Philippine Management Review 2015, Vol. 22, 35-52.

Regime Switching in Inflation Targeting Under Conditions of Public Debt in the Philippines

Noli R. Sotocinal*
Senior Economics Officer, Economics and Research Department, Asian Development Bank

A standard inflation targeting framework assumes the absence of fiscal dominance, and abstracts from the effects of unbalanced fiscal positions and public debt financing. This assumption is relaxed by adding the notion of a fiscal gap into the standard inflation targeting model. The financing of fiscal gaps is assumed to be largely implemented through the creation or retirement of public debt, which then affects the premium levied on Philippine interest and exchange rates in the international and domestic capital markets. A Markovian Regime Switching Vector Autoregression model based on an extended inflation targeting system under the presence of a fiscal gap and public debt is specified and estimated using Philippine data. The research reveals that the fiscal gap significantly impacts on the target variables in the inflation targeting system and directly affects the short-term interest rate contrary to the standard assumption of zero fiscal dominance. Furthermore, there is evidence of the existence of interest rate regimes, such that activist fiscal policies in the low output regimes are only effective in the short term, as their impact on interest rates are larger and tend to lead to interest rate increases beyond those intended by the monetary authorities. The research's findings support the notion that effective macroeconomic management requires some degree of policy coordination between the monetary and fiscal authorities.

1 Introduction

The government's monetary policy has bearing on the interest and inflation rate expectations of the private sector, as it impacts on the term structure of interest rates, the cost of capital, and ultimately investments. Inflation targeting is a monetary policy framework that utilizes short-term interest rates as a nominal anchor to influence inflation expectations of private sector agents. It started to become prevalent in 1990s as countries like New Zealand, Australia, Canada, the United Kingdom, Sweden, Finland and Spain formally adopted the framework in the conduct of monetary policy. The Philippines initially adopted the framework in a less formal and implicit manner prior to its explicit adoption in 2002.

This research extends the characterization of the Philippines' inflation targeting behavior in an open economy specification. An empirical specification based on a Dynamic Neo-Keynesian framework of a small open economy with representative consumers, tradable and nontradable goods, a fiscal authority, a central bank, and monopolistically competitive firms is developed and empirically tested.

The framework typology is extended and includes a measure of fiscal dominance to capture the effects of deviations from the benchmark of a standard inflation targeting framework. Baseline models assume that the only source of distortion in the economy is the market power of monopolistically competitive firms. It is argued that this is not true for most, if not all, economies especially during periods of economic and financial disruptions. It is observed, behaviorally, that fiscal authorities in fact intervene during recessions and in periods of excessive shocks in an attempt to cushion losses in economic welfare. The empirical issue at hand is how the monetary authorities' policy footing and behavior is affected by such policy actions.

The remaining sections of the paper are organized as follows. Section 2 presents a review of literature on inflation targeting and discusses briefly the channels and impact of public debt. Section 3 extends the standard inflation targeting model to one that includes an exogenously determined fiscal gap that impacts on the output gap and uncovered interest parity. It also introduces a specification under the assumption that Markov Switching regimes exist in the endogenous variables of the system

* Correspondence: nrsotocinal@gmail.com

and briefly discusses the underlying hypotheses made in the conduct of this research. Section 4 presents the sources of data, the data transformations, the key trends in movements of relevant variables, and the results of the unit root tests. Section5 presents the results of the Markov Switching VAR estimation procedure, and Section 6 concludes the paper.

2 The Literature on Inflation Targeting and the Impact of Public Debt

Inflation targeting links inflation expectations to explicitly stated inflation targets and uses short term interest rates as the nominal policy anchor. Key to the framework is the monetary authority's transparency and credibility in order to more effectively influence private sector inflation expectations.

The use of inflation targeting requires certain preconditions (see Masson, Savastano, & Sharma (1997); Kongsamut (1999); and Neto, Araujo, & Moreira, 2000). First among the requirements is a *high degree of independence* in the conduct of monetary policy. Masson et al. (1997) notes that this is synonymous to the absence of fiscal dominance, and that public sector debt and the reliance on seignorage are kept to a minimum. A second requirement involves the *absence of a commitment to the use of some other nominal anchor* other than the short term interest rate, the exchange rate included. Masson et al. (1997), Kongsamut (1999) and Neto et al. (2000) stress the need for credibility as a key prerequisite for inflation targeting. Other requirements include relatively developed capital markets (Masson et al., 1997) and the existence of requisite institutional infrastructure (Mishkin, 2004).

Svensson (2000), who presented compelling arguments for the inclusion of the exchange rate and other foreign variables into the inflation targeting framework, argued that it plays in essential role in the transmission mechanism of monetary policy. The exchange rate as an asset price also embodies international shocks and movements in foreign inflation and interest rates, as well as the exchange rate risk premium[1]. He estimated a model of a small open economy characterized by a forward looking Phillips Curve, an expected output gap equation relative to the natural level, a real interest parity condition that is derived by combining the uncovered interest parity condition and the purchasing power parity condition, and an interest rate rule that is linear in all of the predetermined variables. Parrado (2004) extended Svensson's model by explicitly including microfoundations to the Svensson specification using a Dynamic Neo-Keynesian Approach and replicates the Svensson experiment of simulating the model economy with the end of view of assessing the optimality of alternative policy regimes.[2]

The Svensson and Parrado open economy models, like all standard inflation targeting models, implicitly assumed that government continuously balances its budget and that the pressure for excessive public debt and seignorage introduce neither instances of fiscal dominance nor pressures on interest rate policy as intended by the monetary authorities. Frankel (2010) affirmed Mishkin's (2004) earlier assertions and noted in a recent survey of monetary policy in emerging economies that there is a need to use separate models for developing countries since they tend to have less developed institutions and lower monetary authority credibility compared to industrialized economies. Frankel (2010) also argued that the volatility arising from supply and demand shocks in confluence with structural rigidities in the trade sector and domestic macroeconomic and political instability are likewise more pronounced in developing economies. These contribute to the typically higher default risk that is observed for developing economies, such that even if such economies pursue sound macroeconomic policies there is a degree of debt intolerance resulting in higher interest rates even with slight increases in debt.[3] The higher default risk is typically embedded in inflation targeting

---

[1]This is particularly important in times of severe economic and international crisis, when the "pricing" behaviour of agents may have more prominence in the transmission channel from exchange rates to monetary policy. Basurto and Ghosh (2000) present a model of this transmission mechanism in the context of the Asian Financial Crisis of 1997. Golinelli and Rovelli (2001) employed the same specification and applied it in the context of inflation targeting systems.

[2]The Parrado model is similar to the model of inflation targeting with micro foundations proposed by Gali and Monacelli (2005), and reproduced in Chapter 7 of Gali (2008).

[3]See Frankel (2010).

models by augmenting a default risk premium in the Uncovered Interest Parity Condition.[4] Blanchard (2004) asserted that debt levels and the probability of default are related in a non-linear fashion, and that there exists a threshold level of debt where the risk of default begins to introduce a perverse relationship between nominal and real interest rates, the rate of local currency depreciation, and inflation.

The presence of fiscal pressures in the conduct of standard inflation targeting models raises the possibility that monetary efforts may be rendered ineffective when inflationary pressures emanate from the fiscal side of the macroeconomy. Deficit spending and public debt is a feature found in most economies, even in developed ones. Standard inflation targeting models assume governments to have balanced budgets, and in effect assume away the implications of public debt for inflation targeting.

Most central banks that employ flexible inflation targeting take into account the exchange rate, the output gap and the inflation rate when setting policy rates. Parametric shifts in the relative weights accorded to the above interest rate rule variables have been empirically shown to have occurred for the Philippines.[5] Creel and Hubert (2008) found evidence of periodic regime switches in Canada, Sweden and the UK towards and during these countries' adoption of inflation targeting. These empirical studies indicated that the relative weights accorded by the monetary authorities to the above mentioned variables could vary with political regimes as well as the overall state of the macroeconomy. Filardo and Greenberg (2010) noted that while inflation targeting central banks normally implement nominal interest changes so as to meet their inflation targets, they may also be concerned with subpar economic growth, hence the observed asymmetry in deviations from inflation targets. This implies that monetary authorities could exhibit shifts in behavior depending on the certain threshold levels of the endogenous variables. These behavioral switches could be modelled through Markov switching regimes.

The point of departure for linking fiscal dominance and its impact on the effectiveness of inflation targeting lies in the exchange risk premium. Blanchard (2004) noted that an increase in real interest rates encourages the inflow of foreign capital and tends to induce a real appreciation of the local currency. In some cases, however, he argued that increases in real interest rates could also increase the risk of debt default, and instead induce depreciation as a perverse outcome. This in turn adds to inflationary pressure, especially if the country is dependent on tradable goods. When the probability of default is a function of debt and real interest rates, the default probabilities shift with increases in real interest rates and could instead result in currency depreciation.

