INFLATION AND CAUSALITY : A CASE STUDY OF MALAYSIA 1978 - 1992

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This is to certify that Bro./~~Sis~~ ZIAUL AHSAN
has written the Master of Economics research paper entitled:

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under my supervision. The relevant comments made on the paper during its presentation have been incorporated in the present version of the paper to my full satisfaction.

I have pleasure in recommending that the graduate committee may approve the paper in partial fulfilment of the requirements for the degree of Master of Economics.

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Inflation and Causality:

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ABSTRACT

The purpose of this paper is to test the proposition: increase in money, government expenditure, commercial credit, import prices caused price level to rise in Malaysia over the period 1978 Q1 to 1992 Q4. The results lend support to both monetarist and structuralist arguments as money supply as well as income, government expenditure and import prices appear to cause inflation. But contrary to general belief, commercial credit facilities do not cause inflation. Evidence was found to support the central banks initiatives in 1992 to use reserves to contain imported inflation. In addition, money was found to be non-neutral.

INTRODUCTION

Ills of inflation are well-known. It not only erodes purchasing power but also makes rational economic calculations difficult for economic agents and policy makers.

There are many competing hypotheses about the causes of inflation in both developed and developing countries. The monetarist hypothesis assumes the exogeneity of money supply and the existence of a stable real demand function for money. Thus, it views inflation as essentially a monetary phenomenon resulting from money supply growing more rapidly than money demand. The structuralist hypothesis attributes inflation to the autonomous elements like external trade instability and the propagation elements like budget deficits and so on.

This paper is an attempt to contribute additional insights towards understanding the causes of inflation in Malaysia. To be sure, inflation has not been a major threat in Malaysia in recent times. Except for brief spells, price level has been stable over the years. But in the first quarter of 1993, policy makers focused their attention to the ills of inflation once again. The view in the policy making circles is that the slow creeping rates of inflation is habit-forming. To check this

danger at its root is also essential to ensure the realization of Vision 2020. The central bank has identified elaborate actions like controlling money growth,credit card facilities, and so on. In this paper, we concentrated on these identified sources of inflation. More specifically, we have tried to determine if money supply, commercial credit, import prices, real income government expenditure etc actually caused price level to rise in Malaysia or not. This study covers the period of 1978 Q1 to 1992 Q4. We proceed first, by fitting a multiple regression line to identify the determinants of inflation in Malaysia. Then bi-variate models are constructed, which are defined over inflation and one of it's identified determinants at a time. Each series is trans formed and tested for a white-noise structure. A number of alternative lag structures are used in the model specification. Also different causality testing models are fitted with the transformed data. Our approach will allow for a comparison of results for different models specifications, for different lag structures and different causality tests.

The rest of the paper is organized as follows. We review the related literature and some studies in Section II.Section III describes the models used, the tests for causality and the data transformations. The results of the causality tests for alternative lag structures and variable specifications are reported in Section IV. The final section draws the conclusions.

SECTION II

LITERATURE REVIEW

The literature on the determinants of inflation is rich and dates as far back as early post war years. These studies broadly follow two main streams. The early monetarists argue that inflation originates in and is maintained by expansionist monetary and fiscal policies.[1]

The structuralists on the other hand single out factors like market instability, external shock, rigidity in supply, deficits structural bottle-necks etc.[2]

Most empirical literature highlighting the monetarist-structuralist controversy, concentrated on the inflation prone countries of Africa (Tegene 1989) Latin America (Harberger 1963, Sunkel 1960, Vogel 1974) and South Asia (Chakrabarti 1978, Hossain 1989).

Malaysia being less vulnerable to inflation, the empha sis of the empirical studies in this area, appear to be less heightened. Never-the-less there are quite a number of price formation models which are noteworthy.

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1. See M. Parkin and C. Zis (eds), "Inflation in Open Economies" Manchester University Press, Manchester, UK. 1976 for a collection of studies on these theme.

2. For detailed explanations, see V.Argy "Structural Inflation in Developing Countries". Oxford Economic Papers, March 1970, pp. 74 - 89.

Most of these studies of the Malaysian monetary sector tended to follow the Keynesian framework while some attempted a monetarist approach. The Hayes (1977) and Semudram (1982) models fall under the former category. The price formation model by Leong-Jaafar-Ho (1976) is basically of the monetarist type.

