Revisiting the Response of Monetary Policy to Oil Supply Shocks

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Abstract

The paper uses local projections to investigate the macroeconomic and monetary policy responses to adverse oil supply shocks. The Federal Reserve raises interest rates twice: on impact and ten months after the shock to counter ongoing high inflation. A net oil exporter, Canada raises interest rates sharply in response to the shock to counter inflation. Switzerland initially maintains steady interest rates to prevent Swiss Franc appreciation, followed by gradual rate increases to manage inflation as the exchange rate stabilizes. Despite these efforts, inflation remains high in Switzerland.

1 Introduction

Oil supply shocks affect the two variables that central banks care most about – inflation and economic activity. These shocks lead to higher inflation by increasing the costs of production, which are often passed on to consumers in the form of higher prices (Peersman & Van Robays (2009); Baumeister et al. (2010); Peersman

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& Van Robays (2012); Aastveit et al. (2021); Baumeister (2023)). Additionally, oil supply shocks can negatively impact economic activity by reducing the availability of a critical input for production, thereby slowing down growth and productivity (Baumeister et al. (2010); Baumeister & Hamilton (2019)). Consequently, the key question is: do central banks respond to oil supply shocks?

The relationship between oil prices and economic indicators has been long recognized. Sims (1992) and Balke & Emery (1994) highlighted that commodity prices, including oil, contain forward-looking information about future inflation dynamics, as they reflect the prices of input factors in the production process which can eventually be passed on to consumers. An increase in oil price elevates production costs, directly contributing to inflation.

Oil prices affect inflation and output through several mechanisms. Rising oil prices signal a decrease in input availability, which hampers growth and productivity, as noted by Doğrul & Soytas (2010). This scenario can lead to decreased real wage growth and increased unemployment. Persistent high oil prices force firms to adjust their operations, leading to prolonged unemployment as workers reskill. Additionally, higher production costs due to increased oil prices can result in second-round effects where employees demand higher nominal wages to maintain purchasing power, further fueling inflation. In net energy-importing economies, these dynamics are further exacerbated by exchange rate depreciation, which makes imports more expensive and adds to inflationary pressures.

Significant debate has persisted over the years regarding the interaction between oil price shocks and monetary policy. Bernanke et al. (1997) (BGW) used a structural VAR model to examine whether oil price shocks directly cause recessions or if the Fed's response leads to economic downturns. They found that if the federal funds rate had remained unchanged following an unexpected increase in the real price of oil, the recession could have been avoided. However, Hamilton & Herrera (2004) challenged this, arguing that the BGW's counterfactual was not feasible and that their results were driven by short lags. Kilian & Lewis (2011) (KL) used a recursive SVAR model and found that the Fed initially reduces the interest rate in response to oil price shocks, followed by an increase, suggesting a preemptive policy to prevent inflationary pressures.

Aastveit (2014) used multiple approaches to examine the impact of oil shocks on the US macroeconomy and monetary policy. His results varied, with some models showing no monetary policy response and others indicating a persistent increase in interest rates. Aastveit follows the methodology of Kilian & Lewis (2011), which has been critiqued by Baumeister & Hamilton (2019) for underestimating the short-run oil supply elasticity and relying on a potentially flawed measure of global economic activity (Hamilton (2021); Baumeister & Guérin (2021)). Filardo et al. (2020) find that monetary authorities achieve better economic outcomes when they respond to changes in commodity prices rather than headline inflation alone. Recent studies by Känzig (2021) and Gagliardone & Gertler (2023) have examined the response of monetary policy to high-frequency oil supply news shocks, finding a delayed tightening and sustained interest rate increases, respectively.

Our study builds on this literature by addressing several key gaps. First, previous studies such as BGW, Hamilton & Herrera (2004), and KL used the term "oil price shock" without distinguishing the source of the shock, often assuming they were oil supply shocks. However, subsequent research by Kilian (2009), Kilian & Murphy (2014), and Baumeister & Hamilton (2019) has uncovered that oil price shocks not only originate from the supply side but also from multiple sources of demand, each with different effects on the real price of oil and the economy. Our analysis specifically focuses on the Baumeister & Hamilton (2019) oil supply shocks.

Second, we employ the Local Projections (LP) method, which allows us to use exogenous identified structural shocks to directly estimate the response of macroeconomic aggregates without imposing any structural assumptions. Our only assumption is that the energy prices are predetermined to the US macroeconomic aggregates as suggested by Kilian & Vega (2011). This approach enables us to examine the contemporaneous effects of oil supply shocks on the macroeconomic aggregates and monetary policy by only controlling for the lags of these variables and the exogenous shocks.

Our findings indicate that the Fed responds to oil prices by increasing interest rates immediately after an adverse oil supply shock. They then raise interest rates ten months later to curb the persistently high inflation resulting from the oil supply shock. While our results for the Fed's response align with Bernanke et al. (1997), we do not find the same downturn in the output gap as they do. Instead, we find that the output gap initially reduces but recovers in the next ten months. As the Fed increases interest rates a second time after ten months to control inflation, the output gap starts falling. Our results contrast with Kilian & Lewis (2011), who find a reduction of interest rates after an oil price shock. Our results closely align with recent studies by Känzig (2021) and Gagliardone & Gertler (2023). While we observe monetary tightening immediately post-shock and again almost a year later, Gagliardone & Gertler (2023) find that the Fed keeps interest rates high for the first two years after an oil supply news shock. While Känzig does not observe a monetary response immediately after an oil supply news shock, he notes, like us, that the Fed raises interest rates a year after the shock in response to increasing consumer prices.

The United States is a net importer of oil but has a significant domestic oil production sector (Peersman & Van Robays (2012)). This dual role implies that while the overall economy is adversely affected by higher oil prices, the domestic oil industry benefits, partially explaining the observed recovery in the output gap following its initial contraction. Moreover, the Federal Reserve's dual mandate to balance inflation control with economic activity stabilization may account for the observed interest rate increases of short durations in response to the shock. This approach aims to manage inflation without exerting substantial negative effects on economic activity.

