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The Effectiveness of Macroeconomic Policies on the Price Level in Cambodia: A Vector Error Correction Model

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ABSTRACT

This study comprises a modest attempt to examine the impact of macroeconomic policies on economic variables, particularly the price level, in Cambodia. In the long run, broad money had a positive impact on the price level. In contrast, the effects of the exchange rate and government spending on the consumer price index were negative, as indicated by a cointegrating equation of the VECM model. The elasticities of the exchange rate, public spending, and broad money were 1.429, 0.099, and 0.207, respectively. In the short run, the growth rate of public expenditure played a vital role in explaining the inflation rate, while the growth rate of broad money showed no significant effect. Despite finding that the projected cointegrating coefficient had the right sign and significance, the adjustment speed was very low at just 7.364 per cent each month. The variation of the price level was explained by variations of the exchange rate, public spending and broad money, between 0.32 per cent and 9.46 per cent, between 0.15 per cent and 6.10 per cent, and between 0.01 per cent and 3.51 per cent, respectively.

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INTRODUCTION

Worldwide, countries attempt to attain the socio-economic objectives of; steady growth, full employment, price stability, and so on by managing various macroeconomic variables through effective policies, such as monetary, fiscal, and exchange rate policies. These major macroeconomic policy pillars aim to provide a stable economic climate favourable to robust and sustainable economic growth in the long run. Also, governments have continuously been pressured to control price levels to safeguard the interest of poorer segments of their populations, as price volatility affects poor households and has long-term harmful consequences on the standard of living. In addition, price stability contributes to higher levels of economic activity and employment. It prevents an arbitrary redistribution of income and wealth in favour of richer sections of society. Therefore, a detailed assessment of the impact of major economic policies on the price level is necessary from a macroeconomic viewpoint.

Moreover, though debatable, effective macroeconomic policies are required to ensure stable economic growth and equitable income distribution. The Cambodian economy, driven mainly by garment exports and tourism, has sustained an average real growth rate of 7.7 per cent per annum between 1998 and 2019 (World Bank, 2021), making it one of the fastest-growing economies in the world. Cambodia's economy has become more integrated with regional and international markets, and although this has allowed firms access to larger markets, it has also enhanced volatility among economic variables.

The interrelationship between money, exchange rate, and price level was conducted in 2010 in Cambodia using the vector autoregressive (VAR) model with monthly data covered from January 1999 to December 2008. The empirical result of this research showed that the inflation rate was caused by the depreciation of the exchange rate and the growth rate of the money supply, but the model did not take into account government spending, Lim (2010). This research was expanded by using the structural VAR (SVAR), and the gross domestic product was added as an extra to the three variables: consumer price index, exchange rate, and money supply. Quarterly time series data was employed between 1998:Q1 and 2010:Q4. The results showed that broad money expansion had a substantial positive influence on inflation in the short term, Lim (2011). Luyna and Ravin (2011) investigated Cambodia's monetary and fiscal policies. Their study's goal was to assess the impact of the macroeconomic policies on economic growth in Cambodia, not exactly on the price level, by running a reduced-form VAR model on five variables at the same time; government spending, the money supply, the price level, the real effective exchange rate, and the gross domestic product. Quarterly data was used between 1998:Q1 and 2008:Q4. However, the empirical findings of this study indicated that the fiscal policy shocks had a greater impact on production than those of the monetary policy. In contrast, money supply increases had a significant effect on the inflation rate.

Cambodia is classified as one of the highest dollarized economies in the world since foreign currency, especially the US Dollar, which has performed the three functions of money: medium of exchange, store of values, and units of measurement. As domestic currency, Riel has been in use for more than two decades. The conduct of monetary policy in a highly dollarized economy is not an easy task. The policy makers always believe that to achieve price stability, maintaining stable exchange rate in the domestic foreign exchange market is one of the most effective strategic actions which is to be done by the monetary authority. Regarding the limitation of the monetary policy in controlling the money supply in the market due to dollarization, the US Dollar Auction, which is a process of buying or selling US Dollars from money exchangers mostly in the Phnom Penh city, is regarded as one of the monetary policy instruments in controlling the fluctuation of the exchange rate. US Dollars will be sold out to money exchangers in the domestic foreign exchange market in order to collect Riels back to the central bank in case the Riel depreciated against the US Dollar.

However, Cambodia's sound macroeconomic management, coupled with effective policies, has been reflected in the nation's relatively low inflation rate, increasing international reserves, modest fiscal deficits and low public debt. Thus, the impact of macroeconomic policies on economic variables, particularly on the price level, is apparent. Against this backdrop, the present study has been carried out to examine the effectiveness of Cambodia's macroeconomic policies on the nation's price level. The primary goal of this research was to explore the reaction of inflation rate movements to monetary and fiscal shocks that are under the government's control. A system of equation models, known as the Vector Error Correction Model (VECM), was utilised to achieve the goal of this study.

This paper is comprised of five sections. While the first section introduces the topic, an extensive review of literature has been presented in the second section. The methodology adopted in the study is presented in section three. The fourth section discusses the empirical results, and finally, in the last section, a concluding remark has been given.

