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A Macro-Model Approach to Monetary Policy Analysis and Forecasting for Vietnam

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Abstract

The paper develops a small New-Keynesian FPAS model for Vietnam. The model closely matches actual data from 2000-2014. We derive an optimal monetary policy rule that minimizes variablity of output, inflation, and the exchange rate. Compared to the baseline model, the optimal rule places a larger weight on output stabilization as the intermediate target to achieve inflation stability, while allowing greater exchange rate flexibility. We analyze the dynamics of key macro variables under various shocks including external and domestic demand shocks and a lift-off of U.S. interest rates. We find that the optimal monetary policy rule delivers greater macroeconomic stability for Vietnam under the shock scenarios.

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I. INTRODUCTION

The Vietnamese authorities have made commendable progress in achieving macroeconomic stability in recent years after episodes of high inflation in 2008 and 2011. The export sector has grown substantially making Vietnam one of the most open economies in the world. The export product mix has evolved from predominantly commodities to manufacturing of electronics and apparel. Integration into the world economy has been very beneficial for Vietnam, but has also increased exposure to external shocks.

Monetary policy in Vietnam is anchored around exchange rate stability as the intermediate target to achieve price stability. Specifically, the authorities maintain the dong closely linked to the U.S. dollar. In recent years, Vietnam's need for accommodative monetary conditions has coincided with exceptionally easy monetary policy in the U.S. Going forward the balancing act of maintaining a close link to the U.S. dollar and implementing monetary policy appropriate for Vietnam is going to be more difficult. Vietnam is increasingly exposed to asymmetric shocks compared to the U.S. as a result of its evolving trade product and partner mix. The likely start of a monetary tightening cycle in the U.S. in the near-term, associated U.S. dollar appreciation, and currency movements in the rest of Asia could severely test Vietnam's current monetary policy approach.

This paper contributes to monetary policy analysis in Vietnam through estimation of a small New Keynesian macroeconomic model, the Forecasting and Policy Analysis System (FPAS model). FPAS models have become popular for monetary policy analysis due to their simplicity while capturing the key aspects of an economy for monetary policy analysis (Laxton et al. 2009). The model provides a tool for analyzing the monetary transmission mechanism and the dynamics of shocks to the economy. It can also be used for forecasting.

The FPAS model is estimated using Bayesian techniques on Vietnamese data from 2000–14. The baseline parameterization fits the actual data closely and performs well in in-sample forecasts. We find that the inflation process is mostly backward looking, which complicates the conduct of monetary policy and implies that monetary policy has to be more active and maintain a certain stance for longer. In addition to the baseline, we derive an optimal monetary policy rule that jointly minimizes the variability of output, inflation, and the exchange rate. The optimal monetary policy rule places a greater weight on the output gap as the intermediate target to achieve inflation stability, while allowing greater exchange rate flexibility.

We analyze the dynamics of key macro variables under exogenous shocks for the baseline and optimal model parameterization. Shocks include rising U.S. interest rates, an increase in food prices, a domestic demand shock that can be interpreted as a fiscal expansion, and an external demand shock. The optimal monetary policy rule delivers greater macroeconomic stability for Vietnam under the shock scenarios. A critical factor in achieving more output and inflation stability is the buffer role a flexible exchange rate can play when confronted with external shocks.

The paper is structured as follows. Chapter II provides a brief overview of monetary policy and recent economic developments in Vietnam. Chapter III introduces the model including its main properties and equations. Chapter IV provides a brief overview of the data used for model estimation. Chapter V discusses estimation of the model, results, and forecasts. Chapter VI develops an alternative optimal monetary policy rule that increases macroeconomic stability in the model. Chapter VII employs the baseline model and the model with the optimal monetary policy rule to analyze the reaction of key variables to a range of shocks. We conclude in chapter VIII.

II. A Brief Overview of Monetary Policy and Macroeconomic Developments

Growth averaged over 7 percent in the years before the Global Financial Crisis, led mainly by increasingly intensive agricultural production, rapidly expanding state-owned enterprise (SOE) investment, financial services and labor-intensive manufacturing driven by foreign direct investment. In anticipation of WTO accession in early 2007, Vietnam received large capital flows and domestic credit growth reached more than 50 percent. Inflation reached double-digit levels in 2007 and averaged more than 23 percent in 2008. In the wake of the global financial crisis growth slowed and the dong weakened amid large trade deficits and dwindling foreign exchange reserves. Weaknesses in the growth model based on high, but inefficient SOE and state investment were exposed. Confronted with slowing growth, the authorities implemented a large fiscal stimulus combined with a push to increase credit in 2009 and early 2010. While this succeeded in pushing up growth in the short-term, it led to another episode of high inflation in 2011 and pressure on the currency. After stabilization of the economy in 2012, growth fell to around 5 percent in 2012.

In the last three years, growth has slowly recovered to about 6 percent at the end of 2014 supported mainly by a strong FDI-driven export sector. Inflation has been on a downward trend due to a persistent negative output gap and a disinflationary external environment, and there are signs of a recovery in domestic demand in 2015. The economy nevertheless continues to face structural challenges that create a headwind for growth (SOE reform, banking sector weakness and diminishing fiscal space for bank and SOE restructuring costs and countercyclical policies).

The Vietnamese dong has been closely tied to the U.S. dollar since 2012 with small occasional adjustments. In real effective terms, the dong has appreciated by close to 30 percent due to persistent inflation differentials and, more recently, U.S. dollar appreciation vis-à-vis the Euro, the Yen and many EM currencies.

Monetary policy is conducted by the State Bank of Vietnam (SBV). By law, the SBV proposes an inflation target to the National Assembly, which then sets the target as national policy (5 percent for 2015). The SBV is free to use its instruments to achieve that rate of inflation. The SBV also announces an official dong-US dollar exchange rate with bands, and it manages the supply of foreign exchange to keep the interbank exchange rate within the bands.[2] The SBV issues central bank bills, conducts repo operations, sets a reference interbank

[2] The exchange rate trading band vis-à-vis the U.S. dollar was widened to +/- 3 percent from +/- 1 percent in August 2015.

rate, and maintains overnight lending and deposit facilities to manage overall system liquidity. In addition, there are caps on deposit rates. The SBV also announces a domestic credit growth objective including credit growth guidance for individual banks and sectors.

Figure 1: CPI Inflation
(In percent)

