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Master thesis of Finance program in Economics

A Financial Crisis Study:

How Fiscal And Monetary Policy Affects The Stock Market Returns Considering The Specific Counties

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Abstract

This paper measures the impacts of fiscal and monetary policy adjustments on stock markets in U.S., Sweden, and China, during the financial crisis of 2007-2009. The purpose of this paper is to gauge the direction and magnitude of stock market responses to the policy announcements and compare the effects of policies across these three countries. A four-year period prior to financial crisis is selected as benchmark phase to contrast the impact during crisis. The event study methodology is conducted to this investigation. Our results indicate that when facing the crisis, policy adjustments lead to diversified response among different countries. It depends on the features of a country such as the scale of economy, the degree of economic freedom, and vise versa determinates the country's the preference on policy instruments.

Keywords: fiscal policy, monetary policy, stock return, event study, the U.S., Sweden, China

Contents

1. Introduction

The financial crisis of 2007-2009, which initially erupted in the whole U.S., led the global recession later. This recession has resulted in a significant slumping in international trade, expanding unemployment rate, falling commodity prices etc., which is the worst scenario since the Great Depression of the 1930s.

Among the various causes, it is no doubt that government's misjudgments of economic policies play the most significant role. Some studies (Taylor, 2009; Allen and Carletti, 2010) view the improper monetary policy announced during 2003–2005 as one of the main causes of the crisis for the U.S. Some others (Adrian and Shin, 2009; Pozsar et al. 2010) have argued that the regulatory framework did not keep pace with financial innovation such as the "shadow banking system", derivatives and off-balance sheet financing. The "shadow banking system", in contrast to the traditional banking system, does not have access to central bank lender-of-last resort liquidity. They believe that the immatureness of regulations and standards for these emerging financial instruments led to the subprime crisis. Gorton and Metrick (2012) argue that a run on the repo market was the proximate cause of the financial crisis. Kane (2009) defines this was a regulation-induced financial crisis, unsustainable and nontransparent regulatory subsidies result in bad capital misallocation and loan losses. Regulatory forbearance and financial deregulation transfer the losses to the taxpayer, which promotes the financial innovations but weaken the stability of financial system.

Coins have two sides, it was also the governments, who set economic policies to amend the irregular activities and encourage the market upwards during the crisis. Government authorities and central banks have immediately published several announcements to alleviate the market recession. In addition, governments have planned large fiscal stimulus packages[1] to offset the reduction in private sector demand. Governments have also taken actions to incur large financial obligations so that they can bailout a variety of firms. This helps balance competing policy interests during that time (Wafa, 2010). In long-run responses, governments introduced a bracket of regulatory proposals. These proposals mainly focus on consumer protection, executive payment, bank financial cushions or capital requirements, which improves market regulations of the "shadow banking system" and derivatives.

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[1] "BBC – Stimulus Package 2009". BBC News. February 14, 2009. Retrieved February 27, 2009

Fiscal policy is a tradeoff action between government revenue collections and government spending (Laopodis, 2009). Governments implement fiscal policy to influence the level of aggregate domestic demand, targeting to maintain the stability of price, unemployment rate, and economic growth. As this mechanism is to control government revenue and spending, the two main instruments of fiscal policy are taxation and government expenditure.

Monetary policy is implemented by the country´s central bank to control the supply of money and target interest rate with the purpose of promoting economic growth and stability. The monetary policy can be set either expansionary or contractionary. An expansionary policy aims to increase the total supply of money, in order to lower interest rate and stimulate the expansion of the whole economy. On opposite, a contractionary policy is to slow down the money supply to restrain inflation and avoid the biases or decline of asset values. There are several monetary policy tools available to make such adjustments. For example, increasing interest rates, reducing the monetary base, or increasing reserve requirements can be applied to achieve contractionary effect, and vise versa for reaching an expansionary effect.

As discussed above, on the one hand, it was the misjudgment on policy regulation that contributed to the eruption of financial crisis. On the other hand, during the financial crisis, governments and central banks took several emergency activities, like unprecedented fiscal stimulus, monetary policy expansion and institutional bailouts, to rescue the market, as we have seen that the stock market are gradually recovered after 2009. Therefore, it is worth exploring the effectiveness and efficiency of policy announcements to the stock market. Since stock market is an indicator of one country's domestic economy, the response to policy adjustments reflects the economic manipulating power of the government. And we are also interested in whether stock market responses identically to the same type of policy adjustment across the different countries (the U.S., Sweden, and China). How these sets of policy announcements make a difference on their respective stock market is our researching question. The countries are selected based on their different characteristics: For U.S., it is a developed country with a large scale of economy, as well as a high degree of economic freedom; for Sweden, is also a developed country with a same level of economic freedom, but the economy scale is small; as to China, it is a developing country with a large scale of economy but lack of economic freedom (According to the 2012 Index of Economic Freedom). Due to such economic difference, the response of stock market to a series of respective policy adjustments, vary across the countries.

The purpose of this research is to explore the distinct influence of policy instruments on corresponding countries, thus to seize how much diversity of the effect on stock market because of monetary and fiscal policy modification. In the paper, it is supposed to investigate the direction and magnitude of governments' remediation prior to and during financial crisis. In specific, the aim is to capture the response of stock market when a policy alteration is announced. As governments employ fiscal and monetary policies to adjust and regulate the market, such policies can represent the action of government. The event study methodology will be applied to measure the effect. Considering that policy differs among countries, this study will make a comparison among different representative countries to see the diversity and efficiency.

We organized our paper as follow: The first section is the introduction of background and purpose. The second part will be literature review, discussing what related research has been studied in this topic. The third part will discuss the methodology we conduct, including what timeline of the crisis is, a brief of the event study and the design of the significance test. In the fourth part, we describe the stock market for each country and specify the announcements selected to represent policy adjustments. The fifth part will be presented our empirical results and analysis. The last section is our conclusion.

2. Literature Review

The effect of policies on stock market is a widely discussed topic. Many previous studies investigate the responses or relationships between the policy settings and stock movement in one particular country or a pool of representative countries. Both Ozdagli and Yu (2012) and Evers (2012) give a general sketch of the correlation between monetary policy and stock market. Jääskelä and Jennings (2011) examines the transmission of monetary policy and find that sign-restricted VAR models do reasonably well at estimating the responses of macroeconomic variables to monetary policy shocks.

Many more studies focus on specific single market, in order to measure a clear impact. Bredin, et al. (2005) investigates the influence of changes in UK monetary policy on UK stock returns. The results indicate that the monetary policy shock leads to a persistent negative response in terms of future excess returns for a number of sectors. Gregoriou, et al. (2009) focuses on the UK monetary policy as well, but they in particular examine the impact of anticipated and unanticipated interest rate changes on aggregate and sector stock returns. They find that the inability of monetary

policy-makers to reverse, via interest rate cuts, the negative trend observed in stock prices since the onset of the credit crisis. Okpara (2010) analyzes the effect of monetary policy on the Nigerian stock market returns. He mentions that monetary policy is a significant determinant of long-run stock market returns in Nigeria. Evidence shows monetary policy efforts to slow down the economy. While current and one period lag interest rate exert a positive and significant influence on the stock market returns. All of them propose a clear effect from monetary on single country market.

As the hottest researching target, U.S. stock market attracts many researchers. Davidson and Froyen (1982) estimate the relationship between stock returns and monetary policy actions in U.S. in the perspective of efficient market hypothesis theorem. They suggest a possible violation of the conditions for market efficiency. Thorbecke (1997) investigate the relationship between monetary policy and U.S. stock market. Results from estimating a multi-factor model also indicate that exposure to monetary policy increases an asset's ex-ante return. Bjoruland and Leitemo (2008) estimate the interdependence between US monetary policy and the S&P 500. They find real stock prices immediately fall due to a monetary policy shock that raises the federal funds rate. Castelnuovo (2012) studies the effects of monetary policy shocks and predicts a negative and significant reaction of financial conditions to an unexpected monetary policy tightening.

China, which has the world's second large economy, also draws researchers' attention in recent decades. Burdekin and Siklos (2008) argue the post-1990 Chinese monetary policy is modeled with an augmented McCallum-type rule that takes into account the People's Bank of China's emphasis on targeting the rate of money supply growth. They investigate what has driven the central banks change policy since 1990, and find that the People's Bank (Chinese Central Bank) policy appears responsive to the gap between target and actual nominal GDP as well as to external pressures. Zhang, et al. (2011) concentrates on influence of Chinese monetary policy during global financial crisis and find a significant regime shift in the volatility of the stock market when the People's Bank of China adopted an accommodative monetary policy. They suggest that the central bank of China should incorporate stock market volatility into its policy-making process. Chen (2010) makes a comparison of monetary policy between China and U.S. to discover how corresponding countries react during the financial crisis. He argues that due the risk control point difference, the main monetary instrument and adjustment target are not identical.

Not only single market but also areas or correlated economy entities are put together to explore the potential relationship between policy and stock performance. Hofmann

(2009) data investigates a link between money growth and inflation based on euro area data. The results suggest that no monetary (or any other) single indicator significantly outperforms a simple benchmark forecast. The further analysis shows that it would be premature however to discard based on such evidence the usefulness of monetary (and all other) indicators. Ejerskov, et al. (2008) evaluates the functioning of the regular supply of liquidity in the euro area. The main result is that liquidity has normally been provided by the European Central Bank in a neutral and smooth manner, but also that there has been some limited attempt to correct deviations of the overnight rate from the main refinancing rate. The paper also finds that liquidity has affected the overnight interest rate to a significant extent only after the last main refinancing operation of the maintenance period. Valente (2008) investigates the responses of market interest rates to US monetary policy announcements for the US and two emerging economies, Hong Kong and Singapore. The results indicate that Federal Open Market Committee (FOMC) announcements significantly affect the term structure of interest rate in the US and both Asian countries. Furthermore, international interest rate differentials around FOMC meeting dates tend to be negative for short maturities with the impact gradually dissipating as bond maturity increases. Wongswan (2008) analyzes the impact of U.S. monetary policy announcement surprises on 15 foreign equity indexes in Asia, Europe, and Latin America. Using high-frequency data, they find a large and significant response of foreign equity indexes to U.S. monetary policy surprises at short time horizons. This paper also provides evidence that U.S. monetary policy surprises, and by extension changes in U.S. interest rates, affect foreign equity indexes through their discount rate component. This finding suggests that U.S. monetary policy may be a risk factor in global equity markets.

Compare to monetary policy analysis, researches on fiscal policy announcements seem rare. This is mainly because fiscal announcements are uneasy to collect comprehensively. Moreover it is not straightforward to assess the influence of such policy. Andersen (2008) addresses how policy coordination problems between fiscal authorities depend on the type of shocks and the objectives of the monetary authority. It is shown that non-coordinated fiscal policies tend to be too counter-cyclical in the case of aggregate shocks, and that this bias can be reduced by lowering the weight to output stability in monetary policy. Counter-cyclical fiscal policies are identified by government budget deficits and surpluses in periods of low and high economic growth, respectively. Da, et al. (2012) examines whether government fiscal policies lower equity returns by smoothing consumption. Evidence indicates that consumption volatility and stock returns are lowered by counter-cyclical fiscal policies. While differences in consumption volatility attributable to fiscal policy appear to create

distinct state-level pricing kernels, empirical support for an alternative cash flow channel is weaker.

Many critical argued the origin of this crisis. Taylor (2009), Allen and Carletti (2010) view the improper monetary policy mainly causes the crisis for the U.S. Adrian and Shin (2009), Pozsar et al. (2010) argue the flaws of regulatory framework prior to crisis period. They believe that this immatureness of regulations and standards for these emerging financial instruments led to the subprime crisis. Gorton and Metrick (2012) mention that a run on the repo market was the proximate cause of the financial crisis. Kane (2009) defines this was a regulation-induced financial crisis. Bartram and Bodnar (2009) provide a broad analysis of the effect of the current financial crisis on global equity markets and their major components, including examination on the magnitude of the crisis in terms of value destruction in comparison to other market crashes. The global nature of the crisis is also apparent from the high correlations between markets and investment styles that further increased during the crisis. Allen and Carletti (2009) argue that there was a bubble in real estate prices in the U.S. and a number of other countries. The main causes of the bubble were loose monetary policy, particularly by the U.S. Federal Reserve, and global imbalances. Taylor (2009) provides an empirical investigation of the role of government actions and interventions in the financial crisis that flared up in August 2007.

