to frequent Chinese government interventions in both markets.

B. Developing Countries Stock Market Variables and the Real Economy

While literatures studying the relationship between Chinese stock market turbulences and the real economy are limited, studies have been conducted on a similar topic for other developing economies. Hammami and Boujelbene (2015) found that the lack of significant effect of stock market crashes on real economic variables also holds for Tunisia. The study analyzed the effect of a stock market crash shock on the Tunisian economy through the VAR model, setting stock market crash as a binary variable with a value of 1 for crash period and 0 otherwise. The impulse response analysis showed no significant effect of stock market crashes on most real economic variables, with the exception of a negative effect on the real investment growth rate. The Stock market in Pakistan, another similarly under-developed economy, is also shown to not play its due role in influencing aggregate demand. Hsain and Mahmood (2001) examined the causal relationship between stock prices and macro variables like consumption expenditure, investment spending, and economic activity measured by GDP in Pakistan. The study utilized Granger causality test and the Error Correction Model (ECM) to determine long-term relations between stock prices and macro variables and scrutinize causal relations. Correlation analysis showed similar results as in the previous study: no significant correlations exist between stock prices and macro variables. Even though co-integration analysis indicates the presence of a long-run relationship, the ECM suggests only a unidirectional causality from macro variables to stock prices. Therefore, from the two studies cited, stock market crashes or variables do not appear to have a significant effect on the real economy in developing or underdeveloped countries.

C. Developed Countries Stock Market Variables and the Real Economy

Despite the lack of empirical evidence establishing the impact of stock market variables on real economic variables in under-developed or developing countries, studies on such relations in developed countries show more promising results. Evidence suggests that changes in United States equity values affect U.S. consumption according to Fair (2000). Investigating whether the Fed has the power to offset negative effects of a stock market crash on the economy, Fair examined the size of the effect of a change in US equity values on U.S. consumption, known as the wealth effect, and found strong evidence that equity wealth affects household expenditures. Utilizing macroeconometric modeling, he estimated the size of the wealth effect to be 3%. Poterba (2000) came to a similar conclusion as he consolidated literature on how stock market wealth affects household behavior and consumption in the U.S.; citing pre-existing studies, he also suggested that a 3% wealth effect over the period of 1979-1998. Moreover, he highlighted the potential asymmetry in the wealth effects of equity prices on consumer expenditure; this possibility of a greater wealth effect in the case of equity wealth contractions is much relevant to my study. Douch (2010) approached the question of macroeconomic effects of monetary policy shocks and stock market crashes in the postwar U.S. using the VAR model and concluded similar results. Estimating a VAR model with data from 1960 to 2000 and with variables such as industrial production, consumer prices, Treasury bill rates and the binary market crash variable, he found that stock market crash shocks have significant effects on output, price level and other

variables. The macroeconomic effect of stock market crashes and variables hence proves significant in the U.S. by the cited studies. With one of the most developed financial markets, the correlation between stock market fluctuations and the real economy in the U.S. should be no surprise. However, results for other relatively developed countries appear to vary as per Boone *et.al.* (1998). In a study examining the impact of stock market fluctuations in the G7 countries, Boone *et.al.* confirmed statistically significant stock market wealth effects for the U.S. using Johansen co-integration tests. However, extrapolating these estimates to other G7 countries while accounting for differences in stock market capitalization, the study found significant but weaker effects for other G7 countries. Moreover, for the US, a 10% decrease in stock prices leads to a 0.5% reduction in annual consumption due to solely the decrease in consumer confidence, whereas for the U.K., Japan and Canada, the reduction is only 0.4%, 0.3% and 0.2%. The authors theorized that the weaker effects are due to smaller stock ownership and later financial liberalization. Aside from the wealth effect which holds that as wealth increases, spending increases, the stock market may also have real economic effects through the aforementioned consumer confidence channel, as examined by Jansen and Nahuis (2002). The study focused on another proposal, that booming stock markets could lead to higher consumer confidence and thus greater consumption; it investigated the short-run relationship between stock market development and consumer confidence in 11 European countries with confidence indicators obtained from surveys and using the Johansen co-integration test and the Granger causality test. The study found a positive correlation between stock returns and changes in sentiment for 9 countries. Stock returns were found to unilaterally Granger-cause consumer confidence in the short-term. The results of this study suggest the existence of macroeconomic effects of stock market variables through confidence. Stock market fluctuations may also have an effect on the real economy via the q-channel, through which they affect investment spending and in particular those with access to equity finance. Forster (2005) studied the effect of stock price movements on real economic variables in Germany through both channels. Running a Johansen-test and a vector ECM, he concluded statistically significant effects of stock market price changes on consumption and investment, but both effects are limited compared to the U.S. due to low stock market participation from German households and companies. While significant macroeconomic effects of stock market variables through the wealth channel, the q-channel and the confidence channel have been evidenced in developed economies, the effects for developing and under-developed economies remain nonexistent or unclear. Moreover, few have provided in-depth analysis of real effects of stock market crashes in developing economies. China, with a rapidly expanding financial market that sits between developed and under-developed markets and with features distinct from many stock markets, is a peculiar case worth investigating. Employing mainly the framework of Hammami and Boujelbene (2015), my study thus seeks to expand on the current literature by examining stock market crashes specifically in the case of China and incorporating newer data that includes the 2015 stock market turbulence, one of the few major financial crashes since the markets recent rapid development.

III. Mode, Methods and Data

A. Identifying Stock Market Crash Periods

As this study focuses on the effect of Chinese stock market crashes from 1998 to present on the real economy, stock market crash periods will primarily be identified in order to generate the dummy variables necessary for any subsequent analysis. Following the study of Hammami and Boujelbene (2015), I will use the modified Bry and Boschan (BB) algorithm developed by Harding and Pagan (2002) to first identify stock market peaks and troughs. Turnings points are defined by this algorithm as the following:

$$\textit{Peak at t if } (y_{t-2}, y_{t-1}) < y_t > (y_{t+1}, y_{t+2})$$

$$\textit{Trough at t if } (y_{t-2}, y_{t-1}) > y_t < (y_{t+1}, y_{t+2})$$

Other censoring criteria also apply following the framework of Hammami and Boujelbene; turning points within two quarters and complete cycles of less than five quarters are eliminated. A progression from peak to trough is labeled a bear market, whereas a progression from trough to peak is labeled a bull market. I then determine periods of stock market crashes, utilizing the framework of Bordo*et.al.* (2008). Stock market crashes are identified when the stock market index decreases at least 20% during a phase of at least four quarters. Once the periods of stock market crash are determined, a crash dummy variable will be created, with an assigned value of 0 if the given time period is not in a period of crash, and an assigned value of 1 if the given time period is in a crash.