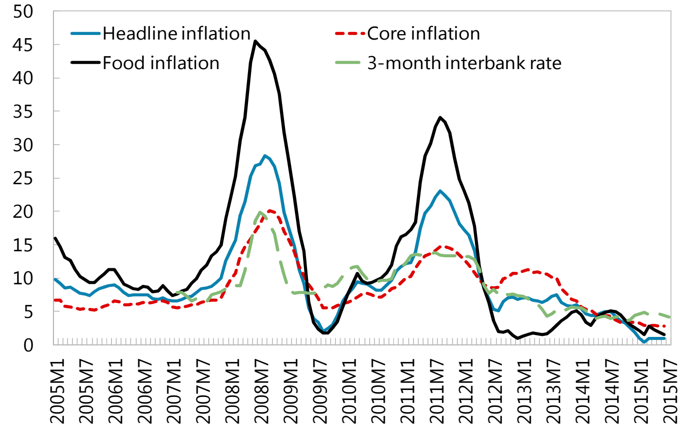


Figure 2: Exchange Rate

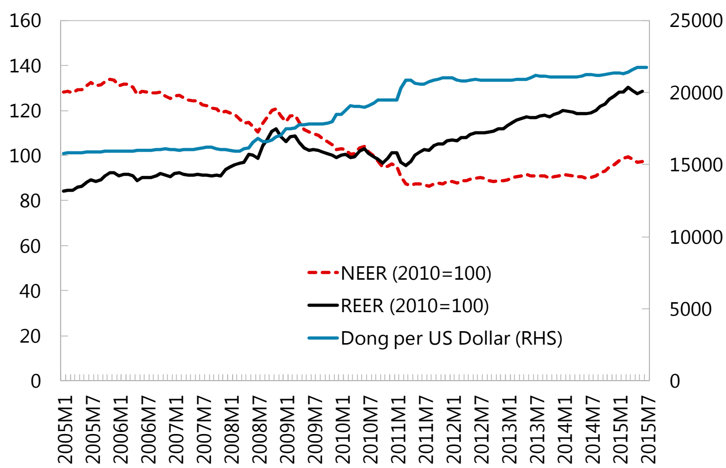
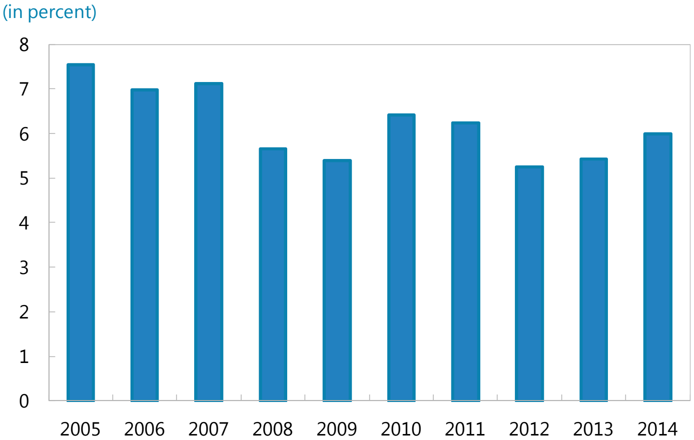


Figure 3. GDP Growth
(in percent)



III. THE FPAS MODEL

The analysis employs a small New Keynesian model following Berg and others (2006) with some extensions to better capture Vietnam specific factors. Small New Keynesian or FPAS models are increasingly used in central banks and at the IMF for monetary policy analysis and forecasting. A key advantage of FPAS models is transparency and simplicity, while allowing for an analysis of the key features of an economy. FPAS models can help frame policy discussions about forecasts, risks to forecasts, and the appropriate responses to shocks.

FPAS models are dynamic stochastic general equilibrium models. They are structural in the sense that the model's equations have an economic interpretation. They are general equilibrium because the main variables are endogenous and jointly determined. FPAS models are stochastic as each equation in the system contains a random error term that allows the quantification of uncertainty in the model's forecast. They incorporate partly forward-looking expectations that depend on the forecasts the model produces. To keep the model tractable and intuitive for monetary policy analysis, it abstracts from issues related to aggregate supply, fiscal policy, and the levels of real variables but instead expresses variables in terms of deviation from their long-run trend (in "gap" terms). Long-run trends are assumed to follow autoregressive processes that map properties of the data.

Four equations constitute the core of the model: (1) an aggregate demand curve that relates real activity to expected and past real activity, the real interest rate, and the real exchange rate; (2) two Phillips curves that relate components of inflation to past and expected inflation, the output gap, and the exchange rate; (3) an uncovered interest parity condition for the exchange rate;[3] and (4) a monetary policy rule, which is a function of the output gap, changes in the exchange rate, and deviations of expected inflation from the authorities' inflation target.

(1) Aggregated demand curve

The output gap y_{GAP_t} depends on its own lag and projected values, on deviations from the neutral real interest rate (RR^*), on deviations from the steady state real exchange rate (z^*), and on foreign demand ($ygap^{RW}$) which is approximated by the U.S. output gap:

$$y_{GAP_t} = \beta_{ld}\, y_{GAP_{t+1}} + \beta_{lag}\, y_{GAP_{t-1}} - \beta_{RRGAP} * (RR_{t-1} - RR^*_{t-1}) + \beta_{zgap} * (z_{t-1} - z^*_{t-1})$$
$$+ \beta_{RWGAP}\, ygap^{RW}{}_t + \varepsilon_t^{\,y}$$

The neutral real interest rate is not constant over time, but evolves according to an AR(1) process:

$$RR^*{}_t = \rho RR^*{}_{t-1} + (1-\rho)\overline{RR} + \varepsilon_t^{\,RR}$$

[3] The forward-looking expectations assumption is relaxed here as some forms of backward-looking expectations are allowed in determining the exchange rate.

(2) Phillips curves

Price dynamics are described by two Phillips curves, one for food and fuel inflation and one for core inflation (Andrle and others 2013). Modeling these categories separately allows us to capture differences in dynamics between the categories. Food and fuel inflation is likely to be determined by domestic or international shocks to a large degree with a limited impact from monetary policy, while core inflation is more sensitive to changes in monetary conditions. Both Philips curves have the same functional form but different coefficient priors for estimation (see section III).

The Philips curves are given by:

$$\pi^{t} = \alpha_{\pi ld}\pi 4_{t+4} + (1-\alpha_{\pi ld})\pi 4_{t-1} + \alpha_{s}(s_t - s_{t-1}) + \alpha_{gap}\, y_{GAP_t} + \epsilon_t^{\pi}$$

so that the year-on-year quarterly consumer price index (CPI), π^{t}, depends on the expected annual change in the CPI ($\pi 4_{t+4}$), the change in the CPI over the previous year ($\pi 4_{t-1}$), changes in the nominal effective exchange rate (s_t), and the output gap (y_{GAP_t}).

For Vietnam, we expect a relatively small coefficient on expected inflation due to price frictions and a weak monetary transmission mechanism (IMF 2014). We expect the coefficient on exchange rate changes (α_s) to be relatively large for a very open economy such as Vietnam.

(3) Uncovered interest parity

The uncovered interest parity is determined as follows:

$$z^{t} = \delta_z z_{t+1}^{e} + (1-\delta_z) z_{t-1} - \frac{\left[RR_t - RR_t^{US} - \rho_t^{*}\right]}{4} + \epsilon_t^{z}$$

where z^t is the real exchange rate (defined so that an increase is a depreciation), RR_t is the policy real interest rate, RR_t^{US} is the real U.S. interest rate, and ρ_t^{*} is the equilibrium risk premium. The interest rate term is divided by 4 because the interest rates and the risk premium are measured at annual rates. It is assumed that the risk premium ρ_t^{*} is not constant and evolves depending on the difference between Vietnam's and the world's neutral interest rates. We allow, but do not impose, forward-looking expectations for the exchange rate[4], that is:

$$z_{t+1}^{e} = \delta_z z_{t+1}^{e} + (1-\delta_z) z_{t-1}$$

(4) Monetary policy rule

[4] Berg, Karam, and Laxton (2006a/b) discuss how incomplete forward-looking expectations provide for realistic dynamics.

We assume that the central bank sets short-term nominal interest rates to achieve a target level for inflation, π*. The central bank also reacts to deviations of output from its trend and to changes in the real exchange rate. The rule is given by:

$$RS_t = \gamma_{RSlag} RS_{t-1} + (1 - \gamma_{RSlag}) * (RR_t{}^* + \pi 4_t + \gamma_\pi [\pi 4_{t+4} - \pi_{t+4}{}^*] + \gamma_{ygap} ygap_t + \gamma_S (z_t - z_{t-1}) + \epsilon_t^{RS}$$

where the nominal policy rate (RS_t) depends on its own lag, the equilibrium real rate ($RR_t{}^*$), the annual inflation rate ($\pi 4_t$), deviations of expected inflation from the target rate of inflation ($\pi_{t+4}{}^*$), the output gap ($ygap_t$), and changes in the real exchange rate z_t.