The effects of an oil supply shock vary significantly between oil-importing and oil-exporting countries. For oil-importing countries, such shocks typically lead to higher production costs, reduced economic activity, and increased inflation. Conversely, oil-exporting countries may benefit from higher oil prices, boosting economic activity and improving trade balances (Peersman & Van Robays (2012)). Baumeister et al. (2010) find that net energy-importing economies raise interest rates to tackle the inflation resulting from an oil supply shock, while the monetary policy reaction is weaker in oil-exporting countries due to the negligible long-run effect on consumer prices.

In net energy-importing economies, oil supply shocks usually result in a permanent fall in real economic activity (Baumeister et al. (2010); Peersman & Van Robays (2012)). For instance, Switzerland experiences a temporary but insignificant rise in economic activity, while the US sees an immediate decline. Inflationary impacts also differ, with strong effects on consumer prices in net energy-importing economies and negligible or negative effects in energy-exporting countries like Canada. Exchange rate responses play a crucial role, with appreciation in energy-exporting countries exerting downward pressure on inflation. Consequently, net energy-importing economies substantially raise interest rates to combat inflationary pressures, aligning monetary policy responses with inflation dynamics.

We extend our analysis to include Canada and Switzerland to compare the responses of countries with distinct roles of oil and energy within their economies and different monetary policy regimes. Canada is a significant net exporter of oil and other energy products, and its central bank, the Bank of Canada, operates under an inflation-targeting regime. Peersman & Van Robays (2012) find that Canada benefits from higher oil prices, boosting economic activity. Conversely, Switzerland, fully dependent on energy imports, is highly vulnerable to oil price fluctuations. However, Switzerland's net oil imports share of GDP is significantly smaller than that of the

US, mitigating some adverse impacts. Additionally, the Swiss National Bank (SNB) conducts inflation targeting while closely monitoring exchange rates. International money often flows into Switzerland during periods of global economic uncertainty, leading to an appreciation of the Swiss franc (Jordan (2020)), which can complicate the SNB's response to oil supply shocks.

The Bank of Canada raises the interest rate by 7 basis points on impact in response to the oil supply shock, with a negligible initial impact on the output gap but a notable increase in inflation by 0.09 percentage points. As the oil price remains above 10% in the subsequent months, Canada, being a net oil exporter, benefits, causing the output gap to peak at 0.55% ten months post-shock. As the price rises by 0.37% 9 months after the shock, the bank adjusts interest rates dynamically to manage inflation, gradually raising them by 18-21 basis points. Reducing oil prices and high interest rates lead to a fall in the output gap, but inflation fluctuates. By 22 months, the oil prices and the output gap return to baseline, leading to a reduction in interest rates as inflation peaks and begins to decline.

Switzerland focuses on maintaining exchange rate stability alongside inflation targeting. The Swiss National Bank (SNB) does not react immediately to oil supply shocks to prevent the Swiss Franc from strengthening as it is considered a safe haven currency. The output gap increases by 0.22% after six months and remaining stable until 15 months. This initial increase in the output gap might be due to Switzerland's economic structure, which is less reliant on energy-intensive industries and benefits from a robust service sector that can temporarily absorb the shock. The initial non-response by the SNB could be attributed to concerns about the appreciation of the Swiss franc. While inflation increases by 0.04% on impact, it stabilizes around 0.22% six months after the shock, at which time the SNB increases interest rates. An immediate rate hike could have strengthened the franc, negatively impacting exports. The delayed response allows the SNB to manage inflation without exacerbating currency appreciation.

In summary, our comparative analysis highlights the varying impacts of oil supply shocks across the United States, Canada, and Switzerland. While the US shows a measured response in interest rates with a temporary decline in the output gap, Canada raises interest rates significantly yet struggles to fully control inflation over the two-year period, while its economic activity benefits from the high oil prices due to its status as a net oil exporter. Switzerland's economic activity sees a boom because it is less dependent on oil imports, and the initial appreciation in the exchange rate makes imports cheaper. The SNB increases interest rates only when the exchange rate depreciates, and while it is able to contain the increase in prices, it fails to bring them to the pre-shock levels.

The plan for the paper is as follows. We describe the data used in section 2 and the local projection model employed in our analysis in section 3. In section 4, we present the results of our analysis for the US; in section 5, we extend our analysis to Canada and Switzerland and conclude in section 6.

2 Data

Our analysis focuses on three key variables: interest rate, a proxy for the state of the economy, and inflation, all measured at the monthly frequency. Our primary policy instrument for the US is the effective federal funds rate, which reflects the interest rate at which depository institutions trade federal funds with each other overnight. While the market determines the effective federal funds rate, the Federal Reserve influences this rate through open market operations to reach the federal funds rate target. Additionally, to account for the zero lower bound, we substitute the Federal funds rate with Lombardi & Zhu (2018)'s shadow rate between 2009 and 2015. Our choice of shadow rate is motivated by the fact that Lombardi and Zhu use an entirely data-driven approach to calculate the shadow rate while other measures rely on a specific term structure.

We measure the US price level using the Consumer Price Index for All Urban Consumers (CPIAUCSL). The CPI tracks changes in the cost of a basket of goods and services consumed by urban households, providing a comprehensive measure of inflation.

To assess economic activity, we utilize the output gap, defined as the difference between Real Gross Domestic Product (GDP) and Real Potential GDP. By indicating how much actual economic output deviates from potential output, the output gap helps gauge economic slack or overheating.

Given that the GDP series are available only at a quarterly frequency, we interpolate the data to a monthly frequency for our analysis. We use cubic spline interpolation for potential GDP and apply the Chow & Lin (1971) method for real GDP, utilizing monthly indicators such as industrial production, continued unemployment claims, a manufacturing confidence indicator, and total nonfarm employment, as recommended in the literature, including Bernanke et al. (1997).

We obtain all the US macroeconomic and interest data from the FRED database, covering the period from February 1975 to December 2019. This timeframe aligns with the availability of oil supply shocks data from Baumeister & Hamilton (2019) and encompasses significant events in the oil market, such as the outbreak of the Iranian revolution in September 1978, the start of the Iran-Iraq war in September 1980, the collapse of OPEC in December 1985, the outbreak of the Persian Gulf War in August 1990, the Asian financial crisis in July 1997, the Venezuelan crisis in November 2002, the global financial crisis in September 2008, and the 2014 oil price crash driven by increased US shale production and OPEC's response.