We conduct the approach based on Aït-Sahalia, et al. (2010). This paper examines the impact of macroeconomic and financial sector policy announcements in the U.S., the United Kingdom, the euro area, and Japan during the recent crisis on interbank credit and liquidity risk premia. They concentrate on the announcements impact of policies, which were associated with a reduction of interbank risk premia, albeit to a different degree during the subprime and global phases of the crisis. The event study methodology in this paper is our fundamental analysis method, which will be presented in detail in the following chapters.

3. Methodology

This paper has explored the power of fiscal and monetary policy announcements on the stock market returns using event study. This methodology is highly appreciated for its simplicity and parsimony to examine the narrow window effects of the policy announcements. In this section, we first introduce our foothold for separating the normal and crisis period. Then a short overview of the event study and the contributions test of each type of policy to the overall policy announcements impact are provided. Last, we interpret how our parametric and nonparametric statistical tests have been designed.

3.1 Timeline Analysis

3.1.1 Previous Studies of Crisis Definitions and Timeline

There is no uniform definition and timeline for the 2008 financial crisis. Laeven and Valencia (2008) indicate that the crisis was "a nominal depreciation of the currency of at least 30 percent that is also at least a 10 percent increase in the rate of depreciation compared to the previous year". They believe that banking crisis simultaneously coincided with a currency crisis gives rise to the 2007–2009 financial crisis. On the other side, Jickling (2008) defines the occurrence of a crisis "when the flow of credit to households and businesses is constrained and the real economy of goods and services is adversely affected".

Hoffmann, Post, and Pennings (2012) denote their crisis period from April 2008 to March 2009 based on the trend of stock index. They find that stock markets were relatively stable at the beginning of the April 2008, which is regarded as the stating point of the crisis. Moreover, after big recession the trend showed the recovery in March 2009, corresponding to the ending points. They also find two obvious crisis signals which occurred in September and October 2008. One is that the Lehman Brothers went bankrupt and AIG was bailed out in U.S.; and the other is that, in Europe, some departments of ABN AMRO Group and Fortis were nationalized. Cassola and Morana (2012) start the crisis period in August 2007 in relation to the worldwide financial market turbulence. Taylor and Williams (2009) investigate the trend of overnight index swap (OIS) and find that the OIS rate was well described condition of the financial crisis. The nonstationarity in the OIS spreads exhibits the stress in the interbank market. The first wave of OIS spreads incurred after 9 August 2007, following the day that the French bank BNP Paribas closed two of its investment funds; the second wave came after 16 September 2008, the day after the bankruptcy of Lehman Brothers. They also made an explanation why these obvious signals are neglected by the people. First, the incredible ten-fold increase of OIS after August 2007, and an additional two fold increase after September 2008, covered the unfolding of the crisis. It yielded a significant increase in their persistence and led to a switch from stationary to nonstationary. After December 2008, a declining trend in the level and volatility of the OIS spreads was detected, since the sequence of ECB policy rate cuts started since October 2008.

3.1.2 Separation between Normal Period and Crisis Period

According to previous studies, our paper distinguishes the normal period and crisis

period based on US Libor-OIS spread. The London interbank offer rate (Libor) is the rate at which banks indicate that they are willing to lend to other banks for a specified term of the loan. The overnight indexed swap (OIS) rate is the rate on a derivative contract on the overnight rate. The term Libor-OIS spread is usually viewed as a proxy of the health of the banking system and reflects the liquidity and risk of default for lending money to other banks (Thornton, 2009). Since the 2008 financial crisis was derived from the banking systems in U.S. market, we believe it is more precise and direct to separate normal and crisis period by the trend of US Libor-OIS spread than that of stock return.

The US Libor–OIS spread is the difference between London Internal Bank Offered Rate and the Overnight Index Swap rates in US dollar. In U.S., the overnight rate is the effective federal funds rate since it is also the weighted average rate at which borrowers can roll over overnight funding. Below chart respectively shows the trend of three month and one month US Libor-OIS spreads which extend form 2003-01-01 to 2009-12-31.

■ Figure 1 LIBOR-OIS spread from 2003-01-01 to 2009-12-31
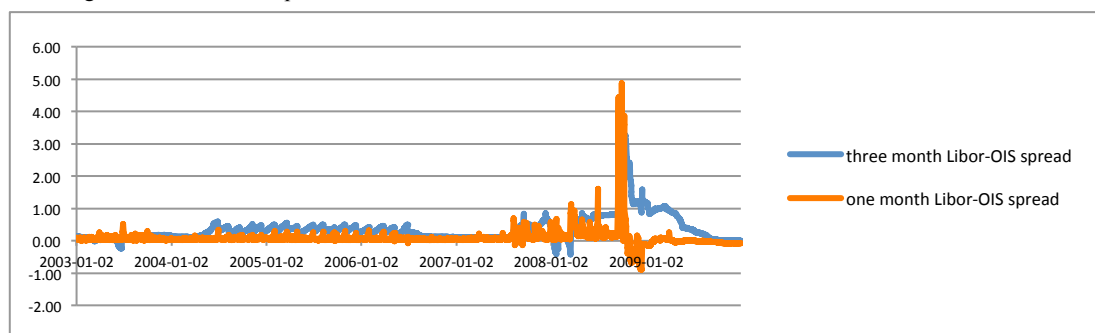
In the period of sufficient liquidity in the credit market, the Libor-OIS spread is close to zero. A higher spread indicates a declined willingness of lending by major banks. On the contrary, a lower spread points to the higher liquidity in the market. As presented in the figure 1, both the one-month and three month LIBOR-OIS spreads had historically waved around zero with a low volatility from 2003-01-01 to 2007-07-12, defined as our normal period. We regard the first shock (at 13th, July 2007) as a sign of the beginning of the financial crisis. The two spreads started to fluctuate severely in persistence. The trend of the one-month Libor-OIS spread exhibits a sharply sudden jump to 487 basis points in the midst of 2008, meanwhile, the three-month spread spiked to the highest points, 305. This period with high volatility in cluster is considered as the crisis period, which extends from 2007-07-13 to 2009-08-24, indicating a severe credit crunch. As for the ending point 2009-08-24,

both one-month and three-month Libor-OIS spreads went back to zero with no upwards trend.

In summary, our analysis period is stretched from 2003-01-01 to 2009-08-24. The normal period is from 2003-01-01 to 2007-07-12, while crisis period starts at 2007-07-13 and ends at 2009-08-24. The reason for us to choose long normal period is to obtain sufficient observations to assess the model since there are not many policy adjustments during the normal period. Another motivation for defining starting point in 2003 is that some country only archives the recent ten years' policy announcements. As such, the available data provide a relatively complete coverage of the crisis's impact on the stock markets.

3.2 Event Study Methodology

3.2.1 Previous Studies of Event Study

In an attempt to analyze the influence of the policy adjustments on the stock markets, many researchers have the same preference on event study methodology. Willem Theorbecke (1997) conducts a survey on the neutrality of the monetary policy and concludes that expansionary policy increases ex-post stock returns as Federal Reserve policy changes. Results from a multi-factor model estimation also indicate that the exposure to monetary policy increases an asset's ex-ante return. Wang and Mayes (2012) investigate the effect of domestic monetary policy changes on the stock markets of New Zealand, Australia, the United Kingdom and the euro area, and find that the euro area and the UK are more severely influenced by financial crisis than other areas.

The event study is not only applied to efficiency test in short-term analysis (Eckbo, Masulis and Norli, 2000; Mitchell and Stafford, 2000), but also can be suggestive of policies' long-term effectiveness (Aït-Sahalia et al., 2012). The study of Aït-Sahalia et al. points out that the positive immediate market reaction is self-fulfilling, laying ground for a sustained policy success. Referred to the previous articles' application and the advantages of event study, it is feasible and appropriate for our paper to adopt event study methodology.

3.2.2 Design of the Event Window

We mainly apply the event study methodology of Aït-Sahalia et al. (2012) in this paper. In their analysis, LIBOR-OIS spread is chosen as the main indicator of financial distress. They made an exploration on the response of the LIBOR-OIS

spread to the policy announcements in the U.S., the United Kingdom, the euro area, and Japan during subprime crisis period and globe crisis period. Both parametric and nonparametric statistics are tested before and after the announcements. Their results indicate that announcements were associated with a reduction of interbank risk premia in spite of a different severe degree comparing the subprime and global phases of the crisis.

Different from their focus on the Libor-OIS spread, we conduct a survey on the return of the stock market at the country-level. Because the return of the stock market to some extent reflects the economy and growth of a country. Another modification is that we concentrate on both fiscal and monetary policy announcements and select three countries, which are China, Sweden, and the U.S., based on their different economic characteristics. Policy announcement effects are likely to vary across countries. In addition, the central bank in different countries would have different preference on the policy instruments. Thus, it is meaningful to compare the different reactions of these countries to the same type of policy announcements.

In particular, the day of the event is *announcement day*; and the impact before the announcement day and subsequent days, as known as *event window*, are analyzed respectively in the crisis period and the normal period. Event is the announcement from the central banks and governments of the individual countries described in the appendix table 1. A narrow 5-trading-day event window, one day before the announcement day and three days after announcement, is selected in order to decline the overlapping effect. Meanwhile the analysis of a 3-trading-day event window is implemented since the smaller the event window is, the less other declarations can influence the results, suggested by Kothari and Warner (2007). This symmetric 1-day event window further ascertains the results of policy announcement are not influenced by other announcements during the event window. The estimation period is 20-trading days before the events window (as one month). See the figure below,

- Figure 2 Event window
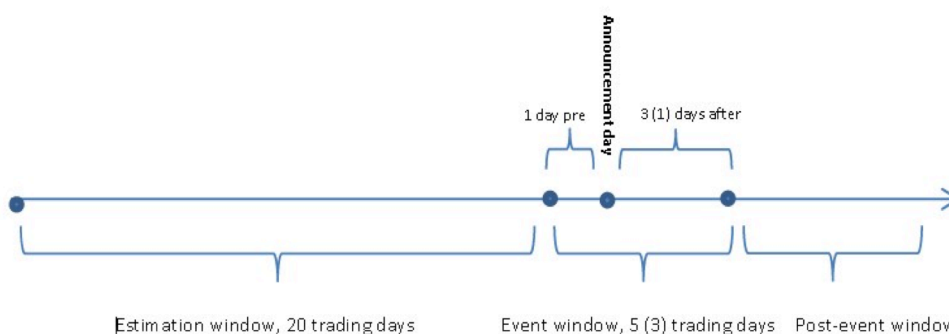
Based on event study, we evaluate the response of market stock return to the fiscal and monetary policy announcement, and capture the cumulative impact of the announcement within each event window. *Cumulative abnormal returns (CAR) are* calculated by aggregating the abnormal return over the event window, and then average these abnormal returns across the same type of policy measure to obtain *average cumulative abnormal return (ACAR). Abnormal returns (AR) are defined as* the actual daily changes in the stock returns. In both normal period and crisis period, the abnormal returns are not equal to zero.

- Daily stock return is calculated by taking the log difference of the price of each stock index:

$$R_{i,t} = \log (P_{i,t}/P_{i,t-1})$$

where $R_{i,t}$ is the daily return and $P_{i,t}$ and $P_{i,t-1}$ are the stock price on day t and *t-1* respectively.

- Abnormal return, $AR_{i,\tau}$ is generally defined as the daily change of market return in response to policy announcement i.

$$AR_{i,\tau} = R_{i,\tau} - R_{i,\tau-1}$$

where, the $\tau \in [-1,3]$ or $t \in [-1,1]$, is the day in the event window (announcement day occurring at $t = 0$).

- Cumulative abnormal return, $CAR_{i,\tau}$ for policy announcement i and average cumulative abnormal return ($ACAR_{i,\tau,m}$) for the policy type m

$$CAR_{i,\tau} = \sum AR_{i,\tau,}, \qquad ACAR_{i,\tau,m} = \frac{1}{N_m} \sum_{i \in N_m} \sum_{\tau \in T} AR_{i,\tau}$$

T equals to 5 (or 3), which is the length of the event window. N_m represents the number of announcements of policy type *m*.