The literature covering inflation targeting under conditions of fiscal imbalances and public debt finance shows that there are channels by which fiscal actions significantly affect the conduct of monetary policy. These channels are through the impact of public debt on the currency exchange risk premium, and through their impact on inflation expectations.

3 An Inflation Targeting Model with Public Debt

The standard inflation targeting model has four equations composed of the aggregate demand equation (AD), an expectations augmented Phillips curve or aggregate supply equation (AS), the risk-adjusted uncovered interest parity condition (UIPC), and a Taylor rule (ITR)[6].The following standard inflation targeting system follows Parrado (2004), with some minor modifications. The equations are broadly similar to the Svensson model except for added microfoundations used to derive the underlying inflation targeting model equations.

$$AD: \quad y_t = E_t(y_{t+1}) + \phi_\pi E_t(\pi_{H,t+1}) - \phi_e E_t(e_{t+1} - e_t) - \phi_i i_t + \mu y_t^* + \varepsilon_{y,t} \tag{1}$$

$$AS: \quad \pi_t = \lambda \pi_{H,t} + (1-\lambda)\omega(e_t - e_{t-1} + p_t^* - p_{t-1}^*) + \varepsilon_{\pi,t} \tag{2}$$

[4]See for example Basurto and Ghosh (2000), Golinelli et al. (2001) and Parrado (2010)
[5]See Sotocinal (2010).
[6]The ITR form followed here is originally presented in Clarida, Gali, and Gertler (1999).

$$UIPC:\ i_t = i_t^* + E_t(e_{t+1} - e_t) + \varphi_t \tag{3}$$

$$\varphi_t = \eta_0 + \eta_1\varphi_{t-1} + \varepsilon_{\varphi,t} \tag{4}$$

$$ITR:\quad i_t = \rho_i i_{t-1} + \kappa_\pi E_t(\pi_{t+k}) + \kappa_y y_t + \kappa_e e_t + \varepsilon_{i,t} \tag{5}$$

where

y_t	is the output gap of the country at time t
y_t^*	is the output gap for the rest of the world at time t
$\pi_{H,t}$	is the inflation rate for "home goods[7]" at time t
e_t	is the nominal exchange rate at time t
i_t	is the nominal interest rate at time t
$q_t = e_t + p_t^* - p_{H,t}$	is the real exchange rate at time t
π_t	is the inflation rate at time t
$\pi_{F,t}$	is the inflation rate of imported goods at time t
i_t^*	is the foreign interest rate
φ_t	is the risk premium on domestic interest rates

In the AS equation, the parameter λ is the share of nontradeable goods in the domestic economy. The parameter ω is added to capture the pass through rate of changes in prices of imported intermediate and consumption goods. The parameter $\omega(1-\lambda)$ defines what may be called as imported inflation, which is the composite effect of foreign price movements and devaluations of the local currency. The AS equation incorporates the Calvo price setting behavior of monopolistically competitive firms, such that the inflation rate of domestically produced goods is a function of expected price adjustments, and hence inflation, in the succeeding period.[8]

The uncovered interest parity condition defines the relationship between the nominal interest rate to the exogenous variable i_t^*, the expected devaluation or appreciation rate of the domestic currency, and the risk premium attached to local currency denominated debt in the global capital markets. Any shift in regimes or in the conduct of policy would be indicated by statistically significant changes in the parameter estimates of κ_π, κ_y and κ_e. Parametric shifts in equation (5), when they occur, is evidence of a shift in policy focus of the monetary authorities and could be driven by several factors.

While standard inflation targeting models assume the absence of fiscal dominance, it is argued that it could exist in the presence of excessive public debt, and that regime shifts in fiscal policy could either reduce or reinforce the objectives of the monetary authorities. This in turn would generally diminish the level of overall effectivity of monetary policy under an inflation targeting framework. Fiscal stimulus financed through seignorage tend to be inflationary in the long run, while excessive issuance of public debt will tend raise to interest rates beyond the targets set by the monetary authorities. While there is an argument for policy coordination between the government treasury and the monetary authorities to optimize the combined effects of fiscal and monetary policy, this runs counter to the independence requirement of inflation targeting.

To account for the potentially significant impact of fiscal dominance on the conduct of inflation targeting, deviations from the long run government spending is added into the aggregate demand equation specified in equation (1).

$$y_t = E_t(y_{t+1}) + \phi_\pi E_t(\pi_{H,t+1}) - \phi_e E_t(e_{t+1} - e_t) - \phi_i i_t + \phi_g g_t + \mu y_t^* + \varepsilon_{y,t} \tag{1'}$$

The term g_t in equation (1′) is the government spending equivalent of the output gap. It is defined as the deviation of government spending from its long term level implied by its sustainable level of its primary deficit[9]. Its presence in the aggregate demand equation is meant to capture any potential acceleration in fiscal spending in response to current and expected output downturns. Substantial

[7]Home goods are defined in the model as domestically produced goods.
[8]See Calvo (1983).
[9]Romer (2000) defined the primary deficit as the difference between total government spending and its tax intake.

increases in fiscal spending over and above its equilibrium levels shall invariably affect the output gap. The direct impact of countercyclical fiscal spending during economic and financial crises is explicitly accounted for in the above specification. It is expected that ϕ_g is negative if the government strictly conducts countercyclical policies. However, the value and direction of ϕ_g could be asymmetric, especially if the government opts to increase spending permanently such that it does not lower its spending outlays after any crisis event. Accommodative fiscal policies and budget setting processes on the part of government could result in such an asymmetry and should be differentiated from the conduct of a strictly countercyclical policy.

The variable g_t can be thought of as a fiscal budget gap defined by:

$$g_t = \tau_t Y_t - \left(G_t - \tilde{G}_t\right) + (r_t + \delta_t) B_{t-1}$$

Gt is the fiscal expenditure at time t, $\tilde{G}_t$ is the level consistent with a balanced fiscal budget, B_{t-1} is the stock of public debt in period $t-1$, r_t is the pay-off from holding government debt, and δ_t is the debt retirement rate at time t. When output falls below or is above the natural output level, it is possible that the fiscal authorities deviate from $\tilde{G}_t$ in response to the output gap.The above presupposes that the government follows an activist fiscal policy, and sets fiscal spending in a countercyclical manner. If $Y_t < \tilde{Y}_t$, it increases fiscal spending and decreases it otherwise.

When governments embark on fiscal policies that result in unsustainable deficits, this often results in some costly correction at some future date, if not a debt crisis. In such a scenario, public debt as a percentage of gross domestic product tends to increase to a level and the risk premium on domestic interest rates also increases and affects both consumption and investment activity.

To capture the impact of deficit spending and its effect on domestic interest rates, the following modification is introduced to equation (4), which is the risk premium attached to the UIPC:

$$\varphi_t = \eta_0 + \eta_1 \varphi_{t-1} + \eta_d d_t + \varepsilon_{\varphi,t} \qquad (4')$$

The variable d_t is the increase or decrease of the government's debt at time t, net of debt repayments on maturing loans. It is expected to positively affect the risk premium on the returns from holding all domestic currency denominated assets. An increase in the risk premium tends to proportionately increase the domestic interest rate via the uncovered interest parity condition. Note also that in the above model specification, an increase in government deficit is financed only through the issuance of public debt instruments such that $g_t = d_t$.[10]

The following equations characterize the extended inflation targeting model, inclusive of the identities which relate endogenous and predetermined variables as well as the as yet undefined forward looking variables which are likewise endogenously determined.

$$y_t = E_t(y_{t+1}) + \phi_\pi E_t\left(\pi_{H,t+1}\right) - \phi_e E_t(e_{t+1} - e_t) - \phi_i i_t + \phi_g g_t + \mu y_t^* + \varepsilon_{y,t} \qquad (1')$$

$$\pi_{H,t} = \beta E_t\left(\pi_{H,t+1}\right) + \gamma_y y_t + \gamma_q q_t + \varepsilon_{\pi H,t} \qquad (2')$$

$$\pi_t = \lambda \pi_{H,t} + (1 - \lambda)\omega(e_t - e_{t-1} + p_t^* - p_{t-1}^*) + \varepsilon_{\pi,t} \qquad (2)$$

$$i_t = i_t^* + E_t(e_{t+1} - e_t) + \varphi_t \qquad (3)$$

$$\varphi_t = \eta_0 + \eta_1 \varphi_{t-1} + \eta_d d_t + \varepsilon_{\varphi,t} \qquad (4')$$

$$i_t = \rho_i i_{t-1} + \kappa_\pi E_t(\pi_{t+k}) + \kappa_y y_t + \kappa_e e_t + \varepsilon_{i,t} \qquad (5)$$