In the models of Hayes(1977) and Cheong-Tillman (1976), prices are explained by import prices and wage rates. Hayes also includes tax rates while Cheong-Tillman considers productivity. Semudram's and other Keynesian models postulate that price formation is determined in the real sector through adjustments of aggregate supply and demand. All these studies identifies the determinants of price formation but none establishes a decisive causality.

Most studies mentioned so far, mainly concentrated on identifying the determinants of inflation only. There are also studies which uses Granger (1969) notion of causality and establishes one to one causal relationships between inflation and its determinants. Parikh and Starmer (1988) found evidence of significant unidirectional feedback running from prices to money in Bangladesh. Manning and Mohammed (1990) on the other hand, found causal relationship running from money to prices and income in Singapore for the period 1967 - 1985. In another study, Yang (1990) finds interest rates causes whole-sale prices to rise in Taiwan supporting the notion of cost push inflation.

On the study of causality, a number of procedures have been suggested. Most of these procedures like Sims (1972) Geweke et. al. (1983) Holmes and Hutton (1990) are similar to the pioneering work by Granger (1969) in their underlying logical structure. A number of authors have argued that, these procedures are sensitive to the functional forms as well as lag structures used in estimation (See Feige and Pearce 1979, Roberts and Nord 1985, Sephton 1989). We employed the original Grangers (1969) model and Hsiao's (1981) model which has a slight superiority over the others in terms of optimal lag usage.

SECTION III

MODELS AND TESTS FOR CAUSALITY

In identifying the determinants of inflation, we followed the existent literature and also included a few variables which are suspected to cause inflation. Lag length was limited to eight periods. Darbin-Watson test was conducted to detect auto correlation. We also conducted a Chow test by splitting the sample into two (i.e. 1978Q1 - 1980Q4 and 1981Q1 - 1992Q4) and the results determine the stability of the estimates. In selecting the explanatory variables, we used the step-wise procedure, whereby, lags were introduced in steps and only those variables were retained which maintained significance at least at 0.05 level for each step.

We also plotted the dependent variable (i.e. inflation) against all the explanatory variables (growth of money, commercial credit, import prices, real income and government expenditure). The plots give a general picture of the trend and helps in forming a priori expectations in our study.

In causality testing, the general procedure is to regress past (and in some cases future) values of a white noise process, say Y_t ,on current values of some other white noise process, say X_t. If Y_t contains information which helps to predict X_t then, in the Granger sense Y_t causes X_t. (Y_t ---> X_t).

The reverse procedure will allow testing X_t ---> Y_t. If both regressions test positive for causality then, a bidirectional relationship exists between X_t and Y_t ($X_t \Longleftrightarrow Y_t$). In this paper two different parametric tests are applied, namely Granger's (1969 and 1988) and Hsiao's (1981). The models specified over X_t and Y_t are reported in Table 1. Table 2 shows the hypothesis testing procedures. In the Granger model, the procedure is to determine whether the inclusion of the causal variable minimizes the forecast error. A null-hypothesis of no causality is tested based on a joint test that the coefficients of the lagged causal variable are significantly different from zero.

The above mentioned models require the researcher to set lag lengths for both the dependent and causal variable. Inappropriate lag lengths may result in model misspecification and, (as Gordon and Bekoe (1993) demonstrates) in unreliable causation results. On the other hand, the Hsiao model, using the Granger specification, employs Akaike's Final Prediction Error (F.P.E.) procedure to determine optimal lag length. The FPE is defined as

FPE = [Sum of Squared Residuals (T+r+s+1)] / T (T-r-s-1)

where,

T is the number of observations and r and s are the lag orders for the dependent and causal variables respectively.

The optimal lag length is one which yields the minimum FPE. If the inclusion of the causal variable reduces the FPE for the dependent variable alone, then causality exists. It can be readily seen that the FPE criteria is equivalent to an F test applied to the Granger model with optimal lag specification.

