WHEN OIL BOILS, DOES GLOBAL INFLATION BUBBLE?

Christian Falcon, Christopher Lopez, Katiuska Diaz, and Sergio Mancilla

1. Introduction

The oil industry plays an important role in the global economy, it deeply influences geopolitics, energy policy, and financial stability. Understanding the main determinants of oil prices is crucial for investors, consumers, and policymakers. The volatility of oil prices—often driven by external geopolitical events, shifts in supply and demand, and broader macroeconomic indicators—has prompted extensive research aimed at modeling and forecasting price behavior. Because of the high dependency on oil, when prices fluctuate, economic implications occur , driving markets and influencing customer behavior, that is why forecasting volatility and oil prices are crucial.

Countless studies have attempted to identify the key factors influencing oil prices. These include both market-based elements such as global production and consumption levels, and non-market factors such as geopolitical tensions and economic shocks. In this project, we have dedicated a significant portion of our research to identifying the most relevant fundamental variables that affect inflation globally. The variables analyzed include inflation rate, oil output, war or conflicts, unemployment rate, real GDP growth rate, and exchange rates.

Building on the existing literature, we employed a regression model to test the impact of these factors on global inflation. Surprisingly, our findings indicate that the Brent crude oil price, traditionally assumed to have a strong influence, does not exhibit statistical significance in determining inflation. However, the model still shows a positive relationship with the price of oil and war conflicts.

These results suggest that while geopolitical events may generate short-term market reactions, they do not consistently affect inflation in the long run when controlling for economic fundamentals. Our findings contribute to a growing body of research that calls for a more data-driven and fundamentals-focused approach to understanding oil price behavior, rather than overemphasizing the role of unpredictable external shocks.

2. Survey of the Literature

The relationship between oil price shocks and inflation has long been a focus of economic research, beginning with early empirical studies in the 1970's and 1980's that documented a strong positive correlation between oil price increases and inflation, especially in developed economies. These studies typically relied on time-series data and basic OLS regressions to analyze the pass-through effect of oil prices on consumer prices. However, they often lacked the ability to disentangle supply-driven from demand-driven oil shocks, which led to oversimplified conclusions.

Killian and Zhou (2023) offer a more nuanced approach by distinguishing among different types of oil shocks. Namely, supply disruptions, precautionary demand, and aggregate demand shocks, using structural vector autoregressive (SVAR) models. Their findings reveal that only supply-driven oil shocks exhibit a consistent inflationary effect, while demand shocks may have ambiguous or even deflationary impacts, depending on economic context. This methodological refinement marks a significant evolution from earlier literature by accounting for the heterogeneity of oil shocks and their asymmetric effects.

Recent empirical work, including the findings in the current panel study of 30 countries from 2000 to 2024, attempts to extend Killian's framework into cross-country settings. This project uses a panel fixed effects model to capture how oil price movements (measured via Brent crude) influence inflation across both oil-importing and oil-exporting nations. Despite theoretical support, results show weak individual statistical significance. Possibly due to outliers like Venezuela, but a strong joint significance, confirming that oil prices are still a key part of the global inflation narrative.

In contrast to Killan's SVAR models, this study uses panel data to account for heterogeneity and includes additional macroeconomic controls, such as exchange rates, wars and unemployment. The literature suggests that while oil remains influential, its inflationary impact has diminished or become more conditional over time, shaped by exchange rate regimes, monetary policy creditability, and global supply chains.

3. Model

The empirical model used in this project is inspired by the economic theory of cost push inflation, which suggests that increases in input costs, such as oil, can drive up consumer prices. Given the global nature of oil markets and their influence on production and transportation costs, oil price shocks are modeled as a key determinant of inflation. The model is estimated using a panel Ordinary Least Squares (OLS) regression with country fixed effects to control for unobserved, time-invariant characteristics specific to each country that might influence inflation, such as institutional quality or structural economic features.

The dependent variable is annual inflation, measured as the percentage change in the Consumer Price Index (CPI). The main independent variable is the natural logarithm of Brent crude oil prices, which captures global commodity price shocks. Additional explanatory variables include oil output (to account for supply-side effects), exchange rates (reflecting import cost channels), war dummy (capturing geopolitical disruptions), real GDP growth (demand-side pressures), and unemployed rate (labor market effects). The model tests both direct and interaction effects, including a lag structure, to explore immediate and delayed inflation responses. This framework provides a comprehensive approach to understanding the macroeconomic transmission mechanisms linking oil prices to inflation.

