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Role of expected inflation in explaining the liquidity puzzle

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Abstract

Some previous studies have reported puzzling responses of macroeconomic variables, including liquidity, price, and exchange rate anomalies, following central banks' policy disturbances. The objective of this paper is to address the anomalies, with a focus on the liquidity puzzle, by disentangling the policy effect on expected inflation from its effect on the expected real interest rate (ex-ante). First, I extract the ex-ante real rate and expected inflation from the one-year Treasury yield using the Blanchard-Quah (1989) SVAR together with the Fisher equation. Then, I use these decomposed variables along with other variables to develop a Canada-specific open-economy SVAR model. Applying Bayesian estimation via Gibbs sampling, I find that shocks in M1 decrease the expected real interest rate, increase expected inflation, depreciate the Canadian dollar, and boost output. I posit that the increase in nominal interest rates found in previous studies likely reflects a dominant rise in inflationary expectations that outweighs the fall in the ex-ante real rate. These results highlight the importance of isolating expected inflation from real interest rate movements for policy analysis and underscore the need for the Bank of Canada to closely monitor money supply trends to enhance the effectiveness of its policy framework.

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1. Introduction

Some previous studies documented liquidity puzzles and a few other anomalous results following central banks' policy disturbances.[1] For example, Christiano (1991) and Leeper and Gordon (1992) found that shocks to monetary aggregates increased the interest rate, which is contrary to the concept of the liquidity effect. Muhanji et al. (2013) also reported similar liquidity puzzles for several African countries. Focusing on Canada, Cushman and Zha (1997) and Bhuiyan (2012) attributed these anomalies to a misspecified policy reaction function—one that does not fit the structural realities of a small open economy. These authors suggested specifying the monetary authority's reaction rule using the short-term Treasury bill rate. Alternatively, Champagne and Sekkel (2018) suggested employing the Romer and Romer's (2004) narrative strategy to build a series of policy innovations for Canada. For the U.S., Strongin (1995) and Christiano et al. (1996) recommended using narrow measures of money supply as policy variables because shocks to broader monetary aggregates may capture non-policy disturbances.

While prior studies showed that monetary aggregate shocks increase nominal interest rates, a critical question is: which specific element of the nominal rate—the expected (ex-ante) real interest rate or expected inflation—primarily drives the net increase? This paper addresses this question by examining how each element of the nominal rate reacts to monetary aggregate shocks. To achieve this objective, I first use the Fisher equation to estimate the expected real rate and expected inflation for Canada by decomposing the nominal interest rate—measured by the one-year Government of Canada Treasury yield—using the Blanchard–Quah (1989) SVAR (hereafter, the BQ model). Subsequently, I incorporate these estimates, along with other variables into a Canada-specific Bayesian SVAR following the frameworks of Cushman and Zha (1997) and Bhuiyan (2012).

After estimating the SVAR model with a Bayesian approach implemented via a Gibbs sampling estimation technique, I find that a positive shock in the monetary aggregate M1 lowers the expected real interest rate, drives up expected inflation, depreciates the domestic currency, and stimulates output. Therefore, I argue that the liquidity puzzle—the previously observed increase in the nominal interest rate following shocks to monetary aggregates—is not attributable to rises in the real rate. This paper makes contributions to the existing literature by resolving the liquidity puzzle, showing that the net increase in the nominal yield is caused by a dominant increase in its expected inflation component, which outweighs a smaller fall in the ex-ante real rate. I also demonstrate that shocks to M1 produce macroeconomic responses that are consistent with Obstfeld and Rogoff's (1995) Open-Economy New Keynesian Model.

This article proceeds in seven sections. Section 2 summarizes prior research and outlines the conceptual framework; Section 3 details the data sources, variable selection rationale, and preprocessing steps; Section 4 explains how expected inflation and expected real interest rates are calculated employing the BQ method; Section 5 develops the SVAR used to identify M1 shocks; Section 6 reviews empirical findings and discusses their broader context; and Section 7 draws conclusion and outlines key policy implications.

[1] For a detailed explanation of these puzzles, please see Kim and Roubini (2000).

2. The Literature Review and Theoretical Framework

In Obstfeld and Rogoff's (1995) framework, monetary policy transmits to real activity mainly via interest-rate and exchange-rate movements. Building on Sims' (1980) foundational work, a wide range of VAR models have been developed and applied across different economies to measure the impact of monetary policy disturbances. However, as noted by Kim and Roubini (2000) and Muhanji et al. (2013), a substantial portion of this literature reports puzzling and sometimes counterintuitive macroeconomic responses to such shocks. Regarding the Canadian economy, Cushman and Zha (1997) and subsequently Bhuiyan (2012) attributed these anomalies to the misidentification of the monetary policy function within VAR models, particularly when applied to small open economies. These studies argued that traditional VAR models often fail to account for the unique dynamics of small open economies, leading to inaccurate identification of monetary policy shocks. To address this issue, both studies advocated SVAR approaches that explicitly integrate small-open-economy characteristics, thereby improving the identification of policy innovations and clarifying the paths through which they propagate.

