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How does the U.S. stock market affect the stocks of Chinese state-owned companies?

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Abstract: This paper examines how the U.S. stock market affects the Chinese stock market, with a focus on Chinese state-owned companies, and compares the impacts on different industries and time periods. Results show that the U.S. stock market affects non-state-owned companies and state-owned companies with international business, but not state-owned companies without international business. The correlations between two markets are stronger in industries with lower percentages of state-owned companies. The impacts the U.S. stock market has on the Chinese stock market are increasing in time and in longer term.

I. Motivations

The extent to which the Chinese stock market is linked with global stock markets is an empirical question that interests both researchers and investors. Analyzing the linkages has great implications for both domestic firms and overseas investors. According to the Modern Portfolio Theory, one can maximize a portfolio's expected return for a given amount of portfolio risk, or equivalently minimize risk for a given level of expected return, by carefully choosing the proportions of various assets. As the Chinese stock market becomes more internationally integrated, the opportunities for international investors to diversify their portfolio to gain higher return at lower risks increase. The correlation provides portfolio managers the chance to achieve an efficient frontier for risk management and also develop the most appropriate risk-hedging strategies.

Additionally, based on the Efficient Market Hypothesis-which suggests that existing share prices always incorporate and reflect all relevant information, shocks from other countries affect the Chinese stock market. For example, economic crises overseas, such as the sub-prime mortgage crisis in 2008, spread to China as well. It is essential for policy-makers to make appropriate risk management strategies to deal with adverse economic shocks from other countries. Understanding the relationship between the Chinese stock market and global stock markets will serve policy-makers as the basis on which to formulate appropriate strategies.

II. Literature Review

Many researchers have studied how global stock markets affect the Chinese stock market and the correlation between the two markets has become controversial. Some research argues that there are strong correlations between the Chinese stock market and global stock markets. Zhang, Fan and Li (2010) study the co-movements between stock returns using daily price data from the Shanghai Stock Exchange Composite Index and the Dow Jones Industrial Average Index from December 2001 to

January 2009. They use the Granger causality test and show that U.S. stock returns have had a remarkable impact on Chinese stock returns in recent years. Notably, the Granger causality test does not imply a true causality relationship; it only helps determine whether one time series is useful in forecasting another. Also, the price data of thirty companies listed on the Dow Jones are not representative of the U.S. stock market or international stock markets.

On the other hand, some studies point out that there are neither positive nor negative correlations between the Chinese stock market and international stock markets. Hsiao and Yamashita (2003) use Pairwise Granger causality tests and find that the slump in U.S. stock price indexes leads the stock market recession in Japan, Korea, and Taiwan, but not China. They test daily data of the Shanghai Stock Exchange Composite Index and S&P 500 from September 2001 to December 2002. Hsiao and Yamashita achieve an opposite result even though they also apply the Granger causality test. This might because they use different dataset from Zhang, Fan and Li (2010). Also, Hsiao and Yamashita's dataset only covers a short period in the late 20th century. It is rational to expect that the extent of integration between the Chinese stock market and global stock markets is lower due to the lack of advanced information technology and international trades in the late 20th century.

Furthermore, Lin and Wu (2003) perform analysis on daily data from January 2000 to May 2003 using the multivariate GARCH models of several market returns to investigate the directions of spillover in mean level as well as in volatility level. They conclude that the Chinese stock market does not correlate with the U.S. stock market at both levels. Li (2007) also uses the multivariate GARCH model to analyze daily data from January 2000 to August 2005 and finds no evidence of a direct linkage between the Chinese and the U.S. stock markets. Both papers use similar methodologies, but neither of them implies a true causality relationship. This is because Lin and Wu (2003) and Li (2007) only test on the Chinese stock prices and the U.S. stock prices. They do not control for common third factors that

affect both the Chinese market and the U.S. market. Thus, their results are about the correlation between the two markets, not the causality relationship. Also, they do not control other factors, such as Chinese macroeconomic factors. This indicates global stock markets, though not dominant, can still influence the level of the Chinese stock market.

Therefore, whether global stock markets affect the Chinese stock market is still an open question. Different from most other countries, China, the largest developing country and socialist country, has a sizable number of state-owned companies in its stock market. Zhang (2002) claims that the Chinese government heavily intervenes in the pricing of stocks, especially state-owned companies' stocks. For instance, the Chinese government controls the number of new shares state-owned companies issue and adjusts the stock prices through selling and buying state-owned shares from state-owned companies. Since the Chinese government interferes with the stock market, the price changes of Chinese state-owned companies' stocks are not determined by free markets. Global stock markets, such as the U.S. stock market, have a weak influence on the Chinese stock market. Wang (2006) points out those global shocks have few effects on Chinese state-owned companies' stocks. This is because Chinese state-owned companies have government support and government funds as backing and tightly follow government targets. Instead of global factors, it is Chinese domestic factors, such as Chinese government announcements, that primarily affect state-owned companies' stocks. Hence, to study the relationship between the Chinese stock market and global stock markets, it is not sufficient to test the effect global stock markets have on the overall Chinese stock market; it is necessary to separate state-owned companies from private ones.

Additionally, through analyzing the impact global stock markets have on the Chinese stock market, especially state-owned companies, we can study the efficiency of the Chinese stock market. If the stock prices sufficiently reflect all publicly available market information, including both domestic

factors and global factors, the Chinese stock market is efficient. Otherwise, the Chinese government hurts the regular stock market developments as it controls state-owned companies' growth and intervenes in state-owned companies' stock prices.

Therefore, I build a null hypothesis that global stock markets do not affect the Chinese stock market, including both non-state-owned companies and state-owned companies, and an alternative hypothesis that global stock markets have an influence on the Chinese stock market, including both non-state-owned companies and state-owned companies. This paper will also analyze whether global stock markets affect non-state-owned companies and state-owned companies differently.

This paper is going to test how the Chinese stock market links to the U.S. stock market which may reflect global markets as well, because the U.S. is the largest developed country, has the most advanced financial market and owns the world's leading technology. Also, most literature discusses the linkages between the Chinese stock market and global stock markets through analyzing the relationship between the U.S. stock market and the Chinese stock market. For Chinese stocks, I categorize them into three types: non-state-owned companies, state-owned companies with international business, and non-state-owned companies without international business. Then, I will further examine whether time periods and industries affect the influence the U.S. stock market has on the Chinese stock market. I will collect daily stock return data and analyze three types of companies' stock returns in different time periods and different industries using the ordinary least square. The regression model will control for domestic factors and industry factors.

