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Effects of the Global Financial Crisis on Chinese Economy

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Abstract

China is one of very few countries to escape the world financial crisis and experienced only a mild slowdown in economic activity without a recession. Experts point out that the global financial crisis in United States has had no major impact on China. Also, it has been estimated that China was less affected by the financial meltdown than other countries, due to its more closed financial system. The aim of this paper is to investigate the effects of the global financial crisis on Chinese economy. For this reason we have studied two models; one is the E-GARCH Model, which estimated the effect of the crisis on the Chinese stock exchange, and second is the Extended Gravity Model with Panel Least Square Method, which examined how China's exports have been affected by the global financial crisis. Our empirical results suggest that global financial crisis moderately impacted the Chinese stock exchange and but it badly affected China's exports.

Keywords: China, E-GARCH model, extended Gravity model, the Global Financial Crisis

1. Introduction

The global financial crisis was widely examined in reports, academic articles, discussion, and working papers of economic experts, observes, and still is frequently investigated. Brunnermeier (2009) was one of the first to give a detailed description of the course of events in the United States. Taylor (2009) provides an empirical analysis of what went wrong focusing on policy responses, though the results must be considered preliminary to some extent reflecting the time it was authored. Adrian and Shin (2010) described "the changing nature of financial intermediation in the market-based financial system, chart the course of the recent financial crisis, and determine the policy responses that have been implemented by the Federal Reserve and other central banks." Blanchard, Faruqee, and Das (2010) that seek to realize the initial effect of the financial crisis over the developing countries and Kshetri (2011) examine for the case of China and India. Yongding (2010) considered four main channels via which the global financial crisis impacted on the Chinese economy: 1- direct losses in the US capital market; 2- changes in capital flows; 3- decrease in exports; 4- foreign exchange reserves.

China is one of very few countries to escape the world financial crisis and experienced only a mild slowdown in economic activity without a recession. Experts point out that the global financial crisis in United States has had no major impact on China. In addition, it has been estimated that China was less affected by the financial meltdown than other countries, due to its more closed financial system.

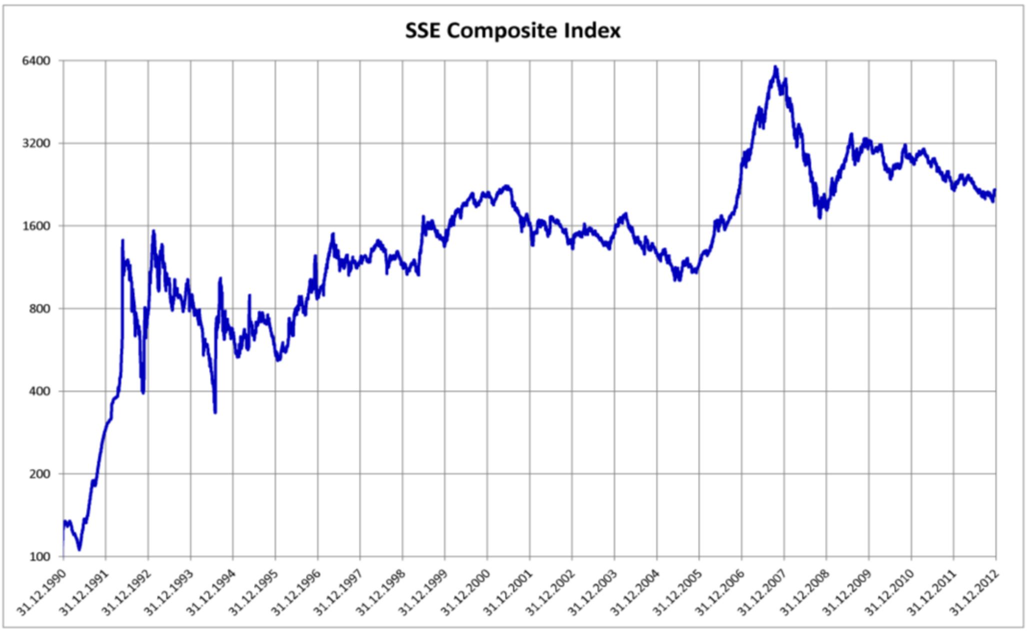
This study is organized as follows: Section 2 empirically examines impact of the global financial crisis on China's stock exchange namely Shanghai stock market (using daily closing Shanghai Stock Exchange Composite Index) through E-GARCH model. Section 3 empirically studies China's exports growth during the global economic meltdown using the extended Gravity model. This section considers the theoretical Gravity Model, implementation of the Extended Gravity Model and then makes an analysis the estimated results of Panel Least Square Method. Finally, section 4 includes the conclusion.

2. Effect of the Financial Crisis on the Shanghai Stock Exchange

In this section, it has been empirically estimated Shanghai stock market's (using daily closing Shanghai stock exchange Composite index) behavior for the financial crisis. So our purpose is empirically learn about the effect of the financial dissolving on the Chinese stock market.

There are two stock exchanges functioning independently in the China. One of them is The Shanghai Stock Exchange (SSE) and the other one is the Shenzhen Stock Exchange index. The base day for Shanghai stock exchange composite Index (A shares and B shares) is 19th of December 1990. The SSE index was established in 15th of July 1991.

As shown in Graph 1, after attainment of the highest point on 16th of October, 2007, Shanghai Stock Exchange lost 65% of 124,044 point by the end of 2008.



Graph 1. Shanghai Stock Exchange Composite Index, 31.12.1990-31.12.2012

Source: World Federation of Exchanges monthly statistics, 1990-2012

2.1 Literature review

The asymmetric volatility, temporary volatility, and permanent volatility of stock markets returns is being popular in recent years. Many researchers have been studied the models to estimate the impact of the financial crisis on stock markets and stock volatilities of different stock exchanges.