4. Data

The dataset used for this project comprises 30 countries spanning the period from 2000 to 2024, resulting in a panel structure with 25 observations per country. The dependent variable is inflation, expressed as the annual CPI percentage change, which was obtained from the World Bank's World Development Indicators. Missing inflation data was filled for an entire row of Argentina. Russia, which was missing data from 2022 to 2024, the UAE, missing data from 2000 to 2007, and Venezuela, missing data from 2000 to 2008 and 2017 to 2024, sourced from the International Monetary Fund (IMF), and filled in the remaining 2024 data for countries Egypt, Indonesia, Iran, Iraq, Nigeria, and the UAE from World Data. The primary independent variable of interest is the natural logarithm of Brent crude oil prices, expressed as full-year spot averages in dollars, with no missing data, sourced from the U.S. Energy Information Administration (EIA). Captures global commodity price shock as foreign nations use Brent crude oil. Additional explanatory variables include Oil Output, measured as real raw oil production, which directly affects Brent and WTI prices. This variable was filtered to include only the liquids produced at the wellhead before refining or processing, expressed in million barrels per day (Mb/d). Controls for domestic oil supply effects include the possibility that a nation's production cut can cause oil prices to rise, ultimately impacting inflation. This was also sourced from the EIA. This data had to be standardized in Excel by dividing by 1000 to make the coefficients more interpretable in regression outputs. The exchange rate variable was filtered for 26 countries, including three euro nations, expressed as local currency per USD, also sourced from the IMF. Missing data was then filled for Iran, Peru, Russia, and Venezuela from XE. Reflects movements that influence inflation by affecting the price of imports when rates increase because of currency depreciation. The war dummy variable was expressed as a binary indicator for conflict years, according to the Uppsala

Conflict Data Program (UCDP database). Missing data for 2024 were filled in for Iraq, Nigeria, and Ukraine, sourced from the World Bank, and the last missing data for Iran were sourced from Reuters. Accounts for disruptions in the event of war, which can destroy infrastructure and limit the energy supply. Added Real GDP growth expressed as annual percentage change in real inflation-adjusted GDP rate sourced from the IMF. Affects inflation through demand-side pressures, which can drive up prices. The unemployment rate, expressed in percentage terms, has missing data for Ukraine due to the ongoing conflict with Russia, which has disrupted economic reporting and statistical capacity. As a result, these values were left missing, and the remaining data was sourced from the World Bank. Influences inflation through demand and wage pressures when low unemployment increases spending and wage growth, which contributes to upward pressure on prices. After data cleaning and proper formatting, the final dataset comprised 743 observations across 30 countries. The structure provided enough variation both cross-sectionally and over time to estimate panel regression.

5. Empirical Application

The model was estimated using a level-log panel OLS estimation with entity fixed effects added to control for country-specific, fixed traits and unobserved heterogeneity across countries, thereby eliminating bias that might arise from excluding these unobserved factors. The estimated regression equation is:

$$\pi_{i,t} = \alpha_i + \phi_1 \text{In}(OilPrice_t) + \phi_2 Oiloutput_t + \phi_3 ExchangeRate_{i,t} + \phi_4 WarDummy_t + \phi_5 RealGDPGrowth_{i,t} + \phi_6 UnemploymentRate_{i,t} + u_{i,t}$$

