# THE IMPACT OF FOREIGN LABOR MOBILITY ON BUSINESS CYCLE IN THAILAND BY USING STRUCTURAL VECTOR AUTOREGRESSIVE MODEL (SVAR MODEL)

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**MASTER OF ECONOMICS**



**GRADUATE SCHOOL**
**CHIANG MAI UNIVERSITY**
**APRIL 2019**

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**RUNGPUNSA LOHPHET**

**A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ECONOMICS**



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THIS THESIS HAS BEEN APPROVED TO BE A PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ECONOMICS

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Rungpunsa Lohphet

| | | |
|---|---|---|
| **หัวข้อวิทยานิพนธ์** | ผลกระทบของการเคลื่อนไหวของแรงงานต่างชาติในไทยกับวัฏจักรธุรกิจของประเทศไทยโดยใช้แบบจำลองเวกเตอร์อัตราถดถอย แบบมีโครงสร้าง | |
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## บทคัดย่อ

วิทยานิพนธ์เล่มนี้จุดประสงค์ของรายงานเล่มนี้เป็นการศึกษาความสัมพันธ์ระหว่างการเปลี่ยนแปลงของแรงงานต่างด้าวกับวัฏจักรธุรกิจของไทย วัตถุประสงค์ของวิทยานิพนธ์เล่มนี้คือการทดสอบว่าการเปลี่ยนแปลงของแรงงานต่างด้าวมีผลต่อวัฏจักรธุรกิจของไทยอย่างไร โดยการใช้แบบจำลองเวกเตอร์ อัตราถดถอย แบบมีโครงสร้างในการศึกษาความสัมพันธ์ระหว่างตรวจแปร ข้อมูลที่ใช้ในการศึกษาครั้งนี้เป็นข้อมูลที่อยู่ระหว่างปี 2550 ถึงปี2558 แลข้อมูลทุติยภูมิที่ใช้ในแบบจำลองคือจำนวนของแรงงานต่างด้าวที่เข้ามาทำงานในไทยทั้งหมด 3 สัญชาติได้แก่ พม่า ลาว และกัมพูชา ตัวแปรหลักที่ใช้อาทิ ผลิตภัณฑ์มวลรวมในประเทศ อัตราค่าแรง และชั่วโมงการทำงาน เป็นต้น โดยผลของการวิจัยพบว่าการเปลี่ยนแปลงของแรงงานต่างด้าวในไทยมีผลกระทบต่อวัฏจักรธุรกิจของไทยจริง ซึ่งการเปลี่ยนแปลงอยู่ในทิศทางที่ถดถอย

| | | |
|---|---|---|
| **Thesis Title** | The Impact of Foreign Labor Mobility on Business Cycle in Thailand by Using Structural Vector Autoregressive Model (SVAR Model) | |
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# ABSTRACT

This study focuses on the relationship between in-country employment of foreign workers and Gross Domestic Product that reflects the business cycle of Thailand. The purpose of this paper is to examine how migrant labor mobility affect the business cycle by using Structural VAR model. This study use the time series annual data of Thailand, since 2007-2015. The secondary data is the number of foreign labor which includes Myanmar, Laos and Cambodia, Gross Domestic Product, real wage, the labor force, work hours, consumption and investment. The study result reveal that when the migrant labor shock change, Thailand's real business cycle is affected and end up in a recession stage. The proportion of foreign workers shock with the variance of GDP has been steadily decreasing.

# CONTENTS

# LIST OF TABLES

page

# LIST OF FIGURES

page

# CHAPTER 1

# Introduction

## 1.1 Rationale Background

The opening of the ASEAN Community comes with a free flow of labor. Thailand is the country of origin and destination for the migration of workers. Skilled workers in ASEAN from low-paid countries will move to work for higher compensation. Some Skilled Thai workers will move to work to Malaysia and Singapore. Whereas, low-level workers from underdeveloped countries, such as housewives and construction workers, will flow into Thailand. The elderly tend to increase in Thailand. The structure of the population has changed with the proportion of the elderly. At the same time, the labor force has the same or decreased. This will have a direct impact on the manufacturing industry and production in Thailand. Labor demand in the manufacturing industry is dwindling. The decline in labor force may be offset by the use of machine technology to replace workers or the introduction of foreign workers. This results in more labor mobility.

There are two types of immigration which are illegal immigrants and legal immigrants. From 2007 to 2015, Legal Foreign workers are likely to increase. Meanwhile, illegal migrant workers are likely to decline according to foreign workers' management policies. All foreign workers who work in Thailand, whether they applied for permission or not. They and their family will be registered and proved their nationality every year for legal process.

**Table 1.1:** Foreign workers in Thailand, 2007-2015

| Years | Legal foreign worker | Illegal foreign worker | total |
|---|---|---|---|
| **2007** | 209,151 | 596,613 | 805,764 |
| **2008** | 228,353 | 562311 | 790,664 |
| **2009** | 210,745 | 1,314,382 | 1,544,902 |
| **2010** | 379,560 | 955,595 | 1,335,155 |
| **2011** | 678,235 | 1272,415 | 1,950,650 |
| **2012** | 940,531 | 193,320 | 1,133,851 |
| **2013** | 1,155,826 | 28,009 | 1,183,835 |
| **2014** | 1,316,842 | 22992 | 1,339,834 |
| **2015** | 1,416,513 | 29,062 | 1,445,575 |

Source: Foreign Workers Administration Office (2007-2015).

Table 1.1 shows the government of Abhisit Vejjajiva has had a lax in illegal immigration. The number of foreign workers left in Thailand at the end of 2009 soared from the previous year to double. There were 1,544,902 people, of which only 210,745 were legal immigrants and 1,334,157 illegal immigrants. The number of foreign workers left in Thailand remains at the level of millions until Cambodian soldiers capture seven Thai men and collide along the border several times. In early 2011, the Abhisit government adopted a policy to push illegal migrant workers, especailly the Cambodian and Burmese people, to go out.

When classified by nationality, the first - nationality that work as legal workers were Myanmar, Cambodia and Laos as shown in Table 1.2.

**Table 1.2:** Foreign workers in Thailand 2015, Classified by Nationality (Top 3)

| | Foreign Workers in Thailand | | | |
|---|---|---|---|---|
| | Legal | | Illegal | |
| | Nationality | Person(s) | Nationality | Person(s) |
| **1** | Myanmar | 992,983 | Tai-Yai people | 14,590 |
| **2** | Cambodia | 210,207 | Myanmar | 3,624 |
| **3** | Laos | 67,980 | Karen people | 2,982 |

Source: Foreign Workers Administration Office (2007-2015).

Considering foreign workers in Thailand, it is found that most of the workers are unskilled workers who migrate from neighboring countries which are Myanmar, Laos and Cambodia

In 2015, the number of foreign worker per total labor in Thailand, Myanmar, Laos and Cambodia is accounted as 6 percent and the rest are at 0.38 percent as shown in Table 1.3.

**Table 1.3**: The rate of employment of foreign workers, skilled foreign workers and 3 nations foreign workers to total number of employed persons

| Year | The rate of employment of foreign workers to total number of employed persons. | The rate of employment of skilled foreign workers to total number of employed persons. | The rate of employment of 3 nation's foreign workers*to total number of employed persons. |
|---|---|---|---|
| **2007** | 2.22 | 0.3 | 1.74 |
| **2008** | 2.14 | 0.34 | 1.59 |
| **2009** | 4.1 | 0.24 | 3.77 |
| **2010** | 3.51 | 0.24 | 3.16 |
| **2011** | 4.47 | 0.26 | 4.14 |
| **2012** | 2.91 | 0.32 | 2.55 |
| **2013** | 3 | 0.33 | 2.67 |
| **2014** | 7.55 | 0.36 | 7.12 |
| **2015** | 6.45 | 0.38 | 6 |

Source: Labor Market Warning System (2007-2015).

**foreign workers 3 nations included Myanmar, Laos and Cambodia.*

Migration of migrants is a resulting from the demand of some types of workers, especially the lower-level workers (unskilled workers) of the destination countries. Or the developed countries that motivate skilled labors of developing countries come to work in developed countries. Since 2011-2015, foreign workers in Thailand increase continually. While Thai workers who work Overseas tend to decline as shown in table 1.4.



**Table 1.4**: Labor mobility in Thailand 2011 – 2015

| | Thai workers abroad | Foreign workers in Thailand |
|---|---|---|
| **2011** | 90,237 | 1,950,650 |
| **2012** | 79,628 | 1,133,851 |
| **2013** | 78,105 | 1,183,835 |
| **2014** | 68,802 | 1,339,834 |
| **2015** | 69,664 | 1,445,575 |

Source: Department of Employment (2007-2015).

The situation of migrant workers in 2012 is different. The key factor is that the regime has become more democratic. The release of Aung San Suu Kyi, the Leader of the opposition party, cause the election nationwide. Foreign investment increased. Burma is becoming a new market of the global. Traders and investors from Europe, America, Asia, and Thailand are gradually preparing to do business in Burma. In addition, in 2013, Myanmar is also assigned to host the SEA Games. All this makes Burma's need for labor. Therefore, Burmese migrant workers working in Thailand returned to work in their own homeland.

In September of 2012, the number of foreign workers left in Thailand decreased by more than eight hundred thousand or nearly half from the beginning of the year. The number of Burmese migrant workers has declined the most. This decline is different from the decrease in early 2011, as a result of the government's policy. But the foreign workers have come back so there was a temporary reduction. In 2012, this decrease is due to the increasing demand for labor within Burma which may be a permanent reduction in the number of foreign workers in Thailand.

In terms of security and career opportunities of Thai workers, it is a good thing. But in economic terms. The disappearance of many lower-level workers for a long time. It can cause a break in manufacturing, construction and service sectors. Because migrant workers have been occupied by heavy, dirty, and low wages for many years. So long as Thai workers at one time in the past have been with this job. Need to find a job that is more comfortable. It is difficult for Thai workers to return to work instead of migrant workers returning home. This may result in a shortage of labor in the lower labor market in the near future.



Nevertheless, it should not neglect to consider the issue of the adjustment of the number of foreign workers in Thailand that affect the business cycle of Thailand through various macroeconomic indicators. The number of 3 nationalities migrant workers in the manufacturing sector can be shown in the table below. Thailand has a share of foreign workers in GDP which has been continuously decreasing.

**Table 1.5**: Gross Domestic Product of Thailand and The number of foreign worker in Thailand

| | **Gross Domestic product of Thailand(USD billion)** | **The number of 3 nationalities foreign workers in Thailand** |
|---|---|---|
| 2007 | 262.94 | 546,272 |
| 2008 | 291.38 | 501,570 |
| 2009 | 281.71 | 1,314,382 |
| 2010 | 341.11 | 932,255 |
| 2011 | 370.82 | 1,248064 |
| 2012 | 397.56 | 167,881 |
| 2013 | 420.53 | 28,009 |
| 2014 | 406.52 | 22,992 |
| 2015 | 399.23 | 2,101 |

Source: Foreign worker administration office. The Journal of foreign workers Statistics in Thailand. (2007-2015).

Compared to the increase in GDP. The number of foreign workers in Thailand is likely to decrease and fluctuate more and more, as seen from Table 1.5 Number of foreign workers between the year 2007 to year 2015 has decrease from 546,272to 2,101

Studies related to the impact of migrant workers on the business cycle have been studied by Marek Antosiewicz and Piotr Lewandowski (2017). The recession of the country is caused by the relocation of labor. They found that the relationship between work and GDP was not linear / non-linear. Then there is the study of foreign countries in this way, followed by many more. This has led to increased understanding of the relationship between migrant workers and the macro economy.

Considering the volatility trend of migrant workers and some macroeconomic variables, for example, Gross Domestic Product, which reflects economic and business cycles, found that the change in the number of foreign workers in Thailand With the real gdp of Thailand. It mostly changes in the opposite direction. For example It shows that the Thai economy has a recession or business cycle in contraction due to Real GDP of Thailand has fallen On the other hand If the employment rate of foreign workers in Thailand increases, the Thai economy may tend to expand or the economic expansion due to the real GDP growth in Thailand.

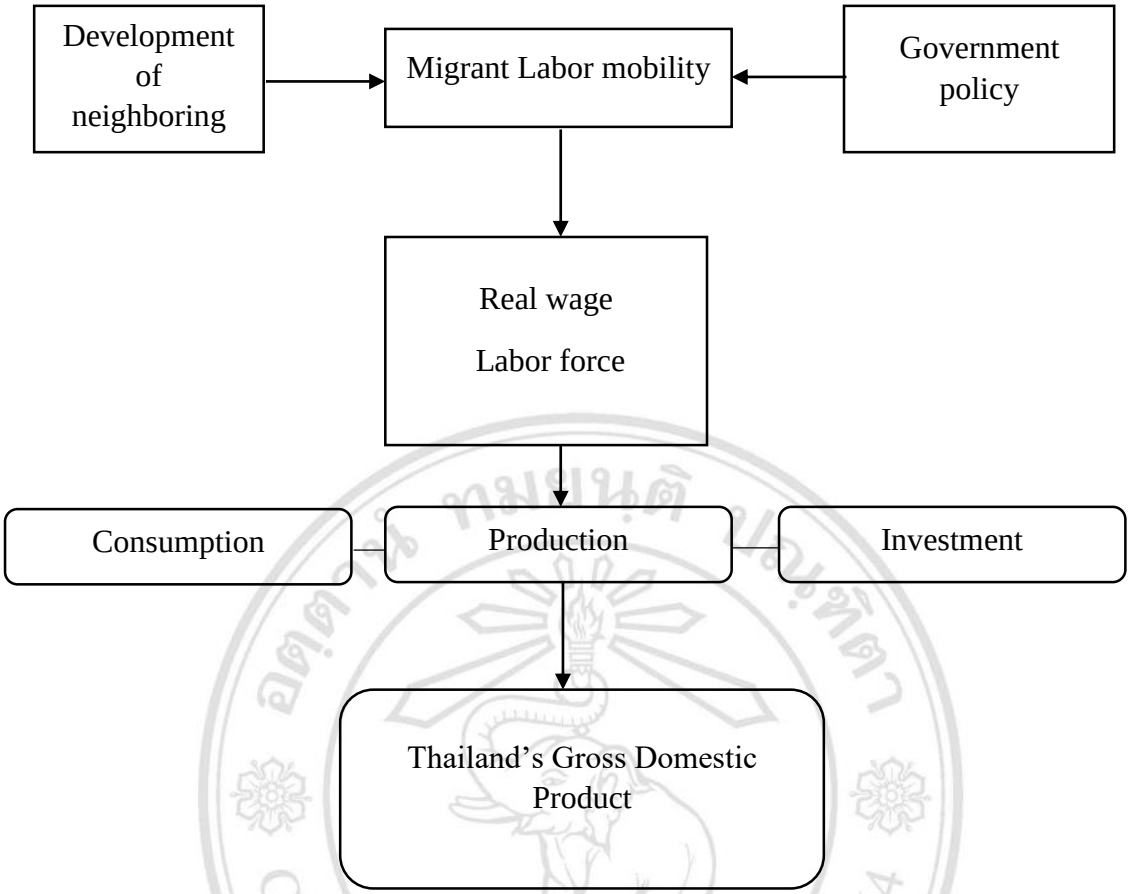



**Figure 1.1**: the relationship between migrant labor mobility and macroeconomic variables

Source: Author

For this study. It is a study that focuses on the relationship between in-country employment of foreign workers and Gross Domestic Product that reflects the business cycle of Thailand. There is no exact data available for this study. And no one has specifically studied it. The study of historical data is an important issue because of the decline in the number of foreign workers in Thailand. This may be the reason for the change in Thai GDP or to affect the growth and contraction of the business cycle. Therefore, this study is beneficial for planning decisions. Many of the public and private sectors are working to address the problem of migrant workers who are likely to decline.