Mani and Kumar (2009) used E-GARCH framework to study the impact of financial dissolving on Indian economy through slowdown in stock market, decreasing rupee, negative profits of Indian banks. However, they did not find any important effect of financial crisis on Indian stock market.

Lim, Brooks, and Kim (2008) examined the efficiency of some Asian countries stock exchanges in order to determine the effect of 1997 Asian financial crisis. They found that the main sacrifice of 1997 Asian financial crisis was Hong Kong stock exchange. The estimation has been done by the E-GARCH model.

Rafaqet and Afzal (2012) used E-GARCH framework to estimate the effect of the financial meltdown on Pakistani and Indian stock exchanges. They observed that bad news have more sounded effect on the volatility than good news. Both stock exchanges confronted continual volatility clustering. They concluded that the financial crisis had damaging effect on stock returns and this effect is more intense on Indian stock market than on Pakistani stock market.

Verma, and Mahajan (2012) applied an augmented E-GARCH framework to figure the demeanor of Indian stock prices for the global financial crisis. The study implied that the effect of USA financial dissolving on the Indian stock market volatility has been important.

Abidin (2012) investigated the asymmetric volatility in New Zealand stock exchange for the time period 2007-2008 by employing two models, E-GARCH and T-GARCH, to capture the asymmetric effects on New Zealand stock exchanges The results provided evidences of the presence of asymmetric volatility in the New Zealand stock market for the entire time period of study.

2.2 E-GARCH model

As it is mentioned by (Engle, 2001) "The ARCH and GARCH models, which stand for autoregressive conditional heteroskedasticity and generalized autoregressive conditional heteroskedasticity, are designed to deal with just this set of issues. They have become widespread tools for dealing with time series heteroskedastic models. The goal of such models is to provide a volatility measure—like a standard deviation—that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing."

Common GARCH model contains a coefficient that can catch statistical relationship between stock returns and "conditional variance". These models are called asymmetric or leverage volatility models. "The asymmetric response of volatility to positive or negative shocks is well known in the finance literature as the asymmetric/leverage effect of the stock market returns." (Karanasos, Kim, sited to Black 1976). "Asymmetric/leverage effects means whether negative shock of bad news is more pronounced than positive shock of good news for stock markets or vice versa" (Rafaget and Afzal, 2012).

One of the earliest asymmetric information GARCH is the EGARCH framework. This model first proposed by Nelson (1991). "The EGARCH model is more general than the standard GARCH model in that it allows innovations of different signs to have a differential effect on volatility than does the standard GARCH model. Also in contrast to the conventional GARCH specification which requires nonnegative coefficients, the EGARCH model by modelling the logarithm of the conditional variance does not impose the no negativity constrains on the parameter space" (Karanasos, Kim, 2000).

General mean and conditional specification of E-GARCH is as follows Verma and Mahajan (2012)'s model; Mean Specification for variable of X_t

$$X_t = c + \mu_t \tag{1}$$

Variance Specification

$$log(\sigma_t^2) = \omega + \alpha \, log(\sigma_{t-1}^2) + \gamma \left| \mu_{t-1} / \sigma_{t-1} \right| + \beta(\mu_{t-1} / \sigma_{t-1}) \tag{2}$$

In the equation (2), 'α' is called GARCH term. It evaluates effect of final periods' variance. "A positive 'α' indicates volatility clustering implying that positive price changes are associated with further positive changes and vice versa. The coefficient 'γ is the ARCH term that measures the impact of news about volatility from the previous period on current period volatility" (Verma and Mahajan, 2012). In other words, ARCH and GARCH term cover the effects of new and old information respectively. ARCH term points out how volatility is affected by current news. However, GARCH term suggests how volatility is connected by old news. 'β' assesses the "leverage effect and it is supposed to be negative. It means that bad news has a larger effect on volatility than the good news of the same magnitude." (Verma and Mahajan, 2012)

Following the Verma and Mahajan (2012)'s model, the mean and variance specification for stock market index;

Mean specification for stock markets:

$$R_t = \delta + \beta X_t + \varepsilon_t \tag{3}$$

In the equation (3), R_t is stock return series, δ denotes for constant, X_t is independent variable, and β is the coefficient of independent variable. εt is residuals. Finally, subscription 't' symbolize the time.

Conditional specification for stock markets:

$$log(\sigma_t^2) = \omega + \sum_{i=1}^{p} \alpha_i \left| \mu_{t-i} / \sigma_{t-i} \right| + \sum_{j=1}^{m} \gamma_j \mu_{t-j} / \sigma_{t-j} + \sum_{k=1}^{q} \beta_k \, log(\sigma_{t-k}^2) \tag{4}$$

In conditional variance specification, equation (4), Akaike Information Criterion (AIC) is used for determination of p, m, q. The influence of global financial crisis on stock markets is considered by employing dummy variables. Dummy D_1 is for period of global financial crisis. Dummy D_2 refers for period of after the financial crisis. The new mean equation including dummy variables as follows:

$$R_t = \delta + a_1 D_1 + \mu_t \tag{5}$$

In the equation (5), a_1 captures the differences in mean stock incomes because of financial crisis. In other words, it evaluates the effect of the financial crisis on stock incomes.