[10] The specification could be expanded such that, where the latter is the increase in government expenditure financed thru an increase in the money supply. This shall however necessitate the addition of another equation specifying the relationship between money supply and short term interest rates. This line of modeling shall however not be pursued in this paper, as it contravenes the practice of inflation targeting.

$$q_t = p_t^* + e_t - p_t \tag{6}$$

$$p_t = p_{t-1} + \pi_t \tag{7}$$

$$d_t = g_t \tag{8}$$

$$E_t(y_{t+1}) = E[y_{t+1}|I_t] \tag{9}$$

$$E_t(\pi_{H,t+1}) = E[\pi_{H,t+1}|I_t] \tag{10}$$

$$E_t(e_{t+1}) = E[e_{t+1}|I_t] \tag{11}$$

$$E_t(\pi_{t+k}) = E[\pi_{t+k}|I_t] \tag{12}$$

The endogenous variables are $y_t, E_t(y_{t+1}), \pi_{H,t}, E_t(\pi_{H,t+1}), \pi_t, E_t(\pi_{t+k}), p_t, i_t, e_t, E_t(e_{t+1}), q_t, \varphi_t$ and d_t. The predetermined variables at time t are $e_{t-1}, \varphi_{t-1}, i_{t-1}$ *and* p_{t-1}. The system's exogenous variables are $y_t^*, i_t^*, p_t^*, p_{t-1}^*$ *and* g_t. It is assumed that each of the error terms $\varepsilon_{y,t}, \varepsilon_{\pi_{H,t}}, \varepsilon_{\pi_t}, \varepsilon_{\varphi,t}, \varepsilon_{i,t}$ are independently and identically distributed with zero means and constant variance.

The identities specified in equations (6) to (8) close the system in the sense that it allows for invertibility of the coefficient matrix of endogenous variables, and hence a fully identified system of equations is obtained. Equations (9) to (12) are incompletely specified. These simply assert that the monetary authorities exhibit strong form rational expectations[11] with respect to the forward looking variables $y_{t+1}, \pi_{H,t+1}, \pi_{t+k}$ *and* e_{t+1} given the prevailing information I_t at time t, which is composed of the current and past observed values of all exogenous and predetermined variables and error terms. Following Fuhrer and Moore's approach[12], we assume that $E_t(x_{t+j}) = x_t$ such that $E\left(E_t(x_{t+j})\right) = E(x_t) = \mu_x$ for any stationary series x with white noise errors. This condition is invoked such that all forward looking variable values are naive forecasts of current period observations.

The extended inflation targeting system is used to determine the existence of Markovian regime switches in periods of excessive swings in the output gap, inflation expectations and exchange rates. The possibility of significant changes in the monetary authorities' conduct of monetary policy with respect to inflation or output gap targets in the presence of domestic demand or supply shocks are of particular interest. In addition, external supply shocks and imported inflation that operate through the exchange rate channel are also expected to affect the interest rate target. In particular, the arguments of the interest rate rule in equation (5) could therefore be regime switching variables as the monetary authorities alter their priorities in response to changes in expectations or in reaction to political pressure. Markovian switching in the priorities and weights accorded to the three arguments in the interest rate rule appear as discrete jumps in the coefficient values.

The avenues for Markovian switching are not confined to the arguments in the interest rate rule. Note that the fiscal authorities are postulated to carry out activist policies depending on the size of the output gap. It is possible that this level of activism and its effectivity varies across political regimes[13] as well as the extent of the output gap. This would manifest as a Markovian switch in the parameter ϕ_g in equation (1′). Discrete jumps in ϕ_g are possible and were thought to be driven by the effectives of stimulus programs, which could vary across political administrations.

Government stimulus programs that show up as increases in g_t raise the budgetary outlay of the government, and proportionately increases public debt in the absence of seignorage and under the

[11] See Tesfatsion (2009).
[12] See Fuhrer and Moore (1995).
[13] This argument presupposes that different political administrations systematically approach output gaps in distinctly different ways and, as such, vary in their efficiency and effectivity in the execution of countercyclical policies.

assumption that the *ex-ante* fiscal balance is neutral. This inevitably affects the currency exchange rate through the uncovered interest rate parity condition specified in equations (3) and (4′), which in turn affects the short term interest rate. Secondary pressures on local interest rates are channeled through the risk premium in the uncovered interest rate parity condition, since increases in public debt could positively affect it. It should also be noted that the impact on the risk premium in so far as increases in public debt is concerned may also be piecewise non-linear and may exhibit regime switching relative to the values of d_t. In any case, the above model specification, inclusive of the possibility of regime switching in the models' parameters, allows the researcher to test for the presence and assess the impact of fiscal dominance, which is presumed absent in standard inflation targeting models.

Estimates of the structural parameters of the inflation targeting model with public debt show that g_t and d_t exert statistically significant effects on the output gap and the risk component of the interest parity condition.[14] Given these findings, it is of interest to test whether the system has endogenous shifts in its parameters.

The inflation targeting model with public debt could be written in a Markov Switching Vector Autoregressive (MS-VAR) form consistent with Krolzig's MS(M)-VARX(1) form[15]. Allowing for Markov switching in all parameters, the inflation targeting model with public debt could be written in its structural form as:

$$\Theta_0(s_t)Y_t = \Phi(s_t)E_tY_{t+1} + \Theta_1(s_t)Y_{t-1} + \Omega_0(s_t)X_t + \Omega_1(s_t)X_{t-1} + U_1(s_t) \quad (13)$$

$$E_tY_{t+1} = \Pi_0(s_t) + \Pi_1(s_t)Y_t + U_2(s_t) \quad (14)$$

where Y_t is the vector of all endogenous variables at time t, X_t is vector of exogenous parameters at time t, U_1 and U_2 are error term vectors, and $\Theta_0, \Theta_1, \Omega_0, \Omega_1, \Phi, \Pi_0, \Pi_1$ are parameter matrices. Specifically,

$$Y_t = \left[y_t \pi_{H,t} \pi_t p_t i_t e_t q_t \varphi_t d_t\right]'$$
$$E_tY_{t+1} = \left[E_t(y_{t+1})E_t(\pi_{H,t+1})E_t(\pi_{t+k})E_t(e_{t+1})\right]'$$
$$X_t = [e_{t-1}\varphi_{t-1}i_{t-1}p_{t-1}y_t^* i_t^* p_t^* p_{t-1}^* g_t]'$$

The variable s_t in parenthesis is the regime shift indicator variable. Note that by allowing the parameters of the system of equations defined by (13) and (14) to exhibit regime switching, the model becomes a Markov Switching Rational Expectations (MSRE) model of the form consistent with those presented by Farmer, Waggoner, and Zha (2008)[16]. The reduced form of which may be written as:

$$Y_t = B^{-1}\Phi\Pi_0(s_t) + B^{-1}\Theta_1(s_t)Y_{t-1} + B^{-1}\Omega_0(s_t)X_t + B^{-1}\Omega_1(s_t)X_{t-1} + B^{-1}(U_1 + \Phi U_2)(s_t) \quad (15)$$

where $B = \Theta_0 - \Phi\Pi_1$. Since it was assumed that the individual error terms are independently and identically distributed with mean zero and constant variances, it follows that their linear combinations in $(U_1 + \Phi U_2)$ are likewise independently and identically distributed with zero means and constant variance. This specific assumption shall be statistically tested and if necessary, the alternative MS(M)H-VARX(1) shall be specified, effectively taking into account heteroscedasticity in the error terms. In any case, the reduced form equation (15) is the measurement equation for the state-space representation of a Markov switching system.

Following Krolzig, the measurement equation may itself be rewritten as:

$$Y_t = B^{-1}\Phi\Pi_0\varepsilon_t + B^{-1}\Theta_1Y_{t-1}\varepsilon_t + B^{-1}\Omega_0X_t\varepsilon_t + B^{-1}\Omega_1X_{t-1}\varepsilon_t + B^{-1}(U_1 + \Phi U_2)\varepsilon_t \quad (16)$$

---

[14]Sotocinal (2014) used a three-staged least squares estimation procedure (3SLS) to verify the statistical significance of the structural parameters of the inflation targeting model with public debt. The choice of 3SLS over full information maximum likelihood (FIML) alternatives is largely due computational convenience and the argument that it is just as efficient as FIML without the assumption of normality of error terms.

[15] See Krolzig (1997).