The monetary policy rule follows standard formulations, and we allow the central bank to smooth interest rates. In addition, we include a term to account for the monetary authorities' response to exchange rate fluctuations, which is important in the case of Vietnam.[5] Deviating from standard formulations, we allow the central bank to specify a stochastic process for its inflation target π*, that is:

$$\pi_t{}^* = \rho_\pi \pi_{t-1}{}^* + (1 - \rho_\pi)\pi^* + \epsilon_t^\pi$$

This specification seeks to capture time-varying central bank tolerance to different levels of inflation and has been shown useful in mimicking inflation dynamics in developed and emerging markets.[6]

Foreign block
The model includes a similar set of equations as discussed above representing the foreign sector. We use the U.S. to represent the foreign sector in the model.

IV. Data

The sample covers the period 2000 to 2014 with most data series at a quarterly frequency. The real effective exchange rate is obtained from IFS. Headline, core and food and fuel CPI are provided by the Vietnamese authorities. We use the weekly interbank rate (averaged into quarters) as the short-term interest rate in the model, as the reference interbank rate has been almost constant in the last three years and does not capture the policy stance. For the output gap we use a simple HP filter. Other approaches to output gap estimation yield qualitatively similar model results.

We estimate the foreign block in the model with U.S. economic data. Our sample is based on data from the International Finance Statistic and the IMF's World Economic Outlook, from 2000 to 2014. The federal funds rate was used as the nominal interest rate to the rest of the world.

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[5] Since our model assumes serially correlated errors in exchange rate expectations ($\delta z < 1$), there is a role for monetary policy to respond directly to exchange rate changes.

[6] Berg, Karam, and Laxton (2006a/b) and Smets and Wouters (2003).

V. Estimation and Results

A. Estimation

We use a Bayesian approach to estimate the parameters of the model. Bayesian estimation involves the estimation of the posterior distribution for the model's parameters, and an evaluation of data likelihood given the parameters, the model, and parameters' prior distributions. The principle is to first approach the data with a set of prior views on the appropriate values of the parameters of the model, and then to adjust these prior views based on Vietnam's data.

The Bayesian methodology has a number of advantages over classical estimation or the calibration of macro-models. The Bayesian approach formalizes the incorporation of prior empirical and theoretical understanding about the parameters of interest and delivers more stable estimation results with short samples. It also allows for measurement error, so that some of the excess volatility in the data is allocated to measurement error instead of entering the stochastic simulations. These advantages are particularly relevant in the case of Vietnam where sample periods are short and measurement error is an issue.

The priors and estimated posterior values on the main parameters in the model are summarized in Table A1 at the end of the paper. We chose priors' functional forms based on the existing literature on FPAS models. The prior means were chosen to reflect views about structural features of the Vietnamese economy. In the following paragraphs we discuss some key parameters of the model.

In the aggregate demand curve, the relatively large backward-looking term and small forward-looking term account for the view that expectations of future developments play a relatively small role in output dynamics. The priors on the lagged real interest rate and real exchange rate (β_{RRGAP} and β_{zgap}) reflect our view that the effect of a 100-basis-points increase in the real interest rates on the output gap would be equivalent to a 1 percent appreciation in the real exchange rate. The choice of these parameters result in hump-shaped dynamics in response to monetary induced interest rate shocks. The large parameter on the international output gap reflects the high degree of openness of the Vietnamese economy.

For the Phillips curves, we estimate separate single equation Phillips curves for core and for food/fuel inflation. The estimated parameters from these equations are then used as prior means in the FPAS model. The single equation estimations confirm a greater responsiveness of core inflation to changes in the output gap when compared to food/fuel inflation. In turn, food/fuel inflation is more responsive to exchange rate movements (large α_s coefficient). This result is as expected, since food and fuel are either imported or determined by world market prices to a larger degree than components of core inflation.

For the monetary policy rule, the relatively high prior on the parameter on the lagged interest rate (γ_{RSlag}) implies a high degree of inertia in the policy rate as observed in the data. We also assume that the central bank adjusts the policy rate incrementally to the desired value based on deviations of inflation from the official target and output from equilibrium. To reflect the State Bank of Vietnam's focus on stabilizing the exchange rate, we allow a response of the policy rate to nominal exchange rate movements.

The priors on the foreign block of the model are taken from applications of similar models estimated for the U.S. economy (Coats, Laxton and Rose (2003); Anand, Ding, and Tulin (2014); Andrle and others (2013)). The prior means of the autoregressive coefficients of most exogenous variables, as well as the variances of the shocks are chosen so that the model delivers plausible interpretations of recent macroeconomics dynamics in Vietnam.

B. Baseline Results

One way to assess how well the overall estimation of the model fits the data is through the comparison of the moments predicted in the model with the actual Vietnamese data. Table 1 provides means and standard deviations of the actual data and estimated moments in the model. The baseline model fits actual means and standard deviations very well. The only significant deviation from the actual data moments occurs for the standard deviation of nominal interest rates. This can be rationalized by considering that in the model different tools of monetary policy are subsumed in the interest rate. In reality, monetary policy in Vietnam does not exclusively rely on interest rates but a number of measures including credit targets, guidance, and management of the exchange rate. To capture monetary policy in only one variable, the interest rate has to be more reactive in the model than observed in actual data.

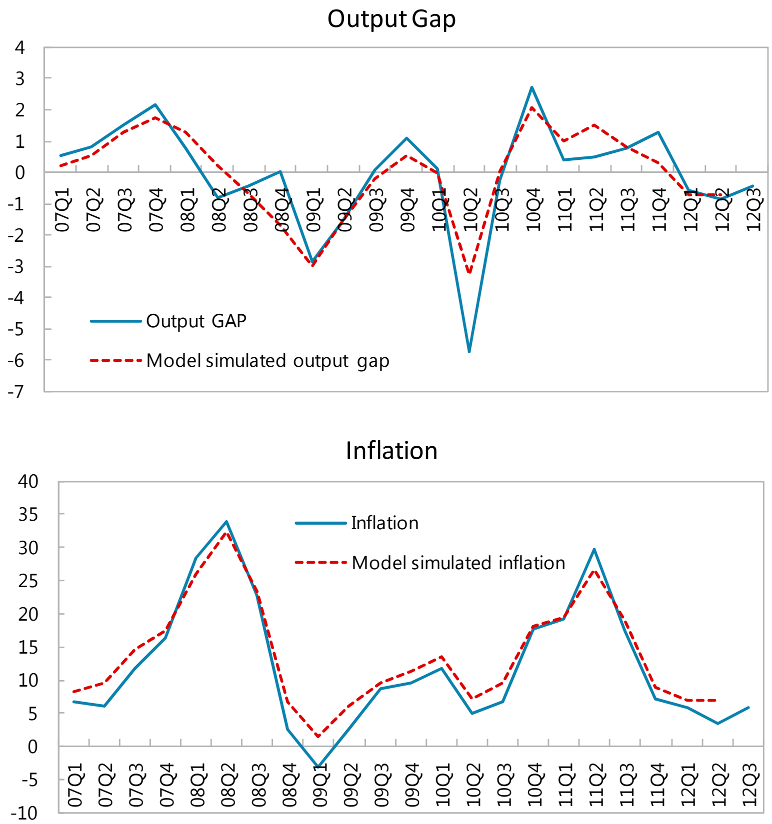
Table 1. Actual data and baseline model moments

