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THE RELATIVE EFFECTIVENESS OF MONETARY AND FISCAL POLICIES
An Econometric Study

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Abstract. This paper develops a multivariate model to test the effectiveness of monetary and fiscal policy for the economic growth in five Asian Countries (Pakistan, India, Thailand, Indonesia and Malaysia). Most of the previous studies in this area have paid less attention to stationarity, cointegration and causality issues. The series M_1 (Money Stock), Government Expenditure, GDP and exports are tested for time series properties. It is found that the series are non-stationary in their levels but stationary at the difference and hence can be cointegrated. Cointegration analysis shows that long-run relationship exists among the variables. Having established the fact of long-run relationship we further extend our analysis to focus on the causal relationship among the variables. On applying Granger Causality Test two problems were met. One is the choice of optimum lag and second is that the standard Granger or Sims tests results provide invalid causal inferences, as error-correction terms are omitted in these tests. To overcome the issue concerning optimal lag length the minimum final prediction criterion suggested by Hsiao is used, the order in which the variables entered into the model is also considered by using specific gravity criterion (SGC) proposed by Canies and Sethi. This criterion also provides temporary causal inferences between the variables. The second problem is avoided by applying alternative tests for Granger causality based on error correction model. The results show that there exists a strong bi-directional causality between fiscal policy and economic growth and also between monetary policy and economic growth for Thailand. In the case of Indonesia we observed a unidirectional causality between monetary policy and economic growth and a unidirectional causality between fiscal policy and economic growth. Estimation results for Malaysia show only unidirectional causality between the variables representing both of the policies and economic

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growth. In the case of Pakistan, monetary policy is found to be influencing economic growth. While for India study found out a unidirectional causality between monetary policy and economic growth.

I. INTRODUCTION

In recent years, the relative effectiveness of monetary and fiscal policy action on economic activity has been the source of considerable debate among economists. Empirical studies using monetarist models suggest that monetary actions have a greater impact on economic activities of the developed countries. On the other hand, studies using the structural models suggest that fiscal actions appear to have a dominant influence on economic activity in these countries (Chowdhury, 1986). While a macroeconomic policy regime consists of both the monetary and fiscal policy strategies that are implemented, the monetary and fiscal policy strategies are interacting and their joint implementations affect macroeconomic adjustments. Even in the simple framework, there are clear interrelations between monetary and fiscal policy rule. The design of the monetary rule will affect the macroeconomic conditions, which on their turn affect the fiscal policy (Aarle *et al.*, 2003). In his classic article on the subject, Mundell (1962) concluded that in dis-equilibrium situation "Monetary policy ought to be aimed at external objectives and fiscal policy at internal objectives." On the ground that to do the opposite would worsen the dis-equilibrium situation. Ott *et al.* (1968) claims that this view is probably accepted by a majority of economists, and what is important, since 1961 monetary and fiscal policy measures, by design or accident, have tended to confirm to the mix prescribed by Mundell. Extending the traditional research several studies have presented different results, but still the recent macroeconomic research controversy among the economists over the effectiveness of monetary and fiscal policies could not die out. Many of these empirical studies in this issue have focused on the experience of the developed countries using St. Louis[1] equation. Their findings suggest that monetary actions have a stronger, more predictable and

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[1]A three variable equation, known as St. Louis equation in the economics literature, was developed by Anderson and Jordan (1968) with the object of testing the relative effectiveness of monetary and fiscal policies for economic stabilization in the US. This equation had the following linear form: $Y = \alpha_0 + \alpha_1 \text{MO} + \alpha_2 F + u$

Where α_0 is the intercept, α_1 is the regression coefficient of MO and α_2 is the regression coefficient of F, a general variable representing monetary actions and u is the unexplained error term. When the relevant variables were expressed in the first difference, this equation assumed the following form: $\Delta Y = \alpha_0 + \alpha_1 \Delta MO + \alpha_2 \Delta F + u$

faster impact on economic activities than fiscal actions. Debating on the issue, Friedman and Meiselman (1963) found out the consumption was also correlated with changes in money but not fiscal variables, suggesting that monetary policy can have a stronger impact on taming business cycle than fiscal policy. They, along with other monetarists, using a "St. Louis" equation argued against the effectiveness of fiscal policy based on its inflationary and crowding out effects.

While Darrat (1984) using same St. Louis type reduced form single equation model found out that fiscal actions were more effective in explaining the GNP growth in developing countries. Taylor (1993) and Blanchard and Perotti (1999) also provide evidence for the effectiveness of fiscal policy. Chowdhury (1988) shows that fiscal policy effects are different across industrialized countries and very dependent upon institutional factors in each country. He later suggests that increase in government expenditures is fully offset by negative wealth and substitution effects on private investments, resulting expansionary fiscal policy eventually lowering income by crowding out private investment. Chowdhury (1988) working on St. Louis equation argued that most of the studies on this subject have confined their attention to the experience in developed countries and the result of these studies cannot be generalized for developing economies. He proposed that St. Louis type equation approach should be applied to the less developed countries in order to determine the relative effectiveness of monetary and fiscal policy.

