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The Relationship Between Policy Rates and Domestic Debt in Ghana

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ABSTRACT: *The principal purpose of this study is to investigate the relationship between policy rates and domestic debt in Ghana. Utilizing a time series data, the study adopted the Vector Error Correction Model (VECM) for result analysis. Over the long run, domestic debt was found to have a negative impact on monetary policy rate, with the reverse observed for the short run. However, both models yielded statistically insignificant results. Nevertheless, the study revealed a statistically significant relationship between inflation and real GDP with the monetary policy rate in the long run, indicating a positive and negative impact, respectively. In the short run, only inflation was found to be statistically significant. The study's findings and analysis were found to be reliable as there was no evidence of serial correlation or heteroskedasticity in the model. In the end, the study was able to address a crucial gap in the literature on public debt by primarily investigating the influence of domestic debt on monetary policy rate in Ghana.*

KEYWORDS: Monetary Policy Rate, Domestic Debt, Vector Error Correction Model

INTRODUCTION

Governments often rely on debt to meet their financing needs or cover fiscal deficits. When a government's capacity to generate resources and attract savings is insufficient, borrowing becomes necessary to fund productive activities. Governments have the option to borrow either externally or internally, with the choice depending on costs, risks, and specific objectives such as stabilizing inflation, achieving low interest rates, maintaining foreign reserves, or developing domestic capital markets.

Domestic borrowing is considered less burdensome, offering lower volatility and positive effects on the economy (Aybarç, 2019). It also helps governments mitigate the risk of crisis-induced disruptions in international capital flows (Eichengreen & Hausman, 2010; Calvo, 1998). Consequently, there has been a significant increase in government domestic borrowing, attracting interest among researchers.

The debate surrounding desirability debts remains contentious. While borrowing for productive sectors can enhance growth and productivity, consistently high levels of debt can lead to financial and macroeconomic instability, adversely affecting a country's growth. Domestic debt, in particular, has significant implications for the economy, including its impact on monetary policy and inflation levels. For instance, lowering the interest rate to reduce the debt burden may result in the accumulation of more debt with the potential of rising inflation levels that can undermine public and investor confidence.

In Ghana, public debt as a percentage of GDP has been steadily increasing, both domestically and externally. According to statistics from Ghana's Ministry of Finance (MoF), public debt (as a percentage of GDP) rose to 76% in 2020 from around 63% in 2019 (MoF, 2020). Reflective of the upward trend, it was shown that in 2017 and 2018, public debt (as a percentage of GDP) was around 56% and 58%, respectively (see MoF, 2020). In terms of classification, domestic and external debt (as a percentage of GDP) equally showed an increasing trend whilst, evenly averaging around 31% between 2017 and 2020 (MoF, 2020). The rate of debt accumulation has also been on the rise, possibly influenced by declining monetary policy rates (see MoF, 2020).
Given the importance of understanding the relationship between policy rates and domestic debt, it is crucial for researchers and policymakers to investigate this issue further. With the exception of Karanja (2013), empirical investigations on this topic have been limited, with most studies focusing on public debt (or external debt) and interest rate (Iddrisu & Alagidede, 2020 and Mitra, 2007). But since monetary policy operation is not universal but country-specific, it provides this study enough grounds to look at it from the Ghanaian perspective. As such, this study aims to provide new insights and evidence on the relationship between monetary policy rates and domestic debt in Ghana, acknowledging the country-specific nature of monetary policy operations, as well as, utilizing a time series approach that includes rigorous pre-estimation checks for data validation. Hereafter, the study proceeds as follows: Section Two presents a comprehensive review of the literature from both the theoretical and empirical fronts. Section Three presents the methodology for data analysis. Based on methodological approach, Section Four presents the estimation results for interpretation and empirical analysis. In the final section, Section Five, the study concludes and presents policy recommendations.