## 1.2 Purpose of the study

The purpose of this paper is to examine how migrant labor mobility affect the business cycle by using Structural VAR model.

## 1.3 Advantage of the study

This study reveal the process of Thailand's business cycle in the expansion period and contraction period which is the result from the change of the number of foreign workers in Thailand. The results of the study can benefit the government in preparing policies to support the problems that may arise from the impact. It also benefits the business sector in adjusting and preparing for the changes that will occur in the business cycle.

## 1.4 Definition

1.4.1 Business cycle: the rise and fall in production output of goods and services in an economy. Business cycles are generally measured using the increasing and decreasing in real gross domestic product (GDP) or GDP adjusted for inflation.

1.4.2 Migrant Labor: the labor from one country move to another for the purpose of employment.

1.4.3 Neighboring country: the country that is in relation to others next or near to it. For instance, Laos, Myanmar and Cambodia are neighboring countries of Thailand.

1.4.4 Gross Domestic Product: the total value of everything produced in the country. It doesn't matter if it's produced by citizens or foreigners. If they are located within the country's boundaries, their production is included in GDP.

1.4.5 Economic Growth: the increase in the market value of the goods and services produced by an economy over time.

# CHAPTER 2

# Theories and Literature Review

## 2.1 Economic Theories

2.1.1 Dynamic Stochastic General Equilibrium

The Extended Model

This topic offers more complex models. Therefore, in order for the model to explain the nature of the real economy more closely, the model is expanded by adding another factor of production: labor

$$y_t = y(k_t, n_t) \tag{2.1}$$

Where $y_t$ as output at time $t$

$k_t$ as capital at time $t$

$n_t$ as labor supply at time $t$

Households own labor factors. Households allocate part of their income for investment. Manufacturers then hire those workers for use in production and workers receive compensation in the form of wages. Consequently, the budget constraint of consumers is the following equation:

$$c_t + i_t + s_{t+1} + T_t \leq w_t(1 - l_t) + \left(1 + r_t^b\right)s_t + r_t^k k_t \tag{2.2}$$

Where $c_t$ as consumption at time $t$

$i_t$ as investment at time $t$

$s_t$ as saving in form of government bond at time $t$

$T_t$ as tax at time $t$

$w_t$ as ratio of real wage

$l_t$ as leisure at time $t$

$r_t^b$ as interest rate of government bond

$r_t^k$ as interest rate which is the return of capital

Moreover the consumer has an limitation, there is a law of motion of capital:

$$k_{t+1} = (1-\delta)k_t + i_t \tag{2.3}$$

Where $k_t$ as capital at time $t$

$\delta$ as capital depreciation

$i_t$ as investment at time $t$

It means that capital left after deduction of depreciation plus with new investment, It will become a capital factor for the next production round. Thus, the problem of consumer under the budget constraint and the equation of the change of labor will be shown in the following equation:

$$\max_{c_t, l_t, k_{t+1}, s_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_t, l_t) \tag{2.4}$$

Lagrange's equation:

$$L = \sum_{t=0}^{\infty} \beta^t u(c_t, l_t) + \sum_{t=0}^{\infty} \lambda_t \beta^t \left[ w_t(1-l_t) + \left(1 + r_t^b\right) s_t + r_t^k k_t - c_t - k_{t+1} + (1-\delta)k_t - s_{t+1} - T_t \right] \tag{5}$$

Conditions that give consumers the most satisfaction is:

$\frac{\partial L}{\partial c_t}$: $\beta^t u_1(c_t, l_t) - \lambda_t \beta^t = 0$ ; $\lambda_t = u_1(c_t, l_t)$

$\frac{\partial L}{\partial l_t}$: $\beta^t u_2(c_t, l_t) - \lambda_t \beta^t w_t = 0$ ; $\lambda_t = \frac{u_2(c_t, l_t)}{w_t}$

$\frac{\partial L}{\partial k_{t+1}}$: $\lambda_{t+1}\beta^{t+1}\left(1 + r_{t+1}^k - \delta\right) - \lambda_t \beta^t = 0$ ; $\lambda_{t+1}\beta\left(1 + r_{t+1}^k - \delta\right) = \lambda_t$

$\frac{\partial L}{\partial k_{t+1}}$: $\lambda_{t+1}\beta^{t+1}\left(1 + r_{t+1}^b\right) - \lambda_t \beta^t = 0$ ; $\lambda_{t+1}\beta\left(1 + r_{t+1}^b\right) = \lambda_t$

Therefore, the Euler's equation are the following equations:

$$\frac{u_2(c_t, l_t)}{u_1(c_t, l_t)} = w_t \tag{2.6}$$

$$\beta u_1(c_{t+1}, l_{t+1})\left(1 + r_{t+1}^b\right) = u_1(c_t, l_t) \tag{2.7}$$

$$r_{t+1}^b = r_{t+1}^k - \delta \tag{2.8}$$

From $r_{t+1}^b = r_{t+1}^k - \delta$, it means that the return from investment in two types of property which are government bond and capital goods, there are equal in the equilibrium. The consumer decide to hold these types of property. If any property gives more return. The consumer chooses only one property.

The producer equation:

$$\max_{k_t, n_t} \pi_t = y_t - w_t n_t - r_t^k k_t \tag{2.9}$$

Where $y_t = y(k_t, n_t)$

Hence, the condition that make the maximum profit is in the following equation:

$$\frac{\partial \pi_t}{\partial k_t}: \qquad \frac{\partial y_t}{\partial k_t} = r_t^k$$

$$\frac{\partial \pi_t}{\partial n_t}: \qquad \frac{\partial y_t}{\partial n_t} = w_t$$

There are the return that producer spend for two inputs, which are labor and capital, will be equal the efficiency of the final input in the production. (Arunnee Panyasawat, 2544)

2.1.2. Real Business Cycle Theory

Real business cycle model focus on the real technology shock that effect on the economic system and time adjustment of variables. The model is an equilibrium model in perfect competitive market which include household and manufacturing sector. The goal is to achieve the optimization and having the production equation that is affected from technology shock. However, the business cycle model currently is not emphasize only the study of impact from technology shock, there also cover the effect of financial variables such as money supply and the impact of government policy such as the government expenditure and taxation.

In this study, the research use the real business cycle theory in a different way from older concept. Originally, there estimated by using the regression analysis which use the real data to estimate coefficient of variables in the equation for explaining the economic system but this research that related on the business cycle will impose the calibration, then generate a set of variables and compare it with a set of real data.



The business cycle theory and time series data of macroeconomic variable

In the study of the volatility of the economy. Originally, economists focused on cycle of output that fluctuates from the trend by seeing that output is growing steadily. The level of output in each year is increased smoothly. This is called yield trend. But the actual of the increase is different from the trend, which is called the cycle. The economists have tried to explain why the cause for volatility and offer the solution to reduce volatility and return to the trend.

Keynes's theory emphasis that the change of aggregate demand of private sector is cause of decreasing in productivity and economic slowdown whereas the new Keynesian theory emphasize on the financial distractions. However, these methods are

argued by Nelson and Plosser (1982). They research the time-series data of economic variables in the United State. They discovered that Gross National Product(GNP) was a random walk data which means that the volatility of output did not happened temporarily and the output could return to the trend. The impact occur permanently, If this study assume that the increase in the output variable changes as the following equation:

$$y_t = g_t + by_{t-1} + z_t \quad (2.10)$$

Where

$y_t$ as output at time $t$

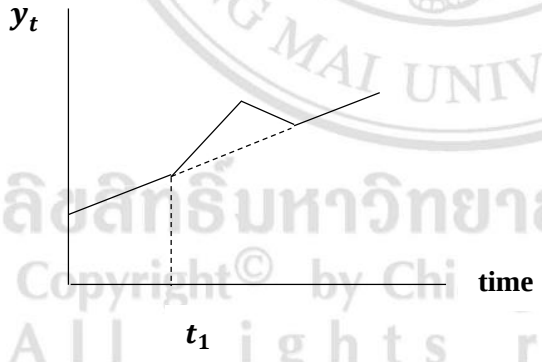
$g_t$ as ratio of average yield increase which is deterministic trend

$b$ as coefficient ;$0 < b < 1$

$y_{t-1}$ as output at time $t-1$

$z_t$ as random shock

Therefore, when shock happen in the economy such as positive shock($z_t > 0$) that will make the output at time $t$ ($y_t$) increase from the trend and affect to the output at time $t+1$ ($y_{t+1}$) because the output at time $t+1$ depend on the output at time $t$. However, from $0 < b < 1$, the impact from these shocks slowly gone and the output will return to the trend. this change of time-varying variable is called Trend stationary which shocks will happened temporarily as shown in figure 2






source: Arunnee Panyasawat,(51-55)

**Figure 2.1:** Trend stationary

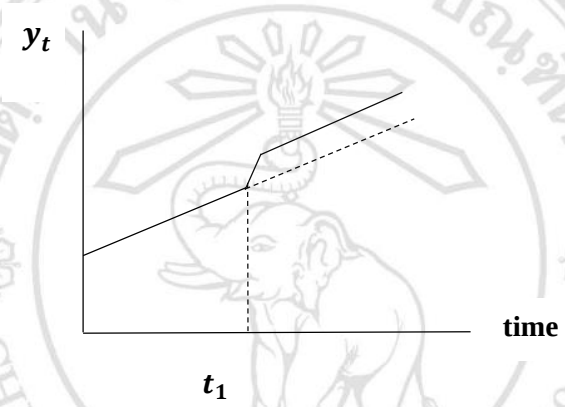
Figure 2.1, suppose that the increasing in money supply cause the volatility of output increase away from the trend at point $\boldsymbol{t_1}$**.** However, the ourtput will return to the trend later, if the increase of output is trend stationary. On the other hand, if

the change of time-series data of output is random walk, this study will get the following equation:

$$y_t = g_t + y_{t-1} + z_t \tag{2.11}$$

(In the case of random walk with drift which include coefficient $g_t$)

Equation (2.11) It found that the effect of shock$z_t$ did not disappear over time because the coefficient of $y_{t-1}$ equal to 1 ($b = 1$). It means that current output will affect the next year one by one, therefore the impact of shock is permanent or the output has unit root.




Source: Arunee Panyasawatsut (2544:112)

**Figure 2.2:** Random walk

Figure 2.2 at time $t_1$ , the occurrence of shocks in the economic system will cause the rising in output and this result is permanent, therefore the trend of output has changed.

Moreover, from Nelson and Plosser (1982), said that real shock will affect the level of output permanently and there are not financial shock. There is the beginning of studying of the business cycle theory. The study did not separate growth rate and short-term fluctuations or cycles, but there is a study of the economic growth model along with fluctuations because the shock affect the growth rate or output trend. There fluctuate at the same time.

Theory and hypothesis of business cycle theory (Snowdon, Vane and Wynarczyk, 1994)

1.) The economic unit aims to achieve the highest satisfaction or the highest profit under limitations on resources.

2.) Economic units are reasonably predictable. There has not the information asymmetry. Economic units likely has the signal extraction problem such as economic units may not know that the technology shocks are temporary or permanent. However, the perception of price level information is generally made public.

3.) The price is fully adjusted. The market is always at equilibrium.

4.) Volatility of productivity and employment occur because of randomly changing technology and the propagation mechanism of the variables in the economy.

5.) Employment fluctuations are caused by the voluntary change of labor where work and leisure can be completely substituted.

6.) Financial policy will not affect the true variables. There is not true because the next generation of business cycle theory found that changes in money supply can affect real economic variables.

7.) No short-term and long-term isolation. Focus on the study of fluctuations and traends of variables.



Real business cycle model

In this study, this is the real business cycle model that was developed from the study of Federico Mandelman and Adrei Zlate(2010). The authors studied the relationship between Immigration, Remittances and Business Cycles in the United States and Mexico. This study assume that the economy include 2 parts 1. Household sector 2. Firm sector.

1. Household

The household is the consumer and the owner of the inputs. Household sector is infinity and identical, so only one household could be a representative agent of all households sector. The goal of a household is to find the maximum present value of utilities or lifetime satisfaction. There includes a continuum of two types of infinitely lived households that supply units of skilled and unskilled labor. The planner maximizes the weighted sum of utilities for the two representative households as shown in the following equation.

$$\max_{c_s,t,l_s,t,c_u,t,l_u,t,K_{t+1}} E_t \sum_{s=1}^{\infty} \beta^{s-1} \{\phi s U(c_s, t, l_s, t) + (1-\phi)(1-s)U(c_u, t, l_u, t)\} \quad (2.12)$$

Where $c_{j,t}$ as consumption of the two representative households every period $t$.

$l_{j,t}$ as unit of labor ; $j \in \{s, u\}$ shows skilled and unskilled labor

$s$ as the fraction of skilled households

$1-s$ as the fraction of unskilled households in the total population

$\phi$ as the weights of the utility of skilled

$1-\phi$ as unskilled households

The per-period utility takes the log-CRRA form:

$$U_t = \varepsilon_t^b \left( \ln c_{j,t} - \frac{X_j}{1+\psi} l_{j,t}^{1+\psi} \right) \quad ; j \in \{s, u\} \quad (2.13)$$

Where $\frac{1}{\psi} \geq 0$ as the Frisch elasticity of the labor supply

$X_j$ as the weight on the disutility from labor

$\varepsilon_t^b$ as a preference (demand) shock that a§ects intertemporal substitution

The per-period utility takes the log-CRRA form:

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Where $\frac{1}{\psi} \geq 0$ as the Frisch elasticity of the labor supply

$X_j$ as the weight on the disutility from labor

$\varepsilon_t^b$ as a preference (demand) shock that rejects intertemporal substitution

The planner maximizes the objective function subject to the budget constraint:

$$w_{s,t} L_{s,t} + w_{u,t} L_{u,t} + r_t K_t \geq C_{s,t} + C_{u,t} + I_t \tag{2.14}$$

Where $L_{s,t} = sL_{s,t}$ $C_{s,t} = sc_{s,t}$

$L_{u,t} = (1-s)\, I_{u,t}$ $C_{u,t} = sc_{u,t}$

$L_{s,t}$ as the aggregate amounts of skilled labor

$L_{u,t}$ as the aggregate amounts of unskilled labor

$w_{s,t}$ as the equilibrium wages of skilled labor

$w_{u,t}$ as the equilibrium wages of unskilled labor

$C_{s,t}$ as the aggregate consumptions of the skilled

$C_{u,t}$ as the aggregate consumptions of the unskilled

$r_t$ as the gross rental rate

From the budget constraint equation, the output is consumed for consumption, investment and in form of revenue for labor. It assume that the input of production could be explained as the rate of wage of skill and unskilled workers. When the government has control over the allocation of output. Government manage the productivity to provide public service for citizens



Capital accumulation follows the condition:

$$K_{t+1} = (1-\delta) K_t + \varepsilon_t^I I_t \tag{2.15}$$

Where $\varepsilon_t^I$ as an investment-specific technology shock

The maximization problem for the two representative agents generates the usual first order conditions for consumption, labor and capital accumulation, in which $\varsigma_t$ is the budget constraint multiplier:

$$\frac{\phi \varepsilon_t^b}{c_{s,t}} = \frac{(1-\phi)\varepsilon_t^b}{c_{u,t}} = \varsigma_t, \tag{2.16}$$

$$\frac{w_{s,t}}{c_{s,t}} = \chi_s(l_{s,t})^{\psi}, \frac{w_{u,t}}{c_{u,t}} = \chi_u(l_{u,t})^{\psi}, \quad (2.17)$$

$$\frac{1}{\varepsilon_t^I} = \beta E_t \left[\frac{\varsigma_{t+1}}{\varsigma_t}\left(r_{t+1} + \frac{1-\delta}{\varepsilon_{t+1}^I}\right)\right]. \quad (2.18)$$

2.1.3 Labor Theory of Value

The labor theory of value says that the value of a finished good correlates solely with the number of labor hours required to produce it. Economist Adam Smith, the founder of the idea of modern capitalism, first conceived of the labor theory of value in the second half of the 18th century -- the time of the industrial revolution. By the mid-1800s, political economist Karl Marx, the founder of communism, suggested that the marked-up price of goods above and beyond their labor cost resulted in the exploitation of workers. Marx touted the labor theory of value as the exclusive basis for determining the market price of goods. In other words, any two goods requiring an identical number of labor hours to produce them should have the same market price. For example, if an 18-karat gold filigree bracelet and an electronic toy car each require 10 hours to complete, both should have the same price.