Upadhyaya (1991) concluded that St. Louis type reduced form single equation method may not be applicable in all the developing countries. His empirical analysis shows a lack of uniform result across the countries. The estimates of his paper show that only monetary policy is significant in explaining the changes in GNP of Nepal and Pakistan. But in case of Sri Lanka neither variable is found to be significant, while in the case of India, St. Louis type reduced form equation is found to be inapplicable, as the monetary variable is not exogenous. Cosewell and Bruce (2001) also noted that this single equation (St. Louis type) makes exogeneity assumptions, which places structural causality assumptions on to the model. Following Choudhury *et al.* (1986), they employ a VAR technique instead of the "St. Louis" type approach to avoid imposing potentially spurious *a priori* constraint on the erogeneity of the variables in the system. This helps them to avoid a simultaneity bias. A VAR approach also allows to incorporate the proper lags of each series to avoid an omitted variable bias.

Taking into consideration all these controversies and arguments on "St. Louis" type equation, this study attempts to examine the relative effectiveness of both types of policies in the context of modern time series econometrics. The analysis is done for five Asian countries (Thailand, Indonesia, Malaysia, India and Pakistan). The paper has applied ADF test to check the stationarity, cointegration test to check the long-run relationship among the variables and final prediction error (FPE) criterion to test the causal inference among the variables and to choose the optimal lags of the series. By using Granger causality model based on error correction model the study further checks the causality, as it was argued that without error correction term in the model any causal inferences detected from the standard Granger test is invalid. The paper is structured as follows. Section II gives a brief overview of the fiscal and monetary policies rule discussed in the prior literature. Section III discusses the methodology and data used in the paper while Section IV provides empirical analysis of the data and Section V concludes.

II. BASIC FRAMEWORK OF THE STUDY

After a period of accelerating inflation in the early 1970s, the industrial countries in 1974-75 entered their most severe recession since the 1930s. The recession was brought on primarily by restrictive monetary and fiscal policies coupled with the dramatic rise in petroleum prices during 1973-74. Since early 1976 there have been some recovery, but unemployment continues to be a problem while inflation rates, although gradually moderating, remain at historically high levels. In this environment, governments have acted with caution in formulating their policies. In many of the industrial countries, monetary targets have been maintained at fairly modest levels and fiscal policy, which was expansionary during 1975, revered itself in 1976 and remained conservative. Overall, the desire to stimulate production has been tempered by concern over the inflationary consequences (Vector *et al.*, 1979). But much has happened in macro-economics since the 1960s and 1970s (when discretionary counter-cyclical fiscal policy was last considered a serious option). Monetary policy-making also has changed substantially over the last two decades in United States, the Federal Reserve's interest rate decisions have become more explicit, more systematic and more reactive to changes in both inflation and output. The Fed has placed a greater emphasis on keeping inflation low. The experience with this new policy has been very favourable, inflation has been low since the early 1980s and the real economy has been more stable. The 1980s and the 1990s saw two lengthy expansions in the history of US separated by a relatively short and mild recession. In term of the trade off between output variability and inflation variability, monetary policy has helped to move the US economy closer to the efficient frontier.

In the case of USA, empirical studies using a reduced form “St. Louis” equation has shown that monetary actions have a permanent influence on economic activity while fiscal actions have no lasting influence whatsoever (see Anderson and Carlson, 1970; Carlson, 1978; Hafer, 1982). On the other hand, structural models such as the FRB-MIT model, suggest that fiscal rather than monetary action exerts the dominant influence on economic activity in the USA (*see* deLeeuw and Kalchbrenner, 1969; Modigliani and Ando, 1976). Keran (1970), Dewald and Marchon (1978) and Batten and Hafer (1983) have discussed the relative effectiveness of the two stabilization tools in certain other developed countries within the “St. Louis” equation framework. However, their analysis has been limited to countries with a highly developed and sophisticated economy, such as Canada, France, Germany, Japan and the United Kingdom. Substantially less work has been done for countries with a much less developed and sophisticated economy except studies by Atesoglu (1975) and Atesoglu and Tillman (1980) for the case of Korea and Turkey and by Darrat (1984) for five Latin American countries.

Influenced by the monetarist assertion that monetary policy is more effective in economic stabilization in developed countries than fiscal policy, a number of economists have suggested that a monetary policy could be more effective in developing countries (Park, 1970; Polak, 1957). The explanation given for this phenomenon runs like this: Because the volume of financial assets such as government securities, treasury bills, industrial bonds and readily marketable shares is usually very limited in developing countries, the impact of increases in money supply is not diffused among various money substitutes but is transmitted directly to the real asset markets. Consequently, the increase in a money supply directly impinge on expenditures and thus the monetary policy could be expected to exert a quicker and stronger impact in developing countries then in more developed countries (Hussain, 1982).

Keynesian economists are of the view that fiscal policy is more effective than monetary policy in economic stabilization and they hold that the “full-employment budget surplus” is the crucial and strategic variable in the context of implementation of fiscal policy. Soligo (1967) argued that in developing countries where significant non-monetized sector exists and where a few financial assets and financial intermediaries are available and where financial assets are very imperfect substitute for cash or currency, the conventional monetary policy will have very limited success. Hafer (1982) has tried to establish the monetarist position on the relative effectiveness of the monetary and fiscal policies by using Granger's causality test in US data from the first quarter 1960 to fourth quarter 1980. According this test, if unidirectional causality from money to GNP is detected and a unidirectional causality from GNP to an appropriate indicator of fiscal policy is detected or independence between GNP and the fiscal indicator is found, then it would indicate that monetary variables are exogenous while the fiscal variable is not exogenous with respect to nominal GNP. Consequently, we shall be in a position to say that monetary policy is relatively more effective in influencing GNP than fiscal policy. Empirical findings contrary to the above will indicate that fiscal policy is more effective than the monetary policy. Earlier Andersen and Jordan (1968), using US quarterly data in the first differences for the period from the first quarter of 1952 to the second quarter of 1968 estimated St. Louis equation and found that "the response of economic activity to monetary actions compared with that of fiscal actions is larger, more predictable and faster" (Davis, 1969).

