LUND UNIVERSITY
School of Economics and Management

Master programme in Economic History

The Impacts of American Economy on Swedish Economy from 1985 to 2009

A Long-term Perspective

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Abstract: In this article, I estimated the impacts of American economy on Swedish economy from long-term perspective with using the standard form vector autoregression model (VAR model). In order to obtain a comprehensive point of view, I decided to investigate the relationship between these two countries from three aspects, living and working environment, export and import volumes and stock market. After general analysis, I found two countries had strong correlation, but there was a lag from one quarter to three quarters in Swedish economy to American economy. With the purpose of quantity the lag-length and dynamic mechanism, I employed three VAR models to test how fast Swedish economy could react to the changes of American economy and how big the American economy could influence Swedish economy. In the end, I found Swedish real GDP needed three quarters to respond to a shock happened in the United States. And American economy had positive impacts on Swedish trading volumes. In addition, I also found Swedish stock market only needed one quarter to react to the changes of American stock market due to the widely usage of information and communication technologies.

Key words: Vector autoregression model, dynamic mechanism, American economy, Swedish economy

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Context

1. Introduction

1.1 Research problem

During 2008, the global economy was affected by a huge financial crisis, which was original from subprime mortgage crisis in the United States. According to the recent researches, the financial crisis happened in 2008 was due to the growing level of mortgage delinquencies and foreclosures in the United States, which triggered the real estate catastrophe and financial crisis. About 80% of the mortgages were issued at adjusted-rate to the subprime borrowers in the nearly ten years[1]. After the house price peaked in 2006, real estate bubble began to burst afterwards. It induced the increasing level of adjusted-rate for mortgages and made refinancing becoming more difficult than before. As the assets of the most firms in the United States were secured by subprime mortgages, those companies suffered great losses for their value and some of them even bankrupted, such as Lehman Brothers. Many banks and government supported enterprises tightened their credits. Based on the weaknesses of financial industry regulation and less of supervision in the United States, the subprime crisis eventually influenced the whole financial system in USA[2].

As the most powerful and influential country in the world, the economy situation of the United States could not only affected domestic industries and companies, but also the global economy and people's living standards from past to the present. As it was happened in 1930s, the Great Depression also originated in the United States but from the stock market in October 29th, 1929, and then spread to almost every country in the world, which was also called Black Tuesday[3]. According to Frank, Robert H.; Bernanke, Ben S. (2007), the Great Depression had greatest influence on in the 20th century, which was also used as an example to measure how large the world's economy could decrease in the 21st century[4]. The financial crisis happened in 2008 also brought great influence on global economy, which was still under the recovery procedures.

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[1] "Senator Dodd: Create, Sustain, Preserve, and Protect the American Dream of Home Ownership". DODD. 2007-02-07. Retrieved 2009-02-18.

[2] Chairman Ben S. Bernanke speech, At the Morehouse College, Atlanta, GeorgiaApril 14, 2009

[3] Charles Duhigg, "Depression, You Say? Check Those Safety Nets", *New York Times*, March 23, 2008

[4] Frank, Robert H.; Bernanke, Ben S. (2007). *Principles of Macroeconomics* (3rd ed.). Boston: McGraw-Hill/Irwin. p. 98.

Be famous for its well recognized social security system and solid economic policies, Sweden occupies the third largest country in terms of area in the European Union, whose GDP per capita was ranked 26 in the world based on the data from CIA World Factbook[5]. In addition, Sweden is an export-oriented country, who has excellent communication and distribution systems and very high skilled labor force. The engineering industry accounts for almost 50% of the total export, and its telecommunication industry, automotive industry and pharmaceutical industry also occupy a leading position in the world[6]. However, Swedish economy also suffered a deep decline due to the financial crisis happened in 2008. Based on the data from OECD Stat Extracts, the total value of stock market fell down approximately 30% in the fourth quarter of 2008[7].

In my thesis, I would like to investigate the relationship between two economies, the United States and Sweden, from a long-term perspective, examining and estimating the impacts of American economy changing on Swedish economy. In addition, I also would like to test how Swedish economy responds to the changing of American economy from quantitative aspects, drawing a clear picture of the dynamic situation between two countries.

1.2 Aim and scope

1.2.1Writing aims

In order to estimate the impacts of American economy on Swedish economy from a long-term perspective, the standard form vector autoregression model (VAR model) will be employed. As it will be difficult and unclear to include all variables into one regression and there will be interactions and cancelation effects among different variables, I will build three standard form VAR models, observing the total economic situations changing from three aspects, living and working environment, international trading volumes and stock market. After testing these three standard form VAR models, I could answer the question that how fast the economy of

[5] Ref to CIA, the World Factbook. https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html
[6] Swedish Ministry of Defence (2008-01-08). "The EU Battlegroup Concept and the Nordic Battlegroup". Government Offices of Sweden. http://www.sweden.gov.se/sb/d/9133/a/82276. Retrieved 2008-01-19
[7] Ref to OECD statistics, http://stats.oecd.org/index.aspx?queryid=350

Sweden could react to the changing of American economy and how large the impacts of American economy on Swedish economy could be.

1.2.2 Research Period

In order to observe a long-term relationship between the United States and Sweden, I decided to choose my research period from the beginning of 1985 to the end of 2009. I believed with using the data crossing more than 20 years, it could clearer than using a short-term data when observing the general movements of the total economic situation. Besides, with using the long-term data, it could automatically eliminate the short-term disturbs and macroeconomic shocks, which might induce the total economy with a huge fluctuation in the short-term and influence the final results. The last but not the least, I found most scholars chose to investigate more than 15 years period when estimating the impacts between two or more economies. And the results of my research could provide a comparison with previous researches, if we focused on the same market or the same field. Thus, I would like to choose my research period from the first quarter of 1985 to the fourth quarter of 2009.

1.3 Outline of the thesis

The structure of my thesis will be organized as follows: In section 2, I will review previous researches and literatures based on the relationship between the United States and Sweden and different types of vector autoregression (VAR) model. And based on the literature review, I would like to raise my hypothesis in this article, which will be examined with using the three standard form VAR models. In section 3 I will explain the data I will employ in the standard form VAR models and the selection criterion of sorting the data into three groups in order to fit for the three standard form VAR models. Section 4 will describe the methodology I will use, discussing the advantages and disadvantages for the VAR model. And I will also highlight the criteria of selecting the optimal lag-length. In section 5 will be the empirical analysis, discussing the results generated from the VAR model. Section 6 will be the conclusion part.

2. Background

In this part, I would like to generally review some previous researches and works based on the usage of the vector autoregression model (VAR model) when dealing with financial issues and estimating financial impacts. And in the following, I will raise the hypothesis based on my writing purpose, explaining the reasons that why I had such hypothesis before quantitative testing.

2.1 Literature review

As it was first introduced by Sims (1980), the vector autoregression model was a system regression model, which could contain more than one dependent variable in one regression. As vector autoregression model (VAR model) is good at estimating the responses of other variables in one model, if one variable changes, many economists and scholars contributed and developed the results of VAR model, testing a group of factors, especially estimating the impacts for the changing macroeconomic data.

Sims (1980) introduced vector autoregression model (VAR model) when he analyzed the existing strategies for macroeconomics. His analysis was recognized as a benchmark when analyzing and modeling the transmission of monetary policies. He tested time series data of the United States and West Germany on monetary policies with using vector autoregression model. The data that was included in the model were GNP, unemployment rate, price level and import price index, total 144 parameters, where the author input them into an unconstrained vector autoregression model. Not like traditional "data driven" approach or economic theory based approach, the author concluded that this kind of model could provide a certain combination for the above two models[8].

Mattesini and Quintieri (1997) investigated the economic performance of Italy during and after the Great Depression from 1929 to 1936, compared with other major industrial countries in Europe[9]. They used monthly data of industrial production index, consumer price index and exchange rate to represent output of industry, price level and wage level respectively. And

[8] Christopher A. Sims, 1980, "Macroeconomics and Reality", Econometrica 48

[9] Fabrizio Mattesini (1997), "Italy and the Great Depression: An Analysis of the Italian Economy, 1929–1936", *ECONOMIC HISTORY* ***34,*** *265–294 (1997)* ARTICLE NO. EH970672

they estimated a small structural VAR model with using above data. As the monetary of Italy was restrictive by the rule of Gold Standard, the result they attained indicated that the increasing level of real wage was the most important reason to influence the decreasing level output, which also caused deflation. But they did not find the evidence that financial factors played an important role in the Great Depression.

Buckle, Kim, Kirkham, McLellan and Sharma (2002) studied the business cycle and economy of New Zealand from 1983 to 2002 with using structural VAR model[10]. According to their paper, they developed the appoaches of Cushman and Zha (1997) and Dungey and Pagan (2000) when estimating the responses of New Zealand to the shocks both from the international and national aspects. In order to obtain a general view of global economy, they used a weighted average interest rate of Australian, Japan, the United States and United Kingdom to represent the foreign nominal interest rate. At the same time, they also used the average GDP for these countries to represent the GDP level. Most importantly, they introduced the national climate variable, which showed the deficit of soil moisture estimated by the National Institute of Water and Atmospheric Research Ltd (2001)[11]. After testing with the structural VAR model, they found that the international variables played an important role in the business cycle of New Zealand and the climate factor also occupied a significant position to influence the economy of New Zealand.

Groenewold and Tang (2004) examined the relationship between the level of GDP and the natural rate of unemployment rate for the Four Asian Tigers, Hong Kong, Taiwan, Korea and Singapore from 1982 to 2000 with using the structural VAR model[12]. After plotting the data and analyzing the features of the labor markets for these four countries, the authors found that the demand shock influenced the unemployment rate for both Korea and Hong Kong. But the structural change was not as significant as it was argued. The unemployment rate for Taiwan was relatively stable compared with other three countries. But the increasing level of unemployment rate for Singapore corresponded to the total level of the GDP growth rate.

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[10] Buckle, Kim, Kirkham, McLellan and Sharma (2002), "A structural VAR model of the New Zealand business cycle", Economic Modelling 24 (2007) 990 – 1017

[11] National Institute of Water and Atmospheric Research Ltd.: http://www.ssc.govt.nz/display/document.asp?NavID=47

[12] Groenewold and Tang (2004), "the Asian financial crisis and the natural rate of unemployment: Estimates from a structural VAR for the newly industrializing economies of Asia", *Pacific Economic Review*, 9: 1 (2004) pp. 45–64

By following the method of Andersen (2004)[13], Rafiq, Salim and Bloch (2009) used VAR model to estimate the impacts of the oil price volatility in Thailand from 1993 to 2006[14]. They employed quarterly data of oil price to estimate the model with Granger causality test and impulse response estimation. During their estimation process, they found that the connection between all variables and structural moving was broken during the Asian Financial Crisis, which happened between 1997 and 1998. And they also found that budget deficit was mainly caused by the fluctuation of the oil price during the post-crisis period, which might due to the usage of floating exchange rate policy, as the authors argued in the end of their paper.

Gonga, Leea and Chen (2004) studied the transmission channels for Asian Financial Crisis happened from 1997 to 1998 by building a VAR model with using the data of both industrial countries, such as Japan, Korea, and emerging countries, such as Thailand, Malaysia and Indonesia, from the beginning of 1990 to the end of 1998[15]. The authors found that the economic transmission was more significant in the crisis period than the ordinary periods. And there was no significant evidence that the financial crisis transmitted between industrial countries. But for the emerging countries, it showed significant data for the financial crisis transmission between Thailand and Malaysia, which might due to the geographic factors. In addition, among these transmission channels, the so-called wake-up effect was more significant than others. And between the developed and developing countries, there was no such kind of crisis transmission.

