

# The Impact of Macroeconomic Variables on Cambodia Garment Export Using Bayesian Regression

<sup>[1]</sup> Sreyneth Tum, <sup>[2]</sup> Pathairat Pastpipatkul, <sup>[3]</sup> Chaiwat Nimanussornkul

<sup>[1]</sup> Master Student, <sup>[2]</sup> Associate Professor. Dr, <sup>[3]</sup> Assistant Professor. Dr  
Email: <sup>[1]</sup> tumsreyneth.ts@gmail.com

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**Abstract**— The purpose of this research is to find out the impact of macroeconomic variables on Cambodia garment export for the period of 2008-2019. To achieving paper goals, we have used the Cambodian garment export as dependent variable and the macroeconomic variables which will be our independent variables, we have global gross domestic product growth, FDI inflow on garment and textile, nominal exchange rate, unemployment rate, and inflation rate. Data have been collected from different sources like Ministry of Economics and Finance in Cambodia, National Bank of Cambodia, and World Bank. For analysis of our data, Bayesian regression is introduced to be the method of this research with MCMC stimulation to approximate desired posterior distributions. R program is used to estimate and display the result of this study. To finding out an objective of our paper we have been using different types of test. Geweke Diagnostic test result shows that data is stationary and convergence. Raftery and Lewis test result also indicates the convergence and stationary in the chain as well. We also used Autocorrelation, Cross-correlation and MCMC plot such as Kernel Density plot, Trace plot, Running mean plot and Autocorrelation plot. Our analysis shows that there was a positive relationship between garment export with Global GDP and Unemployment rate. However, we receive negative relationship between garment export with FDI inflow, Exchange rate, and Inflation rate.

**Keywords**— Garment, Export, Macroeconomic, and Bayesian

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## I. INTRODUCTION

The Garment industry is a major component of manufacturing and trade in many developing countries in the world. This industry has helped in fueling the growth of many economies of the world. Asian and African countries depend on this industry for export revenue. It has proved and offers a great potential to contribute significantly to economic and social development. Remarkably, the global apparel industry employed more than 75 million of workers worldwide, 75% of all garment workers are women (World Bank, 2017). Undoubtedly, China is the largest clothing exporter in the world follow by EU, Bangladesh, and Vietnam. With a share of 1.5% in the world's export value, Cambodia is the 9th largest garment producer in the world. Cambodia's garment export value increased by 8% in 2017 allowing the country to create more employment (ILO, 2019). If we talking about Industrial sector in Cambodia, it grew steadily at 11.3%, a similar rate compared to 2018, thanks to the robust growth in construction and non-garment manufacturing sectors (including food and beverages, vehicle assembly and electronic products, spare parts, furniture, and solar panel). However, growth in the garment sector weakened. This industry is estimated once again

falling in her growth from 9.6% in 2018 to 6.6% in 2019 due to the weak performance of garment exports to the EU undoubtedly the uncertainty of EBA's suspension. (Ministry of Economic and Finance in Cambodia.)

## II. THEORY

Theoretically, the impact of macroeconomic variables such as the relationship between trade and economic growth has preoccupied economists for a long time. Economists such as Adam Smith, neoclassical and more recent have attempted to provide theories and evidence that link the export and GDP growth to each other. Exchange rate instability is one of other features that affect exports mainly. The exchange rate volatility and monetary stability can affect negatively or positively to the exports of the developing countries in the shorter or longer periods. FDI is often contributes significantly to output growth as well as the expansion of exports (Ludo Cuyvers & Reth Soeng, 2006). What is more, export and inflation have inverse relation with each other. Inflation leads to costlier goods and services in the international market. Export of goods and services will increase only if demand for domestic export in foreign countries is inelastic (Fleming, 1962; Mundell, 1963). Thus, inflation affects export primarily through their

influence on exchange rate. Last but not least, according to the existing theory, free trade promotes each country's national income in the long-run at the expense of a higher unemployment rate and greater wage inequality (e.g., Autor et al., 2013; Cosar et al., 2016). It is accepted that trade may destroy jobs in import-competitive sectors, create jobs in export-advantage sectors, and reallocate employment from less productive firms to more productive firms.

