Dynamic Behavior of Inflation in Nigeria: A P-Star Approach

Ikechukwu Kelikume
Lagos Business School

The P-star model performance in predicting inflation renders it a valuable tool in analyzing dynamic behavior of prices. This study tests the performance of the P-star model in Nigeria with a view to ascertaining its usefulness in predicting price movement. Using quarterly data obtained from the Central Bank of Nigeria statistical Bulletin over the period 1970 to 2011, we obtained estimates of the price-gap, velocity-gap and output-gap model. The result obtained shows the usefulness of the price-gap model in explaining and predicting inflation in Nigeria.

INTRODUCTION

One of the most frequently debated issues in contemporary economics, especially in developing and emerging markets is the issue of inflation forecasting given the role of price movement in the business cycles. Usually, the Central Bank or the monetary authorities periodically set or forecast base inflation as a strategy in defining inflation target for the given period. The ability of monetary authorities to predict the movement of the general price levels guarantees to a large extent the relative effectiveness of monetary policy in pursuing either a tight or loose monetary policy as a veritable tool in checking deflationary and inflationary pressures in the economy. Between the periods, 1970 to 2000, high and persistent inflation was a characteristic feature of the Nigerian economy (See Figure 1), but the trend in inflation between 2000 and 2010 showed the general price level has been receding towards a single digit level. 12 month moving inflation averaged 13.22 percent in the period 1970-1979 but rose to an average of 22.88 percent and 30.65 percent in the periods 1980-1989 and 1990-1999 respectively. The period 2000 to 2009 showed a significant decrease in average inflation to 12.31 percent marking a step towards single digit inflation. (See figure 1)

The word inflation is a steady increase in the general price level of goods and services "in an economy". When rise in the price level is a result of excess demand over supply, Inflation is a monetary phenomenon (Friedman 1963). However, inflation can be described as cost-push where the main driver is a steady increase in production cost driven primarily by an increase in; exchange rate, interest rate, salaries and wages, taxes, profits, commodity price, external shocks, depletion of natural resources imported input prices and international oil price trend. This latter phenomenon-the supply-side factors are studied in the literature extensively (Bernake 2005, Haque and Qayyum 2006). For effective forecasting of the general price trend, it is expedient for the monetary authorities to understand factors that drive the long-term price changes and short term determinants of inflation.

Two key variables that have played the crucial role in inflation targeting and forecasting in most research studies is the money supply variable narrowly defined (M1) and the money supply broadly defined (M2). It is certified that these variables with the output gap and price gap model to forecast inflation successfully in different countries. Following the framework developed by Hallman, Porter and Small (1991) we build on the reputed P-star model of inflationary pressure based on the classical equation of exchange in which changes in the money stock determines the equilibrium path of price level to which the actual price level has to adjust. The forecasting abilities of the P-star model in predicting long term determinant of inflation and short term changes in the current price level; renders the model a helpful tool in predicting the dynamic behavior of prices changes in a developing country like Nigeria.

Given the role of price movement in the business cycles, inflation forecasting has become one of the most debated issues in modern economics and emerging markets in particular. Usually, the Central Bank or the monetary authorities periodically set or forecast base inflation as a strategy in defining inflation target for the given period. The ability of monetary authorities to predict the movement of the general price levels guarantees the effectiveness of monetary policy in checking deflationary and inflationary pressures in the economy. Between the periods, 1970 to 2000, high and persistent inflation was a characteristic feature of the Nigerian economy (See Figure 1), but the trend in inflation between 2000 and 2010 showed the general price level has been receding towards a single digit level. 12 month moving inflation averaged 13.22 percent in the period 1970-1979 but rose to an average of 22.88 percent and 30.65 percent in the periods 1980-1989 and 1990-1999 respectively. The period 2000 to 2009 showed a significant decrease in average inflation to 12.31 percent marking a step towards single digit inflation. (See figure 1)

FIGURE 1
TREND IN INFLATION IN NIGERIA (1970-2010)