The labor theory of value is ineffective on a practical level because it fails to account for materials costs, workers' skill levels, or capital usage and depreciation costs. In addition, it ignores the effect of varying consumer demand for different types of goods.

2.1.4 Wage theory

Wage theory, portion of economic theory that attempts to explain the determination of the payment of labour. A brief treatment of wage theory follows. For full treatment, see wage and salary. The subsistence theory of wages, advanced by David Ricardo and other classical economists, was based on the population theor y of Thomas Malthus. It held that the market price of labour would always tend toward the minimum required for subsistence. If the supply of labour increased, wages would fall, eventually causing a decrease in the labour supply. If the wage rose above the subsistence level, population would increase until the larger labour force would again force wages down.

The wage-fund theory held that wages depended on the relative amounts of capital available for the payment of workers and the size of the labour force. Wages increase only with an increase in capital or a decrease in the number of workers.

Although the size of the wage fund could change over time, at any given moment it was fixed. Thus, legislation to raise wages would be unsuccessful, since there was only a fixed fund to draw on.

The marginal productivity theory of wages, formulated in the late 19th century, holds that employers will hire workers of a particular type until the addition to total output made by the last, or marginal, worker to be hired equals the cost of hiring one more worker. The wage rate will equal the value of the marginal product of the last-hired worker.

**2.2 Literature review**

These studies examine the relationship between labor mobility and business cycle from both foreign and Thai research. From reviewing these papers, the author acknowledged the direction and size of the relationship between variables.

**1) Liis Roosaar, Pille Mõtsmees, Urmas Varblane, (2014)** study about Occupational mobility over the business cycle. The purpose of this paper is to examine how occupational mobility varies over the business cycle and how selected factors contribute to occupational mobility in different stages of the business cycle. By using annual micro data from the Estonian Labour Force Survey (2001-2010) and implementing probit models with interaction terms, the paper investigates occupational mobility as a change of occupation in two successive years during recovery, boom and recession periods.

This study found that the analysis indicates that occupational mobility is higher during the recovery and boom periods and lower during the recession stage. The demographic characteristics (gender, marital status, knowledge of local language) influence the probability for occupational change during the recovery stage of the business cycle. The position of employees in the occupational hierarchy is significant during the recovery and boom periods. Employees working in the public sector have a lower probability for occupational change compared with private sector employees during the recession. Training has a positive effect on occupational mobility during recession. Tenure reduces the probability of occupational mobility over the whole business cycle.

**2) Peter Enderwick, Rosalie L. Tung, Henry F.L. Chung, (2011),** the topic is Immigrant effects and international business activity, This paper aims to examine the

myriad linkages between cross-border migration and international business activity through a conceptual framework of international arbitrage. While labour is internationally the least integrated of the various markets (capital, product, labour) the increasing co-movement of both tasks and workers has created opportunities for the arbitrage and exploitation of differences between national labour markets. Because national labour markets typically display the two characteristics of separation and price discrepancy it is possible to utilise the principle of arbitrage and within this framework examine cost, intellectual, knowledge and employment arbitrage.

This research found that migrants can help reduce transaction costs for bilateral trade, contribute to nostalgic trade, encourage outsourcing and foreign direct investment through referrals and performance signalling, assist country of origin development through remittances and return migration and provide valuable knowledge to their employers in the country of residence

**3) Tony Elliman, Julie Eatock, Nicky Spencer, (2005)** study about Modelling knowledge worker behaviour in business process studies. The propose of the study is to describe a successful use of simulated knowledge worker behaviour used in the developing online procedures and software for arbitration – the E-Arbitration-T project. By using presents four common factors – deadline, length of task, importance of customer, importance to business – that need to be incorporated within any business process model of knowledge worker behaviour.

The research found that a richer model of knowledge worker behaviour is postulated and elements not necessary for the E-Arbitration-T model are identified. The knowledge worker's day was defined as being made up of Scheduled, On-demand and At-will tasks, only some of which may relate to the business process being modelled. A particular question that must be addressed in this extended model is how to model the choices knowledge workers make between competing at-will tasks.

**4) Raul Eamets, Krista Jaakson, (2014)**, the topic is about Labour market flexibility and spatial mobility. Recent economic recession has highlighted the role of labour market flexibility as a key factor of competitiveness of a country. Despite the fact that labour mobility can essentially be seen as part of labour market flexibility, there is notable research gap concerning spatial mobility and other facets of labour market flexibility. The purpose of this special issue is to fill these gaps. The papers in

the special issue represent various quantitative methods and databases, whereas mainly micro data (workplace, labor force or immigrant surveys, job search portal, etc.) is used. However, the type of labor market flexibility addressed is both micro- and macro-level.

It is demonstrated that labor occupational mobility is determined by the business cycle, numerical flexibility, occupational categories, and sector. Spatial mobility may have counterintuitive effects on individual occupational mobility depending on gender and it is related to various flexibilities in the workplace. It is also suggested that different types of flexibilities on a firm level are interdependent of each other.

**5) Husain ALOmar, (2007) "Determinants of Inflation in Kuwait",** This paper is an attempt to study the factors affecting the behavior of domestic inflation in Kuwait for the period from 1972 to 2004. To achieve this goal the study used three variables believed to influence inflation in a small open economy, namely, foreign inflation, domestic money supply and domestic real GDP. The variables were subjected to a stationary test which indicates that domestic inflation and money supply are first difference stationary, while foreign inflation and domestic income are stationary in their level. Accordingly, it may be argued that there is no evidence of a long run relationship between domestic inflation and its foreign counterpart. Based on these results the study tested the cointegration between domestic inflation and domestic money supply. The results indicate the exisence of long run relationship between inflation and the broad measure of money supply.

The study then moved to examine the possibility of short run relationships between domestic inflation and the rest of the variables using Granger causality test which indicates the lack of such relationships. Therefore, the study reveals that domestic inflation is influenced mainly by the development of domestic liquidity which overwhelmed the theoretically expected effect of imported inflation. These results might be caused by two main factors; the first is the economic and political developments during the period of study, and the second is the difference in constructing each measure of inflation. These factors might be responsible for distorting the expected relationship between domestic and imported inflation.

**6) Jan Saarela, Fjalar Finnäs, (2009)** the topic is Return migrant status and employment in Finland. The purpose of this paper is to examine the relative employment levels of return migrants in Finland with regard to their re-adaptation into the labour market.

Both male and female return migrants have odds of employment that are only about half those of their non-migrant counterparts. The employment differential is stable over time and, consequently, not particularly sensitive to changes in the macroeconomic environment. Relative employment rates of migrants with short periods abroad and long periods in the home country are somewhat higher than those of other migrants, but still lower than those of non-migrants. Difficulties in readapting into Finnish society are consequently associated with personal characteristics that cannot be observed explicitly but are apparently associated with job-finding probability.

**7) Arthur Morgan, Jocelyn Finniear, (2009)** "Migrant workers and the changing psychological contract", The influx of migrant workers in the UK has widespread interest. This group's experience of the British work place has evoked considerable debate ranging from the potential to be exploited through unscrupulous practices to allegations about taking away jobs from British workers. The purpose of this paper is to extend knowledge about the workplace experiences of migrant workers and discuss the implications this may offer for human resource management practice.

The dynamics of the psychological contract has been fundamentally affected by increasing numbers of migrant workers in the workplace. There is clear potential for a dual system to exist where migrant workers are treated differently in terms of recruitment, training and deployment. The ability to ensure employees work safely and are equipped to undertake their job roles is a key concern.

**8) Renate Ortlieb, Barbara Sieben, (2010)** "Migrant employees in Germany: personnel structures and practices", The purpose of this paper is to examine the representation of migrant employees in German organizations and to demonstrate that their employment opportunities are outcomes of diversity strategies – i.e. patterns of personnel practices and the reasons that cause them or are alleged to do so.



Empirical analyses revealed that diversity strategies are tightly related to personnel structures and practices. The best employment opportunities and career prospects for skilled migrants are offered by companies pursuing a diversity strategy labelled learning. In addition, the findings demonstrate the robustness of this typology.

**9) Matthew F. Pierlott, (2004)** "Moral considerations in outsourcing to foreign labor",This paper argues that the principles of capitalism do not condone the widespread practice of labor exploitation occurring across the globe. Instead, they demand that

some countermeasure be enacted to mitigate the structural oppression of laborers in less developed economies.

Through heavy use of two scholars, Horace Fairlamb and Robert Goodin, the author concludes that corporations outsourcing their labor to such workers must pay a "sustainable living wage". Fairlamb's analysis of Adam Smith reveals the potential undervaluation of labor in free markets, and Goodin's ethical theory produces a principle of group responsibility that the author applies to corporations, who are in the best position to remedy the situation.

**10) Ihab Khaled Magableh, Abdel Baset Athamneh, Maher Almahrouq, (2010)** "The economic impact of inbound and outbound labor migration: the case of Jordan (1970-2006)", The purpose of this paper is to examine the impact of inbound and outbound labor migration on the Jordanian economy.

The characteristics of foreign labor and the Jordanian labor abroad, in terms of skills and qualifications are completely different. Productivity of a local worker is found to be higher than of a foreign worker. Thus, replacement of foreign labor is highly recommended but difficult due to "shame culture". Foreign labor deepens unemployment and negatively affects economic growth through their effect on capital account, total reserve, and investment. Outbound labor migration reduced unemployment and speeds economic growth. They induce investment and increase reserves, but they also put an upward pressure on overall price and induce imported inflation.

**Table 2.1:** The conclusion of Literature review

| Author | Topic | Purpose | Finding |
|---|---|---|---|
| Liis Roosaar, Pille Mõtsmees, Urmas Varblane, (2014) | Occupational mobility over the business cycle | To examine how occupational mobility varies over the business cycle and how selected factors contribute to occupational mobility in different stages of the business cycle. | This study found that the analysis indicates that occupational mobility is higher during the recovery and boom periods and lower during the recession stage. |
| Peter Enderwick, Rosalie L. Tung, Henry F.L. Chung, (2011) | Immigrant effects and international business activity | To examine the myriad linkages between cross-border migration and international business activity through a conceptual framework of international arbitrage. | This research found that migrants can help reduce transaction costs for bilateral trade, contribute to nostalgic trade, encourage outsourcing and foreign direct investment through referrals and performance signalling, assist country of origin development through remittances and return migration and provide valuable knowledge to their employers in the country of residence. |
| Tony Elliman, Julie Eatock, Nicky Spencer, (2005) | Modelling knowledge worker behaviour in business process studies. | To describe a successful use of simulated knowledge worker behaviour used in the developing online procedures and software for arbitration – the E-Arbitration-T project. | The research found that a richer model of knowledge worker behaviour is postulated and elements not necessary for the E-Arbitration-T model are identified. The knowledge worker's day was defined as being made up of Scheduled, On-demand and At-will tasks, only some of which may relate to the business process being modelled. |

**Table 2.1:** The conclusion of Literature review (continued)

| Author | Topic | Purpose | Finding |
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| Raul Eamets, Krista Jaakson, (2014) | Labor market flexibility and spatial mobility | To fill these gaps. The papers in the special issue represent various quantitative methods and databases, whereas mainly micro data (workplace, labor force or immigrant surveys, job search portal, etc.) is used. However, the type of labor market flexibility addressed is both micro- and macro-level. | It is demonstrated that labor occupational mobility is determined by the business cycle, numerical flexibility, occupational categories, and sector. Spatial mobility may have counterintuitive effects on individual occupational mobility depending on gender and it is related to various flexibilities in the workplace. It is also suggested that different types of flexibilities on a firm level are interdependent of each other. |
| Husain AL-Omar, (2007) | Determinants of Inflation in Kuwait | This paper is an attempt to study the factors affecting the behavior of domestic inflation in Kuwait for the period from 1972 to 2004. To achieve this goal the study used three variables believed to influence inflation in a small open economy, namely, foreign inflation, domestic money supply and domestic real GDP. | The study reveals that domestic inflation is influenced mainly by the development of domestic liquidity which overwhelmed the theoretically expected effect of imported inflation. These results might be caused by two main factors; the first is the economic and political developments during the period of study, and the second is the difference in constructing each measure of inflation. These factors might be responsible for distorting the expected relationship between domestic and imported inflation. |

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| Arthur Morgan, Jocelyn Finniear, (2009) | Migrant workers and the changing psychological contract | To extend knowledge about the workplace experiences of migrant workers and discuss the implications this may offer for human resource management practice. | The dynamics of the psychological contract has been fundamentally affected by increasing numbers of migrant workers in the workplace. There is clear potential for a dual system to exist where migrant workers are treated differently in terms of recruitment, training and deployment. The ability to ensure employees work safely and are equipped to undertake their job roles is a key concern. |

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| Author | Topic | Purpose | Finding |
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| Renate Ortlieb, Barbara Sieben, (2010) | Migrant employees in Germany: personnel structures and practices | To examine the representation of migrant employees in German organizations and to demonstrate that their employment opportunities are outcomes of diversity strategies | Empirical analyses revealed that diversity strategies are tightly related to personnel structures and practices. The best employment opportunities and career prospects for skilled migrants are offered by companies pursuing a diversity strategy labelled learning. In addition, the findings demonstrate the robustness of this typology. |
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| Ihab Khaled Magableh, Abdel Baset Athamneh, Maher Almahrouq, (2010) | The economic impact of inbound and outbound labor migration: the case of Jordan (1970-2006) | To examine the impact of inbound and outbound labor migration on the Jordanian economy. | The characteristics of foreign labor and the Jordanian labor abroad, in terms of skills and qualifications are completely different. Productivity of a local worker is found to be higher than of a foreign worker. Thus, replacement of foreign labor is highly recommended but difficult due to "shame culture". |