LITERATURE REVIEW

Theoretically, interest rates play a crucial role in establishing a link between monetary policy and debt. To alleviate the burden of government debt servicing and accumulation, interest rates can be kept at lower levels. This is because high levels of debt, coupled with an increase in interest rates, can further burden the government and lead to more borrowing (Iddrisu & Alagidede, 2020). However, it is important to consider that lowering interest rates can also have counterproductive effects, such as increasing inflation. This creates a dilemma for central banks, as they must balance stabilizing rising inflation by adjusting interest rates or implementing policies to reduce the burden

of public debt on fiscal authorities. According to Iddrisu & Alagidede (2020), "for inflation targeting central banks, this has serious consequences for the publicly announced inflation target, commitment to achieving it, and detrimental effects on public confidence and the need to anchor inflation expectations." Therefore, in the face of increasing public debt, adopting a tighter monetary policy stance only amplifies the burden on the existing debt stock, which can ultimately widen the budget deficit gap.

The literature on public debt and monetary policy has received significant empirical attention, particularly regarding its relationship with economic growth. However, there is a noticeable disparity in the amount of research dedicated to public debt and monetary policy.

Numerous authors, such as Fosu (1999), Senadza et al. (2017), Amoateng & Amoako-Adu (1996), Tarawalie & Jalloh (2021), Duramany-Lakko (2022), Jarju et al. (2016), and Owusu-Nantwi & Erickson (2016), have conducted research on public debt and economic growth. Nonetheless, few researchers have made effort to understand the concept from the angle of monetary policy. Karanja (2013) examined the relationship between domestic debt and interest rate in Kenya using Analysis of Variance (ANOVA) and multiple linear regression. The result from the study showed that domestic debt positively affects interest rates in Kenya. However, the study was primarily interested in providing a correlation between the variables. Iddrisu & Alagidede (2020), on the other hand, adopted a linear Taylor rule to examine whether high debt levels constrain the setting behaviour of interest rates by the Bank of Ghana (BoG). From the result, the study failed to find any constraint in interest setting behavior of BoG for any debt concern. Specifically, the authors also used a threshold model to analyse BoG's monetary policy response in a high public debt regime. From the result, it was shown that in a high debt regime with a threshold of 35.1%, monetary policy response to inflation gap is woefully disproportionate. In a similar study, Mitra (2007) investigated how the quantity of government debt affects interest rate level that is consistent with the central bank's monetary policy objectives in Canada. The study relied on the optimization based closed economy framework to estimate the optimal interest rate under a discretionary policy. After deriving an interest rate rule for monetary policy, it was revealed that in a debt-constrained interest rate rule with a threshold level of debt (50.2%), a high government debt level could constraint monetary policy if government spending - rather than taxes – is expected to adjust in the future and in line with debt service costs.

The existing literature lacks comprehensive analysis on the relationship between domestic debt and policy rate. Even the study that tried to address this relationship is limited in scope. For instance, using a time series data Karanja (2013) failed to account for necessary pre-estimation

checks: stationarity, heteroskedasticity[1], and serial/autocorrelation[2] which raise concerns about the reliability of the study's findings. In contrast, this study aims to thoroughly investigate the relationship between domestic debt and policy rate in Ghana by ensuring that pre-estimation checks are done to validate the analysis' credibility and reliability.

METHODOLOGY

To investigate the relationship between monetary policy rates and domestic debt in Ghana, the empirical model of the study is specified as follows;

$$MPR_t = \gamma_0 + \gamma_1 DD_t + \gamma_2 Inf_t + \gamma_3 RDGP_t + \varepsilon_t \dots\dots\dots (1)$$

Where *MPR* is the dependent variable representing Monetary Policy Rate; *DD, Inf,* and *RGDP* are the regressors representing Domestic Debt, Inflation, and Real Gross Domestic Product respectively. The subscript t denotes the time dimension, whereas, $\gamma_0 \, and \, \gamma_i \, (where \, i = 1, 2, \dots, 3)$ represent the intercept and parameters to be estimated; ε_t is the random error term respectively, assumed to be independently and identically distributed with zero mean and constant variance. All the variables are in percentages and as such, are interpreted as elasticity.

In brief, the Monetary Policy Rate (MPR) is the interest rate set by a country's monetary authority with the intention of influencing other key monetary variables in the economy like inflation, exchange rate or credit expansion, among others. Importantly, the MPR determines the rate at which other interest rates are set in the rest of the economy. In this study, the MPR is sourced from the Central Bank of Ghana's online database measured as MPR (%).