We are going to estimate following modified variance equation for the stock markets. Verma and Mahajan, (2012)

$$\log(\sigma_t^2) = \omega + \sum_{i=1}^{p} \alpha \ \mu_{t-i} / \sigma_{t-i} + \sum_{j=1}^{m} \gamma_j \mu_{t-j1} / \sigma_{t-j} + \sum_{k=1}^{q} \beta_k \log(\sigma_{t-k}^2) + \tau_3 D_1 + \tau_4 D_2 \tag{6}$$

In the equation (6), τ_3 describes the sudden change of direction in Return-Volatility for the time period of financial crisis and τ_4 illustrates post crisis period. To understand the volatility spillover, coefficient of ω, α, γ and β are going to be calculated.

2.3 Data

In our empirical analysis, we use daily indices of SSE composite, BSE-30, Nikkei-225, S&P 500, and NYSE for the period 6th January 2006 to 22nd of April 2011. The data is obtained from Yahoofinance.com. Following Ke, Wang, and Murray, (2010) stock return is estimated as:

$$R_t = \log P_t - \log P_{t-1} \tag{7}$$

Where R_t denotes stock return at time t

P_t symbolizes stock exchange index at time t

P_{t-1} also symbolizes stock exchange index at time t-1

To investigate the volatility of stock returns, R_t has been calculated. The entire period of the analysis is separated into three parts. First period is pre-crisis period [6th of January 2006 to 21st of January 2008]. Second period is crisis-period [22nd of January, 2008 to 25th of March 2009]. Third one is post-crisis period [26th of March 2009 to 22nd of April 2011]. 26th of March 2009 has been chosen as a beginning of the post crisis period since March 2009 the global commodity prices were started to stabilize and it contributed to the rebound in global stock markets (Noughton 2009). Hence, the effect of the breakdown on the stock return's volatility is examined in the paper by including the empirical results for three periods. In the following sections, to understand the effect of the 2007 financial crisis on volatility of stock returns, two dummy variables are estimated. Crisis period dummy variable estimates the volatility of stock returns during the global meltdown, and post crisis dummy variable examines how changed volatility of returns in the post crisis period. All estimations have been done through Eviews-7 Software.

2.4 Unit root test

Taking the difference of the time series to make them stationary, we gain the statistical adequacy, which is achieved at the expense of losing valuable long-run information. To provide further estimations time series have to be stationary. Otherwise, "spurious regression" might appear. It is generally accepted to use Augmented Dickey-Fuller test to check whether time series is stationary or non-stationary. Unit root tests for SSE index are described in Table 1.

Table 1. Unit root test for Shanghai composite stock exchange

Stock return	Shanghai composite stock exchange
ADF statistic	-36.69063 (0.0000)*
ADF(i)	-36.72070 (0.0000)*
ADF(i&t)	-36.78340 (0.0000)*

Note 1: ADF means exclude intercept and trend items, ADF(i) means include intercept only, ADF(i&t) means include intercept and trend items P-values of the ADF test are reported in the brackets.

Note 2: * denotes 1% significance level.

Table 1 shows us that the test results of ADF, ADF(i), and ADF(i&t) all reject null hypothesis at 1% significance level and accept alternative hypothesis. It means the SSE time series does not have a unit root. The stock return series are stationary processes. Thus, there is no need to difference the data.

2.5 Empirical results

The results of E-GARCH model for Shanghai composite stock exchange is shown in Table 2. It considers results of the E-GARCH model including dummy variables to see effect of financial crisis on stock returns. (Appendix A)

Table 2. Parameter Estimates of E-GARCH model for Shanghai composite stock exchange

Variables	Coefficients (Probability) Shanghai Composite stock exchange
Mean Equation	
δ	0.000660 (0.0006)*
a_1	-0.001680 (0.0086)*
Variance Equation	
ω	-0.416477 (0.0000)*
α (ARCH effect)	0.136407 (0.0000)*
γ (Leverage effect)	-0.017720 (0.0755)***
β (GARCH effect)	0.967107 (0.0000)*
τ_3 (Crisis period)	0.020988 (0.0336)**
τ_4 (Post crisis period)	-0.017904 (0.0036)*
Diagnostic Test	
Q-Stat of the squared standardized residuals (up to 24 lags)	All insignificant

Note 1: The decision of Lag Length has been done on the base of Akaike Criterion.

Note 2: *, ** and *** stand for statistically significant of estimated coefficients at the 1%, 5%, and 10% level of significant, respectively.

Second column of Table 2 estimates Shanghai composite stock market. From mean equation, the coefficient of the crisis "a1" of Shanghai composite stock exchange is significant at 1% level and has negative sign. It reveals that there is weak effect of financial crisis on Shanghai stock exchange. Hence, market return was decreased by 0.17 percent due to the crisis. The coefficient of "α" is 0.136 which is significant, by means of that describing the existence of ARCH effect which infers that recent past news had an effect on the current period. The estimated "β" is positive and highly significant. Its value is 0.967 which implies the existence of GARCH impact i.e. volatility clustering stands very firm in Shanghai stock market and volatility takes long times to disappear. This illustrates that favorable changes in the past are pursued by more favorable changes and the opposite way. Shanghai composite stock exchange confronts the effect of asymmetric information in volatility of stock return. The estimated "γ" is -0.017720 and negative. That supports the existence of leverage effect, which exhibits that the effect of bad news is more sounded. Dummy variable "τ_3" for crisis period has positive sign and statistically significant. In other words, the global financial crisis increased only 2.1 percent volatility of stock return on Shanghai composite stock market. On the other side, the dummy variable for post crisis "τ_4" is negative and significant. It estimates that volatility calmed down by 1.8 percent when the impact of financial crisis reduced.

