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# *ЭМПИРИЧЕСКАЯ ОЦЕНКА ЭФФЕКТИВНОСТИ ТЕОРИИ ТРАНСМИССИОННОГО МЕХАНИЗМА МОНЕТАРНОЙ ПОЛИТИКИ В ЭКОНОМИКЕ*

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**Аннотация**

Денежно-кредитная политика, несомненно, является эффективным инструментом в глобальных финансовых системах, однако, несмотря на это, иногда возникают непредвиденные последствия. Для обеспечения успешного механизма денежно-кредитной политики необходимо, чтобы директивные органы и / или регуляторы имели точную оценку сроков и результатов реализации такой политики в экономике. В данной статье дается оценка и анализируются различные направления реализации монетарной политики.

**Ключевые слов:** трансмиссионный механизм, денежно-кредитная политика, банки

# *AN EMPIRICAL ASSESSMENT OF THE EFFECTIVENESS OF THE TRANSMISSION MECHANISM THEORY OF MONETARY POLICY (TMTM) ON REAL ECONOMIES*

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**Abstract**

Monetary policy is undeniably an effective tool in global financial systems; that notwithstanding it sometimes come with unanticipated consequences. For there to be a successful monetary policy arrangement in place, there is the need for policy makers and or regulators to have a precise assessment of the timing and the result of such policies within the economy. This article assesses and analysis the various channels in the theory.

**Keywords**: Transmission Mechanism, Monetary Policy, Banks

## Overview

The transmission mechanism theory is a tool that defines how policy variations in nominal money stock or short-term interest rate affect real economic variables not limited to employment as well as aggregate output. The theory of transmission mechanism comes through several channels including the interest rate, exchange rate, asset price, credit as well as the expectation channels.

**Interest rate channel: -** this channel plays a critical role in transmitting monetary changes amongst firms and households. This channel from the Keynesian approach was made of two phases; a movement from the short-term nominal interest rate to that of the long-term interest rate and the effects realized from real interest rate growth on aggregate demand as well as production in the real economy. [1] It is worthy to note that as policy makers and or regulators put in place tighter monetary policies in the economy, long as well short run nominal interest rates alike increases leading to a fall in business and investment by households, leading to a fall in aggregate output. [2] We are however faced with confronting effects with changes in interest rates; the effects are not limited to income which could be attributed to earnings of interest generating asset holders as well as a substitution effect which causes people to save instead of consuming [3]

**Exchange rate channel: -** this channel is concerned with changes in the rates of the domestic currency in lieu to a foreign currency. We employ two major ways i.e.

fluctuation in interest rates; that is to say as real interest rates goes up, the domestic currency deposits become more attractive in comparison to foreign currency deposits leading to a rise in the rate of exchange of the domestic currency. This however has a negative effect on the level of competitiveness externally on domestic goods thus creating downward pressures on the net export accounts as well as aggregate out within an economy. On the other hand, direct interference of policy makers and or regulators in the forex market is also considered. The price exchange rate pass-through is dependent on the pricing behaviour of firms that import goods. If local importers set prices in the local currency, changes in exchange rate will be transmitted automatically to the supplying country thus leading to complete exchange rate pass-through also known as the Grassman Law. On the other hand, if import prices are fixed in local currency, the exchange rate movements will not show in the local price leading to zero pass-through.

