Do Exchange Rate, Money Supply, Import and World Gold Price Impact on the Consumer Price Index? – An Empirical Evidence in a Developing Country

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Abstract

The purpose of this paper is to finding whether there exists the effects of exchange rate, money supply, import and world gold price on the consumer price index in a developing country of Vietnam. Using an autoregressive distributed lag model (ARDL model) on the monthly data during the period over Jan 2009-May 2019, collected from World Development Indicators, Department of Statistics in Vietnam. Evidence from the study shows that inflation in the country is strongly negative influenced by expected inflation factor; exchange rate has a positive impact on the consumer price index; import value has a positive, but low impact on the consumer price index and money supply creates a positive impact of on consumer price index.

Keywords: Consumer price index, exchange rate, money supply, import and world gold price, Autoregressive Distributed Lag Model.

1. Introduction

Macroeconomic stability is the main item on the policy agenda of Vietnam in 2010. The four most important issues related to macroeconomic stability in Vietnam these days are namely inflation, exchange rate management, trade deficit and budget deficit. Prices of goods and services fluctuate over time, but if prices change too quickly, it could be a shock to the economy. The Consumer Price Index (CPI) is a basic indicator that measures the prices of goods and services and indicates whether the economy is experiencing inflation or deflation. According to the national General Statistics Office, Vietnam's economy is facing a very rapid increase in the consumer price index. CPI is formed from spending information of thousands of households nationwide. Information was collected through interviews and spending diaries of selected subjects for research. These figures will creat a picture of the volatility of the cost of living, thereby helping financial experts identify whether inflation is at risk of causing an entire economy to collapse, in case inflation is at a too high a level. Both excessive inflation and deflation are very harmful to the economy, although excessive deflation occurs less frequently. Changes in market prices of goods and services have a direct effect on fixed-rate securities. If prices rise, the fixed returns will be of less value and thus reduce the returns on the securities. Inflation will also affect wages, benefits, and pensions because they are fixed payments. Besides, price fluctuations can adversely affect companies. Mild inflation is generally expected in a growing economy, but if the prices of inputs rise too quickly, producers will experience reduced profits. On the other hand, deflation will inevitably lead to a decrease in consumer demand. In this case, producers are forced to reduce prices in order to sell goods, but the prices of inputs may not decrease by the same amount. Therefore, the producer's profit margin will also be affected.

In the current era, inflation, especially its determinants and volatility, is one of the most controversial topics in developing countries, such as Vietnam. The reason is rational that Vietnam experienced hyperinflation in the 1980s and early 1990s. Persistent hyperinflation has been one of the reasons triggering economic reforms in Vietnam since the late 1980s. Except for the period 2000-2003 when inflation was low and stable at 5% or less, the inflation rate in Vietnam was higher, more persistent and volatile than in its trading partners. Understanding the causes and consequences of these problems is essential for assessing the impact of macroeconomic policy on the economy. Camen (2006) and Baker et al. (2006) are comprehensive research samples on monetary policy and inflation dynamics of the period before 2005. However, recent events such as WTO accession, large foreign exchange flows in 2007-2008, problems in the foreign exchange market in 2009 and 2010 and the global economic crisis as well as the threat of inflation return. In addition, it has raised many new problems and challenges for macroeconomic management and especially inflation control in Vietnam. Many changes in the macroeconomic environment and economic policy over the past few years have necessitated a systematic and thorough approach to identifying the main macro determinants of inflation in the new context of Vietnam. Some previous studies have used some methods such as Granger test (Tiwari, 2012)

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or the popular method is using vector autoregressive model - Vector AutoRegressive. – VAR (Camen, 2006). However, a more advanced and modern method is the Autoregressive Distributed Lag (ARDL) model that has not been applied in the subject to analyze the impact of some macroeconomic factors. to the consumer price index. Therefore, this article focuses on studying the impact of a number of macroeconomic factors on the consumer price index in Vietnam, approached by the ARDL model.