Therefore, from the empirical results we can see that global financial meltdown diminished stock returns of the financial market by the value i.e. 0.17 percent. Also financial crisis increased volatility of stock return of Shanghai composite stock exchange by 2.1 percent.

3. Impact of the Global Financial Crisis on Chine's Export

Due to fall of the international demand, China's export growth was badly hurt during the financial crisis. That's why, we are going to understand the effect of the financial crisis on China's export growth using the Extended Gravity Model.

3.1 Literature review

Tripathi and Leitao (2013) "examined the India's trade flows using a gravity model for the period 1998-2012. They included the following major trade partners: China PRP, United Arab Emirates, United States, Saudi Arabia, Switzerland, Singapore, Germany, Hong Kong, Indonesia, Iraq, Japan, Belgium, Kuwait, Korea RP, Nigeria, Australia, United Kingdom, Iran, South Africa, and Qatar. They found evidence that political globalization and cultural proximity have a positive influence in bilateral trade. They also introduced that common border have a positive effect of bilateral trade. The calculation has been done by Dynamic Gravity model."

Nguyen (2010) estimating both dynamic and static gravity framework, "found that there is a strong correlation between the Vietnamese contemporary export flows and those of the previous year, and he stated the extended model fits the data better than the static one. Vietnamese export growth generally has a positive correlation with Vietnam's and trading partner income growth. In addition, transport costs have significant effects on Vietnamese export performance. Other important factors include the exchange rate and the ASEAN membership of trading partners."

Khan and Hossain (2010) has "developed a model of Gravity with some extensions that captures the effects of all factors influencing trade balance as suggested by elasticity, absorption, and monetary approaches for Bangladesh bilateral trade with selected countries. Using standard panel data techniques the model is empirically tested and the results show significant effects of all the relative factors on the bilateral trade balance of Bangladesh in trading with its partners."

Hatab, Romstad, and Huo (2010) "employed gravity model approach to analyze the main factors influencing Egypt's agricultural exports to its major trading partners for the period 1994 to 2008. Their findings are that an increase in Egypt's GDP causes increase in Egypt's agricultural export flows. In contrast, the increase in Egypt's GDP per capita causes exports to decrease, which is attributed to the fact that an increase in economic growth, besides the increasing population, raises the demand per capita for all normal goods. The exchange volatility has a significant positive coefficient, indicating that depreciation in Egyptian Pound against the currencies of its partners stimulates agricultural exports. Transportation costs, proxied by distance, are found to have a negative influence on agricultural exports."

Gu (2008) "estimated Gravity model based on the export of goods from China to 30 OECD countries between 1999 and 2005. The empirical results indicate that the traditional explanatory variables, GDP per capita, and population have strong and significant effects on China's export trades, while physical distance and remoteness have negative effects. Moreover, the empirical results demonstrate that trade cooperation applies significantly positive effect on the export trade."

Josheski and Apostolov (2013) "examined the export performance of the Republic of Macedonia to its main trading partners; hence they focused on the major importing countries which are most present in the Macedonian trade balance. The data sample is formed on the Balkan countries i.e. Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Romania, Slovenia, Turkey and Serbia and Montenegro. The results showed that the domestic country GDP is positively correlated with the exports from the source country to target countries and that Balkan countries have positive propensities to import from Macedonia, however it was found that populations of source country and target country are negatively correlated with exports from the source country to target countries. Additionally, the business cycles had no positive effect on Macedonian export to the target countries."

Brambila-Macias, Massa, and Salois (2011) "used a mixed-effects trade gravity model on a sample of 83 developing countries over the period 1990-2007 to assess the impact of trade finance and foreign aid on bilateral export flows. In addition to traditional variables, they also include a banking crises variable and a global economic downturns variable among the regressors. Differences across developing regions are taken into account. Their results suggest that: trade finance has a positive and significant impact on bilateral export flows in all developing regions except Latin America; foreign aid matters in all regions; global economic downturns exert a negative and significant impact on export flows in all developing countries, and especially in Latin American and Sub-Saharan African economies; banking crises appear to have no significant impact in most developing regions."

Eita (2008) "studied Namibia's bilateral exports to its main trading partners. The analysis indicated that increases in importer's GDP and Namibia's GDP cause exports to increase, while distance and importer's GDP per capita are associated with a decrease in exports. Namibia's GDP per capita and real exchange rates do not have an impact on export. Namibia exports more to countries where it shares a common border and SADC (Southern African Development Countries) as well as to the European Union. The study showed that there is unexploited export potential to among others, Australia, Belgium, Kenya, Mauritius, Netherlands, Portugal, South Africa, Switzerland, and the United Kingdom."

Martinez-Zarzoso and Nowak-Lehmann (2003) "applied the gravity trade model to assess Mercosur-European Union trade, and trade potential following the agreements reached recently between both trade blocs. The model is tested for a sample of 20 countries, the 4 formal members of Mercosur plus Chile, and the 15 members of the European Union. A panel data analysis is used to disentangle the time invariant country-specific effects and to capture the relationships between the relevant variables over time. A number of variables, namely, infrastructure, income differences, and exchange rates added to the standard gravity equation, are found to be important determinants of bilateral trade flows."

3.2. Theoretical framework of the Gravity model

The Gravity Model is an empirical model, which is widely used in the research of the international economics. Gravity model was inspired by Newton's "Law of Universal Gravitation", which describes the magnetic power between two objectives (i.e. in physics "the gravitational attraction between two objects is proportional of their masses and inversely relates to distances square").