We use the immediate interest rate: call money/interbank interest rates from the OECD data explorer as our policy instrument for Canada, which is analogous to the US federal funds rate. Similar to the US, the price level is measured using the Consumer Price Index (CPI), while the economic activity is gauged by the output gap. We obtain the CPI from the IMF IFS database and the 2018Q4 vintage quarterly output gap data from the Staff economic projections. The data up to 2018Q3 is the actual output gap, while the data from 2018Q4-2019Q4 are projections. We use piecewise cubic Hermite interpolation to create a monthly output gap series. This interpolation method ensures smooth joining of piecewise cubics, maintaining continuity in both the interpolated function and its first derivative while also being shape-preserving to avoid local overshooting, as described by Moler (2004, Ch. 3). The data for Canada spans from January 1992 to December 2019. We select this period for our analysis because the Bank of Canada adopted an inflation-targeting regime in February 1991, and Champagne & Sekkel (2018) use the start of 1992 as the beginning of this regime in their analysis.

Like Canada, our policy instrument for Switzerland is the immediate interest rate: call money/interbank interest rates obtained from the OECD data explorer. We obtain the Swiss CPI from the IMF FIS database to measure the price level. We acquire the quarterly output gap from the State Secretariat for Economic Affairs (SECO) and use the piecewise cubic Hermite interpolation method to convert this output gap to monthly frequency. Since Switzerland's Central Bank also considers the Swiss Franc exchange rate when conducting monetary policy, we additionally obtain the broad Nominal Effective exchange rate index from The Bank of International Settlements. The new broad exchange rates from the BIS, available from 1994, are preferred over the narrow indices because they provide a more comprehensive and stable measure of Switzerland's international economic position by capturing a wider range of trading partners and economic interactions, reducing volatility, and better reflecting structural changes in the economy. Consequently, our analysis of Switzerland's monetary policy response to oil supply shocks spans from 1994 to 2019.

Finally, our oil price measure for the US is the US refiners' acquisition cost (IRAC) for imported crude oil, as reported by the EIA, deflated by the US consumer price index. For Canada and Switzerland, we use the monthly European Brent spot price FOB, as reported by the EIA, deflated by the US consumer price index.

3 Model

We employ the Local Projections (LPs) method, introduced by Jordà (2005), to estimate the monetary policy response to structural oil supply shocks. This method offers a flexible approach to separate the choice of identification scheme from the estimation approach, which is particularly beneficial when dealing with multiple endogenous variables and varying horizons (Plagborg-Møller & Wolf (2021)).

Kilian (2009) and Aastveit (2014) use an augmented distributed lag (ADL) model to examine the impact of oil market shocks on macroeconomic aggregates and, in the latter case, on monetary policy as well. However, Choi & Chudik (2019) critique the ADL method for its inefficiency due to the need for estimating a large number of parameters. Their simulations show that LPs achieve lower root mean squared errors (RMSE) compared to the ADL approach. Following this insight, we adopt the local projections method to estimate the impact of oil price shocks. By running separate regressions for different horizons and controlling for the lags of the three key variables – output gap, CPI, and interest rates – we aim to enhance the efficiency and accuracy of our results.

To ensure an accurate estimation of impulse responses, choosing an appropriate lag length in our model is crucial. Hamilton & Herrera (2004) emphasize the importance of selecting a lag order sufficient to capture the effects of oil price shocks, noting that using fewer than 12 lags may compromise the reliability of the estimates. Additionally, our identified shock series comes from the monthly global oil market model estimated by Baumeister & Hamilton (2019), who use a lag length of 12. Furthermore, Montiel Olea & Plagborg-Møller (2021) suggest that if the true model is believed to be a VAR of order l, then $l+1$ lags should be included in the local projections. Therefore, we choose $l = 13$ in our estimation to ensure robustness.

We estimate the following local projection (LP) for horizons, $h = 0, 1, \ldots, H$

$$x_{t+h} = \mu_h^x + \beta_h^x \epsilon_t + \sum_{l=1}^{13} \delta_{h,l}^{x\prime} \mathbf{w}_{t-l} + \xi_{h,t}^x \tag{1}$$

where, x_t is the outcome variable, $x_t \in \mathbf{y}_t$, the set of outcome variables. $\mathbf{y}_t = \{i_t, y_t, p_t\}$ where, i_t, y_t, and p_t are the interest rate, output gap, and the natural log of the CPI price index at time t, respectively. $\mathbf{w}_t = [\epsilon_t, i_t, y_t, p_t]$ is the vector of the data at time t. Here, ϵ_t, is the identified structural oil supply shock. Our main coefficient of interest is $\{\beta_h^i\}_{h\geq 0}$, the impulse response function of i_t with respect to ϵ_t at horizon h. Additionally, to get a complete picture of the monetary policy response to oil supply shocks, we also discuss the responses of the output gap, $\{\beta_h^y\}_{h\geq 0}$, and the price level, $\{\beta_h^p\}_{h\geq 0}$.

We normalize the response of the three variables to an oil supply shock that increases the oil price by 10% on impact. The normalization is achieved by scaling the LP coefficient of the response of interest rate, β_{t+h}^i, output gap, β_{t+h}^y, and prices, β_{t+h}^p, to the oil supply shock ϵ_t by β_t^o, the LP coefficient of the real oil price at $h = 0$, the impact horizon of the oil supply shock, from equation (2).

The LP specification for the oil prices is below:

$$o_{t+h} = \mu_h + \beta_h^o \epsilon_t + \sum_{l=1}^{13} \delta_{h,l}^{\prime} \mathbf{x}_{t-l} + \xi_{h,t} \tag{2}$$

where o_t represents the natural log of the real oil price at time t and $\mathbf{x}_t = [o_t, \epsilon_t]$.

4 Results

We present the response of the US interest rates, output gap, and CPI price levels to an adverse oil supply shock in panels a–c of Figure 1.

Immediately following a negative oil supply shock that increases the oil price by 10% on impact, the US economy experiences significant changes. The increased input costs reduce the output gap by 0.11% on impact, while inflation increases by 0.13 percentage points (pp). In response to these changes, the Fed increases the interest rate by 7.7 basis points (0.077 pp) on impact.

