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Global Commodity Prices, Monetary Transmission, and Exchange Rate Pass-Through in the Pacific Islands

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Global Commodity Prices, Monetary Transmission, and Exchange Rate Pass-Through in the Pacific Islands

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Abstract

Pacific Islands countries are vulnerable to commodity price shocks, and this poses challenges to monetary policy. The high degree of exchange rate pass-through to headline inflation and the weak monetary transmission mechanism in PICs suggest a greater efficacy of exchange rate changes in affecting inflation rather than monetary policy. To assess the tradeoff between the use of the exchange rate and monetary policy in macroeconomic stabilization, we employ a model-based approach to examine the optimal policy in response to the historical distribution of exogenous shocks in a Pacific Island (Tonga). The empirical evidence and model simulations tilt in the favor of exchange rate policy given the close relationship between exchange rate changes and headline inflation and the low interest rate sensitivity of aggregate demand.

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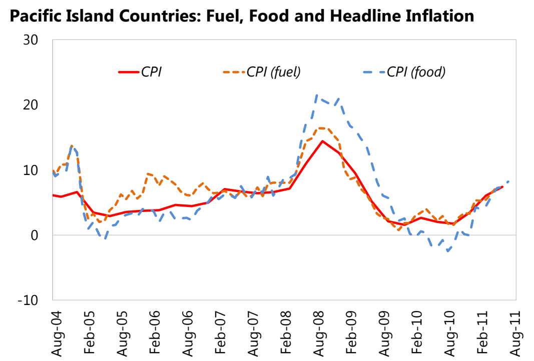
I. INTRODUCTION

Pacific Island countries (PICs) are vulnerable to commodity price shocks, and this poses challenges to monetary policy. The spike in global commodity prices in 2007−08 led to rise in headline inflation. The global financial crisis that intensified in September 2008 exerted downward pressure on both imported and domestic inflation through lower commodity prices and weak demand conditions. The authorities loosened monetary policy but there have been limited reductions in bank lending rates and private credit growth has been anemic. These sluggish responses raised a key question about the effectiveness of monetary policy transmission mechanisms in PICs and the appropriate nominal anchor given the renewed surge in global commodity prices.



Sources: IMF, *International Financial Statistics*.

The exchange rate could be used as an additional tool to cushion against exogenous shocks.[2] With a conventional exchange rate peg, the burden of addressing the impact of exogenous shocks falls on monetary and fiscal policies. Given the limited degree of capital mobility, monetary policy enjoys a certain degree of freedom despite the exchange rate peg regime. However, if monetary policy transmission is weak and the prospects for improving its effectiveness are limited in the short run, counter-cyclical policies will require an appropriate mix of monetary, fiscal and exchange rate policies.[3] Monetary policy could be closely coordinated with fiscal policy to achieve the desired impact but that is often constrained by the lack of fiscal buffers. Therefore, pegged exchange rate regimes should not preclude considerations to introduce some flexibility to increase the role of the exchange rate in absorbing external shocks and to provide additional freedom for monetary policy.

This paper provides an assessment of the impact of international commodity price shocks, and monetary and exchange rate transmission in PICs to explore whether the exchange rate could help absorb exogenous shocks. The paper is structured as follows. The next section reviews the key objectives of monetary policy and how it is conducted in PICs. This is followed in Section III by an empirical assessment of monetary and exchange transmission mechanisms in PICs, focusing on the responses of real GDP and headline inflation to external shocks, exchange rate changes, and monetary aggregates or interest rates. The next section more formally considers the appropriate nominal anchor to maintain macroeconomic stability in a Small Island Country (SIC) using a model-based approach applied to Tonga. Section IV concludes with some policy implications.

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[2] The de jure exchange rate regimes in PICs are adjustable pegs or bands to a basket of currencies except PNG that is a managed floating regime.