The most recent literature on this issue is of Taylor (2000), who points out that a rule-based approach towards fiscal policy may be useful and delivering new insights. He shows how a simple fiscal rule can be used to explain most fluctuations in fiscal deficits. Taylor's starting point is the division of the fiscal deficit into a cyclical component and a structural component. The first part can be interpreted as the systematic response of fiscal policy to output fluctuations, the second part contains structural and discretionary components of fiscal policy. Taylor estimates this fiscal rule in order to evaluate the respective roles of automatic stabilizers and discretionary fiscal policy in stabilizing output fluctuations in the US economy.

III. TESTING THE TIME SERIES PROPERTIES OF THE DATA

The distinction between whether the levels or differences of a series is stationary leads to substantially different conclusions and hence test of non-stationarity, that is unit roots are the usual practical today. Engle and Granger (1987) define a non-stationary time series to be integrated of order d if it achieves stationarity after being differentiated d times. This notion is usually denoted by $X_t \sim I(d)$. Hence, all the series are tested for the probable order of difference stationarity.

Using the Augmented Dickey-Fuller (ADF) test stationarity of the series is tested. ADF test is a standard unit root test; it analyzes order of integration of the data series. These statistics are calculated with a constant and a constant plus a time trend, respectively. These tests have a null hypothesis of non-stationarity against an alternative of stationarity. ADF test to check the stationarity of the series is based on the equation of the form:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_1 \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t$$

ε_t is a pure white noise error term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ etc.

These tests determine whether the estimates of δ are equal to zero. Fuller (1976) provided the cumulative distribution of the ADF statistics, if the calculated t ratio of the coefficient δ is less than the critical value from Fuller table, then Y_t is said to be stationary. (Note that 't' ratio of coefficient δ is always with a negative sign.)

Now, consider, for example, two series X_t and Y_t both integrated of order (d). Engle and Granger have shown that their linear combination will in general also be $I(d)$. It is an empirical fact that many important macro-economic variables appear to be integrated of order (d) [or $I(d)$ in the terminology of Engle and Granger (1987)] so that their changes are stationary. Hence, if GDP (Y_t), government expenditure (Z_t), M_{1t} and export (X_t) are each $I(d)$ then it may be true that any linear combination of these variables will also be $I(d)$.

Having established that all the series are integrated of order (d) that is $I(d)$ the study then proceeds to determine the long-run behavioural relationships among these variables because the determination of the order of integration of a series is a necessary procedure that precedes the analysis of long-run relationships among the variables.

For the purpose to examine the long-run relationship between the variables, they must be co-integrated. Two or more variables are said to be co-integrated if their linear combination is integrated to any order less than 'd'. Co-integration test[2] provides the basis for tracing a long-term

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[2]The most interesting case of one unit root corresponds to the definition of co-integration given by Engle and Granger (1987), where x_1 and x_2 are integrated processes of order 1 but

relationship among GDP, government expenditure, money stock and export. The theory of co-integration put forward by Johansen and Juselius (1990) indicated that the maximum likelihood method is more appropriate in a multivariate system. Therefore, this study used this method to identify the number of co-integrated vectors in the model. The Johansen and Juselius method has been developing in part by the literature available in the field, and reduce rank regression is closely related to the economic model of simultaneous equations. To determine the number of co-integrating 'r', Johansen and Juselius describe two likelihood ratio tests. The selection of 'r' co-integrating vector is based on the two statistics defined by Johansen as the maximal eigenvalue and the trace statistic. There are 'r' or more co-integrating vectors.

The test for co-integration among GDP, government expenditure, money stock and export, is a multivariate co-integration methodology. Johansen (1988) and Johansen and Juselius (1990) have proposed this multivariate co-integration methodology and can be defined as:

$$S_t = (Y_t, Z_t, M_{1t}, X_t)$$

which is a vector of $P (= 4)$ elements. Considering the following auto-regressive representation of:

$$S_t = \pi_0 + \sum_{i=1}^{k} \pi_1 \, S_{t-1} + \mu_t$$

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where a linear combination exists, βx_t, which is stationary. Co-integration tests are carried out using the well-known procedures of Engle and Granger (1987) and Johansen (1988). The Engle-Granger test involves testing the null hypothesis of non-co-integration between x_1 and x_2 as follows:

H_0: $a = 1$ against h_1: $a < 1$ where,

$$\Delta u_t = a u_{t-1} + c_1 \, \Delta u_{t-1} + \ldots + c_k \, \Delta u_{t-k} + v_t$$

And $u_t = x_{1t} - b_1^{ols} - b_2^{ols} \, x_{2t}$.