REVIEW OF LITERATURE

Deravi et al. (1995) examined "exchange rates and the inflation rate" in the United States. The research used a reduced-form VAR model with three variables, namely, money supply, exchange rate, and the consumer price index, to examine the influence of exchange rate movements on the inflation rate (CPI). The research extended the earlier studies conducted by Whitt et al. in 1986 and Kahn in 1987. While the previous studies were only concerned with the relationship between the exchange rate and the price level in the United States, the study conducted by Deravi et al. incorporated money supply in its model due to currency depreciation. However, all of the variables were represented as natural logarithms. Money supply increases not only Granger-caused exchange rate swings but increased inflation as well. Furthermore, the results of the variance decomposition yielded two distinct assumptions. One was that the money supply was exogenous, which meant that it was shocked first, followed by the exchange rate and price level, and it was designated as Ordering1.

The alternative assumption was that money supply was endogenous, in which case, the price level was shocked first, followed by the exchange rate and money supply, and it was designated as Ordering2. The Ordering1 variance decomposition revealed that increased money supply growth and an exchange rate depreciation could affect the inflation rate over 48 months. Still, the explanations were no more than 9 per cent and 11 per cent of the variation in the money supply and exchange rate to inflation, respectively. While the forecast error variance of the price level explained by itself reduced over time, it remained around 80 per cent after four years. Furthermore, the Ordering2 results indicated that the money supply explained 28.1 per cent of the forecast error variation in inflation, and the exchange rate explained 41.1 per cent after a four-year timeframe. Compared to Ordering1, the prediction error variance of inflation explained by itself decreased to about 31 per cent. The impulse response function was conducted in addition to the variance decomposition. As a result, the price level increased in response to a change in the exchange rate.

Deme and Fayissa (1995) carried out a study covering Egypt, Morocco, and Tunisia with the same goal. According to their findings, Morocco's price level was Granger-caused by the exchange rate but not Egypt's or Tunisia's. In contrast, Ghana's inflation was Granger-caused by the exchange rate, according to Kyereme (1991). Contrasting the research findings in Morocco and Ghana, Rittenberge (1993) discovered that the price level Granger caused the exchange rate but gave no feedback in the case of Turkey.

Furthermore, Kim (1998) investigated US inflation and the dollar exchange rate using a vector error correction model. At that time, the VECM dynamic model was utilised to conduct an empirical examination of the relationship between five variables; the producer price index, trade weight exchange rate (TWEX), M2, personal income, and the interest rate. Natural logarithms were used to express all of the variables. The outcome indicated that Granger caused exchange rate fluctuation drove the price level. Tan and Baharumshah (1999) performed a study in Malaysia with the same objective as the study in the United States. Which the same as studies carried out on other countries, such as Turkey, and some African nations. However, the results indicated that all of the factors had a long-term relationship. Mohammed and Lee (2000) conducted a study on "money, exchange rates, and inflation: Evidence from Malaysia," their study technique was derived from a study carried out by Kim in 1998 using the VECM, a typical VAR model. Five variables were used to build the model; the CPI, the exchange rate, three-month Treasury bill interest rates, the industry output index, and wide money. The results suggested a long-run link between the Malaysian Ringgit-US dollar exchange rate, inflation, domestic output, the money supply, and Malaysian interest rates. In addition, the Granger caused exchange rate affected both the domestic price level and inflation.

Erjavec and Cota (2003) researched Croatia using the VECM on monthly data from October 1994 to October 2004, taking into account five variables: actual production, the money supply, interest rates, prices,

and the exchange rate. The empirical results showed that the interest rate and exchange rate were economically exogenous in the near term, and they were the model's leading variables.

Wolff et al. (2006) studied the effects of fiscal policy in Germany from 1974:1 to 2004:1 using a structural VAR (SVAR) model with five variables; tax, government spending, output, inflation, and the interest rate. Their results revealed that government expenditure shocks increased output and boosted private consumption but not private investment. Their study also discovered that government investment had a larger impact on macroeconomic activity than government public spending and that indirect tax shocks appeared to have a smaller impact than direct tax shocks. A similar five-variable SVAR research study carried out in Spain, Fernández and Hernández de Cos (2006) found that increases in government spending had a favourable influence on economic growth in the short term but had a negative impact in the long term. The study used quarterly data from 1980:Q1 to 2004:Q4. Increases in government spending and net taxation created public deficits in the medium run, but they had opposing effects on the price level and production. Government expenditure shocks caused price rises, but net-tax increases caused a negative short-term price reaction. Finally, these scholars concluded that the reactions of the GDP on prices changed considerably depending on the expenditure or tax component evaluated. In another research study, Shaheen and Turner (2010) obtained similar results for the impact of Pakistan's fiscal policy when applying a similar methodology.

Nonetheless, these authors pointed out a shortcoming of the SVAR method, stating that the findings from an SVAR model may lose accuracy over longer time horizons and should be regarded with caution. The structural VAR technique has also been utilised to examine the effects of fiscal policy in certain middle-income and developing nations. Restrepo and Rincón (2006), for example, applied this approach to Chile and Columbia.