On the other hand, outside the VAR literature, a good number of studies highlight how expected real interest rates and expected inflation influence the decisions of central banks, consumers, and businesses. Coibion et al. (2020) claimed that inflation expectations and expected real rates are critical determinants of household decisions regarding consumption, savings, wage bargaining, and labor supply. Similarly, firms' beliefs about future inflation play a pivotal role in pricing strategies, wage-setting, and investment decisions. Therefore, as Sousa and Yetman (2016) demonstrated, central banks also place significant weight on ex-ante real interest rates and inflationary expectations when formulating monetary policy.

Although Cushman and Zha (1997) and Bhuiyan (2012) proposed SVAR specifications that better reflect Canadian monetary policy, important scope remains to improve the policy identification. This paper extends the SVAR by incorporating inflation expectations and the expected real interest rate to determine which component of the nominal interest rate accounts for its net increase due to an M1 shock. I trace the separate responses of the expected real interest rate and expected inflation to the shock, providing a more direct explanation of the liquidity puzzle. In addition, the inclusion of these variables strengthens the SVAR identification by embedding forward-looking information about broader macroeconomic conditions, as argued by Sousa and Yetman (2016). Motivated by the gap in the literature, this paper tests the following central hypothesis: the post-shock rise in the nominal interest rate is driven primarily by an increase in expected inflation rather than by an increase in the expected real interest rate.

As illustrated in Figure 1, this paper follows a two-step strategy to meet its objectives. In step 1, I applied the BQ model to extract expected inflation and the expected real rate embodied in the nominal yield. In the decomposition process, I assume that innovations to the expected real interest rate leave the nominal interest rate unchanged in the long run, while expected inflation shocks drive its permanent component. In step 2, I feed these constructed series—along with selected Canadian and external variables—into the SVAR to examine the effects of the shock in M1 on different macroeconomic variables, specifically the liquidity effect. I carry out the estimation via Bayesian Gibbs sampling in the spirit of Waggoner and Zha (2003), which yields more stable and statistically reliable impulse-response.

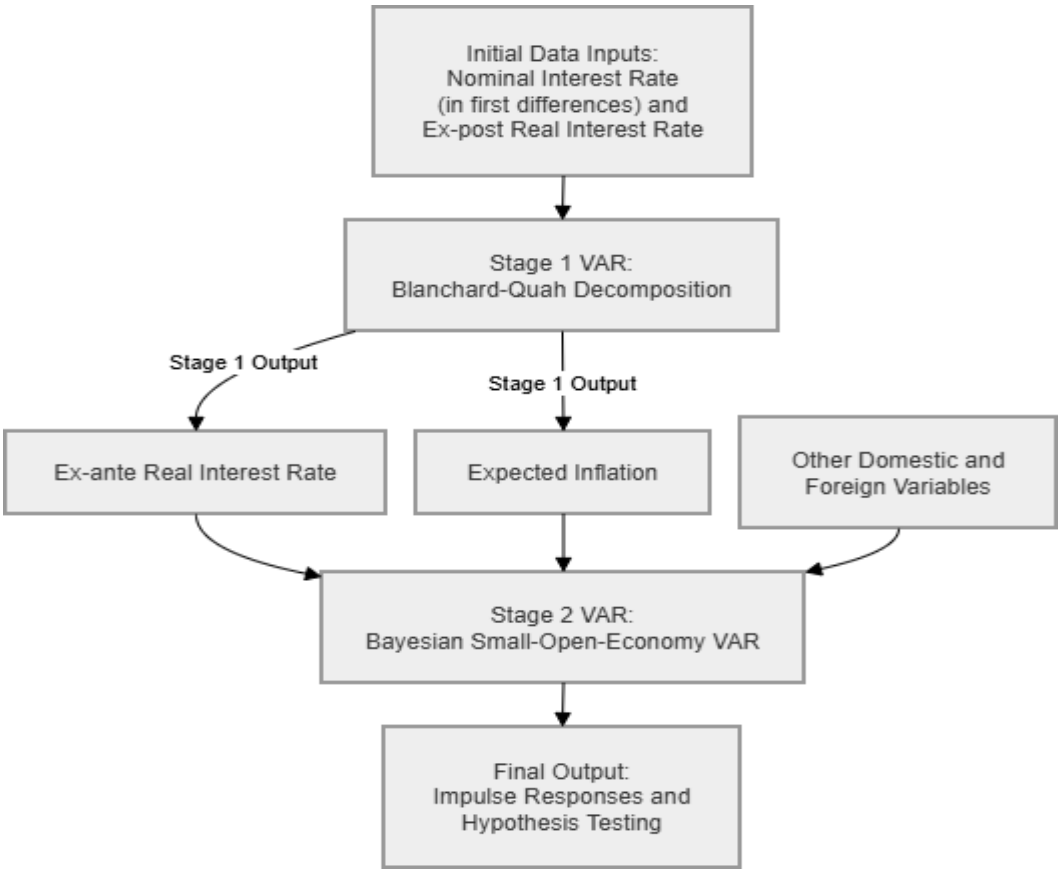


Figure 1: Conceptual Framework of Two-Stage Empirical Strategy

3. Data Collection, Variable Selection, and Preprocessing

The dataset runs monthly from 1975:01 to 2023:12. The selection of variables is guided by the specific dynamics of Canada's economy. Given Canada's status as a minor participant in global markets with highly open trade, U.S. macroeconomic variables are modeled as strictly exogenous.