Domestic Debt (*Debt*) refers to the total government debt owed to residents within the same country. It is measured as the stock of domestic debt as a percentage of GDP. The level of government debt has significant influence on the formulation of monetary policy by the central bank (Balino, 1995; Mitra, 2007). To reduce the cost on government borrowing, the central monetary authority could alter its monetary policy stance by reducing the MPR (Iddrisu & Alagidede, 2020). As a result, the study expects *Debt* to have an inverse relationship with *MPR.*
Inflation (*Inf*) is an important aspect of monetary authorities' responsibility, and a very important objective in its operations. Generally, part of central banks' objective is to maintain stable rates of inflation in the economy. And in doing so the central authorities are often influenced to utilize the

[1] Heteroscedasticity occurs when the assumption of constant residual variance across vector elements, as required by Ordinary Least Squares (OLS), is violated. It affects the efficiency of the estimator and can result in misleading coefficients in the model.
[2] Serial correlation refers to a situation where the error term in the current period is correlated with the error term in previous periods. If a model exhibits serial correlation, the test statistics may be inaccurate, leading to inefficiency and inaccuracy in the estimation process.

MPR. For instance, at higher levels of inflation, above its normal target, the central authorities could raise the rate of interest as a form of tightening the monetary policy space; likewise, if inflation is falling below target and causing decline in economic output, the central bank could lower its MPR and make borrowing cheaper (Ross, 2021). Therefore, the study expects *Inf* to have a positive relationship with *MPR*.

The Real Gross Domestic Product (*RGDP*) reflects the productivity level in an economy. In this study, it is measured as total growth rates of GDP in percentage. According to Ross (2021b), a rise in economic activity in an economy often leads to an increase in the volume of money in circulation which is expected to lower the rate of interest in the economy. Thus, it is expected that *RGDP* and *MPR* share a negative relationship.

Estimation Procedure

Unit Root Test

In general, time series data normally follow a random walk and tend to be non-stationary. When series are non-stationary, it can lead to spurious regression analysis. Therefore, it is critical to account for series stationarity before carrying out any regression analysis.

To test for time series stationarity, many tests including the Phillips-Perron test, Dickey-Fuller Generalized Least Squares test, and Kwiatkowski, Phillips, Schmidt and Shin (KPSS, 1992) test have been proposed. However, in this study, the Augmented Dickey-Fuller (ADF) test which happens to be one of the most commonly used is adopted. The ADF test is a test that is extended from the Dickey-Fuller test proposed by Dickey and Fuller (1979). The procedure for testing the ADF test follows three versions: constant, constant and trend or none. This is characterized in equation (2);

$$\Delta Z_t = \alpha_0 + \alpha_1 t + \delta Z_{t-1} + \sum_{i=1}^{\rho-1} \delta_i Z_{t-i} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2)$$

Where:$\Delta Z_t = Z_t - Z_{t-1}$; Z denotes the series, α_0 is the constant term, *t* denotes the linear time trend and u_t is an error term. Equation 2 represents the version with both constant and trend. So, if second term from the right hand side of the equation is taken out, the version that remains will be the one with only constant; and if the first two terms are removed, the unit root version will be without a constant and trend.

The main objective of the test is to investigate the null and alternative hypotheses as shown below;

$$H_0: \delta = 0 \rightarrow Series\ have\ unit\ root$$
$$H_a: \delta < 0 \rightarrow Series\ stationary$$

Decision on the stationarity of a series is made by comparing the *t*-statistic in equation (3) to the critical value. If the null is rejected, then it is concluded that the series is stationary at all level otherwise, its non-stationary. In that case, the series can be differenced and tested again.

$$t = \frac{\delta}{\sqrt{var(\delta)}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Where; $\sqrt{var(\delta)}$ = Standard error.