# CHAPTER 3

# Methodology

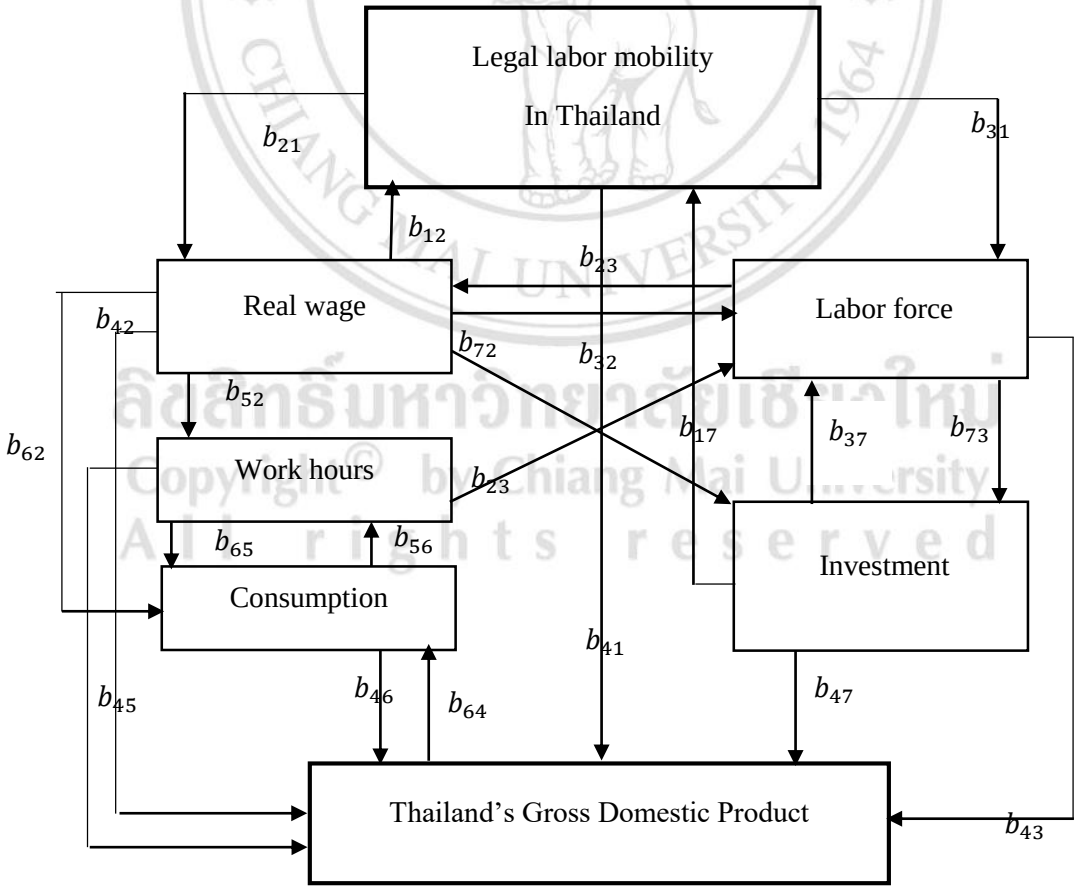
## 3.1 Scope of the study

This study use the time series annual data of Thailand, since 2007-2015. The secondary data is the number of foreign labor which includes Myanmar, Laos and Cambodia, Gross Domestic Product, real wage, the labor force, work hours, consumption and investment.

## 3.2 Conceptual framework

This conceptual framework shows the impact of migrant labor mobility in Thailand on Thailand's Real Gross Domestic Product which reflect on business cycle.

**Figure 3.1:** Conceptual Framework




Source: The author

### 3.3 Model

A study of the relationship between the mobility of migrant workers and the business cycle of Thailand. Population growth rate of Thailand is likely to decrease and demand for labor in Thailand grows every year according to the Thai economy. The author decided to use the real business cycle model that used in the study of $b_{41}$

### 3.4. Data collection

**Table 3.1: Data collection**

| Variable | Meaning |
|---|---|
| **MLR** | Migrant labor (Myanmar, Laos and Cambodia) |
| **LF** | Labor force |
| **Y** | Gross Domestic Product |
| **h** | work hours |
| **c** | consumption |
| **i** | investment |
| ***w*** | wage |

Source: Author

### 3.5 Research Methodologies

3.5.1 SVAR model

The data in conceptual framework is used to generate the model for quantitative analysis. The variables of the model consist of the number of migrant worker 3 nationalities (Myanmar, Laos and Cambodia) (MLR), the real wage, the labor force (LR), Gross Domestic Product(Y), work hours(h), consumption(c) and investment(I). This study use Structural Vector Auto Regression model (SVAR) by Sims(1980) because this method is widely use to estimate multi-variable data set the dynamic effects of shock or innovation. This model use an impulse response function to calculate the direction and size of the correlation between the migrant labor mobility and business cycle of Thailand after the shocks happened. And this function denote how the variables respond to structural shock. Then the author will test the variance decompositions for the variables that respond to the shocks of Thailand's business cycle.

SVAR model impose that all variables in the model is endogenous variable and relate with time $(t)$. SVAR is contrary to Vector Auto Regression model(VAR) which has exogenous variable.

$$X_t = [MLR_t, w_t, LR_t, Y_t, h_t, c_t, i_t] \quad (3.1)$$

From equation…, $X_t$ is vector of endogenous variable

In form of multivariate equation:

$$AX_t = C + A(L)X_{t-1} + \varepsilon_t \quad (3.2)$$

Where $A$ is Matrix multiplication ($7 \times 7$), which denote the impulse response of endogenous variable to structural shocks.

$C$ is constant value

$A(L)$ is matrix polynomial at time $t-1$

$\varepsilon_t$ is the vector of structural shock ; $\varepsilon_t = [\varepsilon_{MLR}, \varepsilon_w, \varepsilon_{LR}, \varepsilon_Y, \varepsilon_h, \varepsilon_c, \varepsilon_i]'$

From equation (3.2), multiple by $A^{-1}$ for adjust the equation into reduced form:

$$A^{-1}AX_t = A^{-1}C + A^{-1}A(L)X_{t-1} + A^{-1}\varepsilon_t \quad (3.3)$$

Assume that $A_0 = A^{-1}C$

$A_1 = A^{-1}A(L)$

$e_t = A^{-1}\varepsilon_t$

Therefore,

$$X_t = A_0 + A_1X_{t-1} + e_t \quad (3.4)$$

Rewritten $e_t = A^{-1}\varepsilon_t$ into the matrix form as the following form because SVAR only concentrate on shock.

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} & a_{17} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} & a_{27} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} & a_{37} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} & a_{47} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} & a_{57} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{75} & a_{76} & a_{77} & a_{77} \end{bmatrix}^{-1} \begin{bmatrix} \varepsilon_{MLR} \\ \varepsilon_w \\ \varepsilon_{LR} \\ \varepsilon_Y \\ \varepsilon_h \\ \varepsilon_c \\ \varepsilon_i \end{bmatrix} = \begin{bmatrix} e_{MLR} \\ e_w \\ e_{LR} \\ e_Y \\ e_h \\ e_c \\ e_i \end{bmatrix} \quad (3.5)$$

Assume that

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} & a_{17} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} & a_{27} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} & a_{37} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} & a_{47} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} & a_{57} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{75} & a_{76} & a_{77} & a_{77} \end{bmatrix}^{-1} = \begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} & b_{16} & b_{17} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} & b_{26} & b_{27} \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} & b_{36} & b_{37} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} & b_{46} & b_{47} \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & b_{56} & b_{57} \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} & b_{67} \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & b_{77} \end{bmatrix} \quad (3.6)$$

Take equation (3.6) into (3.5):

$$\begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} & b_{16} & b_{17} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} & b_{26} & b_{27} \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} & b_{36} & b_{37} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} & b_{46} & b_{47} \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & b_{56} & b_{57} \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} & b_{67} \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & b_{77} \end{bmatrix} \begin{bmatrix} \varepsilon_{MLR} \\ \varepsilon_w \\ \varepsilon_{LR} \\ \varepsilon_Y \\ \varepsilon_h \\ \varepsilon_c \\ \varepsilon_i \end{bmatrix} = \begin{bmatrix} e_{MLR} \\ e_w \\ e_{LR} \\ e_Y \\ e_h \\ e_c \\ e_i \end{bmatrix} \quad (3.7)$$

Then, impose $n$ to be the number of variable, in this case$n = 7$. So, there are 21 structural shocks which calculated from $\{n(n-1)\}/2$ and each structural shock has a zero restrictions

1) The equation describes the effect of shock on migrant labor mobility. Equation (3.7) can be rewritten as the equation describe the effect of shock on migrant labor mobility:

$$b_{11}\varepsilon_{MLR} + b_{12}\varepsilon_w + b_{13}\varepsilon_{LR} + b_{14}\varepsilon_Y + b_{15}\varepsilon_h + b_{16}\varepsilon_c + b_{17}\varepsilon_i = e_{MLR} \quad (3.8)$$

From the above reason, This study found migrant labor is influenced by changing in real wage and investment in the equation(3.8). Therefore, the coefficient of other variables which are GDP, work hour, labor force and consumption equal to zero whereas the change of the real wage on migrant labor is determined by $b_{12}, b_{17}$. The coefficient of migrant labor $\varepsilon_{MLR}$ equal to 1, which means that the change of real wage will affect itself at the same rate. as shown in the following equation:

$$e_{MLR} = (1)\varepsilon_{MLR} + b_{12}\varepsilon_w + (0)\varepsilon_{LR} + (0)\varepsilon_Y + (0)\varepsilon_h + (0)\varepsilon_c + b_{17}\varepsilon_i \quad (3.9)$$

Or

$$e_{MLR} = \varepsilon_{MLR} + b_{12}\varepsilon_w + b_{17}\varepsilon_i \quad (3.10)$$



2) The equation describes the effect of shock on real wages.

Equation (3.7) can be rewritten as the equation describe the effect shock on real wages:

$$b_{21}\varepsilon_{MLR} + b_{22}\varepsilon_w + b_{23}\varepsilon_{LR} + b_{24}\varepsilon_Y + b_{25}\varepsilon_h + b_{26}\varepsilon_c + b_{27}\varepsilon_i = e_w \quad (3.11)$$

This study found that real wage is influenced by changing in labor force and migrant labor in the equation (3.11). Therefore, the coefficient of other variables which are GDP, work hour, consumption and investment equal to zero whereas the change of the quantity of migrant labor and labor force on real wage is determined by

$b_{21}, b_{42}$. The coefficient of real wage$\varepsilon_w$ equal to 1, which means that the change of real wage will affect itself at the same rate. as shown in the following equation:

$$e_w = b_{21}\varepsilon_{MLR} + (1)\varepsilon_w + b_{23}\varepsilon_{LR} + (0)\varepsilon_Y + (0)\varepsilon_h + (0)\varepsilon_c + (0)\varepsilon_i \quad (3.12)$$

Or

$$e_w = b_{21}\varepsilon_{MLR} + \varepsilon_w + b_{23}\varepsilon_{LR} \quad (3.13)$$

3) The equation describes the effect of shock on labor force.

Equation (3.7) can be rewritten as the equation describe the effect shock on labor force:

$$b_{31}\varepsilon_{MLR} + b_{32}\varepsilon_w + b_{33}\varepsilon_{LR} + b_{34}\varepsilon_Y + b_{35}\varepsilon_h + b_{36}\varepsilon_c + b_{37}\varepsilon_i = e_{LR} \quad (3.13)$$

This study found labor force is influenced by changing in real wage, work hours investment and migrant labor in the equation (3.13). Therefore, the coefficient of other variables which are GDP and consumption equal to zero whereas the change of the quantity of migrant labor, real wage, work hours and investment on labor force is determined by $b_{31}, b_{32}, b_{35}, b_{37}$. The coefficient of labor force$\varepsilon_{LR}$ equal to 1, which means that the change of labor force will affect itself at the same rate as shown in the following equation:

$$e_{LR} = b_{31}\varepsilon_{MLR} + b_{32}\varepsilon_w + (1)\varepsilon_{LR} + (0)\varepsilon_Y + b_{35}\varepsilon_h + (0)\varepsilon_c + b_{37}\varepsilon_i \quad (3.14)$$

Or

$$e_{LR} = b_{31}\varepsilon_{MLR} + b_{32}\varepsilon_w + \varepsilon_{LR} + b_{35}\varepsilon_h + b_{37}\varepsilon_i \quad (3.15)$$



4) The equation describes the effect of shock on gross domestic product.

Equation (3.7) can be rewritten as the equation describe the effect shock on real wages:

$$b_{41}\varepsilon_{MLR} + b_{42}\varepsilon_w + b_{43}\varepsilon_{LR} + b_{44}\varepsilon_Y + b_{45}\varepsilon_h + b_{46}\varepsilon_c + b_{47}\varepsilon_i = e_Y \quad (3.16)$$

This study found Gross Domestic Product is influenced by changing in migrant labor, real wage, labor force, work hours, consumption and investment in the equation (3.16). So, the change of these six variables on GDP is determined.

by$b_{41}, b_{42}, b_{43}, b_{45}, b_{46}, b_{47}$. The coefficient of GDP $\varepsilon_Y$ equal to 1, which means that the change of GDP will affect itself at the same rate as shown in the following equation:

$$e_Y = b_{41}\varepsilon_{MLR} + b_{42}\varepsilon_w + b_{43}\varepsilon_{LR} + (1)\varepsilon_Y + b_{45}\varepsilon_h + b_{46}\varepsilon_c + b_{47}\varepsilon_i \quad (3.17)$$

Or

$$e_Y = b_{41}\varepsilon_{MLR} + b_{42}\varepsilon_w + b_{43}\varepsilon_{LR} + \varepsilon_Y + b_{45}\varepsilon_h + b_{46}\varepsilon_c + b_{47}\varepsilon_i \quad (3.18)$$

5) The equation describes the effect of shock on work hours.

Equation (3.7) can be rewritten as the equation describe the effect shock on work hours:

$$b_{51}\varepsilon_{MLR} + b_{52}\varepsilon_w + b_{53}\varepsilon_{LR} + b_{54}\varepsilon_Y + b_{55}\varepsilon_h + b_{56}\varepsilon_c + b_{57}\varepsilon_i = e_h \quad (3.19)$$

This study found work hours is influenced by changing in real wage and consumption in the equation (3.19). Therefore, the coefficient of other variables which are migrant labor, labor force, GDP and investment equal to zero whereas the change of the real wage and consumption on work hours is determined by $b_{52}, b_{56}$. The coefficient of work hours $\varepsilon_h$ equal to 1, which means that the change of work hours will affect itself at the same rate. as shown in the following equation:

$$e_h = (0)\varepsilon_{MLR} + b_{52}\varepsilon_w + (0)\varepsilon_{LR} + (0)\varepsilon_Y + (1)\varepsilon_h + b_{56}\varepsilon_c + (0)\varepsilon_i \quad (3.20)$$

Or

$$e_h = b_{52}\varepsilon_w + \varepsilon_h + b_{56}\varepsilon_c \quad (3.21)$$

6) The equation describes the effect of shock on consumption.