The Johansen procedure focuses on the rank of matrix, which determines the number of distinct co-integrating vectors. Johansen and Juselius (1990) describe two likelihood ratio tests. The first test is based on the maximal eigenvalue and is designed to test the hypothesis $H(r)$: rank $= r-1$ against the alternative $H(r-1)$. The maximal eigenvalue test is given by $J_{me} = -T$ in $(1 - \lambda_r)$ where T is the number of observations and λ_r is the maximal eigenvalue. The second likelihood ratio test is based on the trace of the stochastic matrix and is defined as $J_t = -T \, \Sigma_i$ in $(1 - \lambda_i)$. In a bivariate system the maximum number of co-integrating vectors is one so that the null hypothesis is that there is no co-integrating vector and the alternative is that there is one co-integrating vector.

Applying Johansen's method, which involves estimation of above equation by maximum likelihood technique, and testing the hypothesis H_0: ($\pi = \Psi\,\xi$) of 'r' co-integrating relationships, $\xi_i\, S_t = n_{it}$.

Where r is the rank of the matrix π ($0 < r < P$), Ψ is the matrix of weights with which the variable enter co-integrating relationships. And ξ is the matrix of co-integrating vectors. The null hypothesis of no co-integration between variables is rejected when the estimated likelihood ratio test statistic $\phi_i \left\{ = -n \sum_{i=r+1}^{p} \ln(1-\lambda_i) \right\}$ exceeds its critical value. Given the estimate of the eigenvalue (λ_i), the eigen vectors (ξ_i) and the weights (Ψ_i), we can find whether or not the variables in the vector (S_i) are co-integrated in one or more long-run equilibrium relation.

Having established the long-run positive relationship between the variables, the question that remains is which variable Granger causes the other and provides the short-run dynamics toward long-run equilibrium. When series are co-integrated, Granger argues that standard Granger or Sims tests will result in invalid causal inferences, as error correction terms are omitted from these tests. Therefore, in deriving the causal model, the research strategy adopted here is to start with a multivariate extension of Granger bivariate causal structure (Granger, 1969) and correct it for the shortcomings. A multivariate Granger causality test is based on the following regressions:

$$y_t = a_0 + \sum_{i=1}^{n} a_{1i} y_{t-i} + \sum_{j=1}^{m} a_{2j} z_{t-j} + \sum_{k=1}^{p} a_{3k} M_{t-k} + \sum_{l=1}^{q} a_{4l} x_{t-l} + \mu_{1t} \qquad (1)$$

$$z_t = b_0 + \sum_{i=1}^{n} b_{1i} z_{t-i} + \sum_{j=1}^{m} b_{2j} y_{t-j} + \sum_{k=1}^{p} b_{3k} M_{t-k} + \sum_{l=1}^{q} b_{4l} x_{t-l} + \mu_{2t} \qquad (2)$$

$$M_t = c_0 + \sum_{i=1}^{n} c_{1i} M_{t-i} + \sum_{j=1}^{m} c_{2j} y_{t-j} + \sum_{k=1}^{p} c_{3k} z_{t-k} + \sum_{l=1}^{q} c_{4l} x_{t-l} + \mu_{3t} \qquad (3)$$

Where μ_{1t}, μ_{2t} and μ_{3t} are serially uncorrelated zero mean stochastic error term, capturing all short-run deviation.

There are some difficulties with this set of procedures as mentioned above. First problem with the Granger test procedure is that it only examines whether or not past (and present) changes in a variable explain the current changes in another variable. It does not allow one to test for Granger causality in the presence of a stochastic trend common to all the variables in question. This type of alignment between variables is beyond the short-run dynamic adjustment captured by the error term in the standard Granger model.

Granger himself argues that standard Granger or Sims tests are likely to provide invalid causal inferences when the time series are co-integrated. To avoid this difficulty the alternative test for Granger causality based on error correction model is adopted, that incorporate information from the co-integrated properties of the variables involved. The error correction models thus formulated as:

$$\Delta Y_t = \alpha_0 + \sum_i \alpha_{1i} \Delta Y_{t-i} + \sum_j \alpha_{2j} \Delta Z_{t-j} + \sum_k \alpha_{3k} \Delta M_{t-k} + \sum \alpha_{4l} X_{t-l} + \alpha_5 \vee_{t-1} + \mu_{1t} \quad (4)$$

$$\Delta Z_t = \beta_0 + \sum_i \beta_{1i} \Delta Y_{t-i} + \sum_j \beta_{2j} \Delta Z_{t-j} + \sum_k \beta_{3k} \Delta M_{t-k} + \sum_l \beta_{4l} X_{t-l} + \beta_5 \vee_{t-1} + \mu_{2t} \quad (5)$$

$$\Delta M_t = \gamma_0 + \sum_i \gamma_{1i} \Delta Y_{t-i} + \sum_j \gamma_{2j} \Delta Z_{t-j} + \sum_k \gamma_{3k} \Delta M_{t-k} + \sum_l \gamma_{4l} X_{t-l} + \gamma_5 \vee_{t-1} + \mu_{3t} \quad (6)$$

Where *Y*, *Z*, *M* and *X* signify the *GDP*, government expenditure, money stock and export respectively. V_{t-1} is the error correction term retrieved from Johansen Juselius maximum likelihood method. Where Δ is the difference operator that induces stationarity and *i*, *j*, *k* and *l* are the optimal lag lengths for *Y*, *Z*, *M* and *X*, respectively.