[16]The authors discuss Minimal State Variable (MSV) the necessary and sufficient conditions for the existence of stable and unique solutions to MSRE models.

where $\varepsilon_t = [I(s_t = 1) \; ... \; I(s_t = M)]'$, and M is the number of possible regimes.
Furthermore, the state equation is defined as:

$$\varepsilon_{t+1} = P\varepsilon_t + \xi_{t+1} \tag{17}$$

where

$$P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1M} \\ p_{21} & p_{22} & \cdots & p_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ p_{M1} & p_{M2} & \cdots & p_{MM} \end{bmatrix}$$

is the transition probability matrix and $\xi_{t+1}$is assumed to be identically and independently distributed with zero mean and constant variance.

Since Y_t in equation (16) is a vector of endogenous variables, each of its elements may be written in the following form for each of the endogenous variables in the inflation targeting model with public debt:

$$y_{i,t} = \beta_0(s_t) + \sum_{k=1}^{p} \left[\sum_{i=1}^{n} \beta_{ki}(s_t) y_{i,t-k} + \sum_{j=1}^{m} \beta_{kj}(s_t) x_{j,t-k} \right] + \varepsilon_{i,t}$$

where *p* is the number of lags, *i* is an index for the *n* endogenous variables and *j* is for the *m* exogenously determined ones. The specified inflation targeting model with public debt is essentially described with the above specification albeit with restrictions of the form $\beta_{1i} = \beta_{2j} = 0$ for some or all of the regimes.

Prior to the estimation of a Markovian switching inflation targeting system with public debt, descriptive analyses of the data and unit root tests will be conducted to present secular trends and ensure that these are trend stationary.

Since the primary focus of the research is on the impact of adding fiscal dominance aspects and public debt to a standard inflation targeting model, it is argued that simplifying the system to include only headline inflation rates would not deter the attainment of research objectives and at the same time allow for a wider sample period. The latter is viewed to be critical for assessing the presence of Markov Switching in the system's parameters and obtaining sufficient degrees of freedom in estimation. This necessitates abstracting from the notion of core inflation rate targeting and merely focusing on headline inflation rates. The modeling implications requires a substitution of the hypothesized core inflation equation defined by equation (2) into the headline inflation equation, which is in turn defined by equation (3), and removing the expectations of core inflation from the model. Hence, equation (3) could be rewritten as:

$$\pi_t = \gamma_y^* \cdot y_t + \gamma_q^* \cdot q_t + \gamma_e^* \cdot (e_t - e_{t-1} + p_t^* - p_{t-1}^*) + \varepsilon_{\pi,t}^* \tag{3'}$$

where $\gamma_y^* = \frac{\lambda\gamma_y}{1-\beta\rho_{\pi H}}$. $\gamma_q^* = \frac{\lambda\gamma_q}{1-\beta\rho_{\pi H}}$, $\gamma_e^* = (1-\lambda)\omega$, and $\varepsilon_{\pi,t}^* = \lambda\left(\varepsilon_{\pi_{H,t}} + \beta\theta_{\pi_{H,t}}\right) + \varepsilon_{\pi,t}$.

The above modification reduces the fully specified model's equations from thirteen to eleven, and the number of behavioral equations from six to five. The number of forecasting equations is likewise reduced from four to three. Furthermore, since it is assumed that $E_t(x_{t+j}) = x_t$, the forecasting equations are rendered trivial in the estimated model.

In order to test for the presence of endogenous parametric shifts and characterize the various inflation targeting regimes in the Philippines, we follow Krolzig (1997) and utilize the state-space representation of the inflation targeting system with public debt as presented in the previous section of this paper. For purposes of parsimony, we limit the set of endogenous variables in the Markov Switching VAR model to the output gap, the inflation rate, the depreciation rate, and the short term nominal interest rate, and set the exogenous variables for the MS-VAR model estimation to fiscal gap, the foreign output gap, and foreign interest rate.

The scaled down specification should suffice for purposes of testing the presence inflation targeting regimes, the impact of fiscal dominance, and the effectivity of fiscal actions over the past three decades in relation to the output gap and the conduct of monetary policy. The results of the Markov Switching VAR estimation procedure is presented and discussed in Section5.

4 Data Sources, Definitions and Underlying Trends

The list of data series used in the econometric analyses were obtained from the National Statistical Coordinating Board (NSCB), Bangko Sentral ng Pilipinas (BSP) and the Department of Finance.

The output and government expenditure gaps are computed by taking the logarithms of ratios between the actual quarterly real gross domestic product and real government expenditure data with their respective long run trend series.[17] The latter series were in turn obtained by deseasonalizing the actual data with the X.11 procedure and filtered using the Hodrick-Prescott procedure in Eviews 7.0. The output and fiscal gap series are therefore percentage deviations from the long run stationary trends underlying the actual data series.[18]

The Philippine headline inflation rates were computed on a year-on-year basis from the quarterly consumer price index data obtained from the NSCB. The economic data series for the United States are used as proxies for global output gaps, prices and interest rates[19] and, as mentioned earlier, only headline inflation measured through the consumer price index was used in the estimated model. The short term interest rates used for model estimation were the 91-day Treasury bill rates for the Philippines and the United States. The real exchange rate q_t is estimated by taking logarithms of the peso exchange rate and the consumer price indexes of the Philippines and the United States.

All data series included in the analyses are logarithmically transformed. The sample period used for estimating the model is confined to 1990 to 2010. While the BSP formally adopted inflation targeting as a monetary policy framework in 2002 only, the intervening period from 1990 to 2001 was included in the sample to extend the number of data points and ensure that there is sufficient degrees of freedom for model estimation and statistical inference.[20]

The charts of the logarithmically transformed endogenous and exogenous variables in the extended inflation targeting system is presented in Figure 1 to provide some perspective as regards the secular trends in the data. The Peso-U.S. Dollar exchange rate exhibits a secular depreciation up to 2000, after which a slight long-term appreciation became the norm, except for an episode of substantial depreciation in 2009. Philippine inflation rates seem to have two distinct periods of secular decline in the sample period. They exhibit a relatively steep long term decline from the late 1980s to early 2000s was followed by a relatively flatter declining trend from 2002 to 2010.The Philippine nominal short term interest rates, on the other hand, exhibit a relatively flat downward trend from 1987 to the late 1990s before experiencing a rapid decline from 1999 to 2002, before finally resuming their gradual downward trajectory from 2002 onwards. There were, however, substantial dips in the interest rate in 2007 and 2010.

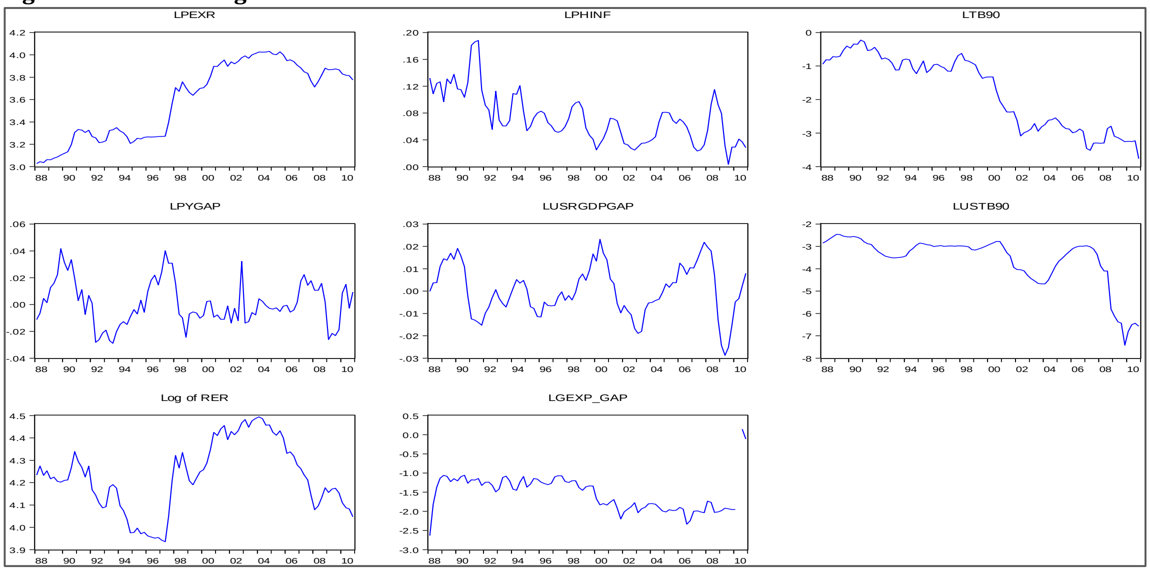
[17] Real government expenditures were obtained by dividing the nominal government data series with the implicit price deflator.

[18]An alternative estimator the output gap involves obtaining theory-based estimates of the output potential and the long-run balanced fiscal expenditure levels implied by the full employment output potential and fiscal revenue regime, and computing the percentage difference of the actual output and fiscal expenditure levels. In the absence of such estimates, the statistical method was resorted to.