### III. LITERATURE REVIEW

Gylfason (1997) studied on "Export, Inflation, and Growth" He found that high inflation has tended to be associated with low exports. An achievement on "Relationship between GDP and Export in Turkey" by Mucahit Aydin (2014), using Yamamoto test based on the quarterly data reported by the OECD covering the period of 1980-2012. The results of the test show that there is a unidirectional causal relationship from GDP to export. Zafar Ahmad Sultan (2013) studied on "A Causal Relationship between FDI Inflows and Export: The Case of India" using The VECM technique of determining causality. The result shows that there is unidirectional causal relation from export to FDI direction and not from FDI to export direction. This implies that inflow of FDI in India is mostly not for efficiency seeking (vertical FDI). This may be coming to take advantage of growing market size determined by large population with high population and economic growth. Adnan Kasman (2005) investigated on "Exchange rate uncertainty in Turkey and its impact on export volume" for the period 1982-2001. By using the techniques of cointegration and error correction methods. His findings suggest that there is a positive and statistically significant short run relationship between exports and exchange rate volatility. According to Melitz (2003) studied on "International Trade and Unemployment: The Worker-Selection Effect" He highlighted that if a country is endowed with a large fraction of low-skilled workers, trade liberalization leads to a decline in aggregate employment. In this case, trade liberalization may even harm a country's welfare.

### IV. OBJECTIVE OF THE STUDY

This study aims

1. To investigate the impact and relationship of the Macroeconomic Variables on the Cambodian Garment export.
2. To provide ideas on policy implication for Cambodia in order to ameliorate the garment sector in Cambodia.

### V. DATA COLLECTION

The data required for this study was collected from many different data sources. In this study, all variables data are collected from the period of 2008 to 2019 totally 12 observations. For dependent variable, Garment export data is collected from Ministry of Economic and Finance in Cambodia. The rest of five independent variables data sources such as FDI inflow into Garment and Textile and Nominal exchange rate are collected from National Bank of Cambodia. Inflation rate, Global GDP growth rate, and Unemployment rate are collected from World Bank, and the other sources such as journal and annual report which are published by relevant ministries in Cambodia.

### VI. CONCEPTUAL FRAMEWORK

As our topic talks about The Impact of Macroeconomic Variables on Cambodia Garment Export, our conceptual framework of the study is designed as below:



We have macroeconomic variables as our independent variables such as; Global GDP growth rate (%), Nominal Exchange rate in Cambodia (KHR/USD), FDI Inflow into Garment and Textile in Cambodia (Million USD), Inflation rate in Cambodia (%), and Unemployment rate in Cambodia (%) that would have impact on our dependent variable Garment export of Cambodia (Million USD).

### VII. RESEARCH METHODOLOGY

In this section, the research methodology will introduce in detail in order to estimate and analyst with our existing data. According to the limited observation which we only can found 12 observations, Bayesian Regression is introduced to be the method in this study. Additionally, this method continues to grow in accessibility and popularity, as more empirical studies are turning to Bayesian approach.

#### A. Bayesian Inference

The Bayesian interpretation of probability is one of two broad categories of interpretations. Bayesian inference updates knowledge about unknowns, parameters, with information from data. Bayesian inference is able to assign probabilities to any statement, even when a random process is not involved. In Bayesian inference, probability is a way

to represent an individual's degree of belief in a statement, or given evidence. Within Bayesian inference, there are also different interpretations of probability, and different approaches based on those interpretations.

### B. Bayes' Theorem

Before introducing Bayesian inference, it is important to understand Bayes' theorem. This theorem is quite useful that allows us to use some knowledge or belief that we already have (commonly known as the *prior*) to help us calculate the probability of a related event. The prior probability is the probability of an outcome based on the current knowledge before an experiment. So, Bayes' theorem is described by:

$$P(A|B) = \frac{P(B|A) * P(A)}{P(B)}$$

Where,

$P(A)$  is the probability of event A occurring, also known as the prior probability.

$P(A|B)$  is the conditional probability of event A occurring, given that B is true. This is the posterior probability due to its variable dependency on B. This assumes that event A is not independent of B.

$P(B|A)$  is the conditional probability of event B occurring given that A is true.

$P(B)$  is the probability of event B occurring.

Bayesian methods can be a useful tool that helps this research move beyond hunting for statistical significance and instead focus on other aspects of statistical models such as prediction, model fit, data visualization, and uncertainty.

### C. Likelihood Function

Bayesian approach is used to estimate the left-over parameters. Likelihood function which matches to joint density in the joint data sample, conditional on structure and the parameter of the model. Hence, the Likelihood function is described as below:

$$\begin{aligned} y_t^* &= M\bar{y}(\theta) + M\hat{y}_t + N(\theta)x_t + n_t \\ \hat{y}_t &= g_y(\theta)\hat{y}_{t-1} + g_u(\theta)u_t \\ E(n_t n_t') &= V(\theta) \\ E(u_t u_t') &= Q(\theta) \end{aligned}$$

Which  $\hat{y}_t$  denotes variables in deviations from steady-state,  $\bar{y}$  is the vector of the value of steady-state and  $\theta$  is the vector of deep or structural parameters to be estimated. For first expression, the only observable variable is  $y_t^*$  and it relates to the true variables with an error  $n_t$ . The second expression shows a connection between true endogenous variables which are not observed directly.