Equation (3.7) can be rewritten as the equation describe the effect shock on **work hours**:

$$b_{61}\varepsilon_{MLR} + b_{62}\varepsilon_w + b_{63}\varepsilon_{LR} + b_{64}\varepsilon_Y + b_{65}\varepsilon_h + b_{66}\varepsilon_c + b_{67}\varepsilon_i = e_c \quad (3.22)$$

This study found consumption is influenced by changing in real wage, GDP and work hours in the equation(3.22). Therefore, the coefficient of other variables which are migrant worker, labor force, consumption and investment equal to zero whereas the change of the GDP and work hours on consumption is determined by $b_{62}, b_{64}, b_{65}$. The coefficient of consumption$\varepsilon_c$ equal to 1, which means that the change of consumption will affect itself at the same rate. as shown in the following equation:

$$e_c = (0)\varepsilon_{MLR} + b_{62}\varepsilon_w + (0)\varepsilon_{LR} + b_{64}\varepsilon_Y + b_{65}\varepsilon_h + (1)\varepsilon_c + (0)\varepsilon_i \quad (3.23)$$

Or

$$e_c = b_{62}\varepsilon_w + b_{64}\varepsilon_Y + b_{65}\varepsilon_h + \varepsilon_c \quad (3.24)$$

7) The equation describes the effect of shock on investment.

Equation (3.7) can be rewritten as the equation describe the effect shock on investment:

$$b_{71}\varepsilon_{MLR} + b_{72}\varepsilon_w + b_{73}\varepsilon_{LR} + b_{74}\varepsilon_Y + b_{75}\varepsilon_h + b_{76}\varepsilon_c + b_{77}\varepsilon_i = e_c \quad (3.25)$$

This study found investment is influenced by changing in labor force and real wage in the equation(3.25). Therefore, the coefficient of other variables which are migrant worker, GDP, work hour and consumption equal to zero whereas the change of the quantity of labor force and real wage on investment is determined by $b_{72}, b_{73}$. The coefficient of investment$\varepsilon_i$ equal to 1, which means that the change of investment will affect itself at the same rate. as shown in the following equation:

$$e_i = (0)\varepsilon_{MLR} + b_{72}\varepsilon_w + b_{73}\varepsilon_{LR} + (0)\varepsilon_Y + (0)\varepsilon_h + (0)\varepsilon_c + (1)\varepsilon_i \quad (3.26)$$

Or

$$e_c = b_{72}\varepsilon_w + b_{73}\varepsilon_{LR} + \varepsilon_i \quad (3.27)$$

Rewritten equation (3.10),(3.13),(3.15),(3.18),(3.21), (3.24) and (3.27) into the form of matrix. As shown in the following equation, there are 21 zero restrictions, then these variables will be tested by exact identification.

$$\begin{bmatrix} 1 & b_{12} & 0 & 0 & 0 & 0 & b_{17} \\ b_{21} & 1 & b_{23} & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & b_{35} & 0 & b_{37} \\ b_{41} & b_{42} & b_{43} & 1 & b_{45} & b_{46} & b_{47} \\ 0 & b_{52} & 0 & 0 & 1 & b_{56} & 0 \\ 0 & b_{62} & 0 & b_{64} & b_{65} & 1 & 0 \\ 0 & b_{72} & b_{73} & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{MLR} \\ \varepsilon_w \\ \varepsilon_{LR} \\ \varepsilon_Y \\ \varepsilon_h \\ \varepsilon_c \\ \varepsilon_i \end{bmatrix} = \begin{bmatrix} e_{MLR} \\ e_w \\ e_{LR} \\ e_Y \\ e_h \\ e_c \\ e_i \end{bmatrix} \quad (3.28)$$



3.5.2 Unit root test

Time-series data of $Y_t$ is a stationary when mean, variance and covariance of series have a constant term.

1) $E(Y_t) = E(Y_{t+k}) = \mu = constant$

2) $var(Y_t) = var(Y_{t+k}) = \sigma^2 = constant$

3) $cov(Y_t, Y_{t+k}) = E(Y_t - \mu)(Y_{t+k} - \mu) = \sigma_{k-\mu} = constant$

3.5.3. Lag

This study use the Akaike information criteria (AIC) for measuring lag.

$$AIC = \ln(|E_u|) + \frac{2pK^2}{T} \quad (3.29)$$

Where

$|E_u|$ as determinant of covariance matrices of fault

$p$ as the number of lag

$K$ as the number of equation

$T$ as the number of example

# CHAPTER 4

# Results

## 4.1 Impulse Response Function

In Impulse Response result, each plot illustrates the impact of a sign one standard deviation change in the variable in the column to the equations in the row. There is divided into 7 cases as follows

4.1.1 Impulse Response from MLR to other variables in figure 4.1.

1) The Impulse Response from MLR to itself when one standard deviation change in the MLR variable. First the number of Migrant labor is strongly increase around 15% for the first one quarter and then suddenly decline to average in the second quarter before heading up to 3 % in the fourth quarter. Then it slightly decrease to 0.5% in the third quarter. There has been a continuous rise and fall until come back to balance at the tenth quarter.

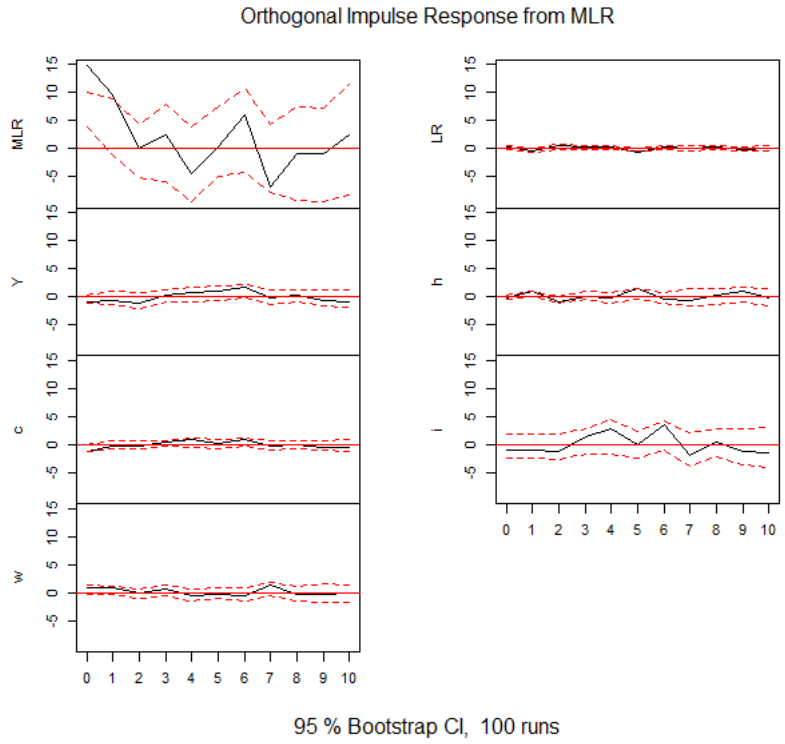
2.) The Impulse Response from Migrant labor to Thailand's Gross Domestic Product (GDP) when one standard deviation change in MLR. Gross Domestic Product is slightly decline before increasing to the equilibrium point in the third quarter and rise in the fourth quarter then coming back to balance and reduce slightly later.

3.) The Impulse Response from Migrant labor to consumption (c), wage(w), labor force(LR) and work hours(h) when one standard deviation change in MLR. The change in Migrant labor does not cause various impact on the consumption, wage, and labor force and work hours.

4.) The Impulse Response from MLR to itself when one standard deviation change in MLR. The investment will not be changed immediately but it will increase in the second quarter and decrease back into the equilibrium point in the fifth

quarter. After that the investment increase and decrease into balance again. Then, there are a small reduction since the sixth quarter.

**Figure 4.1:** Impulse Response from MLR to other variables.

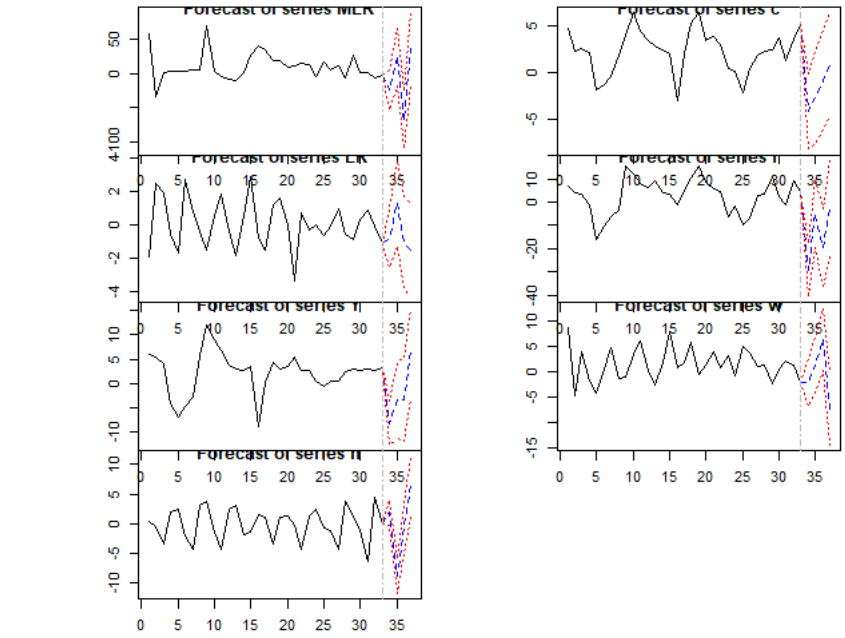



Source: Rstudio program

## 4.2 VAR Model predication (1 year advance)

In addition, there was found that in the long term (next 1 years) the impact of various changes on foreign labor volatility. After Thailand entered the ASEAN Economic Community (AEC) in 2015, it will be a period of liberalization between ASEAN countries. There includes labor liberalization as well. It is expected that more foreign workers in ASEAN will enter the Thai labor market legally. However, when Thailand entered the AEC, it will cause illegal foreign workers from ASEAN countries who come to work in Thailand become legal. The conclusion is that Thailand entering the AEC may be a motivation for foreign workers, both skilled and unskilled. Wage has decreased due to increase of labor supply in the market, result in reduction of demand of labors. The foreign labors want to work in Thailand more legally. Finally, The labor market in Thailand is expanding. Resulting in more economic growth .

**Figure 4.2:** VAR Model predication (1 year advance)




Source: Rstudio program

### 4.3 Variance Decomposition

The resulting from Variance Decomposition of MLR. In the beginning, the volatility of foreign workers will affect itself 100 percent, over time there is less impact on itself. On average, it affects approximately 70 percent. In long run, other variables determine the volatility of foreign workers increase such as LR, Y, h, i and w.

#### 4.3.1 Variance Decomposition of Y

The variance decomposition of Y show that at that time how the variance of Thailand's GDP or Business cycle is affected from the shock of foreign workers. The study indicated that Proportion of migrant workers shock with variance of GDP is about 14 percent. From the first quarter, the proportion of foreign workers shock is at 20 percent. This study found that the proportion of foreign workers shock with the variance of GDP has been steadily decreasing.

**Table 4.1:** Variance Decomposition of Y

| Variance Decomposition of Y | | | | | | | |
|---|---|---|---|---|---|---|---|
| Quarter | MLR | LR | Y | h | c | i | w |
| 1 | 0.200445 | 0.002307 | 0.797248 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.095648 | 0.211238 | 0.422743 | 0.054345 | 0.038097 | 0.175619 | 0.002309 |
| 3 | 0.147372 | 0.219300 | 0.358740 | 0.061667 | 0.039476 | 0.171188 | 0.002256 |
| 4 | 0.130344 | 0.216866 | 0.341443 | 0.112827 | 0.041323 | 0.155199 | 0.001998 |

Source: Rstudio program

### 4.4 Parameter estimation in SVAR model

From equation (44), there are 21 zero restrictions, the variable that have a relationship between each other.

$$\begin{bmatrix} 1 & b_{12} & 0 & 0 & 0 & 0 & b_{17} \\ b_{21} & 1 & b_{23} & 0 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & b_{35} & 0 & b_{37} \\ b_{41} & b_{42} & b_{43} & 1 & b_{45} & b_{46} & b_{47} \\ 0 & b_{52} & 0 & 0 & 1 & b_{56} & 0 \\ 0 & b_{62} & 0 & b_{64} & b_{65} & 1 & 0 \\ 0 & b_{72} & b_{73} & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{MLR} \\ \varepsilon_{w} \\ \varepsilon_{LR} \\ \varepsilon_{Y} \\ \varepsilon_{h} \\ \varepsilon_{c} \\ \varepsilon_{i} \end{bmatrix} = \begin{bmatrix} e_{MLR} \\ e_{w} \\ e_{LR} \\ e_{Y} \\ e_{h} \\ e_{c} \\ e_{i} \end{bmatrix} \tag{4.1}$$

The study of the relationship between foreign labor mobility and Gross Domestic Product(GDP) of Thailand has been used time series data since first quarter of 2007 to second quarter of 2015 which is totally 34 years. These time series data is examined in the matrix form from equation (4.1) by using Rstudio program under SVAR model method.



$$\begin{bmatrix} 1 & 0.19152 & 0 & 0 & 0 & 0 & -0.144203 \\ -0.03697 & 1 & 0.2726 & 0 & 0 & 0 & 0 \\ 0.07432 & 0.10226 & 1 & 0 & 0.03531 & 0 & -0.001194 \\ 0.02345 & 0.35843 & 0.3035 & 1 & 0.32884 & 0.07129 & 0.063407 \\ 0 & 0.33369 & 0 & 0 & 1 & -0.10899 & 0 \\ 0 & 0.03701 & 0 & 0.2545 & -0.17333 & 1 & 0 \\ 0 & 0.19854 & 0.1698 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{MLR} \\ \varepsilon_{w} \\ \varepsilon_{LR} \\ \varepsilon_{Y} \\ \varepsilon_{h} \\ \varepsilon_{c} \\ \varepsilon_{i} \end{bmatrix} = \begin{bmatrix} e_{MLR} \\ e_{w} \\ e_{LR} \\ e_{Y} \\ e_{h} \\ e_{c} \\ e_{i} \end{bmatrix} \tag{4.2}$$

Every numbers in this equation refer to coefficient that indicate the effect of each variable's shock when one of these shock change. For instance, $b_{31}$ equal to 0.07432 so 0.07432 is the coefficient that show the response of GDP shock when MLR shock change.

After using the zero restrictions process with the time series data then, the data is put in parameter estimation in matrix form. It is shown as equation(4.1). After that, those data is run by Rstudio program under SVAR model condition. The study found that the shock of foreign workers ing Thailand can directly affect the gross domestic product in the same direction or in the positive way.

**4.5 Impulse Response Function in SVAR model**

The reason why Impulse Response Function is used in this study because Research need to know that how one variable effect to other variables when shock appear, in positive or negative way. The objective of this study is study how the change of foreign labor (shock) effect to business cycle of Thailand and how long shock affect to other variable by using SVAR model.