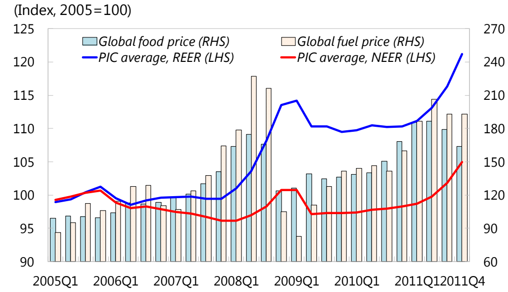
[3] Dunn and others (2011) show that the monetary transmission mechanism in PICs is weak.

II. The Choice of a Nominal Anchor

To ensure price stability, central banks around the world must choose between strategies that target a monetary indicator or the exchange rate.[4] Dynamic Stochastic General Equilibrium (DSGE) model based analyses generally find interest rate based inflation targeting to perform better than exchange rate targeting in terms of maximizing social welfare and/or minimizing macroeconomic volatility (Stone and others, 2009). However, McCallum (2006) compares the performances of Taylor-rule type interest rate rules and exchange rate based approaches to inflation targeting in an economy with varying degrees of openness. The key finding is that as the degree of openness increases an exchange rate based approach to inflation targeting does much better than the standard interest rate based approach in stabilizing output, with no adverse consequences for inflation variability. The reason for this result is that in an interest rate based approach, the variability of the interest rate is low while that of the exchange rate is high, while in an exchange rate based approach, the opposite is found. These results suggest that in an economy with a high exchange rate pass-through to imported goods prices and low interest rate sensitivity of aggregate expenditures, smoothing the exchange rate rather than interest rates may help control inflation and reduce output volatility. Parrado (2004) shows that a trade-weighted exchange rate index (TWI) explained a significant share of the variation in CPI inflation in Singapore and that the Monetary Authority of Singapore has used the TWI to target inflation.

The high pass-through of global commodity prices and import propensity in PICs suggest a greater role for exchange rate flexibility in controling inflation. There is a large weight of fuel and food items in the CPI basket in PICs, and thus a high pass-through of global commodity prices to headline inflation. More generally, the import propensity or share of imported items in consumption and investment is high in most PICs given the small domestic manufacturing base.[5] Therefore, one would expect the exchange rate to be an effective tool to control imported inflation without significant output costs. In fact, it appears that the central banks of PICs have appreciated their currencies in nominal and real effective terms over the last 2 years to cushion the impact of higher global food and fuel prices. This exchange rate adjustment could be based

Pacific Island Countries: Effective Exchange Rates 1/
(Index, 2005=100)



Sources: IMF, INS database and staff estimates.
1/ Pacific Island countries include Marshall Islands, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu.

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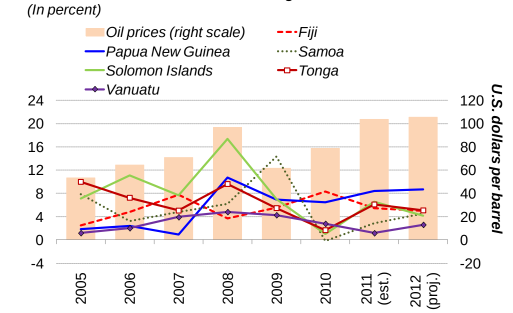
[4] Exchange rate flexibility is also important to maintain external stability, and thus may not be an instrument that is available to target domestic stability objectives. Therefore, this discussion presupposes a comfortable level of international reserves which appears to the case in the Solomon Islands at present but does not preclude the possibility of the exchange rate being subordinate to external stability concerns.

[5] For example, the share of imported items in the CPI basket is more than 40 percent in Solomon Islands and Tonga, two countries that disaggregate the CPI basket between domestic and imported goods.

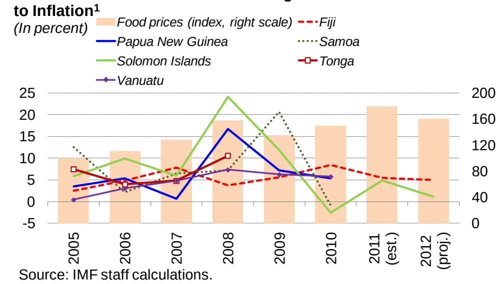
on a view of the greater efficacy of exchange rate flexibility in managing inflation and/or evidence of the limited effectiveness of monetary policy transmission to commercial bank interest rates and private sector credit documented by Dunn and others (2011).