The Johansen Cointegration Technique

This technique is a procedure for testing the cointegration relationship among two or more time series that are integrated of order one. Generally, it allows for the existence of more than one cointegrating relationship. For the cointegration relationship to be determined, the Vector Autoregressive (VAR) model in equation (4) has to be transformed into a Vector Error Correction Model (VECM) which contains first difference terms and cointegration relationships (Xu, 2012).

$$Z_t = \beta_1 Z_{t-1} + \beta_2 Z_{t-2} + \cdots + \beta_k Z_{t-k} + u_t \dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

Where Z_t is an $N \times 1$column vector of dependent variables, integrated of order one. Transforming equation (4) into a VECM gives;

$$\Delta Z_t = \Pi Z_{t-k} + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \cdots + \Gamma_{k-1} \Delta Z_{t-k-1} + u_t \dots\dots\dots\dots\dots\dots (5)$$

Where $\Pi = \left(\sum_{i=1}^{k} \beta_i\right) - I_n$ and $\Gamma_i = \left(\sum_{i=1}^{j} \beta_i\right) - I_n$.

The focus of the Johansen test is on examining the coefficient matrix Π. Setting the error term to zero, a long-run equilibrium exists if all $\Delta Z_{t-i} = 0$ and this will make $\Pi Z_{t-k} = 0$. In essence, establishing whether a cointegration relationship exists, the eigenvalues of the rank of Π is assessed. In light of this, and to make inference on cointegrating vectors, Johansen and Juselius (1990) proposed the trace and maximum eigenvalue statistic tests. The trace and maximum eigenvalue tests are formulated as;

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_r) \rightarrow Trace\ statistic$$

And;

$$\lambda_{max}(r, r+1) = -Tln\left(1 - \hat{\lambda}_{r+1}\right) \rightarrow Maximum\ eigenvalue\ statistic$$

Where *r* is the number of cointegrating vectors under the null hypothesis; *T* is the sample size and λ is the eigenvalues. For the trace statistics, the null hypothesis of at most *r* cointegrating vectors is tested against the alternative of more than *r* cointegrating vectors. However, for the maximum eigenvalues statistic, the null hypothesis of *r* cointegrating vectors is tested against the alternative of more than *r+1* cointegrating vectors.

The Vector Error Correction Model (VECM)

The VECM is a VAR model designed with a cointegrating constraint. Proposed by Sims (1980), the VAR is developed to examine the joint dynamic behavior of variables with little restrictions in identifying structural parameters. A system of VAR contains a set of *n* variables, in which each is linearly expressed as a function of *k* lags of itself and all other *n-1* variables, and can be estimated when there is no cointegrating relationship among the variables. The VECM, on the other hand, is estimated when the VAR variables are cointegrated. The VECM restricts the behavior of the long

run endogenous variables to converge to their cointegrating relationships while it allows for adjustment in the short run dynamics. Basically, the VECM is a modification of VAR in its first difference by adding the vector cointegrating term (Xu, 2012). The cointegration term is referred to as the Error Correction Term (ECT) and it shows how any disequilibrium from the long run is corrected through a gradual adjustment in the short run.
In this study, the VECM can be formulated as;

$$\Delta MPR_t = \gamma_0 + \sum_{l=1}^{k-1} \theta_j \Delta MPR_{t-j} + \sum_{j=1}^{k-1} \gamma_{ij} \Delta X_{i,t-j} + \tau_1 ECT_{t-1} + u_{it} \dots\dots\dots\dots\dots (6)$$

$$\Delta X_{it} = \gamma_0 + \sum_{l=1}^{k-1} \theta_j \Delta MPR_{t-j} + \sum_{j=1}^{k-1} \gamma_{ij} \Delta X_{i,t-j} + \tau_{2i} ECT_{t-1} + u_{it} \dots\dots\dots\dots\dots\dots . (7)$$

Where *k-1* is the optimal lag length reduced by 1*;* X_i is the vector of explanatory variables with the same lag length. θ_j and γ_{ij} are the short run dynamic coefficients, while τ_i is the speed of adjustment parameter for the error correction term (ECT).

Data Sources and Type

The study utilized secondary monthly time series data for the period 2014M1 to 2020M12. Worth noting however, is that the series, *RGDP*, was converted from the original quarterly form to a monthly time series. This was done by using the frequency conversion enabler in the Eviews statistical software package using the linear low-to-high frequency method. Data for this study were primarily sourced from the Central Bank of Ghana's online database and Ghana's Ministry of Finance online database.