The article goes ahead with attendance: In the section "Literature review", review of the literature. Next, the data and method of investigation are given in the section "Data and research model". This investigation's results are supported by the section "Results" at the end conclusions in the section "Conclusions".

2. Literature Review

Inflation is an increase in the general price level over time, the general price level consists of two parts, the consumer price index and the gross domestic product adjustment coefficient. Inflation or deflation both have a very strong impact on the economy, measuring this rate is usually based on 3 indicators: CPI (consumer price index), GDP (gross domestic product), PPI (producer price index). The CPI has a particularly close relationship with the inflation rate, which is considered a typical measure of the inflation rate, also known as an inflation tax. Therefore, studies on inflation can also be considered related to the consumer price index.

Most empirical studies have confirmed the important role of monetary factors on inflation in the long run. In the short term, monetary factors, past inflation, public sector deficit and exchange rate are the contributing factors to inflationary pressures. Samples of such studies are Chhibber (1991) on inflation in Africa, Lim and Papi (1997) on inflation in Turkey, Laryea and Sumaila (2001) on inflation in Tanzania, Akinboade et al. (2004) on South Africa's inflation, Lehayda (2005) on Ukraine's inflation.

The literature on the relationship between exchange rates and inflation also shows rich results. For example, Chhibber (1991) shows that the impact of devaluation on inflation depends on the degree of exchange rate flexibility, the openness of the capital account, and the degree of price control. In addition, many studies analyze structural and cost-push factors such as monopoly pricing and cost pressures stemming from wage increases and devaluations. On the other hand, with some studies showing that there are unexplained periods of persistent inflation and a relatively small impact on inflation while others show a significant effect of spending on inflation. labor costs on inflation in the long run. Case studies such as Lim and Papi (1997), Chhibber (1991), Akinboade et al. (2004) and Leheyda (2005).

Bodart (1996) explored the inflationary effects of exchange rate reform in a small open economy by combining the fiscal view of inflation with multiple exchange rate systems. He found that the fixation of the official exchange rate had only a temporary effect on inflation while amortization had a more permanent effect on inflation under a continuously adjusted system. official exchange rate at the bilateral market rate. In addition, long-term budget deficits lead to higher inflation.

Previous studies on Vietnam's inflation also have many attempts have been made to explain the fluctuations of inflation in Vietnam. These studies range from non-quantitative (non-technical) to extensive empirical work. For the purpose of this study, we will focus primarily on reviewing recent empirical work done on the case of Vietnam. Following the economic theories outlined in the inflation literature, Vietnam's inflation studies also incorporate as many factors as possible from both the cost and demand drivers of inflation in trying to explain Vietnam's inflationary dynamics. However, due to lack of data or the authors' choice, most studies ignore supply-side factors and focus mainly on demand-side factors of inflation. The only inclusion of supply-side factors are external shocks to world prices (world oil prices and, in rare cases, international rice prices). The current literature on the determinants of Vietnam's inflation revolves around the following factors: CPI, total money, interest rates, exchange rates, output, international oil prices and international rice prices.

Similar results on the role of aggregate money on inflation were found in an IMF study (2003), also using a seven-variable VAR model: international oil prices, international rice prices, and output. industrial, exchange rate, currency, import prices and consumer prices for the period from January 1995 to March 2003. The results show internal fluctuations that are important factors in explaining behaviour. of inflation, core inflation (inflation excluding food) and import prices. The exchange rate has a significant effect on import prices, but not on CPI, reflecting the large share of non-tradable products in the CPI basket and import prices not directly included in domestic prices, although the extent openness of the economy is increasing. The authors also show that international rice prices, domestic demand conditions, and money growth have a modest but significant impact on inflation.