	Actual data		Baseline model	
	Mean	Std. Dev.	Mean	Std. Dev.
Output gap	0.0	1.0	0.0	1.4
Inflation	8.9	6.3	8.9	5.3
Core Inflation	7.3	4.5	7.4	7.1
Food Inflation	11.6	10.3	11.3	10.0
Nominal interest rate	7.0	3.4	7.0	9.6
Real exchange rate		11.5		12.4
Nominal exchange rate		2.2		2.3

C. In-Sample Forecast Properties

One-quarter ahead model-based in sample forecasts are created each quarter. The forecasts use only data until the quarter before the forecast. Figure 4 presents in sample forecasts (red) along with the actual data (blue) for the output gap and inflation. The in sample forecasting performance of the model is strong. Forecasts capture the spikes in inflation in 2008 and 2011 and track output gap dynamics well. The forecasting performance confirms that the model matches Vietnam's data well.

Figure 4. In-Sample Forecasts

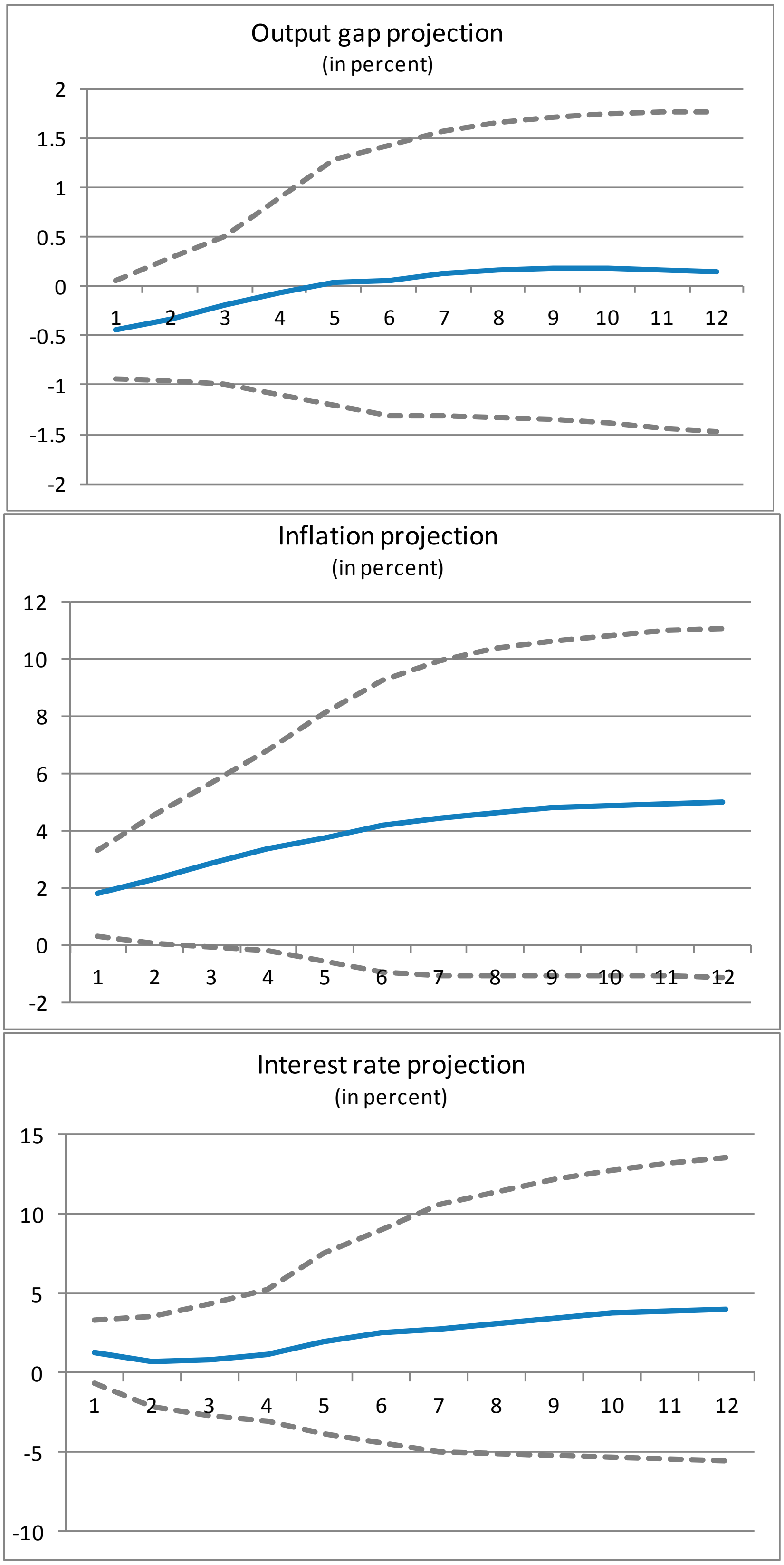


D. Out-of-sample forecasts with U.S. Federal Reserve lift-off

FPAS models can be very useful in the process of forecasting. While the model itself does not make the central forecast, it can serve to frame the discussion about the forecast, risks to the forecast, appropriate responses to a variety of shocks, and dependencies of the forecast and policy recommendations on assumptions (Berg, Karam, and Laxton 2006). In this section we present out-of-sample forecasts for the output gap, inflation and nominal interest rates on a quarterly basis starting at the end 2014 (Figure 5). The forecasts incorporate a gradual tightening of U.S. monetary policy with the Fed Funds rate reaching 2 percent after three years. This is complemented by a discussion of the effect of shocks in section VII.

Consistent with a pick-up in economic growth the model predicts a gradual closing of the output gap. Accordingly, inflation is forecast to slowly increase toward the 4 percent target assumed in the model. However, confidence bands (bands are for 95 percent confidence intervals) leave a wide margin of error, including the possibility of persistently low inflation. The model forecast for the nominal interest rate projects a very slow increase in interest rates starting towards the end of 2015. Again, confidence bands are wide and this should be interpreted as suggesting that monetary policy should closely monitor inflation developments with a bias to tighten if needed.

Figure 5. Out-of-Sample Forecasts for the Output Gap, Inflation, and Interest Rates



VI. Optimal Monetary Policy Response

In this section, we derive an ex-post optimal monetary policy rule for Vietnam. A comparison of the optimal rule with the baseline parameterization provides guidance on how monetary policy could adjust weights on intermediate targets to achieve greater macroeconomic stability.

We define optimality as the joint minimization of output, inflation and exchange rate variability. The derivation of the optimal weights in the monetary policy rule depends on the chosen loss function. Specifically, the minimization problem is:

$$\min_{\theta} E(y_t^{'} W y_t)$$
$$s.t.$$
$$A_1 E_t y_{t+1} + A_2 y_t + A_3 y_{t-1} + Ce_t = 0$$

where θ are the parameters in the monetary policy rule to be optimized, y_t are the model endogenous variables, the e_t are the exogenous shocks, and W is the weighting matrix[7]. The constraint summarizes the path to be followed by the variables so that they are a solution to our model, that is, we are minimizing the variance of the chosen variables subject to them satisfying the model equations.