B. Econometric Methodology

As the data will be organized into panel form, with national economic indicators assigned to each province, a panel Vector Auto-regression (VAR) model will be estimated to examine the responses of macroeconomic variables to stock market crash shocks. This model addresses the auto-correlation of macroeconomic variables that may result in biased estimators. The panel VAR model is a system in which each variable is a function of the lagged values of all variables, while controlling for individual effects, and takes the form as follows (assuming lag period=1):

$$X_{it} = \mu_i + \Phi_1 X_{i,t-1} + e_{i,t}$$

$$i = 1, ..., N$$

$$t = 1, ..., T$$

where X_{it} is a vector of five variables, namely the stock market crash dummy variable as outlined above, the provincial quarterly GDP, the quarterly Consumer Price Index, the Consumer Confidence Index, and the interest rate, respectively of province i and at time t. μ_i is a vector of individual effects, Φ is a 5x5 matrix of coefficients corresponding to the

respective lagged terms, and eit are residuals. To illustrate, a component of the model with the crash dummy as the dependent variable would take the form as follows (with lag period=1 and province i):

$$Crash_{it} = \mu_{it} + a_{11}Crash_{i,t-1} + a_{12}GDP_{i,t-1} + a_{13}interest_{i,t-1} + a_{14}CPI_{i,t-1} + a_{15}interest_{i,t-1}$$

where *a* are the respective coefficients, with the subscripts corresponding to their positions in the Φ matrix. The panel VAR enables me to control for fixed and time effects to maximally eliminate potential omitted variables, and provides insight into the relationship between macroeconomic variables and stock market crashes in particular through impulse response functions (IRF). The IRF allows for the determination of the effect of an exogenous shock to the stock market crash variable on all endogenous variables through the VARs dynamic system, as follows:

$$(\Psi_n)_{i,j} = \frac{\partial X_{i,t+n}}{\partial e_{jt}}$$

where Ψ denotes the response of variable $X_{i,t+n}$ n periods after the shock to a one-time impulse in variable X_{jt} with other variables dated earlier than t held constant. Potential sources of endogeneity inherent in this model includes government intervention policies that occur simultaneously with stock markets turbulences, that either offset or exacerbate any macroeconomic effect of the crashes. The interest rate is included mainly as a means to control for government macroeconomic policies concurrent with stock market crashes. However, we should note that a large number of government policies in China cannot be measured by the interest rate change alone, as they often involve regulation changes and announcements that affect the economy directly. In this model, we will assume that all macroeconomic policies can be measured by policy rate or interest rate alone. I am concerned about the possible lack of a statistically significant result as Chinas financial market is not particularly well-integrated with the real economy due to its relatively short history; in addition, China suffers income disparity among its different regions, with a few provinces and municipalities, notably Shanghai and Beijing particularly well-advanced economically, but sees an asymmetric lack of financial integration in other provinces, such as Qinghai. Consequently, aggregate influences on GDP by stock market crashes could be offset by the absence of impact on financially marginal areas. Thus, as a sub-sample analysis, I will estimate VAR model with the same variables specifically for Beijing, Shanghai and Guangdong and examine whether there appear to be discrepancies in the degree of influence of stock market crash on financially developed regions and the rest of the country. As robustness checks, I will run the panel VAR model with tertiary industry GDP, entrepreneur expectation indicator, and fixed investment growth rate to determine the existence of statistically significant effects in the case no significant results can be concluded for aggregate macroeconomic indicators. Tertiary industry GDP effectively narrows down the aggregate GDP to the service industry component that is more likely to be affected by stock market volatility. On the other hand, entrepreneur expectation indicator and fixed investment growth rate serve as effective indicators for determining the effect of stock market turbulences on the investment sector of the GDP, since quarterly data for aggregate investment is not released.

C. Data

The data utilized in this study include the daily Shanghai Stock Exchange (SSE) composite Index to determine periods of stock market crash, quarterly GDP by province, quarterly consumer confidence index (CCI), quarterly Consumer Price Index, quarterly discount rate, quarterly tertiary industry GDP by province, quarterly entrepreneurship expectation indicator, and quarterly fixed investment growth rate. The discount rate is used as a measure to control for the effect of central bank macroeconomic policies. All time periods covered and sources of data are specified in Table 1. Since numerous indicators, such as interest rate and consumer price index are uniform across provinces while quarterly GDP and tertiary industry GDP are the only variants across provinces, the same national indicator values will be assigned to each province to fit the panel VAR model. The entities observed are 31 Chinese provincial-level administrative units; note that Hong Kong, Macau and Taiwan are not considered part of the Mainland China and thus not included in the study. Table 2 reports summary statistics for all data sets utilized in this study, including those used for robustness checks. The summary statistics reported are those of the raw data; after conversion to panel form, all time-series data will have a new count of their original raw count multiplied by 31 provinces.

IV. Results and Discussion

A. Identifying Stock Market Crash Periods

I first identify stock market turning points using the modified BB algorithm over the period of 1998 Q4 to 2016Q4. The algorithm generates 13 phases, with a total of seven peaks and seven troughs, as shown in Table 3. I then employ the framework of Bordo et.al.(2008) to eliminate bear market phases that do not qualify as market crashes due to failure to meet either the time of at least one year or the amplitude of at least -20%. Following these specifications, I identify five stock market crashes, from 2001Q2 to 2002Q4, from 2004Q1 to 2005Q2, from 2007Q3 to 2008Q4, from 2011Q1 to 2013Q2, and from 2015Q2 to 2016Q2. The market crash dummy is then generated accordingly.

B. Main Findings

Due to the self-regressing nature of the panel VAR model I will estimate, stationary tests will not be conducted, as they are unnecessary in this context. I proceed to first determine the optimal lag lengths in the panel VAR model. Applying five information criteria on each province, namely the Likelihood Ratio test (LR), the Final Prediction Error (FPE), the Akaike Information Criterion (AIC), the Bayesian Information Criterion (SBIC) and the Hannan-Quinn Information Criterion (HQIC), I conclude an optimal lag length