Data Collection and Selection: For domestic variables, I use the Canadian monetary aggregate M1B (m_t) (which I referred to as M1; Statistics Canada, table: 10-10-0116-01) because the Bank of Canada closely monitors its trend to gauge economic activity and inflationary pressures. To capture macroeconomic conditions, I collect Canadian industrial production (y_t) (FRED, CNPROINDMISMEI) and the exchange rate (s_t) measured as CAD per USD (FRED, CCUSSP01CAM650N). To derive the time-series estimates of expected inflation and the ex-ante real interest rate, I use the yield from one-year Canadian Treasury bonds (n_t) (Statistics Canada, table: 10-10-0122-01) and the core consumer price index (CPI) excluding eight volatile components (Statistics Canada, table:18-10-0256-01). The exogenous U.S. block includes industrial production (y_t^*) (FRED, INDPRO), the core CPI excluding food and energy (FRED, CORESTICKM159SFRATL), and the federal funds rate (i_t^*) (FRED, FEDFUNDS).

Data Preprocessing: Prior to estimation, I applied several preprocessing steps to the raw data. First, I calculate the actual inflation rates for both Canada (π_t) and the U.S. (π_t^*) as the annualized

percentage changes in their respective core CPI. Second, to calculate the Canadian ex-post real interest rate (r_t), I subtract the observed inflation rate from the one-year Treasury yield. Third, I transform M1, the exchange rate, and industrial output for both countries into natural logarithms to stabilize their variances. Finally, to ensure stationarity before applying the BQ decomposition in Section 4, I first-difference the nominal Treasury yield (Δn_t). This differenced Treasury yield and the corresponding ex-post real rate serve as the primary inputs of the BQ model.

4. Inflation Expectations and Expected Real Rate: Estimation Using BQ Methodology

This section outlines how I use the BQ model to disentangle the one-year Treasury yield, n_t, into its two components: the expected real interest rate, r_t^e, and the expected inflation rate, π_t^e. I begin with the Fisher relation, which links the nominal Treasury yield to the sum of the corresponding inflation expectations and expected real rates:

$$n_t = r_t^e + \pi_t^e \tag{1}$$

Let the inflation forecast error, ε_t, be the gap between realized inflation, π_t and expected inflation, π_t^e.

$$\varepsilon_t = \pi_t - \pi_t^e. \tag{2}$$

Combining the forecast-error identity in (2) with the Fisher relation in (1) gives the following expression for the ex-post real interest rate:

$$n_t - \pi_t = r_t^e - \varepsilon_t. \tag{3}$$

Building on the Fisher equation and the inflation forecast error identity, Gottschalk (2001) identifies three critical time-series properties required to isolate the unobserved variables embodied in the nominal interest rate. First, assuming that the nominal Treasury yield is a unit-root process, it can be mathematically partitioned into a permanent (stochastic trend) component and a transitory component. Second, if the nominal yield and the observed inflation rate are cointegrated, their long-run comovement reflects a shared underlying stochastic trend. Under the maintained assumption that the expected real interest rate follows a stationary process, it cannot generate permanent movements in the nominal interest rate. Finally, by extension of the cointegrating relationship, any permanent, long-run shifts in the nominal yield must be entirely driven by changes in expected inflation. Together, these three properties provide the exact theoretical justification for applying the BQ long-run identifying restriction to disentangle the nominal Treasury yield into its constituent components: ex-ante real rate shocks exert no long-run effect on this variable.

Before estimating the SVAR, I verify that the data satisfy these assumptions. Based on ADF and Phillips–Perron tests, the nominal yield and the observed inflation rate contain unit roots, while the differenced series are stationary (Table 1). I then assess whether the two series are cointegrated using Johansen's trace and maximum-eigenvalue criteria. The test outcomes reported in Table 2 indicate that the nominal interest rate and inflation rate share a long-run equilibrium relationship. Given these properties, I estimate the bivariate BQ model designed to recover series for inflation expectations along with expected real interest rates. In the BQ model, I include the nominal yield

in first difference and the ex-post real rate in level form.

After estimating the BQ model, I construct the expected real interest rate and expected inflation rate series using a three-step procedure. First, I obtain the stationary (transitory) component of the nominal interest rate by cumulating the historical contributions of the identified expected real interest rate shocks. Second, I recover the ex-ante real interest rate by summing up the unconditional mean of the ex-post real rate and the estimated stationary component. Finally, applying the Fisher relation, I back out the expected inflation series as the difference between the nominal Treasury yield and the estimated ex-ante real interest rate. The estimated series of the expected inflation rate along with the actual realized inflation rate is reported in Figure 1. As we see from the figure, the expected inflation rate and the actual inflation rate closely follow each other.