Burak, İsmail and Cem (2008) analyzed the impacts of constraining inflation policy on current account balance for Turkey from 1990 to 2006 with using VAR model[16]. The authors tested a group of data, including the real GDP growth rate, export and import volumes and the exchange rate between American and Turkish currencies to estimate the effects of policy changing on macroeconomic indicators. With explaining the dynamic process, the relationship between two countries and impulse response function of VAR model, they

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[13] Andersen (2004), "Analytical evaluation of volatility forecasts", International Economic Review 45(4), 1079-1110

[14] Rafiq, Salim and Bloch (2009), "Impact of crude oil price volatility on economic activities: An empirical investigation in the Thai economy", Resources Policy 34 (2009) 121–132

[15] Gonga, Leea and Chen (2004), "Crisis transmission: Some evidence from the Asian financial crisis", International Review of Financial Analysis 13 (2004) 463– 478

[16] Burak, İsmail and Cem (2008), "The Interaction of the Current Account with Its Determinants and the Effects of Inflation Targeting on Current Account Balance: the Case of Turkey", *e-Journal of New World Sciences Academy (NWSA)*; 2009, Vol. 4 Issue 2, p154-169

concluded that the macroeconomic policy played an important role in current account adjustment procedure.

Borys, Horva´th and Franta (2009) examined the impacts of the monetary policies changing in Czech Republic with using the vector autoregression model (VAR model), structural VAR model and Bayesian VAR model. During their testing process, they built a transmission mechanism which was as similar as the Euro area countries. The authors estimated the effects with using the data of real-GDP, net price index, exchange rate, commodity price index, forward agreement rate and interbank rate from 1998 to 2006. They found that both the economic activities and price level had negative reactions against the contractionary monetary policy, which would response to the change in the following one year or afterwards. Additionally, regarding the price level for each industry, the tradable industries could response quickly than the non-tradable industries, which can be explained with the microeconomic theory of price stickiness. They also claimed that they used the number of real GDP instead of the growth rate of GDP, which made the results more reasonable, although they should employ the growth rate of GDP. In the end they concluded that, the value of domestic currency suffered from a sharp appreciation to a gradual depreciation after a tightening of monetary policy[17].

Österholm (2009) reported the impacts of financial crisis happened in the United States in 2008 on Swedish real economy with using Bayesian VAR model[18]. It was the most recent analysis based on the impacts of American economy on Swedish economy. In order to obtain a clear view of the general economic situation and how Swedish GDP were influenced by the financial crisis, the author created a new index to describe the financial situation of Sweden by giving equal weight for three indices, the real interest rate, the return of stock exchange and interbank spread, which was the highlight in his article. With using the created financial index and Bayesian VAR model, the author estimated the impacts of financial crisis in 2008 on the growth of real GDP of Sweden, concluding the financial crisis happened in 2008 had stronger impacts on Swedish economy than the crisis happened in 1990s. And the author also

[17] Magdalena Morgese Borys, Roman Horva´th Æ and Michal Franta (2009), "The effects of monetary policy in the Czech Republican empirical study", *Empirica (2009) 36:419–443*s

[18] Österholm (2009), "The Effect on the Swedish Real Economy of the Financial Crisis", *Working Paper No. 110,* National Institute of Economic Research

forecasted that Swedish economy would suffer a relative slow growth rate in the next few years due to the impact of financial crisis.

Buch, Carstensen and Schertler (2010) employed the panel VAR model to estimate the impacts of macroeconomic shocks on the financial markets[19]. They used the samples of OECD countries to investigate how the financial system and banks respond to the macroeconomic shocks. Due to the transmission effect, the macroeconomic shocks, such as an increase of domestic interest rate, could cross borders to influence the financial market. As a response, the banks reduced the foreign assets for the increasing level of domestic interest rate. However, they found positive evidence that the banks increased their foreign assets, if the price of the global energy grew. The authors also claimed that the impacts of macroeconomic changes could extend over several quarters, as it was a dynamic model and it could adjust itself over time.

2.2 Hypothesis

As I would like to test the impacts of American economy on Swedish economy from three aspects, I will build three standard form VAR models, which means I will have three hypothesizes for the three models. Based on the previous researches and literatures, I will have the following hypothesizes:

Hypothesis 1: The economy of the United States has positive impacts on Swedish economy from living and working environment aspect, which can be observed by decline real GDP level and increasing level of unemployment rate. However, as it was found in Buch, Carstensen and Schertler (2010), I also believe it will be a dynamic process during the impact process, which means the impact of American economy on Swedish economy will extend from one quarter to several quarters.

Hypothesis 2: The economy of the United States has strong impacts on Swedish export and import volumes. But the trading volumes of the United States have relative small effects on Swedish trading volumes, since the United States only occupied the third largest trading partner of Sweden, which was mentioned in OECD Statistics Report.

[19] Buch, Carstensen and Schertler (2010), "Macroeconomic Shocks and Banks' Foreign Assets", *Journal of Money, Credit and Banking,* Vol. 42, No. 1 (February 2010)

Hypothesis 3: The stock market of the United States could influence Swedish stock market in a short term period due to the widely usage of information and communication technologies (ICT), which could increase the speed of information spread.

3. Data

Before getting into the methodology and empirical parts, I would like to investigate the general relationship between the United States and Sweden not only through theoretical point of view but also from quantitative aspects. According to the statistics report of Sweden[20], the United States occupies the third largest international trade partner of Sweden, especially in the export aspects. I think the general analysis of the correlation between the two countries will provide a general idea that how the American economy influenced the Swedish economy and how the Swedish economy response to the movements of American policy changes. And it could also give us some basic inspirations of how fast American economy will affect Sweden.

Based on Borys, Horva´th and Franta (2009) and Österholm (2009), I will analyze the relationship between two economies, trying to figure out how American economy influence Swedish economy from general point of view. According to the writing purpose, I will investigate the impacts from three aspects, the living situation, export and import volumes and stock market. Therefore, I would like to include the following data into my thesis, which were the real GDP and annual growth rate of real GDP for each country, consumer price index for each country, unemployment rate for each country, exchange rate for SEK/USD, import and export index and stock market index. I will discuss why I choose these variables and how to use these data to measure both American economy and Swedish economy in the following parts.

3.1 Data types

Before detailed discussing the data I chose, I will generally discuss them. I will use quarterly data to estimate the impacts of American economy on Swedish economy, which will also be input into three standard form vector autoregression models (VAR models). According to the research period, the quarterly data was from the first quarter of 1985 to the fourth quarter of 2009.

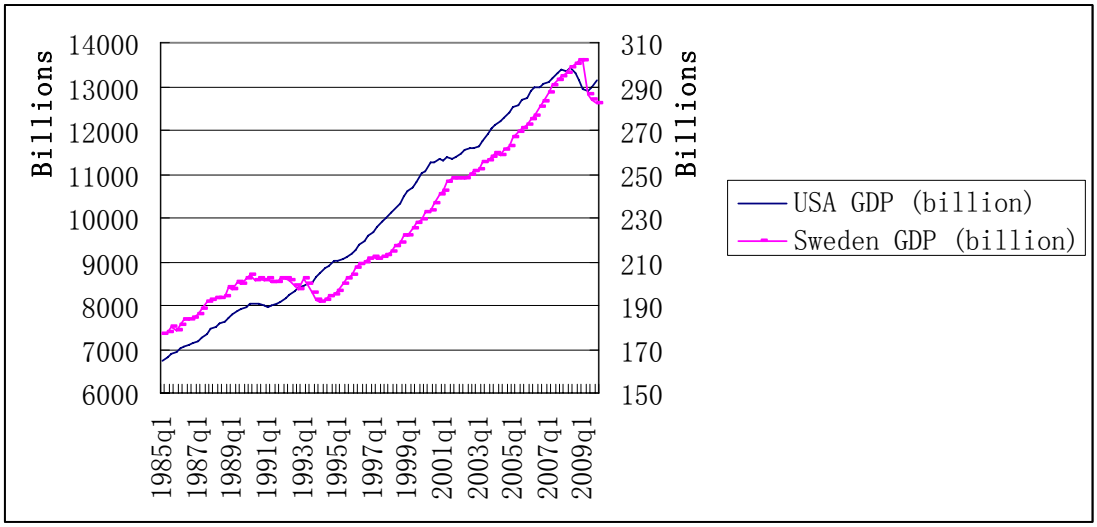
GDP

[20] OECD Stat Extracts, http://stats.oecd.org/index.aspx?queryid=350

The gross domestic product (GDP) is one of the most important factors to measure the overall economic output for one country. The level of GDP could measure the value of goods and services made within one year in the investigated country, providing a direct view for the average level of living standards and general situation of a country[21]. According to the previous researches, I will employ the numbers of real GDP to study the economic situations for the United States and Sweden, instead of looking at the GDP per capita or GDP purchasing power parity.

First of all, I found the quarterly data of real GDP for both the United States and Sweden from 1985 to 2009 from OECD Stat Extract[22], plotting in Figure 1.

Figure 1 Real GDP of the United States (left scale) and Sweden (right scale)



Resource: OECD. Stat Extracts

Generally speaking, the economy of the United States and Sweden kept growing trends from the beginning of 1985 to the end of 2009, which was show in Figure 1. The value of real GDP for the United States was always larger than it for Sweden. The reason was pretty clear that the United States was the most powerful country in the world, and its real GDP also occupied the No. 1 position in the world. Compared with the United States, Sweden is a small country,

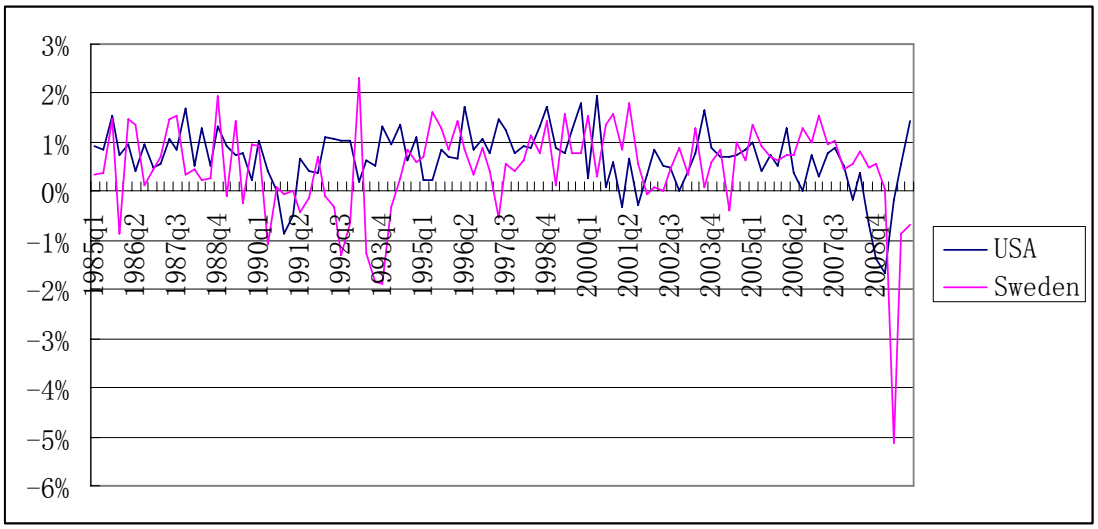
[21] Sullivan, Arthur; Steven M. Sheffrin (1996). *Economics: Principles in action*. Upper Saddle River, New Jersey 074589: Pearson Prentice Hall. pp. 57, 305

[22] OECD. Stat Extracts. http://www.oecd.org/home/0,3305,en_2649_201185_1_1_1_1_1,00.html

and its real GDP is smaller than the United States. Both the Swedish economy and American economy were observed as relative slow increase during the Dot-com bubble, which happened at around 1995 to 2000[23]. In addition, during the period of the most recent financial crisis in 2008, the values of real GDP for both the United States and Sweden suffered a sharp decline. And then, these values were observed a slight recovery from the beginning of 2009.

In the meantime, I found some different trends among these two countries. The most significant difference between Sweden and the United States was that the real GDP for Sweden suffered a relative big decline around 1994, bouncing from the beginning of 1995. And the real GDP kept almost the same pace as American real GDP growth. Besides, I also found that not only among the Dot-com bubble period but also during the most recent period of financial crisis, there seemed a lag between the American economy and Swedish economy, where American economy was ahead to move compared with Swedish economy. In order to obtain a clear sight for these delay between two economies, I decided to calculate the growth rate for real GDP for both the United States and Sweden with using the formula ln(Pt+1/Pt) and plotted the results in Figure 2.