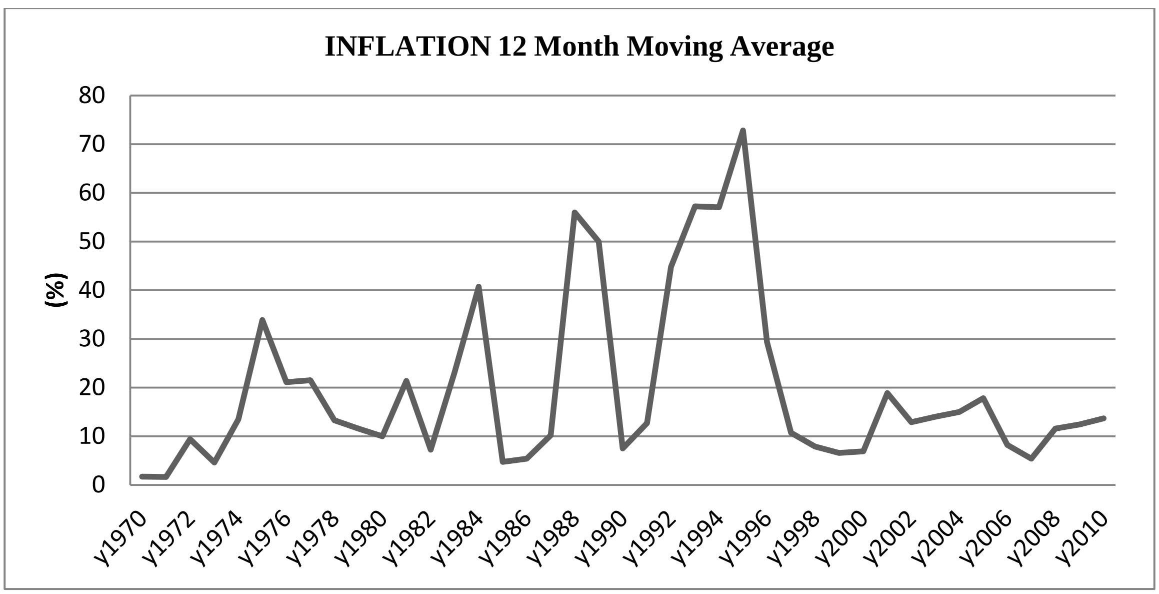

Figure 1 shows significant volatility in the general price level over the periods 1970-2010 with inflation attaining the highest level in 1995. Inflation has been less volatile since 2000

The basic objective of this study is to evaluate the performance of the P-star model for the Nigerian economy. Furthermore, the study anticipates reliable prediction of long and short run determinants of inflation as well as generating recursive forecast from the p-star model.

Following the introductory section, the rest of this paper is structured as follows; section two provides a brief review of the literature while section three sets out the basic methodology underpinning the P-star model. In section four, we present the empirical analysis and forecasting performance of the model while section five concludes the paper.

LITERATURE REVIEW

Debate over the causes of inflation in economics is still on till date leading to the development of various theories and inflation models which are both competing and complementing. Overtime, the causes of inflation have evolved to include; monetary shocks; fiscal shocks; inflation expectation; exchange rate; wage rate; and import prices grouped into supply side shocks; demand side shocks; political and structural shocks.

Decomposing an inflation model into it causal component has been the workhorse of economist. While the monetarist are of the view that inflation is always and everywhere caused by monetary phenomenon (Friedman 1968, 1970, 1971), the Keynesians believe that inflation is a result of a pull in demand and the Structuralist emphasizes increases in cost of production as the cause of inflation (Thirwell, 1974; Aghevei and Khan 1977).

In the past decade, shift to inflation targeting has herald all economies of the world and the success hinges on the ability to forecast inflation with considerable certainty. This has led to the development of many forecasting model ranging from basic regression to Vector Auto regression (VAR) to Autoregressive Integrated Moving Average to P-star model.

Based on the classical quantity theory of money, the P-star model was introduces by Hallman, Porter and Small (1981) as an inflation forecasting model which suggest that price level gravitate towards equilibrium. The conclusion of Hallman et al (1981) that the price gap is a better anchor for inflationary pressure has drawn attention to the idea of P-star model. Following the success of their work in developing a strong measure of inflation pressure in the US economy, numerous studies have applied this same model in predicting and forecasting inflation in both developed and developing countries.