While this initial response of the interest rate is small, it increases by 30 basis points in the first three months as inflation rises, reaching a peak of 0.62pp in six months. The initial reduction in the output gap is short-lived as the effect of increasing oil prices (see Figure 1d) quickly vanishes and becomes insignificant the following month. The interest rate starts falling and becomes insignificant at the 68% level after five months.

The US output gap starts recovering ten months after the impact of the shock, going up by 0.27pp even though the interest rate increase hits its peak at the same horizon with an increase of 44 basis points, suggesting that the central bank reacts to the increase in inflation with a monetary policy tightening. Inflation persists throughout the first year, leading to continued growth in interest rates, which ultimately hurts the output gap. The effect of the Fed's contractionary monetary policy leads to the price levels falling gradually fourteen months after the initial impact. Simultaneously, the rise in the output gap starts dropping from its peak of 0.40pp and becomes insignificant. While the Fed stops increasing interest rates fourteen months after the shock, the output gap stops growing, and the increase in price level is only significant at the 68% level. Ultimately, the price level slowly reduces to 0.44pp above the initial price level at 22 months, after which it becomes insignificant.

Our findings indicate a measured response from the Federal Reserve to oil supply shocks, aligning with and contrasting various studies in the literature. Bernanke et al. (1997) found that the Fed's contractionary response to oil price shocks significantly impacted the economy. Our results support this view, showing an initial rate increase. Kilian & Lewis (2011) highlighted the Fed's differential responses to oil demand and supply shocks. While they found a negative response to oil supply disruptions, our results show a positive and sustained rate increase, suggesting a different dynamic. Recent studies by Känzig (2021) and Gagliardone & Gertler (2023) support our findings of a significant and prolonged Fed response to oil supply shocks. Känzig noted a delayed tightening, while Gagliardone and Gertler observed an immediate and sustained increase in interest rates, which aligns closely with our results.

Our results show a unique dynamic in the monthly output gap response, characterized by an initial sharp drop followed by a rapid recovery, forming an inverted V-shape. While Bernanke et al. (1997) highlighted that output decreases after an oil price shock, their results indicate a reduction in output for up to 48 months, whereas we find a quick recovery the month after an oil supply shock. Thus contradicting their result that the Fed's response causes a recession.

Overall, our results for the output gap and inflation agree with recent literature that finds that adverse oil supply shocks increase prices and decrease economic activity (Baumeister et al. (2010); Baumeister & Peersman (2013); Baumeister & Hamilton (2019); Aastveit et al. (2021); Känzig (2021); Gagliardone & Gertler (2023); Baumeister (2023)).

In summary, the Fed responds to a negative oil supply shock by initially increasing the interest rates. At the same time, the US economy experiences a very short-term contraction and an increase in the price level.

5 Comparative Analysis: Canada and Switzerland

We extend our analysis to include Canada and Switzerland further to understand the implications of adverse oil supply shocks. By examining countries with distinct roles of oil and energy within their economies and different monetary policy frameworks, we can gain a more comprehensive understanding of how oil supply shocks impact various economies.

Canada and Switzerland were chosen for this analysis for several reasons. First, both countries differ significantly as oil and energy importers or exporters. Canada is a substantial net exporter of oil and other energy products, directly benefiting from higher oil prices, which can boost economic activity and improve the trade balance. In contrast, Switzerland is fully dependent on imports of oil and other energy products, making it highly vulnerable to oil price fluctuations. This dependence on imports typically leads to higher production costs and inflationary pressures following an oil supply shock. (Baumeister et al. (2010); Peersman & Van Robays (2012)).

Second, these countries have different monetary policy regimes. Canada operates under an inflation-targeting regime, focusing primarily on maintaining price stability. This allows us to investigate how a net energy-exporting country responds to oil supply shocks compared to a net importer like the US, which operates under a dual mandate to balance inflation control with supporting economic activity.

Switzerland's monetary policy is also primarily focused on inflation targeting but is further complicated by its position as a global safe haven. During periods of global economic uncertainty, international money often flows into Switzerland, leading to an appreciation of the Swiss franc. The Swiss National Bank (SNB) sets the SNB policy rate to maintain appropriate monetary conditions, including interest rates and exchange rates. This exchange rate appreciation can complicate the SNB's response to oil supply shocks, as it must balance inflation control with the impacts of a strong currency on its economy.

The importance of examining these different economic contexts is highlighted by the work of Baumeister et al. (2010) and Peersman & Van Robays (2012), who investigated the economic consequences of oil shocks across a set of industrialized economies. They found that the effects of exogenous oil supply shocks differ significantly between net oil-importing and net oil-exporting countries. Specifically, net oil-importing economies typically experience a permanent fall in economic activity and increased inflation following an adverse supply shock, prompting significant interest rate adjustments. In contrast, the impact on net energy exporters is either insignificant or positive, with a weaker monetary policy response due to the long-run effect on consumer prices being less pronounced.

We analyze the responses of interest rates and macroeconomic aggregates for Canada and Switzerland using the same local projections framework as in equation 1 employed for the United States. In the case of Switzerland, the Swiss National Bank (SNB) also prioritizes the stability of the exchange rate in its monetary policy (Jordan (2020)). Therefore, we also control for the nominal exchange rate in estimating the local projections in equation 1. Additionally, we extend our analysis to examine the impact of oil supply shocks on the nominal exchange rates. This approach is similar to the analyses conducted by Baumeister et al. (2010) on the exchange rates, where they augment one variable at a time to their VAR model.

$$er_{t+h} = \mu_h + \beta_h^o \epsilon_t + \sum_{l=1}^{13} \delta'_{h,l} \mathbf{x}_{t-l} + \xi_{h,t} \tag{3}$$

where er_t represents the natural log of the exchange rate at time t and $\mathbf{x}_t = [er_t, y_t, i_t, p_t, \epsilon_t]$.

5.1 Results for Canada

The impulse responses for Canada to an adverse oil supply shock that increases the real oil price by 10% are presented in panels (a)-(c) of Figure 2. Additionally, panel (d) presents the impulse response of the real oil price for ease of interpretation.

