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The Asset Pricing Implication on CSI 300 Index China of Monetary Policy Announcement

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ABSTRACT

Based on Fama-MacBeth method, three stages of regression are conducted to explore the relationship between stock beta and its excess return from 2003 to 2017 on the Chinese stock market in this paper. This thesis aims to explore the effects of monetary policy on the relationship between market beta and average excess return. We also try to distinguish the impacts of different monetary policies on the Chinese stock market, including interest rate policy, required reserve ratio policy and other policies. A significant negative correlation between market beta and average excess return is found on announcement days on the Chinese stock market. However, on non-announcement days, there is no strong evidence to prove that beta risk premium is different from zero. For different kind of monetary policies, we find that required reserve ratio policy has the strongest effect on the Chinese stock market. Furthermore, we can also conclude that the CAPM does not hold on any types of trading days in Chinese stock market, which is in line with the earlier empirical studies about the Chinese stock market.

Keywords: *Market Beta, Excess Return, Chinese Stock Market, Monetary Policy, CAPM*

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1. Introduction

At present, central banks have been playing a bigger role in the world economy. They influence and direct the economy mainly by implementing monetary policies. So, we are wondering what the effect of monetary policies is on the stock market and how different types of monetary policy impact stock market in various ways, as well as how investors' expectations and behavior change accordingly to the announcement of monetary policies? In this thesis, we will try to answer these questions and explain the result by conducting three stages of regression between assets beta and its excess return and comparing the beta-coefficient for announcement days and non-announcement days. The beta-coefficient is usually called beta risk premium, which exemplifies the relationship between market beta and excess return. A positive beta risk premium implies that investor would require higher expected return for higher risk exposure, as the CAPM states. However, if a negative beta risk premium exists, the CAPM may not hold for cross-sectional perspective. Among announcement days, 87.5% are pressing interest rate policy and required reserve ratio policy. So, we exam the effects from interest rate policy, RRR policy and other policy on the Chinese stock market beta and the expected excess return. This thesis will be the first attempt to examine the relationship between market beta and the expected excess return on the Chinese stock market. Based on previous research papers in America, one always regards stock market beta as the valid measure of risk premium that investors would require, but more and more empirical research reach inconsistent results and undermine the viability of CAPM model on the stock market. Therefore, we will also examine the validity of CAPM as an asset-pricing model and the difference of excess return on different trading days.

According to Savor and Wilson (2014), there exists a positive beta risk premium on announcement days and a negative risk premium on non-announcement days. In other words, on announcement days, rational investors would require a higher return for holding the riskier asset. Savor explained that when the market anticipates a potential change in monetary policy from central banks, it will generate a level of uncertainty and investors want to be compensated by this uncertainty. Later, in the research paper published in 2014, Savor and Wilson continued their study and found out that the announcement news of federal reserve rate had a strong influence on stock market average return. However, voices are suspecting the explanatory power of CAPM and the positive beta risk premium. Fama (1998) once argued a "behavioral finance "that market does not price stocks rationally as expected and various factors and frictions hinder the pricing process. This phenomenon would make individual investors exposed to different behavioral biases and push stock prices away from primary level. In a nutshell, they believe that stock is not just priced by systematic risk but other idiosyncratic risks and CAPM is only suitable to no friction market.

And a negative beta risk premium was also found in the Chinese stock market by Shi (1996), and Li and Li (2012). Hence, there is an urgent need to testify the CAPM model and find the relationship between market beta and return in the Chinese stock market, which hasn't been covered thoroughly before.

We used a method in this study based on Fama and French's methodology and combined with Savor's (2014) idea. The whole procedure consists of four stages. In the first stage, we calculate the individual stock's full-sample beta and the relationship between beta and average excess return on different trading days. In the next stage, the time-varying beta for different trading days and pooled regression are added to process. And in the third stage, we take control variables into account in the Fama-MacBeth approach. Finally, the T-test of excess return for each trading day is conducted to examine if the average excess return is significantly different from zero. The data is derived from the Chinese stock market from the period 2003-01-01 to 2017-12-31. We choose 110 stocks that have been included in the CSI 300 index for the whole period.

Based on the results of the four stages research, we find a robust negative correlation between market beta and average excess return on announcement days, indicating there is a negative beta risk premium. While for non-announcement days, there is no substantial evidence suggesting that beta risk premium is different from zero. These findings are aligned with Fama's research that suggested stocks are not only priced by systematic risk but also idiosyncratic market risks. Also, according to Wu (2011), from 1993-2008, there is a negative relationship between beta and average excess return for monetary expanding period on the Chinese stock market. Besides, among different types of monetary policy days, the beta risk premium is smallest and significant in RRR policy days, implying that RRR policy has the most significant influence on the Chinese stock market.

The whole thesis is divided into seven chapters as follows. The theoretical framework and hypotheses are exhibited in the second chapter. In chapter 3, we reviewed the previous literature about CAPM and effect of central banks on market performance. In the fourth chapter, the process of data collection is presented. In chapter 5, the methodology used in this paper is shown and explained. In chapter 6, we analyze and interpret the empirical research results. The final chapter 7 concludes and summarizes the empirical result.

2. Theoretical framework

In this chapter, we discuss the theory of the Capital Asset Pricing Model and how it motivates and rationalizes our study. We then consider the theory of monetary policy and the past findings from the research combining the CAPM and monetary policy. A presentation of our hypotheses is followed, which includes the explanation and motivation for the defined hypotheses.

2.1 Capital Asset Pricing Model (CAPM) theory

Capital Asset Pricing Model was developed by Sharpe (1964), Lintner (1965), Mossin (1966) and Black (1972), to describe the relationship between systematic risk and expected return for assets, particularly stocks. CAPM indicates that stocks' beta determines the cross-sectional return of stocks under certain assumptions. Investors are assumed to hold an adverse preference in risk and be fully rational, and thus they minimize the overall risk of their portfolios for any given expected return by holding a mean-variance efficient portfolio, introduced by Markowitz. It also assumed that the distribution of stocks' return is determined and there is no limit on borrowing or lending with the risk-free rate for investors. It means that the risk preference is only defined by the risky assets in the market portfolio, i.e., the expected excess return for risky assets is solely determined by the sensitivity of its return to the market returns. Also, beta can be interpreted as the contribution of risky assets to the overall risk of the market portfolio. Therefore, we can express the one-period expected return of a risky asset in the formula followed:

$$\boldsymbol{E[R_i] = R_f + \beta_{i,m}\left(E[R_m] - R_f\right)}$$

$$\boldsymbol{\beta_{i,m} = \frac{Cov[R_{i,}R_m]}{Var[R_m]}}$$

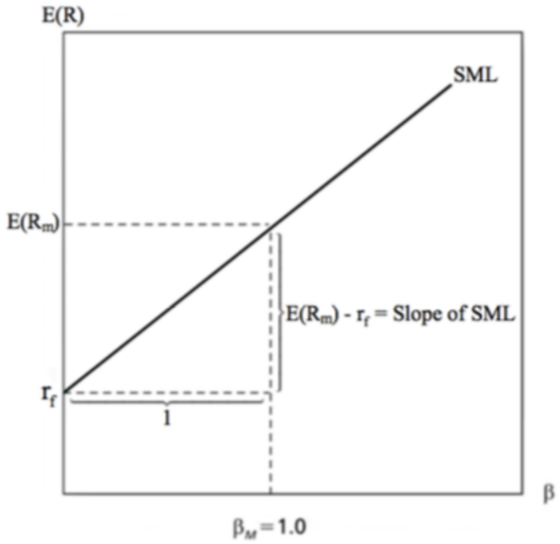
R_m is the return of the market portfolio.

R_f is the risk-free return.

$\beta_{i,m}$ is a measure of the level of systematic or non-diversifiable risk.

Since, according to the CAPM, an asset's expected return should be linearly related to the beta, we can present the model in a graph, which is called the security market line.

Figure 1 – Security market line (Bodie et al., 2014)



In Figure 1, we present the graph of the security market line, which displays that the regression with the beta as the independent variable and the return of the risky asset as the dependent variable has a slope equal to the market excess return of the risky asset and an intercept as the risk-free rate.

However, CAPM cannot be so exhaustive in capturing the risk characteristics of stocks according to studies based on reality. There are many factors such as macroeconomic variables, the scale of stocks and value effect of firms, which can influence the cross-sectional return of stocks, which cannot be explained by CAPM entirely. Fama and French (1993) developed the three-factor model, which shows that a firm's market value and book-market-ratio can explain the difference in the return of most stocks. Also, the relationship between market beta and stock returns becomes insignificant after adding those two variables.

Therefore, we do not examine validation of the CAPM by focusing on whether CAPM beta thoroughly explains cross-sectional returns of stock but aiming to find whether it enhances our prediction of the returns.

2.2 Monetary policy theory

Monetary policy is a set of measures that central banks conduct to achieve specific economic goals with tools that can adjust currency supply and interest rate, to influence macroeconomy. The primary means of monetary policy include currency issuing, government loans, open market operations, required reserve ratio, rediscount rate, selective credit control and direct credit control. Influence of monetary policies can be transmitted through different channels: 1) interest rate: when central banks increase policy rates, market interest rate will increase, investors will prefer saving to consumption, which means the production will be decreased and in turn lower the inflation (Hörngren, 1995); 2) credit: banks will reduce their supply of credit when there is a rise in market interest rates, therefore investment will decrease due to a lack of financing, which will result in a decrease in the production and lower the inflation (Hörngren, 1995); 3) non-currency asset price: the present value of asset will decrease when interest rate increases, which makes the price of stocks fall, and thus there will be fewer interests in investment and less production; 4) exchange rate: domestic assets becoming more attractive than assets in other currencies when the domestic interest rate increases, which leads to an inflow of capital and an increase in the demand for the domestic currency, i.e., a higher exchange rate. It will influence the domestic economy in two ways: firstly, domestic assets become more expensive and less attractive than foreign assets, which leads to lower demand for domestic assets and in turn, the production will be lowered, as well as the inflation. Secondly, the price of foreign assets, denoted in the domestic currency will be reduced so that the inflation will be decreased in turn. (Hörngren, 1995).

When we look at studies conducted on both CAPM and monetary policies, Jensen, Johnson and Mercer (1997) found that both a firm's market value and book-market-ratio have a different influence on stock returns in different monetary policy environments, based on the study of the US stock market. They concluded that both forces are significant when expansionary monetary policies are conducted by Federal Reserve System, while neither of them is significant, or even negative when monetary policies are tight. Gerald R. Jensen and Jeffrey M. Mercer (2002) examined the three-factor model again, considering the monetary environment influences. They found that monetary policies influence the relationships between stock returns and the three factors to a significant degree.

2.3 Hypotheses

The study, examining if the CAPM can explain excess returns, has focused on three aspects: 1) If the intercept equals to zero; 2) if market beta solely describes the cross-sectional variation in excess returns; 3) if the market risk premium is positive (Campbell et al., 1997). Therefore, we design our hypotheses with regard to the three aspects above:

Hypothesis A: *The beta risk premium is positive on announcement days.*

Hypothesis B: *The beta risk premium is not different from zero on non-announcement days.*

Hypothesis C: *The beta risk premium is positive on announcement days of Required Reserve Ratio (RRR) policies.*

Hypothesis D: *The beta risk premium is positive on announcement days of Interest rate policies.*

Hypothesis E: *The beta risk premium is positive on announcement days of other policies.*

Hypotheses *A* and *B* test the joint effect of all types of monetary policies, which are inspired by the findings of Savor and Wilson (2014). They examined the US stock market and found a positive beta risk premium on macroeconomic announcement days and negative or no beta risk premium on other days. Hypotheses *C*, *D* and *E* are motivated by the research done by Wu and Han (2011), in which they examine the interest rate policies' impact on the cross-sectional stock excess return. They found that the effect of the interest rate policy is low. Besides, under a tight monetary environment, there is a positive beta risk premium, while the premium drops while the monetary policy gets expanded.