While some researchers applauded the P-star model for it informative and predictive ability (Hallman, Porter and Small 1981; Qayyum and Bilquees 2005). Some have shown that the model outperforms other elementary inflation model and forecast (Hallman et al 1989, 1991; Christiano 1989; Hoeller and Poret 1991; Qayyam and Bilquees 2005; Anglingkusumo 2005; Mujeri, Shahiduzzaman and Islam 2009). Others have criticized it as having excessive dynamic behaviour and low predictability in forecasting performance (Pecchemi and Rasche 1990; Hoeller and Poret 1991; Funke and Hall 1994; Hall and Milne 1994; Vicente and Vicente 1999; Nachame and Lakshmi 2002).

Although, the P-star model has the problem of measuring potential variable of output and velocity of money circulation since they are unobservable series (Tatom, 1992; Muzafer 1997). However, it is satisfactory for long run inflation forecasting and analysis (Kool and Tatom 1994; Gerlash and Svensson 2003). Evidence from the P-star model has shown the existence of long run relationship between inflation and money growth (Tatom 1992; Todter and Reimers 1994; Kool and Tatom 1994; Svensson 1999; Frait, Komarek and Kulhane 2000; Belke and Polleit 2004; Azim and Mesut 2008) - this gives credence the proposition of the classical quantity theory of money that inflation is always and everywhere a monetary phenomenon (Friedman, 1956).

Empirical evidence from the p-star model has shown that it is satisfactory for short-run forecast although the conclusions are mixed. While some conclude that the approach yields a reasonable estimate and forecast for developed countries, others have found evidence that the estimates of the model for developing countries are poor

METHODOLOGY

The theoretical framework of this study is an outcome of the prestigious P-star model which has a substantial degree of success in both developed and developing countries. (Hallman, Porter and Small (1989, 1991), Allen and Hall (1990), Bordes, Girardin and Marimoutou (1993), Todter and Reimers (1994), Hoeller and Poret (1991), Nachane and Laxmi (2002), Todter (2002), Qayyum and Bilquees (2005) and Mujeri, Shahiduzzaman and Islam (2009)). The classical quantity theory of money is the foundation of the P-star model as demonstrated in pioneering works of Hallman et al (1989, 1991). We begin with the basic classical equation of exchange.

$$MV=PY \tag{3.1}$$

Where M is the total stock of money (Notably the broad money supply M2), V is the velocity of money circulation, P is the general price and Y is real output.

The P-star model combines the long-term and the short-term determinants of changes in the price level in the economy. It assumes that real GDP fluctuates around its full employment level and the existence of equilibrium level for income velocity of money, which can be obtained directly from the equilibrium price level in the classical equation of exchange as follows;

$$P^* = \frac{MV^*}{Y^*} \tag{3.2}$$

Where; P* is the equilibrium price level, Y* is equilibrium output and V* is the equilibrium level of income velocity. By simply letting the lower case letters denote logarithms, we can rewrite equations (3.1) and (3.2) as follows;

$$m + v = p + y \tag{3.3}$$

$$m + v^* = p^* + y^* \tag{3.4}$$

By subtracting equation (3.4) from equation (3.3), we obtain the price gap, the output gap and the velocity gap, which is usually the proxy for liquidity overhang in the economy.

$$v - v^* = (p - p^*) + (y - y^*) \tag{3.5}$$

By simply transposing equation (3.5) we obtain the price gap model as;

$$(p - p^*) = (v - v^*) - (y - y^*) \tag{3.6}$$

Where; (p - p*) is the price gap, (v - v*) is the income velocity gap or the proxy for liquidity overhang in the economy and (y - y*) is the output gap.