[19] Ideally, a weighted average of economic time series of the Philippines' major trade partners should have been used.

[20]See BSP (2013).

Figure 1. Charts of Log Transformed Variables



Note: LPEXR=log of Peso-U.S. dollar exchange rate, LPHINF=log of the Phil. Inflation Rate, LTB90=log of Phil. 90-day T-Bill Rate, LPYGGAP=log of the Phil. Output Gap, LUSRGDPGAP=log of U.S. Output Gap, LUSTB90=log of the U.S. 90-day T-bill Rate, RER=Phi. Peso-U.S. Dollar Real Exchange Rate, LGEXP_GAP=Phil. Fiscal Spending Gap

The Philippine output gap seems to move cyclically from 1987 to 1997. It went substantially negative in the wake of the Asian Financial Crisis in 1998, and then remained largely negative from 2000 to 2006. It was above potential from 2006 to 2010, except for about three quarters between 2008 and 2009 when the country experienced some negative spillover effects of the Global Financial Crisis.

The Philippine Peso-U.S. dollar real exchange rate was appreciating during 1988 to 1997 and from 2004 to 2010. The first episode of secular gains in the price-adjusted value of the peso relative to the U.S. dollar is attributable to relatively flat nominal depreciations and substantial reductions in Philippine inflation, whereas the later episode is attributable to an environment of muted inflation in confluence with nominal appreciations. The real depreciation in 1997 to 2004 is due to the successive exchange market pressure on the Philippine peso due to the Asian financial crisis in 1997 and the technology bubble adjustment in 2002-2003. Lastly, the long-term, albeit gradual, decline in real government expenditures is evident in the chart of the Philippine fiscal expenditure gap in Figure 1. The decline in the fiscal gap is much faster in 1997-2002 though, as fiscal space became more constrained during the successive periods of crises in that period.

The foregoing narrative on data trends point to non-stationarity in the data and the likely presence of unit roots. Table 1 summarizes the results of Augmented Dickey-Fuller tests on variables in the extended inflation targeting model.

Table 1. ADF Statistics

	Augmented Dickey Fuller Statistics
Philippine Output Gap	-5.718016***
Phil. Headline Inflation Rate	-1.302718
Phil. Exchange Rate	-1.593138
Phil. 90-Day T-Bill Rate	0.355591
Phil. Fiscal Spending Gap	-4.414016***
Phil. Real Exchange Rate	-1.547589
U.S. Output Gap	-4.491141***
U.S. 90-Day T-Bill Rate	-2.115145

* - significant at .10,** - significant at 0.05,*** - significant at 0.01

Under the null hypothesis that the variable in question has a unit root, the gap variables are stationary as indicated by their respective Augmented Dickey Fuller test statistics. The Philippine Inflation, Interest Rate, Nominal Exchange and Real Rates, and the U.S. T-bill rates have unit roots. It is critical therefore that the error terms of the estimation be diagnosed and checked for statistical independence and homoscedasticity, in order to examine whether the arguments in the model equations exhibit co-integration.[21] The MS-VAR models used for testing the presence of endogenous structural shifts in model parameters were also slightly modified to include the peso depreciation rate rather than the level of the exchange rates because of the presence of a unit root in peso-dollar exchange rates.

5 Estimated MS-VAR Models and Regimes

As mentioned in Section 3, the set of endogenous variables in the Markov Switching VAR model is limited to the output gap, the inflation rate, the depreciation rate, and the short-term nominal interest rate, while the exogenous variables are the fiscal gap, the foreign output gap, and foreign interest rate.

Two reduced form specifications of the extended inflation targeting model were estimated using Krolzig's expectations maximization algorithm as implemented in the Ox Console 3.4 software. The only difference between the two specifications is the exclusion of the real exchange rate in the second specification. The motivation for excluding the real exchange rate in the second specification is largely due to the likelihood of high multicollinearity between the real exchange rate, the Philippine and U.S. inflation, and Philippine exchange rate. Because of data constraints, only two-regime specifications with 4 quarter lags were estimated for both specifications.

The results of the Markov Switching Vector Autoregression Model estimation procedure are not presented anymore because of space constraints but will be made available upon request.

Table 2 shows the cumulative lag effects of inflation to a unit increase in nominal depreciation. It is negative for both regimes, contrary to expectations that the impact of a nominal depreciation to be positive or zero. Also, the impulse response of the output gap to an increase in nominal interest rates is positive in both regimes – a result that runs counter to theory. Multicollinearity in the right hand side variables is suspected to be significant enough such that it is necessary to omit one or more variables from the analysis. The choice of omitting the real exchange rate is based on its high correlation with the exchange rate, its redundancy since it is a function of the nominal exchange rate and inflation rate, and its absence in the theoretical form of the interest rate response equation.

It is noted that the estimates of the coefficients of the MSIA-VARX(4) model without the real exchange rate are all consistent with theory. A comparison of the cumulative effects of each right hand side variable's lagged terms[22] in the two models is shown in Table 2.The greyed out areas indicate inconsistency with expected signs based on standard theory.

Table 2. Sign of Cumulative Lagged Effects of Right Hand Side Variables

	With Real Exchange Rate								**Without Real Exchange Rate**							
	Regime 1				**Regime 2**				**Regime 1**				**Regime 2**			
	y_t	π_t	de_t	i_t	y_t	π_t	de_t	i_t	y_t	π_t	de_t	i_t	y_t	π_t	de_t	i_t
y_t	-	+	+	+	-	-	-	+	0	-	+	+	+	-	+	+
π_t	-	+	+	+	-	+	+	-	-	+	+	+	-	+	+	+
de_t	+	-	-	-	+	-	-	+	-	-	-	+	-	0	-	-
i_t	+	+	+	+	+	-	-	+	0	+	-	+	+	0	+	+
g_t	-	-	-	-	-	+	+	+	+	-	+	+	+	+	-	+
y^*_t	+	+	+	-	+	+	0	+	0	+	-	-	+	+	-	-
i^*_t	0	-	-	+	+	-	+	+	-	-	-	+	0	+	+	+
q_t	-	+	+	+	-	+	+	-	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

[21]Co-integration should result in identically and independently distributed residuals under the condition that the variables with unit roots have the same order of integration. See Danao (2002), p. 337.

[22]The cumulative lagged effects are computed as the sum of a given variable's lagged terms, and correspondents to the impulse response function of that variable.

The theoretical inconsistencies center on the depreciation and short term interest rate, as well as the fiscal gap in the Markov Switching VAR model that contains the real exchange rate as an exogenous variable. Hence, we focus on the results of the MSIA-VARX(4) model without the real exchange rate. There are two distinct regimes, largely differentiated by the magnitude of the output gaps and their distances from the overall sample mean. One is characterized as recessionary, with the output level and gap considerably below the sample mean, while the other has output gaps that are largely positive and lies above the sample average. The estimated MS-VAR equations all have fairly high coefficients of determination ranging from 0.95 to 0.99.

Table 3. Regime Properties and Transition Probabilities

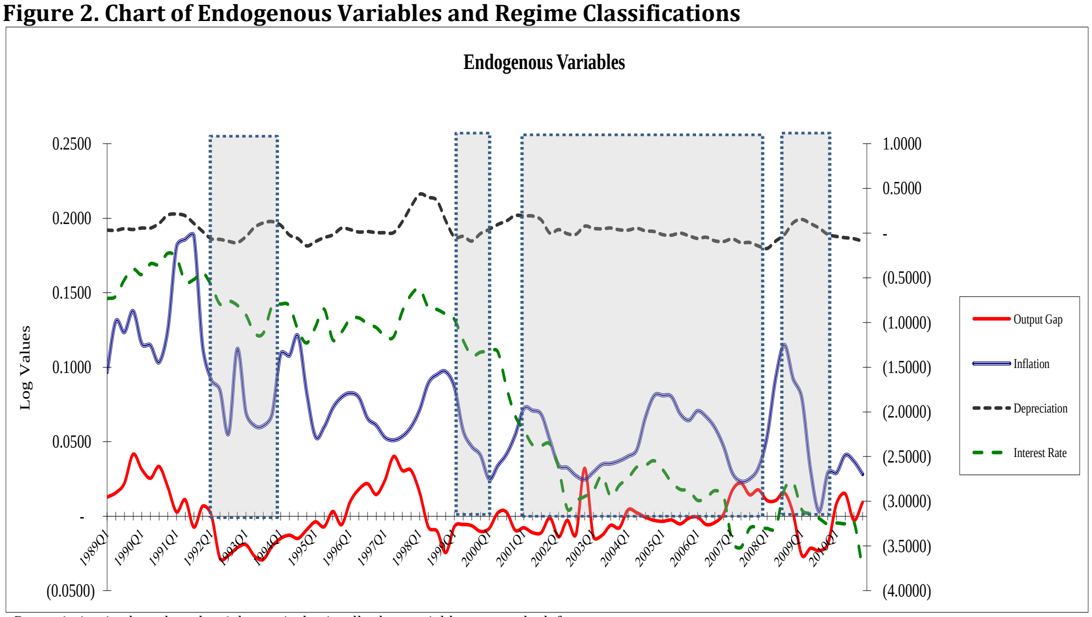
	Number of Observations	Probability	Duration	Transition Probabilities	
				Regime 1	Regime 2
Regime 1	47	0.607	15.02	0.9334	0.0666
Regime 2	38	0.393	9.72	0.1028	0.8972

Table 3 shows the regime properties for the sample, which covers the first quarter of 1989 to first quarter of 2010. Each regime appears to exhibit persistence. Sub-periods with below average output have a long average duration of 15 quarters and periods of high economic activity last only 10 quarters on average. The regime transition probabilities matrix indicate that the chances of remaining in a low output environment in succeeding quarters is at 0.93, and that of remaining in a high output environment is around 0.90. The probability of a reversal from a low output environment to one of rapid economic activity and vice-versa is only 0.07 and 0.10, respectively.