Pacific Island Countries: Pass through of Oil Prices to Inflation
(In percent)



Source: IMF staff calculations.

Pacific Island Countries: Pass through of Food Prices to Inflation[1]
(In percent)



Source: IMF staff calculations.
[1] Food only consumer price inflation for Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu; and overall consumer price inflation for Fiji.

III. Monetary and Exchange Transmission Mechanisms

There has been a burgeoning literature on the transmission mechanism of monetary policy in advanced countries and emerging markets but a dearth of studies on Pacific Islands. Typically, this strand of research has been conducted in the context of a VAR framework pioneered by Sims (1980). Notable examples using VAR to identify transmission of monetary policy for advanced economies include Christiano, Eichenbaum, and Evans (2000) for the United States and Kim and Roubini (2000) for the G-7 Economies. However, there has been little analysis of the monetary transmission mechanism in the Pacific Island economies, leaving a number of unanswered questions and somewhat of a vacuum of knowledge in this area.[6] Dunn and others (2011) use single-equation econometric techniques to assess the pass-through of policy rates to lending rates and private credit growth and conclude that the monetary transmission mechanism is relatively weak in the Pacific Islands. As the same time, Jayaraman and Choong (2009) show that the most effective channel of monetary policy transmission in Fiji is money supply using a simple VAR approach. Jayaraman and Dahalan (2009) also suggests that the money and exchange rate channels are important in transmitting monetary impulses to Samoa's output while monetary aggregates matter more for inflation. We follow a similar approach but take into account the pass-through of international commodity prices and alternative channels of monetary and exchange transmission by using a more comprehensive set of external and macro-financial variables. We cover six PICs and control for the endogenity among variables by using a panel VAR framework.[7]

A panel VAR model is estimated for PICs to reflect the pass-through of global commodity prices and monetary and exchange rate transmission mechanisms to the real economy.[8] The

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[6] This has been partly related to data limitations (particularly lack of quarterly real sector aggregates).

[7] The panel VAR consists of Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu.

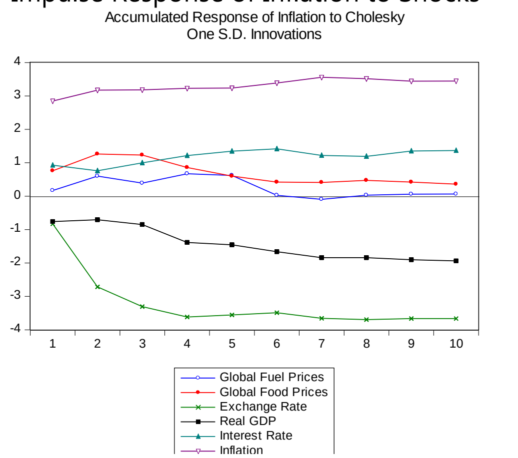
[8] See Appendix I for more details on the VAR modeling approach.

ordering of variables in the recursive VAR is the following: the global exogenous factors (global fuel and food prices) come first followed by the assumption that the exchange rate and monetary indicators (interest rates or monetary aggregates) respond to demand conditions (real GDP). These factors can impact headline inflation (inflation) with no immediate effects vice versa. The VAR models are estimated using annual data between 1995 and 2011 given data availability for all countries and minimize structural breaks. All variables are in log-differences, except interest rates. Standard information criteria are used to select the lag lengths of the VAR, which turn out to be 2 years. Results of Granger causality tests lend support for a transmission of external shocks and exchange rate to the domestic economy.