However, a later study by the IMF (2006) using quarterly data from 2001 to 2006 showed a significant role of total money on inflation. Although the results are questionable due to the limitation of the rather small sample size, the authors have also stated that money and credit growth began to be correlated with inflation from 2002. Part of this This change can be explained by the liberalization of different price levels in the early 2000s. This study also shows that while inflation expectations and output differentials have an effect on inflation. Inflation, oil price shock and exchange rate have a modest role in explaining inflation in the studied period. In addition, Vietnam's inflation has a higher inertia component than that of other countries in the region. This suggests that once inflation expectations emerge, it becomes more difficult to control inflation. The higher inertia may be the result of public memory of hyperinflation that lasted until the early 1990s. In addition, the Balassa-Samuelson effect is not strong on inflation, despite high productivity growth. than in the tradable zone, there is no strong evidence of a medium-term price increase between the tradable and non-tradable zones.

Camen (2006) used a VAR model with monthly data for the periods from February 1996 to April 2005 and found that: (i) total credit to the economy accounted for 25% of the volatility of CPI and is the main variable in explaining CPI after 24 months; (ii) total liquidity and interest rates explain only a very small part of CPI volatility (below 5%); (iii) oil and rice prices are very important which shows the important role of commodity prices and exchange rates (19%). (iv) The US money supply (M3) as a measure of international liquidity also plays an important role in most of the sampling period.

Another study that focuses mainly on the effect of dollarization on inflation is Goujon (2006), who shows that given the dollarized nature of the economy, money is only important for inflation. if holding dollars. The study used a monetary approach, with data for the period from January 1991 to June 1999.

In addition, there are a number of other non-technical studies related to the volatility of inflation and its determinants such as UNDP (2008) on food inflation in Vietnam. Both studies tend to support the government's position that inflation is mainly externally generated.

It is at these points that we hope to make improvements in the data as well as the model in this study. The idea of the topic will update research data on CPI and macroeconomic factors affecting CPI, with a new approach, which has not been implemented in empirical studies related to CPI, with the similar idea as in Alsamara et al. (2020). The form autoregressive model with lagged distribution is presented in detail as in Nkoro and Uko (2016).

3. Data and research model

3.1 Research data

The study uses monthly data sets of variables selected from previous studies.

Table 1: Margin specifications

Variable	Denotation	Source	Unit
Consumer Price Index	CPI	https://finance.vietstock.vn/	%
Exchange rate	EXR	https://vn.investing.com/	VND/USD
World gold price	WGP	https://vn.investing.com/	USD/ounce
Money supply	MS	https://finance.vietstock.vn/	Billion VND
Import value	IMP	https://finance.vietstock.vn/	Million USD

This part will implement ARDL model with monthly data, from January 2009 to May 2019, including 125 observations, with the goal of analyzing the impact of VND/USD exchange rate, world gold price (USD/ounce), money supply (billion VND) and import value (million USD) to consumer price index (%).

3.2 Research model

The mathematical form of the ARDL model used in the article is as follows:

$$D(CPI)_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i D(\mathrm{EXR})_{t-i} + \sum_{i=1}^{n} \beta_i D(\mathrm{WGP})_{t-i} + \sum_{i=1}^{p} \beta_i D(MS)_{t-i} + \sum_{i=1}^{q} \beta_i D(IMP)_{t-i} + u_t, \qquad (1)$$

where D is the difference operator; α_i, β_i are the regression coefficients, and u_t is the residual which has a simultaneous correlation but no correlation with its lags and all independent variables. So the right side of the regression equation consists of the lags of independent and dependent variables.

4. Empirical results

First, we perform the data analysis steps, as in Table 2.