According to the security market line, the intercept in the CAPM should generally be equal to the risk-free return, but in our study, it should be equal to zero since we use excess returns. Therefore, if this holds and if the beta risk premium is not found significantly different from the average stock market excess return, the CAPM functions as a valid asset pricing model, may hold (Cochrane, 2009).

3. Literature review

In this chapter, we present our reviews and discussion of relevant literature. We start with a review of the development of the CAPM and past empirical research of the validation of the model. Then we discuss the studies on the transmission and effect of monetary policy and finish the chapter with earlier research on the impact that monetary policy makes on the validation of the CAPM.

3.1 Empirical research of the CAPM

CAPM has been considered a milestone of capital pricing model development, not only because it is an utterly theoretical model but also an empirical model that can be examined. Researchers also tried different methods and data to test CAPM's fitting effect with actual data while they are correcting the model. However, CAPM does not perform well in its empirical research, even as it does not hold in reality (Fama and French, 2004). The problems that showed in the examination may reflect its shortcomings of the theory, in which CAPM is built on many strict assumptions, and maybe results from that it is not examinable in reality. Therefore, large amounts of empirical tests indicated that CAPM could not explain the variation of returns in the market efficiently. However, in the process of examining the CAPM, researchers have achieved many findings so that people can understand the change of asset prices better. From above, empirical research about the CAPM meant a lot to the development of asset pricing models afterward. In this section, we aim to summarize the studies about the CAPM, focus on the essential theories, methodologies, and conclusions.

Classic empirical research of the CAPM in earlier time include Jensen (1968), Black, Jensen and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973), Fama and MacBeth (1973). They all started with estimating the beta of assets and ran cross-section or time-series regressions with returns of assets and estimated betas. The methodology has become an example of studying capital assets pricing afterward, even nowadays. Fama and French (2004) used cross-sectional tests to test if it holds that the expected return of assets with zero beta equals risk-free rate and the market premium equals the difference between expected market return and risk-free return. They conducted a regression with the average return of a stock as the dependent variable and estimated beta as the independent variable. The regression is as follows:

$$\boldsymbol{R_i = \gamma_0 + \gamma_1 \widehat{\beta}_i + \varepsilon_i, i = 1, \ldots, n}$$

R_i is the average return of stock i.

$\hat{\beta}_i$ is the estimated beta of stock i.

The cross-sectional regression is not useful in examination due to two problems. Firstly, the estimates of the beta of a single stock are not entirely accurate, which will result in measurement error when explaining returns. Secondly, there is a problem of cross-sectional correlation. For example, stocks from the same industry are influenced by the same industries, so the errors of regression show positive correlations. Positive autocorrelation will underestimate the variance of the estimates in OLS, which will make the t-statistics more significant and thus the coefficient will look significantly different from zero, which is not the case in reality.

Blume (1970), Friend and Blume (1970), Black, Jensen and Scholes (1972) examined the portfolio returns instead of the single stock returns, as a purpose of eliminating the first problem. However, there is a problem of sorting stocks into portfolios. If stocks with more massive beta and smaller beta are classified into the same portfolio, the range of the beta of final portfolios will be narrowed, and it will limit the statistical power. To avoid the problem, they changed the sorting process to be based on the size of beta, which has become a standard methodology in the empirical researching of capital asset pricing nowadays (Fama and French, 2004; Hou et al., 2012; Artmann et al., 2012). However, the second problem was not solved, so the earlier cross-sectional regression cannot provide a compelling examination.

Since there are issues regarding cross-sectional series, Black, Jensen and Scholes (1972) came up with a time-series methodology. It started from a study of Jensen (1968), which is as follows:

$$\boldsymbol{R_{it} - R_{ft} = \alpha_i + \beta_{iM}(R_{Mt} - R_{ft}) + \varepsilon_{it}, i = 1, \ldots, n, t = i, \ldots, T}$$

Jensen applied the CAPM to different periods, which means that in each period, investors invest with the mean-variance analysis framework. According to Jensen, if the CAPM holds, a stock’s return can be determined by the product of its beta and the market excess return, and the intercept of the regression should be zero. Based on this, Black, Jensen and Scholes (1972) conducted a time-series regression on the beta portfolios’ excess returns, to test if the intercept is significantly different from zero. They found that the null hypothesis where the intercept is equal to zero, cannot be rejected, and thus from the time-series regression perspective, the Sharpe-Lintner CAPM holds.

Earlier cross-sectional regression had two issues, measurement error and cross-sectional correlation. Measurement error is solved by acquiring portfolio’s returns while cross-sectional correlation is resolved by Fama and MacBeth (1973). Instead of using the average returns, they used returns of each period to run the regressions, i. e., month-by-month cross-sectional regression. By conducting several regressions, a time-series of the intercept and beta-coefficient can be obtained. They calculated the average of the time-series and its t-statistics to examine if the excess return is positive and if the zero-beta asset has a return rate the same as the risk-free return. They found that the intercept is more significant than risk-free rate, which means that the Sharpe-Lintner CAPM does not hold, while the Black CAPM (1972) still holds. This methodology captures the auto-correlation of the cross-sectional error terms, which has become a standard for cross-sectional test afterward.

Although the Black CAPM (1972) holds under the earlier examination, its validation is challenged by many research, mainly including “Roll’s Critique” (1977) and the discovery of many CAPM anomalies. Roll (1977) pointed out that CAPM had never been examined or would never be examined, because it is difficult to find the market portfolio, the core of the model, in theory, and empirical research. Also, many studies found that the variation cannot be wholly explained by the market beta, while many other variables can influence the return. For example, Basu (1977) studied the earnings-price’s influence on the return and found that stocks with higher earnings-price have higher future return than how the CAPM predicts. Fama and French (1992) did a summarizing study, indicating that the market beta has no significant explaining power.

There has also been empirical research about the validation of the CAPM in Chinese stock market. Yang and Xing (1998) studied the stock price in Chinese stock market and found that the relationship between the risk and return are not as expected as the CAPM, and the systematic risk is not the only factor determining the excess return.

3.2 The effect and transmission mechanism of monetary policy on stock market

Monetary policy has gradually become one of the most critical factors in the stock pricing process, and the most focused one by empirical research. According to relative financial theory and research by Jensen (1995), Xing (2011), and Alexandros (2013), central banks can control the interest rate of stock market and the supply of currency via public policy tools such as changing required reserve ratio, altering the benchmark interest rate of loans and deposits and open market operation. And the adjustment of interest rate and currency's supply can affect investor's expectation and company's profitability, thus changing stock price. In Lynge (1981), Pearce (1983) and Roley (1985)'s studies, they find that the change of money supply plays an essential role in the stock price. For example, a prominent decrease of the money supply can result in the rise of interest rate and refinance rate, thus increasing the cost of capital raising for companies and lowering the stock price. What's more, some research papers suggest that central bank refinancing rate has a significant impact on the stock market

(Jensen,1995; Sims,1992; Blidner,1992). Change of interest rate can steer the capital flow. The decrease in interest rate can direct investor into the stock market and push stock price to increase.

Therefore, it is essential to understand the transmission process to figure out the effects of monetary policy on the stock market. In fact, the transmission mechanism of monetary policy on the stock market has received a lot of attention in recent years. Based on Alexandros (2013) research, there are mainly two ways monetary policy affects stock market: changing companies value and adjusting lending of banks. Firstly, the central banks can use interest rate policy to adjust market interest rate, which is one of the detrimental factors of the company evaluation. (Patelis, 1997). Besides, the interest rate policy can change the value of assets used as collateral, affecting companies cost of debt and risk exposure. In the other way, central banks can control the money supply to achieve its goal by implementing required reserve ratio policy, according to Xue (2012). This process influences stock market more directly by improving the requirement of loans and size of funds company can raise. For example, if a tighter monetary policy is implemented, it will be more difficult for companies to raise external capital and companies are forced to abandon projects that can enhance its value. Therefore, company value reduces as well as its stock price. In Xue's study, required reserve ratio policy has a significant influence on real estate industry stock in the Chinese stock market. Chinese central bank has raised required reserve ratio ten times in a year, significantly decreasing the market average excess return the day after the policy release.

3.3 The impact of monetary policy on the validity of CAPM

So far, the relevant studies of CAPM and the effects of monetary policy have been discussed and reviewed. The relationship between monetary policy and explanatory power of CAPM will be considered in this section. There are a lot of research papers covering the validity of CAPM. The most famous would be Fama-MacBeth (1973) two-stage regression to testify several factors in asset pricing. In the first step, the estimated beta for each stock is calculated through OLS regression based on time-series data. Then in the second stage, the cross-sectional regression is conducted on beta and other independent variables to get their risk premiums. Based on Fama-MacBeth's methodology, Savor and Wilson(2014) ran regressions separately on announcement days and non-announcement days to examine the relationship between the announcement of monetary policy and risk premium of specific factors. While different from the Fama-MacBeth method, Savor and Wilson chose time-varying beta over a five-year rolling window to capture movements of the market instead of constant beta. And the time-series data they used was the value-weighted index from NYSE. To diminish the errors in variables, they also classify individual stocks into ten portfolios according to industry, book-to-market ratio and size levels. They found a strong positive relationship between asset beta and excess return on announcement days. On non-announcement days, there is no strong but a weak negative correlation between market beta and its average excess return. In a nutshell, they suggested that CAPM is valid for cross-sectional research, especially on announcement days. And beta can still be regarded as a correct explanatory factor for systematic risk. Savor's paper is legitimately the first one to explore the relationship between monetary policy and CAPM model validity.

However, there are different voice recently criticizing CAPM is not a valid model and claiming that beta is dead. In Banz (1981) paper, he found that beta in CAPM model is not enough to explain systematic risk in asset pricing. Later, in 1992, Fama and French found that beta is not positively related to average excess return as expected, and in 1995 they designed three-factor model to define risk and enhance explanatory power than CAPM model can.

Despite the popularity of CAPM among research papers, there are few papers in China examining CAPM model, not to mention the exploration of the relationship between monetary policy and CAPM. In Sun (2011) and Li (2012)'s papers, they apply Fama-MacBeth method into the Chinese stock market and find out a slight negative relation between average stock return and asset beta, which implies a negative beta risk premium. They concluded that CAPM is still not applicable to the Chinese stock market. There are three reasons for this result. One is because the beta is only responsible for systematic risk and the idiosyncratic risk cannot be neglected in asset pricing process. In other words, the relation between average stock return and beta is not a simple linear relationship. Secondly, Chinese investors are not rational and lack basic investment knowledge. Thirdly, Chinese stock market is far from efficient market and opacity of companies make pricing process more subjective.

From literature presented and reviewed so far, the conclusion can be made that in American stock market, individual stock beta is positively related to its average return on announcement days. And on non-announcement days, there is no strong correlation. On the opposite, there is a negative beta risk premium on Chinese stock market, suggesting a weak explanatory power of CAPM model on the Chinese stock market.

4. Data

In this chapter, we present the dataset used in this thesis and source of data.

4.1 Period

Since we are trying to examine and identify the effect on each announcement day, the data is derived from the database in daily frequency. The sample covers the period from 2003-01-01 to 2017-12-31. The reason we choose 2003 as the start year is because it's the first year that the Chinese Central bank has implemented monetary policy and posted them on the website. To make the result more accurate and related to present days, we retrieve data as late as 2017-12-31.

4.2 Announcement days of monetary policy

To acquire the impact that monetary policy conducted by the central bank on the Chinese stock market, we collect data from all the trading days that have monetary policy pressed. We divide whole days into two groups; one consists of announcement days (noted as “A-days”), the others are non-announcement days (noted as “N-days”) when there is no policy announced. We also separate the announcement days into three sub-groups, which are announcement days of monetary policies regarding interest rate (noted as “Interest rate”), required reserve ratio (noted as “RRR”) and others (noted as “Other”). The central bank we referred to in this thesis is only Chinese Central Bank (People’s Bank of China). We don't consider other countries' banks as Chinese stock market is relatively segmented from world capital. We don't consider unscheduled monetary policy either because investors are not able to absorb this information when reckoning risk exposure and expected return. An example excluded by us is in 2008 when central bank reduced interest and loan rate in banks of Sichuan province due to the earthquake in Sichuan province.

