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IDENTIFYING FACTORS AFFECTING INFLATION RATE IN U.S.A UNDER DIFFERENT SCENARIOS

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ABSTRACT

Inflation is the rise of the price level of an economy and inflation influences consumer behavior and it is important in driving economic growth. The aim of this study is to identify if there is a significant difference between the economic theories related to the inflation rate and behavior of economic variables in the USA economy according to the different political phases in the country. In order to identify the gap between theories and practices in economics in the USA, eight economics variables are selected and secondary data is collected from 1981 to 2016. Four vector error correction models are estimated and granger causality is tested to identify the long-run and short-run relationships between economic variables and inflation. Portmanteau tests for autocorrelation, Serial correlation LM have been used to confirm the stability and validity of VEC models. Foreign direct investment shows a negative impact on the inflation rate during four periods. The exchange rate, money supply, balance of trade, and the unemployment rate have a relationship with the inflation rate in accordance with the theories during the economic expansion periods. Gross domestic product and government expenditure have mixed influence on the inflation rate in the US economy; therefore, they do not indicate any pattern of behavior with

the inflation rate. This study shows that the economic theories might be altered with strategic economic decision-making. Therefore, it shows the importance of an independent institute, which actively introduces effective strategic policies to maintain the economy of a country, regardless of the existing political situation.

Keywords – US Economy, Inflation, Vector Error Correction Model

1. INTRODUCTION

Inflation is considered a chronic economic issue around the globe. Inflation is simply defined as the increase of the average price level of goods and services for a sustained period of time. The United States of America (USA) is the largest economy in the world with a net worth of $20.4 Trillion in 2017 (Gray, 2017). With such a reporting economy the United States of America has been successful to maintain its inflation rate of around 2% over the past decades.

Terrorist attacks, on September 11, over the U.S.A, caused around $40 billion insurance loss and hindered the tourism, airlines, and aviation field. Around $2 trillion of damage has been inflicted by the September attack. Despite the terrorist attack, the United States of America was able to keep control of the inflation rate due to the timely reactions of the Federal Bank in St Louise (Bysyuk, 2010).

Keynesian economy and monetarism are two leading economic theories explaining the cause of inflation and other economic indicators influencing it under different circumstances (Barone, 2019). In general, as U.S.A inflation is constant and stable; investors can invest with confidence. However, the slowing rate of inflation or the disinflation could be causing problems for the investors who are involved with bonds commodities and currencies. It is indubitable that a country's political condition affects the economy and its inflation rate.

Macroeconomic performance in the USA accelerated in a high volume from the early 1980s. Two longest economic expansions in United States of America history have happened in the 1980s and 1990s and two mild contractions during 1990 and 2001. 1981, 1998, 2001, 2008 are other crucial years in the latest economy of the United States as the economic activities dropped by a significant and notable amount due to mini recessions.

According to the Keynesian economy (Keynes,1931) when aggregate demand exceeds the aggregate supply there will be a rise in the price level. Employment will increase as a result of the effort to meet the demand. Aggregate demand depends on consumption, investments, government

expenditure, and exports. Imports and tax rates should be increased to lower the inflation rate. When government expenditure is increased it will create more employment and more individual consumption which will result in demand-pull inflation.

The Multiplier Effect introduced by Keynes indicates that increasing government expenditure will increase business activities which will result in economic growth and an increase in the inflation rate. Monetarism (Friedman, 1968), on the other hand, suggests that monetary phenomenon is the only influence that can make the inflation rate fluctuate. In monetarism, Money supply takes a lead role in explaining the inflation rate. Money supply will decrease the interest rate of borrowing. When there is less borrowing interest rate individual consumption will go up and so does inflation. Thus, it is important to find the influence of different economic indicators on the inflation rate under different scenarios. The different scenarios considered in this study are the political party of the president in power and the recessions the U.S economy faces during the identified periods.

Although the United States of America has faced mini recessions in years of 1981, 1998, 2001, 2008 which reduced the economic activities in a significant amount, the country has been able to continue the growth of the economy using several strategies like revising policies of money supply and government expenditure. From March 1991 to March 2001 and November 2001 to December 2007 there were two economic expansions in the United States of America and during these periods inflation rate remained low compared with the preceding decades. The data set is divided into four periods in order to find out the main reasons behind the variation of the behavior of inflation rate according to the period.

In this study, data set is divided into four time periods as below.1st Period – 1981 Q1 to 1992 Q4 is the period of twelve years when Republican Presidents Ronald Regan and George Bush were the presidents of the United States of America. 2nd Period – 1993 Q1 to 2000 Q4 is the period of eight years when Democratic President Bill Clinton was in the presidency of the United States of America.3rd Period – 2001Q1 to 2008 Q4 is the period of eight years when Republican President George W Bush was in the presidency.4th Period – 2009 Q1 to 2016 Q4 is the period of eight years when Democratic President Barack Obama was in the presidency.

Policymakers rely on economic theories to make decisions on the economy. Therefore, there should be studies on economic theories on a regular basis in order to identify if the theories can still be applied in the modern era and modern economy. This study aims to model the relationship between inflation and seven other economic indicators in different scenarios and to assess the

applicability of theories related to inflation of the U.S.A. The United States of America being a developed and powerful Economy in the world has a stable inflation rate irrespective of the time period and thus it is important to understand if the theories of inflation get proven during different periods under the circumstances.

By implementing the right policies, the government can balance the inflation rate which will lead to the prosperity of an economy. When the inflation increases to an unacceptable level then the policymakers try to implement fiscal policies which help to decrease the inflation rate. Many strategic policies can give an optimal balance of low inflation rate which has been achieved by the economy of the United States of America.

This study will be important to Sri Lankan economists to understand how the economic variables influence the inflation rate in a developed country and to identify the methods and policy strategies that are helpful to balance the inflation rate.

2. LITERATURE REVIEW

Keynesian economic theories were introduced by John Maynard Keynes in the 1930s as an attempt to understand the Great Depression which started with the stock market crash of the U.S.A in 1929 (Ahuja, 1986). Keynes explains when aggregate demand (AD) exceeds aggregate supply (AS) at full employment level of output, and then inflation occurs. Aggregate demand depends on consumption, investments, government expenditures, and exports. It is the total spending on goods and services of government and consumers plus the net investments considered by entrepreneurs. The factors that increase aggregate demand are the increase in private consumption, private investments, individual exports, and government expenditure. Decreasing the imports and tax rate underpins augmenting the inflation rate.

It is assumed that low inflation and low wage rate will cause employers to make capital investments which will increase employment rates that restore economic growth. Keynes anyhow refutes the idea of a lower wage rate restoring full employment. He indicates that with a lower wage rate the demand will be lower; hence the employers won't hire more employees to produce the products as there is less demand. Keynes wrote his popular book named "The General Theory of Employment, Interest, and Money" during the great recession, therefore Keynes's economy sometimes is referred to as depression economics. He rejects the idea of a natural state of equilibrium suggesting that the economy will be in constant flux or natural cycle which will be referred to as boom and bust. Keynes suggests increasing government expenditure to alleviate inflation. His notion is when government expenditure

is increased, consumer demand will be increased which results in an overall dynamic of economic activities that reduces inflation.

Many researchers have attempted to study the relationship between economic variables with the inflation rate. Lim and Papi (1997) have taken Time Series data from 1970 to 1995 to determine the variables affecting Inflation in Turkey. Johansen Cointegration technique was used in this study and it concludes that money, prices of exports, and prices of Imports positively affect the domestic price level. The exchange rate has an inverse effect on the domestic price level in Turkey. The study claimed that monetary factors such as exchange rate and money play a central role in determining the inflation rate of the country. Khan and Gill (2010) use several price indicators to find out the determinants for the inflation of Pakistan using the ordinary least square method. The study explains that variables such as the budget deficit, exchange rate, wheat support price, imports, the support price of sugarcane and cotton, and money supply are found to be directly affecting all the price indicators and the interest rate is indirectly affecting all the variables explained in the study in Pakistan. According to the study, the determinants of inflation have been shifted in the modern era and inflation has less sensitivity to the domestic economy and more sensitivity to global factors and inflation expectations. Furthermore, Simionescu (2016) has conducted a study to identify the determinants of inflation rate in the U.S.A using Bayesian Econometric methods using monthly inflation rate during the economic crisis period of 2008 -2015. Variables used are the inflation rate, unemployment rate, the exchange rate, crude oil prices, the trade-weighted U.S. Dollar Index, and the M2 Money Stock. He concludes that the unemployment rate, exchange rate, crude oil prices, trade-weighted U.S. Dollar Index, and M2 Money Stock determine the monthly inflation rate in the U.S.A, since 2008. Results are in accordance with the economic theories.

2.1 Multiplier Effect

The multiplier effect is one of the main components suggested in Keynesian economics which indicates that government expenditure increases business activities adding more spending to the economy. This spending will expand aggregate supply and income will be increased. When extra income is spent, the Gross Domestic Product will increase and the economy will boom. Keynes is not in accordance with the idea of savings and in conformity with spending more. Spending will become the income of another person who will achieve full employment. Full employment supports economic growth. The Multiplier Effect becomes a controversial notion that later economists such as Milton Friedman pointed out that the Keynesian model has misinterpreted the relationship between savings, investments, and economic growth (Friedman, 1968).

Keynesian economics emphasizes the government's intervention in alleviating economic crises. Lowering interest rates is a method to enhance the condition of the economic well-being of a country. When interest rates are lower, many will borrow money and there will be an expansion in the financial sector. But only lowering the interest rate doesn't help improve the economic situation. As an example, during the 1990s even though Japan lowered the interest rate, it didn't help in economic improvement (Chappelow, 2019).