Second problem is that the issue concerning the optimal lag length still remains illusive.[3] To overcome this problem, this paper adopts the minimum final prediction error (FPE) criterion, proposed by Hsiao (1981). Focusing on equation, in the first step we treat the dependent variable, as a one-dimensional autoregressive process initially, regressing it only on its own lagged values. The corresponding *FPE* is calculated by using the formula:

$$FPE(m) = \frac{T+m+1}{T-m-1} \times \frac{Q(m)}{T}$$

[3]The distribution of a test statistic is sensitive to the order of lag used. If the lag order used is less than the true lag, the regression estimates will be biased and the residual will be serially correlated. If the order of lag used exceeds the true order, the power of the test is likely to be reduced.

Where T is the number of observations, m is the order of lags varying from 1 to M, and $Q(m)$ is the associated sum of squared residuals, the specific value of m, say m^*, that minimize FPE is the optimum number of lags. Having estimated the appropriate lag length of Y bivariate regression are tested in which Y is regressed on its own lagged value (determined previously) and on the lagged value of one of the other three variables [$Y = f(y_{t-m} * Z)$, $Y = f(Y_{t-m} * M)$ and $Y = f(Y_{t-m} * X)$] considered one at a time. The three bivariate FPEs are calculated separately with the lag order (n) varying from 1 to maximum of 10 using the formula:

$$FPE(m,n) = \frac{T+m+n+1}{T-M-N-1} \cdot \frac{Q(m,n)}{T}$$

Once again the optimum lag n, say n^*, is chosen to minimize $FPE(m, n)$. We then compare the three bivariate FPEs with the lag length that minimize the FPE, Z_{t-n}, M_{t-n} and X_{t-n} and select the one that has the smaller FPE of the three as the appropriate lag length for the trivariate equations. Next is the estimation of the trivariate regressions that add to the appropriate lagged values of one of the other variables by the same process. The rank by which these variables are included in the equation is called the SGC or the specific gravity criterion proposed by Caines, Keng and Sethi (1981).

THE DATA

For empirical estimation, this study used the data on M_1, representing the thrust of monetary policy, aggregate economic activity (Y) is provided by nominal GDP, total government expenditure (Z) represents fiscal policy. As foreign trade is one of the important variables to explain the GDP growth, many economists have suggested that export should be added as one of the explanatory variables in the analysis of effectiveness of monetary and fiscal policy (Durrat, 1984; Chowdhary, 1988 and Hafer *et al.*, 1983). Batten and Haffer (1983) have provided the reason for including export by arguing that if the missing exogenous variables are policy variables or closely correlated with the variables representing monetary and fiscal actions, their omission may lead to a serious statistical problem. This would be more so for the countries having large degree of openness.

Data series for government expenditure and M_1 is taken from various issues of *International Financial Statistics Yearbook* published by International Monetary Fund, while data series on nominal GDP and export is taken from various issues of *World Development Indicator* (WDI) published by World Bank. Analysis is performed using the annual data spanning the period from 1970 to 2000.[4]

IV. EMPIRICAL ANALYSIS

The preliminary step in our analyses is concerned with establishing the degree of integration of each variable. For this purpose, as mentioned earlier, the test for the existence of a unit root in the level and first difference of each of the variables in the sample is tested by the well-known Augmented Dickey Fuller Procedure (ADF). The ADF test result is presented in Table 1 of Appendix. It reveals that all variables are non-stationary in their level data. However, the stationarity property is found in the first and second differencing level of the variables in case of all the five countries. The ADF is implemented to test the null hypothesis that the series in equation is $I(0)$ in the column under level or $I(1)$ in the column under 1[st] difference and $I(2)$ under the column 2[nd] difference. The variable export is found significant at the second difference, while in case of India all the variables except money stock are found to be integrated of order 2. Money stock and government expenditure of Pakistan and Thailand respectfully are also found to be integrated of order 2. Hence, the study can draw the conclusion that the first or second difference of the variables is stationary.

Now after establishing the fact that the individual series are stationary traditional co-integration method can be used to estimate the long-run relation.

Johansen's maximum likelihood approach is applied for estimating the long-run relationship between the variables. The results are summarized in Table 2 of Appendix. Trace statistics and maximal eigenvalues are used to examine the null hypothesis of non-co-integration against the alternative of co-integration. The test statistics is found well above the corresponding 5%

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[4]The study has used the annual observations first because the impact and adjustment lags of various macroeconomic relations such as M_1 and GEXP are too long for monthly or even quarterly observations to reflect the actual correlation between these macroeconomic variables though annual observations yield smaller degrees of freedom, the noisy effects associated with monthly or even quarterly observations tend to average out with annual data which better approximate M_1 or money GEXP relationship (*see* Masih and Masih, 1975 and Spencer, 1989). Second, Hakkio and Rush (1991), Van Den Berg and Taynetti (1993) have contended that co-integration is a long-run concept and, hence, requires long span of data to give co-integration with much power. The length of time series is far more important than the frequency of observation.

critical value for all the countries. Overall the results ensure that the variables are co-integrating and confirm a single co-integrating vector as well support stable genuine long-run relationship for all the countries. Johansen co-integration test provides four co-integrating equations for long-run in all the countries except for India and Indonesia for which we found only 3 co-integrating equations.