**Asset price channel: -** Monetarists postulate two channels in their analysis of the Transmission mechanism by employing the Tobin's q theory of investment and wealth effects on consumption [3]. Employing the Tobin's ***q*** is described in the following principle that characterizes the effects of monetary policy value on firm's Tobin q and as a result put descending pressure on investment as well as aggregate output.

$$\mathrm{MS}\ \downarrow, \text{People spending}\ \downarrow, \text{demand on equities}\ \downarrow, \text{equity prices}\ \downarrow, \text{tobin's q value}\ \downarrow, \mathrm{I}\ \downarrow, \mathrm{Y}\ \downarrow$$

We then consider the monetary transmission through wealth using the principle below:

$$\mathrm{MS}\ \downarrow, \text{demand on equities}\ \downarrow, \text{equity prices}, \text{wealth} \downarrow, \qquad \mathrm{C}\ \downarrow, \mathrm{Y}\ \downarrow$$

In this case spending and consumption are determined by the availability of resources of consumers, not limited to human capital, real capital as well as financial wealth. Stock is considered a prime component of financial wealth; fall in stock prices leads to a fall in the value of financial wealth leading to a fall in the available resources of consumers thus leading to a fall in consumption [4]

**2-1-4. Credit channel: -** this could be taken from two different perspectives bank lending and balance sheet. The bank lending channel affects small firms that can 't transact business with financial markets directly by way equity and bonds and as such rely on banks and other financial intermediaries. [5]The effect of the transmission shows a negative impact by way of contractionary monetary policy on bank reserves, thus decreasing the account of loans available for individuals and firms leading to a fall in investment and output, below is the principle.[6]

$$\text{MS} \downarrow, \text{Bank reserves} \downarrow, \text{bank loans fund} \downarrow, \text{I} \downarrow, \text{Y} \downarrow$$

Regarding the balance sheet channel, firm's net worth is thus affected. A fall in a firm's net worth has two effects: i.e. increases in moral hazard; since directors tend to have low equity and as such they may resort to engaging in riskier investment choices that may lead to loss of capital by lenders and the lenders on the other hand may have low quality collateral for their loans from borrowers and as a result may decrease their lending (partnership or through equity and debt markets) and as such have a negative effect on finance and investment decisions of firms. This could be seen from the principle below,

$$\text{MS} \downarrow, \text{Equity price} \downarrow, \text{net worth} \downarrow, \text{I} \downarrow, \text{Y} \downarrow$$

**Expectations channel: -** this channel is dependent on the credibility of regulators and or policy makers. It works by directing expectations of market participants regarding future economic conditions and interacts with the entire monetary channels.

**The Empirical Methodology**

The Granger causality tests, variance decompositions, and impulse response functions are employed herein assessing the effect of various shocks on output as well as inflation. VAR model is however used for this work. We further employ a six-variable VAR(P) (or a p-th order vector autoregression) model as indicated below and the variables defined herein:

$R_t$ = Policy rate, Mt = Money Supply, $L_t$ = Bank Credit, $E_t$ = Exchange rate, $Q_t$ = Real output, Pt = Consumer price index.

$$Y_t = \begin{bmatrix} R_t \\ M_t \\ L_t \\ E_t \\ Q_t \\ P_t \end{bmatrix} \qquad Y = \phi_1 \begin{bmatrix} R_{t-1} \\ M_{t-1} \\ L_{t-1} \\ E_{t-1} \\ Q_{t-1} \\ P_{t-1} \end{bmatrix} + \phi_2 + \begin{bmatrix} R_{t-2} \\ M_{t-2} \\ L_{t-2} \\ E_{t-2} \\ Q_{t-2} \\ P_{t-2} \end{bmatrix} + \ldots \phi_p \begin{bmatrix} & R_{t-p} \\ & M_{t-p} \\ & L_{t-p} \\ \epsilon_t & E_{t-p} \\ & Q_{t-p} \\ & P_{t-p} \end{bmatrix} + \epsilon_t$$