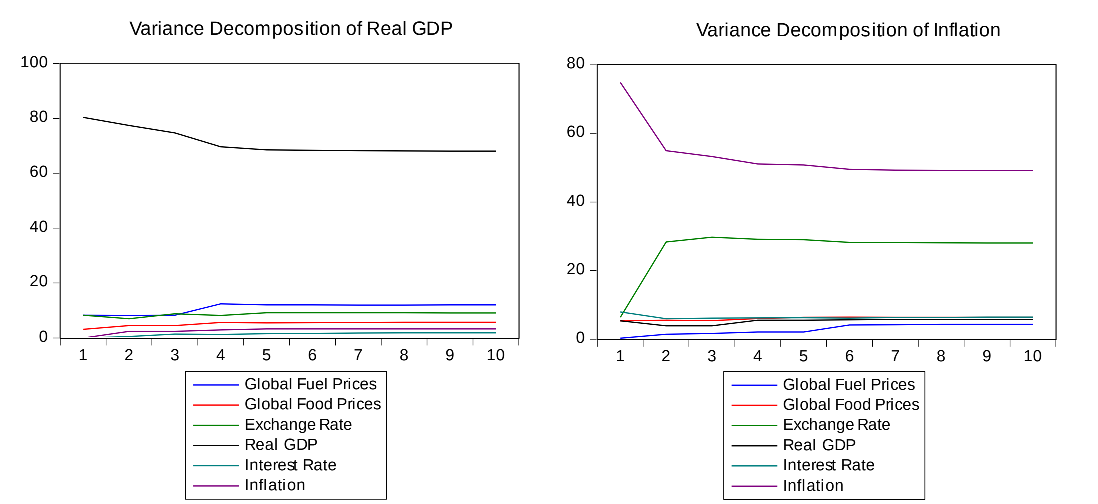
Results

The results of the baseline panel VAR model are shown below. The set of graphs each displays the impact (the impulse response) of headline inflation to a one-standard deviation shock to global fuel prices, global food prices, output, bilateral exchange rate against the U.S. dollar, domestic interest rates and the headline price index itself. The exchange pass-through is calculated as the impact of a shock to the exchange rate (defined as an exogenous, unexpected, temporary rise at t = 0) on the headline inflation index over a specific time interval. The relative importance of the exogenous and monetary shocks for fluctuations in headline inflation and the output gap at different forecast horizons can be gauged through the forecast error variance decompositions.

Impulse Response of Inflation to Shocks



Variance Decomposition of Real GDP and Inflation



The transmission of external and monetary shocks provides little scope for PICs to influence the real economy through monetary management alone. The key insights are as follows:

- As expected, higher global food and fuel prices raise headline inflation. The impact of global food prices is larger and more persistent than global fuel prices given the greater weight of food items in the CPI basket.

- The impact of monetary impulses on headline inflation is not as significant as exchange rate fluctuations. The pass-through of the exchange rate to headline inflation is 60 percent within 4 one year, with a complete pass-through within the second year. On the other hand, the impact on and variation of headline inflation explained by monetary impulses is relatively small whether one considers broad money, domestic credit, reserve money, or interest rates, as in the baseline model. In fact, higher interest rates are associated with greater inflation possibly indicating a reverse causation where exchange rate changes and inflation determine the level of interest rates.

- Real GDP is not well explained by the shocks considered except its own innovations, probably reflecting the importance of supply-side factors and policy variables not captured such as fiscal policy. Interestingly, global commodity prices appear to affect economic activity more than global GDP indicating a relatively weak impact of external demand compared to terms of trade, although none of the these effects are statistically significant.[9]

IV. FPAS Model for Small Island Countries

While the high exchange rate pass-through and weak monetary transmission mechanism provides greater scope to use the exchange rate for controlling inflation, the appropriateness of using the exchange rate as a tool of macroeconomic stabilization is largely dependent on the size and nature of shocks as well as the economic structure. The panel VAR analysis shed light on the relative efficacy of monetary and exchange rate transmission controlling for exogenous shocks but did not take into account the distribution of shocks and structural economic relationships in the economy. In particular, linkages to real economic activity were not well identified possibly due to data limitations and/or country heterogeneity in the transmission of shocks. To better identify the shocks and overcome some of these limitations, we estimate and simulate a small macroeconomic model for Tonga as an illustrative PIC and SIC economy using quarterly data from 1995−2011.