Figure 2 Growth rate of real GDP for the United States and Sweden



[23] James K. Galbraith and Travis Hale (2004). Income Distribution and the Information Technology Bubble. University of Texas Inequality Project Working Paper

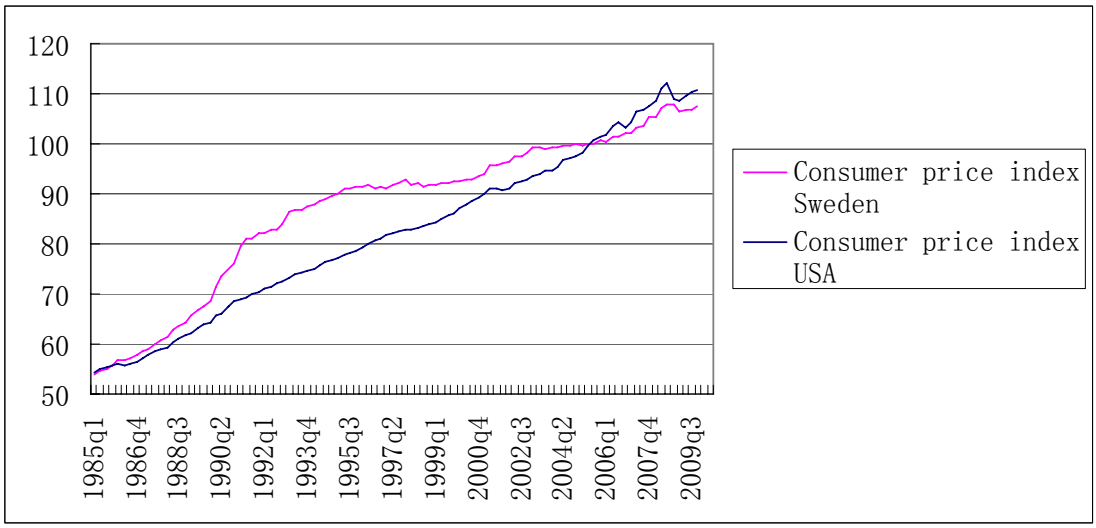
From Figure 2, I found the growth rate of real GDP for the United States was always ahead to the growth rate of GDP for Sweden, which referred to one quarter to a year. For example, during the period of Dot-com bubble, the real GDP of the United States suffered a negative increase rate in the first quarter of 2001, which was -0.33%. While the real GDP for Sweden did not react to this change until the fourth quarter of 2001, which was -0.043%. In addition, the growth rate of Swedish economy always over reacted to the changing of American economy, especially during the period of financial crisis happened in 2008. The growth rate for the United States was -0.678% in the third quarter of 2008, while the growth rate of real GDP for Sweden was -5.137% in the second quarter of 2009. Hence, I do believe that the financial crisis had more influence on Swedish economy than on American economy. And there was some kind of crisis transmission mechanism between these two economies, which first happened in the United States and then transfer to Sweden.

Consumer Price Index

According to Sullivan and Sheffrin (2003), consumer price index is an important factor to measure and estimate the average price of goods and services purchased by households[24]. It could measure the price change in the same country over period, in which the percentage change could show the inflation in one country. Thus, it was one of the most significant statistic data to observe the economic change for one country. I think the consumer price index for both the United States and Sweden could offer me a general idea for the price change in these two countries from the beginning of 1985 to the end of 2009. In order to match the research period, I chose the quarterly data for consumer price index from OECD Statistics, plotting in Figure 3.

[24] Sullivan, Arthur; Steven M. Sheffrin (2003). *Economics: Principles in action*. Upper Saddle River, New Jersey: Pearson Prentice Hall. pp. 339.

Figure 3 Consumer Price Index of the United States and Sweden



Resource: OECD. Stat Extracts

From above chart, I found that the consumer price index for Sweden increased faster before 1992 compared with the rest of time. For the period from 1997 to the end of research period, the consumer price index for Sweden kept a relative stable increase rate. By contrast, the consumer price index for the United States showed stable increase during the research period until 2008, when the financial crisis happened. During the financial crisis, the consumer price for both countries was showed as a decline, where there was a lag for the Swedish index compared with American index.

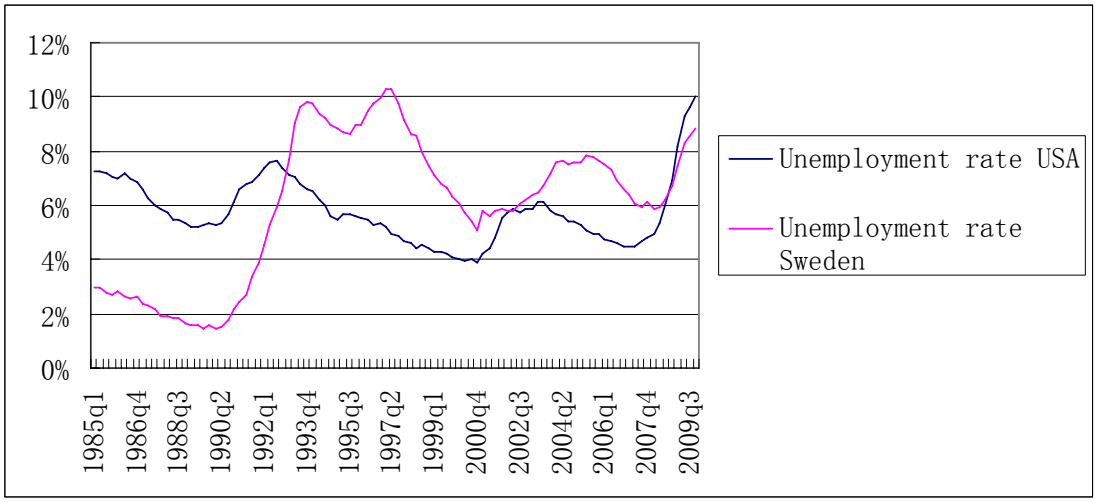
Unemployment rate

According to the International Labour Organization, unemployment rate can be defined as a percentage of unemployed labor force by the total labor force[25]. From my point of view, unemployment rate is an important national indicator for the national economic situation, which has a strong connection with people's living standards. As an increasing unemployment rate could refer to a decreasing level of national economy, it can be employed to express the economic situation of the United States and Sweden in my thesis. In order to

[25] International Labour Organization, Bureau of Statistics, The Thirteenth International Conference of Labour Statisticians, received July 21, 2007

obtain a direct view of the unemployment situation in these two countries, I used the data from OECD Statistics, plotting in Figure 4.

Figure 4 Unemployment rate for the United States and Sweden



Resource: OECD. Stat Extracts

From Figure 4, I found that:

For the Swedish case, the unemployment rate was peaked in year 1997, which was almost 11%. And in 1993, the unemployment rate was also reached at approximately 10%. For the unemployment rate from 2000 to 2997, there was a fluctuation which increased in the first half of period and decreased in the second half of period. From 2008 just after the financial crisis, the unemployment rate grew again, achieved 8.8% in the fourth quarter of 2009.

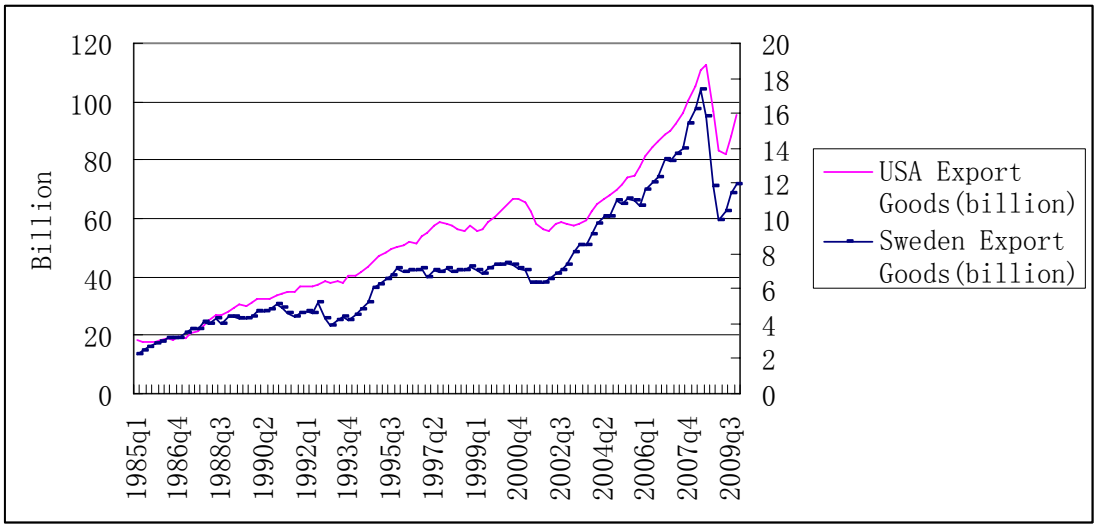
For the American part, the unemployment rate achieved almost 7.6% in the second quarter of 1992, which was the highest value before the financial crisis. However, the unemployment rate increased dramatically, reaching at 10% after the financial crisis happened, which could be concluded as 1/10 of the American labor forces lose their jobs after the financial crisis. For the rest of period, the unemployment rate kept at around 6% even during the period of Dot-com bubble.

Except the period from 1992 to 1997 and after the financial crisis, the unemployment rates for both the United States and Sweden kept the same trends but with 3 to 4 quarters lag. But for the period after the financial crisis, both of them experienced a highly growing of unemployment rate. Besides, from Figure 4, I also found that the Swedish Unemployment rate was relative higher than the American Employment rate, generally. I think the reason inducing to this situation was due to the high level of Swedish social welfare system.

Export and Import Volume

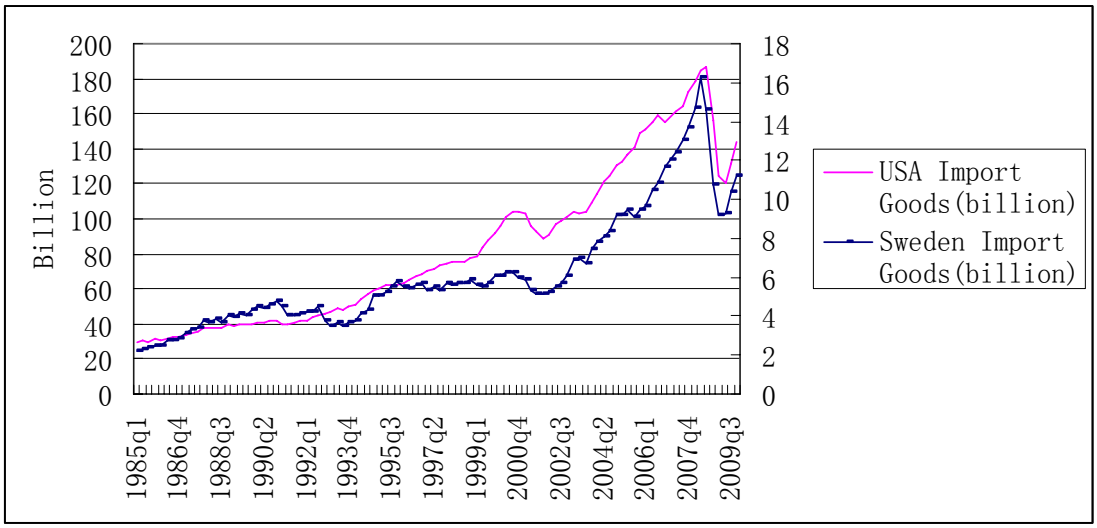
As the United States occupied the third largest international trade partner of Sweden I mentioned above, I do believe the investigation of export and import volumes for both two countries will fully show the relationship and connection between them.