Table 2: Statistical description of variables

|	*CPI*	*EXR*	*IMPORT*	*MS*	*WGOLD*
Mean	0.496	21183.46	12337.47	4893302.	1345.66
Median	0.350	21157.50	12228.00	4524885.	1333.20
Maximum	3.320	23412.50	22800.00	9706888.	1828.50
Minimum	-0.530	17480.50	3333.00	1561466.	890.70
Std. Dev.	0.638	1578.700	4695.83	2442522.	200.65
Skewness	1.512	-0.733	0.307	0.390	0.091
Kurtosis	5.979	2.773	2.187	1.893	2.958
Jarque-Bera	93.866	11.460	5.403	9.557	0.182
Probability	0.000	0.003	0.067	0.008	0.913
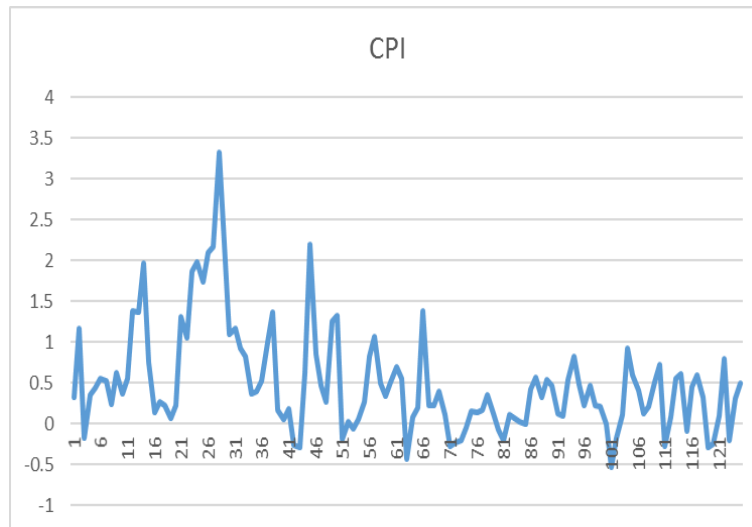
Fig 1: Graph depicting changes dependence variable

First, make sure that the time series are stationary. The stationarity test of the time series thanks to Augmented Dickey–Fuller test are presented in Table 3 below:

Table 3: Result of stationarity test of initial series

Series	*t-statistic*	*Conclusion*
CPI	-5.107	Stationary
EXR	-2.067	Non-stationary
IMP	2.126	Non-stationary
MS	3.455	Non-stationary
WGP	-2.411	Non-stationary

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The results show that, at the 5% level of significance, the initial time series are non-stationary, except for the CPI variable. Table 4 below presents the results of the stationarity test for the first-difference series.

Table 4: The results of the stationarity test of the first-difference series

Series	t-statistic	Conclusion
D(CPI)	-9.663	Stationary
D(EXR)	-11.324	Stationary
D(IMP)	-9.306	Stationary
D(MS)	-10.889	Stationary
D(WGP)	-12.933	Stationary

The results show that, at the 5% level of significance, the first-difference series are stationary. First-difference sequences will be used to feed the ARDL model.

The authors make estimates for the model with the maximum lag for the variables of 10, using Hannan-Quinn criteria to choose the best model.
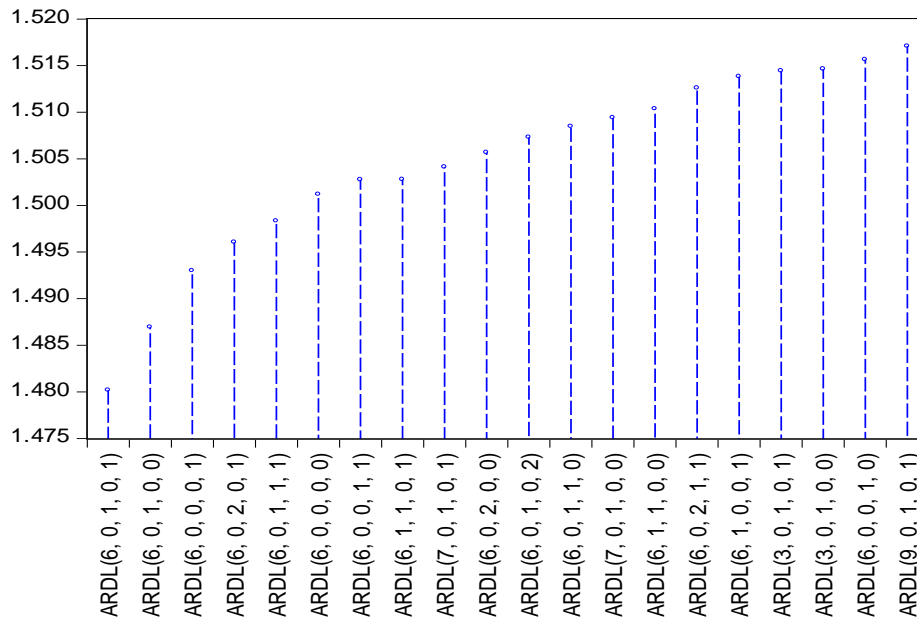

Fig 2: Hannan-Quinn Criterion Illustration for the 20 Best Models

The best model results are ARDL(6, 0, 1, 0, 1).