We retrieve the announcement day from Central Bank's website, ensuring the data is correct. If the press is released after the market is closed, the date is postponed by one day since investors are only able to capture the effect the next day.

Finally, we only include the announcement days that affect bank policy rates in the dataset.

Considering all factors above, we get Table 1 to show the number of trading days of each type.

Table 1 – Number of different types of trading days

Type of trading days	Number of days
General announcement days	96
General non-announcement days	3546
Interest rate policies	35
RRR policies	49
Other policies	26

4.3 Market Index

The market return used is from CSI 300 created by Shanghai and Shenzhen Stock Exchange. The index is retrieved in daily frequency from 2003-01-01 to 2017-12-31. The index is value-weighted and active, which means that the composition of the index is regularly changed according to the performance of the stock. At last, the market return is derived from natural logarithm of the daily index, based on the following equation:

$$\boldsymbol{R_t = ln\,(\frac{P_t}{P_{t-1}})}$$

This return is calculated on continuous compounding assuming the stock is invested continuously.

4.4 Stocks

The original sample includes 300 stocks which are currently in CSI 300 Index since the index is a relatively good representative for the Chinese stock market. It would introduce a survivorship bias to the stock sample. However, since the market index we choose is also actively changed over time, the bias shall not affect our study. We retrieve the daily price for each stock from Wind Data. We retrieve data for the period 2003-01-02 to 2017-12-29. The original sample is reduced because many stocks do not have adequate datasets. We exclude stocks that do not have data during the whole data period. We also exclude stocks that have had more than 500 days, which indicates that the stock is not very liquid. Therefore, our final sample includes 110 stocks, which can be found in Appendix A. We calculate the stock return by applying natural logarithm on the stock price.

4.5 Risk-free interest rate

We use the China Bond 10-year Treasury Bond as a proxy for the risk-free rate. We retrieve the daily data for the period 2003-01-02 to 2017-12-29. Since the interest rates are published in the annual form, we derive the daily return from it.

4.6 Industry

In some part of the study, we sort the stocks into different portfolios based on their industrial characteristics. There is an industry categorization attached to each stock in Wind Data so we use it to create industry portfolios. Industry categories can be found in Table 2:

Table 2 – Industry categories

Industrial goods and services	Durable goods and services	Consumer goods and services	Financial institutions
Real estate	Healthcare	Information technology (IT)	Material
Telecom	Utilities	Energy	

5. Methodology

In this chapter, we present the methodology we use to address our research, which is detailed and split into different stages.

In our study, there are five stages: 1) we analyze the relationship between average excess return and full-sample beta; 2) we investigate the relationship between average excess return and time-varying beta using the Fama-MacBeth approach and pooled regression with dummy variables; 3) we analyze the relationship between average excess return and time-varying beta with control variables; 4) we examine the validity of the CAPM; 5) we test the statistical significance of the excess returns on different types of trading day. From these stages, we study various reactions of CSI 300 China between announcement days and non-announcement days of the Chinese central bank's monetary policies, as well as the validation of the CAPM.

5.1 Regressions with full-sample beta

In the first stage, an ordinary least square regression is conducted to examine the relationship between average excess return and full-sample beta, using full-sample beta as the independent variable and excess return as the response variable. The regressions are detailed below:

$$\boldsymbol{\bar{E}_i = \alpha + \gamma\hat{\beta}_{i,m} + \varepsilon_i}$$

$\bar{E}_i$ is the average daily excess return of stock *i*, which is calculated as the difference between the actual rate of return on a stock and the real risk-free return.

$\hat{\beta}_{i,m}$ is the estimated full-sample beta of stock *i*, which is calculated with the CAPM:

$$\boldsymbol{R_{i,t} - R_{f,t} = \alpha_i + \beta_{i,m}(R_{m,t} - R_{f,t}) + \varepsilon_{i,t}}$$

$R_{i,t}$ is the full-sample return of stock *i*.

$R_{m,t}$ is the market return of whole period, derived from the CSI 300 Index.

$R_{f,t}$ is the risk-free return.

Since we mainly use excess return as the factor in the OLS regression, the excess return can be directly substituted by $E_{i,t}$ and the CAPM regression should become as follows:

$$\boldsymbol{E_{i,t} = \alpha_{i,m} + \beta_{i,m}E_{m,t} + \varepsilon_{i,t}}$$

$E_{i,t}$ is the excess return for stock *i* in day *t*.

$E_{m,t}$ is same day's excess return for the whole market.

The full period consists of 96 announcement days and 3546 non-announcement days and regression is conducted for these two groups of days separately, as well as 35 announcement days of Interest rate policies, 49 announcement days of RRR policies and 26 announcement days of Other policies. We also sort beta of each entity into 11 industries to examine the effect size of monetary policy on different industries.

Also, based on Blume (1970) idea, we divide full sample stocks into ten beta portfolio and eleven industries portfolio to decrease "error in variables" issue. Additional regression is conducted on these two portfolios separately to enhance the accuracy of beta estimates.

Therefore, we sort data into ten portfolios regarding their betas and 11 industry portfolios based on the information provided by Wind database. Since the market index we used is value-weighted, we need to adjust the portfolios to match the index. Then we test the beta and industrial portfolios separately.

5.2 Regressions with time-varying beta

In the second stage, we use regressions with the time-varying beta to test the relationship between average excess return and estimated beta in the time dimension, which is the Fama-MacBeth methodology. The time-varying betas can reflect changes in characteristics of the economy and relevant underlying assets. It can be done by a similar regression from the first stage but cross-sectional:

$$\boldsymbol{E_{i,t+1} = \alpha_t + \gamma_t \widehat{\beta}_{i,t} + \varepsilon_{t+1}}$$

$E_{i,t+1}$ is the excess return of stock *i* at time *t*+1.

$\hat{\beta}_{i,t}$ is the estimated beta of stock *i* at time *t*, which means the betas are time-varying.

We calculate the beta using a method by Asgharian and Hansson (2000). A three-year rolling window is applied on monthly data in their study, which indicates that the betas are derived from stocks' monthly returns. Using monthly returns can lessen the bias caused by the non-trading problem, which is that illiquid stocks underestimate beta and liquid stocks overestimate beta (Damodaran, 1999). Therefore, the OLS regression that we estimate time-varying data with is as follows:

$$\boldsymbol{E_{i,p} = \alpha_{i,t} + \beta_{i,t} E_{m,p} + \varepsilon_{i,p}, in\ which\ p = t - 35, \ldots, t}$$

$E_{i,p}$ is a three-year rolling dataset of monthly excess returns of stock *i*.

$\beta_{i,t}$ is the time-varying beta of stock *i* at time *t*.

$E_{m,p}$is a three-year rolling dataset of monthly market excess returns.

We apply the regression to all stocks at each time t. From the regression, we get T estimates of α_t and γ_t, and we write them as $\hat{\alpha}_t$ and $\hat{\gamma}_t$. Then we calculate the mean of the coefficients and apply test on it. Because stock returns are normally and temporally independent and identically distributed (IID), the estimated coefficients are also normally distributed and IID (Campbell et al., 1997). Therefore, we can use Student's t-test to test for the statistical significance of the estimated coefficients. The t-statistics formulas of t-test are as follows:

$$\boldsymbol{S\ (\hat{\alpha}) = \frac{\hat{\alpha}}{\hat{\sigma}_{\alpha}}}\ \textbf{and}\ \boldsymbol{S\ (\hat{\gamma}) = \frac{\hat{\gamma}}{\hat{\sigma}_{\gamma}}}$$

in which,

$$\boldsymbol{\hat{\sigma}_{\alpha}^2 = \frac{1}{T(T-1)}\sum_{t=1}^{T}(\hat{\alpha}_t - \hat{\alpha})^{-2}}\ \textbf{and}\ \boldsymbol{\hat{\sigma}_{\gamma}^2 = \frac{1}{T(T-1)}\sum_{t=1}^{T}(\hat{\gamma}_t - \hat{\gamma})^{-2}}$$

$\hat{\alpha}$ and $\hat{\gamma}$ are the averages of estimated coefficients.

$(T-1)$ is the degrees of freedom.

We apply the cross-section regression and Student's t-test separately to different types of trading days and observe the difference.

Also, we would like to analyze the differences between the estimated coefficients between different types of trading days and different types of monetary policy. Therefore, we use Welch's test to see if the differences are statistically significant. The Welch's test was developed by Welch (1947) and the formula for t-statistic and degrees of freedom is given by:

$$\boldsymbol{t = \frac{\bar{X}_1 + \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}}$$

$$\boldsymbol{\nu \approx \frac{(\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2})^2}{\frac{\sigma_1^4}{N_1^2(N_1 - 1)} + \frac{\sigma_2^4}{N_2^2(N_2 - 1)}}}$$

$\bar{X}$ is the mean of the estimated coefficients of different types of trading days.

$\sigma^2$is the sample variance of the estimated coefficients of different types of trading days.

N is the sample size.

Besides the Fama-MacBeth regression, we use two pooled regressions with dummy variables of different types of trading days, to distinguish the difference between different trading days. In the first regression, we include a dummy variable of announcement day so that we can identify the difference between announcement day and non-announcement day. In the second regression, we introduce dummy variables of different type of monetary policies' announcement day to distinguish the difference between different types of monetary policy. The regressions are as follows:

$$\boldsymbol{E_{i,t+1} = \gamma_0 + \gamma_1 \widehat{\beta}_{i,t} + \gamma_2 D_t^{A-day} + \gamma_3 \widehat{\beta}_{i,t} D_t^{A-day} + \varepsilon_{i,t+1}}$$

$$\boldsymbol{E_{i,t+1} = \gamma_0 + \gamma_1 \widehat{\beta}_{i,t} + \gamma_2 D_t^{Int} + \gamma_3 \widehat{\beta}_{i,t} D_t^{Int} + \gamma_4 D_t^{RRR} + \gamma_5 \widehat{\beta}_{i,t} D_t^{RRR} + \gamma_6 D_t^{Other} + \gamma_7 \widehat{\beta}_{i,t} D_t^{Other} + \varepsilon_{i,t+1}}$$

D_t^{A-day} is a dummy variable that equals one if the trading day t is an announcement day and equals zero otherwise. Similarly, D_t^{Int}, D_t^{RRR} and D_t^{Other} equals one if the trading day t is an announcement day of the specific type of monetary policy, and equals zero otherwise.

In the regressions, γ_0 represents the intercept of non-announcement days, γ_1 represents the coefficient of beta for non-announcement days, γ_2 represents the difference between the intercepts for announcement days and non-announcement days, and γ_2 represents the difference between the coefficients of beta for announcement days and non-announcement days.

We conduct the above procedure to the full period consisting of different types of trading days separately. Similarly, we implement additional regression to portfolios regarding their betas and industrial portfolios to reduce "errors-in-variables problem". For the beta portfolios, we rebalance it according to the time-varying beta so that it can show the changes. The rebalancing point is the first trading day of each year.