2.2 Fiscal Policy

Fiscal policy is a concept based mainly on Keynesian Economics. It defines the use of government expenditure and tax policies to influence macroeconomic phenomena like inflation, economic growth, employment, and aggregate demand. Expansionary fiscal policy increases the money supply and government expenditure and lowers tax rates in order to increase aggregate demand and economic growth. With lower tax, there will be more individual expenditure which will lead to high demand and high employment. Other than that, the government can increase government expenditure by constructing public properties as highways, schools, universities which ultimately will create more employment.

Contractionary fiscal policy is a rare situation where the government tries to balance the economy by reducing government expenditure and increasing tax when there is a budget surplus. When the fiscal policy is not contractionary or expansionary, then it is neutral. Measuring Core Inflation, the study conducted by Quah and Vahey (1995) confirms that monetary policy has a direct collision with core inflation where the core inflation is defined as the measure of inflation excluding food and energy prices. Data used was the real gross domestic product. And, consumer price index limited influence estimators of twelve countries dating from 1980 to 1990 and early 2000. They have used the VAR model for analyzing data.

2.3 Monetary Policy: The Quantity Theory of Money

The quantity theory of money is an infamous theory of inflation from the 18th century. David Hume (1752) identifies the impact of monetary changes in the economy from one sector to the other in form of quantity and price. In 1817, David Ricardo, a classical economist, revealed that the inflation in Britain was caused majorly by the irresponsible supply of money by the Bank of England due to the war caused by Napoleons. Irving Fisher (1933) in supporting Monetarism presents the below equation to describe the monetary relationship between economic indicators:

$$M*V = P*T \qquad P = \frac{MV}{T} \qquad [1]$$

Where;

MV = Money supply

M= Currency

V= Velocity of circulation

P= General price level

T=Total trade (sales and purchase)

The above equation shows that the general price level increases proportionately to the money supply and the total trade.

Berger and Österholm (2015) examined whether money supply granger causes the inflation rate of the U.S.A by using a quarterly sample from 1960 to 2015 with applying Bayesian VAR as the research methodology. They extended the study further to find indications of real GDP growth and interest rates in the model built for the inflation rate. An outcome of the study suggested that money growth plays a miniature role in determining inflation in the short run which goes against monetarism and other monetary models.

2.4 Printing Money

Printing money is a method of increasing the money supply of an economy. If money is printed excessively disregarding the growth of the number of goods, then the households will have more money to spend, thereby increasing the market price of goods due to competition of demand. During the Civil War of 1861-1864 in the U.S.A, the confederacy printed supplementary paper money of $1 billion which caused an inflation rate of 700% by April 1864. Then by the end of the civil war, people lost confidence in the currency as the inflation rose to 5000%. From 1922 to 1923 due to excess money supply in Germany, the US dollar became equal to 4,210,500,000,000 German marks. It caused hyperinflation and loss of value of the currency (Weidenmier, 2008).

Although in traditional economics, it is suggested that printing money causes inflation and devalues the currency, the modern monetary theory suggests that printing money can be used to solve problems in the economy. Modern monetary theory indicates that the government can create more money to pay off debts in their own currency and the government can grow their spending to an optimal amount which will create more job opportunities, enhance capital for the private and government sector. It suggests when there is non-utilized unemployed labour and economic capacity, increasing government expenditure will not cause inflation. According to this theory, inflation happens due to the demand and supply gap. The Federal Reserve uses the extra money to control recessions which keeps the inflation rate at control. If there is excess money in the economy, the tax rate can be increased to

maintain the value of money in order to keep inflation in check (Edwards, 2019).

2.5 Monetarism: Friedman's Modern Quantity Theory of Money

Milton Friedman in supporting monetarism suggests his new theory of money called the Modern Quantity Theory of Money. He explains that the main factor that affects inflation is the money supply. In economic stabilization, monetary policy plays a more effective role than fiscal policy. Monetarists focus on stabilizing inflation by controlling the money supply. Both excess and insufficient money supply are not healthy for inflation in an economy. When there is high inflation in a country, then contractionary monetary policy is applied and, in a deflation, expansionary monetary policy is used. According to the supply of money, interest rates will fluctuate supporting or opposing the amount of borrowing which again balances the aggregate supply and the aggregate demand (Chappelow, 2019).

Milton Friedman in short, revived the Classical Monetary Theory which indicated that inflation is proportionate to the supply of money Milton Friedman, in contrast, suggests that the increase of inflation is not proportionate to the money supply (Friedman, 1968). Akbar et al (2014) identified that the money supply affects the inflation rate in Pakistan. The money supply grows due to the increase of government sector borrowings in Pakistan. They have used producer price index, money supply, durable goods, electricity, exchange rate, import, export, natural gas, oil products, crude petroleum, capital goods export, capital goods import, food export, food import, agricultural products export, and wages explanatory variables. In order to remove the multi co-linearity among explanatory variables principal component analysis has been performed.

2.6 Equation of Modern Quantitative Theory of Money

Later Milton Freedman presented a new equation of

$$M*V = P*Y \quad [2]$$

Where;

M= Money supply,

V= Average velocity of circulation

P= Price level

Y= Average National Income (T = number of transactions)

In quantitative Monetary Theory it is assumed that

1. Velocity of circulation or speed of money circulation is constant in the short run.

2. Due to full employment in the economy National Income is also constant.

Therefore, money supply and price level have a proportional relationship. When the money supply goes up by x%, the price level also increases by x%. Simply increasing the money supply will increase the price level. Monetarists indicate that in the short run, velocity is fixed as the rate of money circulation doesn't change often and even though velocity changes, it varies by a little amount so that amount can be ignored (Barone, 2019).

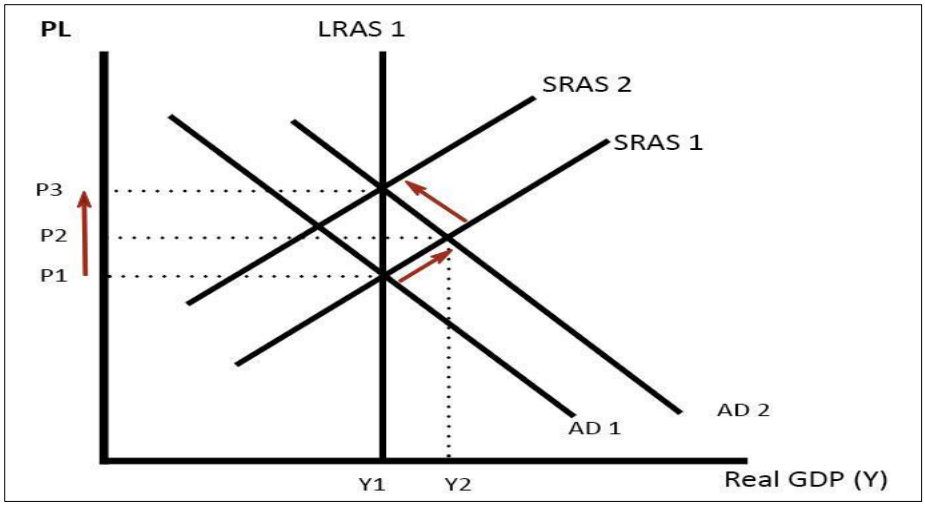
Monetarists also assume that output Y is fixed, stating that Y may vary in the short run but not in the long run (because LRAS is inelastic and determined by supply-side factors.) Therefore, increasing Money Supply will increase inflation (Friedman, 1968)

When the Money Supply increases, citizens get more money, which raises individual consumptions. This shifts aggregate demand (AD) to right from AD1 to AD2.Responding to these producers increases Short-Run Aggregate Supply (SRAS). Real output rises from Y1 to Y2.

The inflationary gap happens as national output exceeds the output level in accordance with the equilibrium. Producers will hire more employees and it will make the rise in costs and prices due to a rise in wages. When prices increase, purchasing power will be low. Employees will demand more wages which will cause Short-Run Aggregate Supply to shift the left. With SRAS2 economy will get an equilibrium level of output, Y1 but the price level will be higher, P3. Long-Run Aggregate Supply Rise (LRAS) is not elastic. An increase in the money supply will cause rise of demand which will cause demand-pull inflation.

2.7 Monetarist View on Aggregate Demand (Ad) and Supply Curve

Economists who criticize monetarism say that the relationship between money supply and inflation is not direct and powerful in the practical world. The United States of America a few times in recent history injected money supply due to recessions and it did not increase inflation (Radcliffe, 2019).