Figure 2 shows a chart of the extended inflation targeting system's endogenous variables and the regime classifications. From the chart, it is apparent that there are more periods classified under the low output regime, at least relative to the statistically computed potential. Characterizing regime differences is also not so straightforward and not immediately discernible by looking at the chart of endogenous variables alone.

To differentiate between regimes, the endogenous variables' regime sub-period means are compared to the full sample mean and their relative distances computed. Table 4 shows the estimated regimes' sub periods, and the sub-sample means of the system's endogenous and exogenous variables, and the distance of the subsample means from the full sample mean.

Figure 2. Chart of Endogenous Variables and Regime Classifications



Depreciation is plotted on the right vertical axis; all other variables are on the left
Shaded areas correspond to Regime 1 periods (regimes with output below average potential)

Regime 1 is largely characterized by periods of below average output, with the average output gaps lower than the mean of the full sample. The output gaps are all below the estimated potential output, except for Q2 2001 to Q2 2008 where it was slightly above. Note, however, that the output gap during this period is still below the sample average.

Table 4. Regime Sub-Periods and Distances from Full Sample Mean

Period	Output Gap	Inflation Rat	Depreciatio	Interest Rat	Fiscal Gap	US Output Ga	US Interest Rat
Full Sample Mean	0.0008	0.0702	0.0348	(1.8262)	(1.5336)	0.0001	(3.6165)
Sample Mean							
Regime 1							
1992Q2-1993Q4	(0.0244)	0.0731	0.0010	(0.9049)	(1.2671)	(0.0040)	(3.4654)
1999Q2-2000Q1	(0.0083)	0.0375	(0.0171)	(1.3418)	(1.4488)	0.0131	(2.9849)
2001Q2-2008Q2	0.0002	0.0515	(0.0024)	(2.8652)	(1.9407)	0.0014	(3.7363)
2008Q4-2010Q1	(0.0132)	0.0441	0.0639	(3.1200)	(1.9585)	(0.0185)	(6.4957)
Regime 2							
1989Q1-1992Q1	0.0166	0.1314	0.0814	(0.4697)	(1.1706)	0.0029	(2.7204)
1994Q1-1999Q1	0.0039	0.0768	0.0695	(0.9708)	(1.2526)	(0.0019)	(3.0263)
2000Q2-2000Q4	(0.0015)	0.0434	0.1439	(1.6998)	(1.8211)	0.0180	(2.8040)
2008Q3-2008Q3	0.0157	0.1149	(0.0167)	(2.8649)	(2.0292)	0.0071	(4.1044)
2010Q2-2010Q4	0.0072	0.0354	(0.0677)	(3.4145)	0.0170	0.0023	(6.5038)
Distances from Full Sample Mean							
Regime 1							
1992Q2-1993Q4	(0.025)	0.003	(0.034)	0.921	0.267	(0.004)	0.151
1999Q2-2000Q1	(0.009)	(0.033)	(0.052)	0.484	0.085	0.013	0.632
2001Q2-2008Q2	(0.001)	(0.019)	(0.037)	(1.039)	(0.407)	0.001	(0.120)
2008Q4-2010Q1	(0.014)	(0.026)	0.029	(1.294)	(0.425)	(0.019)	(2.879)
Regime 2							
1989Q1-1992Q1	0.016	0.061	0.047	1.357	0.363	0.003	0.896
1994Q1-1999Q1	0.003	0.007	0.035	0.855	0.281	(0.002)	0.590
2000Q2-2000Q4	(0.002)	(0.027)	0.109	0.126	(0.288)	0.018	0.812
2008Q3-2008Q3	0.015	0.045	(0.052)	(1.039)	(0.496)	0.007	(0.488)
2010Q2-2010Q4	0.006	(0.035)	(0.103)	(1.588)	1.551	0.002	(2.887)

Regime 2 is characterized by above average output gaps with the domestic economy performing significantly above potential. As in the case of Regime 1, however, the regime classification is imperfect: the average output gap for Q2 2000 to Q4 2000 is negative and below average, but the period has been classified as belonging to Regime 2. An examination Figure 2 reveals that the output gap from Q1 1994 to Q1 1996 is below potential, yet this has been classified as a period under Regime 2.

Inflation rates during the recessionary regime are relatively low as expected, and except for Q2 1992 to Q4 1993, are below the average inflation rate for the entire sample. This finding is consistent with theory, since low output gaps normally lead to low inflation environments. While relatively below average compared to sub periods in the other regime, inflation in regime 1 generally reflects the secular decline in inflation over the entire sample period. Unlike the typically low inflation record during Regime 1 periods, Regime 2 inflation appears mixed, almost evenly falling below the whole sample's average as above it. In fact, except for Q3 2008, it was also below the sample average from Q2 2000 to Q4 2010. This may be due to the relatively high inflation rates in the 1990s and the substantial declines in inflation from the end of the 1990s up to 2010.

The average peso depreciation rates for all Regime 1 sub-periods are generally low, except for Q4 2008 to Q1 2010 when it posted a relatively high depreciation rate of 6.4%. All of the other sub-periods had depreciation rates that are lower or close to the overall average of the sample. This is likely due to the relatively low aggregate demand that prevailed in periods that are characterized by the first regime, which translated into lower pressure on the peso to depreciate against the U.S. dollar with the concomitant low demand for importation. Regime 2 sub-periods, unlike the low output regime, show mixed results in the pattern of depreciation. While regime 2 is characterized by periods of rapid peso depreciation up to 2000 (i.e., Q1 1989 to Q1 1992, Q1 1994 to Q1 1999, and Q2 2000 to Q4 2000), the other two periods classified under regime 2 show an appreciating peso (i.e., Q3 2008 and Q2 2010 to Q4 2010). The mixed results found in the regime classifications, especially from 2008 to 2010, coincides with the 2008-2009 global financial crisis and the U.S. Federal authorities' adoption of an accommodative monetary policy stance. The regime switching algorithm employed in this study seems to have failed in isolating the effects of the change in some exogenous variables (i.e., the U.S. output gap and short term interest rate) on depreciation rate regimes of the Philippine peso.

The differences between interest rates across regimes are not easily discernible by inspection alone. The secular, albeit fluctuating, decline in short term interests makes it difficult to differentiate the underlying policy environments. The long-term downward trend in inflation undoubtedly allowed for the continuous easing of short term domestic interest rates, and although not immediately seen, there are subtle differences in the implicit interest rate rules that are being followed by the monetary authorities.

The lower half of Table 4 shows the difference of regime period means of interest rates from the overall sample mean. Note that the adjacent regime 1 and 2 means show that interest rates are typically higher in Regime 2. The same pattern prevails for the adjacent regime mean inflation rates, where Regime 2 inflation means are typically higher than Regime 1 means for adjacent regime sub-periods. These are consistent with theory, since Regime 2 is characterized by higher than average output levels and a symmetrically opposing environment characterizes Regime 1.

The parameter estimates for Regime 1 and impulse response function in Table 5 show a relatively slight bias accorded towards containing the inflation rate, with quarterly movements in the short term interest rates tending to cancel each other within a span of one year. This suggests a tendency towards small, temporary reactions to movements in both the output gap and inflation rate in low output gap environments. The response to output gaps and inflation in Regime 2 sub-periods are much more activist, judging from the larger magnitudes of the parameter coefficient estimates and impulse responses, and still biased towards controlling inflation. *There is some asymmetry in the behavior of the central bank during low and high output environments. It tends to intervene more during high output, high inflation environments than it does during periods of low economic activity*. Our findings suggest that the central bank seems to accord more importance to inflation, and does not pursue accommodative monetary policies when the output gap is low or negative. Both regimes indicate a relatively high persistence of short term interest rates, with impulse responses tending to settle at around 0.70.