Table I: Unit-root tests

Series	ADF test (Specification, lags)	Phillips-Perron test (specification)
Nominal Treasury yield	-1.8421 (c, 12)	-1.6590 (c)
Δ Nominal Treasury yield	-7.2658 (0, 8)	-14.1055 (0)
Inflation rate	-1.8396 (c, 14)	-2.7570 (c)
Δ Inflation rate	-9.4654 (0, 7)	-23.6942 (0)
Real interest rate	-3.5411 (c, 8)	-3.4632 (0)

Note: The notation in parentheses describes the deterministic terms: **c** means a constant is included and **0** means none. The second number for ADF test corresponds to the selected lag length, which is determined following Ng and Perron (1995).

Table II: Johansen cointegration analysis of the inflation rate and nominal interest rate

H_0	Eigenvalue	λ_{max}	5% Critical value
$r = 0$	0.0295	17.4926	15.8921
$r \leq 1$	0.0085	5.0000	9.1645
H_0	Eigenvalue	λ_{trace}	5% Critical value
$r = 0$	0.0295	22.4926	20.2618
$r \leq 1$	0.0085	5.0000	9.1645

Note: The tests are computed from a VAR with 10 lags. The results indicate one cointegrating relationship linking inflation and the nominal yield.

5. SVAR Methodology for Canada

To evaluate Canada's dynamics as a small open economy, I construct a SVAR model using the estimated expected real interest rates and expected inflation, together with other Canadian and U.S. macroeconomic variables. Building upon the empirical strategy established by Bhuiyan (2012), the dynamic structural relationships can be expressed as:

$$AX_t = \sum_{l=1}^{p} B_l X_{t-l} + \varepsilon_t. \quad (4)$$

In this specification, the endogenous variables are collected in X_t, which is an $n \times 1$ vector formed by stacking the individual series, the matrices A and B_l capture the contemporaneous and lagged structural parameters, respectively, and ε_t represent the $n \times 1$ vector of unobservable structural disturbances. I estimate the system over T observations ($t = 1 \ldots . T$) with a lag length

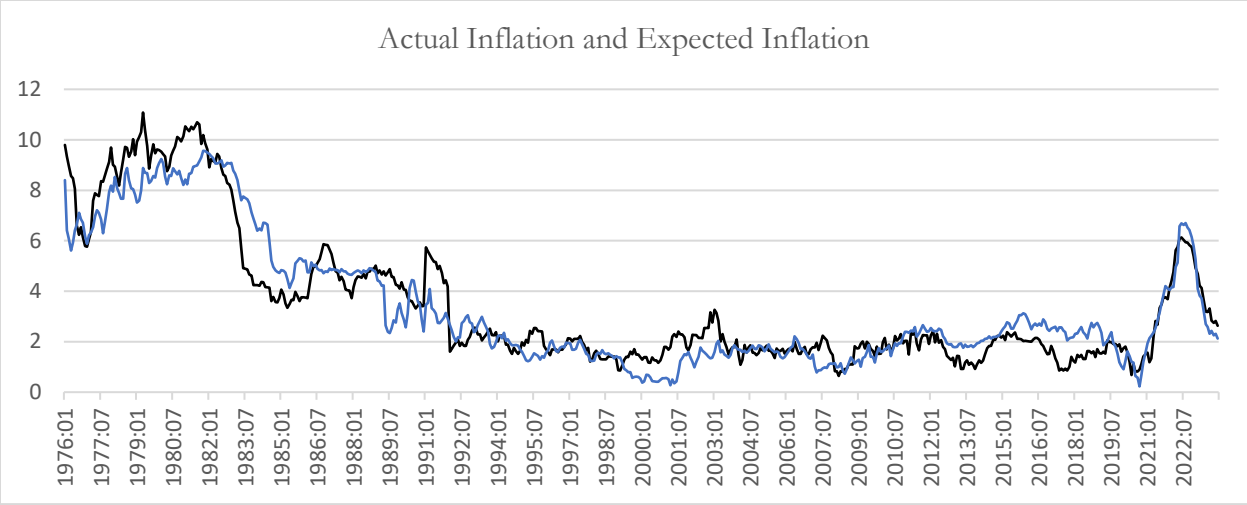


Figure 2: Actual inflation rate and expected inflation rate. The black line represents actual inflation, while the blue line shows expected inflation.

of p. The vector X_t is partitioned into two distinct segments: Canadian block X_1 containing m_t, r_t, π_t^e, s_t, and y_t and U.S. block X_2 comprising y_t^*, π_t^*, and i_t^*. To simplify the notation, the system can be compactly restated as:

$$AX_t = FZ_t + \varepsilon_t. \tag{5}$$

Here, Z_t stacks all lagged endogenous variables, and the matrix F consolidates the corresponding lagged coefficients.

