

## Identifying money and inflation expectation shocks on real oil prices\*



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*Oil shocks have long been described in terms of the supply and demand fundamentals affecting oil markets. Yet evidence shows high correlations between real oil prices and gold prices that are traded in US dollars. This suggests that US monetary factors, in particular expected inflation, may be playing a role. Research investigated this and found Granger-causality from US money supply aggregates, US inflation and US expected inflation to both real oil and gold prices. Given evidence that monetary factors are impacting real prices, there may be departures from fundamentals that could be more precisely identified in these prices. Kilian (2009) provides identification of the oil market supply and demand shocks using an innovative structural vector autoregression model, around which much current oil price research still focuses. In this paper we augment Kilian's model by adding two monetary factors, the US money supply and the US expected inflation rate, to investigate if these shocks significantly affect oil prices using Kilian's methodology and the original fundamental shocks. We find that both the US money supply and inflation expectations significantly increase real oil prices. Then we decompose the historical changes in real oil prices into the contribution by each of the shocks. This variance decomposition shows that three of the four major oil price increase episodes were caused by the monetary shocks. These episodes represent departures from oil market fundamentals due to US monetary policy. We look for a common underlying factor in each of these real oil price episodes and find that in all three, the 1970s-1980s, post-2008, and post-2020, the increase in the US money supply to finance government spending was sterilized by central banks so that inflation did not rise immediately as high as it would have otherwise. During Bretton Woods, it was international central banks doing the sterilization by increasing their US dollar reserves to try to maintain the gold standard foundation of \$32 an ounce of gold; post-2008 and post-2020 it was the Federal Reserve holding trillions in excess reserves by paying interest on reserves. We interpret these episodes as rational departures from fundamentals due to uncertainty regarding when the US money would enter circulation and raise inflation. Energy policy and US monetary policy may be better formulated by taking these results into account.*

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\*This policy brief is based on "[Identifying money and inflation expectation shocks on real oil prices](#)" by Szilard Benk and Max Gillman, 2023, Bank of Finland Research Discussion Papers, No. 10/2023, Bank of Finland.

## Summary

The paper extends a famous study by Lutz Kilian from 2009 that explains how oil prices depend on fundamental shocks to the oil market. Kilian uses an oil supply shock, an aggregate world demand shock, and a residual precautionary oil demand shock to explain real oil price changes.

We extend this with the idea that certain US dollar (USD) denominated asset prices can be influenced by US monetary factors. Oil prices are traded internationally in USD. These monetary factors can drive real US oil prices above fundamentals for extended periods of time. We base our study on previous work that shows how oil (and gold) prices, in real terms when accounting for US inflation, have been “Granger-caused” by the US money supply growth rates and by the actual and expected US inflation rate. Clive Granger won the Nobel prize in Economics in part for originating this type of empirical analysis. It is not true causality but this statistical method is used throughout economics. What it means is that one economic data time series is systematically preceded by another data time series. In this case, changes in US money and inflation systematically precede changes in real oil prices (and gold).

Kilian (2017) has called this Granger predictability since it means that these factors that Granger-cause another data series actually can be used successfully to predict the other data series. We follow Kilian and call this Granger predictability of real oil prices by US money supply and inflation, both actual and expected.

Given this robust evidence of Granger-predictability of oil prices by monetary factors, the next step in our research was to see if these monetary factors would help explain oil prices within Kilian’s (2009) statistical framework. There Kilian uses times series data in what is called a structural vector autoregression (SVAR). Adrian Pagan, with S. Ouliaris and J. Restrepo, has a brilliant review of the SVAR literature in a 2016 book that includes how to implement the analysis using EViews, and is available online for free. Basically an SVAR model restricts times series in such a way as to see what variables may affect another variable. In Kilian (2009), it is the three fundamental factors causing oil prices. This is more of a causal sense than Granger-causality because here the shocks are identified and then implemented to see which ones are responsible for changes in the main variable that is being explained, such as oil prices. Here the shocks are then used to examine how they affect the variable for the data sample and how the variance of the variable of interest is explained historically by each of the shocks. If some relevant shocks are left out, then the existing variables that are included will absorb effects from other shocks.

## Robustness of Results

Using our work on Granger-predictability of oil (and gold) prices from Benk and Gillman (2020), we implement an extended Kilian (2009) SVAR by adding two more shocks coming from the US money supply and the US expected inflation rate. We find a great deal of robustness to our results in doing this SVAR model extension. We use different data sample periods, different model variations, different econometric specifications in the set-up of the SVAR and find the same results.

The results show that increases in the US money supply and in the US expected inflation rate significantly increase real oil prices. This is shown first through “impulse responses” that determine whether over the sample period the shock in question significantly affects a certain variable such as real oil prices. We find high confidence that these shocks increase real oil prices.