The Bank of Canada raises the interest rate by 7 basis points on impact directly in response to the oil supply shock. Concurrently, the output gap exhibits a marginal increase, suggesting a negligible initial impact on economic activity. However, inflation shows a more substantial increase, rising by 0.09 percentage points on impact.

In the subsequent periods, the oil price rises from 10% to 15% in the first thee months and gradually decreases back to 10% 18 months after the shock. Being a net exporter of both oil and non-oil energy, Canada benefits from the high oil prices, with the output gap steadily increasing to reach a peak of 0.55% ten months post-shock. During this period, inflation rises both due to the high oil prices and increased economic activity. Inflation increases sharply in the first month to 0.3% and then to 0.35% above baseline after two months.

The Bank of Canada keeps the interest rates about 7 basis points above the baseline for the first two months to counter inflation. As inflation stabilizes, the bank reduces interest rates for the next two months. The initial decrease in inflation is intermittent due to the increased interest rates in the first two months, but inflation continues to grow starting from the fifth month after interest rates decrease. The bank then increases interest rates again sharply by 7 basis points five months after the shock and by an additional 7 basis points in the next two months to counter rising inflation.

These rate increases affect inflation with a lag, but the increasing output means that the decrease in inflation is marginal. The Bank of Canada continues to raise interest rates to contain the price increase during this period. The output gap responds to the interest rates and gradually declining oil prices starting to decline from the ninth month.

Inflation falls from a peak increase of 0.50% at 13 months, following six months of increasing interest rates and the decreasing yet positive output gap. After witnessing three months of a decrease in inflation from 13-16 months, the Bank of Canada maintains constant interest rates about 18-21 basis points above baseline. However, the constant interest rates do not significantly impact inflation, which continues to increase again, while the output gap and oil prices fall from their peaks.

By 22 months after the shock, oil prices and the output gap return to baseline. Inflation peaks at 20 months but declines thereafter, leading the bank to reduce the high interest rates.

Our results for economic activity contrast with those of Baumeister et al. (2010) and Peersman & Van Robays (2012). Baumeister et al. (2010) found a sustained increase in economic activity in the first two years following an oil supply shock that increases long-run oil prices by 10%, whereas Peersman & Van Robays (2012) found an insignificant increase in economic activity. In contrast, we observed that the output gap falls along with the oil price at the end of two years. This discrepancy could be attributed to different measures of economic activity. While real GDP might grow as in Baumeister et al. (2010), our use of the output gap indicates that potential output could adjust in response to an increase in oil price.

Baumeister et al. (2010) also found that consumer prices rose very little, leading to a reduction in interest rates to boost the economy. Similarly, Peersman & Van Robays (2012) found an insignificant increase in inflation and a reduction in interest rates on impact. In contrast, our results show that consumer prices increased in the first two years, prompting the Bank of Canada to raise interest rates to manage inflation.

In summary, The Bank of Canada raises the interest rate by 7 basis points on impact in response to the oil supply shock, with a negligible initial impact on the output gap but a notable increase in inflation by 0.09 percentage points. As the oil price peaks at 15% 3 months post shock and gradually decreases to 10% in the first 18 months, Canada, being a net exporter of oil, benefits, causing the output gap to peak at 0.55% ten months post-shock. The bank adjusts interest rates dynamically to manage inflation, raising them by 18-21 basis points after initial reductions, gradually stabilizing inflation despite the fluctuating output gap and declining oil prices. By 22 months, the oil prices and the output gap return to baseline, leading to a reduction in interest rates as inflation peaks and begins to decline.

5.2 Results for Switzerland

Figure 3 displays the dynamic responses of Switzerland's interest rates, macroeconomic aggregates, and exchange rates to an adverse oil supply shock. Unlike the US and Canada, Swiss interest rates do not respond immediately to an oil supply shock. While Switzerland is a net importer of oil and non-oil energy, Peersman & Van Robays (2012) note that Switzerland's dependency on oil imports per unit of GDP is far less than that of the US. This could partially explain the marginal increase in the output gap on impact. Another reason for the increase in the output gap could be the initial but insignificant appreciation in the nominal exchange rate in the first three months. As the Swiss Franc is a safe haven currency, global economic distress caused by oil supply shocks increases the demand for Swiss Francs. This appreciation reduces input costs, aiding in a marginal increase in the output gap.

This growth continues, peaking at 0.22% six months after the shock and remaining stable until nine months post-shock. Inflation, meanwhile, rises steadily from the impact. Although it spikes to 0.20% after a month, the rate of increase slows down but continues to rise over the first six months. The SNB does not raise interest rates in the first six months, possibly to contain the appreciation of the Swiss Franc. Once the appreciation becomes insignificant and starts declining, the SNB raises interest rates starting seven months post-shock with an initial increase of 35 basis points.

These rates are maintained for the next two months, resulting in a delayed decrease in the output gap and stabilization of the Swiss Franc between -0.7% and -1% from 9 to 12 months. The price level also remains constant with an increase of 0.3% from the baseline.

When the SNB slightly reduces the interest rate around the ten-month mark, inflation picks up again. The SNB increases interest rates temporarily between 12 and 13 months to stabilize inflation. The output gap does not respond significantly to the slight increase in interest rates as they are very transitory. Inflation, however, responds temporarily to interest rates, increasing again when rates decline. As the Swiss Franc stabilizes around -0.8% 15 months post-shock and inflation stabilizes around 0.3%, the SNB steadily increases interest rates from 18 to 21 months post-shock. This rise in interest rates benefits both the exchange rate and inflation. However, the increase in interest rates leads to a slowdown in the output gap. Towards the end of the two-year period, as oil prices fall and the exchange rates return to baseline, the SNB stops increasing interest rates. While it maintains high interest rates of 16 basis points above baseline, they are cut from the peak of 35 basis points.