Because the U.S. economy is much larger and imports a large share of Canada's goods, U.S. macroeconomic conditions can strongly affect Canada, while Canada has little influence on the U.S. Therefore, the U.S. block is treated as strictly exogenous. This assumption is represented by splitting the system as:

$$\begin{bmatrix} A_{11} & A_{12} \\ 0 & A_{22} \end{bmatrix} \begin{bmatrix} X_{1t} \\ X_{2t} \end{bmatrix} = \begin{bmatrix} F_{11} & F_{12} \\ 0 & A_{22} \end{bmatrix} \begin{bmatrix} Z_{1t} \\ Z_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{6}$$

Multiplying by the inverse of the contemporaneous matrix yields the reduced-form VAR:

$$X_t = EZ_t + e_t, \tag{7}$$

with $E = A^{-1}F$ and $e_t = A^{-1}\varepsilon_t$. The block exogeneous restriction $E_{21} = 0$ ensures that the U.S. variables are Granger-causally prior to the Canadian variables in the tradition of Sims (1980). To empirically validate this restriction, I conduct a likelihood ratio test. Using 12 lags (selected via the Akaike information criterion), I find that the Chi-squared statistic of 156.785 across 180 restrictions cannot reject our null hypothesis.

I identify matrix A, which contains the contemporaneous coefficients, by imposing theory-based restrictions, as summarized in system (8). In the first equation, I allow the monetary aggregate, M1, to adjust contemporaneously to expected inflation, the expected real interest rate, the currency exchange rate, and the U.S. monetary policy variable. In the second equation, expected inflation is constructed using current-period information on the money supply, the

expected real interest rate, the exchange rate, and the U.S. policy stance. In the third equation, the expected real interest rate can respond within the month to the current money stock, expected inflation, the exchange rate, and the U.S. monetary policy variable. The fourth equation characterizes the within-month exchange rate. Consistent with Cushman and Zha (1997), I model the exchange rate as an asset price determined by forward-looking expectations. Therefore, I allow this variable to react immediately to all variables in the system, implying nonzero contemporaneous coefficients in that equation. Finally, I order the foreign block recursively (lower triangular) as $y^*,\ \pi^*,\ i^*$.

$$\begin{pmatrix} \varepsilon_m \\ \varepsilon_{\pi^e} \\ \varepsilon_r \\ \varepsilon_s \\ \varepsilon_y \\ \varepsilon_{y^*} \\ \varepsilon_{\pi^*} \\ \varepsilon_{i^*} \end{pmatrix} = \begin{pmatrix} 1 & a_{12} & a_{13} & a_{14} & 0 & 0 & 0 & a_{18} \\ a_{21} & 1 & a_{23} & a_{24} & 0 & 0 & 0 & a_{28} \\ a_{31} & a_{32} & 1 & a_{34} & 0 & 0 & 0 & a_{38} \\ a_{41} & a_{42} & a_{43} & 1 & a_{45} & a_{46} & a_{47} & a_{48} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & a_{12} & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & a_{12} & a_{12} & 1 \end{pmatrix} \begin{pmatrix} e_m \\ e_{\pi^e} \\ e_r \\ e_s \\ e_y \\ e_{y^*} \\ e_{\pi^*} \\ e_{i^*} \end{pmatrix}. \quad (8)$$

6. Estimated Results and Discussion

I estimated the model with the Bayesian Gibbs sampler developed by Waggoner and Zha (2003), which is well suited to produce reliable statistical inference for the over-identified SVAR designed in the previous section. In addition, while standard unit root tests confirm that most variables in the model are non-stationary—with the expected real interest rate as an exception—Bayesian estimation provides a robust way to handle the data in levels, as emphasized by Giannone et al. (2015).[2] By incorporating prior information, the Bayesian approach stabilizes parameter estimates and avoids the need to difference the data, which would discard valuable long-run cointegrating information. I begin by assessing whether the over-identifying constraints placed on the within-period and lagged parameters are supported by the data. I jointly assess the model's overidentification restrictions on both the contemporaneous coefficients and coefficients on lagged variables adopting Cushman and Zha's (1997) approach. As shown in the system of equations (8), the matrix of cotemporaneous-coefficients, A, has 6 restrictions beyond exact identification, while the number of restrictions on the lagged coefficients on the U.S. variables is 180 for using twelve lags in the SVAR. Thus, imposing a total of 186 overidentifying restrictions yields the Chi-squared statistic $\chi^2(186) = 164.491$, indicating no rejection of the null under conventional levels of significance.

In Figure 3, I present how the monetary aggregate M1 responds to its own structural innovation. The solid line shows point estimates, while the dashed lines indicate two-standard-deviation bands constructed from Waggoner and Zha (2003)'s Bayesian Gibbs-sampling procedure. [3] As shown in the figure, a positive shock to M1 (one standard deviation) raises this variable initially, after which the response steadily fades over time.

[2] I perform ADF and Phillips–Perron tests and find that every series other than the real interest rate is non-stationary.
[3] I generate the error bands based on 10,000 simulated draws using Matlab codes.

Next, I present the responses of the Canadian variables to a one-standard-deviation M1 shock in Figure 4. The upper-left panel illustrates that the positive M1 shock lowers the expected real interest rate by approximately seven basis points, with the maximum impact occurring around the eighth month. This result is in line with the concept of the liquidity effect, which suggests that an exogenous rise in money balances leads to a short-lived decline in interest rates. The top-right panel of Figure 4 reveals that the same shock increases expected inflation by four basis points, with the strongest effect materializing within six months. This result is consistent with theoretical expectations: a surprise increase in money balances leads the public to anticipate higher future inflation. These results are similar to prior studies by Kahn et al. (2002) and Bhuiyan (2007), who observed that positive shocks to monetary aggregates increased inflationary expectations.