$$\phi_1 = \begin{bmatrix} \emptyset_{11} & \emptyset_{12} & \emptyset_{13} & \emptyset_{14} & \emptyset_{15} & \emptyset_{16} \\ \emptyset_{21} & \emptyset_{22} & \emptyset_{23} & \emptyset_{24} & \emptyset_{25} & \emptyset_{26} \\ \emptyset_{31} & \emptyset_{32} & \emptyset_{33} & \emptyset_{34} & \emptyset_{35} & \emptyset_{36} \\ \emptyset_{41} & \emptyset_{42} & \emptyset_{43} & \emptyset_{44} & \emptyset_{45} & \emptyset_{46} \\ \emptyset_{51} & \emptyset_{52} & \emptyset_{53} & \emptyset_{54} & \emptyset_{55} & \emptyset_{56} \\ \emptyset_{61} & \emptyset_{62} & \emptyset_{63} & \emptyset_{64} & \emptyset_{65} & \emptyset_{66} \end{bmatrix} \quad \text{And } E(\epsilon_t) = 0,\ E(\epsilon_t {\epsilon^I}_t) = \begin{cases} \sum_\epsilon t = \tau \\ 0 \ \ t \neq \tau \end{cases}$$

The lag operator is then used in representing the model as below:

$$\left[I_m - \emptyset_1 L - \emptyset_2 L^2 - \cdots - \emptyset_p L^p\right] Y_t = \epsilon_t$$

or

$$\Phi(L) Y_t = \epsilon_t \tag{1}$$

In this case $\Phi(L) = I_m - \Phi_1 L - \Phi_2 L^2 - \ldots - \Phi_p L^p$ is the lag polynomial of order p with m x m coefficient matrices $\Phi_i$, i = 1, ……… p.

If the covariance-stationarity holds then the inverse $\Phi^{-1}(L)$ exists. substituting equation (1) by $\Phi^{-1}(L)$, we get

$$Y_t = \psi(L)\epsilon_t$$

where $\Phi^{-1}(L) = \psi(L) = I_m + \psi_1 L + \psi_2 L^2 + \ldots\ldots\ldots$

The impulse responses trace out the response of current and future values of each of the variables to a one-unit increase in the current value of one of the VAR errors.

From the above analysis,

$$\Phi(L)\, Y_t = Y_t - \Phi_1\, Y_{t-1} - \Phi_2\, Y_{t-2} - \ldots - \Phi_p\, Y_{t-p} \quad \text{and}$$

$$\Phi^{-1}(L)\, \epsilon_t = \psi(L)\epsilon_t = \epsilon_t + \psi 1 \epsilon_{t-1} + \psi 2_{\epsilon t-2} + \ldots\ldots\ldots\ldots$$

Our model can be expressed as

$$Y_t = \epsilon_t + \sum_{i=1}^{\infty} \psi_i \epsilon_{t-i}$$

Expressing the future value of $Y_t$ as $Y_{t+n}$

$$Y_{t+n} = \epsilon_{t+n} + \sum_{i=1}^{\infty} \psi_i \epsilon_{t+n-i}$$

The effect of a unit change in $\epsilon_t$ on $Y_{t+n}$ is

$$\frac{\partial Y_{t+n}}{\partial \epsilon_t} = \psi_n$$

The $\epsilon_t$'s represent shocks in the system, consequently the $\psi_i$ matrices denote the model's response to a unit shock at time t in each of the variables i periods.

We realize the response of $Y_i$ to a unit change in $Y_j$ is thus given by the sequence below, identified as the impulse response function,

$$\psi_{ij,1}, \psi_{ij,2}, \psi_{ij,3}, \ldots,$$

where $\psi_{ij,k}$ is the ijth element of the matrix $\psi_k$(i, j = 1, … , m).