Table 1. Causality Models

MODEL	Specification for testing $Y_t \dashrightarrow X_t$
Granger	$X_t = \sum_j b_j X_{t-j} + \sum_j a_j Y_{t-j} + v_t$
Hsiao	$X_t = \sum_i b_i X_{t-i} + \sum_k a_k Y_{t-k} + v_t$

MODEL	Specification for testing $X_t \dashrightarrow Y_t$
Granger	$Y_t = \sum_j c_j Y_{t-j} + \sum_j d_j X_{t-j} + u_t$
Hsiao	$Y_t = \sum_i a_i Y_{t-i} + \sum_k b_k X_{t-k} + u_t$

Table 2. Hypothesis Testing and FPE Criteria

MODEL	Unidirectional Causality	
	$Y_t \dashrightarrow X_t$	$X_t \dashrightarrow Y_t$
Granger	Ho: $\sum_j a_j = 0$	Ho: $\sum_j d_j = 0$
Hsiao	FPE(X) > FPE(X,Y)	FPE(Y) > FPE(Y,X)

Where,
X_t=Inflation
Y_t=Money supply or Commercial Credit or
Real income or Government expenditure
or Import prices
j = 1,2, ...m
i = 1,2, ...r
k = 1,2, ...s i and k not necessarily equal.

DATA:

Quarterly data covering the period 1978 Q1 to 1992 Q4 was collected from the 'Quarterly Bulletin' published by the Bank Negara Malaysia. The causality models used here require that each data series be white noise. Box-Pearce Portmanteau Q-statistics was generated in levels for each series to test stationarity. Any non-stationary series was transformed by taking differenced form to ensure stationarity. Finally Dickey-Fuller (DF) (1981) test was applied to the levels of each series separately to ensure white-noise properties. Import prices and first differenced forms of inflation, commercial credit, real income, real government expenditure passed the test of stationarity with q-statistics of 28.06, 26.38, 12.35, 22.20 and 18.76 respectively.

Since, quarterly data for import prices were not available, it was generated by use of import volume (IV) as follows

$$UPM_{it} = UPM_t * (IV_{it} * 4) / IV_t$$

where

UPM_{it} = unit price of Imports in quarter i of year t

UPM_t = unit price of imports for year t

IV_{it} = volume of imports in quarter i of year t

IV_t = volume of total imports in year t

SECTION III

EMPIRICAL RESULTS

The results from the estimated function for inflation, is reported in table 3. The step-wise procedure which was adopted in estimation, ensured inclusion of the most significant explanatory variables. R-square and F-value, both indicate signs of a good fit and overall statistical significance. Durbin-Watson statistics rules out the possibility of existence of auto-correlation. A Chow test was conducted which shows that the estimates remain stable over time.

The coefficient of commercial credit has the expected positive sign and on average a 1 percent increase in credit increases inflation by a mere 0.09 percent. The coefficient of growth of money with an year lag has the positive sign but the same with a six quarter lag has a negative sign. on average, 1 percent increase in money supply can increase price level by only 0.03 percent in the long run. the coefficients of government expenditure has the correct sign at all lag lengths and a 1 percent increase in public expenditure is capable of increasing inflation by a total of 0.14 percent in the long-run. Real income and import prices both show the expected positive signs and have coefficients of 0.09 and 0.01 respectively.

The plots are presented in Figure 1 through Figure 7. Inflation plotted against time shows a gradual rising trend in Malaysia. The plots of inflation against money, commercial credit, real income, government expenditure, import prices, all show the same positive slope. This confirms our a priori expectation of a positive relationship between inflation and any of these determinants. Though the plots are smoothly clear enough, they do not give a conclusive result. Also, our results in the estimated regression do not establish causation. Thus, we turn to the causation study to determine the objective one to one causal relationship.

For the causality study, OLS was estimated adopting the bi-variate causality model of Granger, using two alternative lag structures of four and eight periods respectively. It is not uncommon in applied work to specify lag structure in an ad hoc manner and our purpose here is to compare causality conclusions under different lag specifications. Causality results of the models specified over a four period lag structure are reported in Table 4.

A Granger causality was established from real government expenditure to inflation in the bi-variate four lags specification. Government Expenditure appears to create excess demand and liquidity in the face of constrained supply of real goods and

services and thus leads to general price level rise. This causation also proves to be unidirectional, since no causality was established from inflation to real government expenditure.

Surprisingly, no causality was detected from growth of money, real income, commercial credit, and import prices to inflation, though all these are statistically significant determinants of the later. This raises doubts about the optimality of lag lengths.