We also assume that the there is no other intervention except fiscal and monetary policy announcements that significantly change the stocks during the event window.

One of the advantages for short term changes analysis of stock return is that we do not need to run test of deterministic component, nonlinearities and nonstationarity.

3.3 Contributions Test to Overall Policy Impact

We also test the contribution of each type of policy to the overall impact of the policy alterations. It can be regarded as the magnitude of the return response to the given policy announcement among the whole policy system. Since the tests are performed separately for each category of policy announcement, the analysis of contributions requires scaling the impact of individual types of announcements. $\widehat{ACAR}_m$ stands for the scaled contribution of an individual type of policy announcement m to the impact of the whole system:

$$\widehat{ACAR}_m = \frac{N_m}{N_M} ACAR_m * \begin{cases} \dfrac{\sum_M ACAR_m}{\sum_M ACAR_m^+} & if \sum_M ACAR_m > 0 \\[4mm] \dfrac{\sum_M ACAR_m}{\sum_M ACAR_m^-} & if \sum_M ACAR_m < 0 \end{cases}$$

where $\sum_M ACAR_m^+$ and $\sum_M ACAR_m^-$ denote the sum of all positive and negative ACARs associated with the individual types of policy measures that make up the whole policy M.

3.4 Parametric and Nonparametric Statistical Tests

Both parametric and nonparametric statistic test are applied to examine the explanatory power of obtained contributions. These statistics tests the abnormal changes of the stock return over a short period both before and after each policy announcement.

Parametric test

Parametric test implies an equal probability of positive and negative offsets, in another word, an important assumption that abnormal returns are normal distributed in the model. J_1 statistics below follows the standard normal distribution.

$$J_1 = \frac{ACAR_{i,\tau}}{\sigma_{i,\tau}(ACAD)} \sim N(0,1)$$

The standard deviation formula of the abnormal returns $\sigma_{i,\tau}(\cdot)$ is drawn from Mikkelson and Partch (1986). This method balances the specification of volatility during the estimation windows. Thus above test formula is transformed as:

$$J_1 = \frac{ACAR_{i,\tau,m}}{\sigma_{i,\tau,m}(ACAD)} = \frac{\frac{1}{N_m}\sum_{i \in N_m}\sum_{\tau \in T}(r_{i,\tau} - r_{i,\tau-1})}{\frac{\sqrt{T}}{N_m}\sqrt{\sum_{i \in N_m}\frac{\sum_{l \in L}(AR_{i,l} - \overline{AR_{i,l}})^2}{L}}}$$

$$= \frac{\frac{1}{\sqrt{T}}\sum_{i \in N_m}\sum_{\tau \in T} AR_{i,\tau}}{\sqrt{\sum_{i \in N_m}\frac{\sum_{l \in L}(AR_{i,l} - \overline{AR_{i,l}})^2}{L}}} \sim N(0,1)$$

where *L=20*, denotes the length of the estimation window; $l \in [\tau - 21, \tau - 1]$ is the day within the estimation window. Test statistic J_1 asymptotically converges to the standard normal distribution N(0,1).

Nonparametric tests

Previous studies find that abnormal returns distributions are usually right skewed with fat tails. Thus the null hypothesis of the negative abnormal performances is likely to be accepted by the parametric test when it is actually not. And positive abnormal performances are often rejected inappropriately vice versa. When the assumption of normal distributed abnormal returns is violated, parametric tests are not well specified. Another consideration about the weak assumption of normal distribution results from our small sample size. Therefore nonparametric tests are more specified and powerful at detecting the null hypothesis of no abnormal returns as there is no requirement of distribution assumption.

Rank test (Corrado, 1989) is one of the effective nonparametric statistical tests. To implement the Rank test, the first step is to transform each abnormal return in ranks (K_i) over the combined period consist of both estimation window (L) and event window (T).

$$K_{i,l+\tau} = rank(AR_{i,l+\tau})$$

$$AR_{i,t} > AR_{i,s}, \quad K_{i,t} > K_{i,s}$$

The second is to compare the ranks within the event window with the expected average rank:

$$\overline{K_i} = 0.5 + \frac{L + T}{2}$$

The test statistic for the null hypothesis is:

$$J_2 = \frac{\frac{1}{N_m}\Sigma_{i\in N_m}(K_{i,0} - \overline{K_\iota})}{S(\overline{K})} \sim N(0,1)$$

$$S(\overline{K}) = \sqrt{\frac{1}{T+L}\sum_{t\in T+L}\frac{1}{N_m{}^2}\sum_{i\in N_m}(K_{i,t} - \overline{K_\iota})^2}$$

With multi-day event window, the rank test statistics is:

$$J_2 = \frac{\sum_{\tau\in T}\frac{1}{N_m}\Sigma_{i\in N_m}(K_{i,\tau} - \overline{K_\iota})}{\sqrt{\sum_{\tau\in T}S(\overline{K})^2}} \sim N(0,1)$$

$$J_2 = \frac{\sum_{\tau\in T}\frac{1}{N_m}\Sigma_{i\in N_m}(K_{i,\tau} - \overline{K_\iota})}{S(\overline{K})\sqrt{T}} \sim N(0,1)$$

This statistic is asymptotically as standard normal distribution.

Based on the two statistic test above, we assess whether the given type of the policy announcements induces a statistically significant effect on the stock returns. And when there exist differences between the results of parametric test and nonparametric test, we will rely on the nonparametric test since it is more reliable with fewer restrictions.

4. Stock Markets and Policy Announcements

We categorize fiscal and monetary policy depend on specific characteristics of government/central bank actions against the crisis. All the policy announcements are confirmed from the official websites of the country´s government and central bank; the fiscal policy announcements are acquired from the Ministry of Finance, while monetary policy are selected from the release of central bank official websites, the People´s bank of China, Federal Reserve, and the Riksbank of Sweden. It is assumed that there is no delay between the official website of the governments and the official press release to public.

4.1 Overview of Three Countries' Stock Market

The analysis of stock market responses to policy announcements requires country-level daily data. Enforced by the authority, official policy announcements

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guide the economy orientation and investor´s belief on appropriateness, timeliness, and implementation, which indirectly leads to the fluctuation of the stock markets. This feature is especially obviously during the crisis when the authorities announce to rescue the market and relieve the disturbance of investors. The return data consists of daily stock returns on Dow Jones Index (DJI) for U.S., OMX Stockholm 30 Index (OMX 30) for Sweden, and Shanghai Composite Index (SSE) for China. All of these indices are the widely recognized standards to evaluate the market performances respectively.

The U.S.

- ▪ Figure 3: the stock market return and volatility for the U.S. from 2003-01-01 to 2009-12-31
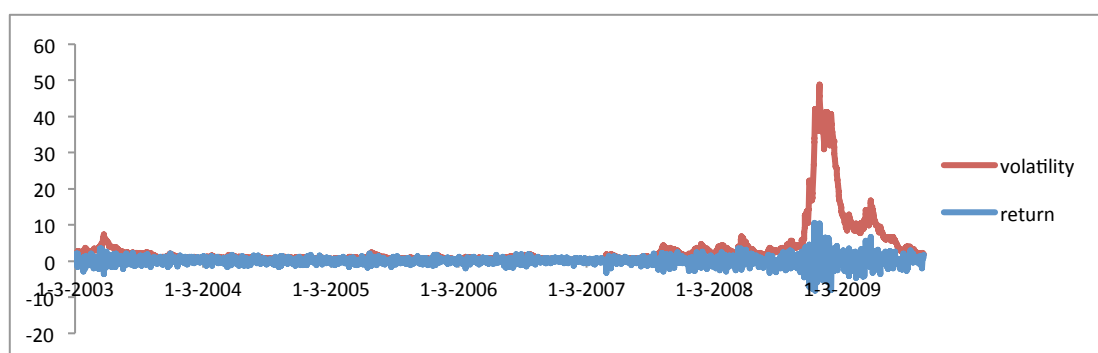
As shown in figure 4, the trend of market return and volatility in the Dow Jones Index (DJI) exhibit explicitly split between normal period and crisis period. From the year of 2003 to the first-half of 2007, market return and volatility slightly waved around zero. The substantial fluctuations were beginning around 12th, July in 2007, which is in accordance with timeline analysis of Libor-OIS spread above. A drastically increase of the volatility started at the time point 30th, July in 2008 and rapidly spiked to the peak of 48.74 basis point at 29th, October in 2008, on which day the Federal Reserve cut the federal fund rate to 1 percent. It was the Federal's latest effort to thaw out credit and slow the slide into recession[2]. Effective as it was possibly, the trend of the return volatility reversed and gradually recovered back to the zero.

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[2] PBS Newshour. Available at: http://www.pbs.org/newshour/news_summaries/2008/10/summary_29.html

Sweden

▪ Figure 4: the stock market return and volatility for Sweden from 2003-01-01 to 2009-12-31
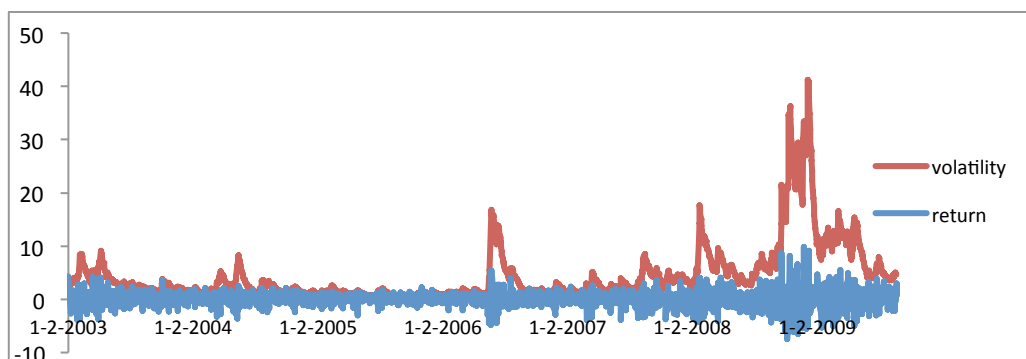
Compared with the return volatility in the DJI, the OXM Stockholm 30 Index (OXM 30) in figure 5 presents a more instable trend and longer volatile period. Generally speaking, there exist several sporadic shocks in the normal period while beginning at the July of 2007, the tendency of OXM 30 return variance appeared a high fluctuation in persistence. The highest point occurred at 15th, December 2008, accounts for 41.26 basis point. Similarly, the market slowly recovered after the post 2009.

China

▪ Figure 5: the stock market return and volatility for China from 2003-01-01 to 2009-12-31
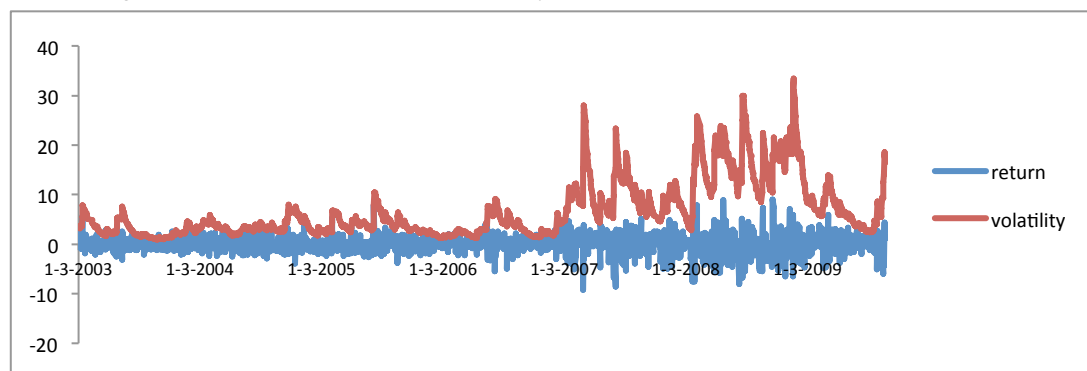
Different from the volatility trend of DJI and OXM 30, the Shanghai Composite Index (SSE) displays the volatile period from the beginning of the year 2007 with a number of substantial peaks in volatility and a number of corresponding peaks and troughs in returns. The summit represented 31.69 basis points at 19th November, 2008. In order to keep comparability with the U.S. and Sweden, we still insist on the crisis period for China from 2007-7-13 to 2009-08-24, which still includes the zenith of the volatility. Even continuous oscillations exist in the normal period, the magnitudes were relatively small.