So far we have established a long-run positive relationship between the variables of all the five countries. The question that remains is which variable Granger causes the other. The answer, as indicated previously, is provided by the estimates of Granger Causality Model based on error correction models. But, as discussed earlier, when there is more than one lagged independent variable, one must select a strategy for choosing the number of optimum lags. Table 3 of Appendix provides the optimum lags of each series calculated by using the Akaike's final prediction error described in the methodology. It also summarizes the Hsiao test result of temporal causality inference among the variables. The variables listed in column 1 are controlled variables, while columns 2 to 4 represent the manipulated variables. Column 5 provides FPE values and in the last column causality inferences were mentioned.

In the case of Thailand and Indonesia, all the three manipulated variables found to have a causal inference of the controlled variables indicating that 'both' the policy is influencing economic growth in these two countries. In the case of Malaysia bidirection causality is found between Y_t and Z_t indicating that fiscal policy is important in explaining the economic growth of Malaysia, M_t is also found Granger causing Y_t, while in case of India all the three manipulated variables are found to have causal inference when the controlled variable is M_t and Z_t, unidirectional causality is also found running from M_t to Y_t. Finally, in case of Pakistan, the three manipulated variables, Y_t, Z_t and X_t, are found to have a causal inference on M_t.

After the careful examination of FPEs, in the final stage the Granger Causality Test based on error correction model is tested for the five countries. The result of error correction model is summarized in Table 4 of Appendix. Column 1 of Table 4 represents the estimation of equation (4), column 2 represents the estimation of equation (5) while column 3 represents estimation of equation (6). [Table 4 reports the results of ECM formulation, equations (3), (4) and (5)]. The temporal causality can arise from either of the two sources: (1) the sum of the coefficients of the lagged change variables (standard Granger test) or (2) the coefficient of the lagged error term, standard Granger causality tests overlook the letter channel. According to Engle and Granger (1987), a co-integrated variable must have an ECM representation. The ECM strategy provides an answer to the problem of spurious correlation. The error correction terms reflect the long-run dynamics and technically measures the speed of adjustment back to the co-integration relationship. The ECM is posited to be a force causing the integrated variables to return their long-run relations when they deviate from it and, thus, the larger the deviation, the greater would be the force tending to correct it (Banerjee, Galbraith and Henry, 1994). Following Hafer (1982) (which state that if unidirectional causality from money to economic growth is detected and a unidirectional causality from economic growth to an appropriate indicator of fiscal policy is detected or independence between economic growth and the fiscal indicator is found, then it would indicate that monetary policy is relatively more effective in influencing economic growth than fiscal policy. Empirical findings contrary to the above will indicate that fiscal policy is more effective than the monetary policy) following conclusions are drawn:

- In the case of Thailand, the study found out bi-directional causality among the variables representing fiscal policy, monetary policy and economic growth (but the effect of economic growth is negative on fiscal and monetary variables) indicating the influence of both the policy on economic growth. Export is also found Granger causing economic growth and fiscal policy.
- In the case of Indonesia, the study found out uni-directional causality between the variables representing monetary policy and economic growth and a uni-directional causality (a negative influence) is also observed from fiscal policy variable to economic growth. While no causal influence is detected between GDP and Z_t and *GDP* and M_t indicating both policy is influencing the economic growth (fiscal action is negative while monetary actions are positive). Export is also found to be influencing economic growth and monetary policy.
- In case of Malaysia, only uni-directional causality is found among the variables Y_t, X_t, Z_t and Mt and the independence between *GDP* to Z_t and *GDP* to M_t also detected showing that fiscal and monetary policy both play an active role in determining the economic growth of Malaysia.
- In the case of Pakistan, uni-directional causality is found among Z_t, M_t and Y_t. Monetary policy is exerting positive effect while fiscal

policy is affecting the growth process negatively as shown by the sign of the coefficients. And independence between *GDP* and Z_t is also detected which shows that monetary policy is positively affecting the process of economic growth in Pakistan. Fiscal policy is negatively affecting the process of economic growth.

- For India we observed the uni-directional causal inference of monetary policy to economic growth. The results also indicate no causality running from *GDP* to Z_t, hence, it can be concluded that monetary policy is relevant in explaining the economic growth.

The coefficient on V_{t-1} is statistically insignificant for all the countries except for Malaysia, which suggest that models under consideration are not converging itself to long-run equilibrium. But overall we cannot ignore the results, as the sum of the coefficients of the lagged change variables is significant to explain any causal influence running from monetary policy and fiscal policy to economic growth.

V. CONCLUSION

This paper empirically examines the relative impact of monetary and fiscal policies on the economic growth of Thailand, Indonesia, Malaysia, India and Pakistan, using the most recent econometric techniques over the period of 1970-2000. Using the co-integration, Hsio version of Granger causality (to choose the optimal lag and any causal inferences among the variables) and error correction representation, the study examines the nature of the relationship between GDP (representing economic growth), money stock (representing monetary policy), government expenditure (representing fiscal policy) and exports. The co-integration test results indicate a reliable long-run relationship among the variables of all the countries. Problems of Granger causality test are removed by adopting final prediction error model combined with specific gravity criterion proposed by Caines and Sethi (1981). In the final stage, the study estimates the error correction model to overcome the shortcoming of Granger Causality Model. Estimation of error correction model shows that both the policies are effective in explaining the economic growth of Thailand and Malaysia. For Indonesia, the study found out monetary policy is effective for economic growth, while for Pakistan and India, monetary policy is found influencing the economic growth in these countries. Overall it can be concluded that the effectiveness of policy differs from country to country, depending upon the nature of the economy in question.