**4.5.1 SVAR Impulse Response from MLR**

During the year 2010-2011, most migrant workers who came to work in Thailand were illegal workers. Since 2012-June 2014, more migrant workers came to work in Thailand legally because the business and the private sector have more cooperative in foreign labor registration with the government policy. After Thailand entered the ASEAN society (AEC) in 2015, there is free trade between countries in the ASEAN community which include labor sector. Thus, more foreign workers are expected to enter Thailand legally.

If economic growth is continually grow and stable, Thai labor market will be able to support the increase of foreign workers from ASEAN countries without problems. But, due to the political problems and administrative problems in Thailand that are unstable, moreover corruption problems which cause the decreasing in the growth rate of Thai economy. In 2011, even though Thailand's GDP growth is declining but it turns out that foreign workers come to work in Thailand more than before. There are caused from many reasons.

Firstly, demand for labor less than supply of labor in neighboring countries in ASEAN. Next, the policy of the Thai government that determines the minimum wage of 300 baht per day is an incentive for foreign workers to work in Thailand because they want to receive wages that are higher than wages in their own country. Thirdly, Thai baht appreciation, Thai baht has a higher value compared to other

countries in ASEAN, encouraging foreign workers to come to work in Thailand in order to exchange wages from Thai baht to their own currency at a high rate. Living standard, society, tradition and religion of Thailand are similar to foreign workers's society such as the workers from Myanmar, Laos and Cambodia. They can adjust themselves for living in Thailand easily. Good transportation system. Thailand has a good transport system for making a convenient for travelers which does not cost much to use the service. Thailand has borders with neighboring countries such as Myanmar, Laos, Cambodia and Vietnam thus those labor could travel and come for a job in Thailand conveniently.

For this reason, in 2011, there were many foreign workers requesting permission to work in Thailand. Due to political problems in Thailand, the private sector has been greatly affected. Because political instability is affect to the decision on investment and business expansionary such as political unrest from 2011-2014, corruption problems and the minimum wage policy. These problems resulted in declining in investment of business sector and partially shut down their business. Higher wages cause the labor demand fall, resulting in decreased GDP

The entry of foreign workers increase public service users in the country. When combining the number of foreign workers with Thai people. The total number of public utilities of users increases, such as the use of free trains, using park service. These are all public goods. When there are more users, the government have to increase personnel and allocate budget for services to be sufficient for everyone

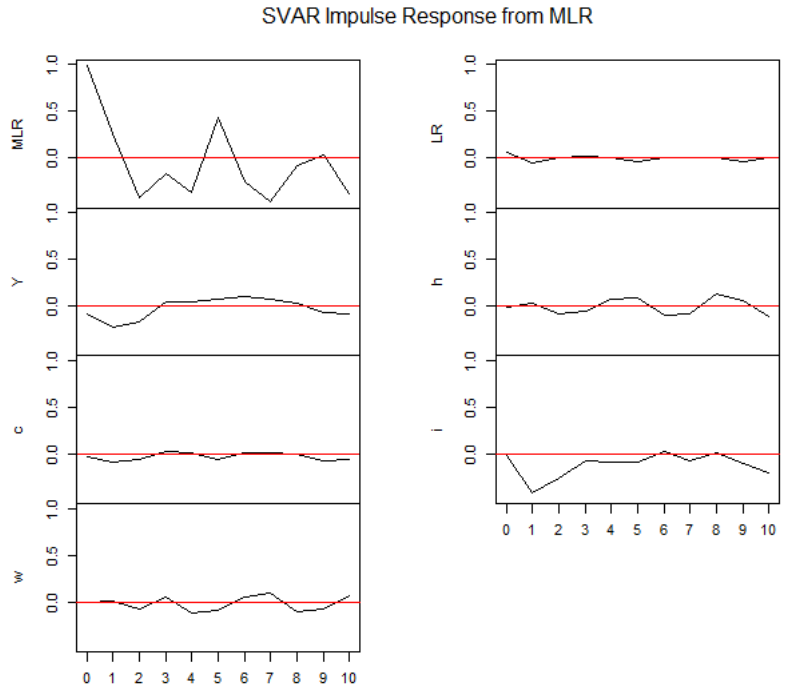
Nevertheless, According to the United Nations reported that migrant workers are extremely important to Thailand's economic development, but at the same time negatively impacting Thai workers in the agricultural sector. From the statistics in 2012, it was found that most of Thailand's labor force was migrant workers from Laos, Cambodia and Myanmar. While most Thai workers are hired to work as low skill labor in Bangkok, South and North West. About 40% of foreign workers are employed in agriculture and fisheries. Another 40% of the foreign workers work in the industrial and construction sectors. The rest are employed in services such as housewives.

In 2015, the agricultural industry has more foreign workers working in the industry than 0.7% of Thai workers, while the wages of Thai workers in this industry decreased by 4.3%. It reflect that foreign workers are able to replace Thai workers as well. The industrial sector found that Migrant workers have reduced the employment of Thai people by 0.3% and result in wages of Thai laborers falling by more than 2.4%.

Employment of migrant workers in the agricultural and industrial sectors has resulted in increased productivity in production. In 2013, the report found that migrant workers play a greater role in Thai economic development, with migrant workers contributing $ 4.4 billion in GDP. There is accounted for more than 1.1% of GDP.

Therefore, when MLR shock occur, in the beginning, the output (GDP) decrease. There is more migrant labor in the economic system while government run the minimum wage policy. When wage rate is rose, investor would change the decision on production management. Private sector could not carry a higher cost of production so they decrease their investment to save production cost. The demand for labor fall. Some firms stop their production for saving their cost. These cause the decreasing in investment in economic system of Thailand which tend to lower Gross Domestic Product (GDP) of Thailand at that time. However, in 2012, the report found that the number of foreign worker who work in Thailand is more than Thai worker due to these foreign labor are willing to work at lower wage rate. Therefore, there are more foreign worker employment in the economic system, especially in agricultural industry. When the investment increase, the GDP is greater. As shown in figure 4.3.

**Figure 4.3:** SVAR Impulse Response from MLR.




Source: Rstudio program

# CHAPTER 5

# Conclusion

## 5.1 Conclusion

The objective of this research is to test the statistical relationship between foreign workers and variables that are related to the business cycle. In order to understand the changes of the economic system resulting from changes in foreign workers. This study was conducted under the Real Business Cycle model used in Burlage and Spannig (2006) studies. In this case, this study insert foreign labor variable into production functions by using Structural Vector Autoregression (SVAR). Moreover, Impulse response analysis and variance decomposition is used to analyze data to answer research objectives. Research data is a quarterly time series data from Thailand since 2007 to 2015. Those variable in this study are Migrant labor(MLR), Labor force(LR), Gross Domestic Product(GDP), work hours(h), consumption(c), investment(i) and wage(w).

The result of unit root test by using Phillip-Perron test is all variable that used in this study is a stationary data. It means that those time series data are all constant over time. After the unit root test, these data need to have appropriately lag value for SVAR model. In this case, the lag value equal to 3. Then, the data is set in to matrix form with zero restriction model. The study found that the shock of foreign workers ing Thailand can directly affect the gross domestic product in the same direction or in the positive way.

Consequently, from the results of the study show the change of foreign labor that occur at various times is a cause of the Thai economy into a recession. At first, Thailand's real business cycle enter a recession period because the result from increasing in the number of migrant labor. It started from the higher wage rate

according to the minimum wage policy therefore the investment is decreased because increasing in the number of migrant labor. There is higher production cost. Following the national income identity, when investment decline, so the economic growth continually fall down which is a depression, until the economic growth is a trough period. After that, The proportion of foreign workers towards Thai workers increases especially in agricultural sector. Investors prefer to hire more migrant labor to work in their firm because those migrant labors are willing to earn wage at the low rate. So that the employment increase, the productivity rise, firm is willing to invest more than before which cause the real business cycle of Thailand was recovered and start to expand. Then the GDP decline to the lower point under the equilibrium line. It tend to the recession stage again following the law of real business cycle theory.

The variance decomposition of Y show that at that time how the variance of Thailand's GDP or Business cycle is affected from the shock of foreign workers. The study indicated that Proportion of migrant workers shock with variance of GDP is about 14 percent. From the first quarter, the proportion of foreign workers shock is at 20 percent. This study found that the proportion of foreign workers shock with the variance of GDP has been steadily decreasing.

**5.2 Suggestion**

In the next phase, if the government and private sectors invest more will help the Thai economy to move forward. The government sector should focus on quality investments. For instance investing and creating benefits for the business sector, such as infrastructure investment which can motivate the business sector to make investment decisions accordingly must focus on investing in the development of new technologies including investment to raise education and labor quality to help increase production capacity. When various facilities are sufficient for investment, the growth rate of domestic investment will increase which result in increased production factors. Factory increase an labor employment. Labor is becoming more desirable. The unemployment problem will be reduced. When the factory has enough factors, these could result in efficient production. The economy growth could rise and the real business cycle expand.

### 5.3 Limitation

The data that was used in this thesis is hard to collect due to the scope of this study is quite long. Therefore some of data is too difficult to find. Moreover, my study use quarterly data which nowadays a few of data have been collected in a quarter form.

The thesis use program Rstudio to analyze the variables that set up for estimate output by VAR package. The code that the author has for run the data is not quite suitable at first due to the data that have been used is quite fluctuate but after the author change the code to run the data again. The result is shown. This study finally got the correct result to study and solve the problem.

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# APPENDIX A

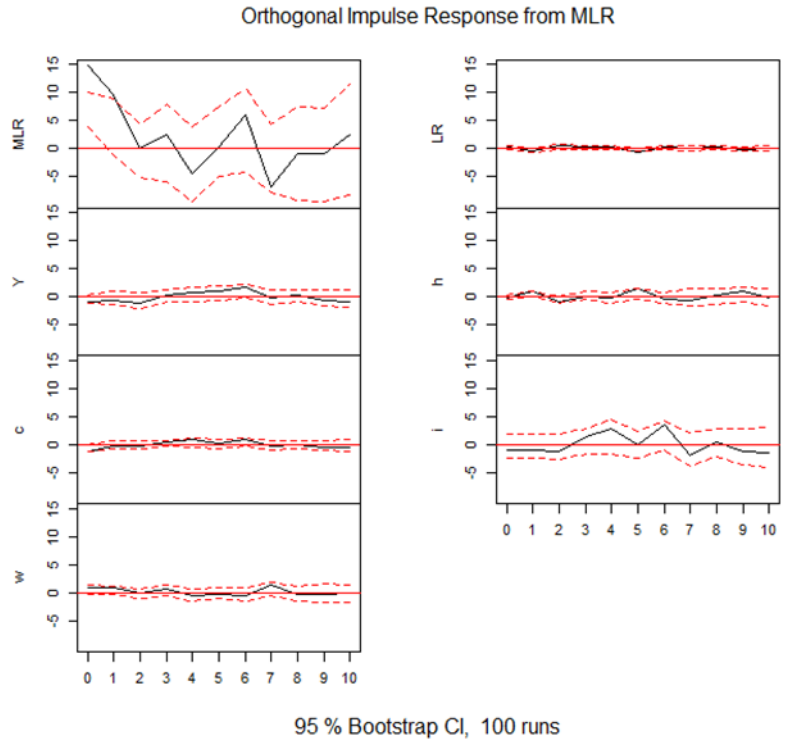
## Data collection

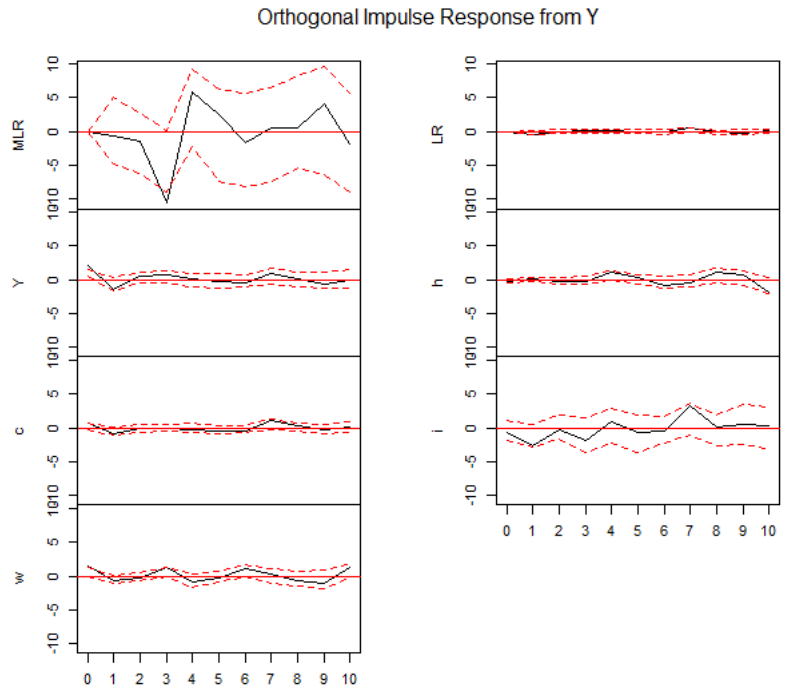
| | MLR | LR | Y | h | | c | i | w |
|---|---|---|---|---|---|---|---|---|
| 2007/Q1 | 56.46 | -1.85 | 6 | 0.5 | | 4.7 | 6.7 | 8.81 |
| 2007/Q2 | -33.59 | 2.53 | 5.3 | -0.5 | | 2.4 | 4.3 | -4.69 |
| 2007/Q3 | 1.88 | 1.93 | 4 | -3.37 | | 2.6 | 3.5 | 3.95 |
| 2007/Q4 | 2.59 | -0.5 | -4.3 | 2.05 | | 2.2 | -1.3 | -1.91 |
| 2008/Q1 | 2.29 | -1.63 | -7.1 | 2.47 | | -1.8 | -15.8 | -4.12 |
| 2008/Q2 | 2.81 | 2.75 | -4.9 | -2.05 | | -1.2 | -10.1 | 0.51 |
| 2008/Q3 | 4.03 | 0.82 | -2.8 | -4.24 | | -0.3 | -6.3 | 4.82 |
| 2008/Q4 | 4.09 | -0.37 | 5.8 | 3.21 | | 1.9 | -3.4 | -1.23 |
| 2009/Q1 | 67.96 | -1.51 | 12 | 3.82 | | 4 | 15.8 | -0.96 |
| 2009/Q2 | 2.95 | 0.62 | 9.1 | -1.39 | | 6.5 | 12.2 | 3.49 |
| 2009/Q3 | -5.48 | 1.85 | 6.7 | -4.24 | | 4.5 | 8 | 6.17 |
| 2009/Q4 | -8.04 | -0.37 | 3.8 | 2.4 | | 3.5 | 6.4 | 0.43 |
| 2010/Q1 | -10.5 | -1.78 | 3 | 3.1 | | 2.9 | 9.3 | -2.58 |
| 2010/Q2 | 0.54 | 0.63 | 2.6 | -1.89 | | 2.5 | 4.1 | 1.84 |
| 2010/Q3 | 25.97 | 2.92 | 3.5 | -1.34 | | 2.1 | 3.3 | 8 |
| 2010/Q4 | 39.64 | -0.8 | -9 | 1.6 | | -3 | -1.3 | 0.83 |
| 2011/Q1 | 34.02 | -1.46 | 0.3 | 1.03 | | 2 | 5.2 | 1.99 |
| 2011/Q2 | 17.85 | 1.25 | 4.2 | -3.33 | | 5.4 | 10.2 | 5.78 |
| 2011/Q3 | 19.06 | 1.6 | 3 | 1.01 | | 6.5 | 15.5 | -0.57 |
| 2011/Q4 | 9 | 0 | 3.6 | 1.35 | | 3.5 | 8.9 | 1.37 |
| 2012/Q1 | 11.55 | -3.36 | 5.3 | -0.15 | | 3.9 | 6 | 3.94 |
| 2012/Q2 | 15.12 | 0.74 | 2.8 | -4.25 | | 3 | 4.5 | 0.82 |
| 2012/Q3 | 12.42 | -0.29 | 2.7 | 1.23 | | 0.5 | -6.5 | 3.16 |
| 2012/Q4 | -5.06 | 0 | 0.6 | 2.48 | | 0.2 | -1.9 | -0.75 |
| 2013/Q1 | 15.73 | -0.58 | -0.6 | -0.66 | | -2.1 | -9.8 | 5.01 |
| 2013/Q2 | 5.21 | -0.03 | 0.4 | -1.11 | | 0.5 | -6.9 | 3.64 |
| 2013/Q3 | 10.47 | 0.96 | 0.6 | -4.26 | | 1.9 | 2.9 | 1.12 |
| 2013/Q4 | -5.89 | -0.55 | 2.3 | 3.75 | | 2.4 | 3.2 | 1.46 |
| 2014/Q1 | 26.77 | -0.82 | 3 | 1.35 | | 2.45 | 10.7 | -2.45 |
| 2014/Q2 | 1.54 | 0.33 | 2.8 | -0.89 | | 3.8 | 2.5 | 0.58 |
| 2014/Q3 | 0.7 | 0.94 | 2.9 | -6.29 | | 1.35 | -1.2 | 2.06 |
| 2014/Q4 | -7.46 | -0.06 | 2.8 | 4.56 | | 3.65 | 9.4 | 1.29 |
| 2015/Q1 | -3.19 | -1.11 | 3.2 | 0 | | 5.15 | 4.7 | -2.02 |
| 2015/Q2 | 7.98 | -0.4 | 3.5 | 0.69 | | 3 | 2.7 | 1.16 |
| 2015/Q3 | 2.22 | 1.37 | 3.2 | -4.78 | | -1.15 | 3.2 | 1.11 |
| 2015/Q4 | -2.11 | -1.99 | 3 | 3.11 | | 2 | 1.8 | 1.16 |

