A Preliminary Assessment of the Price Puzzle and the Transmission Channels in the Philippines Using VAR Analysis

AUTHOR

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1. Introduction and Literature Review

Most of the recent empirical literature makes use of the vector autoregression (VAR) approach to assess the transmission mechanism of monetary policy. The VAR methodology’s advantage over other analytical approaches is that it recognizes explicitly the simultaneity between monetary policy and macroeconomic developments. Representing the transmission process using VAR also eliminates empirical issues on how to correctly specify a monetary policy shock.

Studies which employed VAR models to investigate the empirical effects of monetary policy via the transmission channels have come up with a “price puzzle”—a result that reflects a rise in the aggregate price level in response to a contraction in monetary policy (Hanson, 2000). The initial positive response of prices to a contractionary monetary policy shock is a stylized fact of most empirical studies estimating the impact of monetary policy on the real economy. It is regarded as “puzzling” because macroeconomic models cannot explain the result theoretically. Some studies propose the inclusion of commodity prices as a variable to resolve the puzzle because this variable contains information that helps forecast inflation in varying degrees, depending on the characteristics of the economy in question. However, variables that forecast inflation do not always resolve the puzzle. Alternatively, inflation expectations are also used as an explanatory factor, claiming that it is when expected inflation is omitted from the VAR that accounts for the puzzling response of the price level to a monetary policy shock. This is also consistent with Bernanke’s argument about the price puzzle:

“[...] changes in inflation expectations, which are ultimately the product of the monetary policy regime, can also be confused with truly exogenous shocks in conventional econometric analysis. [...] insuffciently anchored inflation expectations have led to periodic “inflation scares” in which inflation expectations have risen in an apparently autonomous manner [...].”

The presence of a price puzzle is important because it casts doubts on the possibility of correctly identifying a monetary policy shock. As Castelnuovo and Surico (2006) explains, the result of this omission is that a policy tightening in anticipation of future inflation could be wrongly interpreted as a policy shock, creating a strong correlation between a tightening of policy and a rise in inflation: the price puzzle.

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1 In a speech as Federal Reserve Chairman as taken from Castelnuovo and Surico 2006, Bank of England.

2 Dakila and Paraso (2004), for example, looked into the interest rate channel in the Philippines by obtaining coefficients under a general to specific modeling methodology using PC Give with a validation under a Vector Error Correction (VEC) system and saw an initial increase in the inflation rate up to the eighth quarter after a monetary policy shock.
The main objectives of this paper are to use VAR analysis to examine the presence of price puzzles observed in the monetary transmission process using four channels and provide an assessment on whether inflation expectations would resolve such price puzzles empirically. This study will also try to assess the implications of the inclusion of inflation expectations in the transmission channels.

2. Data and Methodology

In this exercise, VARs will be employed to: 1) examine four channels of monetary transmission, namely, the interest rate, credit, asset price, and exchange rate channels, and 2) examine the presence of a price puzzle. The methodology allows for minimal restrictions on how monetary shocks affect the economy, which is a distinct advantage. In addition, the approach recognizes the dependence of monetary policy on other economic variables and vice versa (Ahmed et al. 2005). We will be using here a standard unrestricted VAR methodology. The VAR models were identified using the “recursive” Choleski decomposition. The Choleski ordering for the variables is based on basic economic theory, the assumptions about the dynamic structure of the economy, and is in part guided by the Granger causality tests we have conducted prior to estimation. The results are reliable only if the estimated VAR correctly represents the true process, that is, if the stability condition that no unit root lies outside the unit circle is satisfied. If the VAR, for instance, has a unit root in it then impulse responses will be biased. Thus, all VAR systems in the study were subjected to standard unit root tests and were pursued only if the stability condition is satisfied. For each of the four channels estimated in this paper, impulse response functions will be presented first in order to see how the variables react to changes in the policy rate. Using variance decompositions, the importance and predictive content of policy rates and market interest rates in explaining real variables are then investigated.