The cumulative interest rate response to peso depreciation rates is slightly negative in the long run, with the magnitude slightly higher during Regime 1 sub-periods. The impulse response values are also smaller than those for the output gap and inflation rate. The negative and smaller impact on interest rates is consistent with the central bank's declared policy of allowing the Philippine peso at market consistent levels, and not intervening in the currency markets.

An interventionist exchange rate policy would be reflected by large, positive coefficients of depreciation rates in the estimated interest rate equation. The results of the MS-VAR estimation procedure suggest that the Bangko Sentral ng Pilipinas tends to be less interventionist in the foreign currency markets.

The fiscal expenditure gap tends to increase the short-term interest rate beyond the intended increases of the central bank. The impulse response functions indicate that the cumulative effects of increases in the fiscal expenditure gap on the interest rate are also bigger during Regime 1 sub-periods, when the output gap tends to be below the historical average. Thus, *any accommodative monetary policy actions by the central bank which tends to lower the interest rate is offset by the interest raising effects of fiscal expenditure increases beyond what it's historical trend average value.* The contemporaneous increase in output and the closure of the output gap with increases in the fiscal gap during low output regimes declines in the long run as seen from the coefficients of the output gap equation for Regime 1. The long-run impulse response of the output gap to increases in fiscal expenditures beyond the long run average is negative, presumably due to the long-run increase in interest rates attributable to fiscal gap increases.

The asymmetry in the Bangko Sentral's response to the output gap across different regimes is once again highlighted, particularly in the low output regime. Any acceleration in fiscal expenditures to stimulate economic activity raises output contemporaneously as seen in the output equation, but eventually raises the interest rate and leads to a decline in output in the long run. This is evident from the impulse response function of g_t on y_t during Regime 1 periods as shown in Table 5.

Table 5. MS-VAR Coefficients and Impulse Response Functions

	ESTIMATED COEFFICIENTES AND IMPULSE RESPONSES															
	Regime 1		Regime 2		Regime 1		Regime 2		Regime 1		Regime 2		Regime 1		Regime 2	
	$y_{t,reg\,1}$	cum y=db(x)	$y_{t,reg\,2}$	cum y=db(x)	$dp_{t,reg\,1}$	cum dp=db(x)	$dp_{t,reg\,2}$	cum dp=db(x)	$de_{t,reg\,1}$	cum de=db(x)	$de_{t,reg\,2}$	cum de=db(x)	$di_{t,reg\,1}$	cum di=db(x)	$di_{t,reg\,2}$	cum di=db(x)
c	-0.0917		0.1068		-0.4197		0.407		0.7275		-1.7068		0.9387		0.4444	
y_{t-1}	0.0138	0.014	-0.0056	(0.006)	-0.8199	(0.820)	0.6161	0.616	1.2437	1.244	0.5048	0.505	0.604	0.604	-0.6154	(0.615)
y_{t-2}	-0.1947	(0.181)	0.3115	0.306	0.0051	(0.815)	-0.1904	0.426	0.1243	1.368	2.9744	3.479	0.3515	0.956	0.4244	(0.191)
y_{t-3}	0.009	(0.172)	0.1625	0.468	0.2614	(0.553)	-0.6397	(0.214)	-0.9478	0.420	4.2487	7.728	-0.1874	0.768	2.7696	2.579
y_{t-4}	0.0407	(0.131)	0.3100	0.778	0.3651	(0.188)	-0.0437	(0.258)	-0.1736	0.247	1.238	8.966	-0.3872	0.381	-0.5233	2.055
p_{t-1}	-0.0052	(0.005)	0.0987	0.099	0.4323	0.432	0.1256	0.126	0.5609	0.561	2.1187	2.119	0.9128	0.913	4.6072	4.607
p_{t-2}	-0.2124	(0.218)	0.0372	0.136	0.306	0.738	1.0119	1.138	-0.3779	0.183	-0.5521	1.567	0.4635	1.376	-3.7426	0.865
p_{t-3}	-0.0023	(0.220)	-0.2307	(0.095)	-0.5025	0.236	-0.6707	0.467	-0.5894	(0.406)	-1.1812	0.385	-0.599	0.777	-0.3503	0.514
p_{t-4}	0.0183	(0.202)	0.0651	(0.030)	-0.127	0.109	-0.2979	0.169	0.6164	0.210	-0.9097	(0.524)	-0.1759	0.601	2.2683	2.783
de_{t-1}	0.0041	0.004	-0.0622	(0.062)	-0.1549	(0.155)	0.0908	0.091	0.4684	0.468	-0.1901	(0.190)	-0.0722	(0.072)	-0.4282	(0.428)
de_{t-2}	-0.1546	(0.151)	-0.0314	(0.094)	0.031	(0.124)	-0.1361	(0.045)	-0.8752	(0.407)	0.8183	0.628	0.3993	0.327	0.8058	0.378
de_{t-3}	0.0979	(0.053)	0.0108	(0.083)	-0.081	(0.205)	0.1446	0.099	-0.467	(0.874)	-0.6307	(0.002)	-0.3229	0.004	-0.6419	(0.264)
de_{t-4}	0.0287	(0.024)	-0.0664	(0.149)	0.1345	(0.070)	-0.1096	(0.010)	-0.1587	(1.033)	-0.4518	(0.454)	-0.0444	(0.040)	-0.0152	(0.280)
i_{t-1}	0.0239	0.024	-0.0198	(0.020)	-0.0111	(0.011)	-0.2032	(0.203)	0.1758	0.176	0.5678	0.568	0.7703	0.770	1.3503	1.350
i_{t-2}	-0.0035	0.020	-0.0049	(0.025)	0.3237	0.313	0.2056	0.002	-0.6766	(0.501)	-0.1467	0.421	-0.0876	0.683	-0.6202	0.730
i_{t-3}	0.0242	0.045	-0.0046	(0.029)	-0.0818	0.231	0.0199	0.022	0.1792	(0.322)	-0.2481	0.173	0.0245	0.707	-0.1729	0.557
i_{t-4}	-0.0275	0.017	0.0403	0.011	-0.0691	0.162	0.008	0.030	0.1149	(0.207)	0.0499	0.223	-0.01304	0.694	0.1441	0.701
g_t	0.0233	0.023	0.0148	0.015	-0.0841	(0.084)	0.0759	0.076	0.0642	0.064	-0.2846	(0.285)	-0.0041	(0.004)	-0.1197	(0.120)
g_{t-1}	-0.0278	(0.005)	0.0032	0.018	0.1244	0.040	-0.0495	0.026	0.1442	0.208	-0.0842	(0.369)	0.1168	0.113	-0.0074	(0.127)
g_{t-2}	0.0202	0.016	-0.0345	(0.017)	-0.0732	(0.033)	0.0063	0.033	-0.3145	(0.106)	0.2391	(0.130)	1.1267	1.239	1.5792	1.452
g_{t-3}	-0.0241	(0.008)	0.0666	0.050	0.0136	(0.019)	0.3435	0.376	0.0624	(0.044)	-0.9031	(1.033)	-0.5322	0.707	-1.6863	(0.234)
g_{t-4}	-0.0687	(0.077)	-0.023	0.027	-0.4211	(0.440)	-0.1925	0.184	0.729	0.685	0.2894	(0.743)	0.1539	0.861	0.7313	0.497
y^*_t	-0.3639	(0.364)	0.1532	0.153	0.9824	0.982	-0.918	(0.918)	-4.488	(4.488)	0.4741	0.474	-0.9481	(0.948)	-1.8806	(1.881)
y^*_{t-1}	0.311	(0.053)	0.6185	0.772	-0.586	0.396	-1.1525	(2.071)	3.2164	(1.272)	10.3923	10.866	1.6915	0.743	13.8061	11.926
y^*_{t-2}	0.1259	0.073	0.933	1.705	-1.1289	(0.733)	3.6903	1.620	-2.4546	(3.726)	-7.8314	3.035	-2.2086	(1.465)	-7.8481	4.077
y^*_{t-3}	-0.0891	(0.016)	-1.037	0.668	2.7841	2.052	1.897	3.517	4.733	1.007	-11.403	(8.368)	-0.1985	(1.664)	-10.1493	(6.072)
y^*_{t-4}	0.5477	0.532	-0.8881	(0.220)	-0.7712	1.280	-0.6645	2.852	-3.1729	(2.166)	8.0633	(0.305)	-3.1931	(4.857)	4.8613	(1.211)
i^*_t	0.0048	0.005	0.0342	0.034	-0.0315	(0.032)	-0.1101	(0.110)	-0.0021	(0.002)	-1.0593	(1.059)	0.027	0.027	-0.1584	(0.158)
i^*_{t-1}	-0.0063	(0.002)	-0.0617	(0.028)	0.012	(0.020)	-0.0269	(0.137)	0.0243	0.022	0.8366	(0.223)	0.0032	0.030	0.8057	0.647
i^*_{t-2}	0.0026	0.001	-0.0441	(0.072)	0.0269	0.007	-0.0676	(0.205)	0.0175	0.040	0.9416	0.719	-0.0215	0.009	-0.1796	0.468
i^*_{t-3}	0.009	0.010	0.0994	0.028	-0.0213	(0.014)	0.127	(0.078)	-0.005	0.035	-0.3159	0.403	0.0065	0.015	-0.5337	(0.066)
i^*_{t-4}	-0.0109	(0.001)	-0.0121	0.016	-0.0065	(0.020)	-0.0186	(0.096)	-0.0317	0.003	-0.7507	(0.348)	0.0355	0.051	0.182	0.116