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APPENDIX

TABLE 1

Unit Root Test

Level	Y		Z		X		M	
	Trend	Intercept	Trend	Intercept	Trend	Intercept	Trend	Intercept
Pakistan	1.887	–3.076	–1.712	–1.903	–0.103	–2.481	–0.465	–2.681
India	3.856	0.358	–1.753	–1.387	3.089	0.721	0.550	–2.236
Indonesia	–0.073	–2.256	–2.345	–2.078	–0.684	–1.606	–1.504	–2.215
Thailand	–0.059	–2.243	–1.418	–0.535	3.194	0.232	0.643	–1.691
Malaysia	1.759	–0.896	–1.733	–1.420	2.428	1.282	–1.022	–2.286
First Difference								
Pakistan	–2.843***	–3.581**	–3.263**	–3.276*	–3.151**	–3.119	–3.224**	–2.995
India	–1.749	–3.984**	–2.817***	–2.812	–1.898	–3.337***	–3.409**	–3.453***
Indonesia	–3.637*	–3.602**	–4.084*	–4.368*	–2.643***	–2.428	–4.130*	–4.173**
Thailand	–3.094**	–3.210***	–0.630	–0.571	–0.914	–3.010	–5.589*	–6.012*
Malaysia	–3.094**	–4.146**	–3.372**	–3.464***	–0.848	–4.114**	–5.004*	–4.903*
Second Difference								
Pakistan					–5.012*	–4.831*	–6.407*	–6.851*
India	–5.799*	–5.664*	–5.212*	–5.484*	–7.259*	–7.102*		
Indonesia					–5.064*	–5.028*		
Thailand			–5.831*	–6.575*	–4.860*	–4.878*		
Malaysia					–3.108*	–3.021*		

NOTE: * represent significant at 1%, ** represent significant at 5% and *** represent significant at 10%. Critical values are: –3.61, –2.94 and –2.61 (significant at 1%, 5% and 10% respectively when difference is constant) and –4.22, –3.53 and –3.21 (significant at 1%, 5% and 10% respectively when difference is constant and trend).

TABLE 2

Johansen Cointegration Test Series: Y, Z, M and X

	Likelihood Ratio	5% Critical Value	1% Critical Value	Max. Eigen-value	5% Critical Value	1% Critical Value
Pakistan						
R = 0	76.14297*	39.89	45.58	49.23*	23.80	28.82
R< = 1	26.91584*	24.31	29.75	14.19	17.89	22.99
R< = 2	12.72516*	12.53	16.31	8.56	11.44	15.69
R< = 3	4.168626*	3.84	6.51	4.16*	3.84	6.51
Thailand						
R = 0	109.8962*	39.89	45.58	57.50*	23.80	28.82
R< = 1	52.38782*	24.31	29.75	30.14*	17.89	22.99
R< = 2	22.24301*	12.53	16.31	16.31*	11.44	15.69
R< = 3	5.930043*	3.84	6.51	5.93*	3.84	6.51
Malaysia						
R = 0	148.8816*	39.89	45.58	82.89*	23.80	28.82
R< = 1	65.98610*	24.31	29.75	45.24*	17.89	22.99
R< = 2	20.74848*	12.53	16.31	16.03*	11.44	15.69
R< = 3	4.722602*	3.84	6.51	4.72*	3.84	6.51
India						
R = 0	101.0252*	62.99	70.05	38.21*	23.80	28.82
R< = 1	62.81607*	42.44	48.45	35.48*	17.89	22.99
R< = 2	27.33199*	25.32	30.45	16.88*	11.44	15.69
R< = 3	10.45415	12.25	16.26	10.45*	3.84	6.51
Indonesia						
R = 0	58.13919*	39.89	45.58	27.02*	23.80	28.82
R< = 1	31.11200*	24.31	29.75	17.92*	17.89	22.99
R< = 2	13.18933*	12.53	16.31	10.29	11.44	15.69
R< = 3	2.891080	3.84	6.51	2.89	3.84	6.51

NOTE: *, ** denote rejection of the hypothesis at 5%, 1%, respectively, significance level. LR test indicates 4 cointegrating equation(s) at 5% significance level. In case of India and Indonesia, LR test indicates 3 cointegrating equation(s) at 5% significance level.