Equation 3.6 represents the price-gap model which is useful in predicting the movement of the inflation rate. However, before the model can be used we have to define potential GDP y* and the equilibrium velocity v*. The definition of equilibrium velocity (v*) is carried out in a way that v (t) is stationary (that is I (0)) either around a constant v_0 or around a linear trend (a + bt). In the former case, the equilibrium (log) velocity is taken as $v^* = v_0$ while the in the latter case, v* is time varying with v*(t) = (a + bt). The potential real GDP can be obtained directly if we assume that a reliable series y_1^* exist. However, we may obtain the potential output by using the same process applied in obtaining the equilibrium velocity (v*). An alternative way of obtaining the potential output is to use the Hodrick-Prescort filter approach (Hodrick and Prescot 1980). The Hodrick-Prescort filter uses the long-run symmetric moving average to de-trend the particular series-in this case the output series. It is essentially a two-sided linear filter that minimizes output from its trend;

$$Min. \sum_{t=1}^{T} \left(\ln Y - \ln Y_t^* \right)^2 \tag{3.7}$$

Subject to $\sum_{t=2}^{T-1} \left[\left(\ln Y - \ln Y_t^* \right) - \left(\ln Y_t^* - \ln Y_{t-1} \right) \right]^2 \leq e$

Specifically, the HP method chooses lnY* to

$$\text{Minimize } \sum_{t=1}^{T}\left(\ln Y - \ln Y_t^*\right)^2 + \lambda \sum_{t=2}^{T-1}\left[\left(\ln Y - \ln Y_t^*\right) - \left(\ln Y_t^* - \ln Y_{t-1}\right)\right]^2 \tag{3.8}$$

Where; Y is the actual output, Y* is a trend or potential output (GDP) at constant market price, Y_{t-1}, is one period lag values of actual output and λ is the Lagrange multiplier. The parameter λ controls the smoothness of the series variance and as λ approaches infinity, lnY* approaches a linear trend.

After obtaining the equilibrium velocity (v*) and the potential output level (y*), the value of the equilibrium price p*, is obtained by simply substituting v* and y* into equation (3.6). Depending on whether the equilibrium v* and y* is around a constant or around a linear trend we will obtain two versions of equilibrium price level P_1* and P_2*. After obtaining the equilibrium price level, we proceed to checking whether P and P* are co integrated (Engle and Granger 1987, Johansen and Juselius 1990). If cointegration is established, the equilibrium price (P*) in excess of the current price (P) indicates a future rise in inflation. However, if the equilibrium price (P*) is less than the current price (P), this indicates future deceleration of inflation. Co integration between P and P* also implies stationarity of both velocity and output gap.

The Model

The precise dynamic inflation model adopted for this study draws from the pioneering works of Hallman et al. (1991) generalizing on the earlier works of McCallum (1980) and Mussa (1981). Using Π_t to denote inflation, they postulate a general model of the form;

$$\Delta\pi_{(t)} = \alpha_o + \alpha_1\left(v_{(t-1)} - v^*_{(t-1)}\right) + \alpha_2\left(y_{(t-1)} - y^*_{(t-1)}\right) + \beta\pi_{(t-1)} + \sum_{j=1}^{q}\phi_j \Delta\pi_{(t-1)} + \varepsilon_{(t)} \tag{3.9}$$

Where, Δ operator denotes one period difference operator, q is the appropriate lag length and $\varepsilon(t)$ satisfies the white noise properties. Equation (3.9) includes a lagged inflation variable to allow for incomplete adjustment and is specified recognizing the possibility that the velocity and output gap may impinge differently on inflation changes.

From the specification in equation (3.9), we proceed to testing the coefficient of the lagged inflation variable (β), to test if β=0 using the Dickey-Fuller non-standard statistic (Dickey and Fuller 1979, Fuller 1976). The test gives rise to two separate models;

$$\Delta\pi_{(t)} = \alpha_1 + \alpha_1^{/}\left(v_{(t-1)} - v^*_{(t-1)}\right)) + \alpha_2^{/}\left(y_{(t-1)} - y^*_{(t-1)}\right) + \sum_{j=1}^{q}\phi_j^{/}\Delta\pi_{(t-j)} + \varepsilon_{(t)} \tag{3.10}$$