### D. Prior Distribution

The prior distribution is a key part of Bayesian inference and represents the information about an uncertain parameter  $\theta$  that is combined with the probability distribution of new data to yield the *posterior distribution*, which in turn is used for future inferences and decisions involving  $\theta$ . The existence of a prior distribution for any problem can be justified by axioms of decision theory. The functional form of prior distribution is specific based on the characteristic of every parameters; thus, it means that inverse gamma distribution for parameter bounded to be positive, beta distribution for parameter bounded in an interval of zero and one and normal distribution for non-bounded parameters.

### E. Posterior Distribution

In Bayesian,  $\theta$  is assumed and considered to be a random variable and its variation can be described by a probability distribution called *prior distribution*. When a sample from population indexed by  $\theta$  is observed, the prior distribution is updated with the information in the sample. Once it is updated, it is called *posterior distribution*. The Bayesian approach is mainly concerned with generating the posterior distribution of the parameters and provides a clear picture of the uncertainty in the estimation of unknown parameters. The basic principle of Bayes Theorem is as follows. If event A happened, the probability that event  $E_i$  also occurred is:

$$P(A) = \frac{p(E_i)p(E_i)}{P(A)} = \frac{p(E_i)p(E_i)}{\sum p(A|E_i)P(E_i)}$$

In structured modeling and analysis, Bayes' method could be written in the following equation:

$$\text{Posterior} = \text{Likelihood} \times \text{Prior}$$

Let assume that we observe data  $y$  from distribution with parameter of  $\theta$  and we would like to make inference about another random variable  $\theta$ , where  $\theta$  is drawn from some distribution  $\pi(\theta)$ . Hence,

$$p(y) = \frac{\pi(\theta)p(y|\theta)}{p(y)} = \frac{\pi(\theta)p(y|\theta)}{\int p(y)p(y|\theta)d\theta}$$

where  $y$  is a vector of the observed data and  $\theta$  is the unknown parameters. The posterior probability conditional on  $y$  is  $P(\theta|y)$ .  $P(\theta|y)$  is sometime called inverse probability which start from observed events and model. It gives the probability of hypothesis that may explain the observed data. The prior distribution is  $\pi(\theta)$  sometime called direct probability. It gives the probability of contingent events for a given hypothesis. The likelihood function is  $P(\theta|y)$  it is sometime called likelihood.

**F. Markov Chain Monte Carlo (MCMC)**

Markov Chain Monte Carlo (MCMC) plays essential role in simulating to provide accurate estimates posterior distributions. The efficiency of MCMC methods is significant practical important, and loosely speaking, is determined by the convergence rate of the chain. Unlike maximum likelihood, the MCMC Bayesian method is useful and reliable even a small sample size. We implement MCMC methods and Gibbs Sampling to facilitate the calculating for the posterior estimator.

**VIII. EMPIRICAL RESULT**

After we get all conditional posterior distributions form each variables and variance, we have Gibbs sampling plays the important tool in sampling for all of the distributions. By using MCMC stimulation with 100,000 iterations and 50,000 as burn-in which suggested by Geyer (1992) that running only one single with very long iteration, there are two main MCMC outputs to be shown and interpreted. First of all, the outputs from MCMC describes each variables and variance in terms of Posterior Mean, Standard Deviation, Naïve Standard Error, and Time-series Standard Error. Secondly, the quantiles of interest output illustrate the values of all parameters and variance that takes the certain quantile 2.5%, 25%, 50%, 75%, and 97.5% as in 95% as confidence interval.

**Table1: MCMC Output (Mean and Standard Error)**

Description	Mean	Standard Deviation	Naïve SE	Time-series SE
Intercept	1.552	1.072	3.389	3.365
GGDP	2.930	6.032	1.908	1.908
FDI	-5.139	9.579	3.029	3.029
EXCH	-3.825	2.584	8.170	8.108
UEM	1.102	7.877	2.491	2.505
INFL	-2.848	1.688	5.339	5.339
Sigma2	6.381	6.424	2.031	3.977

Source: Author's calculation (R program)

**Table 2: MCMC Output: (Quantiles for each variable)**

Description	2.5%	25%	50%	75%	97.5%
Intercept	-57618.25	9.236	1.548	2.182	3.690
GGDP	-903.74	-6.173	2.892	6.452	1.509
FDI	-19.32	-5.655	-4.521	5.594	1.905
EXCH	-89.90	-5.340	-3.815	-2.308	1.310
UEM	-4770.84	6.438	1.104	1.563	2.672
INFL	-622.17	-3.841	-2.849	-1.862	5.347
Sigma2	50748.26	3.238	4.767	7.390	2.051