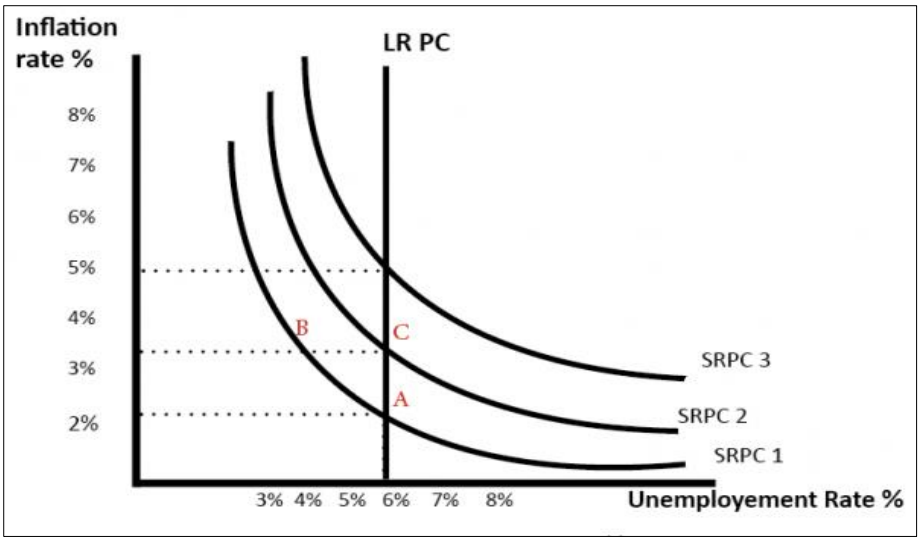


Source: Ahuja (1986)

Figure 1: Monetarist inflation in the Aggregate Demand (AD) and Aggregate Supply (AS) model

2.8 Phillips Curve

Phillips Curve describes the relationship between inflation and the unemployment rate. The Phillips curve is named after a single-equation empirical model built by A.W.H. Phillips (1958). Concepts of demand and supply can be used to explain the theories of the Phillips Curve.



Source: Ahuja (1986)

Figure 2: Phillips curve

It has an impact on the inflation rate which makes the inflation high. In contrast, when the labor supply is greater than the demand then the wages push downwards. It would result in a low inflation rate in the country and the unemployment rate will go up. Rising inflation has a correlation with falling unemployment. Monetarists believe that in the short run, there is a trade-off relationship between inflation and unemployment. Equilibrium of Long-Run Phillips Curve (LRPC) and shift of Short-Run Phillips Curve (SRPC) are shown in figure 2. Dhakal et al (1994) identified the main factors affecting inflation in the United States of America using a Vector Autoregressive model. They concluded that the major factors affecting inflation in the United States of America are money supply, the wage rate, and the budget deficit, and energy prices. Demand and Supply shocks are potential in affecting the inflation rate of the U.S economy. The findings of the study are in accordance with the New Keynesian Phillips curve. Furthermore, they have identified the relationship between real variables, inflation, and expectations of inflation which is independent of the oil cycle, and have explained the dilemma of the behavior of inflation in the last decade by separating the Phillips curve from the oil cycle.

3. METHODOLOGY

Quarterly data from 1981Q1 to 2016Q4 were obtained from the website of the International Monetary Fund and from the website of the Federal Reserve Bank of St. Louise. Variables collected are described below in table 1.

Table 1: List of the variables used for the study

Notation	Stands For	Description	Units
INF	Inflation Rate	Quarterly inflation rate calculated	Percentage Value
GDP	Gross Domestic Product	Real Gross Domestic Product, Quarterly, Seasonally Adjusted Annual Rate	Billions of US Dollars
TOB	Trade of Balance	Trade of Balance	Millions of US Dollars
EXC	Exchange Rate	Real Effective Exchange Rate, based on Consumer Price Index	Percentage Value
MS	Money Supply	M2 Money Supply	Billions of US Dollars
FDI	Foreign Direct Investment	Rest of the world; foreign direct investment in U.S.A.; asset, Flow, Quarterly, Seasonally Adjusted Annual Rate	Millions of US Dollars
GE	Government Expenditures	Federal government total expenditures, Quarterly, Seasonally Adjusted Annual Rate	Billions of US Dollars
UMP	Unemployment Rate	Percentage of unemployment rate quarterly	Percentage Value

3.1 Vector Auto-Regression Model

Economic indicators show long-term relationships among variables. These time-series don't have constant mean or variance as they differ according to the time. Analyzing nonstationary time series will lead to spurious regression, which output error some results. De-trending and differentiating are used to analyze nonstationary data (Maddala, 2001). Co-integration on the other hand is a technique with detrending and differencing nonstationary data which was introduced by Granger's representation theorem.

If Y_t and X_t are integrated of order one I(1) , then Y_t and X_t are co-integrated if and only if $Y_t - \beta X_t = Z_t$,where Z_t in integrated order zero I(0). Therefore if Y_t and X_t are co-integrated, then they move together in the long run so that they cannot drift arbitrarily far apart from each other as time goes on (Maddala , 2001). Two typical methods to which recommended to examine long run relationships of variables are Engle and Granger (1987) co-integration test and Johansen-Juselius (1990) cointegration test. Engle and Granger test is suitable for bivariate analysis and Johansen –Juselius is suitable for multivariate analysis.

3.2 Johansen–Juselius (1990) Co-Integration Test

Johansen Juselius cointegration test is used to identify the long run relationships that may exist between economics variables and inflation rate in the study. In Johansen Juselius cointegration all variables are treated as endogenous variables and it doesn't segregate dependent variables and independent variables. Johansen Juselius approach is a one step approach compared to two step Engle Granger methodology. Due to these reasons Johansen Juselius cointegration is considered as an effective statistical method for testing co-integration.

Johansen Juselius cointegration approach can be expressed using the below equation.

$$Y_t = \mu + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \ldots + A_p Y_{t-p} + \varepsilon_t \quad \textbf{[3]}$$

Where Y_t is a vector containing p variables, all of which are integrated of order one and the subscript t denotes time period. μ is an (n_{x1}) vector of constants, A_p is an (n*n) matrix of coefficients where ρ is the maximum lag included in the model and εt is an (nx1) vector of error terms. This can be written in the form of the error correction model assuming cointegration of order p. Enders (2004) shows how to rewrite the above equation as:

$$\Delta Y_t = \mu + (A_1 - I) Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \ldots + A_p Y_{t-p} + \varepsilon_t \quad \textbf{[4]}$$

Where ($A_1 + A_2 + \ldots + A_{P-1-I}$) represents the dynamics of the model in the short run. In the above equation , ($A_1 + A_2 + \ldots + A_{P-I}$) represents the long run relationship among the variables included in the vector Y, and I is the identity vector. The key idea of the Johansen Juselius approach is to determine the rank of the matrix ($A_1 + A_2 + \ldots + A_{P-I}$), which represents the number of independent cointegration vectors or the number of error correction terms belonging to the model.

3.3 Error Correction Model

Granger Test is valid only when there is no long run equilibrium relationship among examined variables, therefore Engle and Granger (1987) suggest including error terms in the equation which turns it into an Error Correction Model. Error Correction Model is used for data with underlying variables having a long run stochastic trend or a co-integration. It estimates both long term and short term effects of one time series on another time series. Error is short run dynamics and the error correction term is long-run equilibrium.

In two variable setting where X and Y are integrated of order one or I~(1) , the error correction model (ECM) can be formulated as:

$$\Delta X_t = \delta_i + \sum_{i=1}^{p} a_i \Delta X_{t-i} + \sum_{i=1}^{p} \beta_i \Delta X_{t-i} + \gamma_1 \hat{\varepsilon}_{1t-1} + v_{1t} \quad \textbf{[5]}$$

$$\Delta Y_t = \lambda_i + \sum_{i=1}^{p} d_j \Delta X_{t-i} + \sum_{i=1}^{p} c_i \Delta X_{t-i} + \gamma_2 \hat{\varepsilon}_{2t-1} + v_{2t} \quad \textbf{[6]}$$

$\hat{\varepsilon}_{1t-1}$ and $\hat{\varepsilon}_{2t-1}$ are the error correction terms obtained from the long run model lagged once, which can be interpreted as the deviation of X and Y from their long run equilibrium values, respectively. Including the error correction term represents the short-run dynamics necessary to reach the long run equilibrium and opens a channel to detect Granger causality (Granger, 1988). γ_1 captures the long run causal relationship among the variables in the system, and it is expected to be negative and most likely have an absolute value of less than one.

When γ_i's are not statistically significant, the system of equations suggests that the variables of the system are independent in the context of prediction. When γ_1 is statistically significant, while γ_2 is not, the system suggests a unidirectional causality from Y to X, meaning that Y drives X towards long run equilibrium but not the other way around. However, the opposite implication will be observed when γ_2 is significant and γi is not. Indeed, if both coefficients γ_1 and γ_2 are significant, then this suggests feedback causal relationship in the system or bidirectional Granger causality relationships. β_i measures the short run impact of changes in X on Y, d_j measures the short run impact of changes in Y on X and v_{it} is the standard error term.

4. RESULTS AND DISCUSSIONS

The Correlation matrix is a fundamental statistical test that is used to identify the mutual relationship among variables. All variables for four periods were transformed into the natural log to minimize the variance and heteroskedasticity before applying the Vector Error Correction Model. The stationary of the variables should be identified before applying any time series model. Augmented Dicky Fuller Test (ADF) and P-Perron (PP) tests were used to identify the stationary of the economic time series effectively. Identifying a suitable lag length is important before applying a VEC model. Lag is the difference between the current time period to the certain past time period. Lag order n can be selected by using Akaike Information Criteria (AIC), Schwarz Bayesian (SC) and Hannan Quinn (HQ). VEC models are used for I(1) variables. Presence of cointegration indicates non stationary variables. Johansen Cointegration test is used to identify the existence of the co-integration.

Vector error correction model is established to identify the long-term error adjustment between the variables. Residual tests were done to confirm the validity of the model developed. Null hypothesis of no serial correlation at lag order n is tested under Portmanteau Test for Autocorrelation. Hypothesis is tested under 5% of significance level. Jarque –Bera test statistic under the null hypothesis of residuals are multivariate normal is tested in order to confirm the normality of the residuals of the VEC model. Stability of the variables can be identified using the AR root graph. If no root lies outside the unit circle that confirms the stability of the VEC model. Granger causality is used to identify the short term and directional causality of the variables. F-square statistics and probability values are used to test the null hypothesis of non-causality. As indicated in table 2, ADF tests and PP tests show that all variables become stationary by applying first difference as all p-values are less than 5%. Therefore, it is suitable to apply Vector Auto-Regressive model or Vector Error Correction model for the dataset.