Equation (3.10) arises if β is insignificant. However, if β is significant we switch to the model in equation (3.9) which is presented as follows;

$$\pi_{(t)} = \alpha_2 + \alpha_1^{//}\left(v_{(t-1)} - v^*_{(t-1)}\right) + \alpha_2^{//}\left(y_{(t-1)} - y^*_{(t-1)}\right) + \sum_{j=1}^{q}\phi_j^{//}\Delta\pi_{(t-j)} + \varepsilon_{(t)} \tag{3.11}$$

Equations (3.9), (3.10) and (3.11) allows for the use of different lags chosen based on the lag length criteria-Akaike information criteria or the Schwarz criterion.

EMPIRICAL ANALYSIS

The P-Star model is designed for analyzing and forecasting long term behavior of inflation while taking account of short term changes in inflation. However, success in the use of the P* model depends largely on the quality of the frequency data used in generating the result. This poses a serious limitation for a developing country like Nigeria where in most cases some of the reported data are spliced. This limitation, notwithstanding, we utilized quarterly time series data spanning over forty years 1970-2011. The data used in generating the series was sourced directly from the Central bank of Nigeria Statistical Bulletin (CBN). The variable used includes; money supply narrowly defined (M1), nominal GDP, real GDP and implicit GDP price deflator was sourced directly from the Central Bank of Nigeria (CBN) Statistical Bulletin and Nigeria National Bureau of Statistics (NBS). We calculated the income velocity of money directly by simply taking the ratio of nominal GDP to narrow money supply (GDP/M1) given that narrow money supply is the closest proxy for measuring liquidity.

The potential output y* and equilibrium velocity v* are obtained using the Hodrick-Prescort filter approach (Hodrick and Prescot 1980) while inflation is generated by simply taking the log difference of the GDP deflator from the last quarter GDP deflator.

The first step in the empirical analysis is the construction of equilibrium velocity (V*) and potential output (Y*). We start by checking the stationarity properties of V by conducting unit root tests of the Augmented Dickey-Fuller (ADF) to establish whether V is I (0) or I (1) series. The standard procedure conducting the unit root test is the use of augmented Dickey-Fuller test (Dickey and Fuller 1979). This test requires regressing ΔV_t on a constant, a time trend, lagged previous value of V_t, (V_{t-1}) and several lag dependent variables. This is a procedure that has been set by Holden and Perron (1994).

The result of the unit root test is reported in Table 1. From the result, V (t) is stationary at levels at the 5 percent and 10 percent level of significant. Similarly, the unit root test of the output variable Y (t) was stationary at levels.

The next step after establishing the stationary properties of the variables is to test the tendency of the actual price (p) to move to its equilibrium value (P*). This is done by testing the co integrating relationship between P and P* by applying the Engel and Granger (1987) procedure.

TABLE 1
UNIT ROOT TEST FOR THE VARIABLE V(t)

	Augmented Dickey-Fuller Test	
Variables	Levels	Status
V(t)	-3.2155	I(1)
5% critical value	-2.8787**	
10% critical value	-2.5760*	

Note: The table is the result of the unit root test for the variable V(t). * and ** indicate significance at 10% and 5% level respectively.*

The result of the co integrating relationship between actual P and equilibrium P (P*) is reported in Table 3. The result shows there is a tendency for P to gravitate to its equilibrium value. Having established the co integrating relationships between the actual P value and the equilibrium P value, we continue to estimating the dynamic inflation model. First, we need to establish whether the model should be estimated in inflation levels (Π_t) or inflation change ($\Delta\Pi_t$).

TABLE 2
UNIT ROOT TEST FOR THE VARIABLE Y (t)

Augmented Dickey-Fuller Test		
Variables	Levels	Status
Y(t)	-3.2639	I(1)
5 % critical value	-3.4369**	
10% critical value	-3.1426*	

Note: The table is the result of the Augmented Dickey-Fuller (ADF) unit root test for the variable Y (t). ** and ** indicate significance at the 10% and 5% level respectively.*

This last step requires estimating equation (3.9) and testing the coefficient of the lagged inflation variable (Π_{t-1}) (β), to test the null hypothesis that β=0 against the alternative hypothesis using the Dickey-Fuller non-standard statistic (Dickey and Fuller 1979, Fuller 1976).