III. Theory

One of the stock pricing models is the dividend discounted model (DDM). It values the price of a stock by using predicted dividends and discounting them back to present value.

$$P_t = \sum_{i=0}^{n} \frac{D_{t+i}^{E}}{(1 + r_{t+i}{}^{E})^{i}} \quad \text{.....(1)}$$

The Efficient Market Hypothesis suggests that existing share prices always incorporate and reflect all relevant information. ΔP is the stock return, which is a function of ΔD^{E} and Δr^{E}. The change in the expectation is the "news". The expected dividends and expected discounting rates are impacted by news, including global news, national news, and industry news. Hence, global, national, and industry shocks affect stock prices and stock returns.

National shocks are led by domestic macroeconomic factors. Industry shocks include both domestic industry news and foreign industry news. Global news and foreign industry news cause the A stock market to link with the B stock market. Some of the news affects both the A and B stock markets, which is usually called the common third factor. An example of this kind of global shocks is an oil price change. Other news causes the A stock market to affect the B stock market. For instance, a shock from the A country affects the trades with the B country, which then influences the earnings and dividends of companies in the B country. It further impacts the stock returns of companies in the B stock market. Also, new technology developed in the A country earns a higher value for the industry, which causes the industry stock returns in the A country increases. The information about the new technology will spread to the B country and raises the expected earnings, which causes the industry stock returns in the B country increases.

Additionally, there are physiological reasons for why the A stock market affects the B stock market. According to Kodres and Pritsker (2002), the contagion effect refers to a scenario in which small shocks, which initially affect only a few financial sectors or a particular region of an economy, spread to

the rest of the financial sectors and other countries whose economies were previously healthy. The contagion exists because uninformed investors in country B follow informed investors in country A due to the asymmetric information.

Furthermore, the U.S. stock market affects the Chinese stock market because the stocks of two markets can be either substitute goods or complementary goods. For substitute goods, a good's price is increased when the price of another good is decreased. As the U.S. stock market booms, investors will buy more U.S. stocks instead of Chinese stocks; and then the Chinese stock prices decline. If the U.S. stocks and the Chinese stocks are substitutes, an increase in the price of the U.S. stocks will result in a leftward movement along the demand curve of the U.S. stocks and cause the demand curve for the Chinese stocks to shift out.

The U.S. stocks and the Chinese stocks can also be complements because the Chinese finance market attempts to be more international and treats the U.S. finance market as a target. The U.S .stock market booms will be considered as good news and simulate Chinese investors to invest in the stock market, which leads the Chinese stock market boom. If the U.S. stocks and Chinese stocks are complements, an increase in the price of the U.S. stocks will result in a leftward movement along the demand curve of the U.S. stocks and cause the demand curve for the Chinese stocks to shift in.

For national shocks, macroeconomic variables selected to examine the determinants of stock market tend to differs lightly across studies. Nevertheless, in general, Ibrahim and Aziz (2003), Booth and Booth (1997), Wongbangpo and Sharma (2002), Chen (2003), Chen et al. (2005), Maysami and Koh (2000), and Mukherjee and Naka (1995) reveal that economic growth (GDP), the rate of inflation (CPI), interest rates, money supply, reserves, exchange rates and industrial production are the most popular significant factors in explaining the stock market movement. For this paper, a simple linear regression model derived from Al-Tamimi (2007) is adopted.

Economic growth is usually valued by national income. As the expected income increases, expected profit and expected dividends rises. This leads to higher stock prices according to the dividend discounted model. Hence, economic growth is positively correlated with stock returns.

Inflation can also affect the movement of stock prices. P_t and D_{t+i}^E in (1) are both nominal variables. If the expected inflation increases, the expectation of money tightens and r_{t+i}^E in (1) rises, which leads to a decrease in the stock price. This indicates a positive correlation between inflation and the stock price.

Additionally, restrictive policies through higher interest rates would make cash flows worth less after being discounted. This would reduce the attractiveness of investment and shrink the value of stock returns. From the 'substitution effect' hypothesis, a raise in the rate of interest increases the opportunity cost of holding cash, which later on leads to a substitution effect between stocks and other interest bearing securities like bonds. In summary, both the restrictive policy and the substitution effect hypothesis suggest that interest rate should be inversely related to stock market return.

Another macroeconomic factor is money supply. Mukherjee and Naka (1995) argue that if an increase in money supply leads to economic expansion through increased cash flows, stock prices would benefit from economic growth lead by such expansionary monetary policy. The study shows that money supply is positively related to stock returns.

According to Kleidon (1986), the increase in the reserve ratio will cause the stock price to decline. The rising reserve ratio decreases the amount of money outside, so the sell goes up and the buy goes down. The stock price goes down. In addition, a company will pay a higher interest rate on its loans. More interest expenses can slow down its growth, resulting in a decrease in its stock value. Hence, the reserve ratio has a negative effect on the stock price.

Moreover, foreign exchange rates affect stock returns. Both the exchange-rate channel and flow-

oriented models hypothesize that an appreciation (depreciation) of a local currency leads to a decrease (increase) in the firm value of exporting firms, and vice versa for the importing firms. Even if a firm does not directly involve in the export/import business, Adler and Dumas (1984) show domestic firms that have minimal international activities can still be affected by the exchange rate movements if their input prices, output prices, or product demand depends on the fluctuation of the exchange rate. Soenen and Hennigar (1988) find that exchange rates have negative effects on the stock market.

Lastly, positive government announcements and news about the country and the stock market and positive industrial production information about industries lead to higher expected earnings in dividends in (1). Thus, investors will expect higher stock returns. Negative news about the stock market or the industry leads to lower earnings and dividends; and investors will expect a downward trend in the stock markets. The announcements are positively correlated with the stock price.

IV. Methodology

According to the theory section, I build the estimation equation:

$$R_{China} = \beta_0 + \overset{+}{\beta_1} R_{U.S.} + \overset{+}{\beta_2}\,\text{GDP} + \overset{+}{\beta_3}\,\text{CPI} + \overset{-}{\beta_4}\,\text{Interest Rate} + \overset{+}{\beta_5}\,\text{MS} + \overset{-}{\beta_6}\,\text{Reserve Ratio} + \overset{-}{\beta_7}\,\text{FER} + \overset{+}{\beta_8}\,\text{Gov.} + \overset{-}{\beta_9}\,\text{WTO} * R_{U.S.} + \varepsilon$$

R_{china} is the overall stock returns of the Chinese stock market, which is the cross industry average returns. Non-state-owned companies' returns, state-owned companies with international business' returns, and state-owned companies without interatnional' returns for all industries will be analyzed seperately. $R_{U.S.}$ is the overall stock returns of the U.S. stock market, which is also the cross industry average returns. GDP is the Chinese national income. CPI is the Chinese Consumer Price Index. InterestRate is the Chinese interest rate. MS is the Chinese money supply data. ReserveRatio is the Chinese federal banking reserve ratio. FER is the USD/CNY exchange ratet. Gov. is the Chinese governmetn announcements for the stock market, which are government news and documents that affect

the Chinese macroeconomics and the Chinese stock market. For instance, examples of government announcements are the adjustments of stamp tax and regulations about housing prices. WTO* $R_{U.S.}$ is the interaction term of WTO dummy variable and the stock returns of thet U.S. stock market. ε is the error term.