Our results for Switzerland are somewhat consistent with the existing literature but exhibit notable differences. For instance, Baumeister et al. (2010) find that real GDP experiences a minor dip following a slight increase and a permanent dip, consumer prices rise, interest rates gradually increase, and the exchange rate falls immediately. In contrast, we observe an increase in the output gap rather than a decline. While consumer prices rise, the interest rate response in our findings is slower and more intermittent than the continuous increase found by Baumeister et al. (2010). Additionally, we observe an initial increase in the exchange rate before it declines, differing from the immediate fall observed by Peersman & Van Robays (2012). They also report an insignificant increase in real GDP, whereas we find a significant increase in the output gap. These discrepancies may be attributed to differences in the exchange rate measures (broad vs. narrow), frequency (monthly vs. quarterly), and sample periods (1986-2010 for their studies vs. 1994-2019 for ours).

To summarize, following an adverse oil supply shock, the SNB initially maintains steady interest rates despite rising inflation and a slight increase in the output gap, likely to prevent further appreciation of the Swiss Franc. Once the currency depreciates, the SNB raises interest rates to manage inflation. This cautious approach helps stabilize inflation and the exchange rate over the longer term.

5.2.1 Comparative Analysis of Monetary Policy Responses in the US, Canada, and Switzerland

When comparing the monetary policy responses of the US, Canada, and Switzerland to an adverse oil supply shock, several key differences emerge.

In the US, the Federal Reserve's dual mandate focuses on stabilizing economic activity and inflation. Following the oil supply shock, the Fed initially raises interest rates modestly to counteract the immediate inflationary pressures again after a year to counter persistent inflation. We observe an initial reduction in the output gap followed by a rapid recovery, forming an inverted V-shape. The US successfully contains the price level with the two interest rate hikes. The dual mandate of the Fed results in a balanced approach, addressing both inflation and economic activity, which is evident in the dynamic interplay between interest rate adjustments and the output gap over the two-year period.

Canada's response, guided by its inflation-targeting regime, shows a more direct and pronounced reaction to rising inflation due to its status as a net exporter of oil and energy. The Bank of Canada raises interest rates sharply in response to the initial spike in inflation, benefiting from high oil prices which bolster economic activity. However, as inflation continues to rise, the bank dynamically adjusts interest rates to manage inflation while the output gap decreases gradually due to slowing oil prices and high interest rates. The significant and continuous adjustments in interest rates highlight Canada's proactive stance in managing inflation, even at the expense of economic activity fluctuations.

Switzerland, with its inflation-targeting regime that also prioritizes exchange rate stability, exhibits a more cautious approach. The SNB does not respond immediately to the oil supply shock, likely to prevent appreciation of the Swiss Franc, which is considered a safe haven currency. The initial increase in the output gap can be attributed to the reduced input costs from the appreciating Swiss Franc. As the exchange rate stabilizes, the SNB raises interest rates to manage inflation, maintaining a careful balance between controlling inflation and stabilizing the exchange rate. This approach reflects Switzerland's dual focus on inflation and exchange rate stability, leading to a more measured monetary policy response.

Overall, the US exhibits a balanced response due to its dual mandate, Canada demonstrates a strong inflation-targeting approach benefiting from its oil-exporting status, and Switzerland maintains a cautious strategy balancing inflation control and exchange rate stability. These differences underscore the varied impacts of oil supply shocks on net oil importers and exporters and the influence of different monetary policy regimes on managing such shocks.

6 Conclusion

In this paper, we first analyze the responses of the United States's macroeconomy and monetary policy to an adverse oil supply shock that increased the real oil price by 10% using local projections.

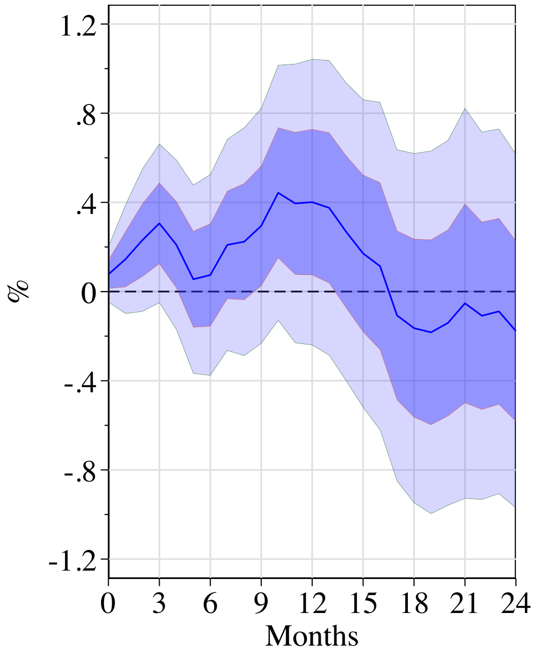
Our results indicate that the Federal Reserve responds to the oil supply shock by initially increasing interest rates to counteract the inflationary pressures. The output gap shows a short-lived decrease before recovering, while inflation persists for an extended period. The Fed then raises the interest rates after a year to contain the inflation. This suggests that the Fed's monetary policy aims to balance the trade-offs between stabilizing inflation and supporting economic activity.

We then extended our analysis to countries with different relationships to oil and monetary policy regimes from the US. For this purpose, we selected Canada and Switzerland, a net oil and non-oil energy exporter and importer, respectively. While the Bank of Canada conducts monetary policy by targeting inflation, the SNB targets inflation while also maintaining exchange rate stability.

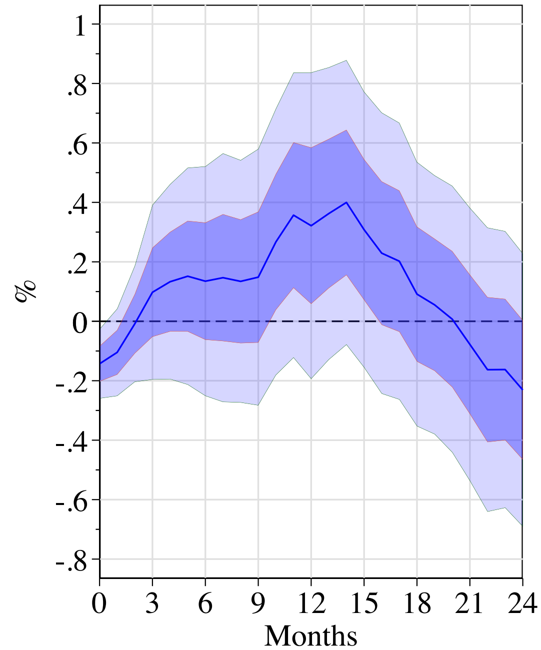
In response to the shock in the oil supply, the Bank of Canada significantly increased interest rates to manage inflation without causing substantial disruptions to overall economic activity. This response is likely influenced by Canada's status as a net oil exporter, which buffers its economy against the adverse effects of rising oil prices. The Canadian output gap gradually declines due to the slowing of oil prices and the increase in interest rates. Despite continuous monetary tightening, inflation persists in Canada.