To compare, during financial crisis, both return and volatility expressed the high

fluctuations in three countries. In addition, the magnitude of the oscillation in the U.S. is the highest (48.74 basis points) while it is the lowest in China, that is, 17 basis points less than U.S.. The volatile degree of Sweden is in the middle with 41.26 basis points. On the other hand, the China has the longest erratic period: relatively small waves persist in the normal period and highvolatilities were starting from the beginning of 2007. Then followed Sweden and U.S., the fluctuations were concentrated within the period of July, 2007 to August, 2009. In spite of associating with the high risk, this was also a time with high positive abnormal returns. To realize the impact of the policy announcements assists the formation of the investment decisions.

4.2 Policy announcements

It is helpful to reduce the noise and overlapping events by carefully classifying the policy announcements and only concentrating on the watershed policy event. Policy initiatives are dated as of their official announcements in their websites. As for such policy announcements that involve a multi-staged process, for instance, the fiscal stimulus package, we record the first meaningful announcement. The subsequences are filtered since we only concentrate on the turning point of the policy. Another reason is that investors are aware of those planned stages in advance and will enact before the consecutive announcements. We filter the announcements that occur within the same event window, since we can not tell which one exerts the more effective impact. All the fiscal policy announcements are collected during the analysis period. Monetary policy alterations are decomposed into following categories: required reserve ratio, base rate, open market operation, financial sector policy, liquidity support, and others (table 1 in the appendix). For announcements comprise several categories, we identify the main measure based on degree of prominence of the official press.

Fiscal policy

Laopodis(2011) examines the dynamic linkages among the federal budget deficit and show a higher sensitivity of the stock market to taxes relative to spending. Conventional analysis suggests that sustained budget deficits have severe implications on interest rates, national saving and the external account (Gale and Orszag, 2003, Engen and Hubbard, 2005). From the results of Aït-Sahalia et al. (2012), fiscal policy events only take up 5% of the whole policy announcements during the financial crisis but exert the significant power on the credit market.

In our classification*, Fiscal policy measures* include all the actions that stimulate

domestic demand, change government revenue (tax) and expenditures, resulting in budget deficits or surpluses. During the crisis, all three countries announce the fiscal economic stimulus plan with billions of money to pull up the domestic demand and rescue the market (for example, U.S. economic stimulus Act, 1/18/2008, 1/24/2008; China economic stimulus plan, 2008/11/9; Sweden economic stimulus plan, 12/5/2008).

Monetary policy

Monetary policy initiatives generally take the responsibility, such as the adjustments of the target interest rate and the supply of money, to maintain a prosperous and stable market. The amendments of the monetary policy by central bank result in a vigorous power on the stock market. Bredin, Hyde and Reilly (2005) adopt the policy rate (the change of the supply of money) and find that the monetary policy shock leads to a persistent negative response in terms of future excess returns for a number of sectors while Gregoriou, Kontonikas, MacDonald and Montagnoli (2009) survey the monetary policy shock of the changes in the three-month LIBOR futures contract, which indicates an important structural break in the relationship between stock returns and monetary policy shifts. During the crisis, there exist high frequent changes of the monetary policy, besides, different types of the countries have the different inclinations towards the monetary policy tools. For Sweden, during the crisis period from 2007/12/12 to 2009/08/26, the Riksbank announced 60 times issuances of the new SEK/US loans to increase the liquidity of the market[3]. While in U.S., Federal Reserve often focus on the asset purchase and recapitalization. Different with those two western countries, China has the preference to the required reserve ratio (RRR) which is the percentage of depositors' balances banks must have on hand as cash required and determined by the country's central bank[4].

In our analysis, the *monetary policy measures* consist of:

1) Decision to the increase/decrease of the required reserve ratio (special for China market);

2) Decision to increase/decrease/inaction of the 'base rate'. 'Base rate', that is respectively denoted as the federal fund rate for U.S., central bank lending rate for China and repo rate for Sweden;

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[3] Financial turbulence-the Riksbank's response. Available at:
http://www.riksbank.se/en/Financial-stability/Financial-turbulence-the-Riksbanks-response/
[4] Definition of RRR. Available at: http://www.investopedia.com/terms/r/reserveratio.asp

3) The liquidity support, which indicates that central bank announce to issue currency loan.

4) Open market operation, the announcements to buy back government bond on the open market.

5) The announcements of financial sector policy, which are constituted by the announcements of *asset repurchase* and *recapitalization*. *Asset purchase programs* are to utilize the public funds to buy risky assets from banks to shield them from losses. *Recapitalizations* are also the instruments that take the advantage of the public funds to inject or nationalize the capital of a bank;

6) Others, including the announcements of new measures or swaps to reinforce the market liquidity (for example, the Risksbank announces new swap in US dollars, 2008/9/29[5]).

It is noticed that in category 1, we respectively allocate the decision changes of the required reserve ratio into two groups: *increase* and *decrease.* Hence, it is apparently to distinguish the different orientations of these policy announcements' power. For the required reserve ratio, western central banks rarely alter this reserve requirements since low excess reserves would cause immediate liquidity problem for banks meanwhile the high frequency of the adjustments may result in the inflations due to the cash multiple. U.S. keeps the 10% required reserve ratio unchanged, and there is no required reserve ratio in Sweden. On the contrary, the People´s Bank of China commonly raises the reserve requirement ten times and then drops three times, regards it as a pivotal tool for inflation and crisis fighting[6]. Thus it is worth investigating the function of this policy adjustment when exploring the countries containing China. In the category 2, we have the same classification for the RRR (*increase* and *decrease*), in addition, we add another group *inaction*. 'Inaction' of the rate indicates that the central bank announce to maintain the rate unchanged. We believe the federal fund rate, central bank lending rate and repo rate are comparable and define them as 'base rate' corresponding to their countries since these three rates act as the criteria for the other interest rates adjustments in lending markets.

5. Empirical analysis

To investigate the influence of the fiscal and monetary policy announcements on the

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stock market returns, we first provide a short summary of each country's policy announcements and then the plots of the average cumulative abnormal return (ACAR) during the event window are exhibited to interpret how the trend of market return are affected by a given type of policy announcements. Finally, magnitude and the statistical significance of the market return responses to policy announcements are tested over the event window

5.1 Descriptive Analysis

In general, the announcement pool includes 132 announcements for U.S., 146 for Sweden and 80 alterations for China during the whole analysis period (table 2 in the appendix). For every country, fiscal policy accounts for fewer shares of the whole policy announcements than the monetary policy. The number of the fiscal policy announcements is slightly increasing from normal period to crisis period. However, the amount of money involved in the fiscal plan during the crisis is much more tremendous than that in normal period. For example, Signed by President Barack Obama, the approximate cost of U.S. economic stimulus package was estimated to be $787 billion at the time of passage while China publish a fiscal stimulus plan that worth $586 billion in November 2008. The Swedish government announced the economic stimulus package of $2.7 billion on 5th, December of 2008 and soon supplemented another $3.8 billion[7] to resist continuously depression of automobile industry.

Although countries' initiatives to rescue the economy are similar, the exact timing and features of measures vary relying on governments' sense of the extent and timing of the financial crisis.

The U.S.

■   Figure 6 Cumulative number of announcements from 2003-01-01 to 2009-08-24
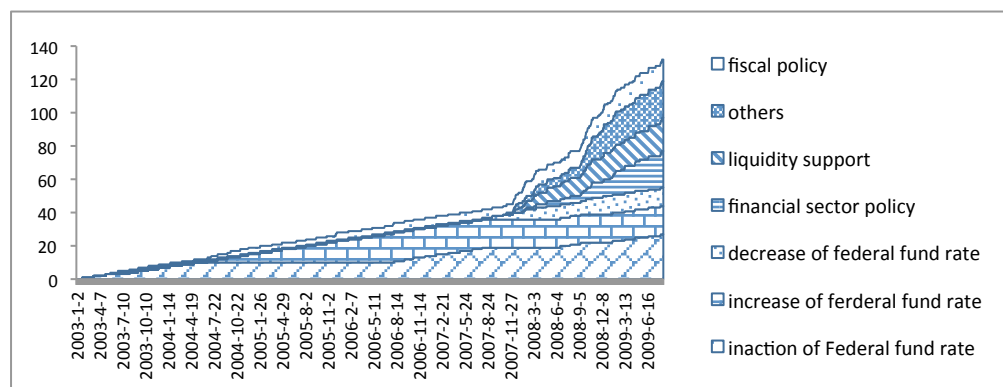
From figure 6, it is obviously to find that the number of the policy announcements drastically rose from 25th, November in 2007. Instead of increase or inaction of federal fund rate during the normal period, the authority lowered the target federal fund rate ten times to support market liquidity in the period of crisis. The target federal fund rate was sharply declining from 4.75% to 0.25% by 0.25% decrement each time with high frequency of announcements. Numerous new instruments were coming out in succession, e.g., asset purchase and recapitalization, issuances of dollar loan, establishment of new swap line or instruments, to pull up the market economy against the crisis.

Sweden

■   Figure 7 Cumulative number of announcements from 2003-01-01 to 2009-08-24
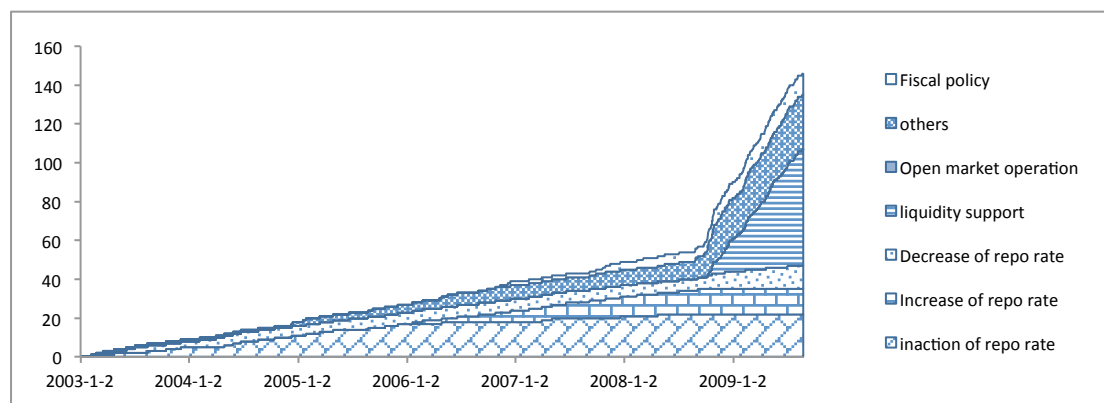
The sharp turning point of Swedish policy was around September of 2008, not surprised to find it was later than that of U.S.. For Swedish central bank, two of the most important policy tools to response to the crisis are the adjustments of repo rate and issuance of the liquidity support. During the normal period, to maintain the level of the repo rate is the most common measure to stabilize the market, which was published 20 times, almost taking up 50% shares of the whole announcements. In the crisis period, even though the number of the announcement is not noticeably altered, the magnitude of the repo rate cut was significant. During the period of January, 2006 to October, 2008 (34 month), the repo rate was raised 13 times by 0.25% increment each time from 1,50% to 4.75%. Since then, it rapidly decreased to against crisis by 1% or 1.5% change each time, and on July 2 (only 9 months) the repo rate declined to the bottom with 0.25%. Liquidity support is another core strategy for government to enlarge the market liquidity. Compared with three countries, Swedish announced the issuance of the loan most frequently, that is, 60, during the crisis period.