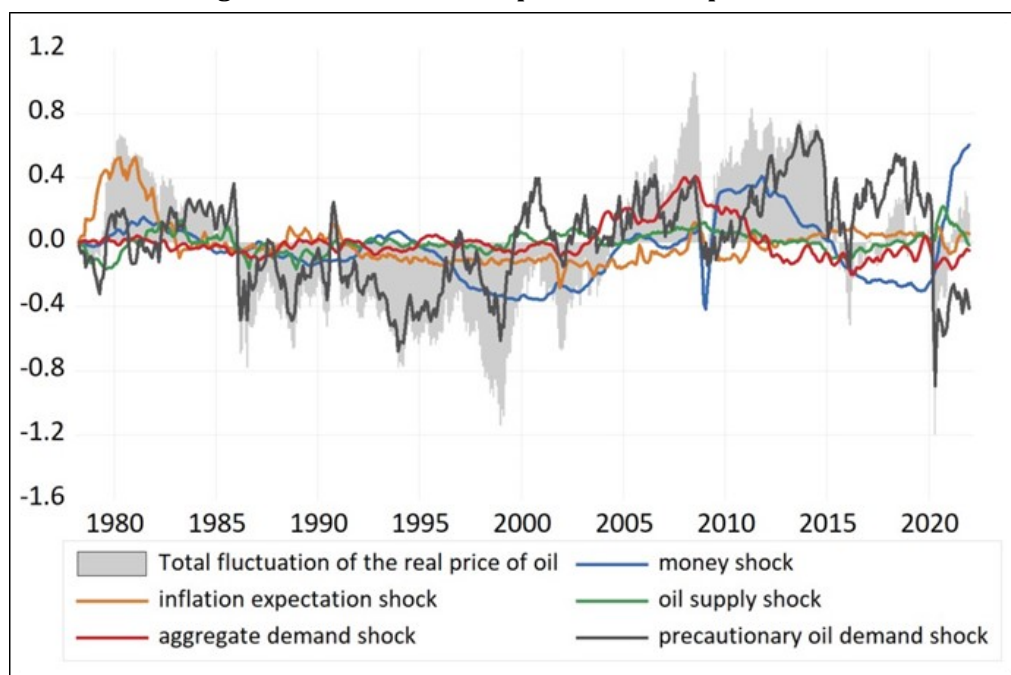
There is one caveat that we apply. We have to consider that the US money supply went up during the bank crisis of 2008 when oil and gold prices were crashing, because the Federal Reserve was short of reserves and borrowed reserves through what are called Central Bank Liquidity Swaps (Swaps). Essentially the Fed prints money and gives it to say Japan, takes yen in return that the Fed counts as reserves, and agrees to shortly sell back the yen for dollars. This is a liquidity provision of money for the Fed rather than an increase in the money supply to finance US Treasury spending as is typically the case for money supply changes. The latter occurs when the Fed buys US Treasury debt. We found in Granger-predictability tests in the Benk and Gillman (2020) article and in this paper that money does not significantly affect real oil prices when the swaps are included. But they do significantly affect real oil prices when the swaps (which count officially as part of the US monetary base) are subtracted. We find this in the SVAR results and so only the money supply as adjusted by subtracting the liquidity swaps positively increases real oil prices. We also show this is the case for an array of US monetary aggregates including the monetary base, M1, M2 as well as Divisia M1 and Divisia M2. We use M1 minus Swaps as our baseline money supply in the paper.

## Importance of Findings

The results that show how the US money supply and inflation expectations increase oil prices in impulse responses are interesting in that they suggest that any historical decomposition of how oil prices have changed over time would be affected by these monetary factors. The literature previously has used only fundamentals in the real oil price historical decomposition. We run this “variance decomposition” and find that the monetary factors replace many of the oil market fundamental shocks in explaining historical changes in real oil prices.

Our data sample, and historical decomposition, is monthly and it starts in 1978 when the University of Michigan inflation expectations data begins. It goes through 2021. Therefore it captures the high inflation of the late 1970s and early 1980s after the Bretton Woods gold standard collapsed and fiat currency began. It captures the surge in oil prices after 2001, after 2008, and again after 2020.

**Figure 1: Historical decomposition of real price of oil**



*Note: money data was measured by the Swap-adjusted M1.*

What we find is that in three of these four major oil price surge periods, monetary factors largely explain the real oil price increases rather than fundamentals as has been put forth in previous literature. We then want to examine how these monetary factors arose, why they affected three of the price surges and not the fourth, and what implications there are for future US monetary policy and world energy policy. In this version of the paper, we go part of the way towards this explanation, which we extend in the draft revised version coming soon.

First, we find that inflation expectations explain the surge in oil prices in the 1970s and 1980s, up to the oil price decline in 1986. Second, for the other two bursts in oil prices explained by monetary factors, these are the post-2008 increase and the post-2020 increase. Here instead of inflation expectations, it is the US money supply that explains the surges in oil prices. Third, we find as in existing literature that the post 2001 oil price USD increase (which for real oil prices started in 2004), that aggregate demand explains the surge.