The theorem suggests that the U.S. stock market and Chinese stock market can be either substitute goods or complement goods. Due to the vague relationship between the demand volume and the stock price in the stock market, I ignore the demand volume and use the correlation between the prices of two stock markets to determine whether they are substitutes or complements. Table 1 and 2 show a positive relationship between the prices of two market stocks and indicate that the U.S. stocks and the Chinese stocks are completments. The U.S. stock market booms will be considered as good news and motivate Chinese investors to invest in the stock market, which leads the Chinese stock market boom. In the theory section, I also discuss the macroeconomic variables that affect the stock returns. GDP, inflation rates and money supply are positvely correlated with the stock returns. Interest rate, reserve ratios and foreign exchange rates are negtively correlated with the stock returns. Therefore, $\beta_1, \beta_2, \beta_3, \beta_5, \beta_8$ are expected be positive. β_4 , β_6 , β_7 and β_9 are expected to be negative. Also, since I want to analyze how different time periods affect the influence the U.S. stock market has on the Chinese stock market, I run regression with interaction terms, WTO.

Lastly, to analyze how different industries affect the influence the U.S. stock market has on the Chinese stock market, I run the regression for each industry with the new regression equestion.

$$R_{China} = \beta_0 + \overset{+}{\beta_1} R_{U.S.} + \overset{+}{\beta_2}\,\text{GDP} + \overset{+}{\beta_3}\,\text{CPI} + \overset{-}{\beta_4}\,\text{Interest Rate} + \overset{+}{\beta_5}\,\text{MS} + \overset{-}{\beta_6}\,\text{Reserve Ratio} + \overset{-}{\beta_7}\,\text{FER} + \overset{+}{\beta_8}\,\text{Gov.} + \overset{+}{\beta_9}\,\text{Ind.Info} + \overset{-}{\beta_{10}}\,\text{WTO} * R_{U.S.} + \varepsilon$$

R_{china} is the industry stock returns of the Chinese stock market. Non-state-owned companies' returns, state-owned companies with international business' returns, and state-owned companies without interatnional' returns for all industries will be analyzed seperately. $R_{U.S.}$ is the industry stock returns of

the U.S. stock market. Ind. Info is the industry production information for each industry. Industry information is industry news that affects both Chinese and U.S. industries and government documents about Chinese industries. Similarly, $\beta_1, \beta_2, \beta_3, \beta_5, \beta_8, \beta_9$ are expected be positive. $\beta_4, \beta_6, \beta_7$ and β_{10} are expected to be negative.

V. Data Summary

Based on the previous theory section, I will test the hypothesis that the U.S. stock market impacts the Chinese stock market through empirical evidence. Since most research analyzes daily data, I will also use daily closing data from the opening date of the Chinese stock market, December 31, 1992, to July 30, 2011. U.S. daily stock return data are collected from Professor Ken French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). Stocks traded on the NYSE, AMEX, and NASDAQ are assigned to 18 industries based on SIC code, which is a four digit code used in business to classify the industry to which a company belongs.

I will then collect stock price data of Chinese non-state-owned companies, state-owned companies with international business, and state-owned companies without international business from the Securities Star program. There are 1,058 non-state-owned companies and 458 state-owned companies in total, including 255 state-owned companies with international business and 203 state-owned companies without international business. Due to the time difference, Chinese stock price data are collected at day t+1 while the U.S. stock price data are collected at day t. According to the sectors in the Securities Star program, I categorize companies into 18 industries: alcohol, real estate, healthcare, chemicals, construction, steel, electronic equipment, autos, carriage, coal & oil, utility, telecommunication, services, transportation, retail, finance, machine and mining. Weighted by the percentage of total volume of companies' stocks in the industry, I calculate average returns, $r_t = (p_{t+1}/p_t-1)*100$, for each industry,

where P_{t+1} is the closing stock price at day t+1 and P_t is the closing stock price at day t. Three types of companies are calculated separated. Therefore, each industry has three average returns for non-state-owned companies, state-owned companies with international business, and state-owned companies without international business.

Table 1 describes basic information of the daily stock. Table 1 shows there are 50,437 observations for the U.S. daily returns, 45,657 observations for the Chinese non-state-owned companies, 41,399 observations for the Chinese state-owned companies with international business, and 43,183 observations for the Chinese state-owned companies without international business. The U.S. returns have higher variance because the Chinese stock market regulation claims that the maximum and minimum of Chinese daily returns are 10 and -10. Since the Chinese stock market index increases much slower than the U.S. stock market index in the recent twenty years, the U.S. stock mean returns are also much higher than the Chinese stock mean returns.

To merge the two markets' data, dates that stocks are not traded in both the U.S. and China are deleted. For instance, stocks are not traded in the U.S. on December 25, so Chinese stock market data on December 25 are deleted. According to Table 1, we can see that non-state-owned companies are much more correlated with the U.S. stock market than state-owned companies on average. Also, the U.S. stock market has more influence on the state-owned companies with international business than state-owned companies without international business.

In addition, the correlation between the Chinese stock market and the U.S. stock market is increasing with time. I separate data into two time periods, before and after the date China officially joins the World Trade Organization (WTO), November 10, 2001. This date is important because it indicates the official linkages between the Chinese and international markets. WTO membership will give China a more stable access to foreign markets because it will reduce disruptions in foreign trade that are caused by

unpredictable policy shifts. Given this, China will be in a better position to attract foreign investors who use China as their export platform. Also, China's entry into WTO will bring 10 million jobs to China.

From Table 2, the correlation between the Chinese stock market and the U.S. stock market is not significant before China joins WTO. Also, the effects the U.S. stock market has on the non-state-owned companies and state-owned companies are close. The correlation depends more on whether the companies have international business. After November 10, 2001, the U.S. stock market becomes more correlated with the Chinese stock market, especially non-state-owned companies. As the international trades between China and other countries become more convenient and frequent after China joins the WTO, the linkages between the Chinese companies and the U.S. companies increase. This further increases the linkages between the Chinese stock market and the U.S. stock market.