China
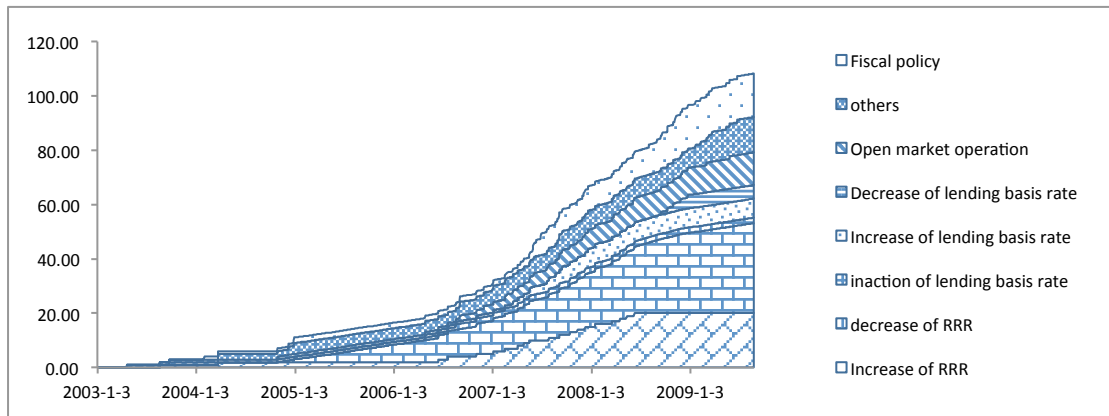
Different from the other two countries, the number of policy announcements is relatively steady, which accounts for 35 pieces of declarations during the normal period compared to 45 pieces over the crisis period. The most important tool, unlike the U.S. and Sweden, is the adjustment of the required reserve ratio to control the supply of money in the Chinese market. This implementation begun around the middle of the 2006.   It was originally at 7%, and adjusted two times to 8.5% in post 2006. Since 2007, it was almost altered each month by 0.5 increments. We believe it is the possible reason that causes the fluctuation of the return in the Chinese stock market at the beginning of 2007. The increasing trend persisted to the September of 2008, reached at 17.5%, and then it slightly fell down to 15% to relieve pressure of the credit market. Simultaneously, the central bank lowered the base lending rate from 7.2% to 5.31%. As for the other measures, there is no obviously amendment.

It is concluded that for the monetary policy, U.S. Federal Reserve takes the advantage of the various initiatives, specifically for the financial sector policy and federal fund rate, to rescue the severe bad subprime situation and mitigate investors' tension during crisis period. Sweden has the tendency to the adjustment of liquidity support against the crisis while adjustments of repo rate are adapted to both normal period and crisis period but in different directions. China mainly utilizes the required reserve ratio to orient the credit market. Fiscal policies are similar to stimulus domestic demand throughout the three countries.

5.2 Graphical Analysis

In order to grasp the impact of policy announcements on stock market, it is interesting to plot the changes of stock returns during the event window, since plot graph provides an ocular way to see the directions and magnitudes of responses caused by

policy interventions.

This part approximately sketches the trend of stock movements prior and after announcements based on the plot graph. The variable plotted on vertical axis is the averaged cumulative abnormal return (ACAR) caused by each type of policy announcement. The reason of choosing ACAR as basis is that it directly reflects the cumulative changes of stock return for each day over the event window. Moreover, in order to introduce a benchmark point, the ACAR on the first day of event window is scaled to zero. The horizontal axis shows the days within an event window, where 0 represents the event day. In a similar way, the other figures on the scale represent the pre-event and post-event days respectively.

Considering there are several types of announcements, to make plots more optical, these announcement measures are generally categorized into three groups. The first group is the official base rate adjustments of each country. The second group is the official required reserve ratio. What should notice is that this group only contains the requirement ratio alteration in China, because there is no such significant adjustment in the other two countries during analyzing period (Discussed in section 4). The first two groups are quantitative collection, which means they contain not only information of occurs of events but also the direction of the event. Say, an increase or decrease of repo rate, for example. However, the last group only accounts non-quantitative announcements, including fiscal policy alterations, governments' open market operations, liquidity support, financial sector policy and other policy adjustments. To compare the contributions of policy to stock market between normal period and crisis period, the whole time-line is separated into two phases. Therefore, a combined figure is constructed including totally 14 graphs for three countries.

To evaluate the impact of policy adjustment announcements on stock market, we first construct a 5-day event window to observe the movement trend of averaged cumulate abnormal return. The 5-day event window consists of one day before the event day and three days after the event day.

According to the plots (See figure 9, 10, 11 in appendix), it is not quite ocular to measure a particular direction for all the announcements, since most of the ACAD moved up and down within event windows. One potential reason is that applying a 5-day event window leads to overlapping problem. Because some policy adjustments were announced within few days, the pre/post-event day might be included into adjacent event window. Therefore it is possible that the ACAD has been enhanced or offset after the event day, due to the new event. Nevertheless, a general trend is accessible. The impacts of all the announcements were larger that during crisis period,

which means that the market had become more sensitive to policy changes when it was in crisis.

In order to measure a clear impact of policy announcements, moreover to avoid the overlap influence, we narrow the event window (three days instead of five). Hence we can observe the instance response of market one day prior to and after the event day. In this way, overlap problem is eliminated, and potential lag effect is reduced as well. It is obvious to see the clear impact of every types of policy announcement in respective countries during both phases.

Base Rate

For U.S (See figure 12 top panel in appendix), increases of federal fund rate were associated with slight increment of stock returns during the normal period, but these tiny changes fell soon after the announcement day. This effect cannot be observed when crisis happened, because U.S. government did not increase the base rate anymore at that time. Similar to base rate increases, announcements of keeping federal fund rate unchanged slightly stimulated the stock market, and the raise fell back one day after. This trend remained during the crisis period, but the announcement day response was more significant than that in normal period. This can be explained that U.S market participants were more sensitive when crisis occurred. The impact of government's reducing base rate announcements was entirely different in both phases. When crisis had not erupted, the rate-cutting announcements were associated with a significant drop of stock returns, but the drop vanished one day after, then the returns start to increase. On the contrary, rate-cutting decision from government gently raised the market but soon the market began to fall.

The situation goes different in Sweden (See figure 12 middle panel in appendix). In both phases, whatever increases or decreases of repo rate announcement led to a reduction of stock on the announcement day, albeit to tiny recovery one day after. And this effect became more pronounced when crisis happened. It is noticed that inaction of repo rate gave opposite impact on Swedish stock market. The inaction was associated with negative "raise-after-fall" response during normal period, while it created a positive and larger "fall-after-raise" response when crisis happened. All in all, the Swedish market reacted more intense when repo rate policy announced during the crisis period.

The impact of Chinese base rate adjustment to its stock market is not as complicated as the other two countries (See figure 12 bottom panel in appendix). In normal period, increases of lending rate were associated with increments of stock market. In crisis

period however, stock market went significant downward when Chinese announced to increase the lending rate (albeit to a tiny increase on event day). When Chinese central bank announced decreasing its lending rate, the market dropped as well. But it only happened in crisis period, because there was no rate-cutting announcement in normal period. China seldom announces the inaction of the lending rate, it announced merely twice before the world went to crisis, which strongly stimulated the market.

Required Reserve Ratio

China is the only country that alters required reserved to adjust the market (See figure 13 in appendix), since it is argued as an uneasily controlled instrument for financial market (Discussed in section 4). U.S keeps the reserve ratio at 10%, and null for Sweden. As for China, increases of requirement ratio were associated with promotion of stock returns during normal period (albeit to a drop on event day). Meanwhile the returns decreased when the central bank announced alteration of requirement ratio during crisis period. The impact of cutting the requirement ratio announcement was twice larger than raising the ratio.

Other Monetary Instrument

From 2003 to 2007 before the crisis started, U.S did not announce any evident monetary policy alteration except regular adjustment of the federal fund rate (See figure 14 top panel in appendix). Therefore it is inapplicable to compare these monetary tools between the two phases. However, the influence of such tools was sharp during crisis period. Since the subprime crisis erupted, U.S government had announced a pool of activities to face the crisis. Among these actions, financial sector policies led to an intermediate reduction on stock returns, as well as the impacts caused by liquidity support. Furthermore, other unconventional rescue announcements were associated with a significant decrease on stock returns.

Similar to U.S, Swedish Monetary Authority announced few dynamic financial decisions before the crisis (See figure 14 middle panel in appendix). Surprisingly, these regular announcements gave a strong negative impact on stock market. This effect reversed in crisis period, in which the magnitude was less and the stock market went up one day after the announcement day. When subprime crisis erupted in U.S, Sweden, as well as other European countries was infected. During that time, the Swedish Riksbank (Swedish central bank) issued a plenty of loans to support market liquidity, which lead a cutting on its stock market.

For China (See figure 14 bottom panel in appendix), open market operations were accompanied by a slight decline of stock returns. This effect was pronounced during

crisis period, with a lagged raise after fall. The People's Bank of China issued loans only once before the crisis and no more loan issued during crisis period. This particular issue generated an obvious decline on the market. Other unconventional policy interventions created distinct impacts on both phases, they promoted the stock market on the announcement day when there is no crisis, whereas making recessions during the crisis.

Fiscal Policy

Any U.S fiscal policy announcements were accompanied by a reduction of stock returns. This trend faded out in crisis. On the opposite, Swedish fiscal policy announcements were associated with increases on stock market. Moreover, this effect was amplified during crisis. The situation in China was resembled. Fiscal policy alteration in China led to temporary increment on its stock returns, but eventually decreased. This impact became pronounced during crisis period.

In summary, based on the plot graph within a 3-day event window, we can understand a general impact of each policy announcements. Furthermore, it is possible to compare the policy influence difference among countries.

During the crisis, whatever U.S policy adjustment announced, stock returns eventually would experience a recession. The possible reason is that every announcement represents a signal of "the situation desires rescue solution", which weakened the confidence of market participants.

In Sweden, when facing crisis, fiscal policy adjustment promotes the stock returns. So did the sporadic unconventional announcement. During the crisis, Sweden issued a plenty of loans, which was surprisingly unable to inspire investors' confidence.

Compare to the other two developed countries, Chinese stock market gave a different responses, fiscal policy adjustment reduces the stock returns. So did the adjustments of all the lending rate and requirement ratio. Open market operation is the only announcement that stimulates the stock market. These monetary alterations led opposite effect before and during the crisis period, while the other two countries did not show these properties.

5.3 Magnitude and Significance Analysis

Statistical tests examine whether each category of policy is associated with a significant influence on the individual stock market. Our test results indicate that the effects of the announcements vary across the different type of policies and

characteristics of the countries.

Most of the directions of stock return responses to the policy could be clearly viewed from graphical analysis, but some with a trend of up and down are hard to tell the real effect of the policy announcements. Therefore we calculate the contributions of policy alterations to the stock returns. The item, *contribution* for each category, indicates that, among our whole policy system, how much stock return response exerts to this given type of policy.

In short, the statistical results for the five-trading-day event window seldom show the significant influence on the stock market. Integrated with the previous graphical analysis, the possible reason is the existence of overlapping or confounding effect, which severely disturbed our results. A simple and effective solution for alleviating this problem is to narrow down the event window, that is, selecting the symmetric 1-trading-day window. Thus we could capture the real power of each kind of the policy implemented in the stock markets.

Within a three-trading-day event window for U.S. (table 3 in the appendix), all the policy announcements except the decrease of federal fund rate exert the negative impacts on the stock return during the crisis period. Fiscal policy on average decreases the stock return by 0.005 basis points during the crisis, while it induces positive effect (0.039) in the normal period even though both of them are insignificant. New announcements of financial sector policy and liquidity support appeared in the crisis period with the aim to be crisis resisters. They have the significant negative effect on the stock market. Generally speaking, financial sector policy and liquidity support aim to salvage the market and enhance the market liquidity, thus associating with the increase of the stock return. Possible explanation of our result violation is that the public requires some time to perceive and understand the core meaning of this policy and then generates positive contributions, which could be witnessed in the 5-day event window. As for *Others* alteration, returns are declined by 0.112 with the t-test of 1.37.

As another vital measure for U.S., the increase of federal fund rate is adjusted only in the normal period and yields negative impact on the stock since it dissuades the interbank loan and makes the money investment hard to procure. Even though the inaction of the federal fund rate contributes the negative effect to the return, both in normal period and crisis period, the market is not sensitive to this type of policy. However, the decision of the federal fund cut in crisis, on the contrary, induces a significantly favorable movement on the stock market. As the authority decreases the federal fund rate, it encourages the bank to borrow money and invest freely. This

function is not noticeably when the stock market is steady. However, during the crisis, it relieves the pressure of the bank, and stimulates bank to borrow and freely invest, thus associating with the increase of the stock return by 0.016 basis point.