Table 2: Stationary of Times Series data for period 1

Variable	Level		First Difference	
	ADF	PP	ADF	PP
LNINF	0.8640	0.0998	0.0007	0.0002
LNEXC	0.8483	0.7329	0.0001	0.0002
LNFDI	0.2785	0.0120	0.0000	0.0000
LNGDP	0.8270	0.9206	0.1202	0.0022
LNGE	0.9694	0.9364	0.0000	0.0000
LNMS	0.0001	0.0000	0.0006	0.0008
LNTOB	0.2340	0.1155	0.0000	0.0000
LNUMP	0.2234	0.4667	0.0119	0.0000

Source: Researchers computation using E-View version 10

4.1 VEC Model for the Period 1 (1981-1992)

According to table 3 the suitable lag length for the given economic variables is lag order 1 as selected by Akaike Information Criteria (AIC), Schwarz Bayesian (SC) and Hannan Quinn (HQ).

Table 3: Determine Lag Intervals with VAR Lag order Selection Criteria for 8 Economical Variables in U.S.A (Period 1)

Lag	AIC	SC	HQ
0	-12.58536	-12.26417	-12.46563
1	-24.79457	-21.90391*	-23.71696
2	-25.80775	-20.34762	-23.77227

Source: Researchers computation using E-View version 10

As indicated in table 4 there exists co-integration between endogenous variables of period 1. When cointegration exists, VEC model should be applied for the time series data instead of Vector Auto- Regressive model.

Table 4: Johansen Cointegration test (Period 1)

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	4	5	4	5	4
Max-Eig	2	3	0	3	3

Source: Researchers computation using E-View version 10

Table 5 shows the VEC model estimated using lag order 1. The t- statistics shown in the squared brackets should be greater than 2.0 for lag order to be significant. Inflation rate is taken as the endogenous variable and the other seven variables as the exogenous variables.

Table 5: Summary of Vector Error Correction Model Results Long Run Equation (Period 1)

Variable	Coefficient
Speed of Adjustment	107.2463 (Long Run)
LNEXC(-1)	-6.808127
	[-5.67571]
LNFDI(-1)	-1.201298
	[-4.72420]
LNGDP(-1)	-9.438562
	[-1.31874]
LNGE(-1)	3.195232
	[0.96507]
LNMS(-1)	-1.45773
	[-0.59800]
LNTOB(-1)	2.768994
	[8.09509]
LNUMP(-1)	-0.160214
	[-0.12975]

Source: Researchers computation using E-View version 10

Below equation 7 of VEC model 1 was derived from table 5. The Equation of the Error Correction Term and the long run model that explains the long run relationship between given economic variables and inflation rate for period 1 is shown in equation.

$LNINF_t = 107.2463 - 6.8081*LNEXC_{t-1} - 1.2013*LNFDI_{t-1} - 9.4386*LNGDP_{t-1} + 3.1952*LNGE_{t-1} - 1.4577*LNMS_{t-1} + 2.769*LNTOB_{t-1} - 0.1602*LNUMP_{t-1}$ **[7]**

4.2 Residual Tests of VEC Model for the Period 1 (1981-1992)

Table 6 shows the test results of portmanteau test for autocorrelation under the null hypothesis of no residual autocorrelations up to lag n proves that there is no autocorrelation among the lags at 5% of significant level.

Table 6: Portmanteau Test for Autocorrelation for VEC Model 1

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	31.68004	NA*	32.38404	NA*	NA*
2	83.70653	0.9952	86.77538	0.9903	120
3	135.1496	0.9973	141.8075	0.9908	184

*The test is valid only for lags larger than the VAR lag order. df is degrees of freedom for (approximate) chi-square distribution

Source: Researchers computation using E-View version 10

Table 7: Serial Correlation LM Test for VEC Model 1

Lags	LM-Stat	Prob
1	94.87869	0.0073
2	68.89682	0.3153
3	64.50707	0.4587
4	67.95152	0.3442
5	57.02050	0.7195
6	47.39647	0.9403

Probs from chi-square with 64 df.

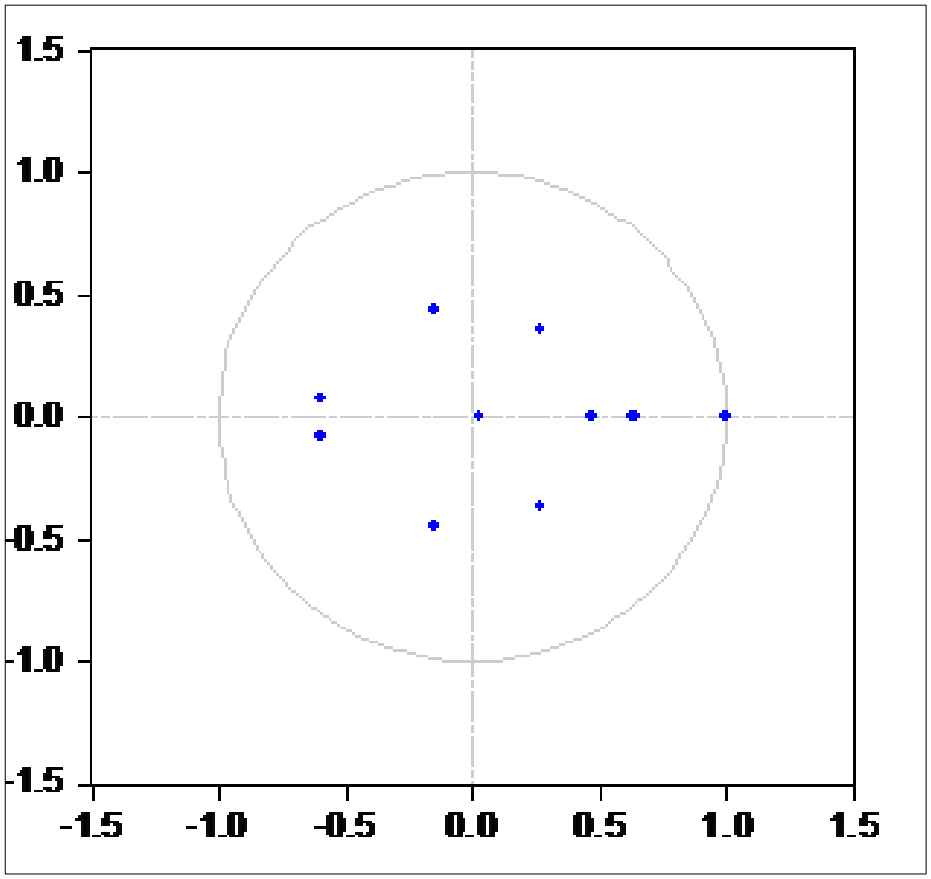
Source: Researchers computation using E-View version 10

Table 8: Normality Tests VEC Model 1

Component	Jarque-Bera	df	Prob.
1	0.761584	2	0.6833
2	5.195985	2	0.0744
3	1.236877	2	0.5388
4	1.652605	2	0.4377
5	1.476601	2	0.4779
Joint	12.82503	16	0.6855

Source: Researchers computation using E-View version 10

Null hypothesis of no serial correlation at lag order 12 is tested in table 7. It confirms that the hypothesis is significant at 5% of significant level. There is no serial correlation among the lags. Jarque –Bera test statistic under the null hypothesis of residuals are multivariate normal is shown in table 8.



Source: Researchers computation using E-View version 10

Figure 4: Inverse Roots of AR Stability of the VEC Model 1

Stability of the variables can be identified using the AR root graph. Unit root graph in figure 4 confirms that there is no root outside the unit circle and VAR satisfies the stability condition

4.3 Granger Causality for Period 1 (1981-1992)

F-Square statistics and probability values constructed under the null hypothesis of non causality show that there is a causal relationship between some variables.

Table 9: Granger Causality test

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
LNEXC does not Granger Cause LNINF	47	1.240	0.271	Do not Reject
LNINF does not Granger Cause LNEXC		9.288	0.003	Reject
LNFDI does not Granger Cause LNINF	47	3.118	0.084	Do not Reject
LNINF does not Granger Cause LNFDI		0.493	0.486	Do not Reject
LNGDP does not Granger Cause LNINF	47	0.434	0.513	Do not Reject
LNINF does not Granger Cause LNGDP		26.782	5.E-06	Reject
LNGE does not Granger Cause LNINF	47	0.652	0.423	Do not Reject
LNINF does not Granger Cause LNGE		4.617	0.037	Reject
LNMS does not Granger Cause LNINF	47	0.186	0.668	Do not Reject
LNINF does not Granger Cause LNMS		0.777	0.382	Do not Reject
LNTOB does not Granger Cause LNINF	47	0.503	0.481	Do not Reject
LNINF does not Granger Cause LNTOB		8.360	0.005	Reject
LNUMP does not Granger Cause LNINF	47	2.027	0.161	Do not Reject
LNINF does not Granger Cause LNUMP		1.208	0.277	Do not Reject

Source: Researchers computation using E-View version 10

As the null hypothesis rejects when the F-statistics are not significant, it can be concluded that there is causality among exchange rate (EXC), government expenditure (GE) and balance of trade (TOB) during the period 1 as explained in table 9.