TABLE 3
RESULT OF CO INTEGRATION (P AND P*)

Variables	Augmented Dickey Fuller (ADF)		
	Actual Value	Critical Value	
		5 (%)	1 (%)
P* and P	-5.7880***	-2.8792	-3.4709

*Note: The table is the result of the Augmented Dickey-Fuller (ADF) which indicates that the series is stationary at levels. *** indicates significance at 1% level.*

The result of the estimation of equation (3.9) is reported in Table 4. The result rejects the hypothesis that β=0 given the significance of the coefficient of the lag inflation variable (Π_{t-1}). The significance of the coefficient means we adopt equation (3.11) and drop the model in its change form ($\Delta\Pi_t$). This is seen in the result reported in Table 4 where it the coefficient of the lag inflation variables passes the test of significance at the 5 percent levels.

TABLE 4
P* MODEL OF EQUATION DYNAMICS. DEPENDENT VARIABLE ($\Delta\Pi_t$)

Independent Variables	Coefficients	T-Stat
$V_{(t-1)} - V^*_{(t-1)}$	-19.5598	-2.1539**
$Y_{(t-1)} - Y^*_{(t-1)}$	35.6375	5.0758***
(Π_{t-1})	-0.4371	-2.4350**
($\Delta\Pi_{t-1}$)	-0.4381	-3.0135
($\Delta\Pi_{t-2}$)	-0.3340	-3.0109***
($\Delta\Pi_{t-3}$)	-0.2591	-3.4696***
Constant	1.0615	0.7255
R^2 (adjusted)	0.5876	
Durbin-Watson	2.0716	

*Note: The table is the result of dynamic change in inflation model. Where *** and ** indicate significance at 1% and 5% levels of significance.*

So far, we have been able to establish and generate the P* model. The model has three parts: the price-gap (p - p*), the velocity gap (v - v*) and the output gap (y - y*). A positive velocity gap simply implies that current velocity (V) is greater than equilibrium velocity (V*) and hence the tendency is for V to fall. In the case of output–gap, a positive output gap (Y > Y*) simply indicates a decline in output to it equilibrium level.

Given the adopted model, equation (3.11), a positive velocity gap and a negative output gap implies that inflation is decelerating while a negative velocity gap and a positive output gap indicate a strong expectation for prices to rise.

The result of the price-gap, velocity-gap and output-gap models is reported in Table 5. On the basis of apriori signs, the velocity-gap and the output-gap is expected to be negatively and positively signed respectively. The result reported in Table 5 shows that velocity gap and the output gap have the correct sign, both passing the test at 5 and 1 percent levels respectively base on the t-test. From the result, the value of the coefficient of the output gap in the price-gap model is greater than the value of the coefficient of the velocity-gap variable in absolute terms.

The implication of this result is that inflation in Nigeria is not purely a monetary phenomenon but rather driven by output and structural rigidities. Although, the adjusted coefficient of determination performed poorly, but the F-statistic passed the test of significance at the 1 percent levels of significance an indication that the overall price-gap model has a good fit. The success in the price-gap model in explaining inflation dynamics simply shows solving the challenges of rising prices in Nigeria requires a hybrid of the neo-classical output-gap framework and the monetarist velocity-gap framework.