Similarly, Gravity framework tries to explain the attractive force between countries: the international trade flows between countries. In 1962, Jan Tinbergen who won the first Nobel Prize in economics first introduced the gravity model. Tinbergen believed that the trade flow between two regions is affected by economies of scale and the distance between these two regions. The trade flow should be positively related to economy of scales, which can be measured by the GDP. Hence, it should be negatively related to the distance between the two regions (Anderson 2011). The main Gravity model for international trade is represented in below:

$$log(T_{ij}) = \alpha\, log(Y_i) + \beta\, log(Y_j) - \gamma\, log(D_{ij}) + \varepsilon \quad (8)$$

"T_{ij}" is the total trade amount flowing from country "I" to country "j", "Y_i" is the GDP of country "I", "Y_j" is the GDP of country j, "D_{ij}" is the distance between country "I" and country j, α, β, γ are coefficients for different components, and "ε" is the error term.

Theoretical foundations of Gravity model for international trade were not developed until 1970s. James E. Anderson was the first person who referred to the theoretical foundation of gravity models. He pointed out "when the economics of scale are certain; the volume of trade will be reduced because of the bilateral trade barriers between two countries." (Huo, Liu, and Chen, 2011)

In most of the applications based on the original gravity model formulation by Tinbergen it is possible to split between two groups of variables, relatively to their effect, that could be push (positive contribution to the flow) or pull (negative contribution). The push factor is represented by the economic size and the GDP of the origin as well as the destination country is the main proxy. It can be used other variables, such as GDP per capita, and population. The pull factor is represented by the transport costs of the traded goods, and it is possible to use the geographical distance between the two countries as an appropriate proxy.

So Gravity framework assumes that the greater the distance two countries, the lower the amount of two-sided trade and the higher the income of each country the greater the amount of two-sided trade.

3.3 Extended Gravity model

One major limitation of the standard Gravity Model is that the equation overemphasizes the impact of geographic locations and ignores possible factors from other perspectives. Many scholars have made improvements by introducing more explanatory variables into the traditional gravity model. In this empirical analysis, we propose the Extended Gravity Model, which includes the lagged China's exports to its export destination partners, real effective exchange rate of China, and financial crisis dummy variable.

In the analysis China's exports to 10 major destination partners has been used as a dependent variable and independent variables such as China's GDP, GDP of China's 10 major export partners, population of China, population of China's 10 major export partners, lagged China's exports to its 10 major destination partners (in order to determine could previous year's exports predict current year's export), distance between China and its export destination countries, real effective exchange rate of China and financial crisis dummy variable have been employed. Most of extended gravity models include dummy variables to understand specific effects. They could be speaking the same language, sharing a common land border, being a member of international agreement, and so on. In this study, dummy variables are included to the model to figure out the effect of the financial crisis on export growth of China. It takes "1" for the financial crisis period between 2008 to 2009, and "0" for non-crisis periods.

The extended Gravity model tested in empirical analysis is:

$$Exp_{ijt} = f(Exp_{ijt-1}, GDP_{it}, GDP_{jt}, Population_{it}, Population_{jt}, Distance_{ij}, REER_{it}) \quad (9)$$

In where "t" is the time, "i" stands for country of exporter (China), and "j" represents China's export destination countries.

To understand the effect of the financial crisis on exports of China, following extended Gravity model has been estimated. We have taken the natural logarithm of all the selected variables to smoothen the overall regression and estimations.

$$Ln(E_{ijt}) = \alpha + \omega Ln(E_{ijt-1}) + \beta Ln(Y_{it}) + \delta Ln(Y_{jt}) + \varphi Ln(N_{it}) + \gamma Ln(N_{jt}) + \theta Ln(Dis_{ij}) + \\ + \phi Ln(REER_{it}) + \tau Ln(D_t) + \varepsilon \quad (10)$$

Where

t: Time period of sample data.

i: Exporter country (China).

j: China's export destination countries.

E_{ijt} : The export volume from China to country j in the time t.

E_{ijt-1} : The lagged export volume from China to country j in time t-1.

Y_{it} : China's GDP in time t.

Y_{jt} : Country j's GDP in time t.

N_{it} : Population of China in time t.

N_{jt} : Population of country j in time t.

Dis_{ij} : Distance between China and country j.

$Re\,er_{it}$: Real effective exchange of China in time t.

D_t : The financial crisis dummy variable ($D_t = 1$, the period of financial crisis; $D_t = 0$, otherwise).

α : Intercept coefficient of regression

$\omega, \beta, \delta, \varphi, \gamma, \theta, \phi, \tau$: Coefficients of variables

ε : Error term.

The data set for this analysis has 100 observations, over a period of 10 years (2001-2010). The countries included in this data set are the major export destination of China: United States, Hong Kong, Germany, Netherlands, United Kingdom, Singapore, Japan, Republic of Korea, India, and Italy.

In this analysis, export and GDP variables belonging to all countries are in real values. Data for real GDP of countries are from World Bank website. Data for Chinese export to its major export destinations are taken from the Customs Bureau of Ministry of Commerce of the China website. Data for population of countries are from the www.worldatlas.com website. Data for distances between two countries are from the Chemical-ecology Net website. Data for real effective exchange rate of Yuan is from the World Bank website. All estimated data are viewed in Appendix B.

In the study the panel least squares has been estimated through Eviews 7 software program.

Before running estimation, Table 3 estimates the expected signs for each variables coefficient.