The monetary policy analysis is conducted by extending to better capture Tonga specific factors the small "New Keynesian" macroeconomic model of Berg, Karam, and Laxton (2006 a, b). The model is a stripped down version of a dynamic stochastic general equilibrium (DSGE) model with rational expectations. In recent years, the macroeconomic literature has used DSGE models and small New Keynesian models to analyze economic

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[9] The panel VAR with global GDP instead of global commodity prices was statistically insignificant and not reported here.

behavior and to forecast future developments. The DSGE models are based on theoretical underpinnings and have been found to be useful for analyzing the effects of structural changes in the economy, as well as the effects of longer-term developments such as persistent fiscal and current account deficits. On the other hand, by virtue of their relatively simple structure, small New Keynesian models have been used for forecasting and policy analysis (FPAS) purposes in central banks and by IMF country desks. A number of inflation-targeting central banks have used similar models as an integral part of their FPAS (see Laxton and others, 2009).

Global commodity prices and the possible use of the exchange rate for domestic stabilization purposes are incorporated as in Carabenciov and others (2008), and Parrado (2004), respectively. To capture the commodity price dependence of Tonga and PICs more generally, the baseline model is extended to incorporate global oil and food prices. Moreover, to better understand the dynamics of inflation, we estimate two Phillips curves like Berg, Karam, and Laxton (2006b): (i) headline inflation; and (ii) domestic price inflation rather than core inflation. The latter provides insights on the potential role of intermediate imports emphasized by McCallum (2006) for very open economies. As a SIC, we incorporate external demand shocks from the rest of the world captured by partner country GDP growth. Output developments in the rest of the world feed directly into the small economy as they influence foreign demand for Tongan products and services (e.g., remittances and tourism). To allow for the possibility of using the exchange rate as the tool of macroeconomic stabilization, we consider two closure rules to the model: (i) a standard “Taylor-rule” and (ii) a modified exchange rate targeting rule following Parrado (2004). Changes in foreign inflation and interest rates affect the interest rate or exchange rate depending on the closure of the model and subsequently, demand and inflation in Tonga.

The extended FPAS model has four behavioral equations: (1) an aggregate demand or IS curve that relates the level of real activity to expected and past real activity, the real interest rate, the real exchange rate, foreign demand, the fiscal stance, and financial conditions; (2) a price setting or Phillips curve that relates inflation to past and expected inflation, the output gap, fuel prices, and the exchange rate; (3) an uncovered interest parity condition for the exchange rate or interest rate, with some allowance for backward looking expectations; and (4) an modified Taylor-rule for setting the policy interest rate or exchange rate as a function of the output gap and expected inflation.

(1) The aggregate demand equation is as follows:

$$ygap_t = \beta ld\, ygap_{t+1} + \beta lag\, ygap_{t-1} - \beta RRgap\, RRgap_{t-1} + \beta Zgap\, zgap_{t-1} + \beta RWygap\, ygap_t^{RW} + \beta BL\eta_t + \varepsilon_t^{ygap}$$

- where $ygap$ is the output gap, $RRgap$ the real interest rate gap, $zgap$ the real exchange rate gap, $ygap^{RW}$ the output gap in the United States, η is a measure of lending conditions specified in the aggregate demand equation as in Carabenciov and others (2008), β a series of parameters attached to these variables, and ε^{ygap} an error term that captures other temporary exogenous demand shocks. Lending conditions are proxied by real credit growth

(2) The Philips curve equation is as follows:

$$\pi_t = \alpha_{\pi ld}\pi 4_{t+1} + (1-\alpha_{\pi ld})\pi 4_{t-1} + \alpha_{ygap} ygap_{t-1} + \alpha_{zgap}(z_t - z_{t-1}) + \alpha_o(\pi_t^o - \pi^o) + \alpha_{olag}(\pi_{t-1}^o - \pi^o)$$
$$+ \alpha_f(\pi_t^f - \pi^f) + \alpha_{flag}(\pi_{t-1}^f - \pi^f) + \varepsilon_t^\pi$$