Finally, in Switzerland, the SNB raises the interest rates cautiously to maintain stability in the exchange rate and inflation. The output gap does not respond adversely to the oil supply shock, probably because Switzerland's dependence on oil is smaller than that of other industrialized countries. Like Canada, inflation persists even at the end of two years despite the late increase in interest rates.

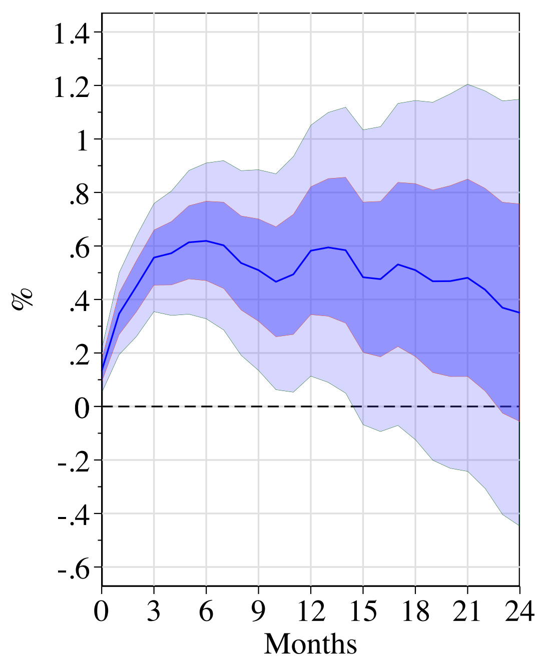
In the next steps for this project, we would like to analyze the pass-through of oil prices to inflation and further explain the underlying mechanisms at play. To achieve this, we plan to analyze the effects of an oil supply shock on CPI energy, Core CPI, GDP and import deflators, nominal wages, investment, and private consumption. This will help disentangle the effects of oil prices on overall inflation. This detailed analysis will help us disentangle the direct and indirect effects of oil price shocks on overall inflation. Specifically, we aim to understand the transmission channels and second-round effects, such as wage adjustments and shifts in consumer spending, and how these dynamics differ across sectors and countries. By integrating these analyses, we aim to provide a comprehensive understanding of the mechanisms through which oil price shocks affect inflation and economic stability.