TABLE 5
P* MODEL OF EQUATION DYNAMICS. DEPENDENT VARIABLE (Π_T)

Independent Variables	Price-gap Model	Velocity-gap Model	Output-gap Model
$V_{(t-1)} - V^*_{(t-1)}$	-18.4322	-13.6035	
	(-1.9766)**	(-1.4089)	
$Y_{(t-1)} - Y^*_{(t-1)}$	24.0980		22.4944
	(3.9218)***		(3.6596)***
$(\Delta\Pi_{t-1})$	-0.0264	-0.0513	-0.0329
	(-0.4122)	(-0.7711)	(-0.5097)
$(\Delta\Pi_{t-2})$	-0.0705	-0.1085	-0.0729
	(-0.9481)	(-1.4076)	(-0.9625)
$(\Delta\Pi_{t-3})$	-0.1311	-0.1547	-0.1253
	(-2.0404)**	(-2.3147)**	(0.0549)
Constant	2.2456	2.1264	2.2059
	(0.7255)	(-0.1547)	(1.5049)
R^2 (adjusted)	0.1000	0.0181	0.0835
Durbin-Watson	1.8252	1.9642	1.8245
F-Statistic	39.4708***	1.7490	4.6903***

*Note: The table is the result of price-gap, velocity-gap and the output-gap model. The t-values are reported in parenthesis. *** and ** indicate significance at 1% and 5% levels of significance.*

To check the validity of the Output-gap and the velocity-gap model we estimated the models separately with both results reported in Table 5. The result shows the output-gap model performed significantly better than the velocity gap-model. The implication of this result for Nigeria is that inflation is not purely a monetary phenomenon in Nigeria and as such the use of interest rate and money supply to check volatility in the general price level may not produce the desired result.

CONCLUSION

The P* model though a tremendously powerful forecasting tool has been used successfully in modeling price movement in developing and developed countries alike. Success in the use of the P* star model depends on the quality of the data and the frequency of the data used. The result obtained from the study shows the price-gap model is useful for analyzing and predicting price movement in Nigeria. This position strongly supports a combination of the neo-classical output-gap framework and the monetarist velocity-gap framework. The study strongly refutes the notion that inflation is purely a monetary phenomenon as is evident in the poor performance of the velocity gap model.

The study question the rationale for the Central Bank continuous use of monetary aggregates (interest rate and money supply) to check volatility in the general price level.

REFERENCES

Aghevei, B. & Khan, M. S. (1977). Inflationary Finance and the Dynamics of Inflation: *Anwkan Economic Review*, 67.

Allen C. & Hall, S.G., (1990). Money as a Potential Anchor for the Price Level: A critique of the P* Approach. *Mimeo London Business School, London.*

Anglingkusumo, R. (2005). Money-Inflation Nexus in Indonesia: Evidence from a P-Star Analysis. *Tinbergen Institute Discussion Papers Series* 054, No. 4.

Azim, K.O & Mesut, S. (2008). Monetary Pressures and Inflation Dynamics in Turkey: Evidence from P-Star Model. *Research and Monetary Policy Department, Central Bank of the Republic of Turkey Working Papers.*

Belke A. & Polleit, T. (2004). A model for Forecasting Swedish Inflation. *University of Hohenheim, discussion paper No. 246.*

Bernanke, B.S (2005). Inflation in Latin America-A New Era. *Remarks at the Stanford Institute for Economic Policy Research Economic summit*, February 11 2005.

Bordes, C.E., Girardin & Marimoutou, V. (1993). An Evaluation of the Performance of the P-star as an Indicator of Monetary Conditions in the perspectives of EMU: The Case of France. *In P. Arestis (ed), Money and Banking Issues for The Twenty-first Century, St. Martin's Press*, New York.

Christiano, L.J. (1989). P*: Not the Inflation Forecaster's Holy Grail. *Federal Reserve Bank of Minneapolis, Quarterly Review* 13, 3–18.

Dickey D.A. & Fuller, W. A., (1979). Distribution of the Estimator for Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association*, 75, (1), 427-431.

Frait, J., Komárek, L., & Kulhánek, L. (2000). P-star-model based analysis of inflation dynamics in the Czech Republic. *University of Warwick Department of Economics, Warwick economics research papers*.

Friedman, M. (1956). The Quantity Theory of Money: A Restatement" in Studies in the Quantity Theory of Money. *University of Chicago Press*.

Friedman, M. (1963). Inflation: Causes and consequences. *New York: Asia Publishing House*.

Friedman, M. (1968). The Role of Monetary Policy. *American Economic Review*, 58, 1-17.