Lastly, the interest rate response in reaction to movements in the U.S. output gap and short term interest rates is mixed, and no discernible differentiating patterns between the two regimes governing the Philippine macroeconomy is concerned.

6 Conclusion

The regime switching vector autoregression model estimation procedure confirms the existence of regimes, which are largely driven by the level of the output gap. Parameter estimates imply that the Bangko Sentral has a relative bias towards inflation and is less concerned about the output gap. It tends to give a higher weight to the output gap during periods where the output gap is positively large, but it does not significantly respond to periods where the output gap has large negative values. This suggests that the Bangko Sentral does not lower interest rates in response to weak economic growth. A similarly asymmetric response to inflation is noted during periods of economic boom, with the reaction to inflation being much greater during periods of positive output gaps relative to the weight accorded to inflation during low output regimes.

Increases in the fiscal gap yield short-run benefits to output levels during low output regimes, but have the long-run tendency to further aggravate negative output gap levels. This is mostly caused by the tendency for the fiscal gap to raise interest rates in the long-run during negative output gap regimes. During high output regimes with large positive output gaps, increases in the fiscal gap raises both output and inflation in the long-run, and tends to raise interest rates as well. The impact of acceleration in fiscal expenditures over its long run trend level is an increase in short-term interest rates in the long run, regardless of prevailing regimes. Thus, large increases in public expenditures beyond what are considered balanced and sustainable tends to subvert the interest rate objectives of the monetary authority. This suggests the possibility of fiscal dominance over the conduct of monetary policy.

The key findings support the notion of discretionary inflation targeting, where monetary authorities adjust the weights accorded to inflation and the output gap contingent on the underlying macroeconomic environment. In the case of the Philippines, the research points to the seeming conservatism of the monetary authorities by implicitly according more emphasis on inflation rather than the output gap even during regimes characterized by below average output gaps. There is also evidence that the BSP switches to a higher gear in so far as inflation targeting is concerned during regimes with higher than average output gaps and inflation, as evidenced by the higher magnitude of the estimated interest rate response function's coefficient attached to inflation. The findings are consistent with standard prescriptions of flexible inflation rate targeting frameworks. Furthermore, the low importance placed on peso exchange rate movements relative to inflation and the output gap is consistent with the market driven approach to exchange rate policy.

The results of provide some evidence pointing towards the existence of fiscal dominance in the Philippines, the impact of which has differing magnitudes during low and high output regimes. In particular, larger fiscal expenditure gaps during periods of low economic activity as government conduct fiscal stimulation have positive effects on short term interest rates. This could potentially offset whatever accommodative policies the central bank does, and renders the fiscal stimulus inutile over time.

The interplay between fiscal expenditures, short term interests and output needs to be considered in the conduct of monetary policy, even if the primary framework being used is inflation targeting. Policy coordination between the monetary authorities and fiscal policy-makers is just as necessary in the effective conduct and management of the macroeconomy under inflation targeting as in other policy frameworks. This finding is again consistent with the stated position of the BSP in so far as the need of policy coordination with other agencies of the Philippine government.[23] While institutional independence still remains important in the conduct of either policy, the magnitude of policy actions and their timing should be coordinated in order to arrive at better outcomes.

[23]Policy coordination with fiscal policy bodies is explicitly stated in BSP (2013).

References

Bangko Sentral ng Pilipinas. (2013). *Primer on inflation targeting*. Philippines: Department of Economic Research, Bangko Sentral ng Pilipinas.

Basurto, G., & Ghosh, S. (2000). *The interest rate-exchange rate nexus in the Asian crisis countries* (IMF Working Paper 2000-19). Available at SSRN: http://ssrn.com/abstract=879355

Blanchard, O. (2004). *Fiscal dominance and inflation targeting: Lessons from Brazil* (National Bureau of Economics Research Working Paper No. 10389). Available at http://www.nber.org/papers/w10389

Calvo, G. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics, 12*(3), 383-398.

Clarida, R., Gali, J., & Gertler, M. (1999). The science of monetary policy: A new Keynesian perspective. *Journal of Economic Literature, 37*(4), 1661-1707.

Creel, J., & Hubert, P. (2008). Has the adoption of inflation targeting represented a regime switch? Empirical evidence from Canada, Sweden and the UK. Retrieved from Sciences Po Publications Info:hdl:2441/9543, Sciences Po.

Danao, R. (2002). *Introduction to statistics and econometrics*. Quezon City: University of the Philippines Press.

Farmer, R., Waggoner, D., & Zha, T. (2008). *Minimal state variable solutions to Markov switching rational expectations models* (Working Paper 2008-23). Georgia: Federal Reserve Bank of Atlanta.

Filardo, A., & Greenberg, H. (2010). *Targeting inflation in the Asia Pacific: Lessons from the recent past* (BIS Discussion Paper No. 52). Available at http://www.bis.org/publ/bppdf/bispap52m.pdf

Frankel, J. (2010). *Monetary policy in emerging markets: A survey* (National Bureau of Economics Research Working Paper No. 16125). Available at http://www.nber.org/papers/w16125

Fuhrer, J. C., & Moore, G. R. (1995). Inflation persistence. *Quarterly Journal of Economics, 440*, 127-159.

Gali, J. (2008). *Monetary policy, inflation and the business cycle: An introduction to the new Keynesian framework*. New Jersey: Princeton University Press.

Gali, J., & Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *Review of Economic Studies, 27*(3), 707-734.

Golinelli, R., & Rovelli, R. (2001). Monetary policy transmission, interest rate rules and inflation targeting in three transition countries. *Journal of Banking & Finance, 29*(1), 183-201.

Kongsamut, P. (1999). *Philippines: Preparations for inflation targeting* (IMF Working Paper WP/01/99). Available at https://www.imf.org/external/pubs/cat/longres.cfm?sk=15250.0

Krolzig, H. M. (1997). *Markov switching vector autoregressions: Modelling, statistical inference, and applications to business cycle analysis*. New York, NY: Springer.

Masson, P., Savastano, M., & Sharma, S. (1997). *The scope for inflation targeting in developing countries* (IMF Working Paper WP/97/130). Available at http://www.imf.org/external/pubs/ft/wp/wp97130.pdf

Mishkin, F. S. (2004). *Can inflation targeting work in emerging market countries?* (National Bureau of Economics Research Working Paper No. 10646). Available at http://www.nber.org/papers/w10646

Neto, J. A., Araujo, F., & Moreira, M. (2000). *Optimal interest rate rules in inflation targeting frameworks* (Banco Central Do Brasil Working Paper). Available at. http://www.bcb.gov.br/pec/wps/ingl/wps06.pdf

Parrado, E. (2004). *Inflation targeting and exchange rate rules in an open economy* (IMF Working Paper 04-21). Location: Publisher.

Romer, D. (2000). *Advanced macroeconomics*. New York: McGraw-Hill.

Sotocinal, N. (2010). *Inflation targeting and interest rate rules: A characterization of the Philippine case* (Discussion Paper No. 10-01). Diliman, Quezon City: College of Business Administration, University of the Philippines.

Sotocinal, N. (2014). *Inflation targeting regimes in the Philippines: Empirical implications of public debt* (Doctoral dissertation). Diliman, Quezon City: C.E.A. Virata School of Business, University of the Philippines.

Svensson, L. E. O. (2000). Open economy inflation targeting. *Journal of International Economics, 50*, 155-183.

Tesfatsion, L. (2009). Introduction to rational expectations (Lecture Notes). Iowa: Department of Economics, Iowa State University. Retrieved from http://www.econ.iastate.edu/classes/Econ502/52tesfatsion