Source: Author's calculation (R program)

**Table 3: Geweke Diagnostic Test**

Fraction in 1st window = 0.1  
 Fraction in 2nd window = 0.5

Intercept	GGDP	FDI	EXCH	UEM	INFL	Sigma2
2.1772	-0.8073	-0.4287	-2.3381	2.7665	-1.0853	0.1334

Source: Autor's calculation (R program)

**Table 4: Raftery and Lewis Diagnostic Test**

Quantile (q) = 0.025  
 Accuracy (r) = +/- 0.005  
 Probability (s) = 0.95

Description	Burn-in (M)	Total (N)	Lower bound (N min)	Dependence factor (I)
Intercept	4	7944	3746	2.12
GGDP	4	7750	3746	2.07
FDI	4	7756	3746	2.07
EXCH	6	8042	3746	2.15
UEM	6	8040	3746	2.15
INFL	6	8220	3746	2.19
Sigma2	3	4348	3746	1.16

Source: Author's calculation (R program)

**Table 5: Autocorrelation result**

Lag	Intercept	GGDP	FDI	EXCH	UEM	INFL	Sigma2
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	-0.007	-0.002	-0.002	-0.008	0.005	0.000	0.595
5	0.002	0.003	-0.002	0.002	-0.003	0.004	0.065
10	0.003	0.003	-0.002	0.004	-0.003	0.002	0.002
50	-0.001	-0.003	-0.002	-0.001	0.000	-0.001	-0.001

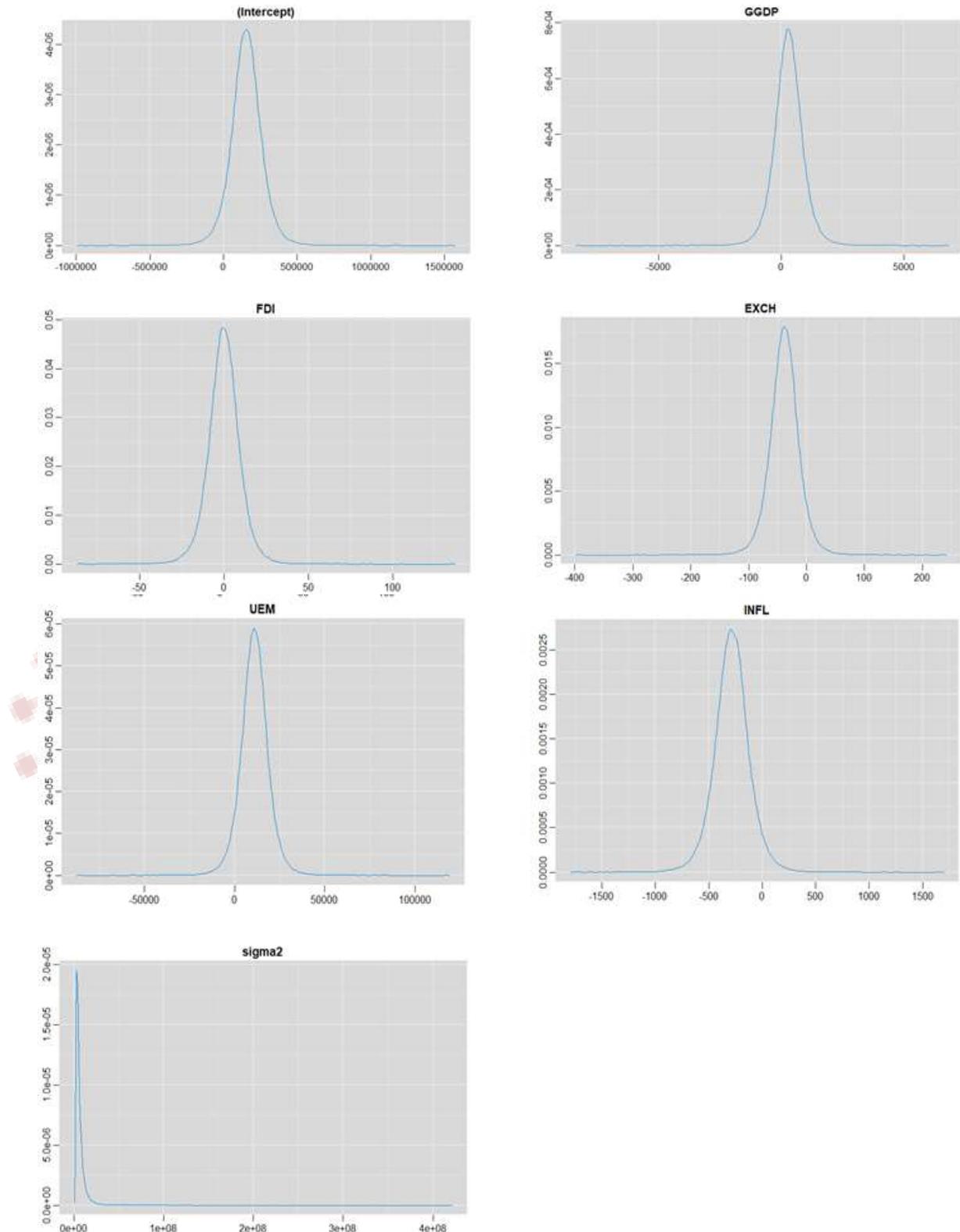
Source: Autor's Calculation (R program)