of 4 as suggested by all criteria for all provinces. Due to the large number of provinces and tests conducted, only the result of a sample province, Anhui is included in Table 4; the asterisks indicate the lag length selected by each criterion. I then estimate the panel VAR for variables stock market crash, GDP, interest, CPI and CCI and their respective impulse responses to a stock market crash shock with a horizon of 10 quarters, as presented in Figures 1-5. Figure 1 illustrates the impulse response of a stock market crash to a shock in itself. As expected, stock market crashes are shown to react initially positively and significantly to shocks in themselves from quarters 1 to 4 after the shock; more significantly, the initial positive response declines to 0 at approximately quarter 5, revealing that Chinas stock markets tend to revert back to normal at an average phase of 5 quarters, a time much shorter than that observed by Hammami and Boujelbene (2015) in Tunisia, an equally, if not more financially under-developed country. I speculate that the observed shorter time span is due to the frequent interventions by the Chinese central bank, leading to faster financial market recovery times, as also suggested by Lin and Lin (2011). Figure 2 illustrates the impulse response of GDP growth rate to a stock market crash shock, and shows a statistically insignificant response throughout the 10 quarters following the shock. This does not support my research hypothesis that stock market crashes have a real effect on the Chinese GDP, and confirms Wang (2010)s finding that there is no causal relationship between Shanghai Composite Index volatility and volatility in real economic variables. This could be attributed to frequent interventions by the Chinese government in the stock market, leading to a fast recovery time and a lack of real correlation between the financial market and the real economy. Wang attributes the absence of response in GDP to the fact that the stock market in China is primarily determined by government orders, while small investors focus on short-term gains; Chinese stocks are consequently less correlated with the longer-term economy. An alternative explanation could be that the effect of stock market volatility on the GDP of relatively financially well-integrated regions is offset by the lack of influence on regions like Qinghai that are much less developed both economically and financially, hence the absence of an overall result. This possibility will be examined in greater details in 4.3. While the overall GDP does not appear to react significantly to stock market crash shocks, Figure 3 shows a statistically significant negative response by consumer confidence index growth rates to stock market crash shocks from approximately quarter 2 to quarter 4. Chinese consumers thus have less optimistic expectations of the future economy after financial crashes despite the apparent lack of response in the aggregate GDP. This finding confirms the theory examined by Jansen and Nahuis (2002) that declines in stock market variables lead to lower consumer confidence, yet the proposed consequent effect on consumption and thereby GDP is not shown. Possible explanations could be that despite the significant drop in consumer confidence, the Chinese economy is investment-driven rather than consumption-dependent. In addition, the validity of Consumer Confidence Index as an effective indicator for consumption is uncertain in the case of China, where Chinese households have a habit of saving rather than spending and a much lower innate propensity to spend. In other words, the effect of any confidence decline is minor as well as the magnitude of wealth effect for Chinese households who tend to only spend on necessities. Hence, the decline in consumer confidence would lead to only a minimal decline in consumption, which is not significant enough to have a real impact on the economy. In addition, in face of volatility in liquid assets, investors could turn to fixed asset investment; this rise in investment could offset any decline in consumption. I will further explore the validity of this explanation through robustness checks. Figure 4 and 5 illustrate the responses of interest growth rate and consumer price index growth, or inflation, to stock market crash shocks. There appears to be a negative and significant response of CPI growth rate to stock market crashes for 7 quarters post-shock. I attribute this to a decline in consumer demand, confirmed by the decrease in consumer confidence. An alternative explanation could be an interest rate raise by the central bank, yet Figure 4 shows a significant yet fluctuating and unclear response of interest rate to market crashes over 10 quarters that initially dips but rises again 3 quarters after the crash, rejecting the possibility of interest-rate raise. It is also possible that banks become more cautious about lending and, combined with increased savings rates, results in a decline in money circulation and a declining inflation, but this tightened lending would lead investment increases to be unlikely, thus conflicting with the previous explanation that increases in investment offsets consumption decrease.

C. Sub-sample Analysis of major regions

While there appears no significant response of national GDP to stock market turbulences, it is possible that the absence of promising results is due to the fact that large disparities in economic and financial development in different regions and provinces of China causes any potential effect in major regions to be offset by a lack of effect in others. To address this explanation, I examine financially developed regions reactions to stock market crashes by estimating VAR impulse responses of GDP to crashes for Beijing, Shanghai and Guangdong. I choose these three regions as they are recognized as the most financially developed, with Beijing as the capital and Shanghai and Guangdong as the districts with Chinas only stock markets, the Shanghai Stock Exchange and the Shenzhen Stock Exchange. The results of the IRF are shown in Figures 6-8. Despite my expectation that the stock market turbulences would have a significant effect on well financially integrated regions like Shanghai, the graphs show a similar lack of statistically significant response of GDP to stock market crashes in the three regions tested. This finding does not support my previous hypothesis that the aggregate effect could be offset by a lack of effect in financially under-developed areas. This leads us back to re-examine the previously proposed explanation that since the Chinese economy is investment-driven, it is rather resilient

to declines in consumption and consumer confidence, whereas any declines in stock market investment are offset by increases in fixed asset investment as small investors withdraw their stock investments and turn to other forms. We will further examine this possibility in the next sub-section.

D. Robustness Checks

I then re-inspect proposed explanations through estimating the panel VAR impulse responses on tertiary industry GDP, entrepreneur expectation indicator and fixed asset investment. The results are shown in Figures 9-11. Figure 9 and 10 reveal statistically insignificant responses of tertiary industry GDP and entrepreneur expectations to crashes. The absence of significant response by the tertiary industry GDP confirms our previous finding of a lack of response in aggregate GDP, and in addition reveals that the service sector is minimally impacted by stock market turbulences. This finding contradicts my expectation that financial volatility would have an impact on service sector activities, such as retail, banks, real estate, and media, industries that would be the most hard-hit by declines in consumption. Nevertheless, it confirms the validity of my previous explanation that a lower consumer confidence does not necessarily translate to a much lower level of consumption as Chinese households have initially low propensity to consume. Figure 10 shows a statistically insignificant response of entrepreneur expectations to stock market crashes. There could be several different takes on this, one being that entrepreneurs do not regard stock market turbulences as a threat to business activities because of the perceived lack of relationship between the real economy and the stock market due to frequent government interventions to save the market as well as a historical absence of financial integration with the real economy. In addition, the majority of firms in China finance through banks rather than stocks and bonds, where IPO is extremely difficult in the former and the latters market is rather under-developed. Figure 10 reveals a statistically significant positive response of fixed investment growth rate to stock market crashes. This supports my explanation that as stock market crashes, capital flows to fixed investment; the increased in fixed asset investment thereby offsets the already minor decrease in consumption, resulting in the insignificant net effect in GDP.