Table 5: Summary of ARDL model estimation results(6,0,1,0,1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(CPI(-1))	-0.237710	0.088392	-2.689264	0.0083
D(CPI(-2))	-0.279387	0.088221	-3.166902	0.0020
D(CPI(-3))	-0.290235	0.091725	-3.164198	0.0020
D(CPI(-4))	-0.084739	0.091192	-0.929235	0.3549
D(CPI(-5))	-0.029586	0.090118	-0.328306	0.7433
D(CPI(-6))	-0.313886	0.085072	-3.689672	0.0004
D(EXR)	0.000262	0.000239	1.097753	0.2748
D(IMP)	0.017198	0.007436	2.312973	0.0227
D(IMP(-1))	0.015417	0.007583	2.033016	0.0446
D(MS)	0.001359	0.000689	1.973063	0.0511
D(WGP)	-4.61E-07	6.38E-07	-0.722760	0.4714
D(WGP(-1))	1.30E-06	6.53E-07	1.989598	0.0492
C	-0.071449	0.076131	-0.938498	0.3501

To use the model in analysis, it is necessary to perform tests on the model. The first is to test the autocorrelation of residuals with the null hypothesis: there is no autocorrelation of residuals. The results of testing the autocorrelation phenomenon using the Breusch-Godfrey test are presented in Table 6.

Table 6: The results of the autocorrelation test of the model

Lags to include	*F statistic*	*Conclusion*
Lag 1	2.099	Accepted
Lag 2	1.362	Accepted
Lag 3	1.146	Accepted
Lag 4	0.983	Accepted
Lag 5	0.931	Accepted
Lag 6	0.768	Accepted

The results show that the model does not have autocorrelation defects of the residuals of order 1 to 6. The following figure 3 illustrates the cumulative sum of the residuals of the ARDL model at the 5% significance level. In Figure 3, the cumulative sum of the residuals of the ARDL model is within the limit line at the 5% level of significance, representing a stable model.
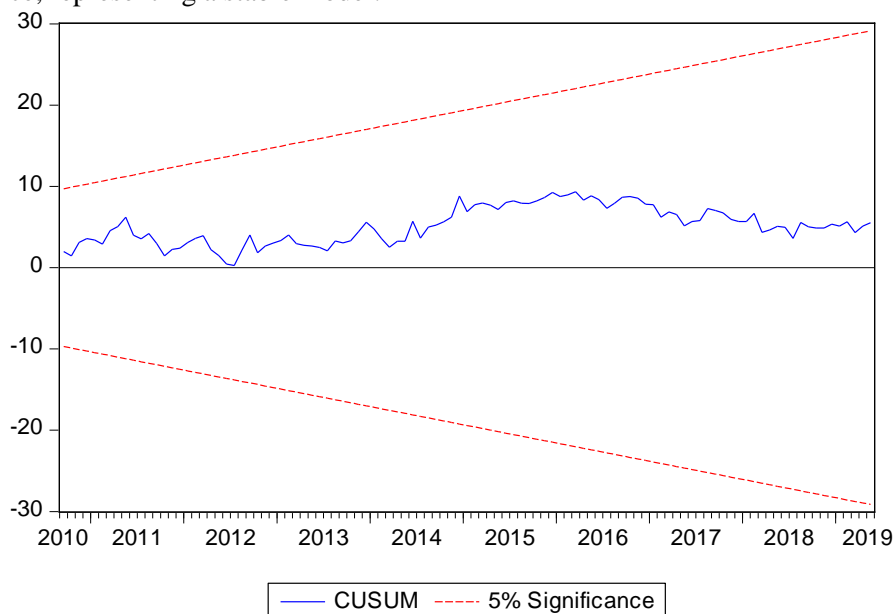