Table 5 shows causality results of models specified over the eight period lag structure. Here, growth of money appears to cause inflation in the Grangers sense lending support to the Monetarist hypothesis. This suggests that one should observe the monetarist rule that is should tie the money growth to the real growth rate of the economy to avoid inflation. Unfortunately, the conclusion that RGOV ---> INF which was reached at four lags specification, fails to hold true at the eight lags stage. Also all other determinants fail to show any causation of inflation. One obvious conclusion is that the causality tests are sensitive to lag specifications. At this stage, our doubts about the optimality of lag lengths still persist, rendering our causality conclusions to be of dubious value.

In search of optimal lag length, we turn to Hsiao's models. The calculation of Final Prediction Errors show that, prediction error increases as additional lags are being included then reaches the optimal minimum with an unexpected drop and keeps on increasing again . Since, no trend can be found in the progress of FPE, grater lag length is no help in getting accurate causality conclusions.

Table 6 shows the optimal FPE and causality conclusions from the Hsiao's model. In general, we get better results due to the use of optimal lag length. Growth of money is once again identified to cause inflation supporting the monetarist hypothesis. But commercial credit fails to show causation. This suggests that contrary to the general suspicion, commercial credit facilities has little relevance to inflation. Central banks attention towards controlling credit card facilities are probably justified on grounds of checking commercial fraud, generating savings and ensuring the smooth running of the monetary system.

Real income increase appears to rise price levels supporting the concept of demand pull inflation. At the same time, real government expenditure is also found to cause

inflation. Under such circumstances, stimulating the supply side of the economy seems to be the best option to meet the excess demand, so that price level remains stable. Thus, the government initiatives like tax holidays, investment credits and welcoming foreign direct investments, which are often thought too generous, seems to be well justified based on our findings.

Import prices are found to cause inflation in Malaysia. This finding supports the central banks initiatives to contain imported inflation by strengthening the Ringgit. Though the loss of other official reserves in the last 3 quarters of 1992 was much criticized, the use of it appears to be justified based on our findings.

Domestic inflation is found to cause real income and import prices. While the relationship between the domestic price level and import prices is only a matter of market fundamentals, the relationship between inflation and real income suggests non-neutrality of money. That is, central bank may influence real income through deliberate money supply. But the merit of such initiative will depend on the circumstances and considerations of other objectives.

SECTION IV

CONCLUSIONS

Major findings from our study of causation and determinants of inflation in Malaysia covering the period of 1978 Q1 to 1992 Q4, can be listed as follows,

1. Causality conclusions are sensitive to the lag structure used in the testing.

2. In Granger causality test, longer lag length do not help to get better results.

3. There is unidirectional causality between growth of money and inflation in Malaysia as is propagated by the monetarists.

4. Commercial credit facilities are irrelevant to the causes of inflation in Malaysia.

5. Evidence of demand pull inflation was found as both real income and real government expenditure causes inflation in Malaysia.

6. Domestic price level is sensitive to import prices in Malaysia but the causality is also bidirectional.

7. Changes in money supply, through changes in price level can cause changes in real income in Malaysia. This non-neutrality of money gives central bank scope for deliberate monetary policy to influence output.

Table 3
Dependent Variable:Log of Consumer Price Index

Variable	Lag	Coefficient	T-Statistics
CONSTANT	0	1.424537	8.759 *
GM	4	0.230688	6.674 *
GM	6	-0.200415	-4.014 *
CCR	8	0.091933	7.506 *
RGNP	3	0.090013	3.243 *
RGOV	1	0.027512	4.155 *
RGOV	2	0.038101	5.363 *
RGOV	3	0.026505	3.686 *
RGOV	7	0.019501	2.602 **
RGOV	8	0.031808	4.449 *
UPM	6	0.001284	6.58 *

Summary Statistics:

Adjusted R-square =	0.9952	S.E.E. =	0.0018
Overall F Value =	1034.548	Sample: 1978:1-1992:4	
D.W. Statistics =	1.9669	Chow Test = F(10,40)	=3.03**