Figure 6 presents the relative weights on the output gap, the nominal exchange rate, and inflation in the monetary policy rule in the baseline model (blue) and in the optimal model (red) as obtained from the above optimization problem. Table 2 compares the standard deviations of the output gap, inflation, nominal interest rates, nominal exchange rate in the baseline and optimal models. The optimal monetary policy rule suggests that the output gap is a better intermediate target than the exchange rate to stabilize the economy. The central bank would be able to deliver substantial improvements in inflation stability and less accentuated business cycles at the cost of a small increase in exchange rate variability (table 2). In other words, a strong focus on nominal exchange rate stability as an intermediate target to control inflation results in more inflation and output variability. The optimal monetary policy rule would require a more active monetary policy as implied by the larger variability of the nominal interest rate in the optimal model.

[7] The only positive weights on the weighting matrix are the ones related to output gap, inflation and exchange rate.

Figure 6. Relative Weights in the Monetary Policy Rule

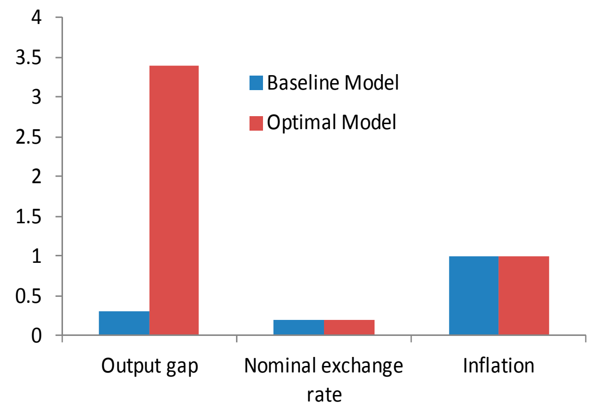


Table 2. Standard Deviations in Baseline and Optimal Model

Standard deviations:	Baseline model	Optimal model
Output gap	1.4	0.9
Inflation	5.3	3.8
Nominal interest rate	9.6	12.4
Nominal exchange rate	2.3	2.4

VII. Shocking the Baseline and Optimal Models

We use the estimated models to analyze the dynamics of shocks to Vietnam's economy. Contrasting the effect of shocks under the baseline and optimal monetary policy rule provides valuable insights into the properties of both policy functions. In the following, we first provide a measure of the monetary transmission in the model and then discuss results for four shocks to Vietnam's economy: a domestic demand shock, a negative external demand shock, rising U.S. interest rates, and an increase in food prices.

A. Monetary transmission in the model

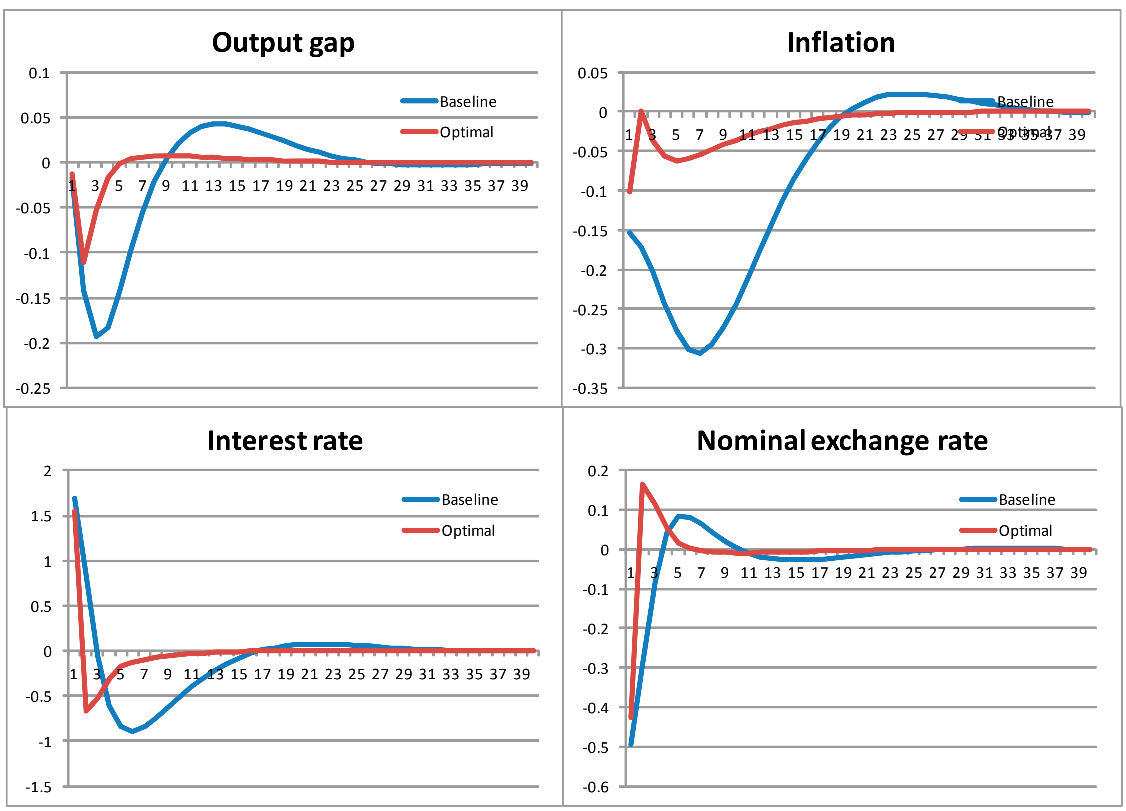
With the model, we can measure the response of inflation, the output gap and the exchange rate to a monetary policy intervention (Figure 7).[8] An increase in the nominal interest rate

[8] Results are presented in deviations, i.e., movements in the variables in relation to their long-run values.

suppresses domestic demand directly through the monetary channel and indirectly through an appreciation of the Vietnamese dong.[9] The appreciation of the currency combined with a contraction in demand leads to a reduction in headline inflation. The model suggests that 100 basis point increase in the nominal interest rate results in a fall in output that reaches a peak of 0.1 percent after about 4 quarters and a real appreciation of about 0.25 percent. The monetary tightening also leads to a decline in headline CPI inflation that peaks at 0.15 percent after two years. The results of our model for Vietnam are qualitatively similar to findings in other empirical studies on the monetary transmission mechanism in developing and emerging countries.

Properties are similar with the optimal monetary policy rule, but deviations from equilibrium are much smaller and reversions back to equilibrium are much faster. This is a result of the greater responsiveness of monetary policy in the optimal model, particularly to output deviations. In the optimal model, the central bank reacts fast to declining output and falling inflation by lowering interest rates. This, in combination with a short-term depreciation of the currency following a brief appreciation in response to the initial rate hike, takes the output gap and inflation back to their equilibrium values after a few quarters.

Figure 7. Monetary Transmission in the Model



[9] Note that with our definition of the exchange rate, a decline is an appreciation of the dong.