4.4 VEC Model for the Period 2 (1993-2000)

As indicated in table 10 ADF test and PP tests show that all variables become stationary by applying the first difference as all p-values are less than 5%. Therefore the dataset is suitable to be analyzed using the Vector Auto-Regressive model or Vector Error Correction model.

Table 10: Unit Root Test results of Sequence of level (Period 2)

Variable	Level		First Difference	
	ADF	PP	ADF	PP
LNINF	0.0256	0.4006	0.0742	0.0024
LNEXC	0.9635	0.9635	0.0001	0.0001
LNFDI	0.7476	0.2614	0.0000	0.0001
LNGDP	0.9902	0.9930	0.0000	0.0000
LNGE	0.6498	0.0173	0.0047	0.0000
LNMS	0.9554	1.0000	0.6001	0.0048
LNTOB	0.9952	0.7369	0.4174	0.0000
LNUMP	0.8082	0.5915	0.1752	0.0001

Source: Researchers computation using E-View version 10

According to table 11 the suitable lag length for the given economic variables is lag order 1 as selected by Akaike Information Criteria, Schwarz Bayesian and Hannan Quinn (HQ).

Table 11: Determine Lag Intervals with VAR Lag order selection criteria for eight (08) economic variables in USA (Period 2)

Lag	AIC	SC	HQ
0	-21.23219	-20.86213	-21.11156
1	-32.99707*	-29.66652*	-31.91140*

Source: Researchers computation using E-View version 10

As indicated in table 12, there exists co-integration between endogenous variables. Therefore, a VEC model should be applied for the time series data.

Table 12: Johansen Cointegration test for eight (08) economic variables in USA (Period 2)

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	6	7	7	8	5
Max-Eig	4	3	2	3	3

Source: Researchers computation using E-View version 10

VEC Model 2 which is shown as equation 8 can be derived from table 13. The Vector Error Correction model is estimated using lag order 1 selected from lag order criteria.

$LNINF_t = 8.8674 - 0.0801*LNEXC_{t-1} - 0.09087*LNFDI_{t-1} - 3.2659*LNGDP_{t-1} - 2.3747*LNGE_{t-1} + 5.3632*LNMS_{t-1} - 1.2684*LNTOB_{t-1} - 4.5197*LNUMP_{t-1}$ **[8]**

Table13: Summary of Vector Error Correction Model Results Long Run Equation (Period 2)

Variable	Coefficient
Speed of Adjustment	-8.867394(Long Run)
LNEXC(-1)	-0.080068
	[-0.23424]
LNFDI(-1)	-0.090865
	[-3.10379]
LNGDP(-1)	-3.265895
	[-1.42887]
LNGE(-1)	-2.374673
	[-3.96969]
LNMS(-1)	5.363180
	[6.36526]
LNTOB(-1)	-1.268402
	[-17.2907]
LNUMP(-1)	-4.519676
	[-18.1068]

Source: Researchers computation using E-View version 10

Table 13 shows the VEC model estimated using lag order 1. The t- statistics shown in the squared brackets should be greater than 2.0 for lag order to be significant. Inflation rate is taken as the endogenous variable and other seven variables as the exogenous variables.

4.5 Residual Tests of VEC Model for the Period 2 (1993-2000)

Table 14 shows the test results of portmanteau test for autocorrelation under the null hypothesis of no residual autocorrelations up to lag h proves that there is no autocorrelation among the lags at 5% of significant level.

Table 14: Portmanteau Test for Autocorrelation for VEC Model 2

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	36.79504	NA*	38.06384	NA*	NA*
2	114.1872	0.6324	120.9840	0.4576	120
3	162.2172	0.8746	174.3506	0.6834	184

*The test is valid only for lags larger than the VAR lag order. df is degrees of freedom for (approximate) chi-square distribution

Source: Researchers computation using E-View version 10

Null hypothesis of no serial correlation at lag order n is tested in table 14, it confirms that the hypothesis is significant at 5% of significant level. There is no serial correlation among the lags.

Table 15: Serial Correlation LM Test for VEC Model 2

Lags	LM-Stat	Prob
1	75.69379	0.1504
2	76.92441	0.1289
3	32.86307	0.9996
4	91.19983	0.0144
5	53.37330	0.8257
6	68.53147	0.3263

Probs from chi-square with 64 df.

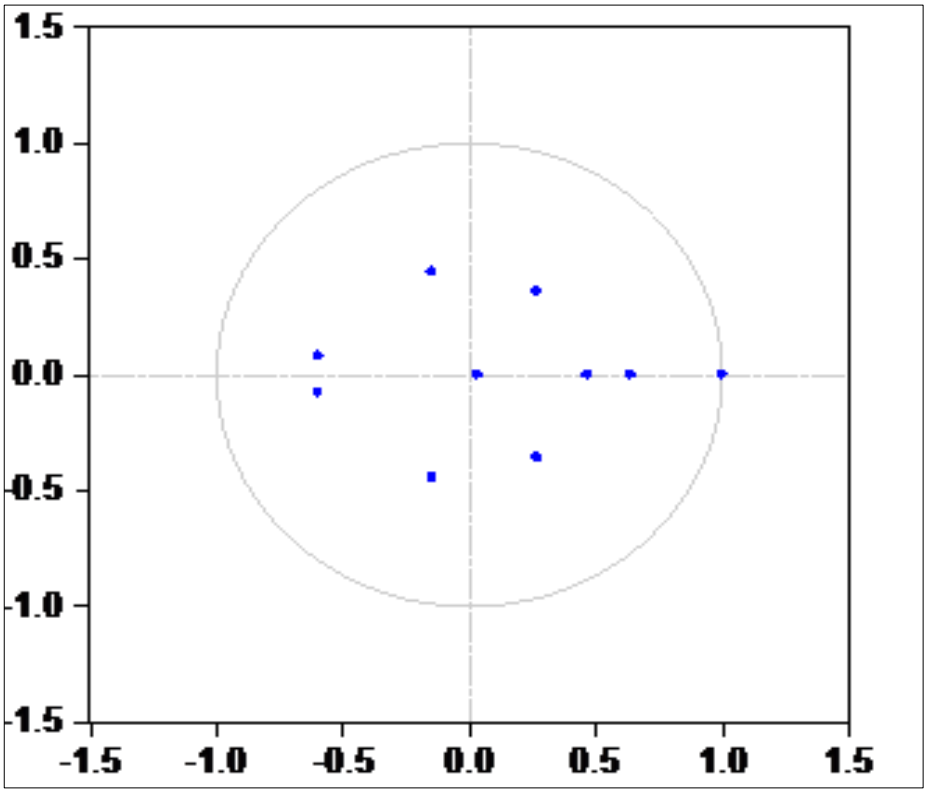
Source: Researchers computation using E-View version 10

Table 16: Normality Tests for VEC Model 2

Component	Jarque-Bera	df	Prob.
1	1.684313	2	0.4308
2	21.74035	2	0.0000
3	0.555336	2	0.7575
4	1.532379	2	0.4648
5	2.296769	2	0.3171
Joint	29.83926	16	0.0189

Source: Researchers computation using E-View version 10

Jarque –Bera test statistic under the null hypothesis of residuals are multivariate normal is shown in table 16. Statistics of skewness and kurtosis support the above indication.



Source: Researchers computation using E-View version 10

Figure 5: Inverse Roots of AR Stability of the VEC model 2

Unit root graph in figure 5 confirms that there is no root outside the unit circle and VEC model satisfies the stability condition

4.6 Granger Causality for Period 2 (1993-2000)

There is no granger causality running among all variables to inflation rate during the period which confirms there is no short-term causality running among variables as explained in table 17.

Table 17: Granger Causality Test for Period 2

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
LNEXC does not Granger Cause LNINF	31	1.47076	0.2354	Do not Reject
LNINF does not Granger Cause LNEXC		0.37257	0.5465	Do not Reject
LNFDI does not Granger Cause LNINF	31	0.94169	0.3402	Do not Reject
LNINF does not Granger Cause LNFDI		0.27560	0.6037	Do not Reject
LNGDP does not Granger Cause LNINF	31	2.15322	0.1534	Do not Reject
LNINF does not Granger Cause LNGDP		1.34713	0.2556	Do not Reject
LNGE does not Granger Cause LNINF	31	1.26751	0.2698	Do not Reject
LNINF does not Granger Cause LNGE		1.0E-05	0.9975	Do not Reject
LNMS does not Granger Cause LNINF	31	2.44156	0.1294	Do not Reject
LNINF does not Granger Cause LNMS		0.75557	0.3921	Do not Reject
LNTOB does not Granger Cause LNINF	31	3.20147	0.0844	Do not Reject
LNINF does not Granger Cause LNTOB		0.35110	0.5582	Do not Reject
LNUMP does not Granger Cause LNINF	31	1.49841	0.2311	Do not Reject
LNINF does not Granger Cause LNUMP		0.61254	0.4404	Do not Reject

Source: Researchers computation using E-View version 10

4.7 VEC Model for the Period 3 (2001-2008)

As indicated in table 18 ADF test and PP tests show that most variables become stationary by applying first difference.