* Significant at the 0.01
** Significant at the 0.05

FIGURE 1

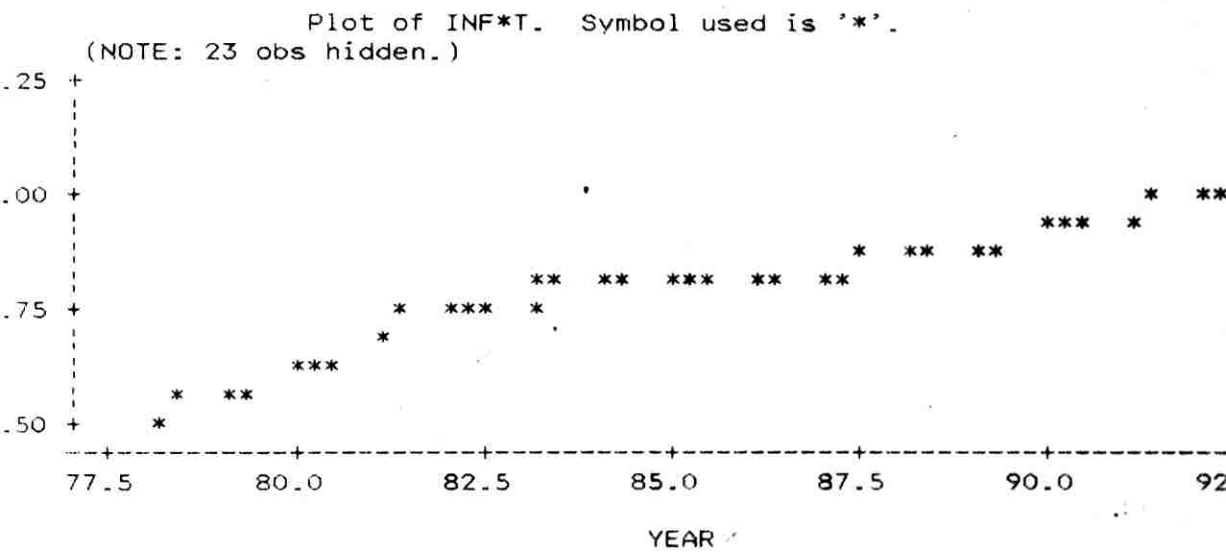
Plot of INF*T. Symbol used is '*'.
(NOTE: 23 obs hidden.)
.25
.00
.75
.50
77.5
80.0
82.5
85.0
87.5
90.0
YEAR

FIGURE 2

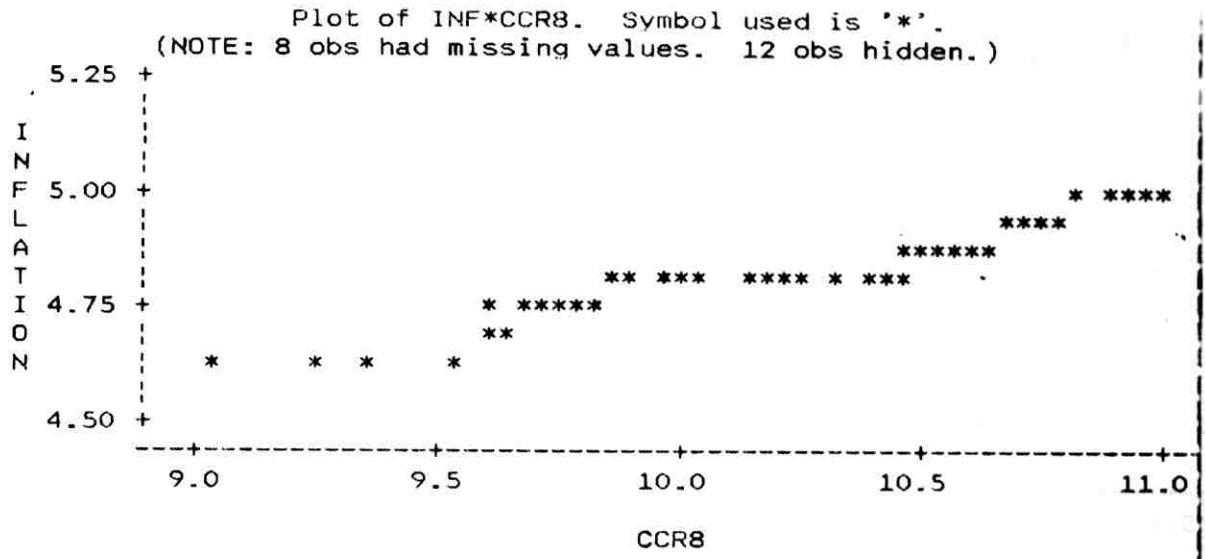

FIGURE 3