- where $\pi 4_{t+1}$ is the four-quarter ahead inflation rate (year/year), $\pi_t\, 4_{t-1}$ the four-quarter lagged inflation rate, *ygap* the output gap, $z_t - z_{t-1}$ the real depreciation, α the parameters, π_t^o international fuel price inflation, π_t^f international food price inflation, and ε_t^π an error term. Note that the international fuel and food price inflation is in terms of domestic price. For example, international fuel price inflation is expressed as:

$$\pi_t^o = (\pi_t^{RWo} + 4*(z_t - z_{t-1})$$

where π_t^{RWo} is the global (brent) oil price inflation

As an extension, we add the following equation for domestic core inflation:

$$\pi_{c,t} = \alpha_{c,\pi ld}\pi 4_{c,t+1} + (1-\alpha_{c,\pi ld})\pi 4_{c,t-1} + \alpha_{c,ygap} ygap_{t-1} + \alpha_{c,zgap}(z_t - z_{t-1}) + \alpha_c(\pi 4_{t-1} - \pi 4_{c,t-1}) + \varepsilon_{c,t}^\pi$$

- where the term $(\pi 4_{t-1} - \pi 4_{c,t-1})$ has been added to the simple canonical inflation equation to allow for the possibility that imported goods are an important input into the production costs of many domestic goods, or if workers resist the reduction in their real wages in response to an increase in headline inflation related to higher imported prices.

(3) The uncovered interest parity equation (UIP) is as follows:

$$z_t = \delta_z z_{t+1} + (1-\delta_z) z_{t-1} - [RR_t - RR_t^{RW} - \rho^*]/4 + \varepsilon_t^z$$

where z_t is the log of real exchange rate (an increase represents a depreciation), RR_t the real interest rate, RR_t^{RW} the U.S. real interest rate, ρ^* the historical average risk premium on the domestic currency, δ_z the smoothness parameter, and ε_t^z an error term. This equation, an uncovered interest rate parity condition, posits that the real exchange rate is a function of the expected real exchange rate (the first two terms), the real interest rate differential (the currency risk premium), and a disturbance term. Note that the above equation is equivalent to the conventional UIP condition, which is usually expressed in nominal terms. Denote the log of nominal exchange rate as E_t, then the change of the nominal exchange rate is:

$$\Delta e_t = N^e_{t+1} - N_t = z^e_{t+1} - z_t + \pi_t - \pi^*_t$$

Substituting this in the conventional UIP condition will derive the UIP condition in real terms. In the case of exchange rate targeting, the UIP condition is written in terms of the domestic interest rate instead.

(4) The Taylor-rule is as follows:

$$RS_t = \gamma_{RSlag} RS_{t-1} + (1-\gamma_{RSlag}) * \left(RR^*_t + \pi 4_t + \gamma_\pi \left[\pi 4_{t+4} - \pi^*_{t+4} \right] + \gamma_{ygap} ygap_t + \gamma_{zgap} zgap_t \right) + \varepsilon^{RS}_t$$

The Taylor-rule can be modified by inverting the equation in terms of the exchange rate as in Parrado (2004).

In the case of exchange rate targeting regime, we replace the Taylor rule and the uncovered interest parity equation with the following equations. We follow the exchange rate targeting framework in Khor and others (2004) and Parrado (2004) in which the change of nominal effective exchange rate (NEER) is a function of inflation gap and output gap

$$\Delta e_t = \Delta e + \gamma_{e1}(\pi_t - \pi^*) + \gamma_{e2}(y_t - y^*) + \varepsilon^N_t$$

where Δe is the long-run equilibrium change in the NEER.