In summary, the U.S. stock market is correlated with non-state-owned companies in China; however, the influence the U.S. stock market has on state-owned companies in the Chinese stock market is much weaker. Notably, conclusions can only be made after I further control for domestic factors and analyze data using regressions.

To control for domestic factors, I select eight variables discussed in the theory section: Chinese Gross domestic product, Chinese Consumer Price Index, Chinese interest rate, Chinese money supply, Chinese reserve ratio, USD/CNY exchange rates, Chinese government announcement and industry information. I collect six variables' date and data announcement dates from December 1992 to July 2011. Data of GDP, CPI, interest rate, money supply and reserve ratio are collected from National Bureau of Statistics of China. For interest rate, I select 1-month saving rate. USD/CNY exchange rates data are collected from www.exchange-rates.org. In China, investors touch more with the percentage changes of macroeconomic variables instead of the absolute value. For example, Chinese GDP increases 8.1% this

month. Therefore, Chinese GDP, CPI, interest rate, money supply, reserve ratio, exchange rates are in the form of percentage changes, instead of absolute value or index.

Government announcement data are every Chinese government documents raised after the National People's Congress of the People's Republic of China, such as new industry development planning documents and housing price regulation documents. Information comes from the www.china.com.cn. I treat nonnumeric government announcements variable as a dummy variable, either positive news, negative news or no news. The categorization of government announcements are based on the ratings of Securities Star program makes on the government documents. If the Securities Star has positive comments on the document, I rate the news as positive; otherwise, I rate the news as negative. If there is no document published, I rate as no news.

Some industry information data are numeric. For the steel industry, I use monthly global steel price index from www.worldsteelprices.com website. For the coal&oil industry, I use daily oil price index from www.oil-price.net website. For the transportation industry, I also use daily oil price index from www.oil-price.net website. For the mining industry, I use average daily prices of gold, silver, wolfram, Tin and copper from www.shmet.com. The numeric industry information for these industries is transformed into percentage changes.

Other industry information data are nonnumeric. I select data based on a financial database, Capital IQ[1], which includes over 20,000 news sources in addition to regulatory filings, transcripts, investor presentations and company websites. I choose news and significant events are monitored by trained data analysts and are claimed to influence both the U.S. industry and the Chinese industry. The nonnumeric industry information is treated as a dummy variable like government announcements, either positive news, negative news, or no news. The categorization of industry information dummy variable is based on Capital IQ. If the comments, which summarize analysts' reports, from Capital IQ say a piece of

[1] Data access is provided by Chartwell Capital Solutions and thanks for their support.

news motivates the companies' stock in the industry, then I rate the news as positive; otherwise, I rate the news as negative. For dates Capital IQ does not has news, I rate as no news. Table 3 indicates the basic information of macroeconomic variables.

VI. Data Analysis

I first test the multicollinearity between each pair of independent variables. Table 4 shows their correlation coefficients. It appears that none of the variables is highly correlated. Thus, I do not need to remedy the multicollinearity.

Furthermore, I test overall returns data and each industry series for heteroskedasticity. Even though I use a time series dataset for single industries, stock returns can have variances that are not constant. I first run the regression and then obtain residuals. I conduct a Breusch-Pagan / Cook-Weisberg test, with the null hypothesis that the residuals have constant variance. Table 5 displays the heteroskedasticity test, including the probability of obtaining the chi-square value if the null hypothesis is true. To deal with the heteroskedasticity problem, I calculate a heteroskedaticity-corrected standard error.

Furthermore, I test the serial correlation for overall returns and each industry using the Dubin-Watson test. Table 6 displays the main test's Durbin-Watson d-statistics, which show that all industries reject the null hypothesis that there are no positive serial correlations. Since the t-value will be overestimated if I leave the serial correlation in the regression, I use the Cochrane-Orcutt method for remedy.

Lastly, I examine whether variables are nonstationary so as to avoid the potential spurious correlation, which will cause the overestimation of R^2. I use the Dickey Fuller test to detect unit roots, which cover most of the nonstationary. Some variables fail to reject the null hypothesis of having unit

roots at a 0.05 significance level. Therefore, I further test the cointegration to see whether variables can match the degree of nonstationarity and make the error term stationary. Table 7 shows the test result for the unit root of residuals. The variables in all tests cointegrated. This means that I can keep the original estimation form for all tests.

After resolving the problems of multicollinearity, heteroskedasticity, serial correlation and cointegration, I conduct the regression separately for three types of companies. Table 8 is the estimation results of regression analysis for overall returns data.

From Table 8, we can see that the U.S. stock returns have statistically significant impact on the non-state-owned companies' stock returns. 1 percent increase in the U.S. stock returns will lead to 0.016 percent increases in Chinese non-state-owned companies' stock returns. The U.S. stock returns also affect state-owned companies with international business. 1 percent increase in the U.S. stock returns will lead to 0.007 percent increases in Chinese state-owned companies with international business' stock returns. Nevertheless, the U.S. stock returns do not affect the stock returns of state-owned companies without international business.

For state-owned companies, instead of the U.S. stock returns, domestic factors, such as national income and inflation rate, matter more. Especially for state-owned companies without international business, government announcements and policies influence much more than some global factors, such as foreign exchange rates and industry information. My model also shows different time periods lead to different degree of influence the U.S. stock returns have on the Chinese stock returns. The interaction terms of WTO and the U.S. stock return are negative. For non-state-owned companies and state-owned companies with international business, the interaction terms are statistically significant. This indicates that time periods are critical to the causality relationship between the U.S. stock market and the Chinese stock market. Before China joins WTO, the Chinese stock market is not tightly linked with global stock

markets; hence, the U.S. stock returns affect the Chinese stock returns less. The regression model explains around 10% of the Chinese stock returns. The R^2s are relatively low, which means my model does not sufficiently explain the variation in Chinese stock returns.

Table 9 shows U.S. return coefficients of regression analysis for 18 industries. For different industries, the U.S. stock returns affect the Chinese stock returns differently. Some Chinese industries, such as real estate, telecommunication and utility, mainly produce products for domestic consumption and have less international trade. For example, real estate industry deals with Chinese buildings and links with domestic demands and government announcements more than U.S. housing prices. Therefore, these industries are less influenced by the corresponding U.S. stock returns. Some industries, such as autos and machinery, have more international trades and are more influenced by the corresponding U.S. industry returns. Furthermore, other industries, such as steel and transportation, are negatively correlated with the U.S. stock returns. This may because U.S. companies are more like competitors, instead of leaders, of companies in these industries.