Figure 5 Export Volumes for the United States (left scale) and Sweden (right scale)



Resource: OECD. Stat Extracts & BEA (Bureau of Economic Analysis, U.S. Department of Commerce)

Figure 6 Import Volumes for the United States (left scale) and Sweden (right scale)



Resource: OECD. Stat Extracts & BEA (Bureau of Economic Analysis, U.S. Department of Commerce)

From Figure 5 and Figure 6, I found both the export and import volumes for the United States and Sweden:

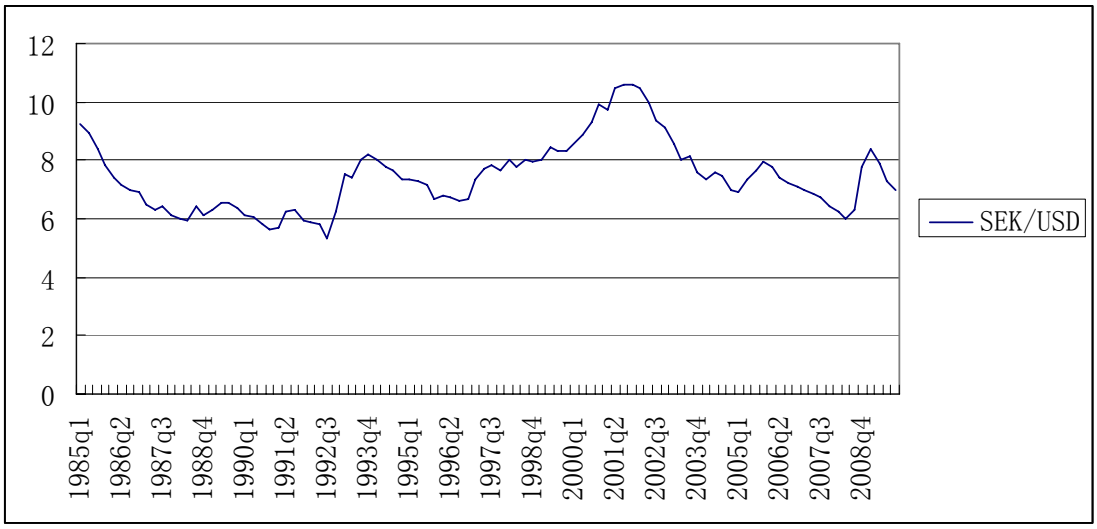
For Swedish export volume, it kept a trend of growing from the beginning of the research period and peaked at 17 billion US dollars in the second quarter of 2008, which was suddenly decline and recovery in the second quarter of 2009. And American export volume had the same trend as the Swedish one, which peaked at 112 billion US dollars in the third quarter of 2008 and decreased sharply to 82 billion until the second quarter of 2009. Then, it bounced to 95 billion US dollars in the fourth quarter of 2009. From these analyses, I concluded that the financial crisis had a strong impact on export volume for both the United States and Sweden.

For the import volume, it had the same tendency as the export volume. Swedish import volume had a growing tendency and peaked at 16 billion US dollars in the second quarter of 2008. And it was observed as a quick decrease after the financial crisis. The American import volume had the same tendency as its export volume. The export and import volume for both countries had highly correlations, which was showed in the above two charts. Therefore, I can conclude that the economies for both Sweden and the United States had highly relations.

Exchange rate

As exchange rate is another important factor that influences the total level of economy, I would like also to investigate the exchange rate between Swedish currency and American currency, which were Swedish kronor (SEK) and US dollar (USD). According to Arthur and Sheffrin (2003), the level of exchange rate could fluctuate along to the GDP, employment situation and business activities in one country. Thus, increasing level of unemployment could devalue the domestic currency. Relatively, foreign currency would increase its value[26].

Figure 7 Exchange rate SEK/USD



Resource: OECD. Stat Extracts

From Figure 7, I found that during the tough period such as the period of Dot-com bubble, and financial crisis, the exchange rate would increase, which means the US dollar becoming valuable during the decline of economy in Sweden. For example, SEK/USD was almost 10.6 SEK=1 USD in the fourth quarter of 2001, which was just during the period of Dot-com bubble. Again, 1 US dollar was equal to approximately 8.4 SEK in the first quarter of 2009. Hence, the exchange rate was an important indicator in my paper, which could reveal the relationship between these two economies.

[26] O'Sullivan, Arthur; Steven M. Sheffrin (2003), *Economics: Principles in action*. Upper Saddle River, New Jersey 07458: Pearson Prentice Hall. pp. 458

Stock Market Index

In this part, I would like to investigate the general economy situation for both the United States and Sweden through not only the GDP level but also through the level of stock market index. According to Amenc, Goltz and Sourd (2006), stock market index is another parameter to observe the situation of economy for a country[27]. And they also pointed out that the stock market index would faster react to big shock or disturbs than the value of GDP. Based on above reasons, I decided to choose S&P 500 and OMX SPI to represent the stock market indices for the United States and Sweden respectively.

The reason that I chose S&P 500 rather than other indices, such as NASDAQ and Dow Jones, since the S&P 500 contained the most widely industries compared with other stock market indices. It included such as mutual funds, pension funds to manufacturing industry, financial industry IT and so on. Compared with other stock indices, S&P 500 could represent and reflect the economy of the United States more precisely, although the stock price like Dow Jones contained more companies.

OMX SPI was original from Stockholm Stock Exchange (Stockholmsbörsen), which was acquired by OMX in 1998. OMX SPI contained 310 companies till the second quarter of 2004 and its market capitalization was SEK 2.521 trillion[28]. According to OMX SPI official website[29], most of the Swedish famous companies were listed in this stock market index, which could indicate the general situation of Swedish stock market.

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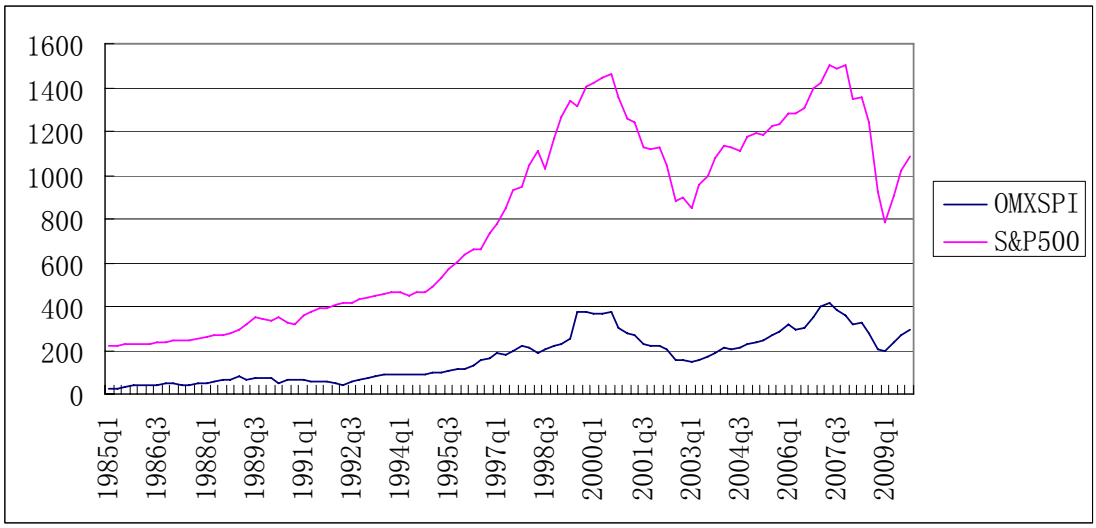
[27] Amenc, N., F. Goltz, and V. Le Sourd, 2006, "Assessing the Quality of Stock Market Indices", EDHEC Publication

[28] Bernhardsson, Jonas (2002) *Tradingguiden*: Bokförlaget Fischer & Co.

[29] NASDOQ OMX Official website:
http://www.nasdaqomxnordic.com/aktier/shareinformation?Instrument=SSESE0000744195

Figure 8 Stock Market Index for the United States and Sweden (S&P 500 & OMX SPI)



Resource: NASDAQ OMX

http://www.nasdaqomxnordic.com/indexes/historical_prices/?Instrument=SE0000744195

In Figure 8, I plotted the stock market indices for both the United States and Sweden. And I found that the stock market index for Sweden and the United States could be observed as the same trends during the research period, only different in the values. The trends from the beginning of 1985 were showed as constant boosting till year 1995. From 1995 to 2000, stock market index for Sweden and the United States experienced high growth rate, where the average quarterly growth rates were 7% and 5.5%[30] for Swedish and American stock market index respectively. However, both of them suffered dramatic decline in the beginning of 2000, because of the Dot-com bubble effects. According to the official website of S&P 500, the index lose approximately half after peaking at 1552.87 on March 24th, 2000 and the whole stock market was suffered the bear market in the following two years, where the index reached at 768.63 on October 10th, 2002[31]. The same situation also happened on OMX SPI stock market index, which could be observed from Figure 3 as a huge loss with concave curve from 2000 to 2007. During the most recent financial crisis, both S&P 500 and OMX SPI suffered huge decline, and it seemed no lag between these two indices. The reason for less

[30] Official webpage of Finanznachrichten:
http://www.finanznachrichten.de/nachrichten-2008-11/12444730-s-p-500-actual-volatility-at-highest-since-1929-020.htm
[31] Sommer, Jeff (2008-11-23), "A Friday Rally Can't Save the Week". The New York Times

lag-effect might due to the highly development of IT technology, which reduced the time consuming for information transmission between countries.

To sum up, these data could help me to better understand the relationship between the two economies, which would provide some useful information for the empirical part and results explanations. Besides, above data partly proved my hypothesis that there was a dynamic mechanism between two economies, which could be observed from the movements of these data. And these was a lag between American economy and Swedish economy, where generally the changing of Swedish economy was one quarter to three or four quarters later than the economy changing of the United States. It indicated that the Swedish economy needed a period of time to respond to the changes of the most influential country.

3.2 Data sort and transformation

Based on the writing aims, I will estimate the impacts of American economy on Swedish economy with using three standard form VAR models. As I have mentioned that it was difficult to include all variables into one regression, I sorted the data into three groups in order to match three standard form VAR models, where I would like to study the situation of Swedish economy from living and working environment, trading volumes and stock market respectively. As the standard form VAR model had some requirements and limitations, I will also introduce how to transform the data in order to make them satisfy the conditions.

The first model

In order to test the effects of American economy on Swedish living standards, I will include the following data into the first standard form VAR model, which are the real GDP of the United States, real GDP of Sweden, Consumer price index of Sweden and Swedish unemployment rate. As it was mentioned in Mattesini and Quintieri (1997), all these data could be considered as national indicators to measure the general level of people's living standards and working situation. Besides, the consumer price index had negative relationship with the unemployment rate, as it was tested in the same article. Thus, I would like to include these data into my first standard form VAR model.

According to Sims (1980), all data in the standard form VAR model should be stationary. However, all the data in the first VAR model showed obvious trends, which could be observed from the data part. Thus, in order to make the data becoming stationary, I used the first-log difference to remove the trends for all the series, where I tested the treated data with using Unit Root test. During the test, GDPUS and GDPSWE represented the first-log difference of real GDP for both the United States and Sweden, Consumer SWE represented the first-log difference of Swedish consumer price index and UnemploySWE was the first-log difference of Swedish unemployment rate. The results for the Unit Root test were showed in Table 1.

Table 1 T-statistics for Unit Root test (First VAR model)

		t-Statistic (critical values)	t-Statistic (I obtained)
GDP US			
	1% level	-3.498439	-3.980478
	5% level	-2.891234	
	10% level	-2.582678	
GDP SWE			
	1% level	-3.497727	-7.351494
	5% level	-2.890926	
	10% level	-2.582514	
Consumer SWE			
	1% level	-3.498439	-4.035198
	5% level	-2.891234	
	10% level	-2.582678	
Unemployment rate			
	1% level	-3.497727	-3.717883
	5% level	-2.890926	
	10% level	-2.582514	

From Table 1, it was showed that the values of t-statistic I obtained were all higher than then the critical values of t-statistic at 1%, 5% and 10% level, which means all the value of t-statistic I obtained were significant. Since according to the Dickey-Fuller test, for example, the critical value for t-statistics for American GDP should less than -3.4984, -2.891234 and -2.582678 at 1%, 5% and 10% level respectively[32]. The value of t-statistic I got was equal to -3.980478, which was less than the critical value at 1% level. I could conclude the data for American GDP was stationary after first-log difference. Hence, based on these results, all these series of data were stationary after using the first-log difference, and I could reject the null hypothesis of existing unit root in these series. Thus, for the first standard form VAR model, Y_t = [GDPUS, GDPSWE, ConsumerSWE and UnemploySWE].