Table 3. Expected signs of coefficients of extended Gravity model

Variables	**Expected signs of variables coefficient**
$Ln(E_{ijt-1})$	"+"
$Ln(Y_{it})$	"+"
$Ln(Y_{jt})$	"+"
$Ln(N_{it})$	"+" or "–"
$Ln(N_{jt})$	"+" or "–"
$Ln(Dis_{ij})$	"-"
$Ln(REER_{it})$	"-"
$Ln(D_t)$	"-"

3.3.1 Lagged exports

The coefficient of " ω " for the China's lagged exports is supposed to be positive. According to Nguyen (2010), "initial investments or sunk costs borne by exporters to establish new distribution and service networks often generate persistency in exported goods through consumption habits and distribution channels newly established in the foreign market. As a result, export performance achieved in the previous year provides a basis for the exporting activities in the current year."

3.3.2 GDP

When China's national income increases, people could be able to purchase more goods. In addition, China's export destination countries with a high level of income will have high imports. Hence, " β " (the coefficient of China's GDP) and " δ " (the coefficient of China's export destination countries' GDP) are positive sign.

3.3.3 Population

The coefficients of φ and γ are for the China's population and China's export destination countries' population could be expected either positive or negative. On the one hand, "a large population will be having a large domestic market and higher degree of self-sufficiency and less trade demands. Also large populations might have multiplicity of labor and opportunities to trade in a variety of goods, so in this case coefficient for populations could be negative" (Martinez-Zarzoso and Nowak-Lehman, 2003).

On the other hand, larger population always represents a larger consumer base. Thus, increase of population of China's export destination countries may cause more requirements for importing commodities. The sign of coefficient will be positive.

3.3.4 Distance

According to the gravity model the coefficient of " θ " for the distance between China and China's export destination countries is expected to be negative. China's exports increase when its export destination partners are geographically close and exports decrease when China and export destination countries are far from each other. So it is expected a negative relationship between distance and bilateral trade

3.3.5 Real effective exchange rate

The coefficient of " ϕ " for the China's real effective exchange rate is assumed has negative sign because in recent years it's generally accepted that the depreciation exchange rate of China's currency RMB strongly shore up the exports of China and induce the appreciation of RMB. Therefore, real effective exchange rate of China included in this model to estimate whether depreciation exchange rate of China can boost exports or not.

3.3.6 Financial crisis dummy variable

As it has been mentioned before, the China's export has decreased during the period of the financial crisis, dummy coefficient, " τ ", for the financial crisis is anticipated to be negative.

3.4 Empirical Findings

Before estimating extended gravity model, it is worth to run coefficient correlation matrix and unit root tests.

3.4.1 Coefficient correlation matrix test

Coefficient correlation matrix determines statistical relationships between two random variables or two sets of data involving dependence. Correlation does not imply causation, it is "just a measure of association between two variables, and it ranges between –1 and 1. If the two variables are in perfect (strong) linear relationship, the correlation coefficient will be either 1 or –1. The sign depends on whether the variables are positively or negatively related. As it approaches zero there is less of a relationship, when it takes 0, it means there is no relationship between two variables" (Taylor 1990). The "Pearson product-moment correlation coefficient" is generally used in measuring the relationship between two variables.

Table 4. Correlation coefficient matrix results

Variables	$Ln(E_{ijt})$	$Ln(E_{ijt-1})$	$Ln(Y_{it})$	$Ln(Y_{jt})$	$Ln(N_{it})$	$Ln(N_{jt})$	$Ln(REER_{it})$
$Ln(E_{ijt})$	1.0000	0.9911	0.5412	0.3276	0.5539	-0.0359	0.1485
$Ln(E_{ijt})$	0.9911	1.0000	0.5661	0.3194	0.5751	-0.0519	0.2027
$Ln(Y_{it})$	0.5412	0.5661	1.0000	0.1951	0.9885	-0.0125	0.5244
$Ln(Y_{jt})$	0.3276	0.3194	0.1951	1.0000	0.2081	0.6038	0.0201
$Ln(N_{it})$	0.5539	0.5751	0.9885	0.2081	1.0000	-0.0181	0.4032
$Ln(N_{jt})$	-0.0359	-0.0519	-0.0125	0.6038	-0.0181	1.0000	0.0190
$Ln(REER_{it})$	0.1485	0.2027	0.5244	0.0201	0.4032	0.0190	1.0000

From Table 4 we can see that $Ln(E_{ijt})$ (China's export to its 10 export Destination partners) and $Ln(E_{ijt-1})$ (lagged China's export to its 10 export destination partners) have almost perfect positive relationship as correlation coefficient is equal to 0.991164.

Also strong positive relationship exists between the variables such as $Ln(Y_{it})$, and $Ln(N_{it})$, $Ln(Y_{jt})$ and $Ln(N_{jt})$, the correlation coefficients between them are 0.988594 and 0.603844 respectively. There are some negative and weak relationships between the variables like $Ln(E_{ijt})$, and $Ln(N_{jt})$, $Ln(E_{ijt-1})$ and $Ln(N_{jt})$, $Ln(Y_{it})$ and $Ln(N_{jt})$, $Ln(N_{it})$ and $Ln(N_{jt})$. Other variables have positive correlation coefficients between them.

3.4.2 Unit Root test results

The first step for panel data analysis is to perform the unit root test in order to identify the nature of the variables in terms of stationary. Prior to the regression analysis, all variables were examined for stationary, applying Augmented Dickey-Fuller (ADF)-Fisher Chi-Square method for panel data. According to the principle of statistics, if the time series is not stationary, then the result will not reflect the real relationship between variables. To provide further estimations panel data have to be stationary. Otherwise, "spurious regression" might appear. The test results for variables in the panel data are given in Table 5.