In the draft revision we include additional robustness tests and then must try to interpret these results more broadly. What we find to be true is that the US money supply was in effect sterilized by central banks in all three of the periods of oil price surges above fundamentals. This sterilization caused uncertainty as to the actual inflation rate that would need to be built into oil prices in order for them to keep stable the real value of the oil assets.

During Bretton Woods, other central banks bought USD with their own currencies to keep pressure down on the official USD price of \$35 an ounce of gold. The market price went above this as the Fed printed money to help finance the Vietnam War, and Bretton Woods countries responded by ending the ability of people to redeem USD for gold, around 1968. After that, only central banks could redeem USD for gold through the US Treasury. So the Bretton Woods countries absorbed the increase USD supply by buying with new currency of their own and holding the USD as reserves; this effectively exported the US inflation to other Bretton Woods countries. France ended this practice in 1971 by trying to redeem USD at the Treasury and Nixon ended gold redemption.

After 2008 and after 2020, the US Fed dramatically increased the money supply to finance US Treasury spending (by buying US Treasury debt with money) and used the payment of interest on reserves to effectively sterilize much of the increase in the US money supply so that it remained at the Fed as reserves rather than entering circulation. Reserves surges to \$2.7 by 2014 (from zero in 2008) and above \$4 trillion after 2020.

## Conclusions

Thus, the common factor in the three surges in oil prices above fundamentals is the sterilization of the increase in the US money supply by central banks, either by international ones or by the US Fed. This created uncertainty that made oil prices surge as markets guessed at the expected inflation to come, since it was unknown when the sterilized USD would enter circulation. It could have been immediately or far into the future.

The post 2001 surge was also accompanied by a surge in US money supply. But none of it was sterilized and it entered circulation as near-zero excess reserves were held at the Fed as in all previous pre-2008 history during the fiat era after Bretton Woods collapsed. And here the monetary factors do not affect oil prices. Rather it is world aggregate demand, consistent with explanations of developing nations increased demand for oil after the fall of the Soviet Union and the entry of China into the World Trade Organization.

Unintended consequences of US monetary policy are that the oil price surges explained by monetary factors coincided with wars waged by oil producing nations, particularly Russia. Oil prices peaked in 2008, 2014, and 2022, all times of Russia militarily attacking sovereign nations. And the oil price collapse in 1986 has likewise been attributed to why the Soviet Union collapsed due to the loss of oil revenue (see Bartel 2022).

We find that these monetary policies of sterilized US money supply increases caused “rational bubbles” in oil prices above fundamentals that US oil markets, capital markets, and energy markets might understand. This could lead to accordingly modified US monetary policy and energy policy.

## Policy Implications

Ending the Emergency Economic Stabilization Act (EESA) of 2008 authorization of the Fed paying interest on reserves is recommended. This policy diverts inflation tax seigniorage from the US Treasury to private banks through a non-Congressionally mandated and budgeted subsidy. But more important than ending the skirting of Congressional budget mandates in which the Fed engages to subsidize banks, eliminating the ability of the Fed to pay interest on reserves would lead to the demise of the sterilization of new US money finance of deficits through increased reserves held at the Fed. These excess reserves may enter circulation at any time and induce uncertainty over future inflation that energy prices and other assets must anticipate. This tends to lead to these prices building-in high prolonged inflation. Eliminating payment of interest on reserves, eliminating the incentive to hold excess reserves at the Fed, and reimposing minimal reserve requirements that the Fed eliminated in 2020, hopefully would avoid future rational departures from fundamentals in oil prices. This in turn would decrease global economic volatility and allow more rational energy policy to proceed without major price bubbles that the paper finds are due to US monetary policy. ■

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**Szilard Benk** is an Associate Professor at Corvinus University of Budapest, and he is the Chief Economist of EXIM Hungary. Prior to this, he was Alternate Executive Director at the International Monetary Fund. His research interest includes empirical macroeconomics, monetary economics, energy markets, public finance, and macroeconomic policies. He holds a Ph.D. from Central European University. His research is published in the *Journal of International Money and Finance*, *Journal of Forecasting*, *Journal of Money, Credit and Banking*, *Journal of Economic Dynamics and Control*, *Review of Economic Dynamics*, *Manchester School*.

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His books include *The Spectre of Price Inflation* (Columbia University Press, 2023, US); *Principles of Macroeconomics: An Evolutionary Approach* (Kendall Hunt 2017), *Advanced Modern Macroeconomics: Analysis and Application* (Pearson 2011), *Inflation Theory in Economics* (Routledge 2009), and he is editor of: Robert E. Lucas, Jr., *Collected Papers on Monetary Theory* (Harvard University Press, 2013).

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