The second VAR model

Based on the writing purpose, I will estimate the influence of American economy on Swedish economy from international trading aspect in the second standard form VAR model. In order to test the impacts on Swedish trading volume, both from export and import aspects, and followed with Burak, İsmail and Cem (2008), I will build the standard form VAR model with including the following data: the real GDP of the United States, real GDP of Sweden, Exchange rate between Swedish kronor and US dollar, the export and import volume of Sweden and the United States.

As I have discussed in the first model, the data imputing into the standard form VAR model should be stationary. But as it was showed in the previous part, all of them were observed with clear trends. Therefore, I still used first-log difference in order to remove the trends, transforming them into stationary. To test whether these data contained unit root, I still employed the Unit Root test, where Exchange represented the Exchange rate between SEK and USD, ImportSWE and ImportUS stood for the import volumes of Sweden and the United States and ExportSWE and ExportUS were Swedish and American export volumes. With using the Unit Root test, I obtained the results, which were showed in Table 2.

[32] Dickey, D.A. and W.A. Fuller (1979), "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association*, 74, p. 427–431.

Table 2 t-statistics of Unit Root test (Second VAR model)

		t-Statistic (critical values)	t-Statistic (I obtained)
GDP US			
	1% level	-3.498439	-3.980478
	5% level	-2.891234	
	10% level	-2.582678	
GDP SWE			
	1% level	-3.497727	-7.351494
	5% level	-2.890926	
	10% level	-2.582514	
Exchange rate			
	1% level	-3.497727	-7.056789
	5% level	-2.890926	
	10% level	-2.582514	
Export SWE			
	1% level	-3.497727	-7.935821
	5% level	-2.890926	
	10% level	-2.582514	
Import SWE			
	1% level	-3.497727	-7.433248
	5% level	-2.890926	
	10% level	-2.582514	
Export US			
	1% level	-3.497727	-6.227929
	5% level	-2.890926	
	10% level	-2.582514	
Import US			
	1% level	-3.498439	-6.376008
	5% level	-2.891234	
	10% level	-2.582678	

As I have mentioned the critical values of Unit Root test, the t-statistics for all these data were significant at all three levels, indicating they became stationary after using first-log difference. So, these data could be input into the standard form VAR model as endogenous variables. Thus, Y_t for the second standard form VAR model would be Y_t = [GDPUS, GDPSWE, Exchange, ExportSWE, ImportSWE, ExportUS and ImportUS].

The last VAR model

The third standard form VAR model will be used to estimate the impacts of American economy on Swedish financial markets, especially for Swedish stock market. In order to quantitative analysis the impacts of American economy and stock market on Swedish financial and stock market, I will build the standard form VAR model by including the following data: real GDP of both the United States and Sweden, OMX SPI as the Swedish stock market index and S&P 500 as the stock index of United States.

Again, as these data was not stationary by observation, I tried to use the first-log difference to remove the trends of these data before imputing them into the third standard form VAR model. During the Unit Root test, OMX stood for Swedish stock market index OMX SPI, and SP500 represented the S&P 500 stock market index in the United States. The t-statistics for the Unit Root test were showed in Table 3.

Table 3 t-statistics of Unit Root test (Third VAR model)

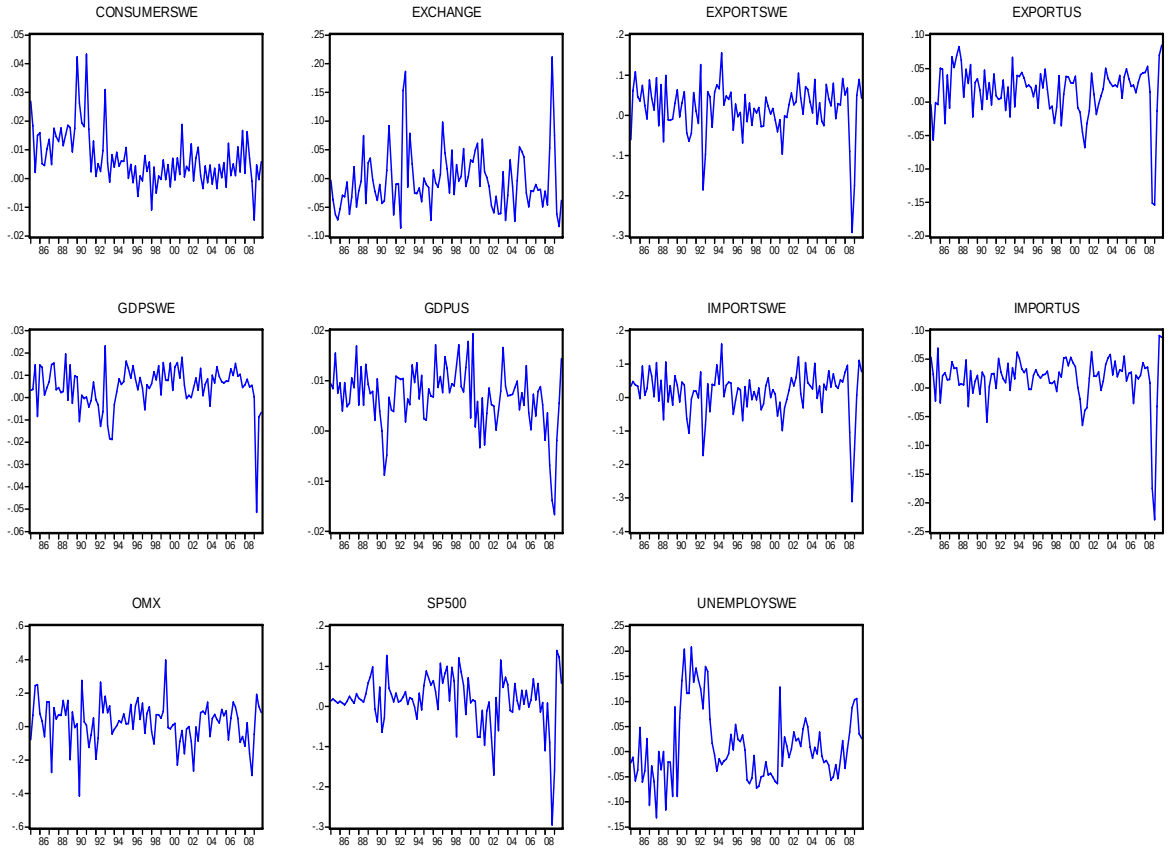
		t-Statistic (critical values)	t-Statistic (I obtained)
GDP US			
	1% level	-3.49844	-3.98048
	5% level	-2.89123	
	10% level	-2.58268	
GDP SWE			
	1% level	-3.49773	-7.35149
	5% level	-2.89093	
	10% level	-2.58251	
OMX			
	1% level	-3.49773	-8.9092
	5% level	-2.89093	
	10% level	-2.58251	
S&P500			
	1% level	-3.49773	-6.94245
	5% level	-2.89093	
	10% level	-2.58251	

Based on the critical values of Unit Root test, all these series became stationary after using first-log difference, where the t-statistics were showed as significant at 1%, 5% and 10% level.

Therefore, the endogenous variables for the third standard form VAR model would be Y_t = [GDPUS, GDPSWE, OMX and SP500].

Until now, I obtained all data that I would need in these three standard form VAR models. And all these data were statistically stationary, which satisfied the requirements and conditions of standard form VAR model. I plotted all these nine groups of data in Figure 9. From Figure 9, I conclude that all these data were stationary.

Figure 9 all data will be employed in three standard form VAR models



4. Methodology

According to the writing purpose, I will estimate the total impacts of American economy on Swedish economy by running three standard form vector autoregression models (VAR models). The first standard form VAR model will estimate how the economy of the United States influenced Swedish economy from living standard aspect, including the price of goods and working opportunity. And the second VAR model will test the impacts of American economy on Swedish economy from international trading aspects, including export and import volume. For the last standard form VAR model, I would like to test the effects of American financial market on Swedish financial market with focusing on the changing of stock market. In this part, I will first describe the standard form VAR models I will employ in my investigation. And then, I will discuss the advantages and disadvantages of VAR model, pointing out the issues of estimating impacts with VAR models. In addition, I will highlight the method of how to decide the perfect lag for the standard form VAR model.

4.1 VAR model description

As I have discussed previously, all variables in the VAR model could be considered as endogenous variables. As it was advocated by Sims (1980), the standard form VAR model was a theory-free model within estimating economic relationships for various factors[33]. Hence, VAR model is a model that contains endogenous variables and the results have strong relationships with the variables themselves and their lag(s).

In my thesis, I will employ three standard form VAR models to estimate the impacts of American economy on Swedish economy, which was mainly following with Buckle, Kim, Kirkham, McLellan and Sharma (2002) and Borys, Horva´th and Franta (2009). According to Sims (1980), the standard form VAR model can be showed as:

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + \varepsilon_t$$

Where: C is a k *1 vector of intercepts

A_p is a k * k matrix

[33] Christopher A. Sims, 1980, "Macroeconomics and Reality", Econometrica 48

Y_t is a group of variables

ε_t is the error terms which is a k * 1 vector

p is the lag length for the endogenous variables

According to the definition of VAR model, the error term should satisfy the following three conditions, which were

1. $E(\varepsilon_t) = 0$, which means each error term should has a zero mean.
2. $E(\varepsilon_t \varepsilon_t') = \Omega$, which means the contemporaneous covariance matrix of the error term is a k*k positive matrix.
3. $E(\varepsilon_t \varepsilon_{t-k}') = 0$, which refers the correlation between different error term should be equal to zero, when t is not equal to k.

4.2 Advantages and disadvantages of VAR model

In this part, I would like to simply introduce the vector autoregression model (VAR model). Vector autoregression model (VAR model) was first introduced by Sims (1980), a system regression model, which could contain more than one dependent variable in one regression. VAR model is always used when facing large scale of simultaneous equations. In addition, VAR model can also be used when some of the variables containing lag(s). According to Brooks (2002), VAR model has some advantages and disadvantage during the usage of estimation.[34] From my point of view, the most significant advantage for VAR model is that there is no special need to identify the endogenous variables from exogenous variables, since all variables in the VAR model can be considered as endogenous variables. Hence, VAR model can be considered as a special form autoregression model (AR model). Compared with AR model, VAR model is more flexible to estimate the total effects of changing economic atmosphere. However, VAR model also contains some shortages. And I think the most difficult part is how to identify which variables should be included in the VAR model and how to decide the optimal lag-length for the decided variables.

[34] Chris Brooks (2002), "Introductory Econometrics for Finance", the Press Syndicate of the University of Cambridge, p332

4.3 Lag length for standard form VAR model

During the process of estimating the impacts of American economy on Swedish economy by using standard form vector autoregression model (standard form VAR model), another important issue is how to choose the optimal lag length for the VAR model. According to Brooks (2002), there were two different methods to choose the optimal lag length for the standard form VAR model, the first one was cross-equation restrictions, and the second method was information criteria[35].

For the cross-equation restrictions method, it can use the likelihood ratio test for testing the optimal lag length, which can be considered as a joint test. More information for likelihood ratio test will be showed in Appendix 1. However, based on the discussion and analysis of Brooks (2002), likelihood ratio test had some limitations when estimating the optimal lag length for standard form VAR model. The most significant disadvantage for the likelihood ratio test was the VAR model should be made as pairwise. It means that these two standard form VAR model could be compared with each other. And as likelihood ratio test is a joint test, it could only generate the results when these two models had the same lag length. Otherwise, there would be no information can be collected from the likelihood ratio test. Another considerable disadvantage for the likelihood ratio test was that the error term for each equation was under the assumption of normal distribution. It means that the likelihood ratio test only valid when its error term is normal distributed, which is not held by the financial data. Therefore, I would like to use the second method to decide the optimal lag length for the standard form VAR model, which was the information criterion.