5.3 Regressions with time-varying beta with control variables

In the third stage, we add control variables into the regressions we run in the second stage, using both the Fama-MacBeth method and pooled regression. The control variables include firm size, which is indicated by the logarithm of market capitalization for the firm, book-to-market ratio (Fama and French, 1992) and past one-year stock return (Jegadeesh and Titman, 1993). It has been identified in the relevant past studies that all the chosen factors can partially explain or related to the stock returns. The regressions are as follow:

$$\boldsymbol{E_{i,t+1} = \gamma_{0,t} + \gamma_{1,t}\widehat{\beta}_{i,t} + \gamma_{2,t}lnMV_{i,t} + \gamma_{3,t}B/M_{i,t} + \gamma_{4,t}R_{i,t}^{Past\ 1-year} + \varepsilon_{t+1}}$$

$$\boldsymbol{E_{i,t+1} = \gamma_0 + \gamma_1\widehat{\beta}_{i,t} + \gamma_{2,t}lnMV_{i,t} + \gamma_{3,t}B/M_{i,t} + \gamma_{4,t}R_{i,t}^{Past\ 1-year} + \gamma_5 D_t^{A-day} + \gamma_6\widehat{\beta}_{i,t}D_t^{A-day} + \varepsilon_{i,t+1}}$$

$$\boldsymbol{E_{i,t+1} = \gamma_0 + \gamma_1\widehat{\beta}_{i,t} + \gamma_{2,t}lnMV_{i,t} + \gamma_{3,t}B/M_{i,t} + \gamma_{4,t}R_{i,t}^{Past\ 1-year} + \gamma_5 D_t^{Int} + \gamma_6\widehat{\beta}_{i,t}D_t^{Int} + \gamma_7 D_t^{RRR} + \gamma_8\widehat{\beta}_{i,t}D_t^{RRR} + \gamma_9 D_t^{Other} + \gamma_{10}\widehat{\beta}_{i,t}D_t^{Other} + \varepsilon_{i,t+1}}$$

$lnMV_{i,t}$ is the natural logarithm of market capitalization for stock *i*.
$B/M_{i,t}$is the book value of equity divided by market value of equity of stock *i*.
$R_{i,t}^{Past\ 1-year}$ is the past one-year stock return of stock *i*.

We conduct the above procedure of Fama-MacBeth method on the full sample of 110 stocks separately on the announcement days and non-announcement days, plus the Student's t-test and Welch's test. From this, we can examine the individual performance on different types of trading day and different types of monetary policy, as well as the difference between different kinds of trading day and different types of monetary policy.

For the pooled regression, we apply it to the full sample of stocks on all days since the dummy variables indicate the type of trading day. We include the dummy variable of announcement day in the first pooled regression, while three dummy variables of different kinds of monetary policy's announcement days in the second pooled regression.

5.4 Examination of the validation of the CAPM

In this paper, we examine the validity of CAPM in the press day and non-announcement day by comparing the estimated beta-coefficient and the slope of the security market line. We define that the CAPM holds if the beta-coefficient is not significantly different from the slope of the security market line and if the intercept is not significantly different from zero. To test it, first we acquire the hypothesized mean by taking the average of the market excess return (Cochrane, 2009), which can be expressed as follows:

$$\bar{E}_{d,i} = \frac{\sum_{t=0}^{n_d} E_{t,i}}{n_d}$$

$$\bar{E}_d = \sum_{i=0}^{I} \bar{E}_{d,i}$$

$\bar{E}_{d,i}$ is the average daily stock market excess returns for type *d* of trading days for stock *i*.

$E_{t,i}$ is the daily stock market excess returns for stock *i*.

n_d is the number of the day of type *d* of trading day.

$\bar{E}_d$ is the average daily market excess returns of the full-sample of stocks for type *d* of trading days.

Then we apply Student's t-test, and acquire the t statistic with the formula as follows:

$$t = \frac{\hat{\beta} - \beta_0}{SE_{\hat{\beta}}}$$

$\hat{\beta}$ is the estimated coefficient of beta in stage one.

β_0 is the hypothesized mean equal to the average stock market excess return.

$SE_{\hat{\beta}}$ is the standard error of the estimated coefficient of beta in stage one.

We conduct this test to the full sample and the portfolios on different types of trading day and different types of monetary policy.

5.5 T-test on average excess returns

In the fourth stage, we test if the average excess returns on different types of trading day are statistically significantly positive, without considering betas. We analyze this by using Student's t-test, and the formula is as follows:

$$t = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$$

$\bar{X}$ is the mean of the excess returns on different types of trading day.

$\mu_0$is the hypothesis mean of the excess returns, which is zero.

s is the sample standard deviation of the excess returns.

n is the sample size.

We implement this test to the full sample, as well as different portfolios.

6. Empirical findings and analysis

In this chapter, we present the findings and analysis of the results of the study. Firstly, we discuss the results from the regressions with the unconditional full-sample beta, the results from the regressions with the time-varying beta and the results from the regressions with the time-varying beta and control variables. Secondly, we present and analyze the findings of the examination and the validation of the CAPM. Lastly, we show the results of the t-test of the average daily excess return for the sorted portfolios.

6.1 Regressions with full-sample beta

Table 2 - Distribution of the estimated beta of full-sample regressions

This table shows the distribution statistics of the estimated beta of full-sample regressions. Min is the minimum of the calculated beta series, Median is the median of the beta series, Mean is the sample mean of the beta series, Max is the maximum of the beta series, SD is the standard deviation of the beta series, Skewness is the skewness of the beta series, and 25% and 75% quantile are the cut points of dividing the range of data into the respective proportions. A-days, Interest rate, RRR and Other represent the different types of the trading days.

Full-sample beta								
Type of day	**Min**	**25% quantile**	**Median**	**Mean**	**75% quantile**	**Max**	**SD**	**Skewness**
A-days	0.2906	0.8875	1.0382	1.0155	1.1261	1.4526	0.2009	-0.331
N-days	0.554	0.9173	1.0216	1.0066	1.1029	1.3169	0.1488	-0.5702
Interest rate	0.0255	0.7755	0.9948	1.0028	1.279	1.8524	0.3365	-0.0685
RRR	0.3383	0.8523	1.0513	1.0427	1.2182	1.5758	0.2577	-0.0582
Other	0.0575	0.8277	1.0215	0.988	1.1749	1.5119	0.2582	-0.612

In Table 2, we present the distribution of the estimated beta of the regressions with the individual stocks, which shows that the betas can be the lowest to 0.0255, to the highest 1.8524, with an average around 1, for all types of trading days. This distribution looks normal for a stock’s market beta, which indicates our beta-coefficients are not driven by any outliners and reasonably calculated.

In Table 3, we report the main regressions with the full-sample beta as the independent variable. It can be found that for A-days, there is a robust negative relationship between average excess return and beta, with a coefficient of -58.0 basis points that is statistically significant at the 1% confidence level. In contrast, a relatively weak relationship is found for N-days. Among the announcement days of different types of monetary policy, on announcement days of Interest rate policies and RRR policies, the relationships between average excess return and beta are both significantly negative at 1% confidence level, with coefficients of -47.80 and -83.05 basis points. On the announcement days of other policies, the beta-coefficient is not statistically significant.

When we look at the intercepts, they are significantly different from zero at 1% confidence level for A-days, announcement days for Interest rate and RRR policies, while is significantly different from zero at 5% confidence level for Other policies announcement days.

The R^2s change a lot among different sets of observations. The beta explains a more substantial fraction of the variation in average excess returns on announcement days than on non-announcement days. Similarly, the beta tells more on the announcement days of Interest rate and RRR policies, compared to Other policies.

For the results of the examination of CAPM validation, all of the five different sets of observations shows that the beta-coefficients are significantly different from their average daily stock market excess return at 1% confidence level. This result implies that the relationship stated by the CAPM may not hold for every circumstance.

Table 3 - Individual stocks with full-sample beta and validation of CAPM

The table shows the results from regressions with the full-sample beta: with the average excess return as the dependent variables and unconditional full-sample beta as the independent variable. A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to full-sample beta and β_0 is the average stock market excess return for each particular type of trading days. For the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

	Regressions of individual stocks				
Type of day	$\hat{\boldsymbol{\alpha}}$	$\hat{\boldsymbol{\beta}}$	**p-value of** $\hat{\boldsymbol{\beta}}$	$\boldsymbol{R^2}$	$\hat{\boldsymbol{\beta}} - \boldsymbol{\beta_0}$
	0.00691***	-0.00580***	0.000031	0.14	-0.00741***
A-days	(4.82)	(-4.19)			(-5.35)
	0.00025	-0.00025*	0.0893	0.03	-0.00048***
N-days	(1.65)	(-1.72)			(-3.26)
	0.006554***	-0.004780***	0.000191	0.11	-0.00761***
Interest rate	(4.76)	(-3.67)			(-5.84)
	0.005325***	-0.008305***	0.000004	0.17	-0.00513***
RRR	(2.78)	(-4.66)			(-2.88)
	0.00390**	0.00005	0.5133	0	-0.00435***
Other	(2.35)	(0.03)			(-2.68)

In Table 4, we report the additional regressions with the full-sample beta as the independent variable. It shows that the relationship between average excess return and full-sample beta is significantly negative at 1% confidence level for A-days in both additional regressions while it is only significantly different from zero at a 5% confidence level for N-days in the regression of beta portfolios. Also, we can see that the beta-coefficients of interest rate and RRR policies are both significantly negative in both additional regressions. Similarly, Other policies' beta-coefficient is only significantly negative at 10% confidence level in the beta portfolios' regressions. The results regarding beta-coefficients can confirm the relationship found by the main regression.

Table 4 - Portfolios with full-sample beta and validation of CAPM

The table shows the results from regressions with the full-sample beta: with the average excess return as the dependent variables and unconditional full-sample beta as the independent variable. A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to full-sample beta and β_0 is the average stock market excess return for each particular type of trading days. For the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

	Regressions of industrial portfolios				
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**p-value of** $\hat{\beta}$	R^2	$\hat{\beta}-\beta_0$
A-days	0.01376*** (4.54)	-0.01264*** (-3.90)	0.00181	0.63	-0.01426*** (-4.40)
N-days	0.00069 (1.33)	-0.00060 (-1.10)	0.301	0.12	-0.00082 (-1.51)
Interest rate	0.01401*** (4.83)	-0.01242*** (-3.85)	0.000196	0.62	-0.01525*** (-4.72)
RRR	0.011497* (1.96)	-0.01481** (-2.33)	0.02240	0.38	-0.01163 (-1.83)
Other	0.00487 (1.20)	-0.00039 (-0.094)	0.4636	0.001	-0.00480 (-1.15)
	Regressions of beta portfolios				
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**p-value of** $\hat{\beta}$	R^2	$\hat{\beta}-\beta_0$
A-days	0.00824*** (4.46)	-0.00678*** (-3.68)	0.003097	0.63	-0.00839*** (-4.56)
N-days	0.00064** (3.11)	-0.00050** (-2.46)	0.0396	0.43	-0.000072*** (-3.58)
Interest rate	0.01149*** (6.18)	-0.00913*** (-4.89)	0.0006	0.75	-0.01195*** (-6.41)
RRR	0.00445 (1.30)	-0.00760** (-2.26)	0.0268	0.39	-0.00442 (-1.32)
Other	0.01141** (2.43)	-0.00693* (-1.44)	0.0936	0.21	-0.01133** (-2.34)

About intercepts, they are significantly different from zero at 1% confidence level for A-days, Interest rate policies announcement days in both additional regressions, which is in line with the main regression. For RRR policies announcement days, it is significantly different from zero at 10% confidence level in the industrial portfolios' regression while not significantly different from zero in the beta portfolios' regression, which contradicts the results of the main regression. Besides, it is significantly different from zero at 5% confidence level for Other policies announcement days in the beta portfolios' regression while not significantly different from zero in the industrial portfolios' regression. For N-days, it has a significant intercept at 5% confidence level in the beta portfolios' regression, which is not similar to the results of the main regression.

The R^2s are generally more massive than the ones in the main regressions. The R^2 for A-days are more significant than the one for N-days, and on the RRR policies' announcement days, R^2 is the largest among different types of monetary policy.

From the tests above of stage one, we can say that the most robust result is that the beta-coefficients for A-days and announcement days for Interest rate policies are found significantly negative for all regressions. It indicates that there is a negative beta risk premium on days when the stock market anticipates receiving information regarding monetary policy decisions, and thus hypothesis *A* and *D* can be rejected. Since that the beta-coefficient for N-days is not significantly different from zero in the industrial portfolios' regression, we cannot reject the hypothesis *B*. The results indicate that beta should be seen as an essential measure of systematic risk when investors anticipate receiving information regarding monetary policy decisions, because investors demand a lower return for holding high-beta stocks on such days. Also, there may be a significant negative relationship on non-announcement days. Besides, there is a negative beta risk premium on days when RRR policies are announced so hypothesis *C* may be rejected. For announcement days of Other policies, there are barely any significant positive results, and thus hypothesis *E* may be dismissed.