The VAR analysis in the paper borrows largely from the study of Gochoco-Bautista (2005) and replicates the VAR systems and methodology of Ahmed, Shah, Agha, and Mubarik for Pakistan (2005) in representing the different channels of transmission. For the indicators used in the study, the data ranged from January 1985 to December 2008. Prior to estimation, all the variables were adjusted for seasonality using X12 in Eviews, and the different transformations of each (such as growth rates, logs, differentiated, or dlog forms) were examined for stationarity using both basic and various more stringent stationarity criteria from Eviews. An important assumption in the study as a whole is that the effective RRP (ERRP) is the main policy rate and the 91-Day Tbill rate is the main conduit by which the policy rate affects the rest of the economy. This is based on the findings of Dakila and

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3 In regard to the question of testing whether the impulses and possible puzzling effects arrived at in the various channels represented in the VARs are significantly different from zero, there is really no accepted “rule of thumb.” There is no consensus on an explicit criterion for significance in a VAR framework. Sim (1987) however suggests that for impulse responses significance can be crudely gauged by the degree to which the function is bounded away from zero, whilst Runkle (1987) suggests a probability range above 10 percent for variance decompositions.
Claveria (2006)\(^4\) which showed that a one-time shock in the RRP rate by one percentage point leads to a maximum increase in the 91-day T-bill rate of 0.70 percentage point in the second month and dissipates thereafter.

3. The Transmission Channels Using VAR and Analysis of Results

I. Interest Rate Channel:

*Taylor Rule Model: OG_SVAR, d(CPI), 91Tbill, ERRP\(^5\)*

We represent the interest rate channel based on the Taylor rule-based model where policy rate changes, via the 91Tbill rate, affect inflation and the output gap. In this four-variable VAR, the impulse response of the real variables to innovations in the Tbill rate in Figure 1 is worth noting. The change in CPI reacts to shocks in the Tbill rate with an initial price puzzle, peaking at around the 3rd month and then falling continuously crossing the axis on the 5th month and dropping to a lower long-term level. We do not find this, however, in the response of prices to the innovations in ERRP. Price changes decline immediately after a rise in the ERRP rate, reaching a long-term level that is lower than the initial equilibrium. Meanwhile, the output gap generally falls in response to a rise in the 91Tbill rate. The trough is at its deepest by the 5th month. What is unique in this VAR system is that the response of the output gap to a shock in the policy rate, or ERRP, is S-shaped, that is, there is an initial rise, before it falls back down and maintains a slightly lower output gap level going forward–some sort of a short “output puzzle.”

In order to have an idea of the share of fluctuations in a given variable that are caused by changes in the policy rate, we now look at the variance decompositions. Looking at Table 1, shocks in the ERRP account for 0.4% of

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\(^4\) In their study, they estimated a VAR system of the RRP rate, month-on-month change in the exchange rate, 91-day T-bill rate, real money supply and deviation of gross domestic product (GDP) from trend.

\(^5\) OG_SVAR is the output gap estimates under the SVAR methodology; d(CPI) is changes to the CPI level; 91Tbill is the 91-day T-bill rate; ERRP is the effective RRP rate (After the removal of the tiering system in 2007, the ERRP rate coincides with the RRP rate)
the variances in the output gap, while innovations in the 91Tbill rate explain 5.9%, both at the end of the 24th month. Price changes, on the other hand, explain only 0.7% of the variances in the output gap for the same period. Meanwhile, 47.4% of the variance in the ERRP is explained by the 91Tbill rate. The ERRP accounts for only 1.3% of the variances in the CPI, whereas market interest rates account for 5.4%. These results are important because it means that although a close relationship exists between the ERRP and market interest rates, the changes in the ERRP explain a smaller proportion of changes in prices. For the period 1988 to 2008, there were structural changes in the economy that may be producing these results. It may be recalled that the role of the ERRP as the BSP’s main policy instrument was only clearly identified upon the implementation of inflation targeting (IT) in 2002.

The BSP’s shift to IT in 2002 may have changed the relationship between the ERRP and the 91Tbill rate. As a result, it may be relevant to assume that there could have been structural changes between these time periods (i.e., pre-IT and post-IT). In the past, the 91-day Tbill rate was considered as the benchmark market interest rate as it responded directly to changes in the BSP’s policy rates, with other longer-term market interest rates following suit. Of late, however, there appears to be some degree of divergence between these rates. In order to look into this issue, let us therefore repeat the VAR exercise but now look into two subperiods: 1985-2001 (before IT) and 2002-2008 (when the IT framework has already been put in place) and then compare the results.