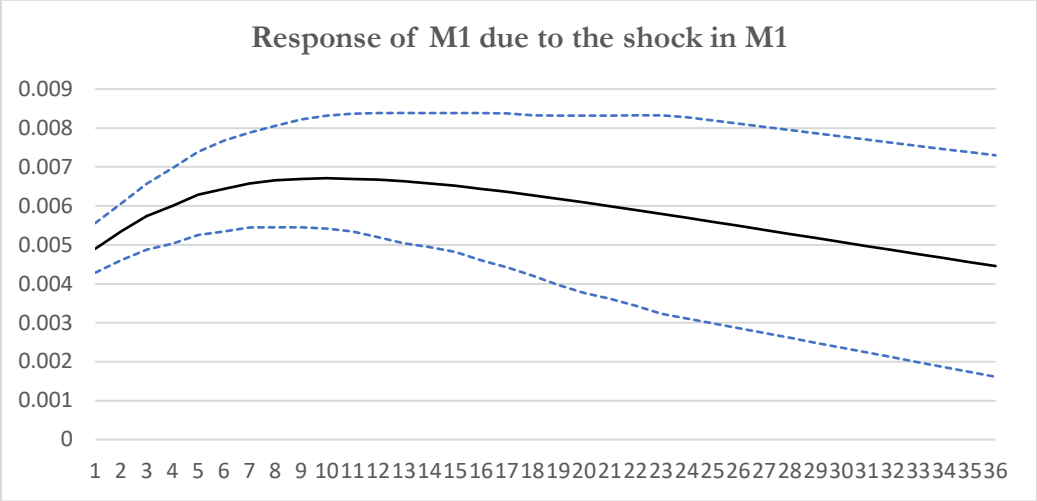


Figure 3: Response function of M1 due to its own shock. The solid curve plots the point estimates, whereas the dashed curves represent ±2 standard-deviation bands. The horizontal axis measures months.

Some past studies reported the liquidity puzzle. For example, Christiano (1991) and Leeper and Gordon (1992) found that innovations in monetary aggregates caused the nominal interest rate to increase, which is contrary to the concept of the liquidity effect. Muhanji et al. (2013) also reported similar liquidity puzzles for a number of African nations, using DSGE model. To help resolve the liquidity puzzle, Christiano and Eichenbaum (1992), Strongin (1995), and Christiano et al. (1996) advocated employing narrow measures of the money supply—for instance as non-borrowed reserves or M0—as the policy instruments. These authors claimed that shocks to broader money measures may pick up other disturbances in the economy, including changes in liquidity preferences, instead of capturing pure monetary policy shocks.

Following Christiano (1991) and Sims (1992), this paper argues that the nominal interest rate's response to a monetary aggregate shock reflects two offsetting forces: higher inflation expectations and lower expected real interest rates. To assess the liquidity effect, it is therefore essential to estimate separately how an M1 shock affects expected inflation and the ex-ante real rate. The point estimates in the upper-left and upper-right panels of Figure 4 show a positive net response of the nominal rate through month six, as expected inflation increases more than the expected real rate declines. Thus, the previously documented liquidity puzzle—an increase in

the nominal interest rate following a monetary aggregate shock—does not necessarily imply a rise in the real rate. Rather, it may reflect a stronger increase in expected inflation that more than offsets the fall in the real rate. These findings contribute to the literature by offering a resolution to the liquidity puzzle, demonstrating that the post-shock rise in the nominal yield is attributable mainly to the rise in expected inflation rather than to the rise in real rates following the shock in M1.

Another important channel through which a central bank influences the economy is the channel of the exchange rate, which is especially significant for an open economy like Canada. As shown in the lower-left panel of Figure 4, the Canadian dollar depreciates almost immediately following the positive shock in M1, which gradually appreciates toward its terminal value. Finally, the lower-right panel of Figure 4 illustrates that industrial production increases in response to the shock, with the strongest impact observed approximately one year after the initial shock. To ensure that the empirical results are not sensitive to the narrow definition of money, I test the robustness of the model by replacing M1 with the broader aggregate M2. Although prior literature cautions that broader aggregates can capture non-policy demand shifts, the overall qualitative findings remain entirely robust. A positive shock to M2 still generates a transient decline in the ex-ante real interest rate alongside a dominant rise in expected inflation.