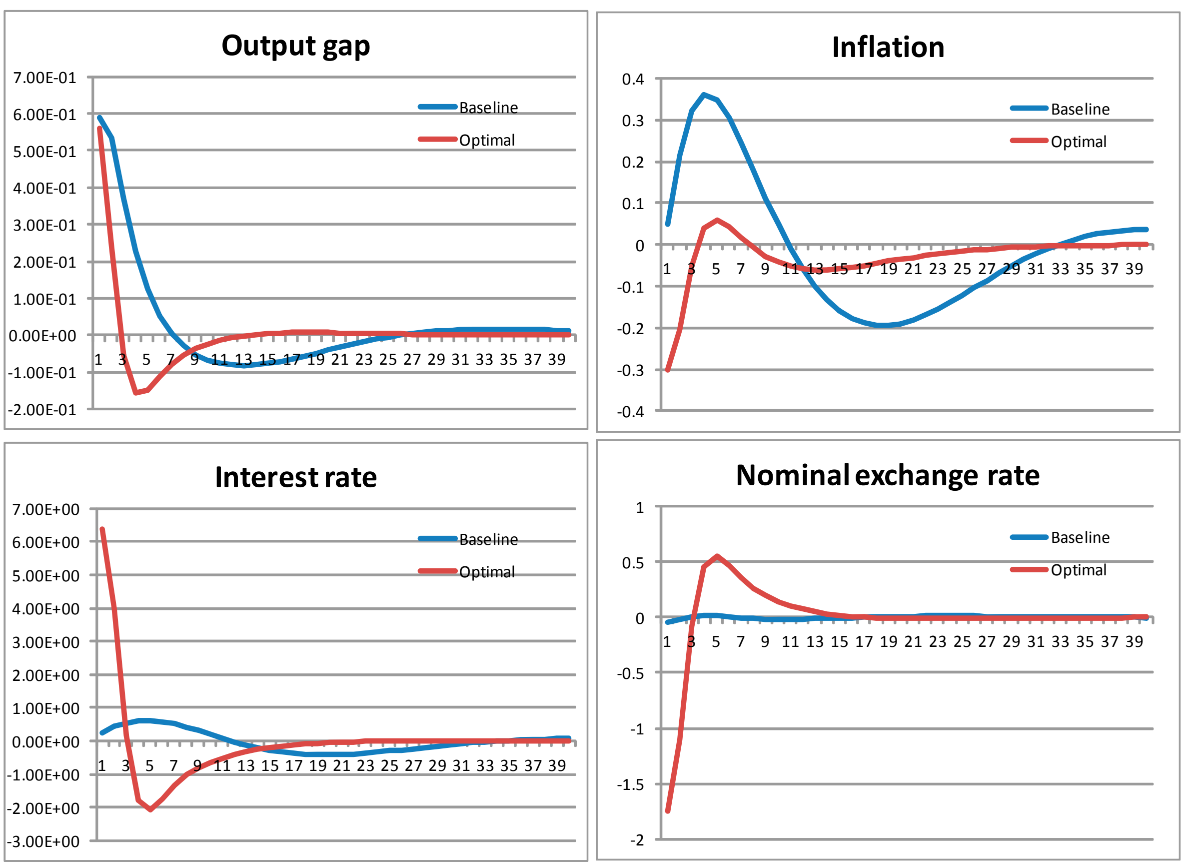
B. Domestic demand shock

Even though fiscal policy has not been directly incorporated in the formulation of this model, we can partially assess the impact of fiscal policy by interpreting a fiscal expansion (contraction) as a positive (negative) shock to domestic demand (Figure 8).

In the baseline model, a fiscal expansion equivalent to a one standard deviation increase in demand (about 0.66 percent), leads to an increase in headline inflation by about 0.35 percent. The central bank responds to rising inflation only with a slow and limited increase in interest rates. Over the medium term, rising inflation leads to a real effective appreciation of the dong (the nominal exchange rate remains stable). The real appreciation causes a medium-term fall in output and inflation falling below target.

In the optimal model, the central bank aggressively raises interest rates to control inflation. The nominal exchange rate is allowed to appreciate which also dampens inflationary pressures. The output gap returns relatively quickly to a neutral level. Shocks dissipate faster with the optimal monetary policy rule than under the baseline.

Figure 8. Positive Domestic Demand Shock

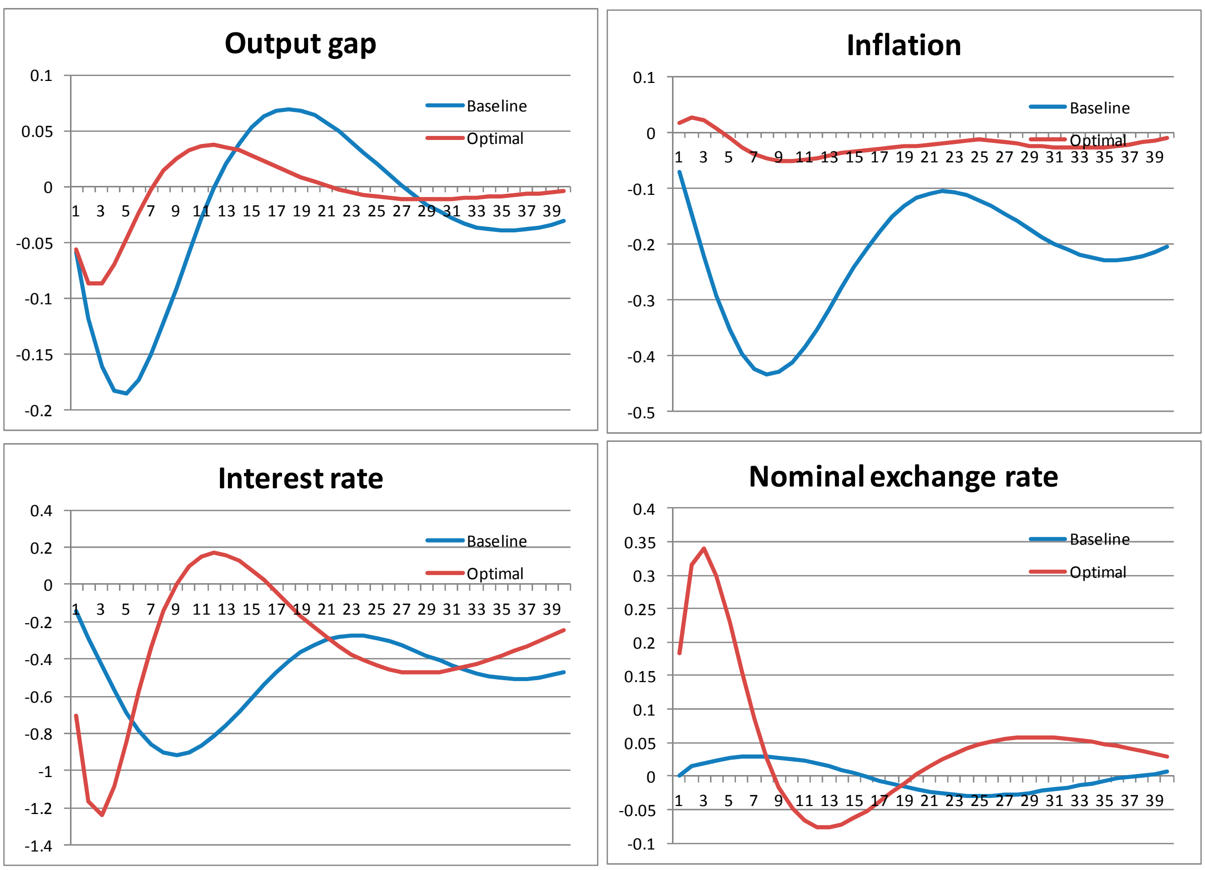


C. External demand shock

Vietnam is one of the most open economies in the world and the export-oriented sector has substantially contributed to growth in recent years.[10] Integration in the global economy has provided many benefits to the Vietnamese economy, but has also increased the exposure to external demand shocks. Growth slowdowns in trade partners or flagging global growth affect Vietnamese exports and growth to a substantial degree. External demand shocks can of course also be positive, including through new trade agreements (bilateral Free Trade Agreements, the Trans-Pacific Partnership, and the ASEAN Economic Community). We present the impact of a decrease in external demand in Figure 9, but an increase in external demand would follow the analog reverse logic.