V. Conclusion

This study inspects the relationship between stock market and the real economy, in particular the effect of stock market crashes on macroeconomic variables in the case of China. Using panel VAR impulse response functions to analyze the reactions of macroeconomic indicators such as provincial GDP, consumer confidence index, consumer price index and interest rate to stock market turbulences in China, I find inconclusive results for GDP and interest rate yet statistically significant negative responses of consumer confidence index and consumer price index to stock market crashes. I speculate that as Chinese households have intrinsically low propensities to consume, a decline in consumer confidence only translates to a minor decline in consumption and the magnitude of the wealth effect is also minimal. In addition, as the Chinese economy is investment-driven rather than consumption-driven, and as capital shifts to fixed investment in face of stock market crashes, the minor decrease in consumption is offset by the increase in fixed investment, thereby yielding the observed GDP resilience to stock market crashes. This speculation is confirmed by the robustness checks, which reveal an insignificant response of tertiary industry GDP and a negative response of fixed investment growth rate to stock market crashes. Nevertheless, limitations for the results and speculation certainly exist. While analysis of consumer confidence and fixed investment growth rate supports the explanation, the explanation is still largely conjectural in nature as it draws from limited evidence and only two indicators. A closer look at the relation between aggregate consumption as well as aggregate investment and stock market crashes could provide further insight into the validity of the explanation. The speculation also holds only minor external validity as it only seeks to explain trends in relation between stock market turbulences and the real economy for China, who exhibits distinct characteristics different from many other economies. In addition, the methodology utilized in this model assumes that changes in interest rate are able to reflect all macroeconomic policies, whereas in reality the Chinese government frequently intervenes in the economy through changes in regulations or announcements. Further studies could address this problem through tracking policy events during individual crash periods and creating policy dummy variables to control for such interventions. Despite the suggested absence in this study of macroeconomic effect of stock market crashes potentially because of the economys investment-dependent nature, the trend may not persist. With recent government policies outlined by Prime Minister Li Keqiang, the Chinese economy is in the process of gradually transforming from an investment-driven one to a consumption-driven one. With the upcoming changes as well as the increasing financial integration, whether the economy would respond similar to future stock market crashes as in the past 18 years is unclear.

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APPENDIX

Table 1: Data Source

Variable	Source	Data Type	Time Period	Unit
GDP, quarterly	CEIC Database	Panel	1998Q4 - 2016Q4	Province
Discount Rate	CEIC Database	Time-Series	1998Q4 - 2016Q4	Country
Consumer Confidence Index	CEIC Database	Time-Series	1998Q4 - 2016Q4	Country
Consumer Price Index	CEIC Database	Time-Series	1998Q4 - 2016Q4	Country
Shanghai Stock Exchange Composite Index	CEIC Database	Time-Series	1998Q4 - 2016Q4	Country
Tertiary Industry GDP, quarterly	CEIC Database	Panel	1998Q4 - 2016Q4	Province
Entrepreneur Expectation Indicator	CEIC Database	Time-Series	1999Q1 - 2016Q4	Country
Fixed Investment Growth Rate	CEIC Database	Time-Series	1998Q4 - 2016Q4	Country

*Data types indicated are those of raw data; data will be converted to panel data in empirical analysis.

Table 2: Descriptive Statistics

Variables	Count	Mean	S.D.	Min	Max
Number of Provinces	31	15.90	8.95	1	31
GDP by Province, quarterly (billions of RMB)	2157	694.15	944.67	3.47	7951.21
Interest Rate (%), quarterly	73	3.18	0.38	2.7	4.59
Consumer Confidence Index, quarterly	73	107.39	4.37	98.27	113.00
Consumer Price Index, quarterly	73	102.06	2.15	97.83	108.03
Stock Market Crash Dummy	2263	0.4658	0.4989	0	1
Shanghai Stock Exchange Composite Index	73	2284.16	911.64	1080.94	5552.3
Tertiary Industry GDP by Province, quarterly (billions of RMB)	2070	303.28	439.95	3.473	7951.21
Entrepreneur Expectation Indicator, quarterly	65	123.06	12.61	91.7	143.1
Fixed Investment Growth Rate (%), quarterly	73	22.32	7.99	6.7	51.27

*Fixed effects are included in the panel VAR but not listed.

Table 3: Market Turning Points Identified Over 1998 Q4 to 2016 Q4 using the BB Algorithm

Phase	Peak	Trough	Peak	Duration (Quarters)	Amplitude (%)
Bear Market	1999 Q2	1999 Q4		2	-19.11
Bull Market		1999 Q4	2001 Q2	6	62.31
Bear Market	2001 Q2	2002 Q4		6	-38.79
Bull Market		2002 Q4	2004 Q1	5	28.28
Bear Market	2004 Q1	2005 Q2		5	-37.93
Bull Market		2005 Q2	2007 Q3	9	413.65
Bear Market	2007 Q3	2008 Q4		5	-67.21
Bull Market		2008 Q4	2009 Q4	4	79.98
Bear Market	2009 Q4	2010 Q2		2	-26.82
Bull Market		2010 Q2	2011 Q1	3	22.09
Bear Market	2011 Q1	2013 Q2		9	-32.41
Bull Market		2013 Q2	2015 Q2	8	116.11
Bear Market	2015 Q2	2016 Q2		4	-31.51

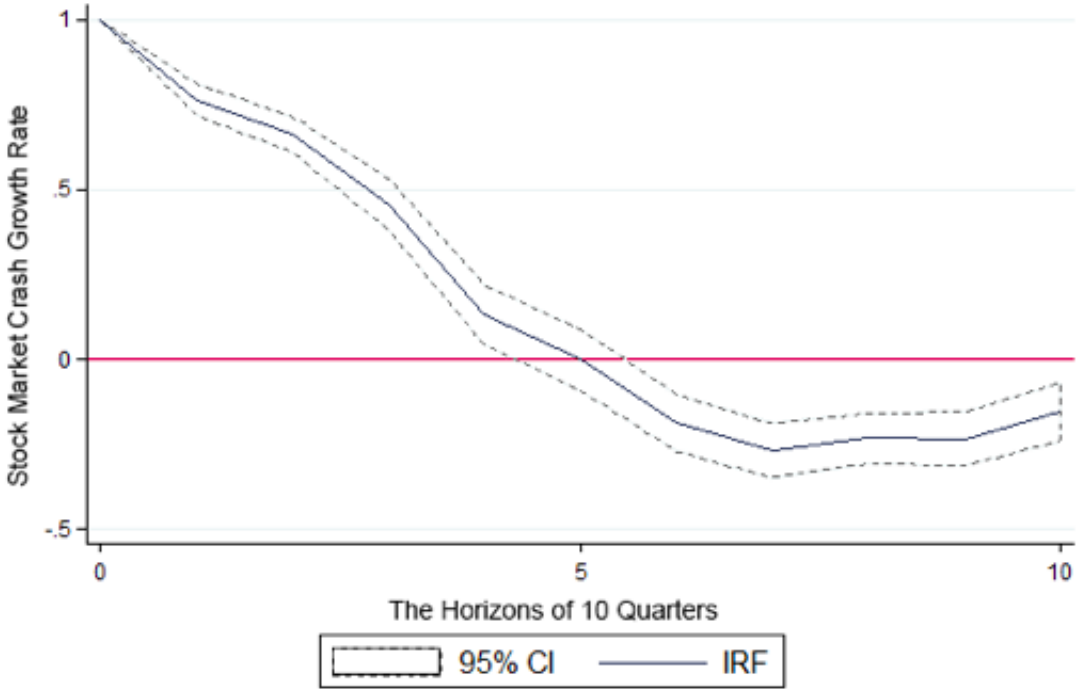
Period of Stock Market Crash

Table 4: Selection of Lag Length for the province of Anhui

Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-726.883	NA	NA	NA	1.6e+06	25.645	26.7007	25.7884
1	--611.329	231.11	16	0.000	49128.6	22.1519	22.4305	22.8688
2	-589.516	45.626	16	0.000	40420	21.9479	22.4494	23.2383
3	-571.51	36.012	16	0.003	38511	21.8775	22.6019	23.7414
4	-382.922	377.18*	16	0.000	94.1688*	15.8218*	16.769*	18.2591*