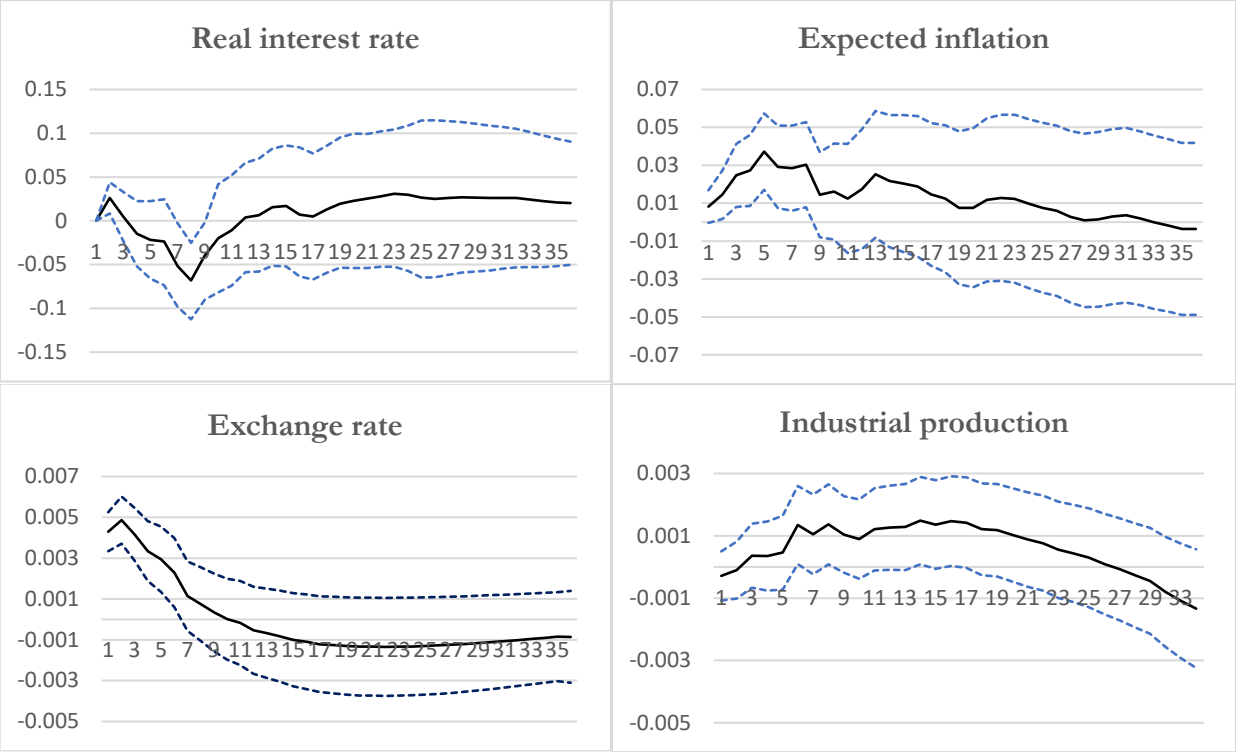


Figure 4: Responses of key variables following M1 shock. The solid curve plots the point estimates, whereas the dashed curves represent ±2 standard-deviation bands. The horizontal axis measures months.

The way macroeconomic variables react to the M1 shock highlights the significance of monetary aggregates for understanding the Canadian economy. Although the central bank of Canada primarily employs the target for overnight rate as its main policy tool, the recent global

inflation surge has renewed policymakers' attention to monetary aggregates. Beretta and Neuberger (2023) and Benk and Gillman (2020) link rapid money growth to rising inflation. For Canada, Laidler (1999) emphasized that money supply growth plays a critical role in determining long-run inflation. Moreover, M1-based vector error correction models (VECM) for Canada—such as those in Hendry (1995), Armour et al. (1996), and Hendry and Adam (2001)—show that M1 is a key variable in explaining movements in Canadian macroeconomic indicators. Taken together, these studies and the results of this paper reinforce the value of monitoring monetary aggregates alongside conventional policy tools when assessing inflationary pressures and broader macroeconomic fluctuations. Given persistent global inflation concerns, the Bank of Canada may benefit from complementing its standard toolkit with measures of inflation expectations and closer tracking of money growth to strengthen policy assessment and communication.

7. Conclusion and Policy Implications

This paper disentangles the nominal interest rate into its components using the BQ model to address the liquidity puzzle and other anomalous results following monetary aggregate shocks. Using a Bayesian SVAR tailored to Canada as a small open economy, I demonstrate that a positive shock to M1 lowers the expected real interest rate while increasing inflation expectations, depreciating the Canadian dollar, and boosting output with a one-year lag. I also find that the net increase in the nominal Treasury yield is driven by a dominant rise in expected inflation, not the expected real rate, which resolves the liquidity puzzle. The overall qualitative results remain robust when using the broader M2 aggregate.

The results of this paper suggest several implications for the central bank of Canada as well as for central banks of other small open economies. First, policymakers should continue to track M1, which appears to be a reliable leading indicator of expected inflation and real economic activity. Second, central banks should decompose the nominal interest rate into its components to properly gauge the stance of policy. Third, because the rise in nominal rates is largely driven by higher expected inflation, central banks should provide clear and credible forward guidance to anchor expectations and reduce bond market volatility. Future research could examine how these dynamics change during large economic shocks.

References

Armour, Jamie, Joseph Atta-Mensah, Walter Engert, and Scott Hendry, 1996, "A distant-early-warning model of inflation based on M1 disequilibria," Bank of Canada Working Paper, 1996-5.

Benk, Szilard and Max Gillman, 2020, "Granger predictability of oil prices after the Great Recession," *Journal of International Money and Finance*, 101, 1-10.

Beretta, Edorado and Doris Neuberger, 2023, "Monetary aggregates in the US since 2020 and post Covid-19 inflation: evidence from equation of exchange," Economics and Business Letters, Oviedo University Press, 12, 321-330.