The results suggest no significant response of the stock return to the policy announcements within the 5-day event window. Except the fiscal policy, the contributions in the normal period have the same signs with that of 3-day event window. And the crisis period, almost all the policy announcements exhibit the favorable power on the market return over the long window (except *Others*).

As for **Sweden** (table 4 in the appendix), it is worth noticing that fiscal policy announcements lead to a significantly increase in the market return during the crisis over both 3-day and 5-day event window. Compared with fiscal stimulus package for U.S. and China, Sweden has the least amount of money involved (around $8.4 billion), but exerts the most significant positive power on the stock return. Sweden, as the small open country with relatively less trading volume, mainly depends on its own domestic market. Thus the releases of stimulus economic plan enlarge the original market and encourage more consumption, which in turn to promote the domestic economy and increase the stock return.

For the monetary policy of Sweden, the repo rate is the measurement tool for market liquidity. Decreasing the repo rate releases the market liquidity. In our statistical results within the 3-day event window, inaction of the repo rate significantly pulls up the stock return in both normal and crisis period but with different degree, that is, 0.005 and 0.016 basis point respectively. This kind of announcements eases the tension of the investors and strengthens their beliefs that market is under the control of the government. The increase of the repo rate declines the stock return by 0.001 basis point, which is worse in crisis period with a reduction of 0.068. The decrease of the repo rate significantly decreases the stock market but in long window it increases the stock by 0.0434 (five-day event window) in spite of insignificance.

Even though the authority announced liquidity support amendments frequently, statistics shows a lightly significant response of stock market to the liquidity support. The policy of *Others*, which includes the establishment of new swap line or any new measure to promote the market liquidity, has a significant positive impact on the stock market during the crisis period. In the five-day event window, the stocks return increases by 0.38 basis point on average, which is the largest positive impact of the whole Swedish policy system.

China (table 5 in the appendix)**.** There is no significant result in the five day event window and neither it is over the 3-day event window during the normal period. We also find that the contributions in the 3-day event window have the same signs with that in 5-day window.

According to the result of 3-day event window analysis on crisis period, both the decrease of the central bank lending rate and the open market operation are associated with an significantly increase of the stock return, respectively 0.11 and 0.16 basis point. Special for China, the market is not sensitive to the announcement of open market operation in the normal phase while in the period of crisis, investors consider this alteration as the signal for government to control the inflation and rescue the market, which results in the positive response of the stock market. Inaction and increase of the central bank lending rate are not significant in both periods. But decrease of central bank lending rate, which lowers the requirements of credit market and promote the liquidity of money, gives rise to the significantly positive jump in the stock return.

Another unique measurement of China is required reserve ratio (RRR). The decrease of the RRR has no sufficient power on the stock market while the increase of the RRR, yields a significant decrease return during the crisis. The negative magnitude of stock return response to this type of policy announcement is the largest, which accounts for -0.23 among the whole policy. Since the frequent increases of RRR can easily contribute to the inflation problem due to the cash multiple. Investors perceive this type of policy and regard it as a signal of high inflation, thus decrease their expectations of the future return of the market.

Conclusion

So far, we have conducted the event study methodology to measure the impact of policy announcement on stock market. Plotting the averaged cumulative abnormal return within event windows sketches a general impact of policy announcement. Followed by a contribution and statistical test on announcement collections, we are able to combine the actual movements of stock returns with empirical test result, and conclude some regular patterns about the role of policy adjustment in selected countries.

When facing the crisis, policy adjustment lead to diversified response among difference countries. It depends on the features of a country such as the scale of economy, the degree of economic freedom, and vise versa determinate the country's the preference on policy instrument.

Compare to normal period, the reaction of stock market to policy announcements is amplified during crisis period. It is common that the market became more sensitive at that time. Every action from government can generate signals and transit to market participants, hence influence their decision more or less.

As an important monetary policy instrument, base rate has proved its power in adjusting the whole market. The announcement about base rate led to significant fluctuations in all countries. This phenomenon is easy to understand since base rate is the foundation of credit market. In addition, cutting the base rate is associated with increment on stock market, because it promotes the market liquidity.

Same types of policies raise different impact on the stock market in respective countries. Moreover, the effective of policy varies among these countries. Thus each country has its own preference on policy instruments choices. Due to its large scale of economy, the U.S. applies a variety of policies simultaneously to ensure the adjusting the market. On the contrary, a small economy entity like Sweden was more affected by its domestic market demand. The Chinese government relies on altering requirement reserve ratio as well as initiating open market operations These two instruments are direct and effective to make macro manipulation in a low economic degree market.

There are some limitations that result in the unsatisfied results of the parametric test, several inspirations is suggested for the further supplement empirical analysis. One is toset an appropriate announcement collection filter to better avoid the potential overlapping problem. Another suggestion to improve the statistical results is to elaborate a reliable method to evaluate the public anticipation of the announcement prior to the event day.

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Appendix

Table 1: Classification of policy measures

Classification of the Policy Announcement	
Measures	Examples
Fiscal Policy	
Fiscal stimulus package	Chinese economic stimulus plan, 9/112008;
	U.S. Economic Stimulus Act (18/1/2008, 24/1/2008);
	Sweden economic stimulus plan (5/12/2008)
Monetary Policy	
Required reserve ratio	
Increase	China increase reserve ratio (16/6/2006, 5/4/2007, 27/4/2007, 10/12/2007, 10/6/2008)
Decrease	China cut reserve ratio (26/11/2007, 25/12/2007, 16/9/2008, 26/11/2008, 12/12/2008,)
Base rate	
Increase	US federal fund rate increase (18/3/2008, 4/30/2008);
	Chinese central bank lending rate increase (29/10/2004, 23/7/2007) ;
	Repo rate increase(20/1/2006,20/6/2007)
Decrease	US federal fund rate cut (18/3/2008, 4/30/2008);
	Chinese central bank lending rate cut (9/10/2008, 23/12/2008);
	Repo rate cut(8/10/2008,4/12/2008,2/7/2009
Inaction	Sweden announce the unchanged of repo rate (7/27/2003, 3/15/2005);
	Announcement of Chinese central bank lending rate (28/4/2006, 21/8/2006);
	Repo rate unchanged (7/2/2003,14/10/2004, 12/12/2005)
Open market operation	People's Bank of China repurchase government bond of 23.7 billion CNY (9/4/2007)
Financial Sector Policy	TARP capitalization of nine U.S. bank (10/28/2008);
Liquidity support	the Riksbank offers dollar loans (10/13/2008, 11/3/2009, 6/16/2009);
	the U.S. offers dollar loans (14/12/2007, 29/5/2008);
	China offer foreign loan (30/6/2005)
Others	New swap facility in US dollars for Sweden (9/29/2008);
	Establishment of new swap line U.S.(24/9/2008, 12/12/2008, 20/5/2009); '
	China new swap line(9/2/2009, 23/3/2009)

Table 2 Number of announcements from 2003-01-01 to 2009-08-24

	China			Sweden			U.S.		
	Normal period	Crisis period	**Total**	Normal period	Crisis period	**Total**	Normal period	Crisis period	**Total**
Fiscal Policy	8	8	**16**	2	9	**11**	5	8	**13**
Monetary Policy									
Required reserve ratio									
Increase	10	10	**20**	-	-	-	-	-	-
Decrease	0	4	**4**	-	-	-	-	-	-
Basis rate									
Inaction	2	0	**2**	20	2	**22**	18	9	**27**
Increase	3	4	**7**	8	5	**13**	17	0	**17**
Decrease	0	5	**5**	6	6	**12**	1	10	**11**
Liquidity Support	1	0	**1**	0	60	**60**	0	20	**20**
Open market operation	5	7	**12**	-	-	**-**	-	-	**-**
Financial Sector Policy	-	-	**-**	-	-	**-**	0	22	**22**
Others	6	7	**13**	7	21	**28**	0	22	**22**
Total	35	45	**80**	43	103	**146**	41	91	**132**

Table 3 Magnitude and Statistical Significance of the U.S. DJI Stock Response to Policy Announcements

Magnitude and Statistical Test for Event Windows							
Normal Period				Crisis Period			
Event Window of 1 Day Before and 3 Days After Annoucement (5-day Event Window)							
Contribution	Parametric Test	Non-parametric Test	Obs.	Contribution	Parametric Test	Non-parametric Test	Obs.
Fiscal Policy							
-0.014	-0,17	-0,08	5	0.0141	0,07	0,31	7
Monetary Policy							
Federal Fund Rate Increase							
-0.083	-0,64	-0,04	17	-	-	-	-
Federal Fund Rate Decrease							
0.020	0,40	0,19	1	0.196	0,58	1,23	10
Inaction of Federal Fund Rate							
-0.005	-0,03	0,11	18	0.173	1,18	0,91	9
Financial Sector Policy							
-	-	-	-	0.161	0,50	-0,24	17
Liquidity Support							
-	-	-	-	0.055	-0,20	-0,29	19
Others							
-	-	-	-	-0.174	-0,40	-1,02	19

Event Window of 1 Day Before and After Announcement (3-day Event Window)							
Contribution	Parametric Test	Non-parametric Test	Obs.	Contribution	Parametric Test	Non-parametric Test	Obs.
Fiscal Policy							
0.039	0,52	-0,08	5	-0.0050	-0,05	1,02	7
Monetary Policy							
Federal Fund Rate Increase							
-0.088	-0,73	-0,28	17	-	-	-	-
Federal Fund Rate Decrease							
0.039	0,82	-0,46	1	0.015	0,12	3,69***	10
Inaction of Federal Fund Rate							
-0.122	-0,78	-0,46	18	-0.023	-0,14	1,06	9
Financial Sector Policy							
-	-	-	-	-0.040	0,25	3,30***	17
Liquidity Support							
-	-	-	-	-0.010	-0,42	2,03**	19
Others							
-	-	-	-	-0.112	-0,53	1,37	19

*: siginificant at 10% critical value
**: siginificant at 5% critical value
***:siginificant at 1% critical value

Table 4 Magnitude and Statistical Significance of the Swedish OXM 30 Stock Response to Policy Announcements

	Magnitude and Statistical Test for Event Windows							
	Normal Period				Crisis Period			
	Event Window of 1 Day Before and 3 Days After Annoucement (5-day Event Window)							
	Contribution	Parametric Test	Nonparametric Test	Obs.	Contribution	Parametric Test	Nonparametric Test	Obs.
Fiscal Policy	0.032	0,38	0,32	2	0.272	0,86	1,85*	9
Monetary Policy								
Repo Rate Increase	0.034	0,14	0,46	8	0.0308	0,16	0,14	5
Repo Rate Decrease	-0.037	-0,22	-0,47	6	0.0434	0,13	-0,51	6
Inaction of Repo Rate	0.071	0,24	0,14	20	0.0654	0,64	1,05	2
Liquidity Support	-	-	-	-	-0.2628	-0,41	-1,31	29
Others	0.058	0,43	0,17	7	0.3812	0,88	2,31**	14
	Event Window of 1 Day Before and After Announcement (3-day Event Window)							
	Contribution	Parametric Test	Nonparametric Test	Obs.	Contribution	Parametric Test	Nonparametric Test	Obs.
Fiscal Policy	-0.0023	-0,19	-0,46	2	0.151	0,87	3,39***	9
Monetary Policy								
Repo Rate Increase	-0.001	-0,02	-0,79	8	-0.005	-0,08	1,30	5
Repo Rate Decrease	0.018	0,73	-0,47	6	-0.068	-0,59	2,01**	6
Inaction of Repo Rate	0.005	3.44***	-0,29	20	0.016	0,47	2,62***	2
Liquidity Support	-	-	-	-	-0.143	-0,65	1,91*	29
Others	-0.018	-0,68	-0,53	7	0.057	0,38	4,34***	14

*: siginificant at 10% critical value
**: siginificant at 5% critical value
***:siginificant at 1% critical value

Table 5 Magnitude and Statistical Significance of the Chinese SCI Stock Response to Policy Announcements