For the information criteria method, there was no such kind of requirement of normal distribution concerning to the error term. And it also can be used to test the financial data without other restrictions, according to Brooks (2002). But it preferred that all variables in one equation should have the same lag length, which also can be considered as a limitation for the method of information criteria. Thus, the information criteria will transform into multivariate version when estimating the VAR model, which was called MAIC. Based on the

[35] Chris Brooks (2002), "Introductory Econometrics for Finance", the Press Syndicate of the University of Cambridge, p334

definition of multivariate version of information criteria, it can be calculated by using the following formula.

$$MAIC = \log|\hat{\Sigma}| + 2k'/T$$

Where: $\hat{\Sigma}$ is the variance-covariance matrix of the residuals

T stands for the number of observations

k' represents the total number of regressors in all equations

The process of using multivariate version of information criteria was that: in the first step, I will calculate MAIC from lag 1 to lag 8, recording in one table for further comparison. And then, choosing the smallest value of MAIC according to the definition of multivariate version of information criteria, where lag length will be used as the lag length of standard form VAR model in the estimation process.

Hence, I calculated the values of MAIC for the above three standard form VAR model, which were discussed above. And I recorded the results for the MAIC for three different models in Table 4.

Table 4 MAIC values for three standard form VAR models

Lag	VAR (Swedish Living Standards)	VAR (Swedish Trading)	VAR (Swedish Stock Market)
0	-22.98155	-34.314	-18.00701
1	-23.80167	**-35.02501***	-18.36685
2	**-24.19904***	-35.0081	**-18.41561***
3	-24.06568	-34.5633	-18.27086
4	-24.17043	-34.5302	-18.07657
5	-24.04076	-34.7025	-18.00737
6	-23.81598	-34.6052	-17.80756
7	-23.61899	-34.3562	-17.64498
8	-23.92645	-34.6257	-17.42556

Note: the "*" showed the smallest value of MAIC from lag 1 to lag 8.

As it was showed in Table 4, the values of MAIC for three different models were smallest at lag 2, which were -24.19904, -35.02501 and -18.41561 respectively. Thus, the optimal lag length for the first and third standard form VAR models were two and the optimal lag length for the second standard form VAR model was one, which indicated that I would use VAR (2) to estimate the impacts of American economy on Swedish living standards and stock market and use VAR (1) to estimate the impacts on Swedish trading volume.

To explain VAR (2), the value in the parentheses was the optimal lag length for all variables in the same model, which indicated the final result had relationship with not only all the variables themselves, but also with the lag one and lag two of these variables. As I have mentioned above, with using the multivariate version of information criteria, all endogenous variables in the standard form VAR model should have the same lag length. For the same reason, the final result of VAR (1) was correlated with all variables and their first lag.

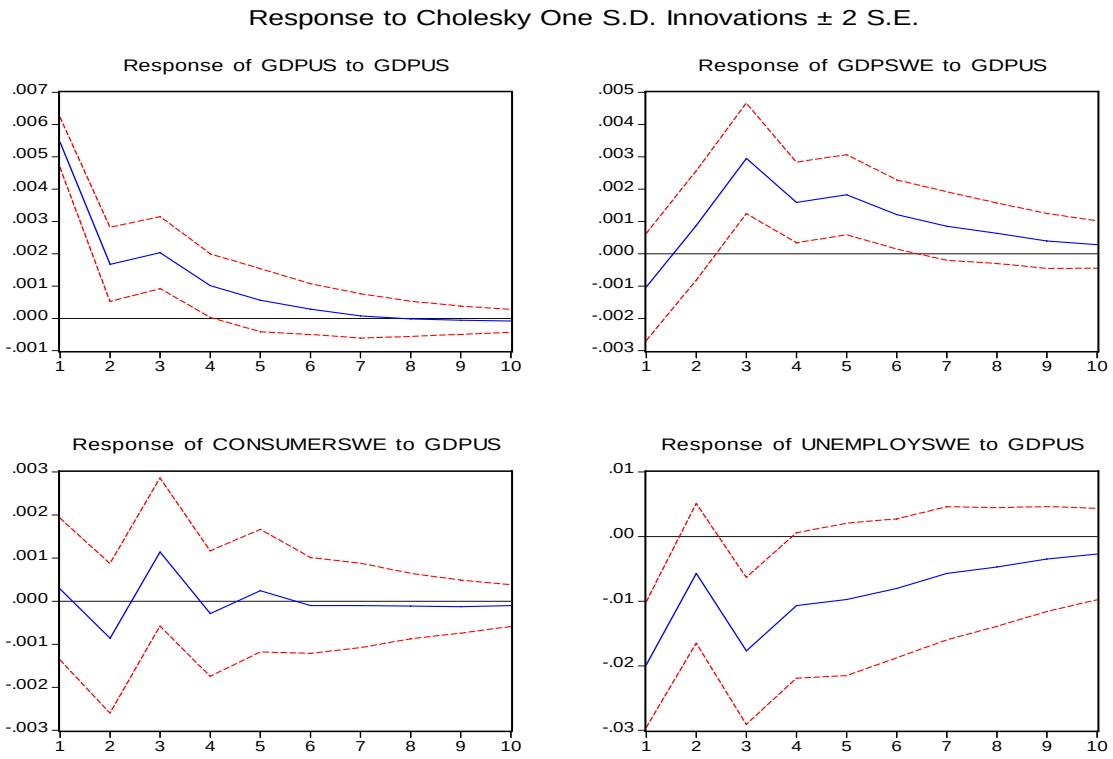
5. Results and discussion

In this section, I would like to discuss the impacts of American economy on Swedish economy from three aspects, Swedish living standards, stock market and trading volume. As I have analyzed and discussed above, I employed VAR (2) to test the impacts of the first two aspects and VAR (1) for the trading aspects.

5.1 The first standard form VAR model

The first standard form VAR model was to test the impacts of American economy changing on Swedish living standards, which could be observed clearly through the changing of Swedish GDP, consumer price index and unemployment rate. The results of the first standard form VAR model were showed in Appendix 2. In the first VAR model, the observations were 98 after adjusted by the software, which were from the third quarter of 1985 to the end of 2009. As the standard form VAR model was good at estimating the impacts on other variables if one variable changing. In order to quantify the impacts, impulse response function would be employed in this paper. During the process of impulse response estimation, I chose American GDP as the changing variable, which was the impulse in the test. And I decided to observe how all variables including the GDP of the United States itself to response to the impulse of the changing of American GDP. The observed period was set by 10 periods. And the results of the impulse response function were showed in Figure 10 as graph lines, where the full line referred to the response to the impulse and the dot line was the confidence interval equaling to the innovation plus or minus two standard errors.

Figure 10



From Figure 10, I found that the GDP of the United States fell sharply from 0.05% to 0.02% for the log value of real value of American GDP in the second period when American encountering big shock and the period referring to one quarter in my paper. From the second period to the third period, the GDP level kept stable. From the third quarter of a big shock, the GDP of the United States began to decrease again. The impacts of the shock disappeared after 7 periods, which referred to seven quarters.

For Swedish GDP level, there was an increase from the first period to the third period after a big shock happened in the United States. And after that, the GDP of Sweden began to fall down. Compared with the movements of American GDP, Swedish GDP had a similar change from the third quarter to the end of observed period. Based on these changing and similar movements, I concluded that the GDP of Sweden was two quarters lag-behind the changing of American GDP changing. In another word, the reacting period for Swedish GDP to a big shock happened in the United States would be two quarters. This result also indicated that

Swedish economy had a strong relationship with American economy, which could be observed through the changes of GDP for two countries.

For the consumer price index of Sweden, it decreased from period one to period 2. But it increased dramatically between period two and three and then it became stable. It indicated that the price level for Sweden reacted to a shock happened in the United States 2 quarters later, showed as increasing level of price. However, as the impact on consumer price index was measured around 0value, I could not conclude that American economy had a impact on Swedish good prices. I thought it might due to the following two reasons: In one hand, as the country like Sweden, it used constant utility index to calculate the consumer price index, which was not followed with pragmatic methods[36]. In the other hand, Swedish government used invisible hand to adjust the consumer price index in order to stabilize the society as a whole and prevent inflation, which was also mentioned in macro economy theories. Thus, I thought it was an important reason for the Swedish consumer price index to become stable soon after the changing of American economy.

For the unemployment rate of Sweden, it peaked in period two and then fell to the bottom in period three. From period, it bounced up and grew gradually till the end of the observed period. Compared to Swedish real GDP movement, I found that the changes of consumer price index and unemployment rate of Sweden showed opposite movements during the observed periods, which could be explained by the supply-demand theory. When the unemployment rate increased and lacking of living expense, the total needs for goods would decline, inducing a decreasing level of price.

To conclude the first standard form VAR model, the indicators of Swedish economy responded two quarters later after a shock of American economy happened. The unemployment rate of Sweden reacted to the changing of American economy longer than other indicators, which might due to the high level of Swedish welfare and social security system. The results of the first model proved the first hypothesis that Swedish economy needed at least one quarter to react to the changes of American economy. And the

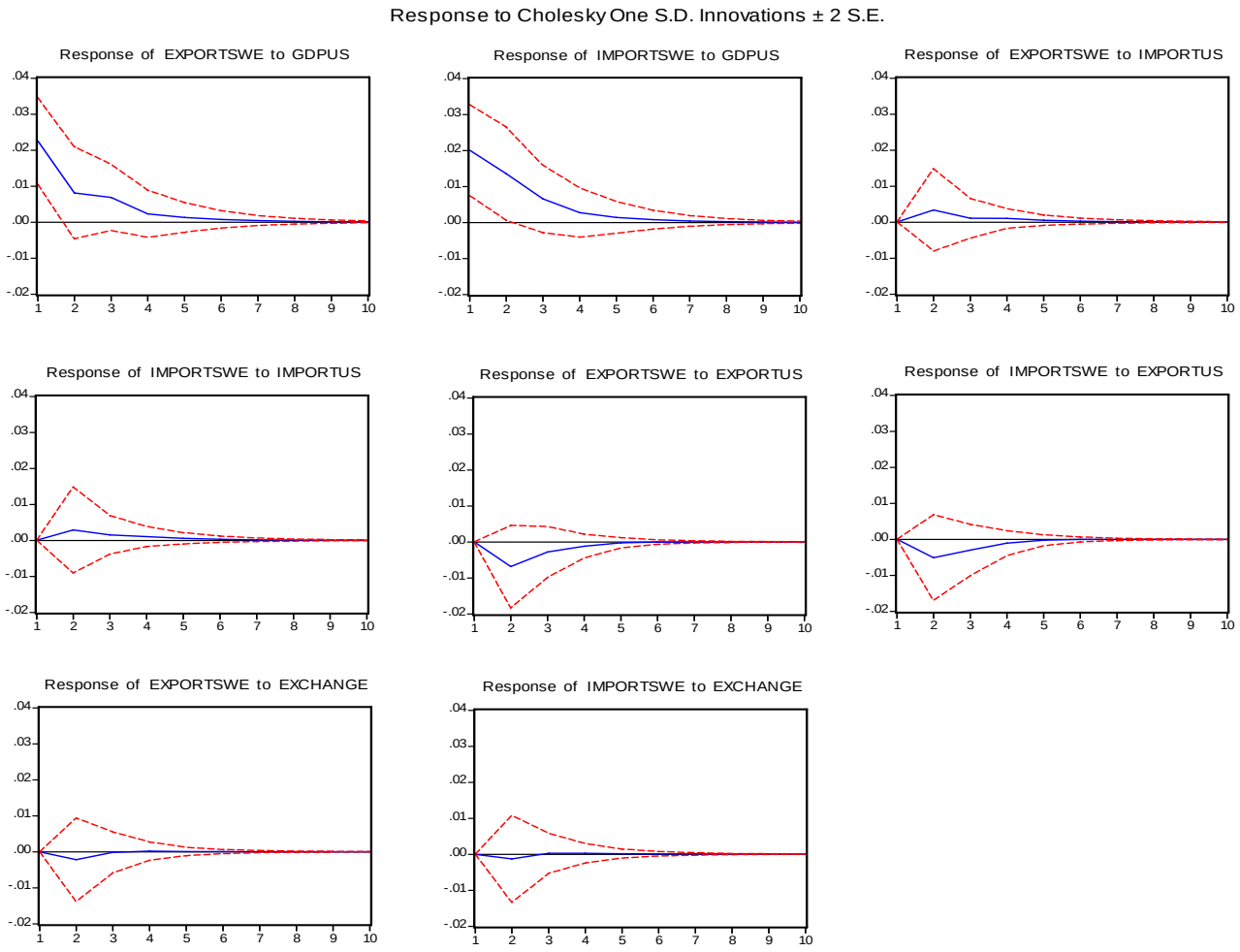
[36] Sullivan, Arthur; Steven M. Sheffrin (2003), *Economics: Principles in action*. Upper Saddle River, New Jersey: Pearson Prentice Hall. pp. 339

unemployment rate and the real GDP change showed opposite relationship, indicating decreasing level of GDP and increasing level of unemployment rate.