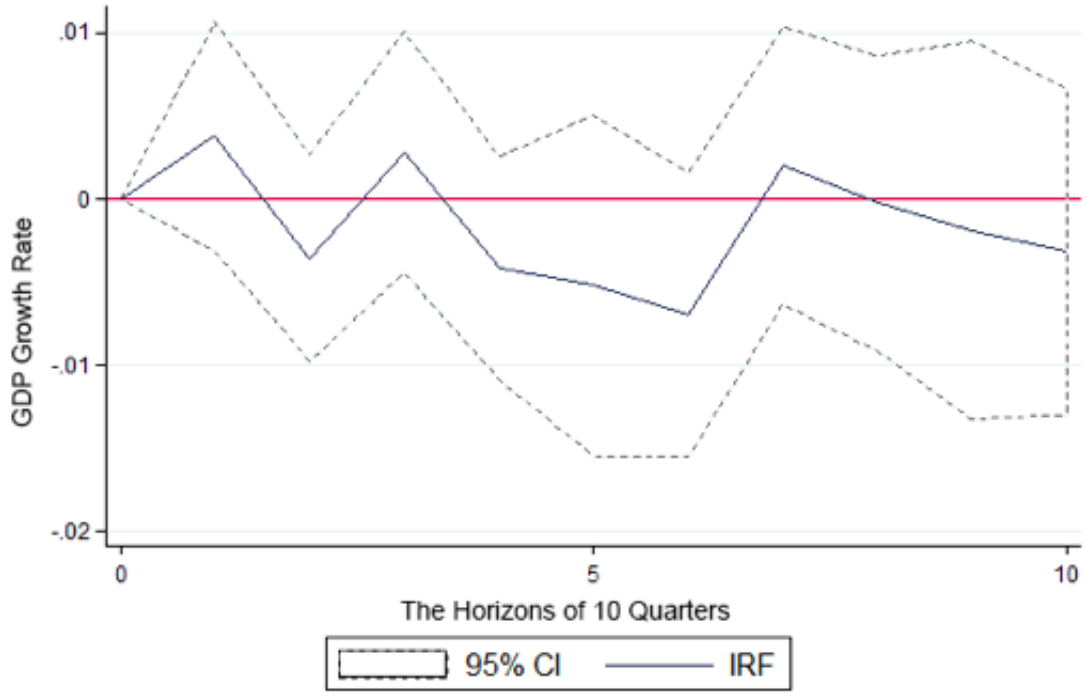
*: selected lag length

Figure 1: Response of Stock Market Crash to Itself



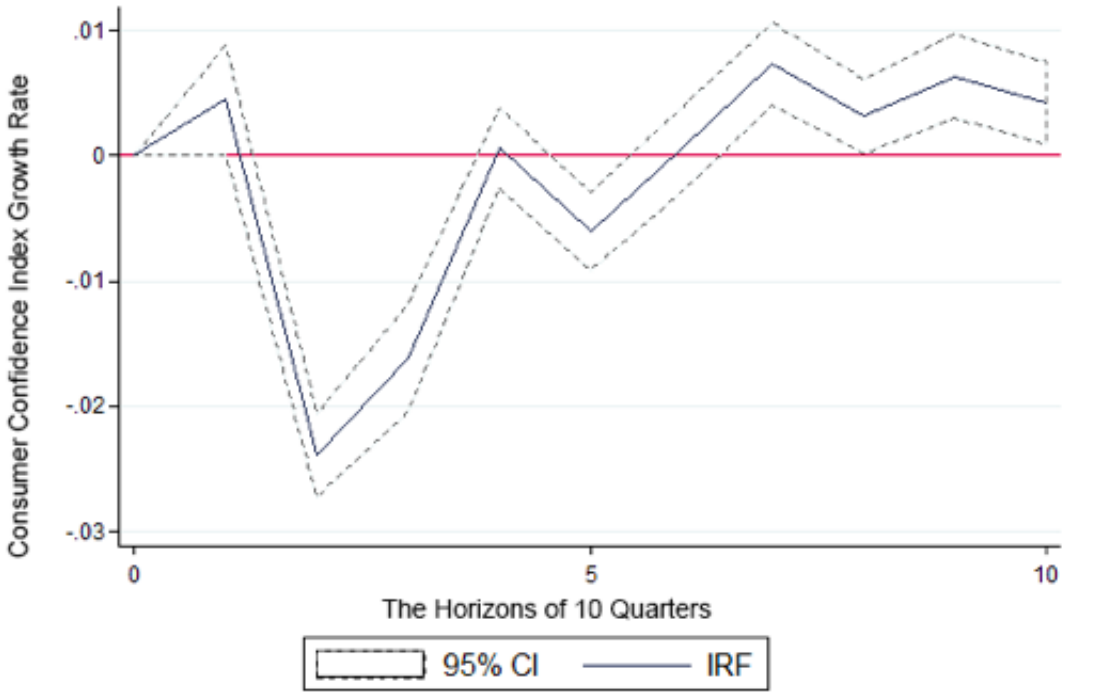
impulse : response

Figure 2: Response of GDP Growth Rate to Stock Market Crash



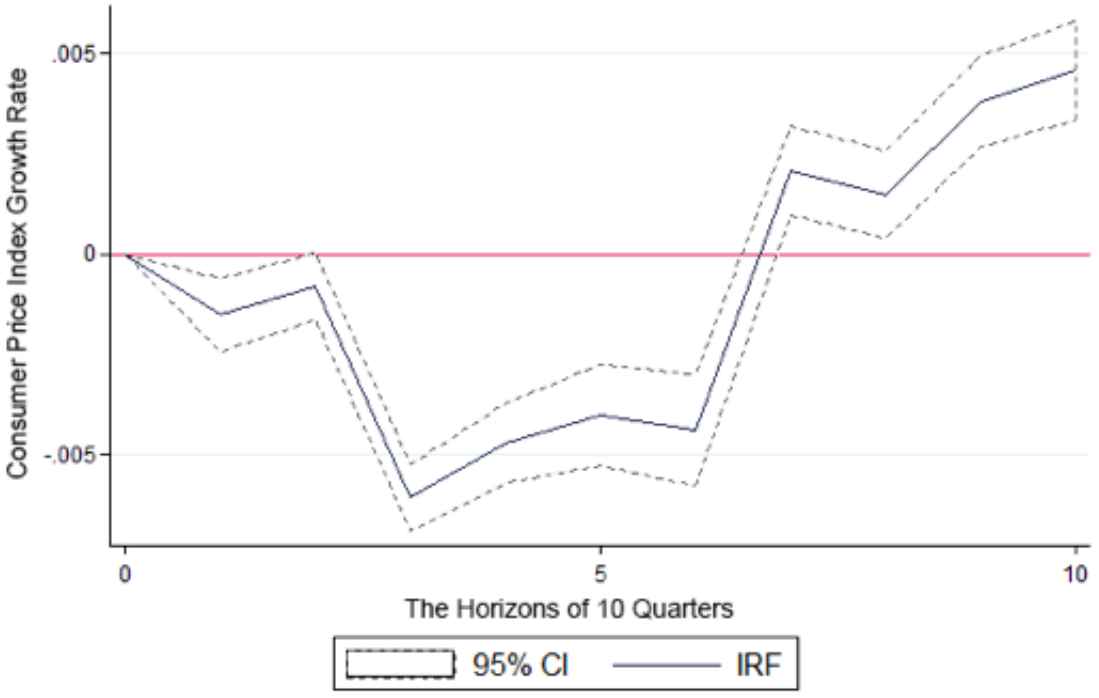
impulse : response

Figure 3: Response of Consumer Confidence Growth Rate to Stock Market Crash