Fig 3: Illustration of the cumulative sum of the residuals of the ARDL model at 5% significance level

5. Conclusion

Thus, the experimental results can be summarized as follows:

$$D(CPI) = - 0.237*D(CPI(-1)) – 0.279*D(CPI(-2)) – 0.290*D(CPI(-3)) – 0.085*D(CPI(-4)) – 0.030*D(CPI(-5)) – 0.314*D(CPI(-6)) + 0.0003*D(EXR) + 0.017*D(IMP) + 0.015* D(IMP(-1)) + 0.001*D(MS) – 0.000*D(WGP) – 0.000* D(WGP(-1)) – 0.071$$

That is, in the short term, the CPI in the last 6 months had a negative impact on the current CPI. Exchange rate in the month, the import value in this month and previous month had a positive effect on the CPI. Money supply in the month had a positive influence on CPI. Finally, world gold price in the month, as well as in the last month had a negative impact on CPI, but the impact of world gold price was so weak.

Thus, we can see the impact of some collected macroeconomic variables on the monthly CPI as follows:

Impact of expected inflation: Regression results show that inflation in the country is strongly influenced by expected inflation factor. If this period occurs high inflation, the public also expects that inflation will continue to increase in the next time. Moreover, the expectation factor still lasts in some months as shown in the coefficient of regression of variable D(CPI(-1)), D(CPI(-2)), D(CPI(-3)), D(CPI(-6)), which are respectively, -0.238, -0.280, -0.290, -0.314, significant at 5% level. This may stem from the quick response of

the policies and measures to curb inflation by the Government and the State Bank, making people believe that the inflation situation will be controlled seriously and effectively. Therefore, they maintain an expectation that inflation will decrease in the next time. This result coincides with previous research results of inflation abroad, especially in countries with low and stable inflation rates, as in Alsamara et al. (2020).

Exchange rate impact: Estimates show that, on average, in the short term, the exchange rate has a positive impact on the consumer price index. Concretely, when the exchange rate increases 1000VND/USD will tend to increase CPI to 0.26 in the long term. This ratio of 0.26:1 is lower than the 1:1 ratio expected for a highly open economy. However, this estimate proved to be consistent with the composition of the basket of consumer goods. Out of 9 commodity groups, 6 groups can be considered as items that can participate in international trade and are likely to be affected by exchange rates. In addition, the group of food products capable of participating in international trade accounts for nearly half of the proportion of the basket of consumer goods.

Impact of import value: Estimates show that on average, in the short run, import value has a positive, but low impact on the consumer price index: when import value increases by 1 billion USD will tend to make CPI increase by 1.7% immediately, and increase by 1.5% in the following month.

Impact of money supply: With monthly data and for the period 2009-2019, the study has found the positive impact of money supply on CPI. In theory, inflation is caused by the money supply, but the money supply is only the result of the interaction between the government's intention and the economy's own demand. The Central Bank by monetary policy actively expands or narrows the money supply through the following tools: required reserve ratio, discount lending rates, open market operations... On the contrary, The demand for the amount of money in circulation is subject to objective impacts of the economy including government spending in fiscal policy, businesses' expansion of business activities and finally the impact of foreign capital flows. flows in with the conversion of foreign currency to local currency. For Vietnam, the expansion of the money supply too quickly to achieve the development goal was identified as the main reason. However, the money supply itself is the result of the combination of the initiative in macro management and the too large scale of investment capital flows, especially capital from outside. In order to gradually reduce inflation and move towards sustainable growth, Vietnam needs to define specific goals in each period and implement effective policies in management.

Impact of world gold price: Estimates show that on average, in the short term, world gold price has a positive impact on consumer price index in the next month but at a very small influence.

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