Nguyen and Kaliappa (2006) published an essay entitled “Can devaluation be effective in improving Vietnam's balance of payments?” The study's major goal was to determine whether or not exchange rate depreciation helped enhance exports and improve the balance of payments in Vietnam. The methodology of this study was based mostly on a study carried out by Deravi et al. (1995), who used a VAR model considering variables, such as: CPI, the nominal exchange rate, and the money supply. All of the variables were written in log form. According to the findings, the balance of payments could be addressed by exchange rate depreciation, which could increase exports and inflows of foreign currency, thereby boosting the current account. In addition, the result further demonstrated that money supply growth Granger caused both the exchange rate and inflation in Vietnam. The forecast error variance decomposition of inflation indicated that shocks of money supply growth contributed a substantial change of around 23 per cent to 28 per cent of inflation variation. In contrast, the exchange rate depreciation contributed around 4 per cent of the forecast error variance of inflation.

Ginting and Bird (2009) undertook a study “explaining inflation in Cambodia” to investigate elements that could be utilised to explain inflation in the country. The VECM was run using variables, such as; the inflation rate, the change in the weighted exchange rates of the Thai Baht and Vietnam Dong per US dollar, the change in M1 (narrow money), and a dummy variable that reflected the excess production gap that occurred in 2007. The analysis only spanned from December 2002 to July 2008 due to Cambodia's scarcity of available time-series data. Furthermore, the inflation rates of Thailand and Vietnam were incorporated in the VECM to explain Cambodia's inflation rate, which was divided into, headline, food, and core inflation. The study's findings showed that, in the long term, the trading partner's inflation rates were the most relevant variable in explaining variances in the Cambodian inflation rate.

Using a single equation Autoregressive Distributed Lag (ARDL) model, Dikeogu (2018) investigated the influence of government expenditure on the price level in Nigeria from 1980 to 2017, using yearly time series data. Aside from applying capital and recurring government expenditure to explain fluctuations in the inflation rate, he also incorporated the money supply and exchange rate into the model. According to the empirical analysis of the ARDL model, government expenditure, both capital and recurring, negatively influenced the inflation rate. In Nigeria, a cyclical influence of the money supply on the inflation rate was discovered.

Yasin and Samuel (2020) used a system of equation modelling known as the VECM to examine four important macroeconomic indicators: broad money, currency in credits to the private sector and circulation, the exchange rate, and the inflation rate. The quarterly time-series data used in the study spanned from 1991 to 2018. the VECM model results indicated that all of the variables under examination exhibited a connection in the long run. Furthermore, according to the estimated results of the error variance decomposition provided by

the VECM model, the variation of the money supply was only minimally affected by the exchange rate and inflation, by 0.16 per cent and 0.34 per cent, respectively, over the past ten quarters.

Ahmmed (2020) performed a study on "cyclical fluctuation, growth, and stabilisation: An empirical assessment" of dual policy aims in Bangladesh. A VECM estimation was also run incorporating five macroeconomic factors: GDP, government spending, the money supply, interest rate, and the consumer price index. The study made use of yearly time series data spanning from 1980 to 2018. According to the empirical findings, price stability in Bangladesh was attained by carefully controlling the money supply and government spending.

To date, several empirical studies have been conducted in Cambodia exploring the influence of monetary and fiscal policy on the price level. No studies have been published quantifying the speed of adjustment or how fast the economy returns to equilibrium when any shock has caused disequilibrium. The data series utilised in earlier studies concerning Cambodia's inflation rate mostly comprised yearly and quarterly time-series data; hence, for detailed study of the influence of macroeconomic policies on Cambodia's price level, high-frequency data (monthly data) should be used. Therefore, the present study was conducted on monthly time-series data from January 2009 to March 2021. A reduced Vector Error Correction Model (VECM) was constructed comprising four macroeconomic indicators: broad money, government expenditure, the exchange rate, and the consumer price index.

RESEARCH METHODOLOGY

A reduced-form vector autoregressive (VAR) model was constructed to determine the long-run interrelationship among the consumer price index (CPI), the foreign exchange rate (FX), government expenditure (G), and the money supply (M) variables. In a highly dollarized economy like Cambodia, the central bank, known as the National Bank of Cambodia, is not able to control the interest rate in the country due to a majority of the loans being executed in the US Dollar. Moreover, the monthly gross domestic product is not available, and there is no any proxy such as the producer price index. This is the main reason why the two variables are not included in the model.

A VAR model is a system of equations where the number of equations equals the number of variables under investigation. The dependent variable is a function of its lags and the lags of other variables in the system. The long-run model is presented below:

$$lnCPI_t = \alpha_{10} + \sum_{i=1}^{p} \theta_{11i} lnCPI_{t-i} + \sum_{i=1}^{p} \theta_{12i} lnFX_{t-i} + \sum_{i=1}^{p} \theta_{13i} lnG_{t-i} + \sum_{i=1}^{p} \theta_{14i} lnM_{t-i} + \epsilon_{1t}$$

$$lnFX_t = \alpha_{20} + \sum_{i=1}^{p} \theta_{21i} lnCPI_{t-i} + \sum_{i=1}^{p} \theta_{22i} lnFX_{t-i} + \sum_{i=1}^{p} \theta_{23i} lnG_{t-i} + \sum_{i=1}^{p} \theta_{34i} lnM_{t-i} + \epsilon_{2t}$$