6.2 Regressions with time-varying beta

Table 5 - Distribution of the estimated beta of full-sample regressions

This table shows the distribution statistics of the estimated beta of full-sample regressions. Min is the minimum of the estimated beta series, Median is the median of the beta series, Mean is the sample mean of the beta series, Max is the maximum of the beta series, SD is the standard deviation of the beta series, Skewness is the skewness of the beta series, and 25% and 75% quantile are the cut points of dividing the range of data into the respective proportions. A-days, Interest rate, RRR and Other represent the different types of the trading days.

			Time-varying beta					
Type of day	**Min**	**25% quantile**	**Median**	**Mean**	**75% quantile**	**Max**	**SD**	**Skewness**
A-days	0.3895	0.8224	0.9974	0.9858	1.165	1.5617	0.2513	-0.2699
N-days	0.3874	0.8822	1.0015	1.0088	1.2001	1.5393	0.2451	-0.2765
Interest rate	0.3809	0.8425	1.0177	1.0032	1.1896	1.5776	0.2515	-0.2832
RRR	0.3678	0.8305	0.99	0.9723	1.1336	1.5689	0.2462	-0.1885
Other	0.2491	0.8532	1.0141	0.9996	1.2015	1.6614	0.284	-0.2146

In Table 5, we report the distributing statistics for the estimated time-varying betas. It shows that the betas can be the lowest 0.2491, to the highest 1.6614, with an average around 1, for all types of trading days. This distribution looks normal for a stock's market beta, which indicates our beta-coefficients below are not driven by any outliners and reasonably calculated.

In Table 6, we can find the primary results in stage two. In this stage, we apply the Fama-MacBeth methodology and pooled regressions on a sample including all individual stocks. It can be seen that the beta-coefficient for A-days is negative but only significant at the 5% confidence level in the Fama-MacBeth approach, with a coefficient of -32.8 basis point. The beta-coefficient for N-days is not significantly different from zero. Among the specific monetary policies, the relationships between average excess return and beta for announcement days of Other policies are not significant while the beta-coefficients for Interest rate and RRR policies is significantly negative at the 10% and 1% confidence level respectively, with coefficients of -39.5 and -67.0 basis point. For the intercepts, it is only significantly different from zero at the 10% confidence level for A-days and Other policies. Average R^2s are very similar among different sets of observations.

As we can see from the results of the Welch's test, the difference in the beta-coefficient between A-days and N-days is significantly different from zero at the 10% confidence level, with -32.9 basis points, which is similar for A-days and N-days. For the different types of monetary policy, RRR policies are found to be significantly different from

N-days and Other policies, while no significant differences in beta-coefficients are found between the other respective announcement days.

The main pooled regressions are also shown in Table 3. For interpretation, the general intercept and beta-coefficient capture the effect associated with N-days. The dummy variables *A-day*, *Interest rate*, *RRR* and *Other*, captures the differences in intercepts compared to N-days. The dummy variables multiplied by the corresponding betas capture the differences in beta-coefficients compared to N-days. In the first regression, the intercept for A-days is significantly different from N-days only at the 10% confidence level, and the coefficient for A-days is found to be -39.3 basis points, which is significantly smaller than for N-days at the 5% confidence level. In the second regression, the intercepts for announcement days of Interest rate and Other policies are significantly different from N-days at the 10% and 5% confidence level respectively. Also, the coefficient for announcement days of Interest rate and RRR policies are found to be significantly smaller than for N-days at the 5% and 1% confidence level respectively, with a coefficient of -56.5 and -71.2 basis points.

Table 6 - Individual stocks with time-varying beta

The table shows the results from the Fama-MacBeth and pooled regressions with the time-varying beta: with the average excess return as the dependent variables and time-varying beta as the independent variable, as well as results from the Welch's tests. For the Fama-MacBeth regressions, A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to the time-varying beta. In the pooled regressions, $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the coefficient associated with the time-varying beta. A-days, Interest rate, RRR and Other represent the coefficient for each respective dummy variable and is the actual estimated time-varying beta. In the Fama-MacBeth regressions, for the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day, intercepts and the Welch's tests. In the pooled regressions, one-tailed t-tests are used for all the day-specific beta-coefficients, and two-sided t-tests are used for $\hat{\beta}$, intercepts and all day-specific intercept. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

Fama-MacBeth Regressions					Welch's test			
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**p-value of $\hat{\beta}$**	**Avg. R^2**	**Difference**	$\hat{\alpha}$	$\hat{\beta}$	**p-value of $\hat{\beta}$**
A-days	0.00393* (1.78)	-0.00328** (-1.93)	0.028295	0.037	A-days - N-days	0.00397* (1.79)	-0.00329* (-1.92)	0.0573
N-days	-0.00004 (-0.15)	0.00002 (0.08)	0.9385	0.032	Interest rate - N-days	0.00515 (1.56)	-0.00397 (-1.41)	0.1671
Interest rate	0.00511 (1.56)	-0.00395* (-1.41)	0.08381	0.034	RRR - N-days	0.00339 (0.87)	-0.00672** (-2.48)	0.0166
RRR	0.00335 (0.86)	-0.00670*** (-2.49)	0.008145	0.041	Other - N-days	0.00551* (1.80)	0.00112 (0.51)	0.613
Other	0.00547* (1.79)	0.00114 (0.52)	0.3026	0.029	Interest rate - RRR	0.00176 (0.35)	0.00275 (0.71)	0.4816
					Interest rate - Other	-0.00036 (-0.08)	-0.00509 (-1.44)	0.1565
					RRR - Other	-0.00212 (-0.37)	-0.00784** (-2.26)	0.0265

Pooled regressions

$\hat{\alpha}$	$\hat{\beta}$	**A-day**	**A-day*$\hat{\beta}$**	**p-value of $\hat{\beta}$**	**p-value of A-day*$\hat{\beta}$**			R^2
-0.00028 (-1.05)	0.00032 (1.25)	0.00396* (2.05)	-0.00393** (-2.12)	0.2127	0.01814			0.001

$\hat{\alpha}$	$\hat{\beta}$	**Interest rate**	**Interest rate*$\hat{\beta}$**	**RRR**	**RRR*$\hat{\beta}$**	**Other**	**Other*$\hat{\beta}$**	R^2
-0.00028 (-1.01)	0.00032 (1.26)	0.00597* (1.81)	-0.00565** (-1.81)	0.00381 (1.30)	-0.00712*** (-2.44)	0.00531** (2.48)	0.00001 (0.01)	0.0026

Table 7 - Industrial portfolios with time-varying beta

The table shows the results from the Fama-MacBeth and pooled regressions with the time-varying beta: with the average excess return as the dependent variables and time-varying beta as the independent variable, as well as results from the Welch's tests. For the Fama-MacBeth regressions, A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to time-varying beta. In the pooled regressions, $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the coefficient associated with time time-varying beta. A-days, Interest rate, RRR and Other represent the coefficient for each respective dummy variable and is the actual estimated time-varying beta. In the Fama-MacBeth regressions, for the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day, intercepts and the Welch's tests. In the pooled regressions, one-tailed t-tests are used for all the day-specific beta-coefficients, and two-sided t-tests are used for $\hat{\beta}$, intercepts and all day-specific intercept. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

Fama-MacBeth Regressions					**Welch's test**			
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**p-value of** $\hat{\beta}$	**Avg.** R^2	**Difference**	$\hat{\alpha}$	$\hat{\beta}$	**p-value of** $\hat{\beta}$
A-days	0.00543** (2.11)	-0.00486** (-1.88)	0.031586	0.1224	A-days - N-days	0.00520** (1.99)	-0.00476* (-1.82)	0.0725
N-days	0.00023 (0.50)	-0.00010 (-0.21)	0.8334	0.1315	Interest rate - N-days	0.00377 (0.92)	-0.00226 (-0.60)	0.5547
Interest rate	0.00400 (0.98)	-0.00235 (-0.63)	0.2676	0.0927	RRR - N-days	0.00416 (0.92)	-0.00776* (-1.84)	0.0712
RRR	0.00439 (0.97)	-0.00786** (-1.88)	0.0332	0.1338	Other - N-days	0.00803** (2.41)	-0.00205 (-0.51)	0.6155
Other	0.00826** (2.50)	-0.00214 (-0.54)	0.2985	0.1228	Interest rate - RRR	-0.00039 (-0.06)	0.00551 (0.98)	0.3306
					Interest rate - Other	-0.00426 (-0.81)	-0.00021 (-0.04)	0.9696
					RRR - Other	-0.00387 (-0.69)	-0.00571 (-0.99)	0.3272

Pooled regressions

$\hat{\alpha}$	$\hat{\beta}$	**A-day**	**A-day*** $\hat{\beta}$	**p-value of** $\hat{\beta}$	**p-value of A-day*** $\hat{\beta}$			R^2
0.00731 (1.05)	-0.00052 (-0.73)	0.01371* (1.82)	-0.01329* (-1.81)	0.4822	0.0503			0.0011
$\hat{\alpha}$	$\hat{\beta}$	**Interest rate**	**Interest rate*** $\hat{\beta}$	**RRR**	**RRR*** $\hat{\beta}$	**Other**	**Other*** $\hat{\beta}$	R^2
0.00079 (1.11)	-0.00057 (-0.78)	0.00718 (0.94)	-0.00523 (-0.68)	0.01908 (1.43)	-0.02228* (-1.66)	0.00228 (0.31)	0.00195 (0.25)	0.003

Table 8 - Beta portfolios with time-varying beta

The table shows the results from the Fama-MacBeth and pooled regressions with the time-varying beta: with the average excess return as the dependent variables and time-varying beta as the independent variable, as well as results from the Welch's tests. For the Fama-MacBeth regressions, A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to time-varying beta. In the pooled regressions, $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the coefficient associated with time time-varying beta. A-days, Interest rate, RRR and Other represent the coefficient for each respective dummy variable and is the actual estimated time-varying beta. In the Fama-MacBeth regressions, for the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day, intercepts and the Welch's tests. In the pooled regressions, one-tailed t-tests are used for all the day-specific beta-coefficients, and two-sided t-tests are used for $\hat{\beta}$, intercepts and all day-specific intercept. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

Fama-MacBeth Regressions					**Welch's test**			
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**p-value of** $\hat{\beta}$	**Avg.** R^2	**Difference**	$\hat{\alpha}$	$\hat{\beta}$	**p-value of** $\hat{\beta}$
A-days	0.00482* (1.86)	-0.00440** (-1.78)	0.0395	0.19	A-days - N-days	0.00442* (1.69)	-0.00415* (-1.66)	0.0999
N-days	0.00040 (1.18)	-0.00025 (-0.71)	0.2384	0.16	Interest rate - N-days	0.00230 (0.56)	-0.00133 (-0.31)	0.7582
Interest rate	0.00270 (0.66)	-0.00158 (-0.37)	0.3574	0.19	RRR - N-days	0.00577 (1.31)	-0.00937** (-2.48)	0.0166
RRR	0.00617 (1.40)	-0.00962*** (-2.56)	0.0069	0.2	Other - N-days	0.00280 (0.81)	0.00314 (0.92)	0.3656
Other	0.00320 (0.93)	0.00289 (0.85)	0.2007	0.18	Interest rate - RRR	-0.00347 (-0.58)	0.00804 (1.41)	0.1632
					Interest rate - Other	-0.00050 (-0.09)	-0.00447 (0.82)	0.4166
					RRR - Other	0.00297 (0.53)	-0.01251** (-2.47)	0.0159

Pooled regressions

$\hat{\alpha}$	$\hat{\beta}$	**A-day**	**A-day***$\hat{\beta}$	**p-value of** $\hat{\beta}$	**p-value of A-day***$\hat{\beta}$			R^2
0.00069 (0.66)	-0.00053 (-0.51)	0.00695 (0.81)	-0.0058 (-0.69)	0.6224	0.2544			0.0009