5.2 The Second standard form VAR model

In the second standard form VAR model, I would like to estimate the impacts of American economy on Swedish economy from trading aspects. As I discussed above, the United States is the third largest trade partner of Sweden. Hence, the export and import volumes of the United States could also influence Swedish export and import volumes. Besides, the level of exchange rate also played an important role during the trading activities. In order to estimate the impacts on Swedish trading volumes, I employed VAR (1) model. The adjusted samples were from the second quarter of 1985 to the end of 2009, which contained 99 observations. The results for the VAR (1) were showed in Appendix 3. To identify the impacts of American economy on Swedish economy from trading aspects, I also employed impulse response function, where I set GDP of the United States, export and import volumes of the United States and exchange rate as the impulses to test the response of Swedish export and import volumes. The observed period was still set as 10 periods. The results for impulse response function were plotted in Figure 11.

Figure 11



In the first place, I would like to investigate the impacts of American GDP on the export and import volumes of Sweden. From above chart, I found that both export and import volumes were decline during the observed periods. And there were no significant lag among the reaction activities, which indicated that the export and import volumes reacted quickly after a shock happened in the United States. And the impacts of the shock were graduated away in the following six quarters.

Secondly, I would like to study how the changing of American import and export volumes influenced both Swedish export and import volumes. For the impacts of American import volume, both import and export volumes for Sweden peaked in the end of second observed period and fell in the following observed periods, based on above chart. And from above curves, both export and import volume of Sweden increased after a shock happened in the

United States. But the quantity of the increasing levels were slightly, which might due to the quantity of trading between the United States and Sweden. Although the United States was the third trading partner to Sweden, the absolute value for the trading volumes for Sweden was far smaller than it for the United States, which could explain the small quantity change of the trading volumes. In addition, for the impacts of American export volume, both import and export volumes of Sweden were decline in the second observed period and recovery to zero. It indicated that the trading volume would fall down if there were a shock happened in the United States. For the export volume of Sweden, the increasing level of American export volume could negatively influence the export volume of Sweden, as Sweden and the United States were competitors in the world trading system.

The last but not the least, I would like to analyze the impacts of exchange rate on Swedish trading volumes. From above chart, both of the import and export volumes were slightly decline after the changing of exchange rate between Swedish Kronor and US dollar. As both Swedish and American currencies are free floating, the exchange rate between them could be changed due to the force of supply and demand[37]. And base on the quantitative analysis showed in the above graph, the exchange rate between these two currencies had slightly impacts on the import and export volumes.

All in all, American import and export volumes had relative strong impacts on the trading volumes of Sweden. The trading volumes of Sweden responded to the shock happened in the United States one period later, which indicated one quarter. The exchange rate played less important role than I expected, which was tested by Figure 11.

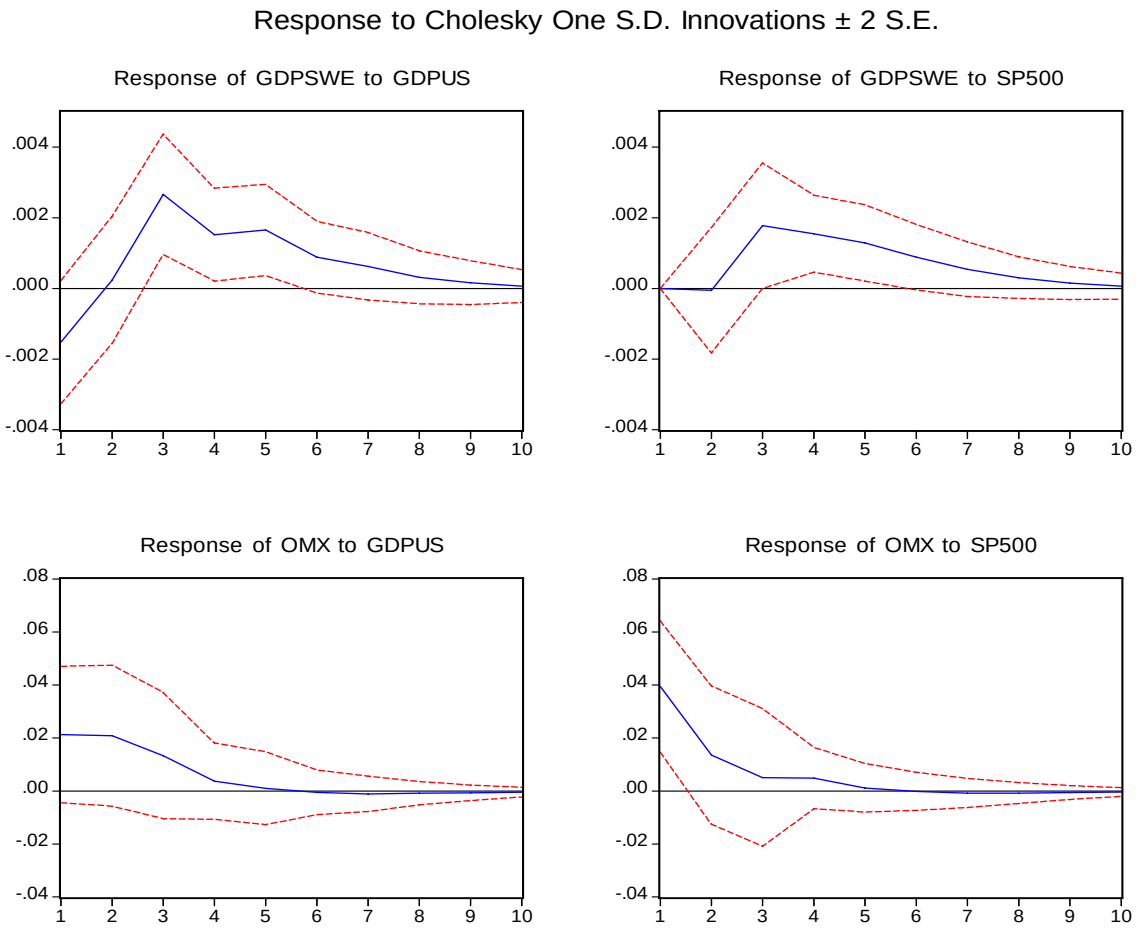
5.3 The third standard form VAR model

According to the writing purpose of this paper, I would like to investigate the impacts of American economy on Swedish economy from stock market aspect with using standard form VAR model. Based on the multivariate version of information criteria, VAR (2) were employed to test the effects of American stock market on Swedish stock market. Before estimation, I expected there was no lag between Swedish and American stock market index,

[37] O'Sullivan, Arthur; Steven M. Sheffrin (2003), *Economics: Principles in action*. Upper Saddle River, New Jersey 07458: Pearson Prentice Hall. pp. 458

since high-tech information and communication technologies (ICT) were widely used worldwide, especially in the financial and communication markets. Thus, the hypothesis for this estimation would be the stock market index of Sweden would respond quickly after a shock happened in the United States. The adjust sample in this estimation was from the third quarter of 1985 to the end of 2009, which contained 98 observations and could fully explained the market activities between these two markets. The results for this standard form VAR model were showed in Appendix 4. In order to observe the impacts of American stock market on Swedish stock market, I still employed impulse response function. In this function, I set GDP of the United States and S&P 500 index as the impulse, while the GDP of Sweden and OMX SPI were the observed indicators in the test. The results of impulse response function were plotted in Figure 12.

Figure 12



The above chart showed the results of how the GDP of Sweden and Swedish stock index reacted to the changing of American GDP and stock market. And I would like to further discuss the impacts for the two impulses, American GDP and S&P 500 index.

Firstly, I would like to analyze the impacts of American GDP changing on Swedish GDP. From Figure 12, it was clear that Swedish GDP peaked in the third period after a shock happened in the United States. And then, it fell down gradually during the following observed periods. The whole curve showed the same result as the first standard form VAR model regarding the mechanism between American GDP and Swedish GDP, which could be considered as a re-confirmation for this relationship with different variables in the model. It indicated a significant 2-quarter lag among them, which also be proved in the first test.

Secondly, I wanted to study the impacts of American GDP on Swedish stock market index OMX SPI. Based on above chart, I found there was one quarter lag between American GDP changing and Swedish stock market index, which indicated that the reaction speed for Swedish stock market was quicker than the reaction speed for GDP. The impact of American GDP decreased in the following observed periods and disappeared in the fifth observed period, which means the impacts of a shock happened in the United States would disappear after 5 quarters.

In addition, I would like to analyze the impacts of American stock market index S&P 500 on both Swedish GDP and stock market index OMX SPI. For the GDP of Sweden, it peaked in the third period of the shock happened and fell down in the rest of the observed periods. It was clear that there was a three quarters lag between the GDP of Sweden and changing of American stock market index, which indicated Swedish GDP needed three quarters to react if there was a shock happened in the United States. However, for Swedish stock market index OMX SPI, there was only one period lag after a shock happened in the United States. It indicated that Swedish stock market index needed one quarter to respond the changing of American stock market index.

Compared to the reaction speed of Swedish GDP, I found Swedish stock price index OMX SPI had faster response to the changing of American economy. Rhode and Toniolo (2006) argued that the third industrial revolution played an important role during the development of world economy, which could be recognized as the development of information and

communication technologies (ICT)[38]. As ICT first developed in the most advanced countries, such as the United States and West European countries, it widely influenced almost all industries, especially in the financial and technology industries, accelerating the speed of information transmission among countries. I thought that was a reason that why Swedish stock market index had a faster response to the shifting of American GDP and stock market index.

To sum up, Swedish stock market index OMX SPI had a faster reaction than its GDP to a shock happened in the United States, not only to the level of American GDP changing but also within its stock market index shifting. I believed that the widely usage of computers and IT technologies was the main reason for this phenomenon, where the financial market had a quicker response than other industries.

[38] Rhode, P. W. & Toniolo, G., the Global Economy in the 1990s. A long-run perspective, Cambridge University Press 2006

6. Conclusion

In this paper, I first general analyzed the relationship between two big economies, the United States and Sweden. As the United States is the most powerful and influential country in the world, I also quantitative analyzed the impacts of American economy on Swedish economy from three aspects, Swedish living standards, international trading volumes and stock market, with employing three standard form VAR models.

In order to observe the correlations between Sweden and USA from long-term perspective, I chose the quarterly data from the first quarter of 1985 to the end of 2009, which were totally 100 observations. As I would like to investigate the relationship between Sweden and the United States, I chose to compare the main indicators, such as GDP, consumer price index, unemployment rate, export and import volumes and stock market index. From the comparison, I found most of the indicators for Sweden had strong relationships with them of the United States. However, there were significant lags for the Swedish indicators compared with them of the United States, which was one to three quarters lag from observation.