$$lnG_t = \alpha_{30} + \sum_{i=1}^{p} \theta_{31i} lnCPI_{t-i} + \sum_{i=1}^{p} \theta_{32i} lnFX_{t-i} + \sum_{i=1}^{p} \theta_{33i} lnG_{t-i} + \sum_{i=1}^{p} \theta_{34i} lnM_{t-i} + \epsilon_{3t}$$

$$lnM_t = \alpha_{40} + \sum_{i=1}^{p} \theta_{41i} lnCPI_{t-i} + \sum_{i=1}^{p} \theta_{42i} lnFX_{t-i} + \sum_{i=1}^{p} \theta_{43i} lnG_{t-i} + \sum_{i=1}^{p} \theta_{44i} lnM_{t-i} + \epsilon_{4t}$$

Each variable was expressed in a natural logarithm. The first difference of each natural logarithm series was interpreted as the percentage change or growth rate. The change of $\boldsymbol{lnCPI_t}$ represented the inflation rate, at time $\boldsymbol{t}$. The nominal exchange rate was quoted as the number of units of domestic currency, Khmer Riel (KHR), per unit of foreign currency, US Dollar (USD). A positive FX growth rate implied that the Riel was depreciating, whereas a negative growth rate indicates that the Riel was appreciating. The growth rates of the money supply and government expenditure at time $\boldsymbol{t}$ were defined as the first differences of $\boldsymbol{lnM_t}$ and $\boldsymbol{lnG_t}$, respectively. $\boldsymbol{\alpha_{j0}}$ were constant terms and $\boldsymbol{\epsilon_{jt}}$ were white-noise disturbance terms, where $\boldsymbol{j = 1, 2, 3, 4}$. $\boldsymbol{p}$ was the optimal number of lags, where $\boldsymbol{i = 1, \ldots, n}$. The optimal lag lengths of the model were determined by the Akaike Information Criterion (AIC).

The Augmented Dickey-Fuller (ADF) test was then carried out for a unit root or non-stationary data series. The null hypothesis of the test was that the series had a unit root. If $\boldsymbol{lnCPI}, \boldsymbol{lnFX}, \boldsymbol{lnG}$ or $\boldsymbol{lnM}$ each were integrated to order one or I(1), the Johansen test for cointegration in the system was performed. If the four variables were cointegrated, a short-run model, the error correction model (VECM), was run. A long-run equation, which explained the long-run relationship among the variables and the speed of adjustment, indicating how fast the economy adjusted back to equilibrium due to any shocks, was defined. A short-run dynamic model which showed the interrelationship among the variables was developed, as follows:

$$lnCPI_t = \alpha_{10} + \sum_{i=1}^{p} \theta_{11i} lnCPI_{t-i} + \sum_{i=1}^{p} \theta_{12i} lnFX_{t-i} + \sum_{i=1}^{p} \theta_{13i} lnG_{t-i} + \sum_{i=1}^{p} \theta_{14i} lnM_{t-i} + \epsilon_{1t}$$

$$lnFX_t = \alpha_{20} + \sum_{i=1}^{p} \theta_{21i} lnCPI_{t-i} + \sum_{i=1}^{p} \theta_{22i} lnFX_{t-i} + \sum_{i=1}^{p} \theta_{23i} lnG_{t-i} + \sum_{i=1}^{p} \theta_{34i} lnM_{t-i} + \epsilon_{2t}$$

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$$lnM_t = \alpha_{40} + \sum_{i=1} \theta_{41i} lnCPI_{t-i} + \sum_{i=1} \theta_{42i} lnFX_{t-i} + \sum_{i=1} \theta_{43i} lnG_{t-i} + \sum_{i=1} \theta_{44i} lnM_{t-i} + \epsilon_{4t}$$

Where $\boldsymbol{D}$ was denoted as the first difference operator. As mentioned earlier, the first difference of the natural logarithm series was interpreted as the growth rate or the percentage change. $\boldsymbol{ECT_{t-p}}$ was each respective VECM equation's error correction term, which constituted the estimated residual term basis for each respective VAR long-term equation. $\boldsymbol{\gamma_h}$ was defined as the speed of adjustment, which was expected to be negative and statistically significant, where $\boldsymbol{h = 1, 2, 3, 4}$. The target variables of this research were the consumer price index and foreign exchange rate, and the policy variables were government expenditure and the money supply. Therefore, the order of the variables in either the VAR model or VECM were arranged as $\boldsymbol{CPI}, \boldsymbol{FX}, \boldsymbol{G}$ and $\boldsymbol{M}$, where $\boldsymbol{G}$ was under the control of the Ministry of Economy and Finance (MEF) using the Ministry's Fiscal Policy. At the same time, monetary expansion or contraction was the responsibility of the National Bank of Cambodia (NBC), using its Monetary Policy. After the estimated parameters of the model were defined, the interpretation of the VEC Granger Causality/Block Exogeneity Wald Tests and forecast error variance decomposition (FEVD) were conducted. The Johansen normalisation cointegrating equation of inflation regression is written as follows:

$$ECT_{t-1} = 1.000 lnCPI_{t-1} - \hat{\beta}_1 lnFX_{t-1} - \hat{\beta}_2 lnG_{t-1} - \hat{\beta}_3 lnM_{t-1} - \hat{\beta}_0$$

Monthly data were employed in this study. The period examined was between January 2009 and March 2021. Consumer price indexes (October-December 2006=100) were extracted from the National Bank of Cambodia's database. The period averages of the exchange rate between the Khmer Riel and US Dollar, government expenditure and broad money were collected from the International Financial Statistics (IFS) of the International Monetary Fund (IMF). All data were expressed as natural logarithms.