$\hat{\alpha}$	$\hat{\beta}$	**Interest rate**	**Interest rate***$\hat{\beta}$	**RRR**	**RRR***$\hat{\beta}$	**Other**	**Other***$\hat{\beta}$	R^2
0.00071 (0.68)	-0.00055 (-0.53)	0.00738 (0.41)	-0.00491 (-0.26)	0.01973 (1.38)	-0.02040* (-1.41)	-0.00442 (-0.45)	0.00900 (0.92)	0.0031

Table 9 - Industrial and beta portfolios with time-varying beta

The table shows the results from the Fama-MacBeth and pooled regressions with the time-varying beta: with the average excess return as the dependent variables and time-varying beta as the independent variable, as well as results from the Welch's tests. For the Fama-MacBeth regressions, A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to time-varying beta. In the pooled regressions, $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the coefficient associated with time time-varying beta. A-days, Interest rate, RRR and Other represent the coefficient for each respective dummy variable and is the actual estimated time-varying beta. In the Fama-MacBeth regressions, for the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day, intercepts and the Welch's tests. In the pooled regressions, one-tailed t-tests are used for all the day-specific beta-coefficients, and two-sided t-tests are used for $\hat{\beta}$, intercepts and all day-specific intercept. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

Fama-MacBeth Regressions					**Welch's test**			
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**p-value of $\hat{\beta}$**	**Avg. R^2**	**Difference**	$\hat{\alpha}$	$\hat{\beta}$	**p-value of $\hat{\beta}$**
A-days	0.00489** (2.11)	-0.00441** (-2.04)	0.022	0.12	A-days - N-days	0.00453* (1.93)	-0.00419* (-1.92)	0.0583
N-days	0.00036 (1.05)	-0.00022 (-0.65)	0.2572	0.11	Interest rate - N-days	0.00241 (0.67)	-0.00123 (-0.36)	0.7214
Interest rate	0.00277 (0.78)	-0.00145 (-0.43)	0.3364	0.09	RRR - N-days	0.00500 (1.23)	-0.00862** (-2.60)	0.0125
RRR	0.00537 (1.32)	-0.00884*** (-2.67)	0.0051	0.13	Other - N-days	0.00453 (1.46)	0.00142 (0.43)	0.6674
Other	0.00489 (1.60)	0.00120 (0.37)	0.3575	0.12	Interest rate - RRR	-0.00260 (-0.48)	0.00738 (1.55)	0.1244
					Interest rate - Other	-0.00212 (-0.45)	-0.00266 (-0.56)	0.5755
					RRR - Other	0.00048 (0.09)	-0.01004** (-2.16)	0.0341

Pooled regressions

$\hat{\alpha}$	$\hat{\beta}$	**A-day**	**A-day*$\hat{\beta}$**	**p-value of $\hat{\beta}$**	**p-value of A-day*$\hat{\beta}$**			R^2
0.00071 (1.88)	-0.00053 (-0.87)	0.01050* (1.88)	-0.00973** (-1.77)	0.0746	0.0458			0.001
$\hat{\alpha}$	$\hat{\beta}$	**Interest rate**	**Interest rate*$\hat{\beta}$**	**RRR**	**RRR*$\hat{\beta}$**	**Other**	**Other*$\hat{\beta}$**	R^2
0.00075 (1.24)	-0.00056 (-0.92)	0.00727 (0.79)	-0.00508 (-0.52)	0.01939* (2.04)	-0.02138** (-2.23)	-0.00091 (-0.15)	0.00531 (0.87)	0.0031

In Table 7, 8 and 9, the results of additional regressions in stage two are presented. The general intercept is more significant in the addition regression of industrial portfolios than in the main regression. The beta-coefficient for A-days is confirmed to be significantly negative by the results from the additional regressions. Among the specific monetary policies, the relationships between average excess return and beta for announcement days of RRR policies is also confirmed to be significant negative by the additional regressions. Also, the differences in the beta-coefficient between A-days and N-days, RRR policies and N-days, RRR and Other policies are in line with the main regressions although not as significantly as in the main ones. The intercept for A-days is also significantly different from N-days only at the 10% confidence level in the industrial portfolios' regression but not in the beta portfolios' one. The coefficient for A-days is confirmed by the additional regression of industrial portfolios to be significantly smaller than for N-days but at a more significant confidence level. For the specific monetary policies, the intercepts for announcement days of all policies are not significantly different from N-days in both additional regressions. Besides, only the coefficient for announcement days of RRR policies can be confirmed to be significantly smaller than for N-days by the additional regressions, although not as significant as in the main regressions.

From the above tests of stage two, it shows that the results with a focus on time-varying beta, are somewhat similar to those in stage one. We find that there is substantial evidence for a negative beta risk premium for A-days and RRR policies, and thus hypothesis *A* and *C* can be rejected, which suggests beta's importance as a measure of systematic risk. However, the relationship between average excess return and beta is not significant in stage two for non-announcement days, so we cannot reject the hypothesis *B*. For the Interest rate policies, the results are not as conclusive, with a significant result in the main regressions but not significant in the Welch's tests and additional regressions. For announcement days of Other policies, there are barely any significantly positive results, and thus hypothesis *E* may be rejected.

We analyze the so-called beta effect in the paragraph above, but there are also general announcement day effects unrelated to beta which is recognized by the intercepts. For A-days, there is a significantly positive intercept at the 10% confidence level, which is a support for general announcement day effect. For the specific monetary policies, the overall results might suggest that the intercepts for Other and Interest rate policies are larger than RRR policies and A-days, which implies that a more extensive general announcement day effect for Other and Interest rate policies.

6.3 Regressions with time-varying beta with control variables

In Table 11, the results of regressions with control variables for stage three are presented. Firstly, in Fama-MacBeth regressions, the A-days' beta-coefficient is -30.4 basis points while beta-coefficient for N-days is only -1.3 basis points and only beta-coefficient for A-days is significantly different from zero at 5% confidence level. Among the specific monetary policies, the relationships between average excess return and beta for announcement days are significantly negative in Interest rate policy and RRR policies, and positive but not significantly different from zero in Other policies. This result is the same as stage two regressions, which means RRR and interest rate policy have more effects on Chinese stock market than Other policies. As for the control variables, the coefficient of past year return and size of companies are negative for all situations but not significantly different from zero. Also, the results for the ratio of book to the market value of companies vary with different days, being positive in announcement days and Interest rate policy days and negative in N-days, RRR policy and Other policies days. The R^2s are consistent among all trading days, higher than 7 percent.

When comparing result for various type of days in Welch's tests, the beta-coefficient in A-days is smaller than it in N-days. But only in RRR policies are the coefficients of beta significantly different and smaller than other types of days. Testing the intercept, the difference between A-days and N-days is 1.04 percent. Besides, the intercepts in all different type of announcement days are higher than in N-days.

In pooled regressions, the result is same as above Fama-MacBeth regression and also stage two regressions, especially for the coefficient of beta. The coefficient of beta in N-days is positive but not significantly different from zero. On the contrary, the coefficient of beta for A-days is, at the 5%-level, 32.2 basis points lower than N-days. And for different types of A-days, the coefficient of beta in Interest rate days is, at 5%-level, smaller than N-days, and it in RRR policy days, is at 1% level, 56.8 basis points smaller than N-days. The coefficient of beta in Other policy is also smaller than N-days, but not significantly. For N-days, there is no strong evidence to show any beta risk premium. Thus null-hypothesis *A*, *C*, and *D* are rejected, while hypothesis *B* and *E* cannot be rejected.

6.4 Comprehensive analysis of regressions’ results

The results of regressions are consistent with whole three stages that there is a strong negative relationship between market beta and average excess return on announcement days. On the opposite, we cannot find any strong evidence to support that there is any significant correlation between the stock’s expected excess return and its beta on the non-announcement days. As we can see from Table 10, the distribution of beta-coefficient is in line with the results of regressions. The 25% quantile, median and mean of beta-coefficients in announcement days are all smaller than non-announcement days, implying that beta-coefficient is lower and farther from zero than non-announcement days. Besides, in first and second stages, the beta-coefficients are positive in the median for non-announcement days while median for announcement days is negative. And the difference of beta-coefficient between announcement days and non-announcement days is more prominent in time-varying beta regression than constant beta regression. This result implies that time-varying beta is more relevant and can better capture the movement of the market. Among different types of announcement day, the beta coefficient is most significant, at 5% confidence level and smallest in RRR policy announcement days. However, we did not find any significant beta risk premium on Other policy announcement days. The rejections of hypothesis have been discussed above so that we will focus more on the economic explanation behind the results. The negative beta risk premium we find in this thesis contrasts with the Savor and Wilson (2014) findings the impact of monetary policy announcement days on the US stock market. As we can see in Appendix C, on the Chinese stock market, the slope of SML on announcement days is significantly negative and nearly flat on non-announcement days. But in Savor’s paper, the slope of SML is significantly positive on announcement days and a little negative on non-announcement days. According to their study, there is a significant positive beta risk premium on announcement days and negative beta risk premium on non-announcement days for American stock market. However, similar results have been found before on Chinese stock market. Shi (1996) and Mao (2004) both found that market beta is significantly negatively related to expected excess return, though they did not separate trading days into announcement days and non-announcement days. They explain this phenomenon by underlining that the Chinese stock market is still an inefficient market, where the beta does not reflect all risk exposure and idiosyncratic cannot be well-diversified or neglected in asset pricing. What's more, Mao (2004) suggested that not only do market affect asset pricing but also the behavior and expectations of investors.

Because of the government policy and limited channels of investment, Chinese investors only have two main investment options: stock and real estate. They invest more speculatively and focus on short-term return instead of long-term return. These preferences in investment decisions increase prices of riskier and high beta stocks, lowering these stocks returns. Not surprisingly, this explanation is aligned with the theoretical base of new investing strategy designed by Frazzini and Pedersen (2013): betting in beta. Betting in beta means that long in the low-beta portfolio and short in the high-beta portfolio. Frazzini and Pedersen believe that CAPM does not hold in all situations so low-beta portfolio can achieve a higher return, outweighing the return from the high-beta portfolio. The hypothesis to explain the poor performance of CAPM model in this scenario is that some investors have leverage constraint. They cannot borrow money to buy high return stock but turn to riskier stocks to achieve their expected return for the portfolio. Chinese stock market is similar to this situation (Li, 2008). Most of the individual investors in Chinese stock market have leverage constraint and do not have access to a large number of company stocks since these stocks are limited by the state.

As for the discrepancy between beta-coefficient in announcement days and it in non-announcement days, Savor and Wilson (2014) have two hypotheses for a positive correlation between beta and excess return. They believe that CAPM still holds and beta is still a good measure of undiversified risk. So, investors would require a higher return for a high-beta portfolio when they presume important information would reveal on announcement days. Another explanation is that with more information provided on announcement days, the noise and idiosyncratic risk can be reduced, making beta a better representative of risk. Since the beta-coefficient is negative and smaller on announcement days in the Chinese stock market, Shi (1996) presumed it is because of the inefficiency and opacity of the Chinese stock market so that risk cannot be well-diversified. We think another theory based on Wachter (2018) can help interpret this result. Most of the Chinese monetary policies aim to direct the capital into other industries than real estate or financial institute to inhibit overheated real estate market. So, investors would expect a lower return for real estate industry whose stocks have the highest average beta, and a higher return for other industries that tend to have lower beta.

To expand research and distinguish the effects of different type of announcement day on the Chinese stock market, we conduct Fama-MacBeth regressions on specific kinds of announcement day through three whole stages, and remarkable results are found. The significant negative relationship between expected excess return and stock beta on RRR policies announcement days is in line with the theory suggested by Zhao (2011) that the increase of required reserve ratio would reduce real estate stock return when real estate stocks possess the highest beta among all stocks. Gao (2014)'s findings strongly support Zhao's hypothesis about RRR policy. She claimed that no matter in a bear market or bull market, the rise of required reserve ratio would significantly reduce the return of stock from real estate industry but no big influence on stocks from other sectors.