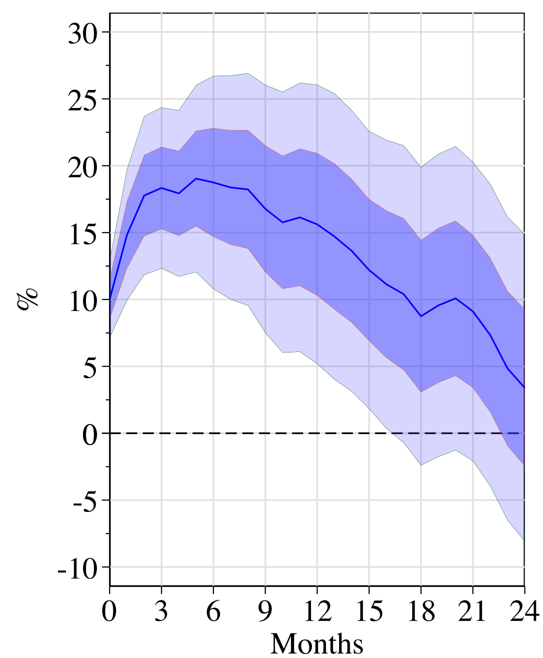
(a) Federal Funds Rate



(b) Output Gap

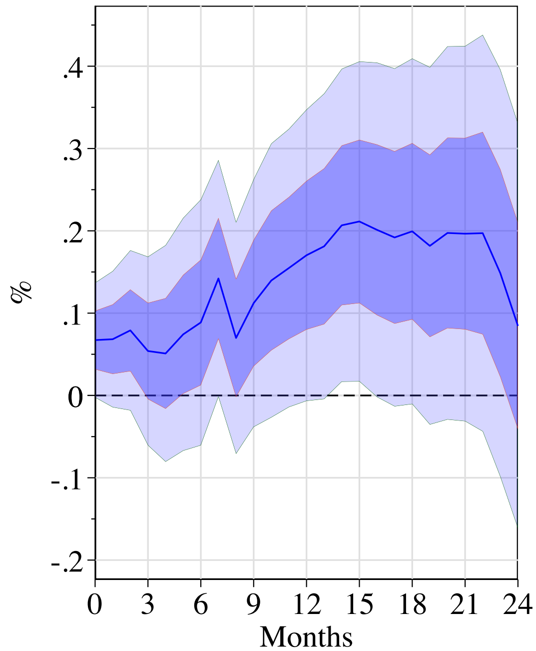


(c) US CPI

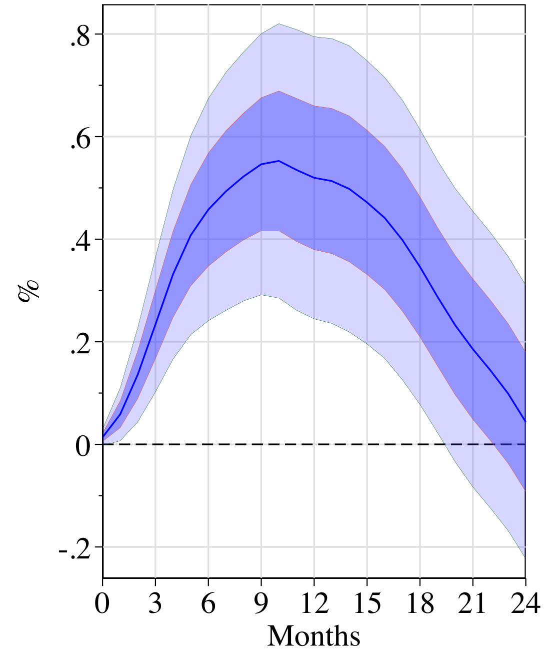


(d) Real Oil Price

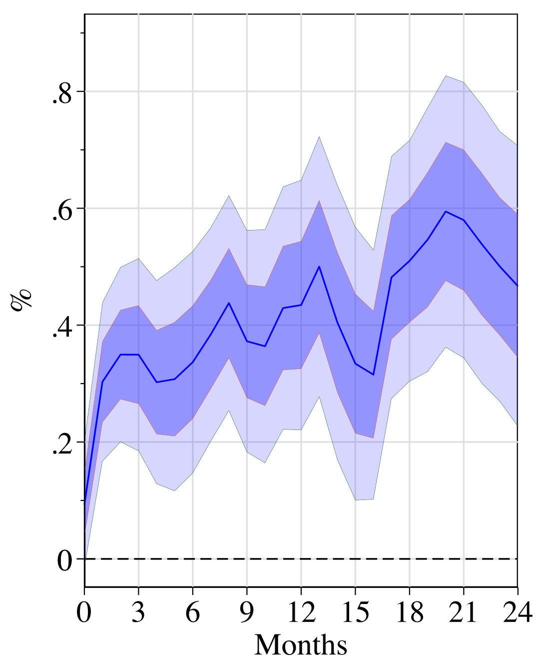
Figure 1: Responses of the US interest rate, macroeconomic aggregates, and real oil price to an adverse oil supply shock. Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.



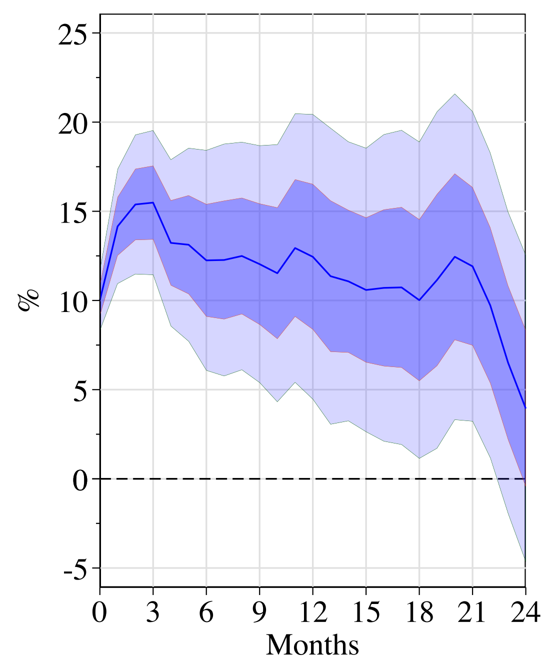
(a) Interest Rate



(b) Output Gap

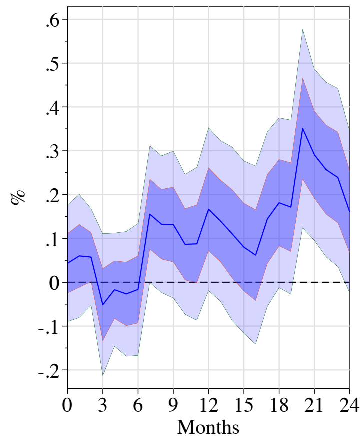


(c) Canada CPI

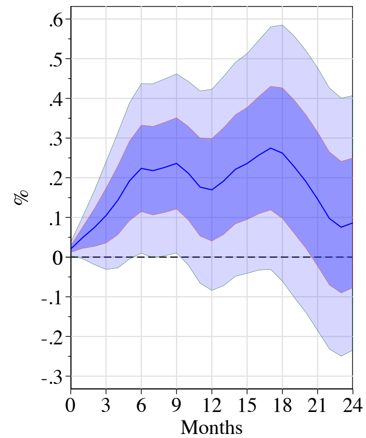


(d) Real Oil Price

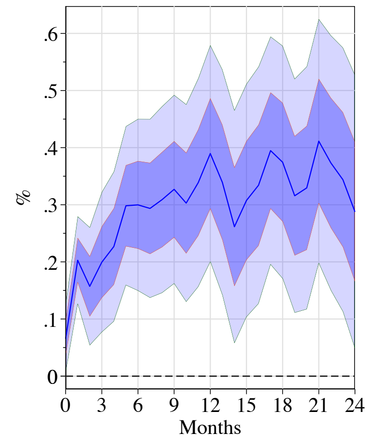
Figure 2: Responses of Canada's interest rate, macroeconomic aggregates, and real oil price to an adverse oil supply shock. Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.



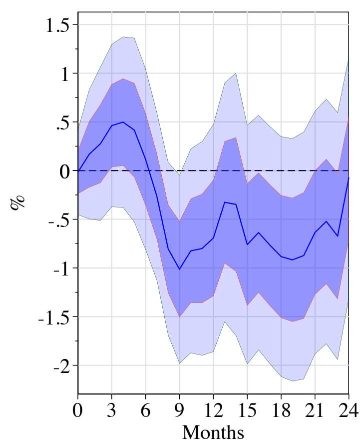
(a) Interest Rate



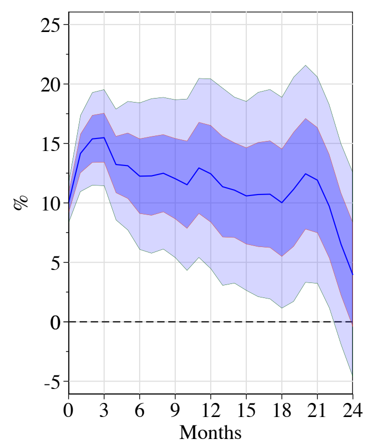
(b) Output Gap



(c) Switzerland CPI



(d) Nominal Exchange Rate



(e) Real Oil Price

Figure 3: Responses of Switzerland's interest rate, macroeconomic aggregates, and real oil price to an adverse oil supply shock. Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

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