Table 18: Unit root Test Results of Sequence of level (Period 3)

Variable	Level		First Difference	
	ADF	PP	ADF	PP
LNINF	0.1119	0.0992	0.0002	0.0034
LNEXC	0.3098	0.6449	0.1108	0.1108
LNFDI	0.0003	0.0003	0.0000	0.0001
LNGDP	0.4344	0.5403	0.4467	0.5546
LNGE	0.1704	0.7278	0.8943	0.0000
LNMS	0.9772	0.9816	0.0002	0.0112
LNTOB	0.4606	0.4244	0.0000	0.0005
LNUMP	0.0915	0.0452	0.2468	0.0000

Source: Researchers computation using E-View version 10

Table 19: Determine Lag Intervals with VAR Lag order selection criteria for 8 economic variables in USA (Period 3)

Lag	AIC	SC	HQ
0	-16.03909	-15.66903	-15.91846
1	-25.98583*	-22.65528*	-24.90015*

Source: Researchers computation using E-View version 10

According to table 19 the suitable lag length for the given economic variables is lag order 1 as selected by Akaike Information Criteria (AIC), Schwarz Bayesian (SC) and Hannan Quinn (HQ).

As indicated in table 20 there exists co-integration between endogenous variables. VEC model should be applied for the time series data.

Table 20: Johansen Cointegration test for eight (08) economic variables in USA (Period 3)

Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	4	7	5	6	5
Max-Eig	4	3	2	3	3

Source: Researchers computation using E-View version 10

Table 20 shows the VEC model estimated using lag order 1. T statistics shown in the squared brackets should be greater than 2.0 for lag order to be significant.

Equation 9 of VEC model 3 can be derived from table 20

$LNINF_t$= - 108.5129 + 1.1500*$LNEXC_{t-1}$ + 0.1466*$LNFDI_{t-1}$ + 15.6210*$LNGDP_{t-1}$ + 3.3601*$LNGE_{t-1}$ - 0.9363*$LNMS_{t-1}$ - 5.1595*$LNTOB_{t-1}$ + 4.4191*$LNUMP_{t-1}$ **[9]**

Table 21: Summary of Vector Error Correction Model Results Long Run Equation (Period 3)

Variable	**Coefficient**
Speed of Adjustment	108.5129 (Long Run)
LNEXC(-1)	1.150042
	[5.20035]
LNFDI(-1)	0.146643
	[30.8125]
LNGDP(-1)	15.62104
	[18.0575]
LNGE(-1)	3.360133
	[13.6842]
LNMS(-1)	-0.936284
	[-3.24126]
LNTOB(-1)	-5.159458
	[-52.6052]
LNUMP(-1)	4.419073
	[22.6733]

Source: Researchers computation using E-View version 10

4.8 Residual Tests of VEC Model for the Period 3 (2001-2008)

Table 22 shows the test results of portmanteau test for autocorrelation under the null hypothesis of no residual autocorrelations up to lag 12 proves that there is no autocorrelation among the lags at 5% of significant level.

Table 22: Portmanteau Test for Autocorrelation for VEC Model 3

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	25.39637	NA*	26.27211	NA*	NA*
2	79.67062	0.9983	84.42309	0.9943	120
3	135.2355	0.9972	146.1618	0.9817	184

*The test is valid only for lags larger than the VAR lag order. df is degrees of freedom for (approximate) chi-square distribution

Source: Researchers computation using E-View version 10

Null hypothesis of no serial correlation at lag order 12 is tested in table 23, it confirms that the hypothesis is significant at 5% of significant level. There is no serial correlation among the lags. Jarque –Bera test statistic under the null hypothesis of residuals are multivariate normal is shown in table 24. Unit root graph in figure 6 confirms that there is no root outside the unit circle and VAR satisfies the stability condition.

Table 23: Serial Correlation LM Test for VEC Model 3

Lags	LM-Stat	Prob
1	56.89827	0.7234
2	50.47181	0.8910
3	64.69199	0.4523
4	80.89332	0.0754
5	90.80821	0.0154
6	66.94242	0.3764

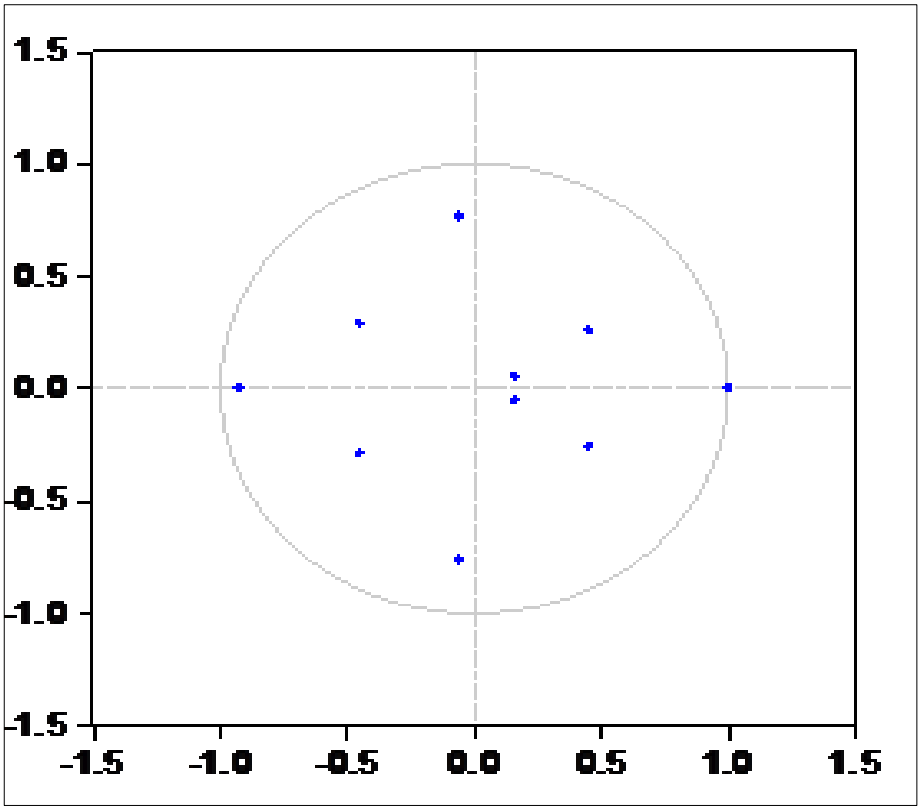
Probs from chi-square with 64 df.

Source: Researchers computation using E-View version 10

Table 24: Normality Tests for VEC Model 3

Component	Jarque-Bera	Df	Prob.
1	0.053533	2	0.9736
2	0.992337	2	0.6089
3	1.952124	2	0.3768
4	1.111649	2	0.5736
5	2.346787	2	0.3093
Joint	8.649543	16	0.9271

Source: Researchers computation using E-View version 10



Source: Researchers computation using E-View version 10

Figure 6: Inverse Roots of AR Stability of the VEC Model 3

4.9 Granger Causality for Period 3 (2001-2008)

There is no granger causality running among all variables to inflation rate during the period which confirms there is no short-term causality running among variables as explained in table 25.

Table 25: Granger Causality Test for Period 3

Null Hypothesis:	Obs	F-tatistic	Prob.	Decision
LNEXC does not Granger Cause LNINF	31	3.68882	0.0650	Do not Reject
LNINF does not Granger Cause LNEXC		2.29385	0.1411	Do not Reject
LNFDI does not Granger Cause LNINF	31	0.78815	0.3822	Do not Reject
LNINF does not Granger Cause LNFDI		3.89614	0.0583	Do not Reject
LNGDP does not Granger Cause LNINF	31	3.42450	0.0748	Do not Reject
LNINF does not Granger Cause LNGDP		4.07563	0.0532	Do not Reject
LNGE does not Granger Cause LNINF	31	1.93271	0.1754	Do not Reject
LNINF does not Granger Cause LNGE		0.11389	0.7383	Do not Reject
LNMS does not Granger Cause LNINF	31	1.96006	0.1725	Do not Reject
LNINF does not Granger Cause LNMS		2.32485	0.1385	Do not Reject
LNTOB does not Granger Cause LNINF	31	2.63879	0.1155	Do not Reject
LNINF does not Granger Cause LNTOB		1.13437	0.2959	Do not Reject
LNUMP does not Granger Cause LNINF	31	0.10616	0.7470	Do not Reject
LNINF does not Granger Cause LNUMP		0.43647	0.5142	Do not Reject

Source: Researchers computation using E-View version 10

4.10 VEC Model for the Period 4 (2009-2016)

Table 26: Unit Root Test Results of Sequence of level for Period 4

Variable	Level		First Difference	
	ADF Test	PP test	ADF Test	PP test
LNINF	0.0002	0.0482	0.0000	0.0000
LNEXC	0.9688	0.9239	0.0135	0.0179
LNFDI	0.0262	0.0316	0.0000	0.0000
LNGDP	0.9525	0.9595	0.0000	0.0000
LNGE	0.5802	0.4905	0.0022	0.0007
LNMS	0.9873	0.9972	0.0204	0.0004
LNTOB	0.0253	0.0028	0.0000	0.0000
LNUMP	0.9133	0.9419	0.0001	0.0000

Source: Researchers computation using E-View version 10

As indicated in table 26 ADF test and PP tests shows that all variables become stationary by applying first difference. According to table 27 the suitable lag length for the given economic variables is lag order 1 as selected by Akaike Information Criteria (AIC), Shwartz Bayesian (SC) and Hannan Quinn (HQ). As indicated in table 28 there exists co-integration between endogenous variables. VEC model should be applied for the time series data.

Table 27: Determine Lag Intervals with VAR Lag order selection criteria for eight (08) economic variables in USA (Period 4)

Lag	AIC	SC	HQ
0	-20.11295	-19.74289	-19.99232
1	-29.49784*	-26.16729*	-28.41216*

Source: Researchers computation using E-View version 10

Table 28: Johansen Co-integration test for eight (08) Economical Variables in USA (Period 4)

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	6	7	6	5	5
Max-Eig	4	5	4	5	5

Source: Researchers computation using E-View version 10

Below equation 10 of VEC model 4 can be derived from table 29.