Graph 1 shows how the U.S. stock returns affect the Chinese stock returns differently for different industries. I use Stata to run the regression that shows how the percentage of state-owned firms in the industry affects the correlation between the Chinese stock market and the U.S. stock market. The dependent variable is the coefficient of regression between the Chinese stock returns and the U.S. stock returns and the independent variable is the percentage of state-owned firms in the industry. The regression line shows that the correlation between two markets stock returns has negative relationship with the percentage of state-owned firms in the industry. This indicates that the U.S. stock market affects the Chinese stock more when there are lower percentages of state-owned firms in the industry companies in China.

In summary, the regression results show that the U.S. stock market affects both non state-owned companies and state-owned companies with international business, even though the U.S. stock market does not impact the state-owned companies in the Chinese stock market. Markedly, compared to non-state-owned companies, state-owned companies are less influenced by the U.S. stock market as expected. The analysis also indicates that state-owned companies are more influenced by domestic factors.

VII. Robustness

From the literature review, we notice that different frequency data used in the studies can lead to different conclusions. I use daily data in the main test section; however, there is no evidence to suggest that daily data is the best frequency that matches the correlation between the Chinese stock market and the U.S. stock market. Therefore, in the robustness section, I use the Band Pass Filter by Cogley (2006), which passes frequencies within a certain range and rejects frequencies outside that range, to separate "short run" relationships (high frequency) from "long run" relationships (low frequency). I utilize the Band Pass Filter to isolate the components of all ten variables that occur at 1-2 weeks and 1-2 months.

Table 10 is the regression result for overall returns at 1-2 weeks frequency. The R^2s are now all above 0.2, which means that my model explains more variation of the daily returns in the Chinese stock market. The U.S. stock market affects both non-state-owned companies and state-owned companies with international business; however, it still does not have a statistically significant influence on state-owned companies without international business. For non-state-owned companies and state-owned companies with international business, the U.S. stock returns affect them more at 1-2 weeks frequency. 1 percent increase in the U.S. stock returns will lead to 0.033 percent increases in Chinese non-state-owned companies' stock returns. 1 percent increase in the U.S. stock returns will lead to 0.012 percent increases in Chinese state-owned companies with international business' stock returns. For state-owned

companies, especially those companies without international business, domestic factors have more significant influence on their stock returns.

Table 12 is the regression result for overall returns at 1-2 months frequency. The R^2s become around 0.3. The U.S. stock returns affect both non-state-owned companies and state-owned companies with international business; and the U.S. stock returns also affect Chinese state-owned companies without international business. Moreover, the coefficients of the U.S. stock returns for all three categories are increasing when the data frequency becomes longer. This shows that the correlation between the U.S. stock market and the Chinese stock market appears to be stronger in the longer term. The influence that U.S. stock returns have on the state-owned companies' stock returns are increasing slower than the influences of U.S. stock returns on the non-state-owned companies' stock returns. This indicates that U.S. stock returns have a much weaker effect on the Chinese state-owned companies' stock returns than the Chinese non-state-owned companies' stock returns in long term.

VIII. Conclusion

This paper has examined how the U.S. stock market affects the Chinese stock market. I conduct an ordinary least square test, which controls for industry factors and domestic factors. Estimation results show that the U.S. stock market has impacts on non-state-owned companies and state-owned companies with international business, but not state-owned companies without international business. Compared to non-state-owned companies, state-owned companies are less affected by the U.S. stock market. Government announcements have statistically significant effects on state-owned companies, especially state-owned companies without international business. Domestic factors, such as national income and inflation rate, matter more than global factors, such as foreign exchange rates and industry information. Moreover, different industries and different time periods lead to different degree of influence the U.S.

stock returns have on the Chinese stock returns. The U.S. stock market and the Chinese stock market are more linked for industries with lower percentage of state-owned companies. The correlation between the Chinese stock market and the U.S. stock market is increasing with time. Also, the U.S. stock market influences the Chinese stock market more in the long term.

This paper has several weaknesses that I could improve in future studies. The first one is the imperfect dataset. Some macroeconomic variables, such as GDP and CPI, are monthly variables. They are not in the same frequency as the dependent variable, Chinese daily stock returns. The unmatched dataset may lead to an imperfect result. Also, I only use the U.S. stock market to represent global factors. If I have more time, I will test the hypothesis on other foreign countries as well.

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X. Appendix:

Table 1: Data Summary

	Obs.	Mean	Standard Deviation	Corr. with US	Min	Max
US	50437	.0729791	1.569901	1	-17.82	21.33
Non-state-owned companies	45657	.0058924	.6301032	0.1758	-9.9953	9.4169
State-owned companies with international business	41399	.0046133	.2528368	0.0766	-8.19923	7.3566
State-owned companies without international business	43183	.0044722	.2531234	0.0422	-7.95876	8.0803

Notes: 1,058 non-state-owned companies and 458 state-owned companies in total

Table 2: Correlation Coefficients before and after China Joins WTO

	Before WTO	After WTO
Non-state-owned companies	0.0122	0.2016
State-owned companies with international business	0.0134	0.1164
State-owned companies without international business	0.0034	0.057

Notes: China joins WTO on November 10, 2001

Table 3: Domestic Factors Data

Variable	Average	Standard Deviation
GDP	.0007123	.0084992
CPI	.0002535	.0036857
Interest Rate	.0265377	.3650071
Money Supply	.0007072	.0127984
Reserve Ratio	.0016274	.0159907
Foreign Exchange Rate	-.0000865	.0007021
Government Announcement	.008922	.1176394
Industry Information	.0010332	.0231906

Table 4: Multicollinearity

	US	GDP	CPI	Interest Rate	Money Supply	Reserve Ratio	FER	Gov. Policy	Industry Info
US	1								
GDP	0.0387	1							
CPI	-0.0271	0.6386	1						
Interest Rate	0.0136	-0.0102	-0.007	1					
Money Supply	-0.0021	-0.0065	-0.0053	-0.0043	1				
Reserve Ratio	-0.0143	-0.0062	-0.0051	-0.0041	-0.0056	1			
Foreign Exchange Rate	0.009	0.0305	0.0251	-0.0058	-0.0079	0.0342	1		
Government Policy	-0.0412	-0.0239	-0.0112	-0.0036	-0.0403	-0.0264	0.0258	1	
Industry Information	0.4063	0.0145	-0.022	0.0115	-0.0033	-0.0028	-0.0067	-0.0271	1