(5) Exchange rate targeting follows:

$$zgap_t = \delta_z zgap_{t-1} + (1-\delta_z)[\delta_\pi(\pi 4_{t+4} - \pi^*_{t+4}) + \delta_y ygap_t] + \varepsilon^z_t$$

where real exchange rate gap is a function of inflation gap and output gap. It is easy to show that the above function is equivalent to the nominal exchange rate targeting rule in Khor and others (2004) as the nominal exchange rate gap depends on the real exchange rate gap and the inflation rates. For model consistency and estimation, we express the nominal exchange rate targeting rule in terms of an equivalent real exchange rate targeting rule.

(6) Corresponding, the real interest rate is determined by the UIP equation as:

$$RR_t = \gamma_{RRlag} RR_{t-1} + (1-\gamma_{RRlag}) * \left(RR^*_t + \rho^* - 4(z_t - z_{t-1} - \pi_t + \pi^*_t) \right) + \varepsilon^{RS}_t$$

where $\rho*$ the historical average risk premium on the domestic currency.

The model is estimated using Bayesian techniques based on prior distributions for the parameters from cross-country work and assumptions about the Tongan economy. Bayesian estimation in a situation of a relatively small sample size (which is almost always the case for macro time series data) helps ameliorate the problems of classical econometric estimation, which often gives macro model results that are inconsistent and faced with simultaneity challenges. This is a particularly important aspect for Tonga and other PICs where data are extremely limited and other cross-country studies could help pin down structural parameters. However, to avoid imposing too much structure, we use diffused priors. All variables are seasonally adjusted using the X12 filter, with the exception of the interest rate and the exchange rate, and expressed in “gap” terms, defined as deviations from a Hodrick-Prescott time trend.

The trade-off between targeting interest rates and exchange rate is assessed based on the historical distribution of shocks. Using the estimated parameters and distributions for the stochastic shocks, solutions are derived for the variability in inflation and the output gap under alternative policy reaction functions where the interest rate or exchange rate is the target variable in the modified Taylor-rule. The rule that minimizes a loss function of inflation and output variability of a standard quadratic form given by the following equation can be used gauge the “optimal” policy rule in terms of minimizing macroeconomic volatility:

$$L = \sum_{t=0}^{\infty} \lambda_{\pi}(\pi_t - \pi^T)^2 + \lambda_y (ygap_t)^2$$

where λ_{π} and λ_y are the relative weights on inflation and output-gap variability and π^T is the inflation target.

The impulse responses and variance decomposition of all stochastic shocks suggest that demand and supply shocks are nearly equally important in accounting for inflation dynamics. As far as the impulse response functions are concerned, the model shows reasonable and expected patterns. Global commodity price and demand shocks have a significant impact on output and inflation dynamics, requiring a policy response to help stabilize the economy. Exchange rate changes have a greater influence on inflation while interest rates affect aggregate demand more than exchange rate changes, albeit a small impact. This contrasts somewhat with the perceived dominance of supply-side factors based on the results of pure empirical panel VAR approach, highlighting the need for more systematic and country-specific analyses to better identify and interpret shocks.

An exchange rate based targeting approach is better at achieving macroeconomic stability. An exchange rate based targeting rule does much better at stabilizing both output and inflation in Tonga. The variance decompositions suggest that this result is a consequence of the greater importance of global commodity prices and external demand shocks that could be more effectively insulated through the exchange rate. The spillover of imported inflation to domestic consumption goods prices through the use of intermediate imports or wage indexation in terms of headline inflation likely makes the exchange rate a more powerful channel in controlling inflation. Moreover, the low interest sensitivity of aggregate demand leads to less macroeconomic volatility under an exchange rate based targeting approach than in advanced countries. The preference for targeting interest rates over exchange rate in PICs and SICs is thus not as clear cut as in advanced inflation targeting economies as suggested by McCallum 2006. Our result is also consistent with the fact that nearly all PICs except Fiji has appreciated the exchange rate in response to the latest surge in headline inflation mainly driven by higher commodity prices.