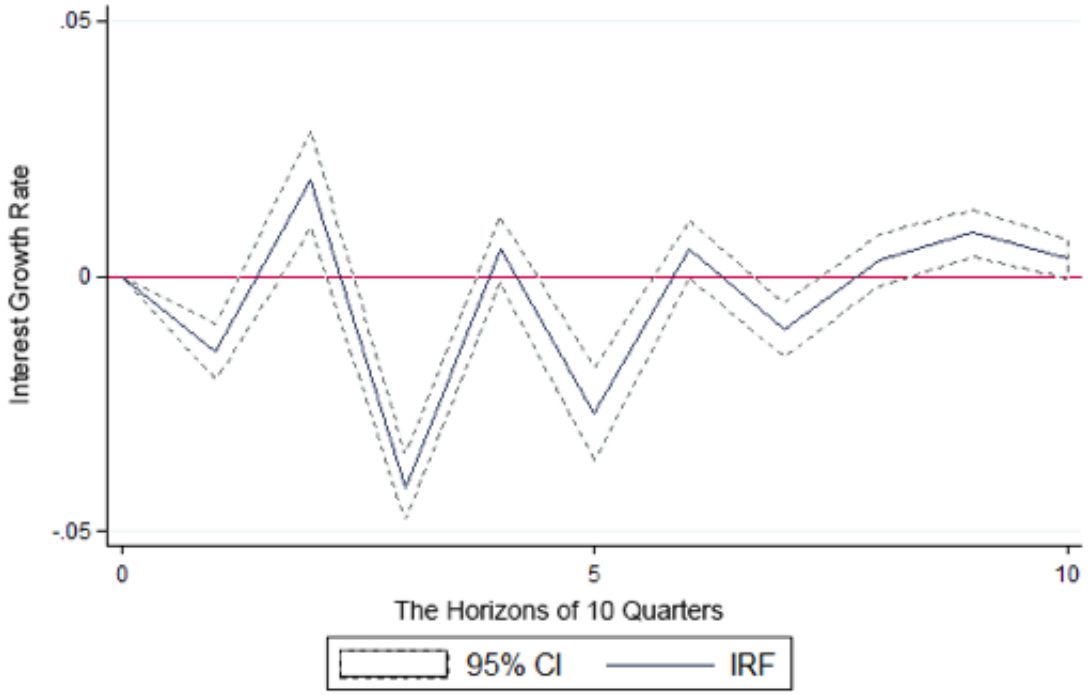
impulse : response

Figure 4: Response of Consumer Price Index Growth Rate to Stock Market Crash



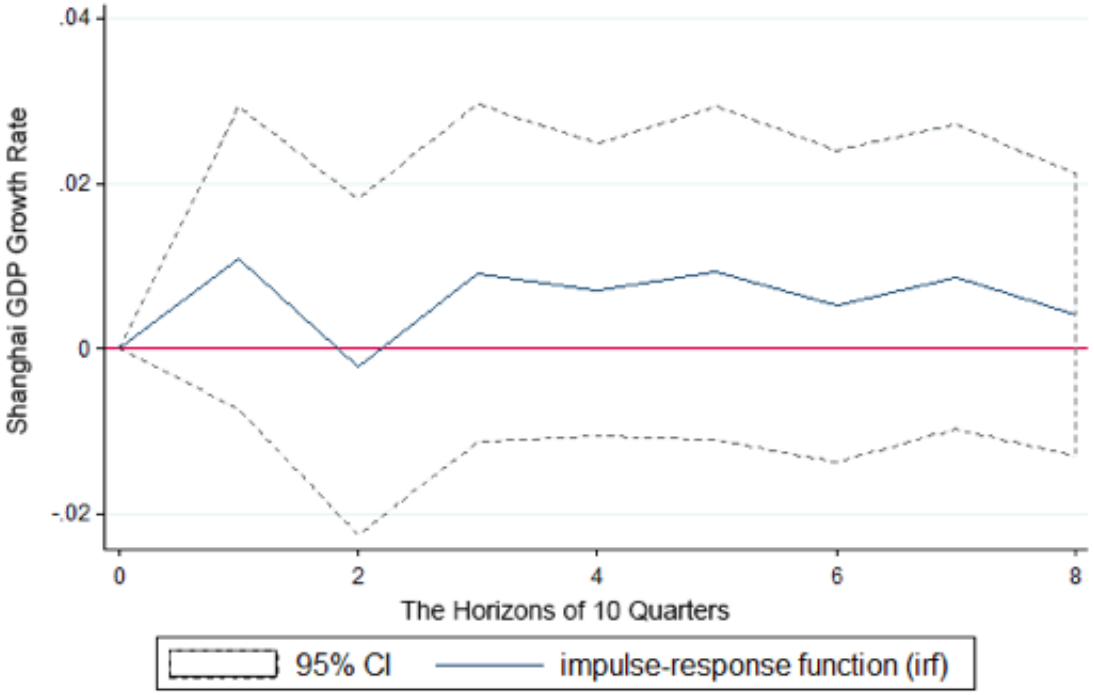
impulse : response

Figure 5: Response of Interest Growth Rate to Stock Market Crash



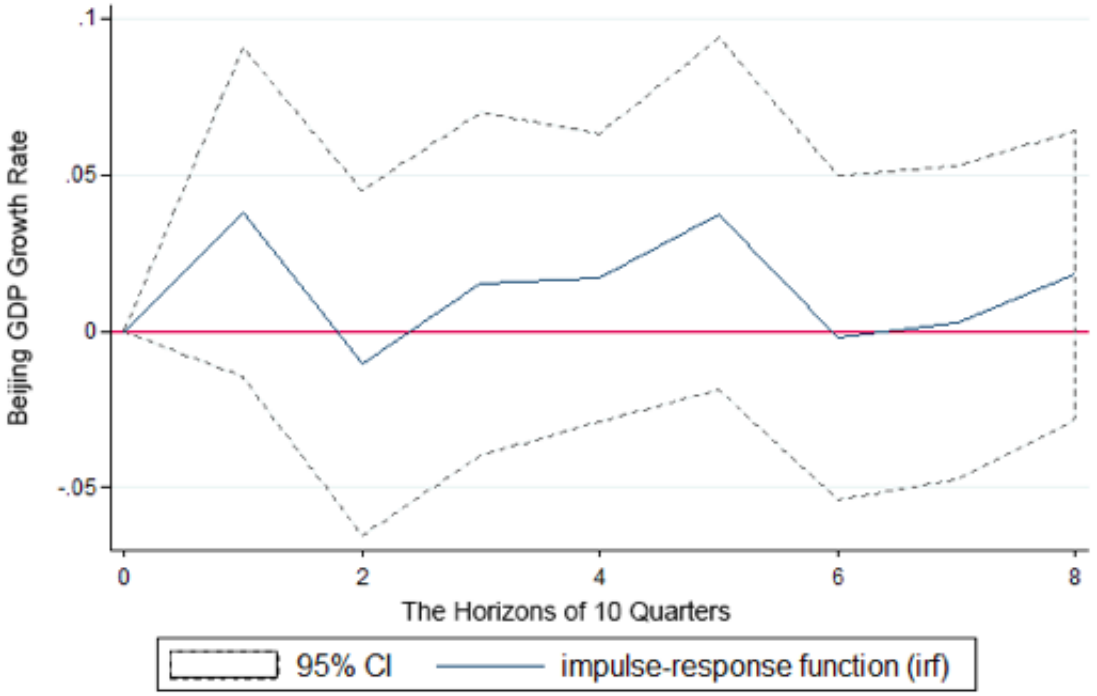
impulse : response