Under the baseline model, a negative external demand shock causes a reduction in output which leads to a decline in inflation. In response, the central bank slowly cuts interest rates. The nominal exchange rate remains broadly stable, while low inflation leads to a real appreciation.

Figure 9. Negative External Demand Shock



[10] The sum of exports and imports is about 160 percent of GDP.

With the optimal monetary policy rule, the nominal exchange rate is allowed to depreciate and the central bank promptly cuts interest rates. A depreciated dong and supportive monetary policy help to dampen the deviation of output from equilibrium and keep inflation close to target.

D. **Tighter U.S. monetary policy**

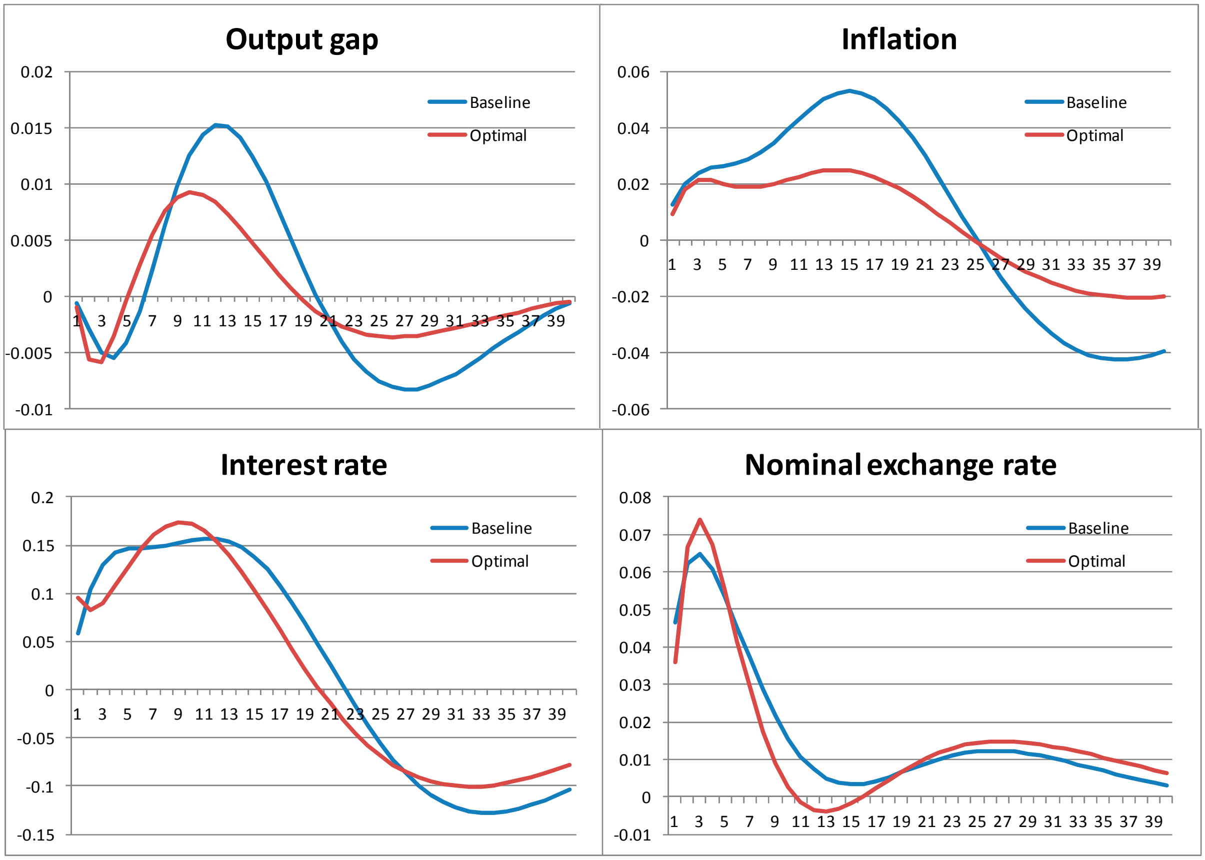
Interest rates have been extraordinarily low in the U.S. for an extended period following the Global Financial Crisis. Easy monetary conditions in the U.S. have benefitted emerging markets including Vietnam through low external borrowing costs. As the U.S. economy strengthens and moves closer to potential, a gradual tightening of monetary conditions in the U.S. becomes likely. The taper tantrum of 2013 when global bond yields and emerging market spreads spiked in response to speculation about an end to quantitative easing provides an example of the possible dislocations associated with a shift in U.S. monetary policy. Vietnam is exposed to spillovers from U.S. monetary tightening through rising external borrowing costs and effective appreciation if the close link between the dong and the U.S. dollar is maintained.

We present model-based impulse responses to a one-standard deviation increase in U.S. interest rates in Figure 10.[11] This shock is in addition to the U.S. monetary policy tightening in the model generated out-of-sample forecasts in section V.D. Under the baseline model specification, the authorities let the exchange rate depreciate in response to higher U.S. interest rates. The dong depreciation supports output, more than offsetting the negative impact from lower external demand and higher domestic interest rates. As a result of the positive output gap and depreciation, inflation remains elevated for an extended period.

Under a more flexible exchange rate regime with a higher weight on output stabilization in the monetary policy rule (the optimal model), the authorities would initially let the exchange rate depreciate more than under the baseline in response to the negative external shock. The dong depreciation stabilizes output, but more active monetary policy keeps inflation relatively stable and output returns faster to equilibrium than under the baseline model. The model demonstrates that by allowing more exchange rate flexibility in the face of a tightening in U.S. interest rates, greater macroeconomic stability can be achieved.

[11] In the data, a one standard deviation move in U.S. rates is 0.21 percentage points.