**Table 6: Cross-Correlation result**

Description	Intercept	GGDP	FDI	EXCH	UEM	INFL	Sigma2
Intercept	1.000	0.128	-0.746	-0.998	0.120	-0.571	0.018
GGDP	0.128	1.000	-0.396	-0.118	-0.278	-0.110	0.016
FDI	-0.746	-0.396	1.000	0.721	0.181	0.534	0.020
EXCH	-0.998	-0.118	0.721	1.000	-0.168	0.577	-0.018
UEM	0.120	-0.278	0.181	-0.168	1.000	-0.387	-0.007
INFL	-0.571	-0.110	0.534	0.577	-0.387	1.000	-0.012
Sigma2	0.018	0.016	-0.020	-0.018	-0.007	-0.012	1.000

Source: Autor's Calculation (R program)

**Figure 1: Kernel Density Plot**



**Figure 2: Trace Plot**

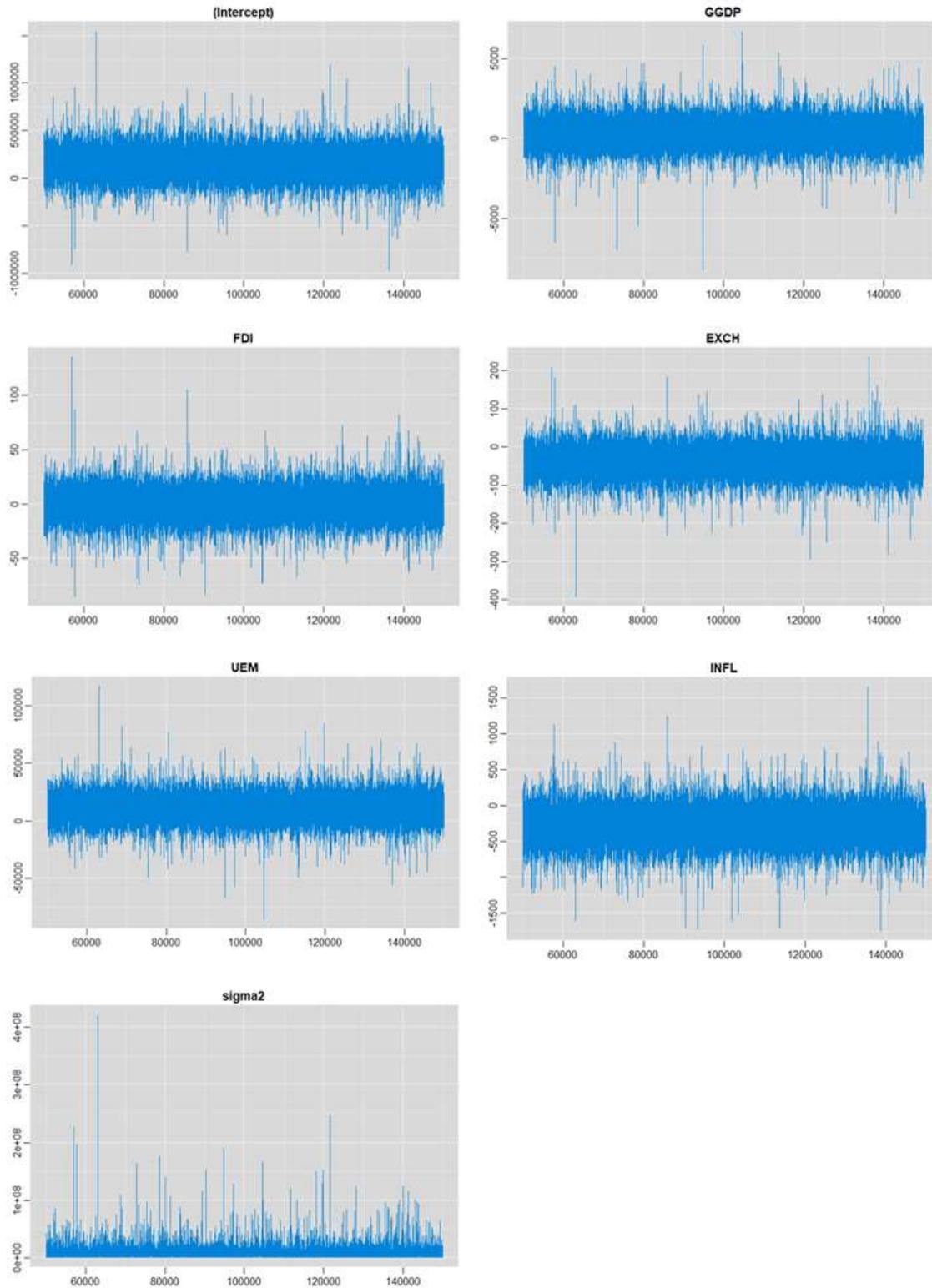
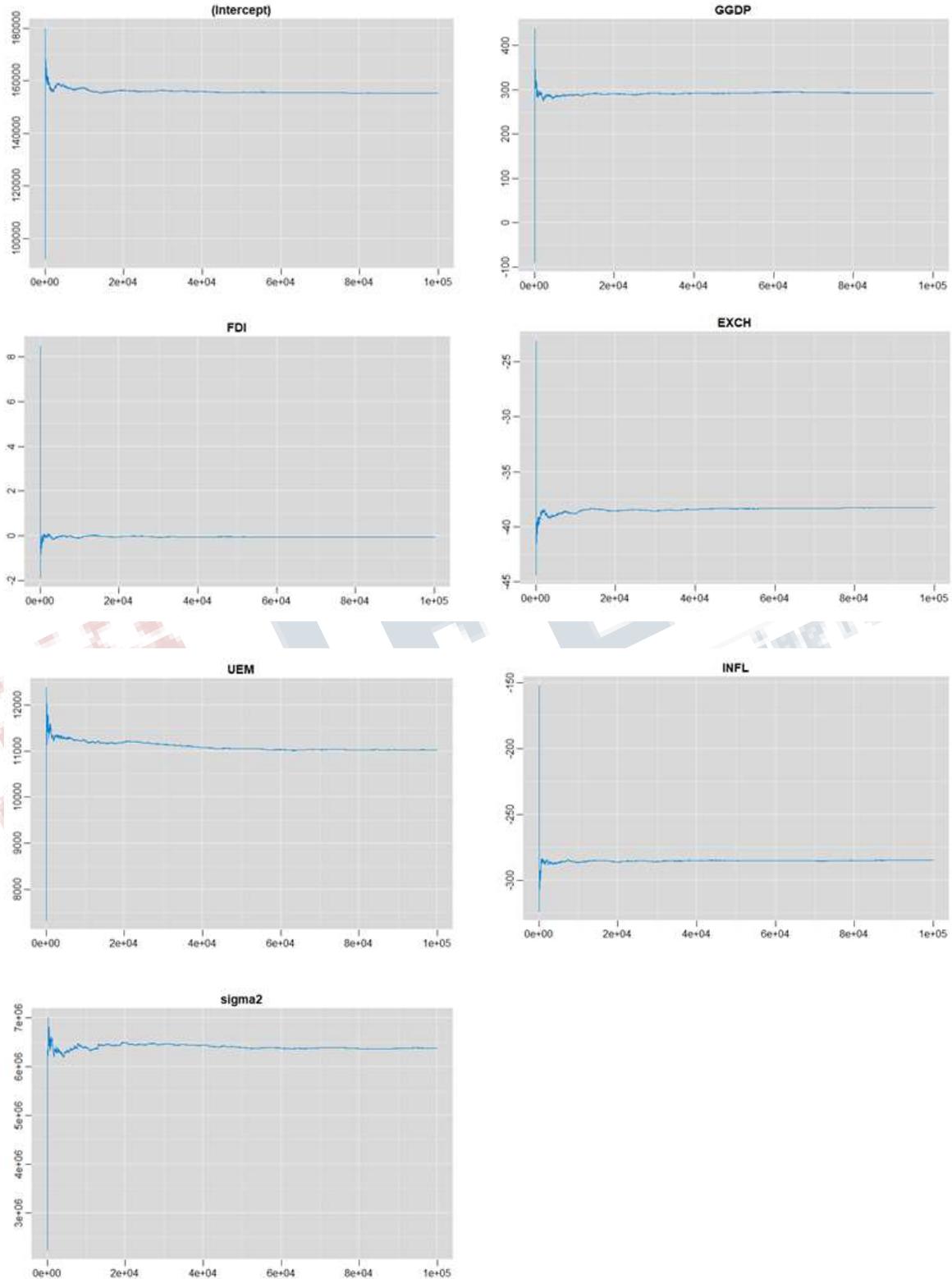
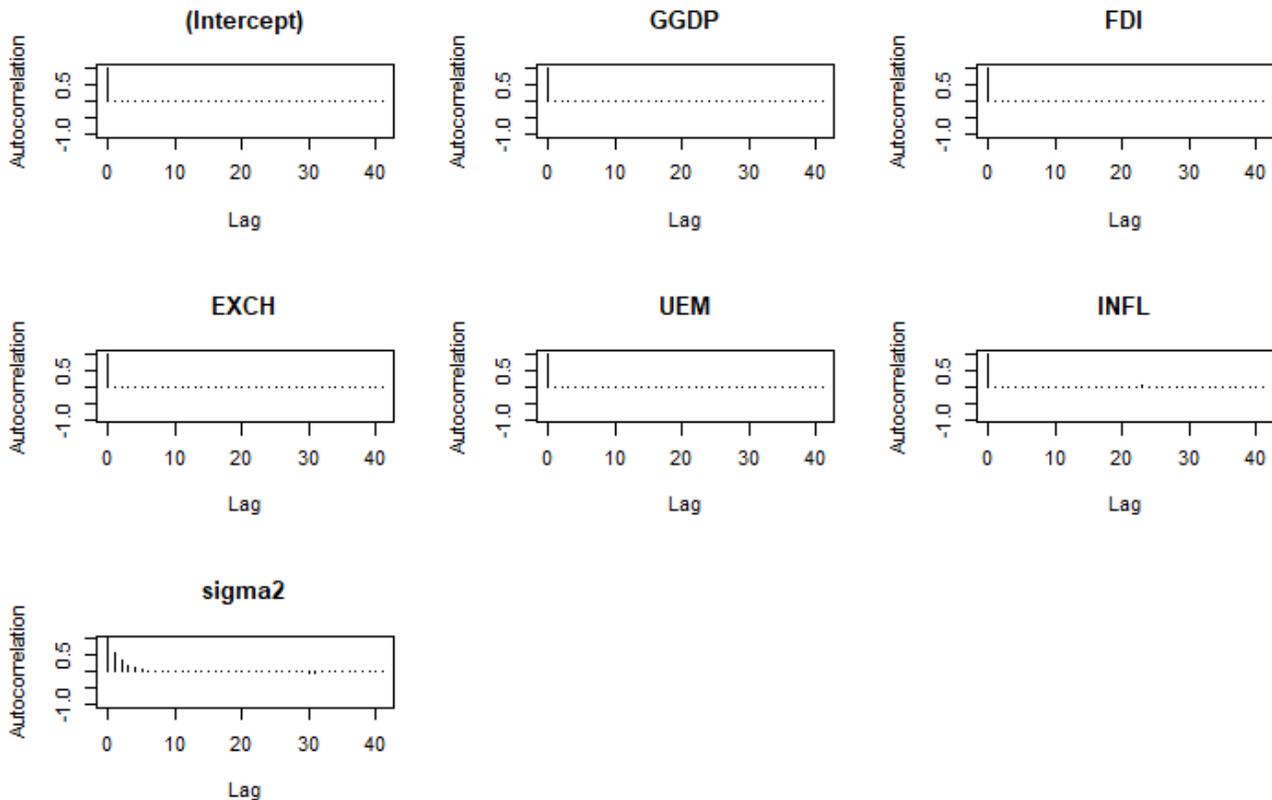