EMPIRICAL RESULT

The average monthly growth rates during the research period were 0.267 per cent, -0.004 per cent, 2.382 per cent, and 1.623 per cent for: the consumer price index, the foreign exchange rate, government expenditure and the money supply, respectively. Positive rates of increase in the CPI were seen as inflation, while negative rates were regarded as deflation. Foreign exchange growth rates, either positive or negative, were regarded as depreciated or appreciations of the Khmer Riel. The standard deviation showed that the government's expenditure level of volatility was the highest at 70.989 per cent a month. At the same time, broad-money (M2) growth, the inflation rate and the percentage change of the foreign exchange rate were 2.692 per cent, 0.502

per cent and 0.544 per cent, respectively. In the normality test, except for inflation, all of the data series were not normally distributed as can be seen from the results of the Jarque-Bera (JB) test, at the five per cent level.

The analysis used four macroeconomic indicators: CPI, FX, G and M. The natural logarithm of the indicators was used to establish a continuous data series. The first difference in the series, therefore, reflects a growth rate or percentage change. Firstly, the ADF unit root test was performed on all data series in level, such as: LNCPI, LNFX, LNG, and LNM. Three distinct models exist in the ADF technique: model with constant, model with constant and trend, and model without constant and trend. If one of the model's data series does not reject a null hypothesis, the series is supposed to have a unit root or is non-stationary, and the test will be carried out again on its first difference.

Table 1 Descriptive statistics

	DLNCPI	DLNFX	DLNG	DLNM
Mean	0.267%	-0.004%	2.382%	1.623%
Median	0.283%	0.000%	4.251%	1.538%
Maximum	1.802%	1.328%	167.531%	16.624%
Minimum	-1.081%	-3.077%	-244.177%	-12.640%
Std. Dev.	0.502%	0.544%	70.989%	2.692%
Skewness	0.0238	-1.1404	-1.0476	0.2620
Kurtosis	3.7355	8.9426	5.7031	14.2717
Jarque-Bera (JB)	3.3050	246.4716	71.1544	774.5647
Probability of JB	0.19157	0.00000	0.00000	0.00000
Sum	0.3902	-0.0060	3.4784	2.3699
Sum Sq. Dev.	0.0037	0.0043	73.0723	0.1051
Observations	146	146	146	146

Source: Authors' estimates using the Eviews 9 software application.

Based on the model with constant of the ADF test, all of the data series at level, other than the price level, were non-stationary since each series had a unit root, according to the null hypothesis that it was not rejected at the five per cent significance level. Although the natural logarithm of the CPI was stationary, the significance level was modest, at the 10 per cent level. Despite using the model with constant and trend, the foreign exchange rate and government expenditure were not stationary. Still, the consumer price index and money supply series were stationary at the five per cent and 10 per cent levels, respectively. The estimated results of the ADF test on a model without constant and trend showed that all series of the data at level had unit roots. Given this finding, the unit root tests of all models—model with constant, model with constant and trend, and model without constant and trend—on the first difference of the four data series under consideration were again implemented. Each of the first different data series of each model was stationary since the null hypothesis of having a unit root was strongly rejected at the one per cent level (See Table 2). According to this outcome, it was concluded that; CPI, FX, G and M each was integrated at order one or *I*(1).

Table 2 Results of the ADF unit root test
Null hypothesis: the variable has a unit root

		At Level			
		LNCPI	LNFX	LNG	LNM
With Constant	t-Statistic	-2.6148	-2.1969	-0.3778	-1.7887
	Prob.	0.0923	0.2084	0.9085	0.3849
		*	n0	n0	n0
With Constant & Trend	t-Statistic	-3.7209	-1.9362	-2.5377	-3.3019
	Prob.	0.024	0.6302	0.3098	0.07
		**	n0	n0	*
Without Constant & Trend	t-Statistic	6.3653	-0.4398	5.3856	7.5787
	Prob.	1.0000	0.5224	1.0000	1.0000
		n0	n0	n0	n0
		At First Difference			
		DlnCPI	DlnFX	DlnG	DlnM
With Constant	t-Statistic	-9.6175	-9.0494	-14.4343	-14.9872
	Prob.	0.0000	0.0000	0.0000	0.0000
		***	***	***	***
With Constant & Trend	t-Statistic	-9.8605	-9.1057	-14.3758	-15.1635
	Prob.	0.0000	0.0000	0.0000	0.0000
		***	***	***	***
Without Constant & Trend	t-Statistic	-7.8954	-9.0697	-12.0452	-4.204
	Prob.	0.0000	0.0000	0.0000	0.0000
		***	***	***	***

Notes: (*) Significant at the 10% level; (**) Significant at the 5% level; (***) Significant at the 1% level and (no) Not Significant
Source: Authors' estimates using the Eviews 9 software application.