Friedman, M. (1970). A Theoretical Framework of Monetary Analysis. *Journal of Political Economy*, 78, 193-238.

Friedman, M. (1971). A Monetary Theory of Nominal Income. *Journal of Political Economy*, 79, 323-337.

Fuller, W.A. (1976). Introduction to Statistical Time Series. *Wesley, New York*.

Funke, M. & Hall, S. (1994). Is the Bundesbank Different from Other Central Banks: A Study Based on P*. *Empirical Economics*, 19, 691-707.

Gerlach, S. & Svensson, L.E.O (2003). Money and Inflation in the Euro Area: A Case for Monetary Indicators. *Journal of Monetary Economics*, 50, 1649-1672.

Hall, S. & Milne, A. (1994). The Relevance of P-Star Analysis to UK Monetary Policy. *Economic Journal*, 104, 597-604.

Hallman, J. J., Porter, R. D. & Small, D. H. (1989). M2 per Unit of Potential GNP as an Anchor for the Price Level. *Federal Reserve System, Staff Study* No. 157.

Hallman, J. J., R. D. Porter, & D. H. Small, (1991). Is the Price Level Tied to the Stock of M2 in the Long-run? *American Economic Review* 81, 841–858.

Haque, U.N. & Qayyum, A. (2006). Inflation Everywhere a Monetary Phenomenon: An introductory Note. *The Pakistan Development Review*, 45, (2), 179-183.

Hodrick, R.J. & Prescott, E.C. (1980). Post-War US Business Cycles: An Empirical investigation. *Evanston, Illinois: Centre for Mathematical studies in economics and management Science, Northwestern University*, Discussion paper 451.

Hoeller, P. & Poret, P. (1991). Is P-Star a Good Indicator of Inflationary Pressure in OECD Countries? *OECD Economic Studies* 17.

Kool, C., & Tatom, J. (1994). The P-Star Model in Five Economies. *Federal Reserve Bank of St. Louis Review,* 3.

Mujeri, M. K., Shahiduzzaman, MD. & Islaam MD. E. (2009). Application of the P-star Model for Measuring Inflationary Pressure in Bangladesh, *The Bangladesh development studies*, 32, (1), retrieved from http://mpra.ub.uni-muenchen.de/2058/

Muzafer Shah Habibullah (1997). Can the P-star Approach be used to model inflation in Indonesia? Some empirical evidence, *Ekonomidankeuangan Indonesia*, 14, (3).

Nachane, D.M. & Lakshmi, R. (2002). Dynamics of Inflation in India- A P-Star Approach. *Journal of Applied Economics*, 34, (1), 101-110.

Pecchenino, R. A., & Rasche, R. H. (1990). P* Type Models: Evaluation and Forecasts. *National Bureau of Economic Research*, Working Papers Series, 3406.

Qayyum, A. & Bilquees, F. (2005). P-Star Model: A Leading Indicator of Inflation for Pakistan. *Pakistan Development Review*, 44, (2), 117-129.

Svensson, L.E.O. (1999). Does the P* Model Provide any Rationale for Monetary Targeting*? National Bureau of Economic Research,* Working Paper Series, 7178 http://ideas.repec.org/a/fip/fedlrv/y1994imayp11-29.html

Tatom A. John (1992). The P-Star Model and Austrian Prices. *The Federal Reserve Bank of St. Louis* working paper series 001. Retrieved from http://www.medwellonline.net/ref.php?doi=javaa.2009.2461.2467

Thirwall, A. P. (1 974). Inflation, Saving and Growth in Developing Economics. *London, Macmillan*.

Tödter, K. H., & Reimers, H. E. (1994). P-star as a Link between Money and Prices in Germany. *Review of World Economics*, 130, (2), 273-289.

Todter, K.H. (2002). Monetary Indicators and Policy Rules in the P-Star Model. *Deutsche Bundesbank*, Discussion papers series 18.

Vicente, J. P., & Vicente, E. (1999). The P-Star Model and Its Performance for the Spanish Economy. *University of Valencia, Department of Economic Application,* working paper 11.

Http://en.wikipedia.org/wiki/Monetarism