With the purpose of estimating the reaction speed of Swedish economy to the changing of American economy, three standard form VAR models were employed to test the impacts from three aspects. From the first standard form VAR model I found that there was a three-quarter lag between American and Swedish GDP, consumer price index and unemployment rate. It indicated that these three indicators of Sweden needed three quarter to response a shock happened in the United States. In the trading volumes, American export and import volumes had strong impacts on Swedish trading volumes. But the exchange rate played less important role in the trading activities. Along with the development of information and communication technologies, Swedish stock market index respond to the changing of American economy faster than the changing of Swedish GDP, which was observed from the third standard form VAR model.

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8. Appendix

Appendix 1

Likelihood ratio test

$$LR = T[\log|\hat{\Sigma}_r| - \log|\hat{\Sigma}_u|]$$

Where: T is the size of the sample

$\hat{\Sigma}_r$ is the variance-covariance matrix of residuals for restricted model (with 4 lags)

$\hat{\Sigma}_u$ is the variance-covariance matrix for the residual for the unrestricted VAR model (with 8 lags)

Appendix 2 Results for the first standard form VAR model (Swedish Living Standards)

Vector Autoregression Estimates				
Date: 05/23/10 Time: 01:59				
Sample (adjusted): 1985Q3 2009Q4				
Included observations: 98 after adjustments				
Standard errors in ( ) & t-statistics in [ ]				
	GDPUS	GDPSWE	CONSUMERSWE	UNEMPLOYSWE
GDPUS(-1)	0.270615	0.165157	-0.132672	0.327723
	(0.11129)	(0.16821)	(0.16640)	(1.02440)
	[2.43166]	[0.98184]	[-0.79731]	[0.31992]
GDPUS(-2)	0.308307	0.317380	0.186245	-1.631875
	(0.11253)	(0.17008)	(0.16825)	(1.03579)
	[2.73989]	[1.86605]	[1.10696]	[-1.57549]
GDPSWE(-1)	-0.012654	0.048611	-0.067919	0.134829
	(0.06508)	(0.09836)	(0.09731)	(0.59904)
	[-0.19444]	[0.49419]	[-0.69800]	[0.22508]
GDPSWE(-2)	-0.060790	0.042008	-0.141400	0.575802
	(0.06313)	(0.09542)	(0.09440)	(0.58112)
	[-0.96290]	[0.44023]	[-1.49796]	[0.99084]
CONSUMERSWE(-1)	-0.083693	0.128499	0.289059	0.244549
	(0.06585)	(0.09953)	(0.09846)	(0.60615)
	[-1.27095]	[1.29102]	[2.93577]	[0.40344]
CONSUMERSWE(-2)	-0.027134	-0.102051	0.262084	1.381245
	(0.06529)	(0.09868)	(0.09762)	(0.60095)
	[-0.41561]	[-1.03418]	[2.68487]	[2.29845]
UNEMPLOYSWE(-1)	-0.010525	0.000493	0.014594	0.374333
	(0.01139)	(0.01722)	(0.01704)	(0.10487)
	[-0.92378]	[0.02861]	[0.85668]	[3.56936]
UNEMPLOYSWE(-2)	0.013844	-0.054903	-0.026195	0.349231
	(0.01141)	(0.01725)	(0.01707)	(0.10507)

	[1.21292]	[-3.18238]	[-1.53488]	[3.32395]
C	0.003981	0.001453	0.003714	-0.002929
	(0.00125)	(0.00188)	(0.00186)	(0.01148)
	[3.19298]	[0.77102]	[1.99233]	[-0.25526]
R-squared	0.281096	0.352291	0.279550	0.538716
Adj. R-squared	0.216476	0.294070	0.214790	0.497253
Sum sq. resids	0.002640	0.006031	0.005901	0.223662
S.E. equation	0.005446	0.008232	0.008143	0.050130
F-statistic	4.349954	6.050920	4.316736	12.99249
Log likelihood	376.5249	336.0418	337.1030	158.9907
Akaike AIC	-7.500508	-6.674322	-6.695979	-3.061035
Schwarz SC	-7.263113	-6.436927	-6.458584	-2.823640
Mean dependent	0.006742	0.004737	0.006867	0.011134
S.D. dependent	0.006153	0.009797	0.009189	0.070701
Determinant resid covariance (dof adj.)		2.77E-16		
Determinant resid covariance		1.88E-16		
Log likelihood		1218.010		
Akaike information criterion		-24.12266		
Schwarz criterion		-23.17308		

Appendix 3 Results for the second standard form VAR model (Swedish trading volumes)

Vector Autoregression Estimates							
Date: 05/25/10 Time: 02:38							
Sample (adjusted): 1985Q2 2009Q4							
Included observations: 99 after adjustments							
Standard errors in ( ) & t-statistics in [ ]							
	GDPUS	GDPSWE	EXPORTSWE	IMPORTSWE	EXPORTUS	IMPORTUS	EXCHANGE
GDPUS(-1)	0.312407	0.21883	1.039135	1.851266	0.705963	2.415678	-0.70309
	-0.11312	-0.17773	-1.25419	-1.30558	-0.66899	-0.68793	-1.0106
	[2.76180]	[1.23124]	[0.82853]	[1.41797]	[1.05527]	[3.51153]	[-0.69572]
GDPSWE(-1)	0.013635	0.252993	-0.03049	-0.30765	-0.624819	-0.84871	0.010756
	-0.06021	-0.09461	-0.6676	-0.69495	-0.3561	-0.36618	-0.53794
	[0.22645]	[2.67419]	[-0.04566]	[-0.44270]	[-1.75462]	[-2.31773]	[0.02000]
EXPORTSWE(-1)	0.012274	-0.04421	-0.3676	-0.07709	0.212359	0.046693	0.228229
	-0.02274	-0.03573	-0.2521	-0.26243	-0.13447	-0.13828	-0.20314
	[0.53983]	[-1.23747]	[-1.45816]	[-0.29374]	[1.57922]	[0.33767]	[1.12352]
IMPORTSWE(-1)	0.001646	-0.00859	0.57427	0.264449	0.024014	0.200865	-0.46012
	-0.02368	-0.03721	-0.26258	-0.27334	-0.14006	-0.14402	-0.21158
	[0.06949]	[-0.23081]	[2.18704]	[0.96748]	[0.17145]	[1.39465]	[-2.17470]
EXPORTUS(-1)	-0.02466	0.010656	-0.30327	-0.23146	0.161628	0.035089	0.370135
	-0.02213	-0.03476	-0.24532	-0.25537	-0.13085	-0.13456	-0.19767
	[-1.11440]	[0.30651]	[-1.23621]	[-0.90638]	[1.23518]	[0.26078]	[1.87246]
IMPORTUS(-1)	0.038792	0.089527	0.159828	0.132737	0.035403	0.062624	0.097468
	-0.02216	-0.03482	-0.24569	-0.25576	-0.13105	-0.13476	-0.19797
	[1.75062]	[2.57136]	[0.65052]	[0.51900]	[0.27014]	[0.46470]	[0.49233]
EXCHANGE(-1)	0.006496	-0.04362	-0.08595	-0.05188	0.046307	0.095091	0.195414
	-0.02058	-0.03233	-0.22813	-0.23748	-0.12169	-0.12513	-0.18382
	[0.31572]	[-1.34921]	[-0.37677]	[-0.21847]	[0.38055]	[0.75994]	[1.06306]
C	0.004173	0.001191	0.008682	0.003771	0.008146	-0.00129	-0.00131
	-0.00088	-0.00139	-0.00979	-0.01019	-0.00522	-0.00537	-0.00789
	[4.72561]	[0.85821]	[0.88685]	[0.37000]	[1.56001]	[-0.24073]	[-0.16631]

R-squared	0.227403	0.247338	0.134504	0.103349	0.311595	0.387158	0.173968
Adj. R-squared	0.167972	0.189441	0.067928	0.034376	0.258641	0.340016	0.110427
Sum sq. resids	0.002839	0.007009	0.349011	0.378194	0.0993	0.105001	0.226605
S.E. equation	0.005586	0.008776	0.06193	0.064467	0.033033	0.033969	0.049902
F-statistic	3.826365	4.27204	2.020296	1.498402	5.884239	8.212633	2.737891
Log likelihood	377.2664	332.5334	139.0898	135.1148	201.3093	198.5458	160.4685
Akaike AIC	-7.45993	-6.55623	-2.64828	-2.56798	-3.905239	-3.84941	-3.08017
Schwarz SC	-7.25022	-6.34652	-2.43857	-2.35827	-3.695532	-3.6397	-2.87047
Mean dependent	0.006759	0.004726	0.016779	0.016262	0.016559	0.016026	-0.00283
S.D. dependent	0.006123	0.009748	0.064147	0.065604	0.038365	0.041813	0.052908
Determinant resid covariance (dof adj.)		1.17E-24					
Determinant resid covariance		6.48E-25					
Log likelihood		1773.594					
Akaike information criterion		-34.6989					
Schwarz criterion		-33.2309					

Appendix 4 Results for the third standard form VAR model (Swedish stock market)

Vector Autoregression Estimates				
Date: 05/25/10 Time: 05:46				
Sample (adjusted): 1985Q3 2009Q4				
Included observations: 98 after adjustments				
Standard errors in ( ) & t-statistics in [ ]				
	GDPUS	GDPSWE	SP500	OMX
GDPUS(-1)	0.130765	0.092316	0.402294	2.580177
	(0.10894)	(0.18537)	(1.28027)	(2.73569)
	[1.20034]	[0.49800]	[0.31423]	[0.94315]
GDPUS(-2)	0.213047	0.405207	-1.103226	1.436856
	(0.10455)	(0.17791)	(1.22870)	(2.62549)
	[2.03772]	[2.27764]	[-0.89788]	[0.54727]
GDPSWE(-1)	0.004814	0.125079	-0.410610	-0.852643
	(0.05835)	(0.09930)	(0.68578)	(1.46538)
	[0.08250]	[1.25966]	[-0.59875]	[-0.58186]
GDPSWE(-2)	-0.040435	0.177991	0.438048	-0.811151
	(0.05679)	(0.09663)	(0.66739)	(1.42608)
	[-0.71203]	[1.84194]	[0.65636]	[-0.56880]
SP500(-1)	0.026462	0.004126	0.190225	0.236158
	(0.00995)	(0.01693)	(0.11692)	(0.24984)
	[2.65977]	[0.24374]	[1.62694]	[0.94524]
SP500(-2)	0.012409	0.024008	-0.048563	-0.024218
	(0.01014)	(0.01725)	(0.11915)	(0.25461)
	[1.22387]	[1.39157]	[-0.40756]	[-0.09512]
OMX(-1)	0.008137	-0.006983	0.152795	0.017534
	(0.00447)	(0.00761)	(0.05256)	(0.11231)
	[1.81938]	[-0.91762]	[2.90701]	[0.15612]
OMX(-2)	-0.003484	0.008699	0.075520	-0.058175
	(0.00463)	(0.00788)	(0.05441)	(0.11627)
	[-0.75238]	[1.10409]	[1.38788]	[-0.50033]

C	0.003888	-0.000536	0.012660	0.004886
	(0.00093)	(0.00158)	(0.01088)	(0.02324)
	[4.20017]	[-0.34010]	[1.16381]	[0.21020]
R-squared	0.368195	0.278554	0.213388	0.059213
Adj. R-squared	0.311403	0.213705	0.142681	-0.025352
Sum sq. resids	0.002320	0.006717	0.320399	1.462935
S.E. equation	0.005106	0.008688	0.060000	0.128209
F-statistic	6.483269	4.295413	3.017934	0.700212
Log likelihood	382.8531	330.7588	141.3786	66.96565
Akaike AIC	-7.629654	-6.566505	-2.701604	-1.182972
Schwarz SC	-7.392259	-6.329111	-2.464209	-0.945577
Mean dependent	0.006742	0.004737	0.016165	0.026058
S.D. dependent	0.006153	0.009797	0.064801	0.126614
Determinant resid covariance (dof adj.)		8.01E-14		
Determinant resid covariance		5.45E-14		
Log likelihood		940.2929		
Akaike information criterion		-18.45496		
Schwarz criterion		-17.50538		