The Johansen Cointegration Test was conducted to evaluate the long-term relationship between the four variables. After the optimum lag length of the VAR model was identified, the test could be carried out. Five different criteria were applicable in defining the optimal lag term of the model, namely, the Likelihood Ratio (LR) test statistic, the Final Prediction Error (FPE), the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and the Hannan-Quinn Information Criterion (HQ). The lower the value of each criterion, the better the model. As referred to in Table 3, the model was run using four lags to produce the estimated result of the AIC.

Table 3 VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	625.0751	NA	1.98E-09	-8.686365	-8.603489	-8.652688
1	1369.626	1437.036	7.46E-14	-18.87589	-18.46151*	-18.7075
2	1401.159	59.09632	6.00E-14	-19.09313	-18.34724	-18.79004*
3	1422.387	38.59586	5.59e-14*	-19.16625	-18.08885	-18.72844
4	1438.551	8.48556*	5.59E-14	-19.16855*	-17.75964	-18.59603

Note: * Indicates the lag order selected by the criterion
Source: Authors' estimates using the Eviews 9 software application.

The Johansen unrestricted Cointegration Rank Test (Trace) was carried out on; LNCPI, LNFX, LNG, and LNM under the assumption of a linear deterministic trend, and the lag intervals in the first difference were from 1 to 4. The results of the trace test indicated two cointegrating equations at the five per cent level. Regarding the test results, the four macroeconomic variables under study had a long-run adjustment mechanism and a short-run dynamic model (VECM), which was further investigated. Despite two cointegrating equations, a single equation was selected based on the consistency level of this equation with economic theory and how well each statistically significant parameter explained the price level in the long term.

The signs of the individual coefficients must be reversed when interpreting the normalised cointegrating coefficients. In the long run, the foreign exchange rate and government expenditure negatively affected the price level. In contrast, on average, the money supply positively impacted the consumer price index, ceteris paribus.

Table 4 Johansen Cointegration Test

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.33733	101.46960	47.85613	0.00000
At most 1 *	0.20037	43.03921	29.79707	0.00090
At most 2	0.05307	11.28803	15.49471	0.19440
At most 3	0.02465	3.54415	3.84147	0.05980

Note: Trace test indicated two cointegrating eqn(s) at the 5% level. * Denotes rejection of the hypothesis at the 5% level. **MacKinnon-Haug-Michelis (1999) p-values.
Source: Authors' estimates using the Eviews 9 software application.

The coefficients were statistically significant at the one per cent level. The elasticity of the exchange rate (1.429) was larger than that of government expenditure (0.099) and the money supply (0.207). The speed of the adjustment coefficient was estimated to be -0.07364 and was statistically significant at the five per cent level, consistent with economic theory. The coefficient of the speed of adjustment was rather low, 7.364 per cent per month, which could be interpreted as that it would take approximately 13.58 months (or a year and one and a half months) to adjust back to the equilibrium if any shock occurred.

Table 5 Cointegrating Equation

Log-likelihood	1419.341			
Normalised cointegrating coefficients (standard errors are in parentheses and t-statistics are in brackets)				
LNCPI	LNFX	LNG	LNM	CONSTANT
1.000	1.429***	0.099***	-0.207***	-15.358
	(0.199)	(0.0185)	(0.0145)	
	[7.180]	[5.328]	[-14.299]	

Note: *** Indicates significance at the 1% level.
Source: Authors' estimates using the Eviews 9 software application.

Table 6 Testing Weak Exogeneity of Variables in VECM

Variables	The test results for lagged variables of error correction term		Weak exogeneity
	F-Statistic	*p*-value	
FX→CPI	0.851	0.494	No
G→CPI	3.105	0.018	Yes
M→CPI	1.620	0.174	No
CPI→FX	0.158	0.959	No
G→FX	11.560	0.000	Yes
M→FX	1.062	0.378	No
CPI→G	3.776	0.006	Yes
FX→G	8.431	0.000	Yes
M→G	0.058	0.994	No
CPI→M	1.265	0.288	No
FX→M	1.672	0.161	No
G→M	0.777	0.542	No

Source: Authors' estimates using the Eviews 9 software application.

Referring to the testing of the weak exogeneity of the variables in the VECM in Table 6, government expenditure is weakly exogenous in relation to the consumer price index and vice versa. This situation has also occurred between government expenditure and foreign exchange. Regarding the testing of the strong exogeneity of the variables presented in Table 7, a strong exogeneity has also been found between the two variables. Nevertheless, the consumer price index is strongly exogenous in relation to the government expenditure.

Table 7 Testing Strong Exogeneity of Variables

Variables	Strong Exogeneity	System
FX→CPI	No	No
CPI→FX	No	
G→CPI	No	No
CPI→G	Yes	
M→CPI	No	No
CPI→M	No	
G→FX	Yes	Yes
FX→G	Yes	
M→FX	No	No
FX→M	No	
M→G	No	No
G→M	No	

Source: Authors' estimates using the Eviews 9 software application.