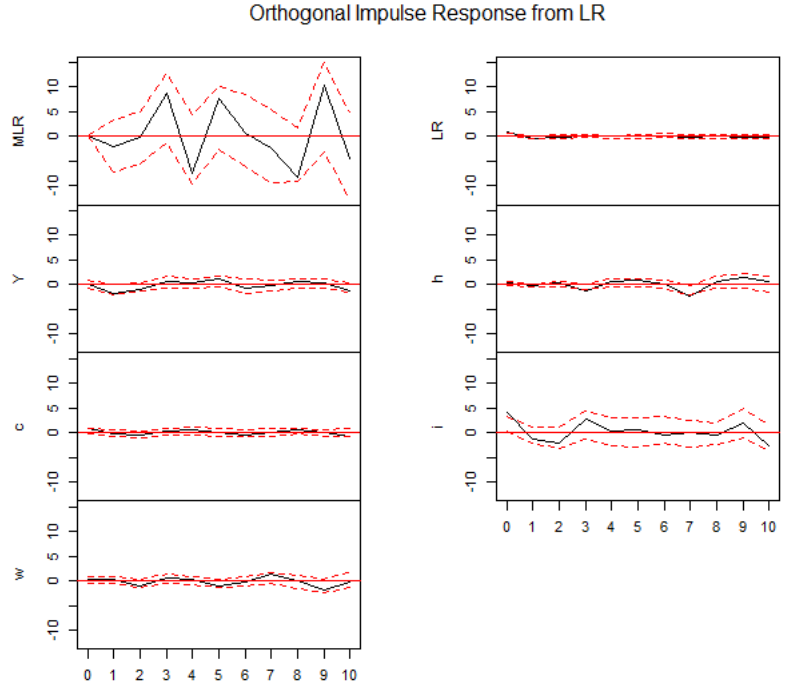
# APPENDIX B

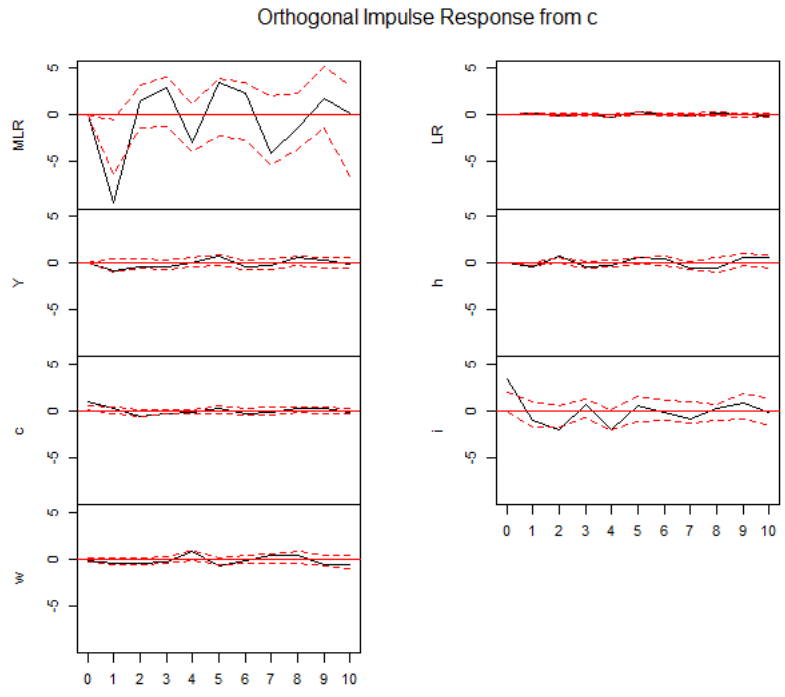
## Data from Rstudio program

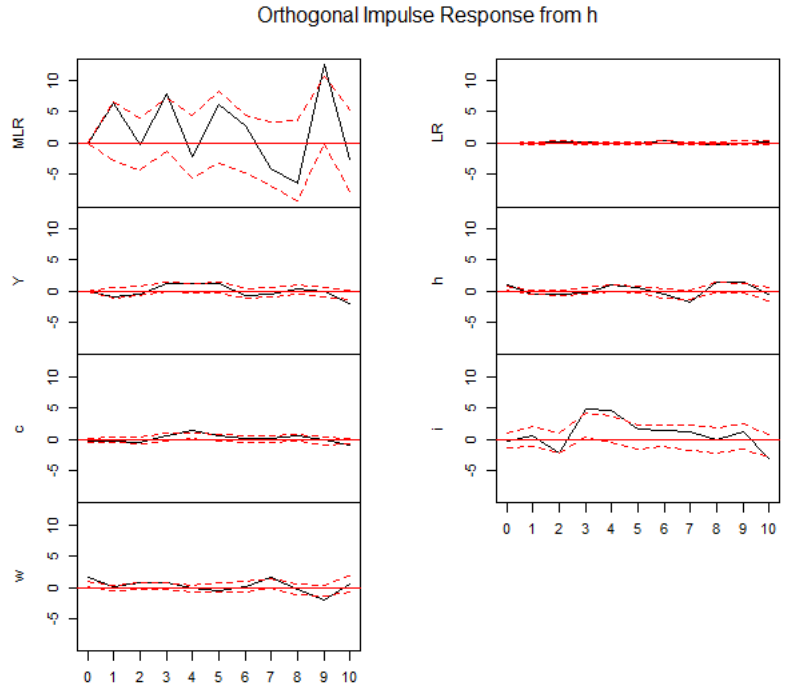
### Appendix B1. Orthogonal Impulse Response from each variable

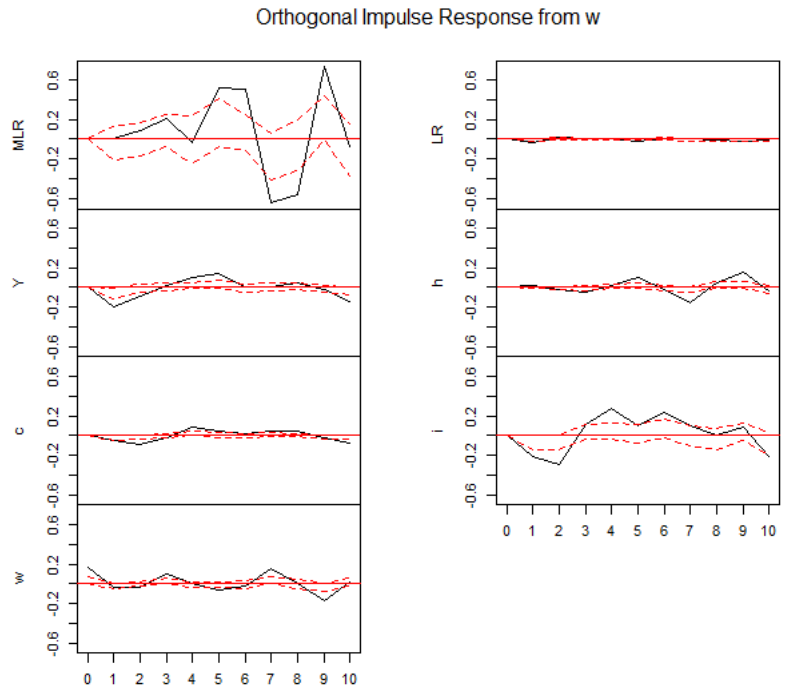


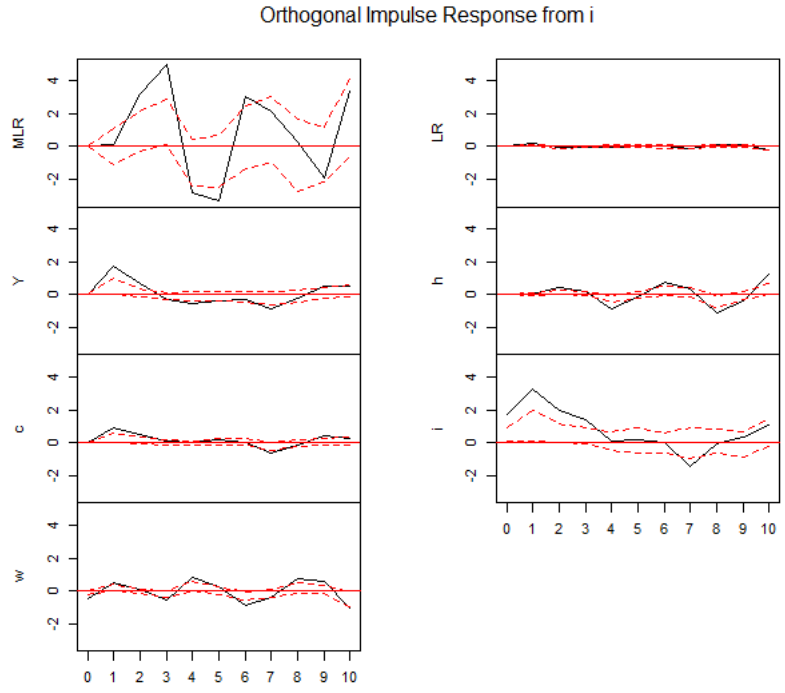

Orthogonal Impulse Response from Y
MLR
Y
c
w
LR
h
i
95 % Bootstrap CI, 100 runs


Orthogonal Impulse Response from LR
MLR
Y
c
w
LR
h
i
95 % Bootstrap CI, 100 runs

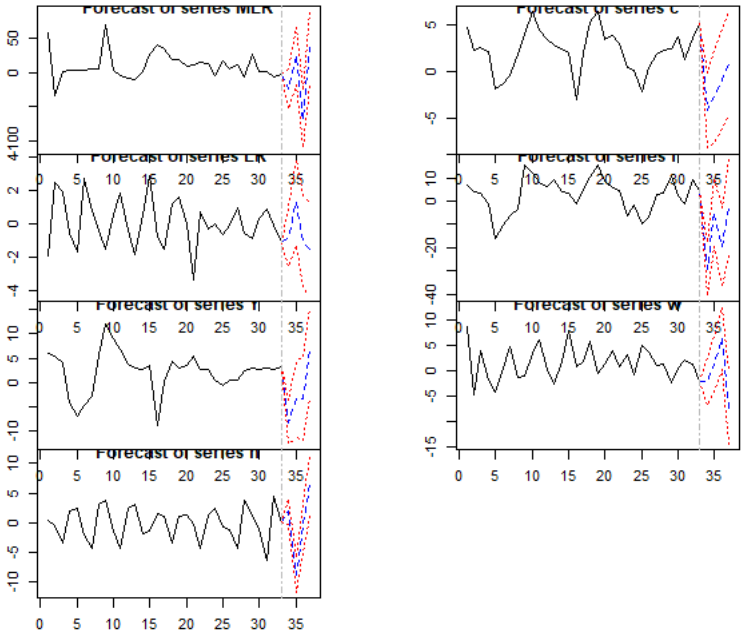

Orthogonal Impulse Response from c
MLR
Y
c
w
LR
h
i
95 % Bootstrap CI, 100 runs


Orthogonal Impulse Response from h
MLR
Y
c
w
LR
h
i
95 % Bootstrap CI, 100 runs


Orthogonal Impulse Response from w
MLR
Y
c
w
LR
h
i
95 % Bootstrap CI, 100 runs


Orthogonal Impulse Response from i
MLR
Y
c
w
LR
h
i
95 % Bootstrap CI, 100 runs

**Appendix B2. VAR Model predication (1 year advance)**



**Appendix B3. Variance Decomposition**

| **Variance Decomposition of MLR** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Quarter** | MLR | LR | Y | h | c | i | w |
| **1** | 1.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| **2** | 0.700803 | 0.009526 | 0.001128 | 0.089769 | 0.198738 | 0.000035 | 0.000000 |
| **3** | 0.679206 | 0.009314 | 0.005967 | 0.087145 | 0.196777 | 0.021576 | 0.000016 |
| **4** | 0.422968 | 0.107412 | 0.156727 | 0.135108 | 0.131361 | 0.046356 | 0.000069 |

| Variance Decomposition of LR | | | | | | | |
|---|---|---|---|---|---|---|---|
| Quarter | MLR | LR | Y | h | c | i | w |
| 1 | 0.068069 | 0.931931 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.236773 | 0.575683 | 0.130860 | 0.016215 | 0.018607 | 0.021188 | 0.000675 |
| 3 | 0.268748 | 0.542685 | 0.118260 | 0.023476 | 0.025939 | 0.020143 | 0.000748 |
| 4 | 0.287485 | 0.516529 | 0.125216 | 0.025022 | 0.025180 | 0.019807 | 0.000763 |

| Variance Decomposition of Y | | | | | | | |
|---|---|---|---|---|---|---|---|
| Quarter | MLR | LR | Y | h | c | i | w |
| 1 | 0.200445 | 0.002307 | 0.797248 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.095648 | 0.211238 | 0.422743 | 0.054345 | 0.038097 | 0.175619 | 0.002309 |
| 3 | 0.147372 | 0.219300 | 0.358740 | 0.061667 | 0.039476 | 0.171188 | 0.002256 |
| 4 | 0.130344 | 0.216866 | 0.341443 | 0.112827 | 0.041323 | 0.155199 | 0.001998 |