Figure 3: Running Mean Plot



**Figure 4 : Autocorrelation Plot**



**IX. CONCLUSION**

The research paper of the impact of Macroeconomic variables on Cambodia garment export using Bayesian Regression consist of two main objectives of study. First, our objective is to investigate the impact and relationship of the Macroeconomic Variables on the Cambodian Garment export. Secondly, this study aims to provide ideas on policy implication for Cambodia in order to ameliorate the garment sector in Cambodia. This study employs time-series data which have total observation 12 years from 2008 to 2019. Garment export in Cambodia is set as dependent variable, while Global GDP growth rate, FDI inflow into Garment and Textile, Nominal Exchange rate, Unemployment rate, and Inflation rate are set to be independent variables of the study.

To analyst and estimate this research, Bayesian Regression is used to be an essential tool with the MCMC stimulation to approximate desired posterior distributions. Once this study employs MCMC, Gibbs sampling is one of many algorithms that is utilized to sample for all conditional posterior distributions. We using 100,000 iterations with

50,000 as burn-in consequence, the output illustrate the mean and standard error and it also illustrates the quantile of interest as well. Moreover, with Markov Chain Diagnostic test such as Geweke test, Raftery and Lewis test, Correlation and Cross-correlation test which are significant test to ensure the convergence in the chain. What's more, with MCMC, it also indicates the important plots such as Kernel density plot, Trace plot, Running mean plot, and Autocorrelation plot to visualize the evidence of the convergence and stationary of the chain in this study.

The empirical result shows that only Global GDP and Unemployment rate have positive relationship with Garment export in Cambodia. The other three variables such as FDI, Exchange rate and Inflation rate have negative relationship with Garment export. Global GDP growth is the factor that stimulate the Garment export in Cambodia, since Cambodian garment export partners are from US, EU, Japan and the other countries of the world that have been dominated their roles in determinant the Garment export performance in Cambodia. For foreign direct investment shows the negative impact however it is not significant on Garment export. Thus, FDI may not reflect the real

contribution and its impact to Garment sector alone, however the investment may have contributed to another textile too. The empirical result illustrates the opposite relationship between Garment export and Exchange rate (Riel/USD). The depreciation of Riel currency will be the appreciation of USD currency and encourage more investment and as well as stimulate the export in the country. Unemployment rate has a negative relationship with Garment export. In order to expand the export destination, reducing the trade barriers improve the profitability of exporting firms, thus leading to an expansion of the trading sector. However, unemployment will increase when workers reallocate toward the exporting sector, if this sector is to a larger extent characterized by labor market frictions. In this sense, an increase in trade leads to high (low) aggregate unemployment as it interacts with relatively rigid employment protection, generous unemployment benefits, strong unions, as well as centralized wage bargaining. Last but not least, Inflation rate in Cambodia is also viewed by foreign investors and the export partners. The manageable increase and decrease of inflation in Cambodia show its potential domestic consumption and price stability management. Regarding the empirical result which illustrates the negative relationship between Garment export and inflation, as the price level drops, it will lead the interest rates fall, the real exchange rate will depreciate and this result will lead to increasing in net exports.

#### **X. POLICY IMPLICATION**

The empirical results are significant tool in setting the policy implication. This finding is very useful for Royal Government of Cambodia and National bank of Cambodia to pay attention on the key factors that statistically impacts on Garment export in Cambodia. Thus, the policy implications will describe as below. Base on the finding of empirical result, Global GDP shows the positive impact on Garment export in Cambodia. Due to this factor is global impact from Cambodian export partners, RGC should ensure the good relationship with export partners countries to maintain the bound between the host country and the country export destination. For inflation and exchange rate, RGC and NBC need to ensure the macroeconomic stability by maintaining the manageable and stable decrease in both inflation and exchange rate. For foreign direct investment, RGC should ensure the political environment by mitigating the political risk which are harmful for investment in Cambodia in order to make more favorable environment for foreign investors in the country. In the sense of unemployment, Social Protection policy and policy toward the goal of full employment must be seen as critically inter related in the fight against poverty. RGC should safeguards

the outcome of these policies as it would be blended toward institutionalizing social welfare.

Last but not least, regarding the current global health crisis COVID-19, the pandemic is much more than the health crisis, it is also the socio-economic crisis. Cambodian Garment is one of the most vulnerable sectors that potentially slapped by the COVID-19 pandemic. A sharp increase of order cancellation since April 2020 by Cambodia trading partners, namely, the US and the EU. What is more, as of August 12 2020, EU announced the decision to partially withdrawal of Cambodia duty-free quota-free or the EBA preference granted. The loss of EBA preference is likely to produce a substantial negative impact on Cambodian economy, such as the closure or the suspension of garment factories and job cuts for garment workers. Hence, with economic recovery is fragile and still rely on external factors, particularly the recoveries in the US and European Union countries, RGC must diversify the economy in the country rather than focus on a concentrating one. Fostering the country's competitiveness, continuing to have a serious infrastructure gap that would benefit from greater connectivity and investments in rural and urban infrastructure. Expanding the use of technology would be the powerful engine of economic growth in Cambodia to approach the economic for the post-COVID-19, this will remain a dedicate task for RGC and policymakers. What is more, the quality of human capital will be the most significant to achieve Cambodia's goal as the middle-income country by 2030.

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