$LNINF_t = 1354.12946 + 13.03348*LNEXC_{t-1} - 0.10276*LNFDI_{t-1} - 158.17008*LNGDP_{t-1} + 15.53531*LNGE_{t-1} + 0.36757*LNMS_{t-1} + 2.90795*LNTOB_{t-1} - 15.20314*LNUMP_{t-1}$ **[10]**

Table 29: VEC Model for selected economic variables in USA (Period 4)

Variables	Coefficient
Speed of Adjustment	1354.129 (Long Run)
LNEXC(-1)	13.03348
	[7.32137]
LNFDI(-1)	-0.10276
	[-0.74463]
LNGDP(-1)	-158.1701
	[-14.9644]
LNGE(-1)	15.53531
	[11.1056]
LNMS(-1)	0.367573
	[0.19222]
LNTOB(-1)	2.907952
	[3.38785]
LNUMP(-1)	-15.20314
	[-15.1020]

Source: Researchers computation using E-View version 10

4.11 Residual Tests of VEC Model for the Period 4 (2009-2016)

Table 30 shows the test results of portmanteau test for autocorrelation under the null hypothesis of no residual autocorrelations up to lag 12 proves that there is no autocorrelation among the lags at 5% of significant level.

Table 30: Portmanteau Test for Autocorrelation for VEC model 4

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	Df
1	53.71270	NA*	55.56487	NA*	NA*
2	114.0223	0.6365	120.1823	0.4781	120
3	155.2505	0.9394	165.9914	0.8254	184

*The test is valid only for lags larger than the VAR lag order. df is degrees of freedom for (approximate) chi-square distribution

Source: Researchers computation using E-View version 10

Null hypothesis of no serial correlation at lag order 12 is tested in table 31, which confirms that the hypothesis is significant at 5% of significance level. There is no serial correlation among the lags.

Table 31: Serial Correlation LM Test VEC model 4

Lags	LM-Stat	Prob
1	101.9437	0.0018
2	59.24034	0.6452
3	35.42927	0.9986
4	65.05559	0.4397
5	81.11653	0.0730
6	84.02485	0.0474

Probs from chi-square with 64 df.

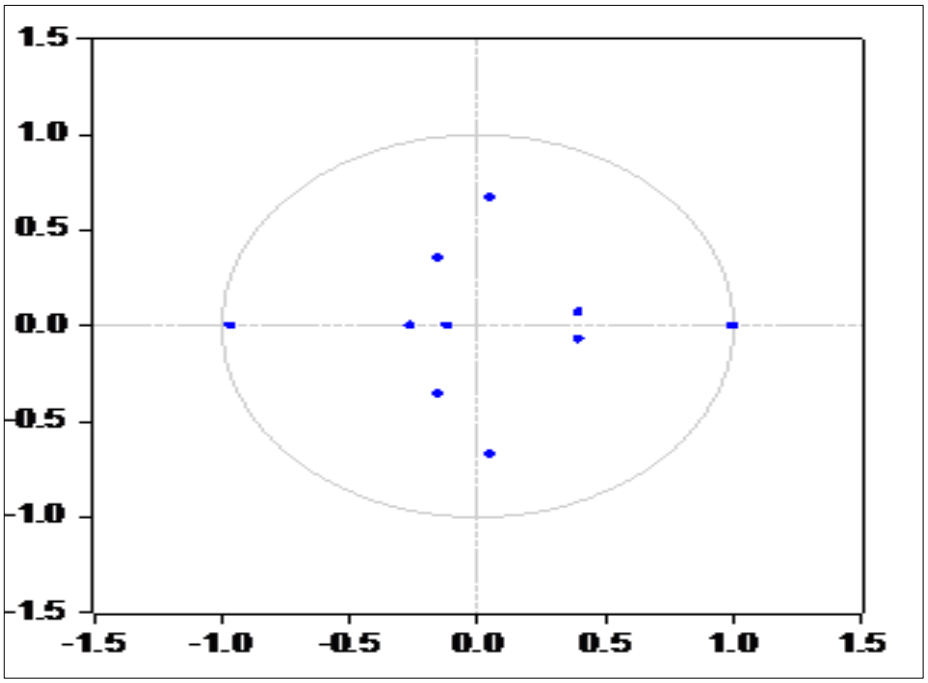
Source: Researchers computation using E-View version 10

Table 32: Normality Tests for VEC model 4

Component	Jarque-Bera	Df	Prob.
1	1.027999	2	0.5981
2	1.224548	2	0.5421
3	1.573487	2	0.4553
4	2.520553	2	0.2836
5	0.838776	2	0.6574
Joint	10.22928	16	0.8544

Source: Researchers computation using E-View version 10

Jarque –Bera test statistic under the null hypothesis of residuals are multivariate normal is shown in table 32. Statistics of skewness and kurtosis support the above indication.



Source: Researchers computation using E-View version 10

Figure 7: Inverse Roots of AR Stability of the VEC model 4

Stability of the variables can be identified using the AR root graph. Unit root graph in figure 7 confirms that there is no root outside the unit circle and VAR satisfies the stability condition

4.12 Granger Causality Test for period 4

There is no granger causality running among all variables to inflation rate except money supply during the period which confirms there is no short-term causality running among variables as shown in table 33

Table 33: Granger Causality Test for period 4

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
LNEXC does not Granger Cause LNINF	31	3.85937	0.0595	Do not reject
LNINF does not Granger Cause LNEXC		4.10419	0.0524	Do not reject
LNFDI does not Granger Cause LNINF	31	0.13058	0.7205	Do not reject
LNINF does not Granger Cause LNFDI		0.12887	0.7223	Do not reject
LNGDP does not Granger Cause LNINF	31	0.37284	0.5464	Do not reject
LNINF does not Granger Cause LNGDP		1.85876	0.1836	Do not reject
LNGE does not Granger Cause LNINF	31	0.28485	0.5977	Do not reject
LNINF does not Granger Cause LNGE		3.36627	0.0772	Do not reject
LNMS does not Granger Cause LNINF	31	0.40974	0.5273	Do not reject
LNINF does not Granger Cause LNMS		7.02772	0.0131	Reject
LNTOB does not Granger Cause LNINF	31	0.56869	0.4571	Do not reject
LNINF does not Granger Cause LNTOB		0.00289	0.9575	Do not reject
LNUMP does not Granger Cause LNINF	31	3.81257	0.0609	Do not reject
LNINF does not Granger Cause LNUMP		1.52854	0.2266	Do not reject

Source: Researchers computation using E-View version 10

4.13 Summary of VEC Models

The factors that influence the inflation rate on a long-term basis for the four periods are as shown in table 34.

Table 34: Summary of Significant Variables (Long Term) during Four Periods

Period	Significant Variables
Period 1	$LNINF_{t-1}$, $LNEXC_{t-1}$, $LNFDI_{t-1}$, $LNGDP_{t-1,}$ $LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$, $LNUMP_{t-1}$
Period 2	$LNINF_{t-1}$, $LNEXC_{t-1}$, $LNFDI_{t-1}$, $LNGDP_{t-1,}$ $LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$, $LNUMP_{t-1}$
Period 3	$LNINF_{t-1}$, $LNEXC_{t-1}$, $LNFDI_{t-1}$, $LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$, $LNUMP_{t-1}$
Period 4	$LNFDI_{t-1}$, $LNGDP_{t-1,}$ $LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$, $LNUMP_{t-1}$

During the first period which is a republican period (From 1981Q1 to 1992Q4) one lagged inflation rate, one lagged exchange rate, one lagged foreign direct investment, one lagged gross domestic product, one lagged government expenditure, one lagged money supply, one lagged balance of trade, and one lagged unemployment rate affected the inflation rate.

During the second period (From 1993Q1 to 2000Q4) which is a democratic period one lagged inflation rate, one lagged exchange rate, one lagged foreign direct investment, one lagged gross domestic product, one lagged government expenditure, one lagged money supply, one lagged balance of trade, and one lagged unemployment rate affected the inflation rate.

During the third period (From 2001Q1 to 2008Q4) which is a republican period one lagged inflation rate, one lagged exchange rate, one lagged foreign direct investment, one lagged government expenditure, one lagged money supply, one lagged balance of trade, and one lagged unemployment rate affected the inflation rate.

During the fourth period (From 2009Q1 to 2016Q4) which is a democratic period one lagged foreign direct investment, one lagged gross domestic product, one lagged government expenditure, one lagged money supply, one lagged balance of trade, and one lagged unemployment rate affected the inflation rate.

Considering table 34 it is visible that one lagged foreign direct investment, one lagged government expenditure, one lagged money supply, one lagged balance of trade, and one lagged unemployment rate affected the inflation rate during four periods. There is no visible pattern that can be identified according to the four periods or political party which ruled the country.

Table 35 shows the nature of the relationship with the inflation rate of significant variables which are displayed in 34.

During the first period which is a republican period (From 1981Q1 to 1992Q4) one lagged inflation rate, one lagged exchange rate, one lagged gross domestic product and one lagged unemployment rate have a positive relationship with inflation rate while one lagged foreign direct investment, one lagged government expenditure, one lagged money supply and one lagged balance of trade have a positive relationship with the inflation rate.

During the second period (From 1993Q1 to 2000Q4) which is a democratic period one lagged inflation rate, one lagged money supply and one lagged balance of trade have a positive relationship with inflation rate while one lagged exchange rate, one lagged foreign direct investment, one lagged gross domestic product, one lagged government expenditure, and one lagged unemployment rate have a positive relationship with the inflation rate.