RESULTS AND DISCUSSIONS

Unit Root Test

As established in the previous section, the Augmented Dickey Fuller (ADF) unit root test was carried out. The results are presented in Table 1. As shown, all the series were found to be stationary after taking the first difference. As a robust check, PP-test was also carried out and the result confirms the ADF test outcome. Based on the finding, the Johansen estimation technique is employed.

Table 1: Unit Root Test

Variable	ADF-Test		PP-Test	
	Level	First Difference	Level	First Difference
MPR	-0.418	-9.019**	-2.757	-9.490**
DD	-1.643	-9.143**	-1.861	-9.314**
Inf	-1.974	-8.604**	-2.097	-8.675**
RGDP	-3.422	-6.609**	-3.283	-12.500**

Note: ** and * indicates significance at the 1 and 5 percent level of significance.
Source: Author's computation using output from Eviews 12

Johansen Cointegration Test

After establishing that the series were stationary, taking the first difference, Johansen test of cointegration was adopted to determine the existence of a long-run relationship among the series. This is done by testing the null hypothesis of no cointegration against the alternative of cointegration of the Trace statistic and Max-Eigen statistic. From the result in Table 2, the existence of a long-run relationship among the variables was established from both the Trace statistic and Max-Eigen statistic.

Table 2: Johansen Cointegration Test (Trace and Max-Eigen)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None*	0.384	62.922	47.856	0.001
At most 1	0.169	23.146	29.797	0.239
At most 2	0.083	7.966	15.495	0.469
At most 3	0.010	0.859	3.841	0.354
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.**
None*	0.384	39.776	27.584	0.001
At most 1	0.169	15.179	21.132	0.277
At most 2	0.083	7.107	14.265	0.477
At most 3	0.010	0.859	3.841	0.354

*Note: * 1 cointegration equation at the 0.05 level*
Source: Author's computation using output from Eviews 12

Vector Error Correction Estimation Technique

After confirming the presence of a long-run relationship through the Johansen cointegration test, an analysis is conducted using the Vector Error Correction Model (VECM) to examine both the long-run and short-run models. It is worthy of note that all variables are interpreted in terms of elasticity. The following presents a discussion of the estimated VECM model.

Long-run Analysis

Table 3 presents the normalized equation for the estimated long-run model. In this form, the interpretation of the coefficients/estimated parameters is reversed. Therefore, a negative coefficient is considered as positive and vice versa. Consequently, the results in the table indicate that Inf and RGDP exhibit statistical significance at the 5% level based on their respective Test statistic values in parentheses. On the other hand, DD is found to be statistically insignificant.

In accordance with the study's expectations, it was observed that DD exhibited a negative correlation with MPR in Ghana during the studied period. Holding other factors constant, a 1% increase in DD led to a monthly reduction of 0.23% in MPR in the long run. This outcome indicates that DD has a negative impact on MPR. Theoretically, when the MPR is low, government borrowing tends to increase as the cost of borrowing for the government decreases, incentivizing more debt accumulation (Iddrisu & Alagidede, 2020). The study's findings align with this theory and also find support in the case of Ghana, where DD has been increasing over the years. However, it is important to note that the result is not statistically significant.

Table 3: Long Run VECM Estimates

MPR	DD	Inf	RGDP	C
1.000	0.231	-0.982	0.393	-14.570
	(0.180)	(0.224)	(0.121)	
	[1.279]	[-4.383]	[3.241]	

Note: values in bracket and parenthesis indicate standard errors and Test Statistic, respectively
Source: Author's computation using output from Eviews 12

Furthermore, the study discovered a positive association between Inf and MPR in the long run in Ghana. Specifically, a 1% increase in Inf resulted in a 0.98% increase in MPR, assuming all other factors remained constant. This finding is consistent with the study's expectations, as Inf was found to have a positive impact on MPR. Generally, when inflation levels are high, monetary authorities are compelled to raise interest rates as a means of tightening monetary policy and making borrowing more expensive (Ross, 2021a).