Figure 10. Tighter U.S. Monetary Policy

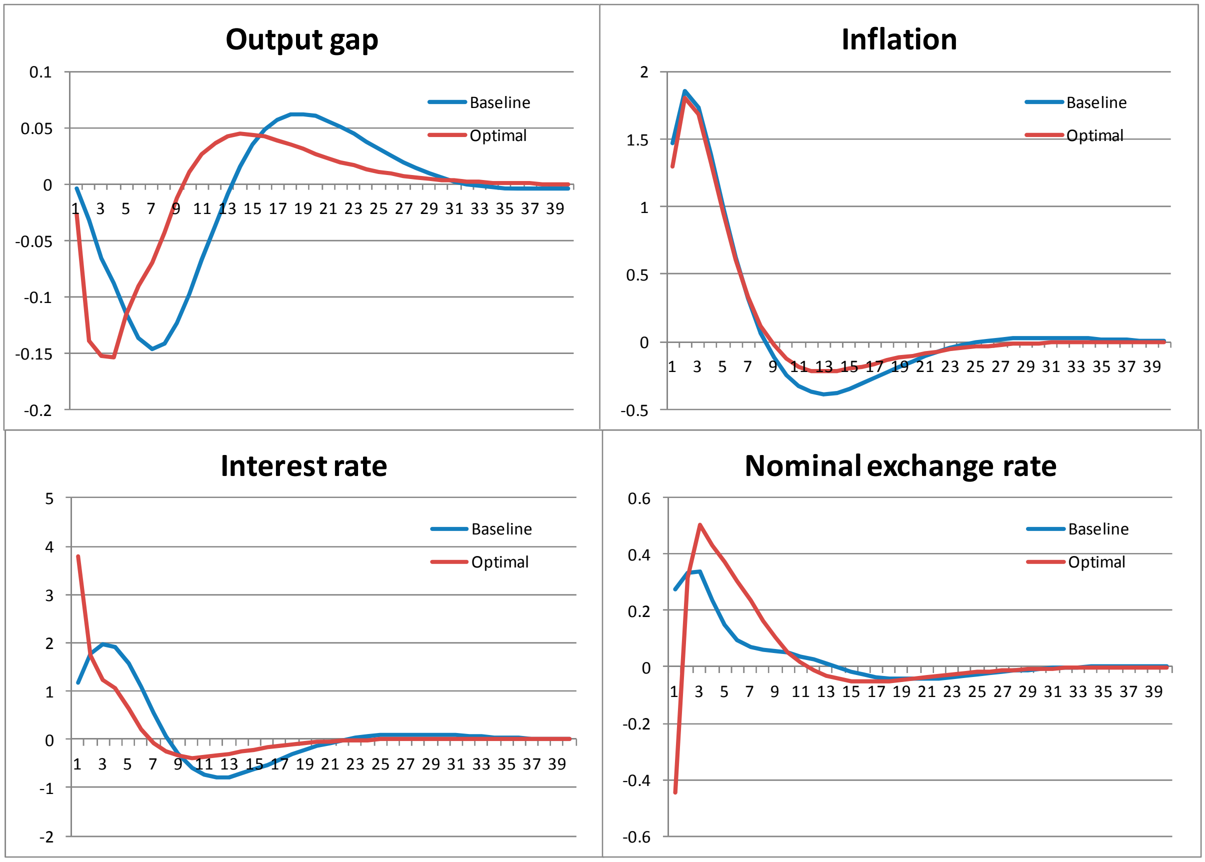


E. Food Prices Shock

Figure 11 presents impulse response functions for a one standard deviation shock in food price inflation under the baseline and optimal monetary policy rules. In the baseline model, the central bank reacts to inflation by increasing the nominal interest rates by about 100 basis points initially. However, the rate hike does not fully offset inflation so that real interest rates decline which leads to an initial nominal depreciation. Rising nominal interest rates lead to a decline in output in the medium-term.

With the optimal monetary policy rule, the authorities react strongly to the increase in inflation raising interest rates by 400 basis points. This leads to an increase in real interest rates and initial nominal appreciation followed by subsequent depreciation. The combined effect of these policies is an earlier contraction in output, and an earlier and quicker recovery. Accumulated output losses are lower than in the baseline model and inflation returns to target more quickly in the optimal model.

Figure 11. Food Price Shock



VIII. Conclusions

The Vietnamese authorities place high importance on maintaining macroeconomic stability with robust sustainable economic growth and low inflation. Monetary and exchange rate policy is essential to achieve this goal. In recent years, the focus of monetary policy has been on the exchange rate as the nominal anchor. Maintaining a de facto exchange rate targeting regime will become increasingly difficult as Vietnam faces asymmetric shocks compared to the U.S. An exit of U.S. monetary policy from quantitative easing will likely test Vietnamese monetary policy. The SBV plans to gradually implement a forward-looking monetary policy framework focused on using inflation as a nominal anchor with greater exchange rate flexibility.

We estimate a stochastic general equilibrium model for Vietnam to aid the analysis of different monetary and exchange rate policies through a consistent framework that formally models and clarifies transmission mechanisms, measures policy stances and allows forecasting given policy actions. The model provides a good fit for actual Vietnamese data over the last 15 years and performs well in in-sample forecasting.

The model estimation provides insights into some structural features of the Vietnamese economy. We find that the inflation process is very persistent, which implies that monetary policy has to maintain a tight stance for a prolonged period of time to bring inflation back to the desired target. This result is not unusual given Vietnam's level of development. The development of an inflation target regime, combined with improved central bank credibility and a better understanding of the monetary transmission mechanism, would over time lower the necessary adjustments in policy interest rates to contain inflation and inflationary pressures. The estimation of Phillips curves for core and food/fuel inflation shows the expected result that monetary policy has little impact on food inflation, and a larger impact on core inflation. These results imply that the sacrifice ratio in Vietnam, the amount of output adjustment necessary to steer inflation, is relatively large and stress the importance of a more active monetary policy that focus on inflation stability.

In addition to the baseline parameterization of the model, we derive an optimal monetary policy rule that jointly minimizes the variability of output, inflation, and the exchange rate. The optimal model places a greater weight on the output gap as the intermediate target to achieve inflation stability, while allowing greater exchange rate flexibility to absorb shocks. The optimal monetary policy function delivers greater macroeconomic stability (reduced inflation and output variability) with only a small increase in exchange rate variability. Over longer periods, the more flexible exchange rate regime does not increase exchange rate variability by much, as large forced exchange rate changes become less necessary.

Finally, we analyze the dynamics of key macro variables under exogenous shocks for the baseline and optimal model parameterization. Shocks include rising U.S. interest rates, an increase in food prices, a domestic demand shock that can be interpreted as a fiscal expansion, and an external demand shock. The optimal monetary policy rule delivers greater macroeconomic stability for Vietnam under the shock scenarios. A critical factor in achieving more output and inflation stability is the buffering role a flexible exchange rate can play to facilitate internal and external adjustment.

The model in this paper provides a tool for a rigorous approach to monetary and exchange rate policy analysis and to support the implementation of a forward-looking monetary policy framework. To transition to a more inflation-centered monetary policy regime, other practical issues also need to be addressed (see Laxton and others 2009 for an overview of practical steps towards an IT targeting regime).

Table A1: Priors and Estimated Posteriors

	Prior	Posterior	Confidence Interval	
IS curve				
β_laggap	0.6	0.5603	0.5537	0.5659
β_lead	0.15	0.2148	0.209	0.2187
β_RR	0.09	0.0984	0.0925	0.1037
β_Z	0.08	0.0932	0.0875	0.0986
β_RW	0.2	0.1258	0.1155	0.1316
Taylor Rule				
γ_π	1.8	1.527	1.5072	1.5462
γ_YGAP	0.45	0.4398	0.4333	0.4465
γ_RSLAG	0.5	0.4909	0.4858	0.4953
γ_ZGAP	0.1	0.1158	0.1044	0.1247
Core Inflation Phillips Curve				
α_πC	0.2	0.2254	0.2184	0.231
α_YGAPC	0.25	0.2726	0.2677	0.2779
α_ZGAPC	0.1	0.0809	0.0767	0.0858
α_C	0.1	0.0797	0.0723	0.0876
κ_πC	0.3	0.2908	0.289	0.2926
ω_πFF	0.52	0.5209	0.5185	0.5235
Food Inflation Phillips Curve				
α_YGAPFF	0.1	0.143	0.1346	0.1507
α_ZGAPFF	0.3	0.3401	0.3356	0.3443
α_πFF	0.8	0.7737	0.7683	0.7797
CTE_πFF	2	1.7907	1.5598	1.8
κ_πFF	0.6	0.6064	0.6002	0.612
AR (1) coefficients and Lead Exchange rate				
DELTA_ZLD	0.25	0.1669	0.1591	0.1751
κ_GDP_GAP	0.6	0.6035	0.5978	0.6108
κ_π	0.9	0.9548	0.9288	0.9728
κ_RS	0.9	0.9018	0.8895	0.913

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