Estimating the VAR for the two subperiods 1998-2001 (before IT) and 2002-2008 (during IT) in Figures 2 and 3, we observe the following results. First, the price puzzle is still observable during the two subperiods both in terms of the response of prices to the ERRP and the response of prices to the 91Tbill rate, but the magnitude and persistence of the price puzzle was generally more pronounced in the periods before IT was established as the BSP’s monetary policy framework. This result indicates that there is reason to believe that the response of price changes to monetary policy has improved in the years during which IT was implemented. The response of the output gap to the changes in the 91Tbill rates during 2002-2008 is now in line with theoretical precepts which say that an upward adjustment in the policy rate results in lower actual output growth and therefore lower output gap, but the magnitude of response of the output gap is relatively smaller in the current period compared to that before IT. This may be a reflection of how, before IT, monetary authorities were viewed as responding more to growth concerns at the expense of inflation objectives.

When we look at the variance decompositions of the variables in Tables 2 and 3, the important result is that during IT, changes in prices are accounted more significantly by changes in the ERRP at 47.3%, compared to the response of

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Granger causality tests show that the RRP rate Granger causes both 91-day and 364-day Tbill rates in the primary market at the 1% confidence level. Likewise, the RRP rate Granger causes the 91-day Tbill rate in the secondary market at the 10% confidence level; while the 91-day Tbill Granger causes the 364-day Tbill rate in the secondary market at the 5% confidence level.

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dCPI to changes in the 91Tbill rate at 29.8%. Meanwhile, the ERRP accounted for only 0.6% of the changes in CPI from 1988 to 2001. Likewise, the output gap responded more to the ERRP rise during 2002 to 2008 than in 1988 to 2001. This may be indicating that under IT, monetary policy has more real effects on the economy, improving the effectivity and perhaps the credibility of a monetary policy response.

II. The Credit Channel

**Credit Channel: OG_SVAR, dCPI, dCredit, 91TBill, ERRP**

We represent this channel by including changes in credit levels in the VAR to examine the effect of bank lending on the transmission mechanism. Figure 4 shows us the impulse responses of the output gap, dCPI, dCredit, and the
91Tbill rate to innovations in the ERRP and then the response of the output gap and prices to innovations in private sector credit (or dCredit). While the inclusion of a credit variable did not change the response of real output and prices on shocks in the ERRP much—a short-lived price puzzle in fact is still observed for innovations in the ERRP—the credit channel appears to have suppressed the response of the output gap to innovations in the 91Tbill rate. The output gap shows a marginally smaller decline persisting over a shorter period and moving almost asymptotically much later on, compared to the earlier VAR model where the output gap reached its lowest point early, within a few months of the contractionary monetary policy. In addition, the credit channel has increased the duration and magnitude of the decline in prices in response to a higher 91Tbill rate before dissipating compared to the basic interest rate channel VAR system.

These results reflect how the credit channel appears to be suppressing the adverse impact of contractionary monetary policy on output albeit not directly but through market interest rates, in this case, the 91-day Tbill rate.

Table 2

Table 3

Figure 4

Credit Channel. 2000-2008
Conversely, therefore, we may assume that in the case of an accommodative monetary policy, the credit channel in the economy could also suppress or delay the expansionary impact of monetary policy on output. The existence of contracts between borrowers and lenders may be providing some “stickiness” or lag in the way the impact of monetary policy is translated into output via the credit channel. In addition, there is some upturn in loans in the face of a positive shock in the ERRP and the 91Tbill rate around 4 to 5 months after the shock, and then later on when credit begins to decline, the response fluctuates erratically across the 12-month period. The positive response of credit is the reverse of what is expected from theory. Higher interest rates should dampen the amount of loans to the private sector since these translate to higher cost of capital or higher interest expense for borrowers.

It is also interesting to note that, although the response of the change in loans to the Tbill rate is sharper and the effects persist over a longer period of time than its response to the ERRP based on the impulse responses, Table 4 shows that variations in dCredit are explained by broadly the same magnitude from changes in ERRP and changes in the 91Tbill rate.