The $\epsilon_t$ is usually correlated. This notwithstanding, the impulse response analysis is not correct if the correlations are high. We then apply some transformations so that the shocks will become orthogonal or uncorrelated and as such will have a unit variance. Several ways of achieving orthogonalization could be done. However, in deriving orthogonal shocks to the endogenous variables, emphasis should be on the Cholesky factorization which comprises a lower triangular variance-covariance matrix of VAR residuals. We then consider the VAR model as below;

$$Y_t = \psi(L)\epsilon_t \text{ with } E(\epsilon_t \epsilon_t^I) = \Sigma_\epsilon,$$

In this case, the orthogonalised impulse response coefficients is obtained by making S the Cholesky decomposition of the residual covariance matrix $\Sigma_\epsilon$ and as such,

$$\Sigma_\epsilon = SS^I,$$

We can then define

$$Y_t = \sum_{i=0}^{\infty} \psi_i \, \epsilon_{t-i}$$

$$\sum_{i=0}^{\infty} \psi_i \, SS^{-1} \epsilon_{t-i}$$

$$\sum_{i=0}^{\infty} \psi_i^* \, v_{t-i}$$

where $\psi_i^* = \psi_i S$ and $\nu_t = S^{-1}\epsilon_t$

Then $Cov(\nu_t) = E\,(\nu_t\,\nu_t^I) = E\,(S^{-1}\epsilon_t\epsilon_t^I S^{-1I}) = E(S^{-1}\Sigma_t S^{I\text{-}1}) = S^{-1}E\,(\epsilon_t\,\epsilon_t^I\,)\,S^{I\,\text{-}1} = S^{-1}\Sigma_\epsilon S^{I\text{-}1} = I$ As a result, the conditions for orthogonalized impulse response functions is satisfied. We then define our new model as;

$$Y_t = \psi^*(L)_{vt} + \sum_{i=1}^{\infty} \psi_i^* v t_{t-i}$$

Where $\psi_i^* = \psi_i s$

We can see then that the impulse response function of $Y_i$ to a unit shock $Y_j$ is shown by the orthogonalised impulse response function;

$$\psi_{ij,0}^*, \psi_{ij,1}^*, \psi_{ij,2}^*, \ldots.$$

**Cholesky Decomposition and Ordering of Variables**

In employing the Cholesky decomposition of $\Sigma_\epsilon$ results in a lower triangular matrix with positive main diagonal elements for $\psi_0^*$, that is

$$\begin{pmatrix} Y_{1,t} \\ Y_{2,t} \end{pmatrix} = \begin{pmatrix} \psi_{11}^{*(0)} & 0 \\ \psi_{21}^{*(0)} & \psi_{22}^{*(0)} \end{pmatrix} \begin{pmatrix} v_{1,t} \\ v_{2,t} \end{pmatrix} + \psi^*(1) v_{t-1} + \cdots$$

This infers that the second shock $\nu_{2,t}$ does not affect the first variable $Y_{1,t}$ in its coexistence, but both shocks can have coexistent effect on $Y_{2,t}$ (and all ensuing variables, if we had selected an example with more than two components). Hereafter the ordering of the variables is important. We thus suggest that the first variable should be chosen such that it is the only one with potential instant impact on all other variables. The second variable may have direct impact on the last m-2 components of $Y_t$, but not on $Y_{1t}$, the first component, and so on.

**Variance Decomposition**

Since the shocks $v_t$'s are uncorrelated and have unit variances the error variance of the forecast of $Y_{it}$ can be decomposed into component stocks accounted for by innovations to $Y_j$ as follows:

Consider an orthogonalized VAR with m components,

$$Y_t = \sum_{l=0}^{\infty} \psi^*(l) v_{t-l}$$

The *n* step-ahead forecast for $Y_t$ will be

$$E_t(Y_{t+n}) = \sum_{l=n}^{\infty} \psi^*(l) v_{t+n-l}$$

Its associated forecast error could be stated as

$$e_{t+n} = Y_{t+n} - E_t(Y_{t+n})$$

giving

$$e_{t+n} = \sum_{l=0}^{n-1} \psi^*(l) v_{t+n-l}$$

It's *i*'th component we then realize

$$e_{i,t+n} = \sum_{l=0}^{n-1} \sum_{j=1}^{m} \psi_{ij}^{*(l)} v_{j,t+n-l} = \sum_{j=1}^{m} \sum_{l=0}^{n-1} \psi_{ij}^{*(l)} v_{j,t+n-l}$$