Table 5. ADF - Fisher Chi-square Individual Unit Root Tests Results

Variable	ADF statistic **(Level)**	ADF statistics (1st difference)	ADF statistics (2nd difference)
$Ln(E_{ijt})$	1.00969 (1,0000)	26.3298 (0,1552)	60.1891 (0,0000)*
$Ln(E_{ijt-1})$	15.8576 (0,7254)	23.6531(0,2579)	58.1428 (0,0000)*
$Ln(Y_{it})$	0.29632 (1,0000)	10.4688 (0,9589)	83.9532 (0,0000)*
$Ln(Y_{jt})$	1,73960 (1,0000)	40.4536 (0,0044)*	109.587 (0,0000)*
$Ln(N_{it})$	0.16013 (1,0000)	16.6411 (0,6761)	36.5320 (0,0133)*
$Ln(N_{it})$	15.1385 (0,7684)	29.0701 (0,0864)***	72.0338 (0,0000)*
$Ln(REER_{it})$	5.60924 (0,9993)	58.9115 (0,0000)*	34.5322 (0,0227)**

Note: *, ** and *** stand for statistically significant of estimated coefficients at the 1%, 5%, and 10% level of significant, respectively.

As it shown in Table 5, results of ADF-Fisher Chi-Square method reveal that all the variables in level are non-stationary. The variables $Ln(Y_{jt})$ and $Ln(REER_{it})$ got stationary in first-difference. Hence, the all variables are stationary at second-difference. The model variables all reject null hypothesis at second-difference. It means each of variables does not have a unit root. Therefore, second-differenced series are set in further panel data estimation.

3.4.3 Extended Gravity Model results

The Panel Least Squares results of Extended Gravity Model are estimated in Table 6 (Appendix B).

Table 6. Panel Least Squares Results for Extended Gravity framework

Variable	Coefficient	Standard Error	t-Statistics	Probability
C	1103.117***	192.2240	5.738706	0.0000*
Ln(E_{ijt-1})	0.911671***	0.014506	62.84572	0.0000*
Ln(Y_{it})	1.929925***	0.324259	5.951799	0.0000*
Ln(Y_{jt})	0.026232*	0.014710	1.783249	0.0779***
Ln(N_{it})	-54.53702***	9.516216	-5.730957	0.0000*
Ln(N_{jt})	0.007998	0.008233	0.971457	0.3339
Ln(Dis_{ij})	-0.032473**	0.012614	-2.574293	0.0117*
Ln($REER_{it}$)	-2.516718***	0.418021	-6.020549	0.0000*
Ln(D_t)	-0.232940***	0.033888	-6.873729	0.0000*
R-squared: 0.992428				
Adjusted R-squared: 0.991762				
F-statistic (Probability): 1490.895 (0,0000), Durbin-Watson stat: 2.162978				

Source: Results from Eviews-7

Notes: Coefficients with *, ** and *** are statistically significant at the 1%, 5% and 10% level, respectively.

The R-squared value is 0.992428, which means that the extended gravity model has strong predictive power. Durbin-Watson statistics equals to 2.162978, it means that our regression model is free from autocorrelation. The regression results have following properties: The coefficient for China's lagged exports to its export destination partners is 0.911671, this coefficient is statistically significant. It means that China's lagged exports provide a base for the exporting activities in the current year. Coefficient of China's GDP is statistically significant

(probability of t-statistics is 0.0000) and has a value 1.929925. It shows that when China's GDP increase 10 percent China's exports for export destination countries raises to 19.2 percent. The coefficient of China's export destination countries GDP also statistically significant and takes value 0.026232, which reveals that China's exports positively affected by export destination countries' GDP. When export destination countries' GDP raises China's exports increases and vice versa. Population of China has negative sign and statistically significant coefficient, which equals to -54.53702. It means that China's population negatively impact its export growth. The parameter estimates on China's export destination countries population is 0.007998. It seems that China's export destination countries population has a positive effect on exports of China. However, this result may not be true because the estimate is not statistically significant (probability of t-statistics is 0.3339). As expected, distance between China and destination country negatively effects its exports. The estimated coefficient for distance is -0.032473 and the t-statistic value is -2.574293, which is relatively significant. The coefficient estimated on China's real effective exchange rate is negative as expected. It has statistically significant coefficient which equals to -2.516718. On this basis we can say that when China's Renminbi (China's Yuan) depreciates to 10 percent China's exports could increase to 25,2 percent and vice versa. Thus, lower exchange rate has an effect on China's export grow. The coefficient of dummy variable is negative as expected, the estimated value is -0.232940. It refers that China's exports reduced during the financial crisis by 23.2 percent.

4. Conclusion

Our main purpose is to examine the impact of the global financial crisis on the Chinese economy through theoretical, statistical, and empirical approaches. Based on literature review on the effects of financial crisis on the China's economy, on empirical studies, on crises-related theoretical approaches and on data availability, two empirical models applied in the study.

First empirical analysis was to find out the impact of the financial crisis on the Chinese economy in terms of Shanghai stock exchange behavior during the financial meltdown. For this purpose, it was applied E-GARCH model.

E-GARCH model results show that global financial meltdown diminished stock returns of the financial market by the value of 0.17 percent. Also, volatility of stock returns of Shanghai stock exchange by 2.1 percent. From the above results, we can conclude that Chinese Stock Exchange is moderately effected by the financial crisis.

The second empirical analysis determines the impact of the financial meltdown on export growth of China. For this purpose it has been employed Extended Gravity Model. Extended Gravity Model with panel least square results describe followings; the coefficient for China's lagged exports to its export destination partners is statistically significant. It means China's lagged exports provide a base for the export growth in the current year. Coefficient of China's GDP is statistically significant and has a value of 1.929925. It shows that when China's GDP increase 10 percent China's exports for export destination countries raises to 19.2 percent.