Macroeconomic Volatility Under Alternative Policy Rules

	GDP Gap	Headline Inflation
Exchange rate targeting	0.34	1.01
Interest rate targeting	1.09	4.76

V. Policy Implications

Exchange rate flexibility could be a useful tool for macroeconomic stabilization in PICs. External shocks particularly global commodity shocks have a significant impact on headline inflation, both directly and indirectly through intermediate imports. The high degree of exchange rate pass-through to headline inflation in PICs and the weak monetary transmission mechanism suggest a greater efficacy of exchange rate changes in affecting inflation rather than monetary policy. The impact of monetary impulses on headline inflation is weak whether one considers broad money, reserve money, interest rates, or domestic credit, probably reflecting the excess liquidity in the banking system and structural impediments to lending such as weak contract enforcement and bankruptcy procedures. In terms of the trade-off between exchange rate and monetary policy in macroeconomic stabilization, the model based approach empirical evidence tilts in the favor of exchange rate policy given the close relationship between exchange rate changes and headline inflation, and the low interest rate sensitivity of aggregate demand. That said, the use of exchange rate flexibility for short-term domestic stability objectives in the context of the de jure exchange rate basket regime will only be possible in a situation of comfortable international reserves, and should avoid the exchange rate from significantly deviating from its medium-term fundamentals.

Greater exchange rate flexibility and structural reforms may help strengthen the effectiveness of the monetary transmission mechanism. While monetary policy is unlikely to be subordinate to the exchange rate regime because of limited interest-sensitive cross-border capital flows, some private transfers such as remittances and nonresident bank deposits may respond to changes in domestic interest rates. Thus, greater exchange rate flexibility may provide greater independence to monetary policy. More importantly, the monetary transmission could be strengthened by enhancing the interest rate pass-through to lending rates by addressing the excess liquidity and structural problems mentioned above including by introducing greater competition in the financial system. The underdeveloped state of the financial markets' also affect the interest rate and credit channel of monetary policy. Collateralized interbank lending is not widely available, and secondary markets for government and central bank paper are virtually non-existent.

Appendix I: Identification of VAR

Structural VAR Modeling

Following Kim and Roubini (2000) and Sims and Zha (2006), we assume the economy is described by a structural form equation:

$$G(L)Y_t = C(L)X_t + \varepsilon_t$$

where $G(L)$ is a $n \times n$ matrix polynomial in the lag operator; $C(L)$ is a $n \times k$ matrix polynomial in the lag operator; Y_t is a $n \times 1$ vector of endogenous variables; and X is a $k \times 1$ vector of exogenous foreign variables; ε_t is a $n \times 1$ vector of structural disturbances, with $\text{var}(\varepsilon_t) = \Lambda$, where Λ is a diagonal matrix and the diagonal elements are the variances of structural disturbances; therefore, structural disturbances are assumed to be mutually uncorrelated.

Corresponding with this structural model we can estimate a reduced form VAR:

$$Y_t = A(L)Y_t + B(L)X_t + \mu_t$$

where $A(L)$ and $B(L)$ are matrices polynomial; μ_t is a vector of reduced form disturbances, with $\text{var}(\mu_t) = \Sigma$.

We assume the exogenous vector X_t contains WEO global fuel prices (Fuel) and food prices (Food):

$$X_t' = [Fuel\ Food]$$

These variables are included to control for changes in overall global economic conditions and fluctuations in the prices of PIC's main imported commodities. The other endogenous variables include the real GDP (Y), exchange rate (E), a monetary aggregate or interest rate (M) and headline consumer price index (HCPI).

$$Y_t' = [Y\ E\ M\ HCPI]$$

In the baseline model, the money policy variable is chosen to be interest rates but other monetary aggregates are tested and domestic credit to the private sector has the largest explanatory power, albeit still relatively small compared to the exchange rate impact on inflation.

Identification Scheme: Recursive VAR

There are many ways of recovering the parameters in the structural form equations from the estimated parameters in the reduced form equation. A popular and convenient method is to orthogonalize reduced form disturbances by Cholesky decomposition using a simple recursive VAR (as in Sims, 1980).

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