III. The Asset Price Channel

**Asset Price Channel: OG_CES, dCPI, d(PHISIX), TBILL91, ERRP**

The asset price channel refers to the impact of monetary policy on financing costs. When interest rates are increased, stock prices fall and the companies’ capacity to find financing, thus resulting in smaller investment. In addition, the fall in the stock market implies a reduction in the wealth of the individuals that invest in this market who, in turn, will reduce their consumption as a result of this shock.

Looking at the impulse responses in Figure 5, we see that before the stock prices index falls, there is an initial upturn in the impulse response of dPHISIX to innovations in the 91Tbill rate and the ERRP rate. The “puzzling” response of prices to a rise in the ERRP rate and the 91Tbill rate is also amplified via the asset price channel: the price puzzle is of larger magnitude and the duration is longer than the price puzzle we have seen in the Taylor model with market interest rates.

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Table 4

<table>
<thead>
<tr>
<th>VARIANCE DECOMPOSITION, on the 24th Month</th>
<th>% of Variance Attributable to Shocks in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>OG_SVAR</td>
<td>dCPI</td>
</tr>
<tr>
<td>OG_SVAR</td>
<td>61.1</td>
</tr>
<tr>
<td>dCPI</td>
<td>9.9</td>
</tr>
<tr>
<td>dCREDIT</td>
<td>9.4</td>
</tr>
</tbody>
</table>

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7 OG_CES is for the output gap estimates under the CES production function approach. We have used this output gap series because the SVAR series produces VAR results with at least one unit root. Meanwhile, dPHISIX is for the changes in the Philippine stock market price index.
The puzzles embedded in the impulse responses above are confirmed by the values in our variance decomposition tables. Table 5 shows how little the variances of other variables account for the variances in the stock prices. The ERRP explains only 2.6% of the variances in dPHISIX, whereas the 91Tbill rate accounts for only 1.0%. Changes in prices account for a relatively bigger portion of the variances in stock prices, at 3.0%. dPHISIX own variances is what accounts for the bulk of the variances in stock prices. These results are affected by the highly volatile nature of stock prices in the Philippines and perhaps in general, and understandably, price changes influenced it moderately because it is driven mainly by expectations. Clearly, monetary policy at this point does not have a direct impact on asset prices, if not only via price levels. We will return to this issue later when we go into the discussion of the various price puzzles we have seen above.

### IV. The Exchange Rate Channel

**Exchange Rate Channel: OG_CES, dCPI, Real effective exchange rate (REER), TBill91, ERRP**

Another way in which monetary policy affects inflation is via the exchange rate channel where we include the REER variable to serve as the conduit of the impact of monetary policy to the real economy. This channel only applies in an economy open both to trade and to capital flows. When there is an increase in interest rates, investment in peso-denominated bonds becomes more attractive, and an increase in the inflow of capital is generated. Under a flexible exchange rate regime, this flow results in an appreciation of the

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8 Ibid.
exchange rate. Demand and supply effects of this appreciation lead to an eventual reduction in the prices of non-tradable goods (Martínez, 2000).

Figure 6 conforms with basic theory that higher policy rates lead to a real appreciation in the exchange rate for the full period. The exchange rate channel is also not showing a price puzzle, because with this channel prices respond negatively to innovations in the ERRP beginning in the period immediately preceding the shock. However, the response of REER to changes in the 91-day Tbill rate is not as conventional. We see a reverse response, that is, the REER tends to rise with an interest rate increase, maintaining a higher level even after two years. There is clearly an omission problem here, as results show that there is something between an ERRP change and its impact on the real exchange rate that is not captured by changes in market interest rates in the VAR model we have investigated.

Our contention above that there is variable omission acting as the link between the real exchange rate and monetary policy is confirmed in the variance decomposition results in Table 6. The variance in REER is accounted for by the ERRP and the 91Tbill rate by only 0.1% and 0.3%, respectively.

In a country like the Philippines, with little influence in the international markets, the appreciation should be translated into a reduction in the national currency price of tradable goods. This fall in the price of tradable goods makes the production of non-tradable goods more attractive, and a reallocation of resources from the tradable sectors towards the non-tradable ones occurs. From the demand side, when non-tradable goods become relatively more expensive, the quantity demanded will fall.
Although 3.8% of the changes in the output gap and 5.6% of the changes in prices are attributable to shocks in the REER, a big portion of the variance in all the variables in this VAR system is attributable to own variances only.