Furthermore, on interest rate policies announcement days, we also found a significantly negative beta risk premium though a little bigger than RRR policies announcement days. It indicates that investors expect negative beta risk premium on interest rate policies announcement days. We believe that this is because, since 2003, most of the interest rate changes are aligned with RRR policy aimed to repress the overheated real estate market, which is closely related to finance industry. Therefore, in interest rate policies announcement days, we expect a smaller return for stocks from these two highest beta industry. Another explanation is that it is possible that the change of interest rate is leaked before the announcement day (Lu, 2003). Therefore, the expectation for the change of interest rate has already been reflected in stock price before the announcement day. The announcement of interest rate policy does not reveal more information to investors or reduce idiosyncratic risk, lessening the explanatory power of beta.

There is no significant positive or negative correlation between average excess return and beta in other policies announcement days. We think it is due to other monetary policies, including foreign currency interest rate and open market operations, are implemented much later and has less influence on the Chinese stock market.

Hence the conclusion would be that there is a negative and lower beta risk premium on announcement days than on non-announcement days. Regarding different types of announcement day, there are significantly negative relationships in interest rate and RRR policy days. And the beta risk premium is lowest on RRR polices announcement days, at 5% confidence level. Results from Welch's tests and pooled regressions are same as full sample regression and Fama-MacBeth regression. There are significant differences in beta risk premium between announcement days and non-announcement day. And for different kinds of policy, the most prominent difference in beta risk premium is between RRR policies announcement days and non-announcement days.

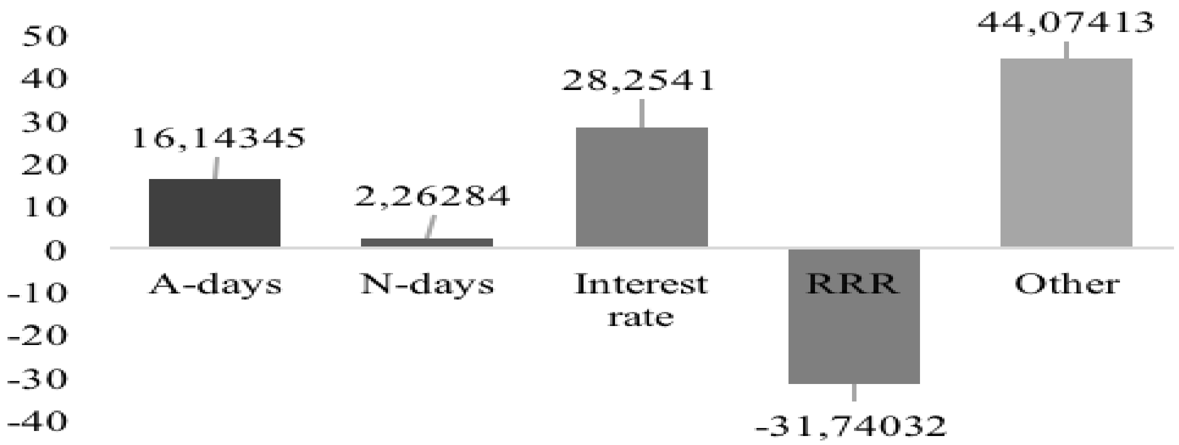
6.5 Examination of the validation of the CAPM

To begin with, we estimated the average stock market excess returns to examine if the estimated beta-coefficient are aligned with the slope of security market line, as stated by the

CAPM. In Figure 2, we can see the average market return for A-days is 16.1 basis points. Conversely, it is found to be 2.3 basis points for N-days. For the specific announcement days of different monetary policies, Other policies show the highest average daily stock market excess return with 44.1 basis points, followed by Interest rate policies at 28.3 basis points. For

Figure 2 – Average daily stock market excess returns

The table shows the average daily stock market excess returns for the announcement and non-announcement days as well as for each announcement days of the specific monetary policies. A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. The return is derived from the average daily basis point change in the CSI 300 Index.



RRR policies, it exhibits a negative average market excess return of -31.7 basis points.

From Table 2 and 3, we can determine if the CAPM is suitable as an asset pricing model for different types of trading days, based solely on the results from regressions of full-sample beta. It is found from the results that the CAPM cannot be a valid model for announcement days overall because the intercepts are significantly different from zero and the beta-coefficients are significantly different from the average stock market excess return in all the regressions. For non-announcement days, the results vary since the CAPM is rejected in two of the three regressions so we cannot firmly conclude that CAPM is or is not applicable for non-announcement days. Regarding the announcement days of specific policies, the CAPM is apparently a valid asset pricing model for announcements days of Interest rate policies. Similarly, we cannot firmly conclude that CAPM is or is not applicable for announcement days of RRR and other policies.

Table 10 - Distribution of beta-coefficient of full-sample regressions

This table shows the distribution statistics of the beta-coefficient of full-sample regressions. Min is the minimum of the beta-coefficient series, Median is the median of the beta-coefficient series, Mean is the sample mean of the beta-coefficient series, Max is the maximum of the beta-coefficient series, SD is the standard deviation of the beta-coefficient series, Skewness is the skewness of the beta-coefficient series, and 25% and 75% quantile are the cut points of dividing the range of data into the respective proportions. A-days, Interest rate, RRR and Other represent the different types of the trading days.

Regressions with time-varying beta

Type of day	Min	25% quantile	Median	Mean	75% quantile	Max	SD	Skewness
A-days	-0.0535	-0.0108	-0.001	-0.0033	0.0075	0.0366	0.0166	-0.5377
N-days	-0.1109	-0.0006	0.00003	0.00002	0.007	0.0892	0.0141	-0.2941
Interest rate	-0.0461	-0.0115	-0.0009	-0.004	0.0061	0.0291	0.0166	-0.8131
RRR	-0.05351	-0.0153	-0.0052	-0.0067	0.0057	0.0366	0.01887	-0.2745
Other	-0.0256	-0.0073	0.0028	0.0011	0.008	0.0251	0.01107	-0.0497

Pooled regressions

Type of day	Min	25% quantile	Median	Mean	75% quantile	Max	SD	Skewness
A-days	-0.0522	-0.0184	-0.0049	-0.0039	0.0095	0.051	0.0194	0.1367
N-days	-0.0064	-0.0012	0.0002	0.00032	0.0013	0.011	0.0027	0.7839
Interest rate	-0.1316	-0.0251	-0.0059	-0.0056	0.0157	0.115	0.0327	-0.1131
RRR	-0.0806	-0.0248	-0.0073	-0.0071	0.0142	0.1069	0.0305	0.2064
Other	-0.0074	-0.0099	-0.0016	0.00001	0.0011	0.0053	0.0208	-0.1401

Regressions with time-varying beta and control variables

Type of day	Min	25% quantile	Median	Mean	75% quantile	Max	SD	Skewness
A-days	-0.059	-0.01167	-0.0021	-0.003	0.0081	0.0355	0.017	-0.5432
N-days	-0.1148	-0.0007	-0.00006	-0.0001	0.0071	0.1025	0.0145	-0.1744
Interest rate	-0.0426	-0.0115	-0.002	-0.0031	0.0087	0.0299	0.0158	-0.5659
RRR	-0.059	-0.0135	-0.0053	-0.0071	0.0057	0.0317	0.0191	-0.4005
Other	-0.0194	-0.0065	0.0025	0.0027	0.0083	0.0355	0.0123	0.6667

Table 11 - Individual stocks with time-varying beta with control variables

The table shows the results from the Fama-MacBeth and pooled regressions with the time-varying beta: with the average excess return as the dependent variables and time-varying beta as the independent variable, as well as results from the Welch's tests. For the Fama-MacBeth regressions, A-days represents the announcement days for all monetary policies and N-days represents the regular trading days when no announcements occur. Interest rate, RRR and Other represents the announcement days for different types of monetary policy respectively. $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the estimated coefficient related to time-varying beta. In the pooled regressions, $\hat{\alpha}$ is defined as the estimated intercept, $\hat{\beta}$ is defined as the coefficient associated with time time-varying beta. A-days, Interest rate, RRR and Other represent the coefficient for each respective dummy variable and is the actual estimated time-varying beta. In the Fama-MacBeth regressions, for the beta-coefficients except for N-days, one-tailed t-tests are used, while two-sided t-tests are used for N-day, intercepts and the Welch's tests. In the pooled regressions, one-tailed t-tests are used for all the day-specific beta-coefficients, and two-sided t-tests are used for $\hat{\beta}$, intercepts and all day-specific intercept. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

Fama-MacBeth Regressions							Welch's test			
Type of day	$\hat{\alpha}$	$\hat{\beta}$	**ln(MV)**	**B/M**	**-1Y return**	**Avg. R^2**	**Difference**	$\hat{\alpha}$	$\hat{\beta}$	**p-value of $\hat{\beta}$**
A-days	0.01097*	-0.00304**	-0.00031	0.00006	-0.00044	0.0778	A-days - N-days	0.01043	-0.00291	0.1004
	(1.76)	(-1.75)	(-1.28)	(0.68)	(-0.39)			(1.65)	(-1.66)	
N-days	0.00055	-0.00013	-0.00002	0.000008	-0.00001	0.0734	Interest rate - N-days	0.00615	-0.00296	0.2771
	(0.51)	(-0.50)	(-0.46)	(0.59)	(-0.07)			(0.57)	(-1.10)	
Interest rate	0.00669	-0.00308	-0.00007	0.00019	-0.00223	0.0751	RRR - N-days	0.00769	-0.00697	0.014
	(0.63)	(-1.16)	(-0.17)	(1.25)	(-1.07)			(0.81)	(-2.55)	
RRR	0.00824	-0.00710***	-0.00021	-0.00006	-0.00004	0.0754	Other - N-days	0.00977	0.00283	0.253
	(0.87)	(-2.60)	(-0.64)	(-0.52)	(-0.03)			(0.93)	(1.17)	
Other	0.01032	0.00270	-0.00022	-0.00009	-0.00228	0.0789	Interest rate - RRR	-0.00154	0.00401	0.2949
	(0.99)	(1.12)	(-0.46)	(-0.60)	(-0.86)			(-0.11)	(1.05)	
							Interest rate - Other	-0.00363	-0.00578	0.1125
								(-0.24)	(-1.61)	
							RRR - Other	-0.00208	-0.00980***	0.0087
								(-0.15)	(-2.70)	

Pooled regressions

$\hat{\alpha}$	$\hat{\beta}$	**ln(MV)**	**B/M**	**-1Y return**	**A-day**	**A-day*$\hat{\beta}$**	R^2
0.01357***	0.00014	-0.00058***	0.00094	-0.00117***	0.00416**	-0.00322**	0.0027
(4.03)	(0.35)	(-4.09)	(1.00)	(-5.24)	(2.20)	(-1.72)	

$\hat{\alpha}$	$\hat{\beta}$	**ln(MV)**	**B/M**	**-1Y return**	**Interest rate**	**Interest rate*$\hat{\beta}$**	**RRR**	**RRR*$\hat{\beta}$**	**Other**	**Other*$\hat{\beta}$**	R^2
0.01304	0.00017	-0.00056***	0.00097	-0.00112***	0.00648**	-0.00526**	0.00336	-0.00568***	0.00573***	-0.00051	0.0042
(3.87)	(0.43)	(-3.93)	(1.02)	(-5.01)	(1.98)	(-1.68)	(1.17)	(-2.00)	(2.73)	(-0.26)	

6.6 T-test on average excess returns

In Table 12, we can find the result of the t-test on the average daily market excess returns for both industrial and beta portfolios. About the industrial portfolio, the average excess return for A-days is only significantly different positive for Healthcare and Consumable goods industrial-portfolio at the 5% confidence level. For N-days, only the consumable goods industrial portfolio has a significantly positive average excess return, at the 10% confidence level. Among the specific types of monetary policies, the average excess return for announcement days of Interest rate policies is significantly positive for Healthcare, Consumable goods, Energy and Utilities industrial-portfolios, at the 10%, 5%, 10% and 5% confidence level respectively. For the announcement days of RRR policies, none of the portfolios have a significantly positive average excess return, except that the Material industrial-portfolio has a significantly positive average excess return at the 10% confidence level. Also, the average excess return for announcement days of Other policies is significantly positive for Finance, Energy and Material industrial-portfolios at the 10% confidence level. Examine the beta portfolios, the average excess returns for A-day and announcement days of Interest rate policies are significantly positive for the Low beta portfolio at the 10% confidence level, while neither of the other portfolios has a significantly positive average excess returns according to the results of Student's t-test.