Table 5: Heteroskedasticity Test

	Prob > chi2	Result
Non-state-owned companies	0.00	Reject
State-owned companies with international business	0.09	Not
State-owned companies without international business	0.00	Reject
Alcohol Non-state-owned companies	0.00	Reject
Real Estate Non-state-owned companies	0.07	Not
Healthcare Non-state-owned companies	0.03	Reject
Chemicals Non-state-owned companies	0.04	Reject
Construction Non-state-owned companies	0.05	Not
Steel Non-state-owned companies	0.01	Reject
Electronic Equipment Non-state-owned companies	0.00	Reject
Autos Non-state-owned companies	0.05	Not
Carriage Non-state-owned companies	0.07	Not
Coal & Oil Non-state-owned companies	0.02	Reject
Utility Non-state-owned companies	0.00	Reject
Telecommunication Non-state-owned companies	0.00	Reject
Services Non-state-owned companies	0.08	Not
Transportation Non-state-owned companies	0.08	Not
Retail Non-state-owned companies	0.04	Reject
Finance Non-state-owned companies	0.08	Not
Machine Non-state-owned companies	0.07	Not
Mining Non-state-owned companies	0.08	Not
AlcoholState-owned companies with international business	0.00	Reject

Real EstateState-owned companies with international business	0.01	Reject
HealthcareState-owned companies with international business	0.05	Not
ChemicalsState-owned companies with international business	0.09	Not
ConstructionState-owned companies with international business	0.04	Reject
SteelState-owned companies with international business	0.02	Reject
Electronic EquipmentState-owned companies with international business	0.00	Reject
AutosState-owned companies with international business	0.06	Not
CarriageState-owned companies with international business	0.08	Not
Coal & OilState-owned companies with international business	0.07	Not
UtilityState-owned companies with international business	0.02	Reject
TelecommunicationState-owned companies with international business	0.04	Reject
ServicesState-owned companies with international business	0.05	Not
TransportationState-owned companies with international business	0.04	Reject
RetailState-owned companies with international business	0.07	Not
FinanceState-owned companies with international business	0.03	Reject
MachineState-owned companies with international business	0.02	Reject
MiningState-owned companies with international business	0.07	Not
AlcoholState-owned companies without international business	0.00	Reject
Real EstateState-owned companies without international business	0.08	Not
HealthcareState-owned companies without international business	0.02	Reject
ChemicalsState-owned companies without international business	0.03	Reject
ConstructionState-owned companies without international business	0.07	Not
SteelState-owned companies without international business	0.03	Reject
Electronic EquipmentState-owned companies without international business	0.00	Reject
AutosState-owned companies without international business	0.02	Reject
CarriageState-owned companies without international business	0.09	Not
Coal & OilState-owned companies without international business	0.05	Not
UtilityState-owned companies without international business	0.09	Not
TelecommunicationState-owned companies without international business	0.00	Reject
ServicesState-owned companies without international business	0.06	Not
TransportationState-owned companies without international business	0.10	Not
RetailState-owned companies without international business	0.02	Reject
FinanceState-owned companies without international business	0.06	Not
MachineState-owned companies without international business	0.01	Reject
MiningState-owned companies without international business	0.05	Not

Notes: Breusch-Pagan / Cook-Weisberg test

Table 6: Serial Correlation Test

	Durbin-Watson d-statistic
Non-state-owned companies	1.61
State-owned companies with international business	1.47
State-owned companies without international business	1.42
Alcohol Non-state-owned companies	0.44
Real Estate Non-state-owned companies	1.02
Healthcare Non-state-owned companies	0.51
Chemicals Non-state-owned companies	0.00
Construction Non-state-owned companies	0.75
Steel Non-state-owned companies	0.59
Electronic Equipment Non-state-owned companies	1.17
Autos Non-state-owned companies	0.67
Carriage Non-state-owned companies	1.10
Coal & Oil Non-state-owned companies	0.77
Utility Non-state-owned companies	0.36
Telecommunication Non-state-owned companies	0.34
Services Non-state-owned companies	0.78
Transportation Non-state-owned companies	1.39
Retail Non-state-owned companies	0.60
Finance Non-state-owned companies	0.57
Machine Non-state-owned companies	1.47
Mining Non-state-owned companies	1.23
AlcoholState-owned companies with international business	0.49
Real EstateState-owned companies with international business	1.07
HealthcareState-owned companies with international business	1.38
ChemicalsState-owned companies with international business	1.33
ConstructionState-owned companies with international business	1.02
SteelState-owned companies with international business	1.14
Electronic EquipmentState-owned companies with international business	0.13
AutosState-owned companies with international business	0.52
CarriageState-owned companies with international business	1.38
Coal & OilState-owned companies with international business	1.44
UtilityState-owned companies with international business	0.96
TelecommunicationState-owned companies with international business	1.35
ServicesState-owned companies with international business	1.45
TransportationState-owned companies with international business	0.72
RetailState-owned companies with international business	0.16
FinanceState-owned companies with international business	0.14
MachineState-owned companies with international business	1.26
MiningState-owned companies with international business	0.24
AlcoholState-owned companies without international business	0.52
Real EstateState-owned companies without international business	0.31
HealthcareState-owned companies without international business	0.76
ChemicalsState-owned companies without international business	0.85
ConstructionState-owned companies without international business	1.49
SteelState-owned companies without international business	0.16
Electronic EquipmentState-owned companies without international business	0.56
AutosState-owned companies without international business	1.15

CarriageState-owned companies without international business	0.60
Coal & OilState-owned companies without international business	0.49
UtilityState-owned companies without international business	0.09
TelecommunicationState-owned companies without international business	0.31
ServicesState-owned companies without international business	1.43
TransportationState-owned companies without international business	1.38
RetailState-owned companies without international business	0.79
FinanceState-owned companies without international business	1.47
MachineState-owned companies without international business	0.36
MiningState-owned companies without international business	1.06