Magnitude and Statistical Test for Event Windows								
	Normal Period				Crisis Period			
Event Window of 1 Day Before and 3 Days After Annoucement (5-day Event Window)								
	Contribution	Parametric Test	Nonparametric Test	Obs.	Contribution	Parametric Test	Nonparametric Test	Obs.
Fiscal Policy	-0.03	-0,19	-0,79	6	0.23	0,51	0,59	7
Monetary Policy								
Reserve Requirement Ratio Increase	-0.004	-0,05	-0,60	10	-0.20	-0,47	-1,54	10
Reserve Requirement Ratio Decrease	-	-	-	-	0.44	1,20	1,60	4
Central Bank Lending Rate Increase	-0.014	-0,19	-0,60	3	-0.10	-0,38	-1,30	4
Central Bank Lending Rate Decrease	-	-	-	-	0.13	0,32	0,40	5
Inaction of Central bank Lending rate	0.006	0,21	0,30	2	-	-	-	-
Open Market Operation	0.028	-0,38	-0,66	5	0.46	0,07	0,14	7
Liquidity Support	0.004	0,39	-0.7	1	-	-	-	-
Others	-0.004	0,01	-0,03	6	0.09	0,14	0,80	7
Event Window of 1 Day Before and After Announcement (3-day Event Window)								
	Contribution	Parametric Test	Nonparametric Test	Obs.	Contribution	Parametric Test	Nonparametric Test	Obs.
Fiscal Policy	-0.13	-0,70	-0,97	6	0.16	0,05	0,91	7
Monetary Policy								
Reserve Requirement Ratio Increase	-0.008	-0,03	-0,07	10	-0.23	0,02	4,09***	10
Reserve Requirement Ratio Decrease	-	-	-	-	0.09	0,21	1,35	4
Central Bank Lending Rate Increase	-0.074	-0,39	-1,45	3	0.09	-0,47	0,83	4
Central Bank Lending Rate Decrease	-	-	-	-	0.11	-0,66	-2,57***	5
Inaction of Central bank Lending rate	0.075	0,99	1,22	2	-	-	-	-
Open Market Operation	-0.064	-1,29	-1,51	5	0.16	1,00	2,70***	7
Liquidity Support	-0.017	-0,17	-0,26	1				
Others	-0.103	-0,91	-0,88	6	0.16	0,04	1,67*	7

*: siginificant at 10% critical value
**: siginificant at 5% critical value
***:siginificant at 1% critical value

Figure 9. Impact of base rate adjustment announcement on stock market (5-day event window)

Normal period   Crisis Period

U.S.
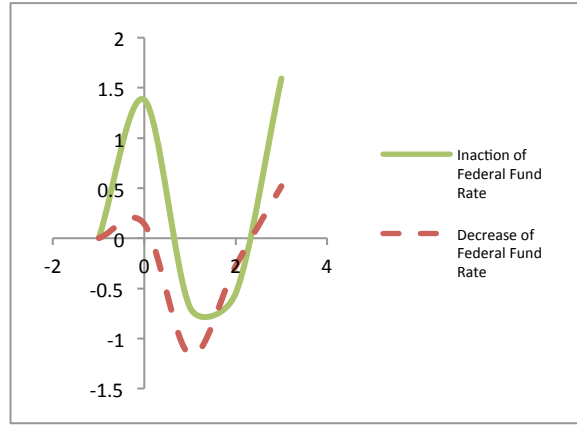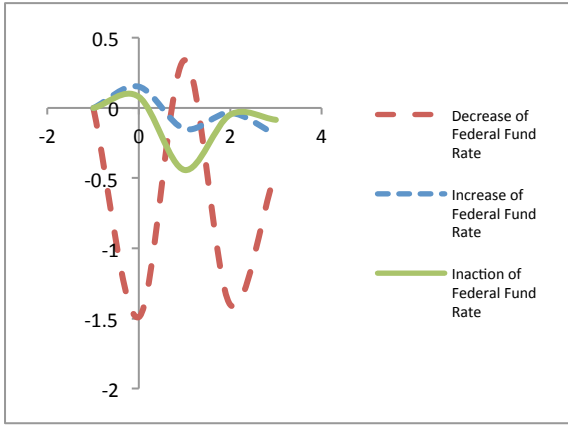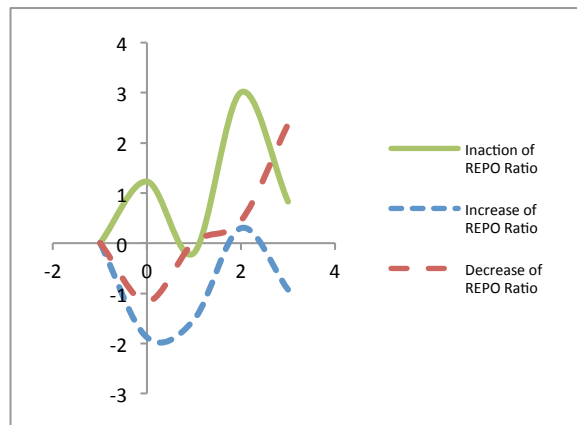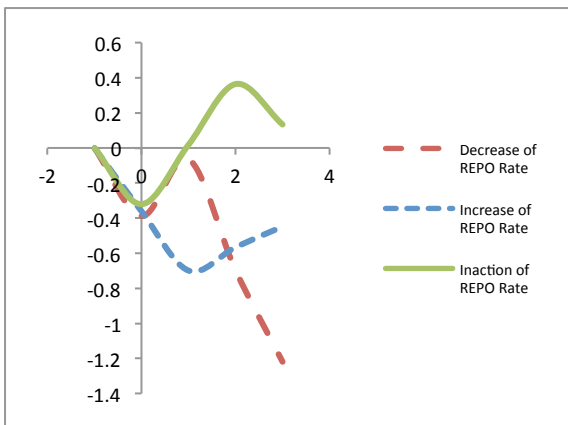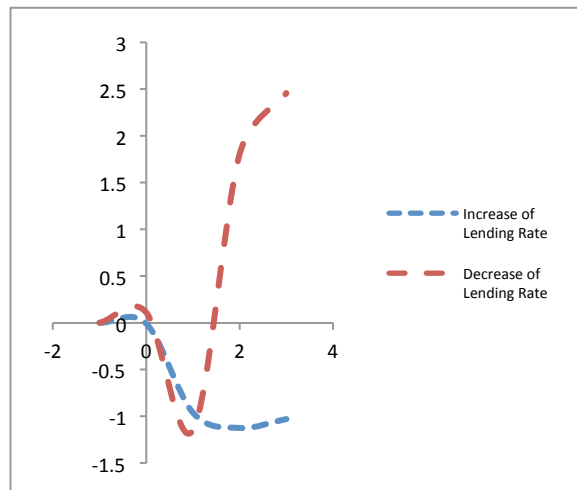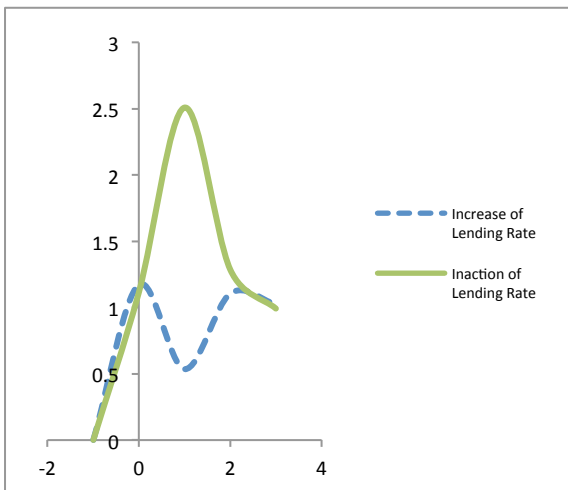
Sweden