Bhuiyan, Rokon, 2012, "Monetary transmission mechanism in a small open economy: a Bayesian structural VAR Approach," *Canadian Journal of Economics*, 45, 1037-1062.

Bhuiyan, Rokon and Robert Lucas, 2007, "Real and nominal effects of monetary policy shocks," *Canadian Journal of Economics,* 40, 679-702.

Blanchard, Olivier and Danny Quah, 1989, "The dynamic effects of aggregate supply and demand disturbances," *American Economic Review*, 79, 655-673.

Champagne, Julien and Rodrigo Sekkel, 2018, "Changes in monetary policy regimes and the identification of monetary policy shocks: Narrative evidence from Canada," *Journal of Monetary Economics*, 99, 72-87.

Christiano, Lawrence, 1991, "Modeling the liquidity effect of a money shock," Federal Reserve Bank of Minneapolis, *Quarterly Review*, 15, 1-34.

Christiano, Lawrence, Martin Eichenbaum, 1992, "Liquidity effects and the monetary transmission mechanism," *American Economic Review*, 82, 346-253.

Christiano, Lawrence, Martin Eichenbaum, and Charles Evans, 1996, "The effects of monetary policy shocks: Evidence from flow of funds," *Review of Economics and Statistics*, 78, 16-34.

Coibion, Olivier, Yurity Gorodnichenko, Saten Kurman, and Mathieu Pedemonte, 2020, "Inflation expectations as a policy tool?" Journal of International Economics, 124, 1-27.

Cushman, David and Tao Zha, 1997, "Identifying monetary policy in a small open economy under flexible exchange rates," *Journal of Monetary Economics*, 39, 433-448.

Giannone, Domenico, Michele Lenza, and Giorgio Primiceri, 2015, "Prior Selection for Vector Autoregressions," *The Review of Economics and Statistics,* 97, issue 2, 436-451.

Gottschalk, Jan, 2001, "Measuring the expected inflation and the ex-ante real interest rate in the Euro area using structural vector auto regression," Working Paper, Keil Institute of World Economics, Keil, Germany.

Hendry, Scott, 1995, "Long-run demand for M1" *Bank of Canada Working Paper*, 11.

Hendry, Scott and Charleen Adam, 2001, "The M1 vector-error-correction model: some extensions and applications," *Money Affairs*, CEMLA, 2, 145-175.

Johansen, Soren and Katarin Juselius, 1990, "Maximum likelihood estimation and inference on co-integration-with application to the demand for money", *Oxford Bulletin of Economics and Statistics*, 52, 169-209.

Johansen, Soren and Katarin Juselius, 1994, "Identification of the long-run and short-run structure: an application to ISLM model", *Oxford Bulletin of Economics and Statistics*, 63, 7-36.

Kahn, Michael, Shmuel Kandel, and Oden Sarig, 2002, "Real and nominal effects of central bank monetary policy," *Journal of Monetary Economics*, 49, 1493-1519.

Kim, Soyoung and Nouriel Roubini, 2000, "Exchange rate anomalies in industrialized countries: a solution with structural VAR approach," *Journal of Monetary Economics*, 45, 561-586.

Laidler, David, 1999, "The quantity of money and monetary policy", *Bank of Canada Working Paper*, 5.

Leeper, Eric and Donald Gordon, 1992, "In search of liquidity effect", *Journal of Monetary Economics*, 29, 341-369.

Muhanji, Stella, Christopher Malikane, and Kalu Ojah, 2013, "Price and liquidity puzzle of a monetary policy shock: Evidence from indebted African countries", *Economic Modelling*, 33, 620-630.

Ng, Serena and Pierre Perron, 1995, "Unit root tests in ARMA models with data-dependent methods for the selection of the truncation lag", Journal of the American Statistical Association, 90, 268-281.

Obstfeld, Maurice and Kenneth Rogoff, 1995, "Exchange rate dynamics redux", *Journal of Political Economy*, 103, 624-660.

Romer, Christina and David Romer, 2004, "A new measure of monetary shocks: derivation and implication", *American Economic Review*, 94, 1055-1084.

Sims, Christopher, 1980, "Macroeconomics and reality", *Econometrica*, 48, 1-48.

Sims, Christopher, 1992, “Interpreting the macroeconomic time series facts: The effects of monetary policy”, *European Economic Review*, 36, 975-1011.

Sims, Christopher and Tao Zha, 1998, “Bayesian methods for dynamic multivariate methods”, *International Economic Review*, 39, 949-968.

Sousa, Ricardo and James Yetman, 2016, "Inflation expectations and monetary policy," BIS Papers Chapters in Bank of International Settlements (ed.), Inflation mechanisms, expectations and monetary policy, Volume 89, pages 41-67, Bank for International Settlements.

Strongin, Steven, 1995, “The identification of monetary policy disturbances: Explaining the liquidity puzzle”, *Journal of Monetary Economics*, 35, 463-493.

Waggoner, Daniel and Tao Zha, 2003, “A Gibbs sampler for structural vector auto regressions”, *Journal of Economic Dynamics and Control*, 28, 349-366.