Figure 6: Response of Shanghai GDP Growth Rate to Stock Market Crash



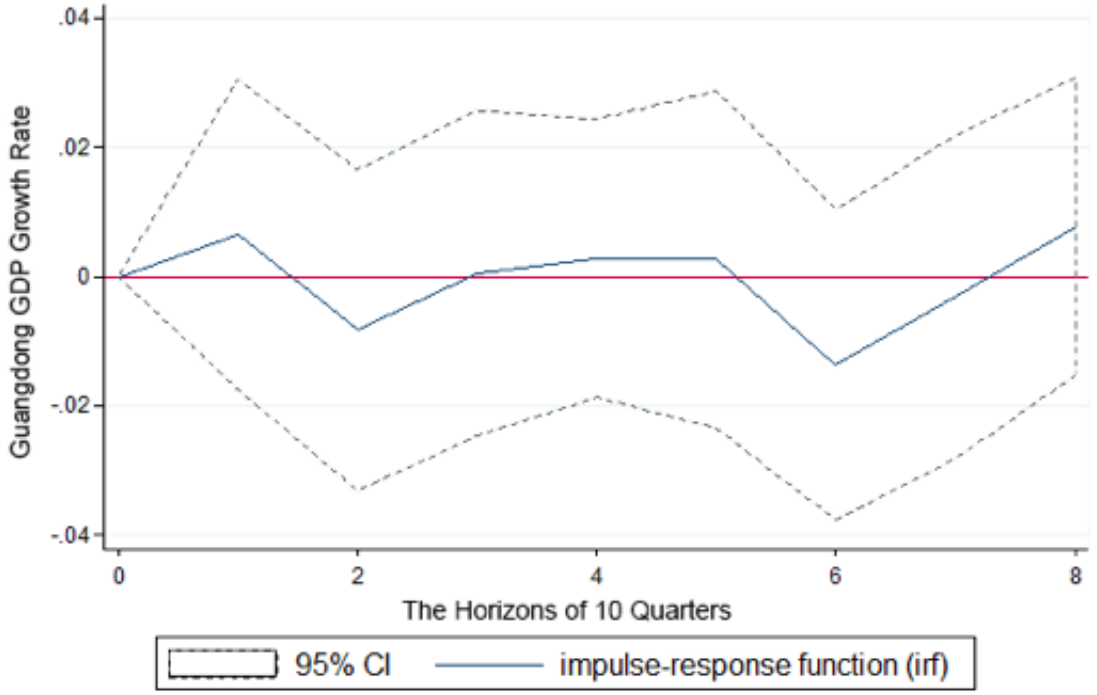
Graphs by irfname, impulse variable, and response variable

Figure 7: Response of Beijing GDP Growth Rate to Stock Market Crash



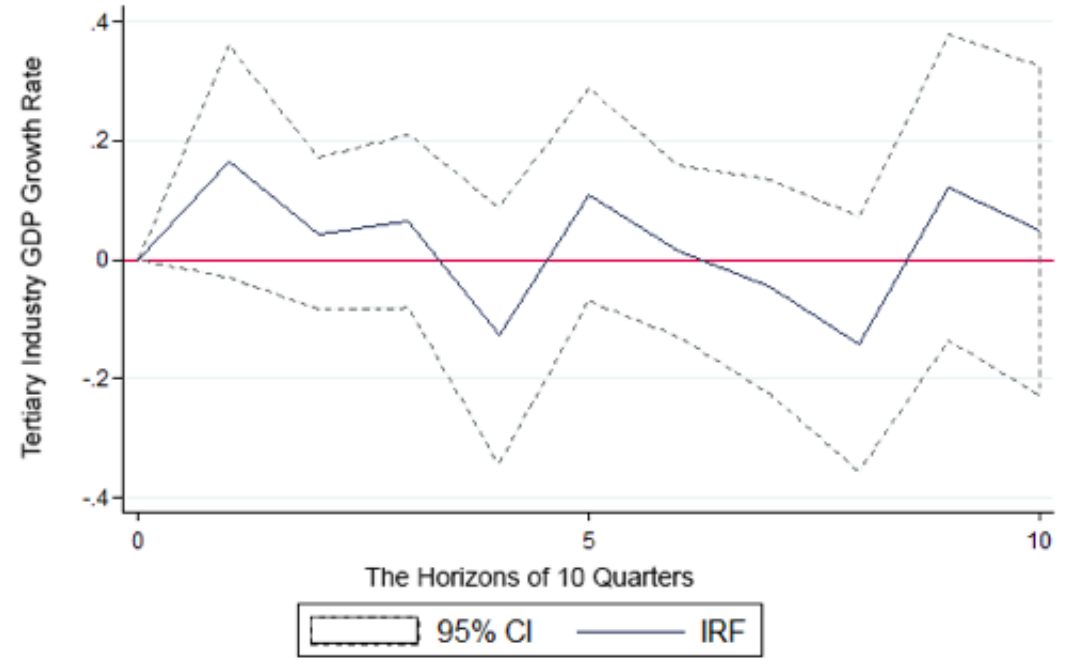
Graphs by irfname, impulse variable, and response variable