Notes: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

TABLE7: Cointegration Test

	Residuals
Non-state-owned companies	0.010
State-owned companies with international business	0.007
State-owned companies without international business	0.000
Alcohol Non-state-owned companies	0.004
Real Estate Non-state-owned companies	0.015
Healthcare Non-state-owned companies	0.001
Chemicals Non-state-owned companies	0.012
Construction Non-state-owned companies	0.004
Steel Non-state-owned companies	0.020
Electronic Equipment Non-state-owned companies	0.009
Autos Non-state-owned companies	0.002
Carriage Non-state-owned companies	0.010
Coal & Oil Non-state-owned companies	0.018
Utility Non-state-owned companies	0.011
Telecommunication Non-state-owned companies	0.003
Services Non-state-owned companies	0.012
Transportation Non-state-owned companies	0.016
Retail Non-state-owned companies	0.019
Finance Non-state-owned companies	0.014
Machine Non-state-owned companies	0.010
Mining Non-state-owned companies	0.003
AlcoholState-owned companies with international business	0.014
Real EstateState-owned companies with international business	0.015
HealthcareState-owned companies with international business	0.018
ChemicalsState-owned companies with international business	0.000
ConstructionState-owned companies with international business	0.016
SteelState-owned companies with international business	0.018
Electronic EquipmentState-owned companies with international business	0.005
AutosState-owned companies with international business	0.010
CarriageState-owned companies with international business	0.017
Coal & OilState-owned companies with international business	0.010
UtilityState-owned companies with international business	0.010
TelecommunicationState-owned companies with international business	0.005

ServicesState-owned companies with international business	0.013
TransportationState-owned companies with international business	0.011
RetailState-owned companies with international business	0.020
FinanceState-owned companies with international business	0.001
MachineState-owned companies with international business	0.011
MiningState-owned companies with international business	0.001
AlcoholState-owned companies without international business	0.008
Real EstateState-owned companies without international business	0.019
HealthcareState-owned companies without international business	0.005
ChemicalsState-owned companies without international business	0.007
ConstructionState-owned companies without international business	0.000
SteelState-owned companies without international business	0.010
Electronic EquipmentState-owned companies without international business	0.013
AutosState-owned companies without international business	0.017
CarriageState-owned companies without international business	0.005
Coal & OilState-owned companies without international business	0.007
UtilityState-owned companies without international business	0.010
TelecommunicationState-owned companies without international business	0.017
ServicesState-owned companies without international business	0.020
TransportationState-owned companies without international business	0.016
RetailState-owned companies without international business	0.003
FinanceState-owned companies without international business	0.006
MachineState-owned companies without international business	0.015
MiningState-owned companies without international business	0.004

Notes: Dickey Fuller test for cointegration

Table 8: Estimation Results

	Non-state-owned	State-owned with int. business	State-owned without int. business
US overall	0.016	0.007	0.002
	(5.13)**	(2.15)*	(1.95)
GDP	0.485	0.085	0.174
	(2.70)*	(4.57)**	(3.08)**
CPI	0.194	0.183	0.294
	(2.28)*	(3.23)**	(3.63)**
Interest Rate	-0.185	-0.083	-0.058
	(1.37)	(1.21)	(2.10)*
Money Supply	0.079	0.036	0.037
	(0.69)	(2.94)*	(0.84)
Reserve Ratio	-0.059	-0.038	-0.076
	(0.49)	(0.70)	(3.83)**
Foreign Exchange Rate	-1.004	-0.272	0.491
	(2.70)**	(3.28)**	(1.49)
Government Announcement	0.007	0.014	0.017
	(0.26)	(1.89)*	(2.24)*
WTO *US	-0.005	-0.003	-0.002
	(1.77)*	(1.14)*	(0.42)
Constant	0.059	0.548	0.438
	(2.45)	(1.34)	(6.39)**
R2	0.08	0.07	0.10
N	3,252	2,886	2,819

Notes: * $p<0.05$; ** $p<0.01$

Table 9: Estimation Results

	Non-state-owned	State-owned with int. business	State-owned without int. business
Alcohol	0.007	0.003	0.001
	(7.54)**	(2.11)*	(1.18)
Real Estate	0.003	0.001	0.000
	(1.52)*	(0.07)	(0.02)
Healthcare	0.007	0.003	0.001
	(0.53)	(0.02)	(0.23)
Chemicals	0.008	0.003	0.002
	(1.15)	(0.13)	(1.19)
Construction	0.008	0.004	0.002
	(0.97)	(0.59)	(0.74)
Steel	-0.001	-0.002	0.000
	(2.05)**	(1.05)*	(0.78)
Electronic Equipment	0.008	0.003	0.002
	(1.22)	(0.02)	(1.32)
Autos	0.009	0.005	0.002
	(2.03)*	(2.01)*	(1.02)
Carriage	0.008	0.003	0.002
	(0.99)	(0.38)	(0.82)
Coal & Oil	0.008	0.003	0.002
	(0.85)	(0.22)	(0.74)
Utility	0.004	0.002	0.001
	(1.83)*	(0.83)	(0.34)
Telecommunication	0.001	0.003	0.001
	(1.61)*	(0.50)	(0.50)
Services	0.007	0.003	0.001
	(0.44)	(0.12)	(0.44)
Transportation	-0.002	-0.001	0.000
	(2.45)**	(1.23)*	(0.45)
Retail	0.006	0.003	0.000
	(1.50)	(0.24)	(1.48)
Finance	0.006	0.003	0.000
	(1.29)	(0.29)	(1.36)
Machine	0.009	0.003	0.003
	(1.63)	(0.39)	(1.59)
Mining	0.008	0.002	0.002
	(1.54)	(0.93)	(1.47)

Notes: * $p<0.05$; ** $p<0.01$

Graph 1: Coefficient vs. percentage of state-owned firms in the industry

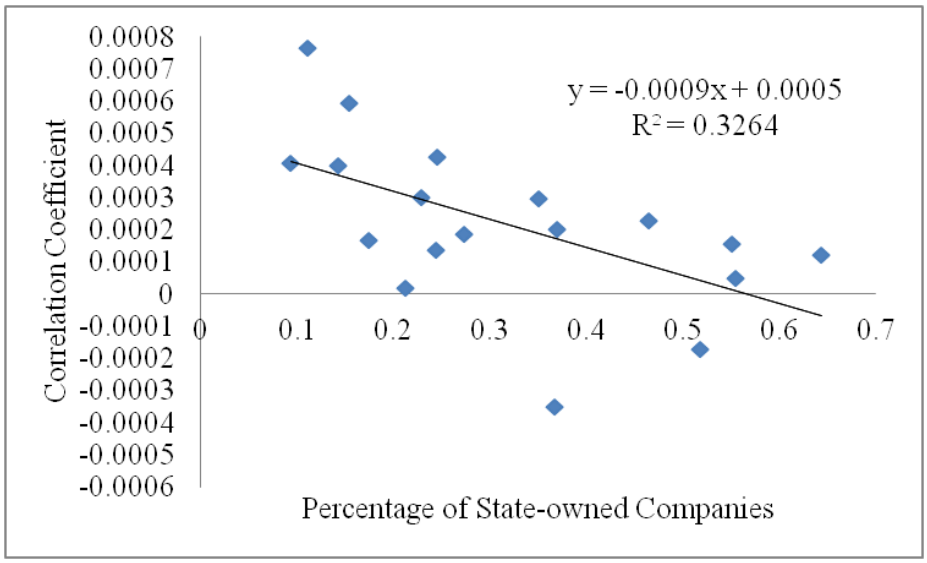

Table 10: Estimation Results (weekly)