4. Inflation Expectations and the Price Puzzle

The results above show that the price puzzle appears in three out of the four VAR systems. Specifically, there is a short, but nonetheless positive, response in price changes after a rise in the ERRP. We also found some other “puzzles”: an early positive response in the level of stock prices, a real depreciation or a rise in the REER, and some unconventional results for the credit channel. Several iterations of each VAR system with the “puzzle” have not been able to arrive at the expected or desired results—different combinations on the years of coverage, iterations on the transformation of the variables, or iterations of the different definition for the variable (specifically for the output gap variables) were either unable to change the puzzling results or produced VARs that did not satisfy the unit root condition.

What we have seen to be consistently able to either improve on or resolve the various puzzles at varying degrees (on price, output, stock price changes, and the exchange rate) in the VAR exercises above is the addition of a variable representing inflation expectations. We examined this by including Asia Pacific Forecasts (APIE) into the VAR equations for the interest rate, asset price and exchange rate channels, and Bloomberg’s inflation expectations survey results for the credit channel (see impulse responses in Figure 7, 8, 9, and 10 in the Annex). As pointed out above, the omission of this variable resulted in radical VAR results especially under the asset price and exchange rate channels.

Figure 7

Interest Rate Channel with Inflation Expectations. 1998 to 2008
5. Conclusion

Including a variable on inflation expectations into the VAR systems gave us a better picture of the transmission process by which monetary policy affects real variables in the Philippines. With inflation expectations as an added variable, we find that the price puzzle and the “output puzzle” (under the interest rate channel) have been minimized to almost nil in the first two to three months. In the case of the credit channel, the response of credit to market interest rates are now negative and stable as theory suggests, in contrast to the fluctuating and volatile response of credit to the 91Tbill rate in the case without inflation expectations. Meanwhile, the response
of credit to changes in the ERRP retains a very small “puzzle” for only the first two months, but of much smaller magnitude than in our earlier credit channel VAR system without inflation expectations. The impact of inflation expectations is even more important for the VAR system depicting the asset prices and exchange rate channel of monetary policy in the Philippines. With the inclusion of the inflation expectations variable (the Asia Pacific consensus forecasts for the asset price channel and the Bloomberg inflation expectations for the exchange rate channel), the “puzzling” results earlier arrived at were eliminated. There is now, as expected, a negative response in the real exchange rate and asset prices to a rise in the policy rate or the ERRP.

The most important finding is that it is necessary to include inflation expectations in any assessment or estimation of the relative importance and magnitude of the transmission effects in all channels if we are to represent as close as possible the process by which monetary policy changes impact the real economy. An assessment of the expected impact of policy rate changes and movements in the market interest rates on the real economy could truly replicate the monetary policy transmission mechanism in the Philippines if monetary authorities factor in how inflation expectations are evolving and how they will change with any policy decision. In retrospect, during the last two quarters of 2008 the BSP decided to raise policy rates mainly in order to anchor inflation expectations, despite an inflation outlook that was seen as broadly remaining within the upper bound of the target ranges for 2009 and 2010. The tightening policy moves at that time were broadly successful in minimizing the adverse impact of the higher inflation expectations on demand and on confidence. The economy continued to post positive growth in Q3 and Q4 2008, and inflation expectations began to subside towards the end of 2008. Had the BSP based its policy decisions on the inflation outlook alone without considering how inflation expectations were evolving, second-round effects of the higher commodity and fuel prices in Q3 and Q4 2008 may have resulted in even higher inflation outturns for the rest of 2008, and may have affected domestic demand conditions fully and therefore aggravated the impact of the worsening global financial crisis on the domestic economy during the same period.

The consideration of the impact of a policy adjustment in the economy should also not be limited to its impact via the basic interest rate route, which we have identified here using the Taylor-rule framework. As seen in the earlier VAR results, the credit channel can “block” or lessen some of the adverse impact of monetary tightening on the domestic output, in the same way that
it can create a lagged response of economic growth to an accommodative monetary policy stance. This may be a result of the fact that credit growth is found to have a lagged response to changes in the business cycle, inasmuch as high transactions costs and information asymmetry as well as a supplier-driven Philippine banking system all contribute to some rigidities in loan growth. It is clearly important that monetary authorities assess the impact of a monetary policy shock via all relevant transmission channels in the real economy.

Bibliography