Variance Decomposition of h

| Quarter | MLR | LR | Y | h | c | i | w |
|---|---|---|---|---|---|---|---|
| 1 | 0.030663 | 0.046130 | 0.032899 | 0.890308 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.344886 | 0.039659 | 0.033192 | 0.524962 | 0.056668 | 0.000556 | 0.000076 |
| 3 | 0.430683 | 0.044271 | 0.042231 | 0.322816 | 0.122595 | 0.037283 | 0.000122 |
| 4 | 0.308592 | 0.244116 | 0.045278 | 0.247284 | 0.123567 | 0.030760 | 0.000401 |

Variance Decomposition of c

| Quarter | MLR | LR | Y | h | c | i | w |
|---|---|---|---|---|---|---|---|
| 1 | 0.394231 | 0.224890 | 0.113532 | 0.038015 | 0.229333 | 0.000000 | 0.000000 |
| 2 | 0.273838 | 0.157347 | 0.227642 | 0.035482 | 0.174334 | 0.130895 | 0.000463 |
| 3 | 0.233578 | 0.165221 | 0.190851 | 0.067087 | 0.196704 | 0.145245 | 0.001314 |
| 4 | 0.238836 | 0.163007 | 0.176450 | 0.096613 | 0.188518 | 0.135311 | 0.001264 |

Variance Decomposition of i

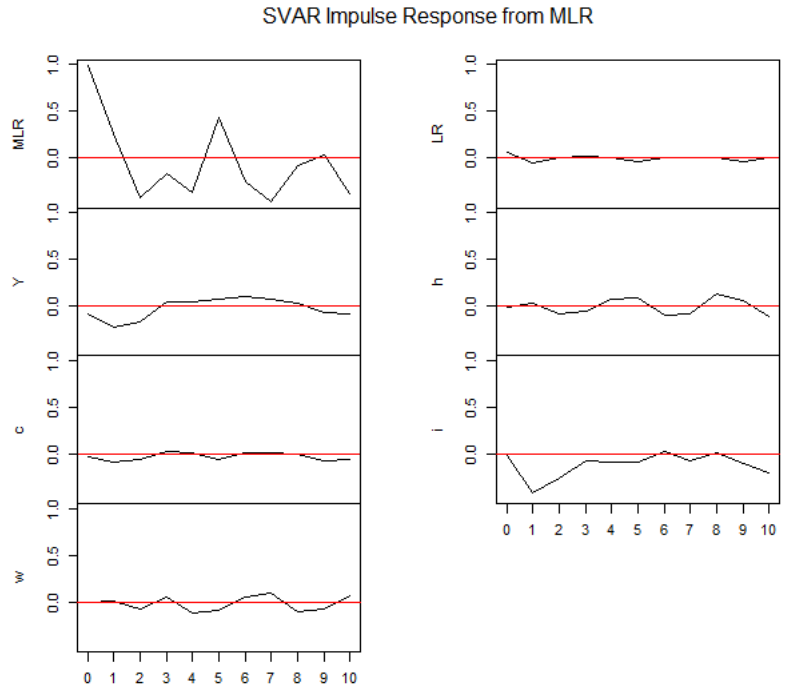
| Quarter | MLR | LR | Y | h | c | i | w |
|---|---|---|---|---|---|---|---|
| 1 | 0.023225 | 0.517463 | 0.016595 | 0.003824 | 0.348810 | 0.090082 | 0.000000 |
| 2 | 0.031099 | 0.340853 | 0.142752 | 0.008302 | 0.230077 | 0.246129 | 0.000788 |
| 3 | 0.044998 | 0.314040 | 0.107485 | 0.074306 | 0.221453 | 0.235957 | 0.001760 |
| 4 | 0.044853 | 0.280446 | 0.101063 | 0.250779 | 0.149217 | 0.172367 | 0.001275 |

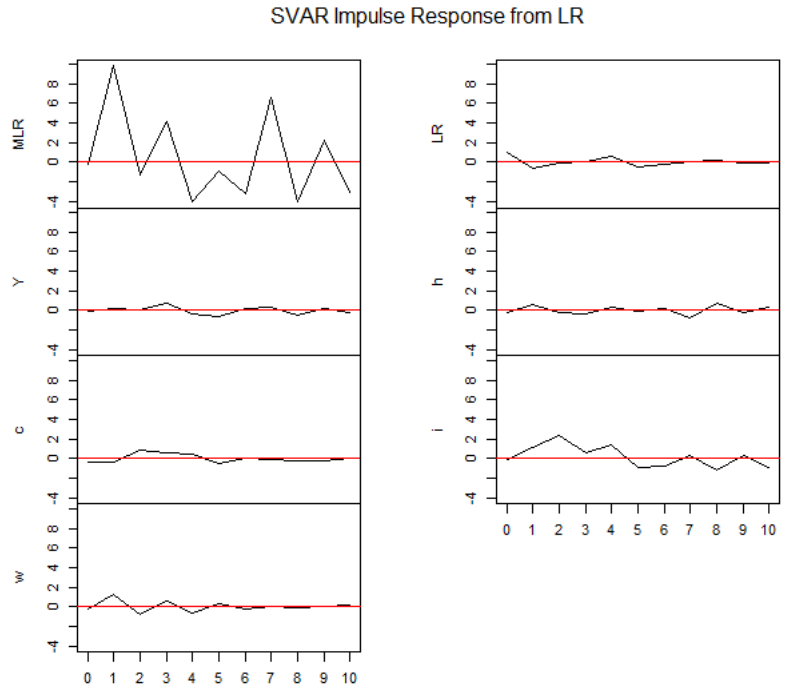


5.7 Variance Decomposition of w

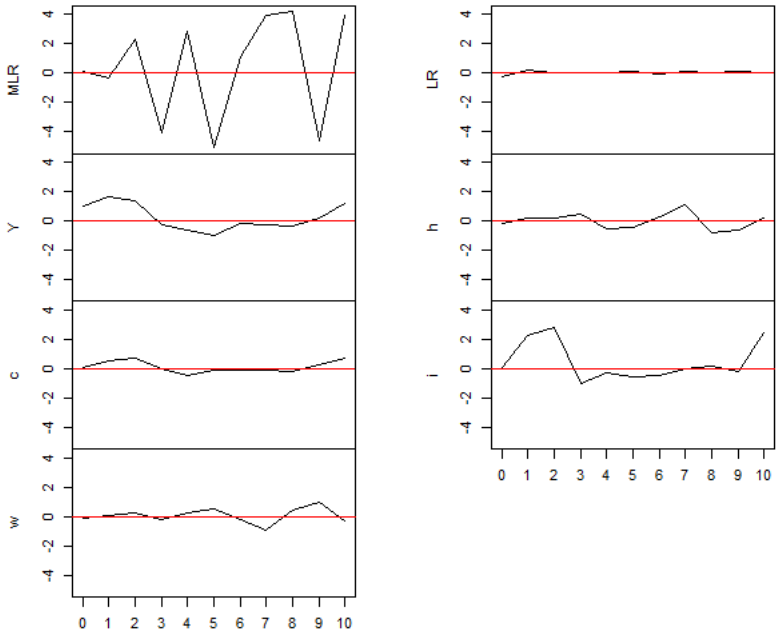
| Quarter | MLR | LR | Y | h | c | i | w |
|---|---|---|---|---|---|---|---|
| 1 | 0.165451 | 0.035412 | 0.369824 | 0.388998 | 0.004708 | 0.030715 | 0.004893 |
| 2 | 0.227168 | 0.041345 | 0.345450 | 0.296008 | 0.025312 | 0.060862 | 0.003855 |
| 3 | 0.184855 | 0.143923 | 0.286109 | 0.288989 | 0.042985 | 0.049924 | 0.003215 |
| 4 | 0.174954 | 0.145807 | 0.337354 | 0.248038 | 0.035509 | 0.055228 | 0.003112 |

## Appendix B4. SVAR Impulse Response from each variable.

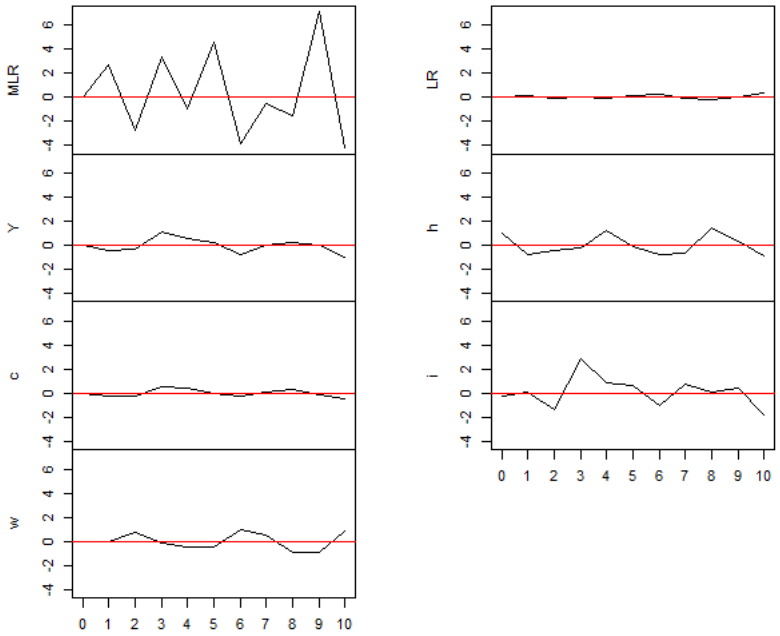


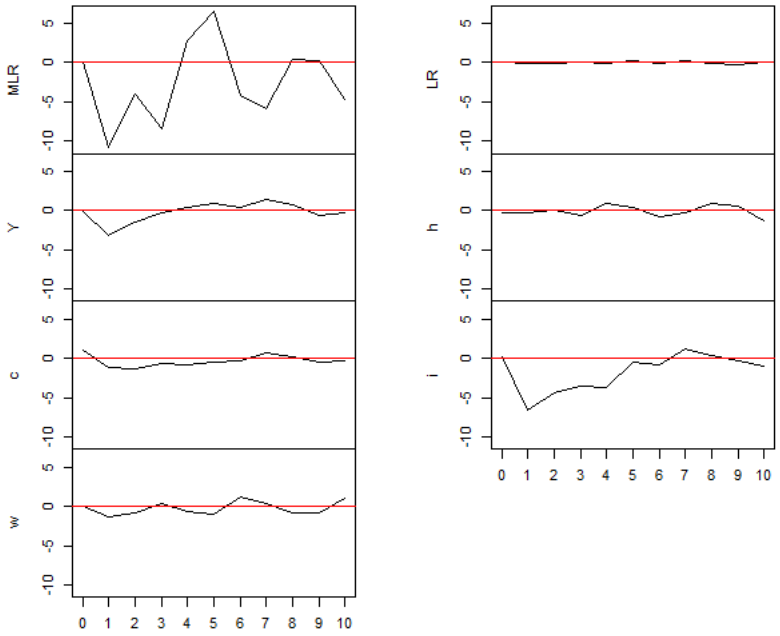
SVAR Impulse Response from Y



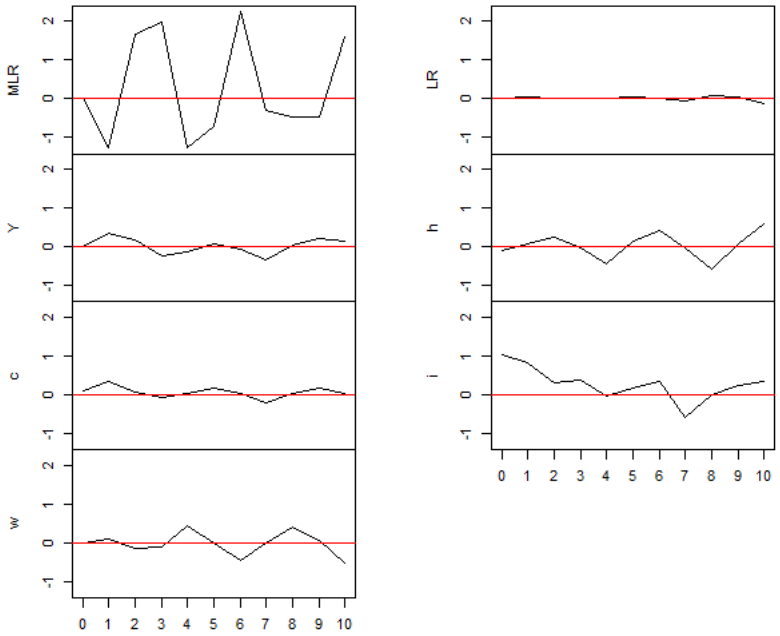

SVAR Impulse Response from h

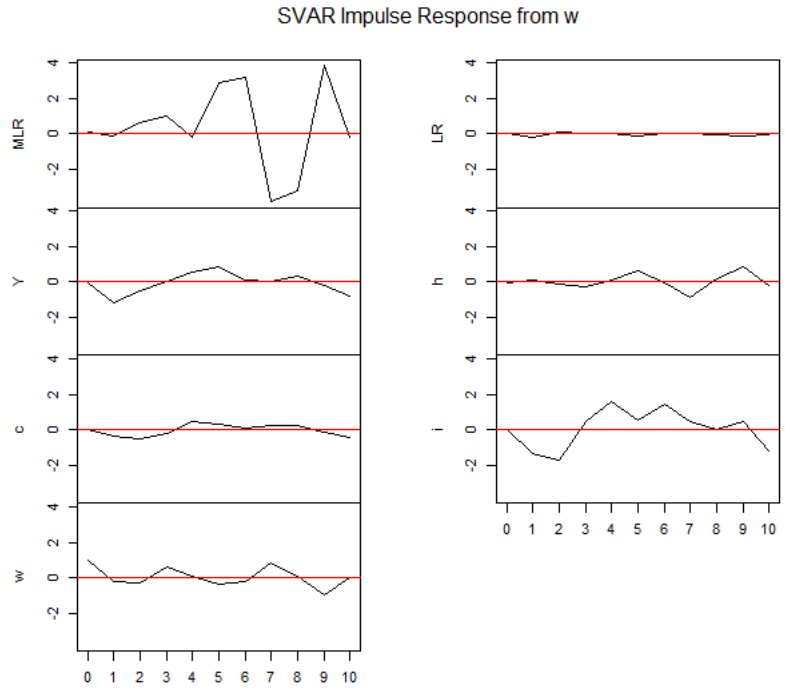


SVAR Impulse Response from c




SVAR Impulse Response from i





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