	Non-state-owned	State-owned with int. business	State-owned without int. business
US	0.033	0.012	0.003
	(4.28)**	(3.71)*	(0.96)
GDP	0.429	0.196	0.393
	(1.55)*	(2.38)*	(5.39)**
CPI	0.598	0.144	0.175
	(0.56)	(1.78)*	(2.34)*
Interest Rate	-0.019	-0.048	-0.029
	(1.22)*	(0.99)	(1.49)*
Money Supply	-0.077	0.010	0.052
	(0.32)	(1.26)*	(1.39)*
Reserve Ratio	-0.069	0.017	-0.038
	(1.51)*	(0.39)	(2.04)**
Foreign Exchange Rate	1.697	-1.604	-1.302
	(3.75)**	(5.82)**	(0.47)
Government Announcement	0.012	0.014	0.019
	(1.60)*	(2.73)**	(3.69)**
WTO *US	-0.007	-0.004	-0.002
	(1.39)*	(1.70)*	(1.38)*
Constant	0.034	0.043	0.049
	(0.64)	(0.49)	(0.40)
R^2	0.22	0.19	0.21
N	3,252	2,886	2,819

Notes: * $p<0.05$; ** $p<0.01$

Table 11: Estimation Results (weekly)

	Non-state-owned	State-owned with int. business	State-owned without int. business
Alcohol	0.011	0.005	0.003
	(6.70)**	(2.45)*	(1.01)
Real Estate	0.004	0.001	0.001
	(3.52)**	(2.07)*	(1.02)
Healthcare	0.009	0.003	0.001
	(1.26)	(1.07)	(1.03)
Chemicals	0.016	0.007	0.005
	(2.15)**	(1.15)	(1.87)
Construction	0.015	0.009	0.006
	(1.77)	(1.77)	(1.32)
Steel	-0.005	0.002	0.002
	(4.13)**	(1.12)	(0.08)
Electronic Equipment	-0.002	0.007	0.005
	(3.22)**	(1.22)	(1.44)
Autos	0.019	0.009	0.005
	(2.87)*	(2.03)*	(1.62)
Carriage	0.016	0.008	0.005
	(1.68)*	(1.33)*	(0.99)
Coal & Oil	0.012	0.007	0.004
	(1.35)	(1.83)	(1.39)
Utility	0.007	0.003	0.004
	(1.63)	(0.83)	(0.39)
Telecommunication	0.008	0.004	0.002
	(1.11)*	(1.05)*	(1.03)*
Services	0.013	0.006	0.003
	(0.95)	(0.68)	(0.47)
Transportation	-0.010	-0.006	0.002
	(4.45)**	(2.23)**	(0.75)
Retail	0.010	0.004	0.002
	(1.50)	(1.24)	(1.52)
Finance	0.012	0.006	0.002
	(0.47)	(0.47)	(0.24)
Machine	0.024	0.008	0.005
	(2.63)*	(0.86)	(0.61)
Mining	0.014	0.003	0.004
	(1.52)	(1.87)	(0.49)

Notes: * $p<0.05$; ** $p<0.01$

Table 12: Estimation Results (monthly)

	Non-state-owned	State-owned with int. business	State-owned without int. business
US	0.045	0.017	0.005
	(5.44)**	(4.32)**	(2.19)*
GDP	0.294	0.206	0.473
	(3.58)**	(3.39)**	(5.03)**
CPI	0.183	0.284	0.382
	(2.37)**	(3.59)**	(3.06)**
Interest Rate	-0.012	0.023	-0.061
	(6.82)**	(0.66)	(5.91)**
Money Supply	0.036	0.076	0.089
	(2.76)*	(8.26)**	(7.13)**
Reserve Ratio	-0.046	-0.042	-0.034
	(2.52)**	(2.43)**	(1.22)*
Foreign Exchange Rate	-1.388	-1.660	-1.398
	(2.86)**	(2.24)*	(0.59)
Government Announcement	0.017	0.020	0.029
	(1.57)*	(4.39)**	(3.29)**
WTO *US	-0.003	-0.004	-0.006
	(2.89)**	(1.28)*	(1.30)*
Constant	0.104	0.556	0.484
	(0.58)	(0.65)	(0.28)
R^2	0.33	0.34	0.28
N	3,252	2,886	2,819

Notes: * $p<0.05$; ** $p<0.01$

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Table 13: Estimation Results (monthly)

	Non-state-owned	State-owned with int. business	State-owned without int. business
Alcohol	0.022	0.006	0.004
	(9.14)**	(4.32)**	(5.50)**
Real Estate	0.009	0.003	0.002
	(3.17)**	(1.91)	(0.79)
Healthcare	0.013	0.006	0.003
	(2.18)**	(0.82)	(0.13)
Chemicals	0.029	0.010	0.006
	(2.01)**	(1.41)	(0.80)
Construction	0.021	0.013	0.008
	(0.16)	(2.47)*	(1.96)
Steel	-0.009	0.004	0.003
	(4.54)**	(0.65)	(0.36)
Electronic Equipment	-0.005	0.009	-0.001
	(3.91)**	(1.04)	(2.31)*
Autos	0.024	0.012	0.006
	(0.92)	(2.62)*	(0.16)
Carriage	0.020	0.010	0.007
	(0.53)	(1.09)	(1.78)
Coal & Oil	0.016	0.009	0.005
	(2.53)*	(1.92)	(0.63)
Utility	0.013	0.004	0.006
	(2.98)**	(0.49)	(0.92)
Telecommunication	0.012	0.007	0.003
	(2.95)**	(0.68)	(0.48)
Services	0.019	0.008	0.004
	(1.31)	(0.75)	(0.26)
Transportation	-0.016	-0.008	-0.001
	(4.76)**	(3.57)**	(2.83)*
Retail	0.015	0.007	0.003
	(1.48)*	(0.66)	(0.78)
Finance	0.018	0.009	0.004
	(1.73)	(1.27)	(0.69)
Machine	0.030	0.010	0.006
	(2.92)*	(1.20)	(0.81)
Mining	0.019	0.004	0.006
	(1.49)	(0.75)	(0.74)

Notes: * $p<0.05$; ** $p<0.01$