China

Figure 10. Impact of required reserve ratio adjustment on stock market (5-day event window)
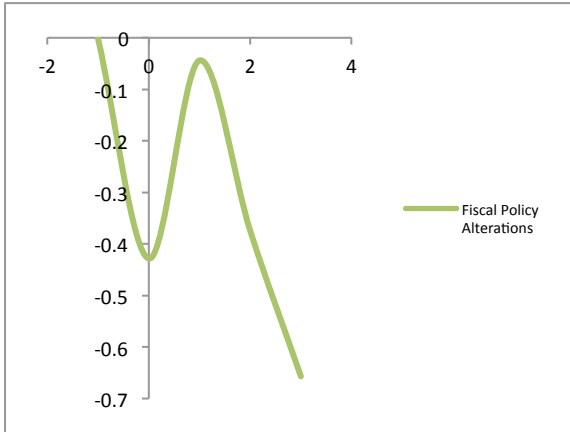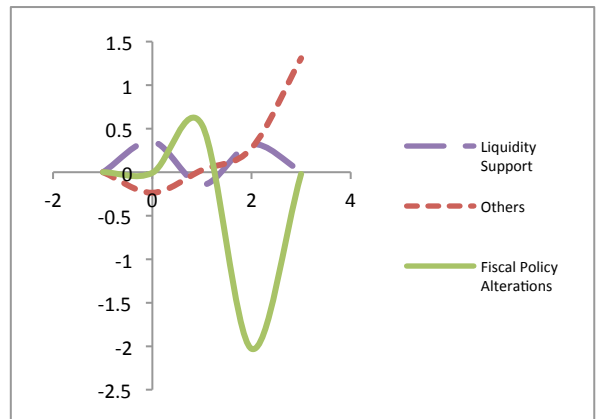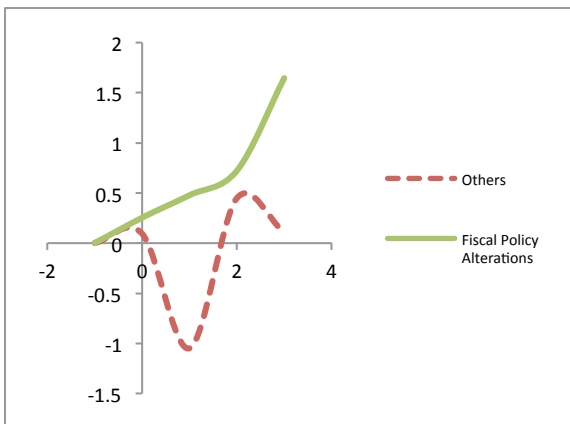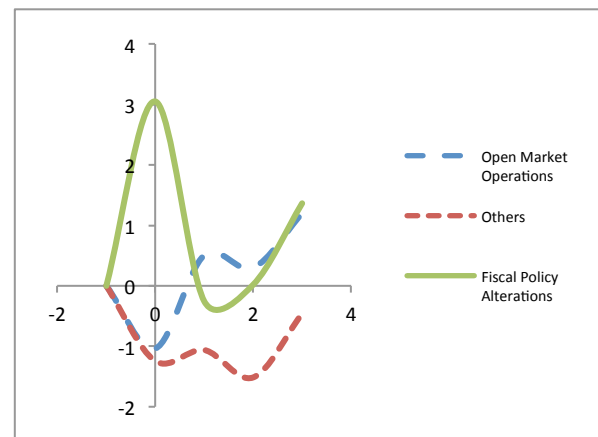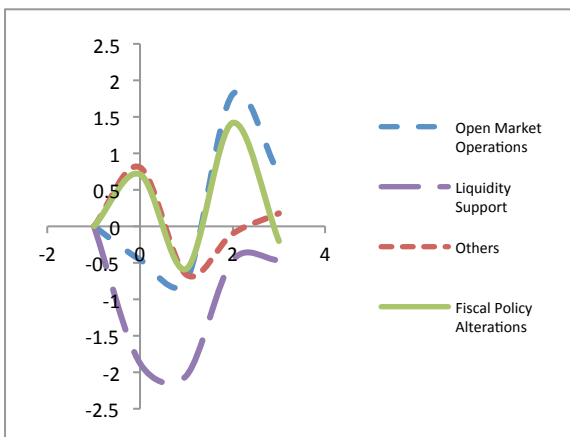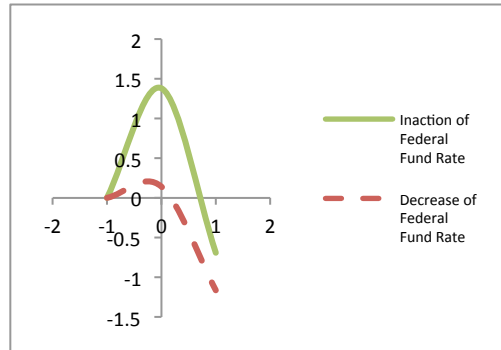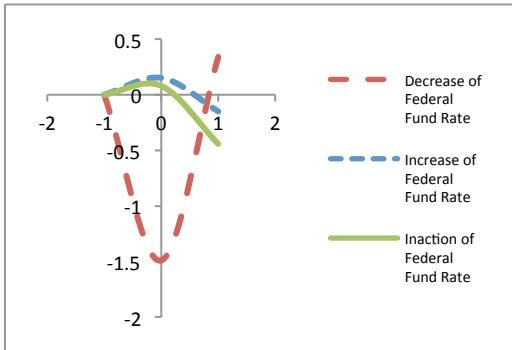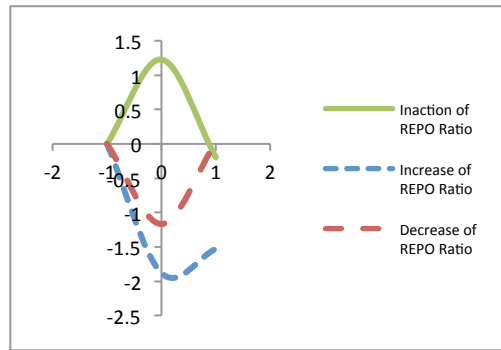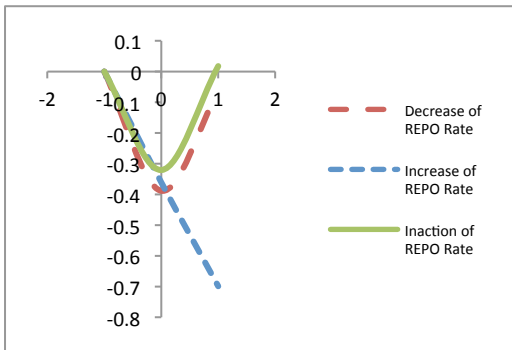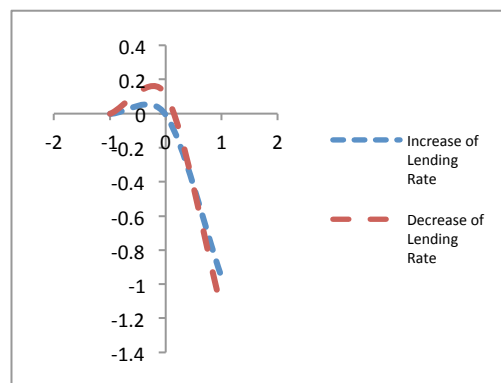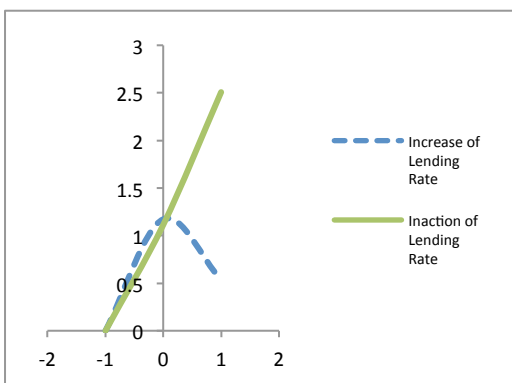
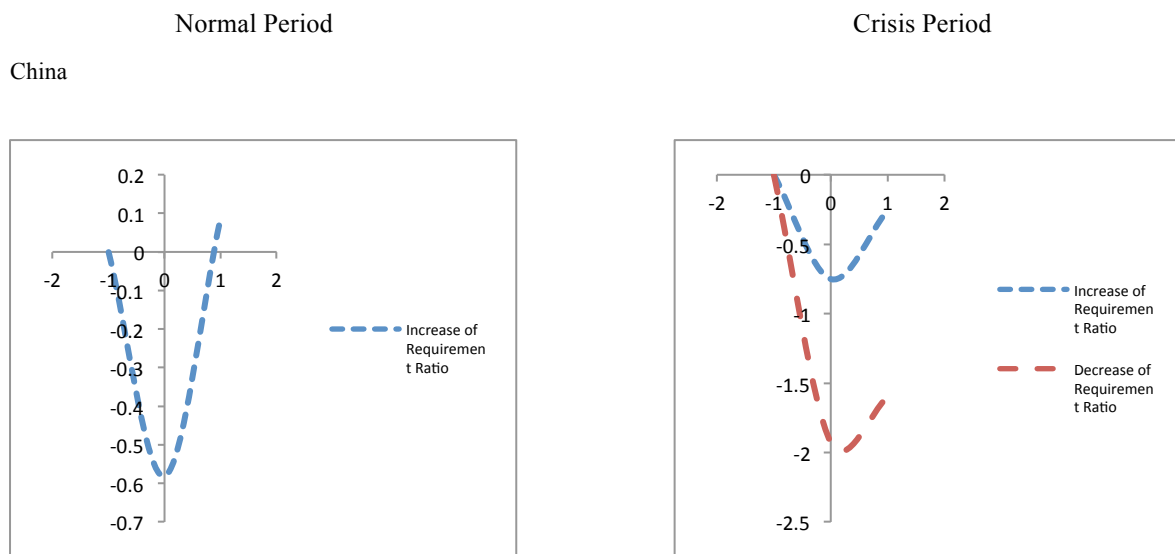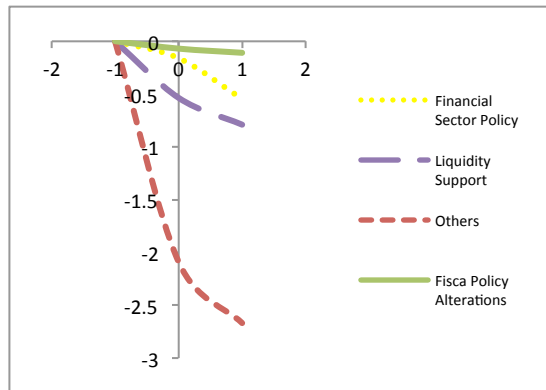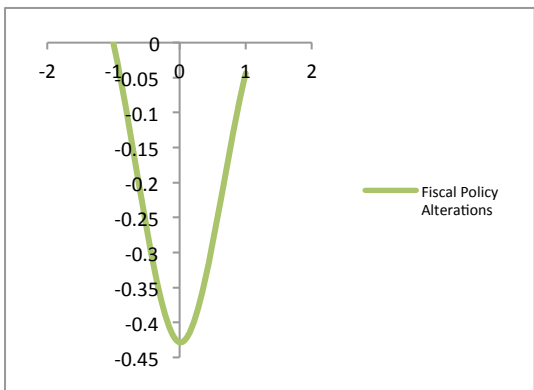Normal Period

Crisis Period
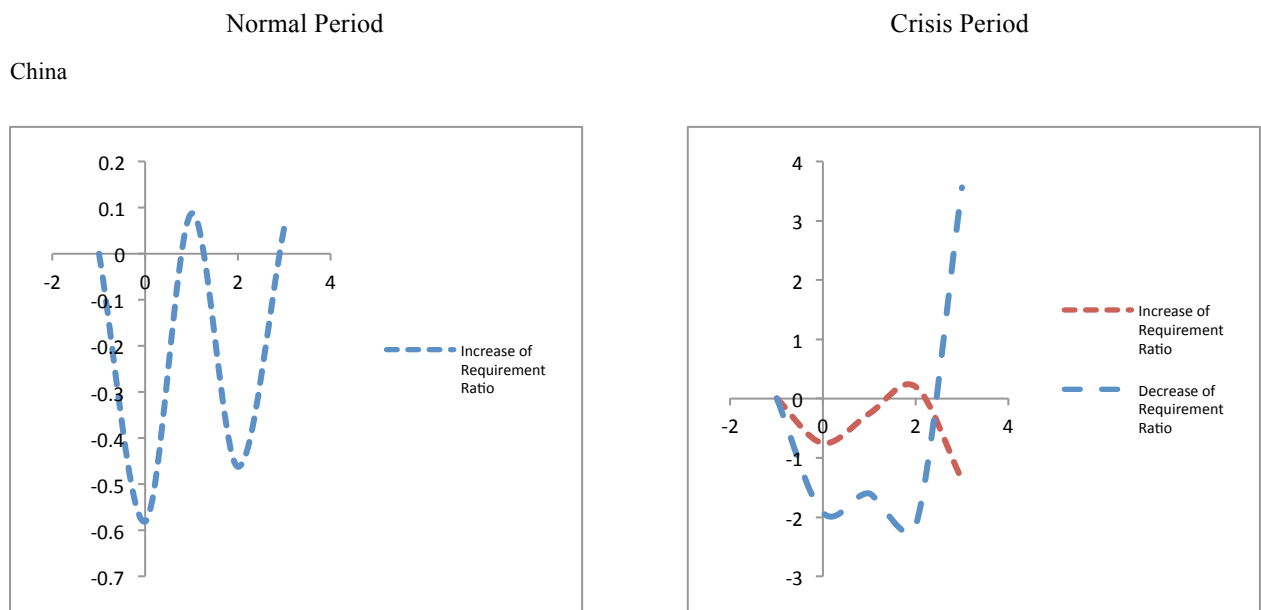
China

Figure 11. Impact of Category 3,4,5,6 policy adjustment of stock market (5-day window)

Normal Period

Crisis Period

U.S.
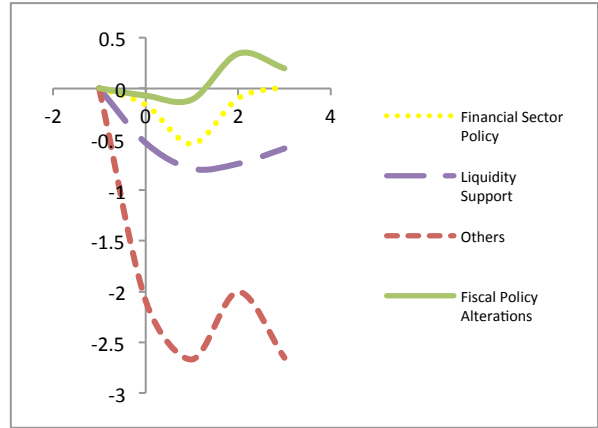
Sweden

China

Figure 12. Impact of base rate adjustment announcement on stock market (3-day event window)
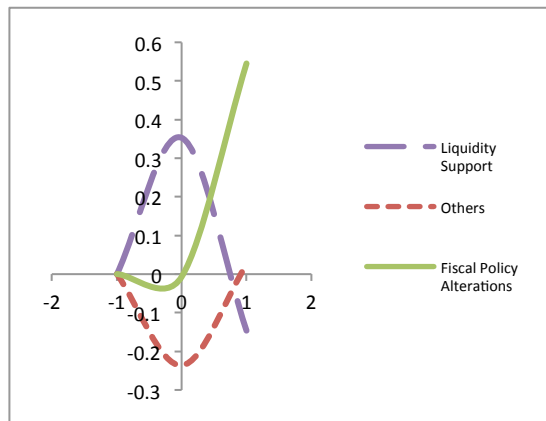
Normal Period

Crisis Period

U.S.

Sweden

China

Figure 13. Impact of required reserve ratio adjustment on stock market (3-day event window)

Normal Period   Crisis Period

China

Figure 14. Impact of category 3,4,5,6 policy adjustment of stock market (3-day window)
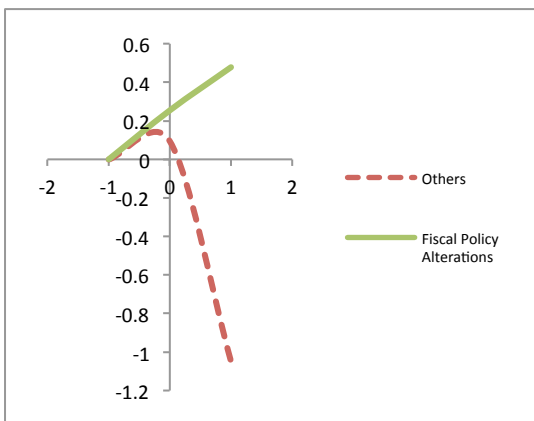
Normal Period   Crisis Period

U.S.

Sweden

China