As indicated by the stability test results, shown in Figure 1, all of the inverse roots of the AR lay inside a unit circle, which was interpreted as the system is stable.

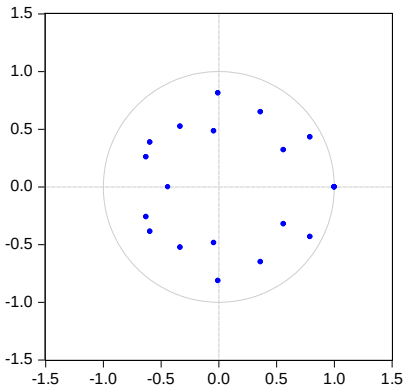

Figure 1 Inverse roots of the AR characteristic polynomial

Table 8 Variance Decomposition of LNCPI

Period	LNCPI	LNFX	LNG	LNM
1	100	0.00	0.00	0.00
2	99.67	0.32	0.00	0.01
3	98.57	1.06	0.15	0.22
4	97.08	1.26	1.06	0.61
5	93.91	1.76	2.43	1.90
6	90.13	2.95	4.40	2.52
7	87.21	4.44	5.48	2.88
8	84.72	6.28	6.05	2.96
9	83.20	7.68	6.10	3.02
10	82.26	8.73	5.86	3.15
11	81.81	9.30	5.57	3.32
12	81.78	9.46	5.25	3.51

Source: Authors' estimates using the Eviews 9 software application.

Table 8 shows the outcomes of the price level's forecast error variance decomposition. The forecasting was made over twelve months. The forecast error variance of the consumer price index was decomposed into the proportion attributable to each of the random shocks of; foreign exchange, government expenditure, and the money supply. According to the predicted result of the model, FX was the most important source of variability for the CPI. The shocks of FX contributed a substantial change from around 0.32 per cent to 9.46 per cent of the CPI. Compared to FX, G played the second role attributing to the variation of the CPI, between 0.15 per cent and 6.10 per cent. In contrast, M played the least significant role accounting for only around 0.01 per cent and 3.51 per cent of the forecast error variance of the CPI.

The response of the LNCPI to the Cholesky one standard deviation (S.D.) innovation of the LNFX shows a downward trend in the first three quarters. The response had increased between the third and fourth quarter and then it had started to decrease again up until the eighth quarter. After that, it started to bounce back. The response of LNCPI to LNG shock has a negative impact between quarter two and quarter six, and the effect become positive from quarter six to quarter twelfth. In addition, the response of the LNCPI to LNM shock exhibits a similar pattern to the LNG as it had decreased in the first five quarters, started to increase between quarter five and the mid of quarter eight, and become stable onwards. The response of the LNCPI to the shock itself was positive between quarter one and quarter three, declined from quarter three to quarter seven, and then become stable.

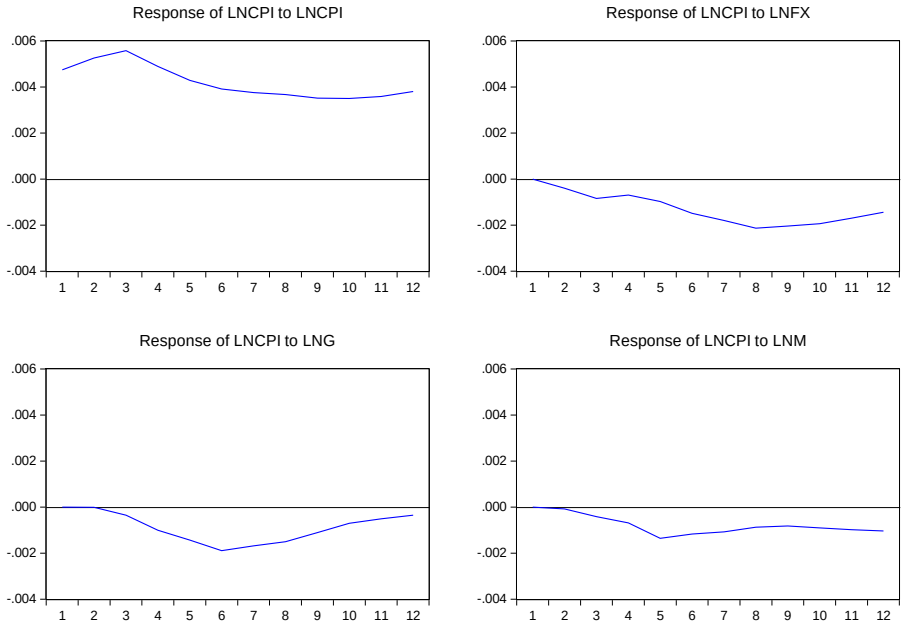

Figure 2 Response to Cholesky One S.D. Innovations

The Granger Causality or Block Exogeneity Wald tests were employed to define the short-run relationship among the variables in the system. The test result showed that percentage changes in government expenditure Granger-caused the inflation rate and vice-versa and was statistically significant at five and one per cent levels, respectively. In addition, a Granger causality between the foreign exchange rate and government expenditure was found at the one per cent level of significance. Surprisingly, the growth rate of the money supply played an insignificant role in the short run in explaining the inflation rate, the percentage change in the foreign exchange rate and the growth rate of government expenditure. The reverse was also true since all of the results of the Wald tests were determined to be statistically insignificant.