During the third period (From 2001Q1 to 2008Q4) which is a republican period one lagged government expenditure, one lagged money supply and one lagged balance of trade have a positive relationship with inflation rate while one lagged inflation rate, one lagged exchange rate, one lagged foreign direct investment, and one lagged unemployment rate have a negative relationship with the inflation rate.

During the fourth period (From 2009Q1 to 2016Q4) which is a democratic period one lagged unemployment rate has a positive relationship with inflation rate while one lagged foreign direct investment, one lagged gross domestic product, one lagged government expenditure, one lagged money supply and one lagged balance of trade have a negative relationship with the inflation rate.

Therefore, according to table 35, there is no similarity between the nature of the relationship between economic variables and inflation rate.

Table 35: Summary of Positively and Negatively Influenced Variables during Four Periods

Period	Positively influenced	Negatively influenced
Period 1	$LNINF_{t-1}$, $LNEXC_{t-1}$, $LNGDP_{t-1}$, $LNUMP_{t-1}$	$LNFDI_{t-1}$, $LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$
Period 2	$LNINF_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$	$LNEXC_{t-1}$, $LNFDI_{t-1}$, $LNGDP_{t-1}$, $LNGE_{t-1}$, $LNUMP_{t-1}$
Period 3	$LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$	$LNINF_{t-1}$, $LNEXC_{t-1}$, $LNFDI_{t-1}$, $LNUMP_{t-1}$
Period 4	$LNUMP_{t-1}$	$LNFDI_{t-1}$, $LNGDP_{t-1}$, $LNGE_{t-1}$, $LNMS_{t-1}$, $LNTOB_{t-1}$

The factors that influence the inflation rate on a short-term basis for the four periods are as in table 36. During the first-period exchange rate, government expenditure and balance of trade influence the inflation rate, and during the fourth period money supply has influenced the inflation rate. During the second and third period, none of the variables has a short-term influence on the inflation rate.

Table 36: Summary of Significant Variables (Short Term) during Four Periods

Period	Significant Variables
Period 1	EXC , GE, TOB
Period 2	None
Period 3	None
Period 4	MS

5. CONCLUSIONS

The study shows that there is a gap between theories of inflation and practices of the economy in the USA during the given periods, but the economic expansion period shows an exception.

Money supply which accelerates the growth of the economy is supposed to have a positive relationship with the inflation rate according to the Equation of Modern Quantitative Theory of Money. But it gives both positive and negative influences on the inflation rate according to the study. As it is mentioned earlier in the study there were two economic expansions during March 1991 to March 2001 and November 2001 to December 2007 in the USA and during this period the inflation rate remained low. It can be observed that during this period money supply has a positive relationship with the inflation rate. During an economic expansion, money is easy to access and cheap to borrow. In such a situation there is a visibly positive effect on money supply on the inflation rate as shown in the study. But during the other two periods, the money supply has a negative relationship with the inflation rate. During the first and fourth periods where there is no indication of economic expansion, the results are reversed.

The exchange rate can affect the inflation rate through wages and prices of goods and services (Svensson,2000) During the economic expansion period exchange rate shows an inverse relationship with the inflation rate which is

not according to the theoretical relationship between exchange rate and inflation rate.

The unemployment rate, on the other hand, is according to the Phillips curve theory during the economic expansion, which means during the economic expansion it shows an inverse relationship with the inflation rate.

In the U.S.A economy's balance of trade indicates that exports exceed imports which helps the economy to maintain a positive balance of trade. Another observation is that during an economic expansion, the balance of trade has a positive relationship with the inflation rate. Positive trade of balance increases money supply which increases inflation rate. Therefore, the relationship between the balance of trade during an economic expansion is not against the theories in the economy.

Foreign direct investment during four periods has an inverse relationship with the inflation rate. Investors typically invest money in countries with a low and stable inflation rate. Therefore, this relationship is theoretically acceptable.

The relationship of inflation rate with money supply, exchange rate, the balance of trade, and unemployment rate during the economic expansion periods are not against the economic theories. But the typical behavior of other variables such as gross domestic product, government expenditure towards the inflation rate is not stable during the given four periods of the study.

It can be concluded that the inflation rate of the country does not vary according to the political party which rules the country. But there is a visible impact of economic expansion of the U.S.A economy on the behavior of the economic variables towards the inflation rate.

The federal bank of the U.S.A influence economic expansions and it also maintains the low inflation rate. (Parry,1999). The active interference of the Federal Bank of the United States can be identified as the main reason to maintain the inflation rate of the country despite the political party or sudden economic shocks. Therefore, the economic theories might be altered with strategic economic decision making. The economy of Sri Lanka, which is highly influenced by political influences, should try to establish an independent body to maintain the inflation rate and apply strategic decisions and policymaking during a time of recession. This method will maintain the economy of the country without much hazard.

Furthermore, although the theories of inflation predefine some influences that can be caused by other economic variables, not in all situations the theories

can be correct. In the US economy, some of the economic practices are in accordance with theories during the expansion period.

Therefore, rather than depending solely on economic variables, economists and policymakers must study the present situation and influences before making decisions on maintaining the inflation rate.

REFERENCES

Ahuja, H. L. (1986). Macro Economics (Theory & Policy). S Chand Publishers

Akbar, M., Arshed M., Jamal, F., (2014). Statistical Analysis of the Factors Affecting Inflation in Pakistan, *International Journal of Research*, 1(4), 331-341.

Barone, A. (2019). What Is the Quantity Theory of Money? https://www.investopedia.com/insights/what-is-the-quantity-theory-of-money

Berger, H., Österholm, P. (2015). Does money still matter for U.S. output? Economic Letters. 102. 143-146. DOI: 10.1016/j.econlet.2008.11.029.

Bysyuk, V. (2010). Impact of 9/11 Terrorist Attacks on US and International Tourism Development. https://www.modul.ac.at/uploads/files/Theses/Bachelor/BYSYUK_Impact_of_9_11_on_US_and_International_Tourism_Development.pdf

Chappelow, J. (2019). Economic Growth Definition https://www.investopedia.com/terms/e/economicgrowth.asp

Dhakal, Dharmendra, Kandil, Magda, Sharma, Subhash C., Trescott, Paul B., (1994). "Determinants of the inflation rate in the United States: A VAR investigation," *The Quarterly Review of Economics and Finance*, Elsevier, vol. 34(1):95-112.

Edwards, J., Mohamed T. (2019). MMT: Here's a Plain-English guide to 'Modern Monetary Theory' and why it's interesting. https://www.businessinsider.com/modern-monetary-theory-mmt-explained-aoc-2019-3

Enders, W. (2004). Applied Econometric Time Series, 2nd Edition. In: Wiley Series in Probability and Statistics, John Wiley & Sons, Inc., Hoboken.

Engle, R. F., Granger, C. W. (1987). Co-integration and error correction: Representation, estimation and testing, *Econometrica*, 55, 251-76.

Fisher, I. (1933). The Debt-Deflation Theory of Great Depressions, *Econometrica*, 1(4),337-357. doi:10.2307/1907327

Friedman, M. (1968). The Role of Monetary Policy, *American Economic Review*, 58, March, 1-17.

Gray, A. (2017) The World's Biggest Economies in 2017, World Economic Forum, https://www.weforum.org/events/the-jobs-reset-summit-2021

Granger, C. (1988). Causality, cointegration, and control, *Journal of Economic Dynamics and Control*, 12, (2-3), 551-559.

Hume, D. (1752). Political discourses. Edinburgh: Printed by R. Fleming, for A. Kincaid and A. Donaldson

Johansen, S., Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics* 52, 169-210

Keynes, J. (1931). Essays of Persuasion, The Economy Report. https://www.economicsnetwork.ac.uk/archive/keynes_persuasion/The_Economy_Report.htm

Khan, R., Gill, A. (2010). Determinants of Inflation: A Case of Pakistan (1970-2007). *Journal of Economics*, 1, 45-51.

Maddala, G.S. (2001). Introduction to Econometrics. 3rd Edition, Wiley, New York.

Papi L., Lim, G.C. (1997). An Econometric Analysis of the Determinants of Inflation in Turkey, No 1997/170, IMF Working Papers, International Monetary Fund

Parry, R.T. (1999). The Role of the Federal Reserve in the Economy. Fed Focus: A Community Conference Fairmont Hotel, San Jose, California

Phillips, A. W. (1958). The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957, 283-299.

Quah,D.,Vahey, S.(1995). Measuring Core Inflation? *Economic Journal*, 105, (432), 1130-44

Radcliffe, B. (2019). Monetarism: Printing Money to Curb Inflation https://www.investopedia.com/articles/economics/08/monetarism.asp

Ricardo, D. (1817). On the Principles of Political Economy and Taxation. Works and Correspondence of David Ricardo Volume I, Cambridge University Press.

Simionescu, S. (2016). "The Identification of Inflation Rate Determinants in The USAUsing the Stochastic Search Variable Selection," CES Working Papers, Centre for European Studies, Alexandru Ioan Cuza University, 8(1), 171-181.

Svensson, L.E.O. (2000). Open-economy ınflation targeting. Journal of International Economics. 50,155–183.

Weidenmier, M. (2008). The Baring Crisis and the Great Latin American Meltdown of the 1890s, *The Journal of Economic History*, 68(2), 462-500.

World Tourism Organization (2005). WTO Report 2005. http://www.world-tourism.org/facts/menu.html