Similarly, RGDP was found to have a negative impact on MPR, indicating an adverse relationship. The study revealed that a 1% increase in RGDP led to a 0.39% decrease in MPR in the long run, assuming all other factors remained constant. This implies that an increase in economic activity or production in Ghana could prompt monetary authorities to lower the policy rate. This is likely due to the fact that an increase in economic activity leads to a greater volume of money in circulation, subsequently reducing the interest rate in the economy. This finding aligns with the research conducted by Karanja (2013).

Short-run Analysis

The findings of the short-run analysis are presented in Table 4. According to the results, the Error Correction Term (ECT) is observed to be negative and highly significant. This suggests that in the model, any short-run disequilibrium from the long-run equilibrium is corrected at a speed of 14% per month. Additionally, the results indicate that approximately 52% of the variation in the dependent variable is explained by the independent variables, as indicated by the R-squared value. Furthermore, the Durbin-Watson statistic has a value of 1.8, indicating the absence of serial correlation in the model.

Regarding the relationship between DD and MPR in the short run, the results revealed a positive association. Specifically, a 1% increase in DD leads to a 0.15% increase in MPR, assuming all other factors remain constant in the short term. This finding contradicts the expectations of the study. However, similar to the long-term analysis, the result is not statistically significant.

Table 4: Short run VECM Model

Variable	Coefficient	Standard Error	*t*-Statistic	Prob
D(DD)	0.019	0.050	-0.388	0.698
D(Inf)	-0.199	0.105	-1.893	0.059
D(RGDP)	-0.021	0.018	-1.144	0.253
ECT(-1)	-0.139	0.025	-5.655	0.000
C	-0.049	0.057	-0.853	0.394
R-Squared		0.524		
Adjusted R-squared		0.479		
Durbin-Watson Stats		1.890		

Source: Author's computation using output from Eviews 12

On the other hand, unlike DD, Inf is found to have a significantly negative relationship with MPR in the short term. Based on the results, it is revealed that a 1% increase in monthly inflation leads to a 0.2% reduction in MPR, assuming all other factors remain constant in Ghana's short-term context. Unlike the long-term analysis, this finding is contrary to the expectations of the study.
Furthermore, just as in the long-run, RGDP was found to have a negative relationship with MPR in the short run. It was revealed that a 1% increase in RGDP leads to a decrease in MPR by 0.02% in the short-run in Ghana, ceteris paribus. However, unlike the long-run, the finding for the short-run was not statistically significant.

Diagnostic Tests

The study also conducted diagnostic tests to examine serial correlation and heteroscedasticity. The results of these tests are presented in Table 5. The null hypothesis of no serial correlation was not rejected based on the Vector Error Correction (VEC) Residual Serial Correlation LM Test (referred to in Table 5). This suggests that the model does not suffer from serial correlation. Also, the VEC

Heteroscedasticity Test was employed. Based on the result, the study did not find sufficient evidence to reject the null hypothesis of homoscedasticity, indicating that the variance of the residuals remains constant

Table 5: Serial Correlation and Heteroscedasticity Tests

VEC Residual Serial Correlation LM Test	
Rao-F-Statistic	Prob.
1.189	0.278
VEC Heteroscedasticity Test	
Chi-sq	Prob.
105.9	0.323

Source: Author's computation using output from Eviews 12

CONCLUSION

The study has provided fresh perspectives on the public debt debate by examining how domestic debt influences monetary policy rate in Ghana. While focusing on this objective, the study empirically demonstrated the existence of a long-run relationship. Over the long run, domestic debt was found to have a negative impact on the monetary policy rate, whereas the opposite was observed in the short run. However, both models yielded statistically insignificant results. Nevertheless, the study revealed a statistically significant relationship between inflation and real GDP with the monetary policy rate in the long run, indicating a positive and negative impact, respectively. In the short run, only inflation was found to be statistically significant. The study's findings and analysis are reliable as there was no evidence of serial correlation or heteroskedasticity in the model. Ultimately, the study effectively addressed a crucial gap in the literature on public debt by primarily investigating the influence of domestic debt on monetary policy rate in Ghana.

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