TABLE 3

Hsiao's Version of Granger Causality

Controlled Variable	First Manipulated Variable	Second Manipulated Variable	Third Manipulated Variable	Final Prediction Error	Causality Inferences
THAILAND					
Y(T=1)				1.16E+19	
Y(T=1)	M(N=1)			3.77E+18	M→Y
Y(T=1)	M(N=1)	Z(J=1)		1.17E+18	Z→Y
Y(T=1)	M(N=1)	Z(J=1)	X(K=2)	3.65E+17	X→Y
M(T=1)				2.25E+14	
M(T=1)	Y(N=1)			1.20E+14	Y→M
M(T=1)	Y(N=1)	Z(J=3)		3.19E+13	Z→M
M(T=1)	Y(N=1)	Z(J=3)	X(K=1)	3.45E+13	X→M
Z(T=3)				7.29E+16	
Z(T=3)	Y(N=1)			4.89E+16	Y→Z
Z(T=3)	Y(N=1)	M(J=2)		2.12E+16	M→Z
Z(T=3)	Y(N=1)	M(J=2)	X(K=3)	2.77E+16	X→Z
INDONESIA					
Y(T=1)				2.57E+19	
Y(T=1)	X(N=1)			1.62E+19	X→Y
Y(T=1)	X(N=1)	M(J=1)		1.45E+19	M→Y
Y(T=1)	X(N=1)	M(J=1)	Z(K=1)	1.38E+19	Z→Y
M(T=1)				7.48E+14	
M(T=1)	X(N=1)			3.34E+14	X→M
M(T=1)	X(N=1)	Y(J=1)		3.45E+14	Y→M
M(T=1)	X(N=1)	Y(J=1)	Z(K=1)	3.70E+14	Z→M
Z(T=1)				4.43E+15	
Z(T=1)	M(N=1)			4.05E+15	M→Z
Z(T=1)	M(N=1)	X(J=1)		4.26E+15	X→Z
Z(T=1)	M(N=1)	X(J=1)	Y(K=1)	4.52E+15	
MALAYSIA					
Y(T=1)				4.36E+18	
Y(T=1)	X(N=2)			3.83E+18	X→Y
Y(T=1)	X(N=2)	M(J=4)		3.39E+18	M→Y
Y(T=1)	X(N=2)	M(J=4)	Z(K=1)	3.41E+18	Z→Y

M(T=1)				1.95E+17	
M(T=1)	Z(N=1)			1.98E+17	
M(T=1)	Z(N=1)	Y(J=1)		2.09E+17	
M(T=1)	Z(N=1)	Y(J=1)	X(K=1)	2.26E+17	
Z(T=1)				9.74E+16	
Z(T=1)	Y(N=1)			9.59E+16	Y→Z
Z(T=1)	Y(N=1)	M(J=1)		1.10E+17	
Z(T=1)	Y(N=1)	M(J=1)	X(K=1)	1.09E+17	
INDIA					
Y(T=3)				6.87E+19	
Y(T=3)	X(N=1)			6.30E+19	M→Y
Y(T=3)	X(N=1)	Z(J=1)		6.52E+19	Z→Y
Y(T=3)	X(N=1)	Z(J=1)	X(K=1)	6.28E+19	X→Y
M(T=1)				5.15E+14	
M(T=1)	Z(N=1)			4.92E+14	Z→M
M(T=1)	Z(N=1)	X(J=1)		3.80E+14	X→M
M(T=1)	Z(N=1)	X(J=1)	Y(K=1)	3.92E+14	Y→M
Z(T=1)				1.76E+16	
Z(T=1)	X(N=1)			1.61E+16	X→Z
Z(T=1)	X(N=1)	M(J=1)		1.72E+16	M→Z
Z(T=1)	X(N=1)	M(J=1)	Y(K=1)	1.72E+16	Y→Z
PAKISTAN					
Y(T=1)				2.51E+17	
Y(T=1)	Z(N=4)			3.03E+17	
Y(T=1)	Z(N=4)	M(J=1)		2.83E+17	
Y(T=1)	Z(N=4)	M(J=1)	X(K=1)	2.99E+17	
M(T=2)				1.14E+16	
M(T=2)	X(N=2)			9.75E+15	X→M
M(T=2)	X(N=2)	Y(J=1)		1.02E+16	Y→M
M(T=2)	X(N=2)	Y(J=1)	Z(K=1)	1.10E+16	Z→M
Z(T=1)				6.69E+16	
Z(T=1)	X(N=1)			6.82E+16	
Z(T=1)	X(N=1)	Y(J=1)		6.87E+16	
Z(T=1)	X(N=1)	Y(J=1)	M(K=1)	7.74E+16	

TABLE 4

Granger Causality Based on Error Correction Model

Dependent Variables	t statistics for $\Sigma\Delta Y_{t-i}$	t statistics for $\Sigma\Delta Z_{t-j}$	t statistics for $\Sigma\Delta M_{t-k}$	t statistics for $\Sigma\Delta X_{t-l}$	t statistics for V_{t-1}	R^2
THAILAND						
ΔY_t	18.37*	14.77*	6.3*	7.51*	0.41	0.99
ΔZ_t	–7.6*	9.45*	5.79*	–2.01**	2.39	0.95
ΔM_t	–9.56*	6.56*	15.58*	–0.28	3.1	0.94
INDONESIA						
ΔY_t	4.45*	–1.72*	2.67*	–3.38*	1.53	0.89
ΔZ_t	0.57	2.19**	0.98	–1.33	–0.86	0.57
ΔM_t	0.97	0.05	3.11*	–5.34*	1.6	0.77
MALAYSIA						
ΔY_t	2.0**	0.47	3.27*	4.8*	0.42	0.85
ΔZ_t	–0.55	4.87*	–0.71	–0.44	–3.2*	0.71
ΔM_t	–0.89	1.5	3.1*	0.9	0.71	0.41
INDIA						
ΔY_t	3.6*	1.0	–2.02**	0.23	–0.4	0.43
ΔZ_t	–0.34	4.84*	0.27	–1.85**	–0.1	0.57
ΔM_t	–1.03	0.144	6.65*	–3.51*	3.47	0.76
PAKISTAN						
ΔY_t	6.1*	–2.6**	1.98**	–0.74	0.34	0.75
ΔZ_t	–0.67	2.89*	–0.32	1.03	–1.29	0.60
ΔM_t	0.92	0.56	3.6*	–2.6**	3.14	0.62

NOTE: *, ** represent t statistics significant at 1% and 5%, respectively.