Table 10 VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(LNCPI)			
Excluded	Chi-sq	df	Prob.
D(LNFX)	3.4172	4	0.4906
D(LNG)	12.4214	4	0.0145
D(LNM)	6.4784	4	0.1662
All	17.2830	12	0.1393
Dependent variable: D(LNFX)			
Excluded	Chi-sq	df	Prob.
D(LNCPI)	0.6314	4	0.9595
D(LNG)	46.2380	4	0.0000
D(LNM)	4.2470	4	0.3736
All	54.6002	12	0.0000
Dependent variable: D(LNG)			
Excluded	Chi-sq	df	Prob.
D(LNCPI)	15.1023	4	0.0045
D(LNFX)	33.7227	4	0.0000
D(LNM)	0.2338	4	0.9937
All	59.0165	12	0.0000
Dependent variable: D(LNM)			
Excluded	Chi-sq	df	Prob.
D(LNCPI)	5.0589	4	0.2813
D(LNFX)	6.6881	4	0.1533
D(LNG)	3.1069	4	0.5401
All	16.6801	12	0.1620

Source: Authors' estimates using the Eviews 9 software application.

CONCLUSION

This research study examined four endogenous variables: the consumer price index, foreign exchange rate, government expenditure, and the money supply. The consumer price index and foreign exchange rate were the target variables. In contrast, government expenditure and the money supply were the policy variables. They were found to be cointegrated or have a long-run adjustment mechanism, as revealed by the results of the Johansen Cointegration Trace Test. In addition, this research showed that the exchange rate and government spending had a negative impact on consumer prices in the long run.

In contrast, the money supply, on average, had a positive effect on the consumer price index, ceteris paribus. The magnitude of the effect was explained by the estimated parameters of the long-run equation, and each slope was described as elastic. The elasticities of the exchange rate, public spending, and broad money were 1.429, 0.099, and 0.207, respectively. The speed of adjustment, which measured how fast the economy converted back to equilibrium in the case of shocks in the system, was found to be -0.07364 and statistically significant at the five per cent level. Despite the estimated cointegrating coefficient having the correct sign and being significant, the adjustment was rather low at just 7.364 per cent per month. In the short run, the growth rate of public expenditure played an important role in explaining the inflation rate, while the growth rate of broad money showed no significant effect. The causalities ran back and forth between the percentage changes of public spending and the inflation rate, which meant that both variables explained each other in the short term. At the same time, the percentage change of the foreign exchange rate had a significant effect on the growth rate of government spending and vice-versa. The variations of price levels were explained by the variation of the exchange rate, variation of public spending and the variation of broad money, between 0.32 per cent and 9.46 per cent, between 0.15 per cent and 6.10 per cent and between 0.01 per cent and 3.51 per cent, respectively. The foreign exchange rate caused the price level to move the most, followed by public expenditure, while the money supply had the least effect. Exchange rate fluctuations comprised the most important element in

changing prices. At the same time, in the second position was variations in public spending, which contributed to variations in consumer prices. Surprisingly, variations of the money supply played the least important role in causing the movement of prices.

The results of this study are comparable to a mirror reflecting the current economy of Cambodia. The vigilant implementation of fiscal policy has ensured a stable exchange rate and prices in the short run. Over the last decade, the exchange rate was the target variable that the National Bank of Cambodia (NBC) adopted to maintain stable prices in the short run. During this time, policymakers in Cambodia visualised the management of the market exchange rate by controlling the money flowing into the foreign exchange market to ensure a balance between the demand and the supply of money; this was the key mechanism used to maintain macroeconomic stability or price stability. Cambodia's economy has been regarded as a highly dollarized economy. As a result, to manage the market exchange rate, US dollar auctioning has been practised. Such auctions have been conducted by inviting key money changers from major currency exchange locations in Phnom Penh, such as Olympic Market, Orussei Market and Psar Thmey Market, to participate in auctions for US dollars at the National Bank of Cambodia. These auctions aimed to collect Khmer Riel circulating in the market to reduce narrow-based money. Such auctions have often been conducted when the value of Khmer riel was depreciated, compared to the US dollar. Such auctions were believed to maintain price stability, although they negatively affect the international reserve.

However, nowadays, Cambodia's policymakers have stopped using this mechanism. Likewise, the results of this research also indicate that, in the short run, a change in broad money does not directly affect the market exchange rate or the inflation rate, explaining why the mechanism mentioned above was not feasible for managing the market exchange rate. However, this study found that broad money positively affected consumer prices in the long run. To conclude, fiscal policy was more effective than monetary policy in managing the foreign exchange and inflation rates in the short run. In contrast, monetary policy was better at controlling prices in the long run. Therefore, close cooperation between the National Bank of Cambodia, which determines monetary policy, and the Ministry of Economy and Finance, which implements fiscal policy, is very important. Such cooperation determines and practises an effective macroeconomic policy ensuring price stability and maintaining sustainable economic growth to increase the living standard of Cambodians.

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