Figure 8: Response of Guangdong GDP Growth Rate to Stock Market Crash



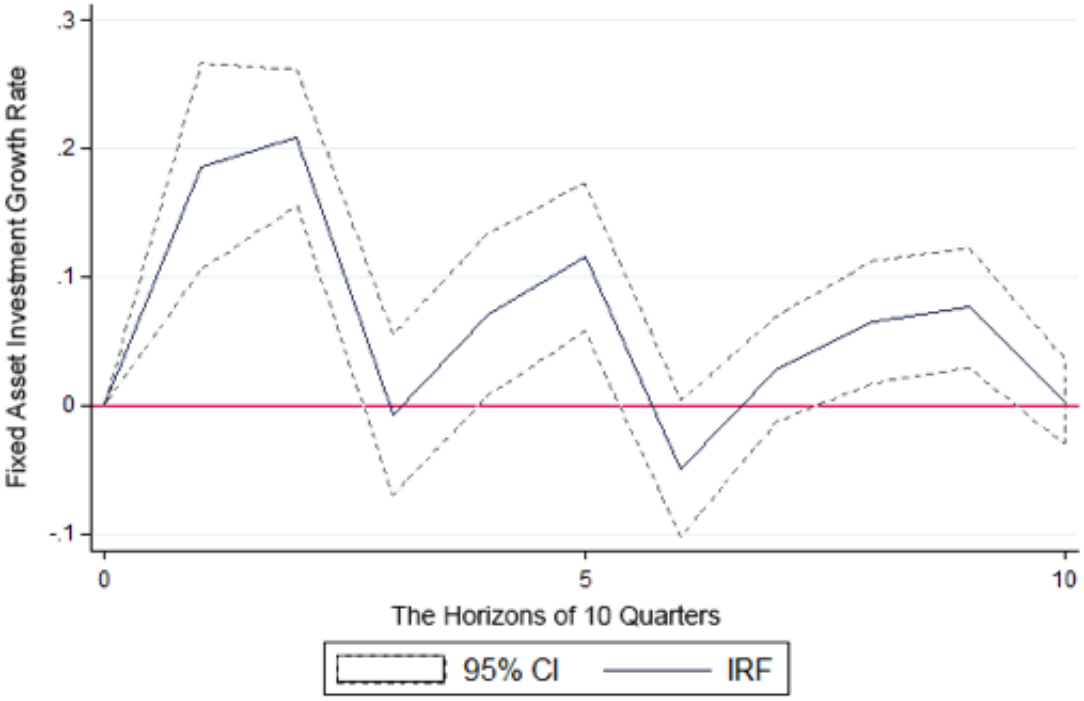
Graphs by irfname, impulse variable, and response variable

Figure 9: Response of Tertiary Industry GDP Growth Rate to Stock Market Crash



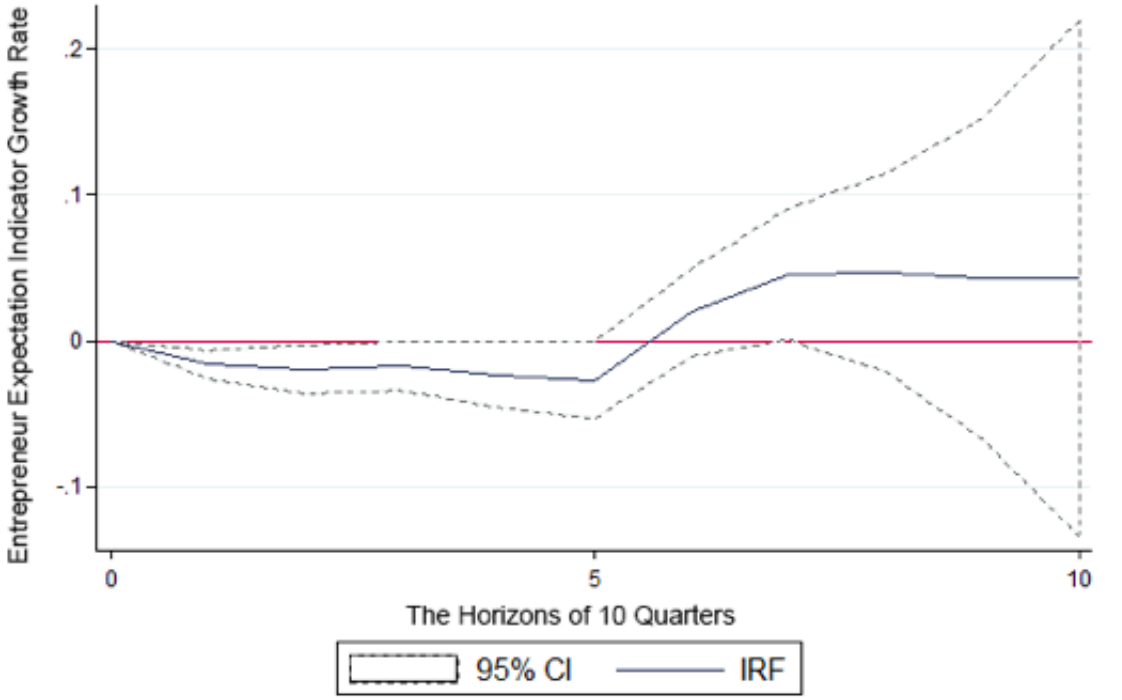
impulse : response

Figure 10: Response of Fixed Asset Investment Growth Rate to Stock Market Crash



impulse : response

Figure 11: Response of Entrepreneur Expectation Growth Rate to Stock Market Crash



impulse : response