The coefficient of China's export destination countries GDP also statistically significant and takes value of 0.026232, which reveals that China's exports positively affected by its export destination countries' GDP. It means that the rate of growth of real GDP of these ten countries decreases, will affect the import of these ten countries. Hence, this will affect the Chinese export. Population of China has a negative and statistically significant coefficient, which equals to -54.53702. It means that population of China has negative effect on its export growth. The estimated parameter of China's export destination countries population is 0.007998. It seems that China's export destination countries population has a positive effect on China's exports. However, this result may not be true because the estimate is not statistically significant.

Distances between China and its export destination countries have negatively impact on export of China. The estimated coefficient for distance is -0.032473 and the t-statistic value is -2.574293 which is relatively significant. It means that the longer distance between China and its export destination countries the larger transportation cost.

The coefficient estimated on China's real effective exchange rate has statistically significant coefficient, which equals to -2.516718. Therefore, we can say that when China's Renminbi (China's Yuan) depreciates to 10 percent exports of China could increase to 25.2 percent and vice versa. Thus, lower exchange rate has an effect on China's export growth.

Moreover, the dummy variable has negative sign as it is expected, and value of estimated coefficient is -0.232940. It means that the global financial crisis decreased exports of China by 23.2 percent.

When we compared with developed and major developing economies, China's financial losses as a result of the US subprime crisis were limited, and the impact of these losses on the its economy also was restricted. Because of China partially liberalized its capital account, its financial system could be immune to adverse effects of the financial meltdown. These assumptions confirmed by E-GARCH model show that Shanghai stock market less affected by the financial meltdown. The far more important effect of the financial crisis on the Chinese economy has been on export. China's Statistics showed that the most influential reason behind the decrease in growth rate of China in the 3rd quarter of 2008 was the sudden collapse of export market, which in turn caused by the sudden worsening of the US financial crisis. Spectacular decline in export demand was the most important cause of economic growth of China's slowdown. Moreover, this assumption confirmed by the extended Gravity model results show that during the global financial crisis China suffered fall in exports. Also, extended Gravity model results estimated that the main reason of exports reduction was the real GDP decline of China's ten major export destination countries during the recession period.

When the worldwide slowdown became obvious, the Chinese government changed in position quickly and forcefully. There were issued different policies from policymakers to rescue China's economy from the global recession. For instance in November 2008 China started to carry out a very large stimulus package with amount 4 trillion Yuan which is $580 billion (People's Bank of China statistics in 2008). Due to expansionary fiscal policy and monetary policy, China could provide positive economic growth during the global slowdown.

We can conclude that as it has shown from the theoretical and empirical approaches, which implemented in this study in comparison with the developed and major developing economies China relatively less affected from the global financial crisis.

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Appendix A: E-GARCH model results for Shanghai Stock Exchange

Dependent Variable: whole period_sse
Method: ML - ARCH (Marquardt) - Normal distribution
Sample: 1/06/2008 4/22/2011
Included observations: 1346
Convergence achieved after 21 iterations
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)
*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1)) + C(7)
*DUMMY_CRISIS + C(8)*DUMMY_POST CRISIS

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000660	0.000192	3.444143	0.0006
DUMMY_CRISIS	-0.001680	0.000639	-2.628672	0.0086
	Variance Equation			
C(3)	-0.416477	0.077593	-5.367446	0.0000
C(4)	0.136407	0.017432	7.825102	0.0000
C(5)	-0.017720	0.009968	-1.777647	0.0755
C(6)	0.967107	0.007419	130.3480	0.0000
C(7)	0.020988	0.009880	2.124256	0.0336
C(8)	-0.017904	0.006151	-2.910902	0.0036
R-squared	0.773007	Mean dependent var		0.000298
Adjusted R-squared	0.699008	S.D. dependent var		0.008535
S.E. of regression	0.008505	Akaike info criterion		-6.877499
Sum squared resid	0.097221	Schwarz criterion		-6.846563
Log likelihood	4636.557	Hannan-Quinn criter.		-6.865912
Durbin-Watson stat	2.018270			

Appendix B: Panel Least Squares Results for Extended Gravity Model

Dependent Variable: LN_EXPORT
Method: Panel Least Squares
Sample: 2001 2010
Periods included: 10
Cross-sections included: 10
Total panel (balanced) observations: 100

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1103.117	192.2240	5.738706	0.0000
LN_EXPORT (-1)	0.911671	0.014506	62.84572	0.0000
LN_CHINA_GDP	1.929925	0.324259	5.951799	0.0000
LN_COUNTRIES_GDP	0.026232	0.014710	1.783249	0.0779
LN_CHINA_POPULATION	-54.53702	9.516216	-5.730957	0.0000
LN_COUNTRIES_POPULATION	0.007998	0.008233	0.971457	0.3339
LN_DISTANCE	-0.032473	0.012614	-2.574293	0.0117
LN_REER	-2.516718	0.418021	-6.020549	0.0000
DUMMY_CRISIS	-0.232940	0.033888	-6.873729	0.0000

R-squared	0.992428	Mean dependent var	24.20566
Adjusted R-squared	0.991762	S.D. dependent var	1.109563
S.E. of regression	0.100705	Akaike info criterion	-1.667555
Sum squared resid	0.922874	Schwarz criterion	-1.433090
Log likelihood	92.37776	Hannan-Quinn criter.	-1.572663
F-statistic	1490.895	Durbin-Watson stat	2.162978
Prob(F-statistic)	0.000000		