We find from the above that within the Healthcare and Consumable goods industry, the average daily excess return appears to be higher on announcement days compared to non-announcement days as it is not significantly positive or has a lower average excess return for the latter. For other industries, although the results of t-tests are not significant, the average excess return for A-days are still noticeably different from the N-days. Within Finance, Telecom, Industrial, Durable, Energy, Utilities, IT and Material industries, the averages are higher on A-days, while it is lower for Real Estate industry. It implies that there is a link between stock prices and risk associated with monetary policy activities. It can also be found that the average excess returns on announcement days of RRR policies are negative in all the industries. It might be caused by the pessimistic perspective of the Chinese market to RRR policies. We also find that portfolios with lower betas are always with a significantly higher average market excess return, which is in line with our findings from the regressions that we expect a negative risk premium of market beta.

Table 12 - T-test on average excess returns

The table shows the results from the Student's t-test on the average excess return for both beta and industrial portfolios that are all value-weighted. For the beta portfolios, portfolio Low include the stocks with the lowest estimated beta and portfolio High include the stocks with the highest estimated beta. A-days, Interest rate, RRR and Other represent the different types of the trading days. The level of statistical significance 1%, 5% and 10% are denoted as ***, ** and * respectively. The figure is the parentheses are the t-statistics.

Value-weighted industrial portfolios

Type of day	Finance	Healthcare	Real Estate	Telecom	Industrial	Consumable	Durable	Energy	Utilities	IT	Material
	0.0015	0.0039**	-0.0015	0.0030	0.00093	0.0050**	0.0021	0.0028	0.0013	0.0014	0.0014
A-days	(0.57)	(1.77)	(-0.48)	(0.94)	(0.37)	(2.07)	(0.76)	(1.09)	(0.41)	(0.50)	(0.53)
	0.000074	0.00026	0.000050	0.00011	0.00010	0.00045*	0.00026	0.000068	-0.00023	0.000073	0.00014
N-days	(0.21)	(0.82)	(0.13)	(0.28)	(0.31)	(1.31)	(0.73)	(0.19)	(-0.60)	(0.20)	(0.40)
	0.0044	0.0045*	0.0007	-0.0004	0.0029	0.0078**	0.0016	0.0047*	0.0067**	-0.0008	0.0014
Interest rate	(0.95)	(1.42)	(0.15)	(-0.08)	(0.74)	(1.99)	(0.39)	(1.41)	(1.83)	(-0.17)	(0.32)
	-0.0029	-0.0008	-0.0028	-0.0042	-0.0013	0.0013	-0.0035	-0.0036	-0.0053	-0.0011	-0.0071*
RRR	(-0.66)	(-0.19)	(-0.61)	(-0.99)	(-0.29)	(0.29)	(-0.72)	(-0.84)	(1.21)	(-0.24)	(-1.42)
	0.0069*	0.0039	0.0030	0.0021	0.0035	0.0056	0.0045	0.0063*	0.0029	0.0043	0.0065*
Other	(1.46)	(1.13)	(0.76)	(0.42)	(0.85)	(1.25)	(0.91)	(1.40)	(0.73)	(0.97)	(1.58)

Value-weighted beta portfolios

Type of day	Low	2	3	4	5	6	7	8	9	High
	0.00419**	0.00289	0.00211	0.00212	0.00135	-0.00073	0.00147	0.00169	-0.00072	0.000906
A-days	(2.24)	(1.16)	(0.86)	(0.95)	(0.55)	(-0.25)	(0.54)	(0.57)	(-0.25)	(0.30)
	0.00044*	0.00009	0.000177	0.00103	0.00021	-0.00005	0.00015	0.00012	0.0000005	0.00016
N-days	(1.56)	(0.28)	(0.56)	(0.33)	(0.62)	(-0.15)	(0.45)	(0.31)	(0.02)	(0.39)
	0.00728***	0.00522*	0.00398	0.00352	0.00359	-0.00177	0.00076	0.00365	0.00060	-0.00008
Interest rate	(2.71)	(1.59)	(1.00)	(1.05)	(0.89)	(0.37)	(0.18)	(0.82)	(0.12)	(-0.01)
	0.00186	-0.00132	-0.00367	-0.00166	-0.00407	-0.00716*	-0.00214	-0.00131	-0.00706*	-0.00452
RRR	(0.70)	(-0.34)	(-1.00)	(-0.51)	(-1.07)	(-1.47)	(-0.51)	(-0.28)	(-1.54)	(-0.94)
	0.00588*	0.00622*	0.00631*	0.00407	0.00561*	0.00429	0.00495	0.00051	0.00371	0.00513
Other	(1.56)	(1.47)	(1.64)	(1.02)	(1.63)	(1.06)	(1.09)	(0.10)	(0.85)	(1.14)

7. Conclusion

Our primary objective of this research is to study different reactions of CSI 300 China between announcement days, non-announcement days and announcement days of different types of Chinese central bank's monetary policies, which is to test if the relationship between market betas and market excess returns is significant. From our paper, we can conclude that there is a significantly negative beta risk premium on days when Chinese central banks announce monetary policy decisions in general. The conclusion holds for individual stocks and portfolios regarding industries and beta. However, there are no evident findings for non-announcement days that there is a significant relationship between average market excess return and beta, i.e., no proof of beta risk premium in any form can be acknowledged. It indicates that beta is a useful measurement of systematic risk, as investors in the Chinese market tend to demand lower returns when holding high-beta stocks when a monetary policy decision is announced. From considering the remarkable influence from the individual investors in the Chinese stock market, a reasonable explanation can be that investors with leverage constrain prefer high-beta stocks with low price and it drives the price of the high-beta stocks up, which means their future return is low (Frazzini and Pedersen, 2013). Besides, the risk appears to be the same on the announcement and non-announcement days because of the asymmetric nature of the rare event. Most likely, investors will learn that the economy continues to be in good shape and the risk of the disaster remains low. However, there is a small probability that they will learn that the economy is in worse shape than believed (Wachter and Zhu, 2018), and thus another possible explanation is that the monetary policies from Chinese central bank are mostly good for the stock market, while the possibility that the news reveals a bad state is what produces the announcement premium.

Considering different types of monetary policy, we can only conclude that when policies specifically about required reserve ratio are announced, there is a significantly negative beta risk premium. However, the results for announcement days of interest rate and other policies can be too weak and indecisive to draw a conclusion.

In addition, this research examines the validation of the CAPM in asset pricing for different types of trading days. From above, we can conclude that the CAPM does not hold on any types of trading days in the Chinese stock market, which is in line with the earlier empirical studies about the Chinese stock market.

8. Outlook and limitations

From this study, we think that monetary policy's impact on stock markets is still an area in need of more research. Broader or more thorough research can be done in further researches, for example, how can the negative risk premium on Chinese stock market be explained deeper? Since the CAPM cannot explain, maybe other alternative model can explain the result? In addition, how the relationship between average excess return and beta vary over different economic periods, such as expansionary and tight monetary environment.

There are also some limitations can be discussed in the study. We notice that the negative risk premium is found by other scholars but there is a limited explanation available for it, thus our explanation can be challengeable. Also, our choice of the risk-free rate is not very robust since Shibor is more common chosen as the risk-free rate in China because its liquidity, however, it is only valid from 2006. Moreover, due to the inadequate supervision of suspension on Chinese stock market, the stock price and estimate beta can be less convincing and accurate. Last, more control variables can be included in the regressions, for example, P/E, ROA, ROE, to acquire more solid result.

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Appendix

A. List of Stocks

PAB	SPD BANK	MINMETALS CAPITAL
VANKE-A	BEIJING CAPITAL	YIWU CCC
CHINA HIGH-SPEED RAILWAY	SIA	FIBERHOME
NONFEMET	BSU	KMYY
ZTE	HPI	KWEICHOW MOUTAI
OCT HOLDING	CMBC	ZTT
ZOOMLION	BAOSTEEL	TASLY
FINANCIAL STREET	SINOPEC	XTC
DONGXU OPTOELECTRONIC	CMB	COOEC
DEEJ	AVICOPTER	ACC
XCMG	CHINA UNICOM	YONYOU
SEARAINBOW	SDIC CAPITAL	GREENLAND HOLDINGS
YUNNAN BAIYAO	YTCO	OPG
ZHONGTIAN FINANCIAL	CGGC	FYG
WXQC	TRT	LJZ
LUZHOU LAO JIAO	TBEA	SCTE
JLAD	THTF	COMEC
CHANGAN AUTOMOBILE	SAIC MOTOR	SPC
BIOCAUSE PHARMA	SINOLINK SECURITIES	HAIER
TLNM	CNRE	WUCHAN ZHONGDA
GREE	CEA	LNCD
SUNSHINE CITY	CHINA SPACESAT	HASCO
NORTHEAST SECURITIES	C&D	GDPD
HESTEEL	WTECL	DR. PENG
BOE	SCG	STEC
GUOYUAN SECURITIES	YANZHOUCOAL	SBGCL
AECC AEC	FOSUN PHARMA	HAITONG SECURITIES
AVIC AIRCRAFT	XINHU ZHONGBAO	SSC
CJZQ	NANSHAN ALUMINIUM	SDIC POWER
QHSLI	HNA	YILI

TUS-SOUND	YTO EXPRESS	ZJHTC
CITIC GUOAN INFO.	HR	SHANGHAI PHARMA
WULIANGYE	CHINA GRAND AUTOMOTIVE	
NEW HOPE	WANHUA	
ANSC	GYBYS	
UNIS	JCCL	
ZHONGNAN CONSTRUCTION	CHINESE MEDIA	
HD MEDICINE	BCDC	
XSCE	GEMDALE	

B. Date for different types of trading days

RRR		Interest rate		Other	
2004-04-26	2010-05-04	2004-10-29	2012-06-08	2005-03-17	2017-01-23
2006-06-19	2010-11-11	2005-03-17	2012-07-06	2005-07-20	
2006-07-24	2010-11-22	2005-05-20	2013-07-23	2005-08-23	
2006-11-07	2010-12-13	2005-07-22	2013-12-09	2005-10-17	
2007-01-08	2011-01-17	2005-08-23	2014-11-24	2005-12-28	
2007-02-26	2011-02-21	2005-10-17	2015-03-02	2011-10-24	
2007-04-06	2011-03-21	2005-12-28	2015-05-11	2012-03-08	
2007-04-30	2011-04-18	2006-04-28	2015-06-29	2013-03-05	
2007-05-21	2011-05-13	2006-08-21	2015-08-26	2013-12-02	
2007-07-31	2011-06-15	2007-03-19	2015-10-26	2014-01-02	
2007-09-07	2011-12-01	2007-05-21		2014-02-07	
2007-10-15	2012-02-20	2007-07-23		2014-03-06	
2007-11-12	2012-05-14	2007-08-22		2014-04-01	
2007-12-10	2014-04-23	2007-09-17		2014-04-28	
2008-01-17	2014-06-10	2007-12-21		2014-08-28	
2008-03-19	2015-02-05	2008-09-16		2015-01-05	
2008-04-17	2015-04-20	2008-10-09		2015-02-02	
2008-05-13	2015-06-29	2008-10-30		2015-03-02	
2008-06-10	2015-08-26	2008-11-27		2015-08-27	
2008-09-16	2015-09-14	2008-12-23		2015-08-31	
2008-10-09	2015-10-26	2010-10-20		2016-01-19	
2008-11-27	2016-01-19	2010-12-27		2016-01-21	
2008-12-23	2016-03-01	2011-02-09		2016-03-25	
2010-01-13	2016-06-06	2011-04-06		2016-05-04	
2010-02-22		2011-07-07		2017-01-19	

C. Average stock excess returns against CAPM betas