Because the shocks are both contemporaneously and serially uncorrelated, the error variance then shows

$$V\left(e_{i,t+n}\right) = \sum_{j=1}^{m} \sum_{l=0}^{n-1} V\psi_{ij}^{*(l)} v_{j,t+n-l}$$

$$\sum_{j=1}^{m} \sum_{l=0}^{n-1} \psi_{ij}^{*(l)\wedge 2} V(v_{j,t+n-l})$$

We then get the equation below with all shock components having a unit variance

$$V\left(e_{i,t+s}\right) = \sum_{j=1}^{m}\left(\sum_{l=0}^{s-1} \psi_{ij}^{*(l)^2}\right)$$

In this case $\sum_{l=0}^{n-1} \psi_{ij}^{*(l)^2}$ is the error variance produced by innovations to $Y_j$

The comparative importance of each random variable j innovation in clarifying the variation in variable *i* at different step-ahead estimates are given as a percentage as indicated below;

$$R_{ij,l}^{2} = 100\frac{\sum_{l=0}^{n-1} \psi_{ij}^{*(l)^2}}{\sum_{k=1}^{m}\sum_{l=0}^{n-1} \psi_{ik}^{*(l)^2}}$$

Also, the impulse response functions trace the effects of a shock to one endogenous variable on the other variables in the VAR. Variance decomposition however separates the variation in an endogenous variable into the component shocks of the VAR and as a result provides information about the relative importance of each random innovation in affecting the variables in the VAR.

**Granger Causality**

We then employ a bivariate VAR system of the two variables $z_t$ and $x_t$. If $x_t$ doesn't Granger cause $z_{t}$ we then have;

$$\begin{pmatrix} z_t \\ x_t \end{pmatrix} = \begin{pmatrix} \emptyset_{11}^{(1)} & 0 \\ \emptyset_{21}^{(1)} & \emptyset_{22}^{(1)} \end{pmatrix}\begin{pmatrix} z_{t-1} \\ x_{t-1} \end{pmatrix} + \cdots$$

$$+\begin{pmatrix} \emptyset_{11}^{(p)} & 0 \\ \emptyset_{21}^{(p)} & \emptyset_{22}^{(p)} \end{pmatrix}\begin{pmatrix} z_{t-p} \\ x_{t-p} \end{pmatrix} + \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{pmatrix}$$

Given rise to

$$\begin{pmatrix} z_t \\ x_t \end{pmatrix} = \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{pmatrix} + \sum_{i=1}^{\infty}\begin{pmatrix} \psi_{11}^{(i)} & 0 \\ \psi_{21}^{(i)} & \psi_{22}^{(i)} \end{pmatrix}\begin{pmatrix} \epsilon_{1,t-i} \\ \epsilon_{2,t-i} \end{pmatrix}$$

We then denoted it as,

$$Y_t = \epsilon_t + \sum_{i=1}^{\infty} \psi_i \epsilon_{t-i}$$

In the event the coefficient matrices $\psi_j = \sum_{i=1}^{j} \psi_{j-i} \emptyset_i$ are lower triangular.

When we realize lower triangular matrices, it is evident that the variable z does not respond to shocks in x; and as such the x does not Granger cause z. Granger causality does not show causality in the more common use of the term, but responds to the query as to whether or not past and current values of x could aid in predicting the future values of z.

**Conclusion**

The empirical impact of monetary policy is transmitted to all economies and as such weak interest rate and bank credit transmission channels means inflation targeting monetary policy will be ineffective in achieving macroeconomic stability. There is the need to employ other instruments such as quantitative targets, reserve requirements per the Basel III requirements as well as taxing of excess reserves. That notwithstanding, there will be need for intensified Institutional and financial reforms so as to reduce asymmetric information and to improve property rights as well as enforcement of contracts. When this happens, it will increase banks readiness to lend.

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