Figure 1 reveals that six variables were not statistically significant in explaining global inflation. The model identified only two variables that show a positive relationship with inflation. The coefficients of the log price of Brent crude oil are 69.647, and the war dummy variable is 50.634. A 1% increase in oil price is associated with a 0.696 percentage point increase in inflation on average, across 30 countries holding oil output, exchange rate, war dummy, and GDP growth constant. Unfortunately, the evidence was insufficient to conclude such an impact on inflation with P-values of 0.4000 and 0.7600 for the war dummy variable exceeding 0.10, as indicated below.

```
                          PanelOLS Estimation Summary
================================================================================
Dep. Variable:              Inflation   R-squared:                        0.0589
Estimator:                   PanelOLS   R-squared (Between):             -5.6963
No. Observations:                 743   R-squared (Within):               0.0589
Date:                Sat, May 17 2025   R-squared (Overall):             -0.3463
Time:                        23:26:23   Log-likelihood                   -6820.5
Cov. Estimator:             Clustered
                                        F-statistic:                      7.3810
Entities:                          30   P-value                           0.0000
Avg Obs:                       24.767   Distribution:                   F(6,707)
Min Obs:                       22.000
Max Obs:                       25.000   F-statistic (robust):             32.424
                                        P-value                           0.0000
Time periods:                      25   Distribution:                   F(6,707)
Avg Obs:                       29.720
Min Obs:                       29.000
Max Obs:                       30.000

                              Parameter Estimates
====================================================================================
                  Parameter  Std. Err.     T-stat    P-value    Lower CI    Upper CI
------------------------------------------------------------------------------------
LogOilPrice          69.647     82.696     0.8422     0.4000     -92.711      232.01
OilOutput           -203.31     199.30    -1.0201     0.3080     -594.60      187.97
ExchangeRate        -0.0046     0.0033    -1.3881     0.1655     -0.0112      0.0019
WarDummy             50.634     165.66     0.3056     0.7600     -274.62      375.88
RealGDPGrowth       -124.32     103.87    -1.1969     0.2317     -328.25      79.604
UnemploymentRate    -103.87     79.404    -1.3081     0.1913     -259.77      52.024
====================================================================================

F-test for Poolability: 1.7653
P-value: 0.0083
Distribution: F(29,707)

Included effects: Entity
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Figure 1. Panel OLS Estimation Summary displaying coefficient estimates, standard errors, and p-values for the inflation model across 30 countries.

We fail to reject the null hypothesis of no effect. The reason might likely be due to extreme outliers, such as Venezuela's triple-digit hyperinflation values, which could have skewed the model and caused inconsistency with other countries' data. I have not excluded Venezuela because it is a member of OPEC and still a significant energy exporter, which is relevant for the explanatory variable of oil output. Although the model is not entirely insignificant, as the F-statistic has a p-value of 0.0000, indicating that the model is statistically significant at the 1% level, suggesting that the independent variables jointly help explain the impact on global inflation, regardless of whether individual coefficients are essential. In the final specification, I checked for multicollinearity before adding each variable, and strangely, there was none after adding six. Then, I decided to create an interaction term between oil and the exchange rate. However, it introduced substantial multicollinearity as shown in Figure 2.

	Variable	VIF
0	const	87.528041
1	LogOilPrice	1.039528
2	OilOutput	1.074018
3	ExchangeRate	2362.433240
4	WarDummy	1.076330
5	RealGDPGrowth	1.105023
6	UnemploymentRate	1.091528
7	OilPrice_ExchangeRate	2363.233052

Figure 2. Variance Inflation Factors (VIFs) show multicollinearity after including the interaction term.

I included the interaction term between oil price and exchange rate because when I first regressed the model, the exchange rate variable was the only significant variable. However, after accounting for Real GDP growth, the exchange rate variable lost significance. This might have been because, once it was added, it reduced the importance of variables that control macroeconomic performance, which may have driven the change. I thought adding the interaction term would increase the significance of the exchange rate variable. I also included a lagged variable of log price for 1 year, but it still did not improve the explanatory power, as the R-squared value remained unchanged. This suggests that inflation may respond immediately to oil price movements and that the lag format requires a more dynamic specification to capture any delayed effects. Despite limitations in model fit and a lack of statistical significance for some coefficients, the price of oil remains a relevant factor in explaining global inflation. Figure 3 shows that modeling inflation is difficult due to the influence of numerous macroeconomic and geopolitical factors.

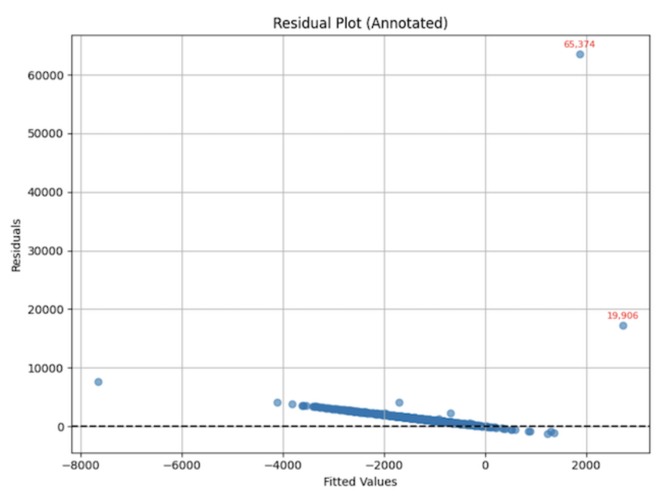

Figure 3. A residual plot, used for diagnostic purposes, shows that the model effectively captures inflation trends for many countries, with residuals clustered around zero. However, the model predicts unrealistic negative values, reflecting the limitations of linear regression when dealing with extreme inflation values.

According to Federal Reserve Bank of Dallas report, while many studies focus on the U.S., historical evidence shows oil price shocks was once the most fundamental global driver of inflation for decades. Figure 4 illustrates that oil's role today is more complex, as other variables, such as monetary policy, supply chain dynamics, and global demand conditions, have become critical in influencing inflation.

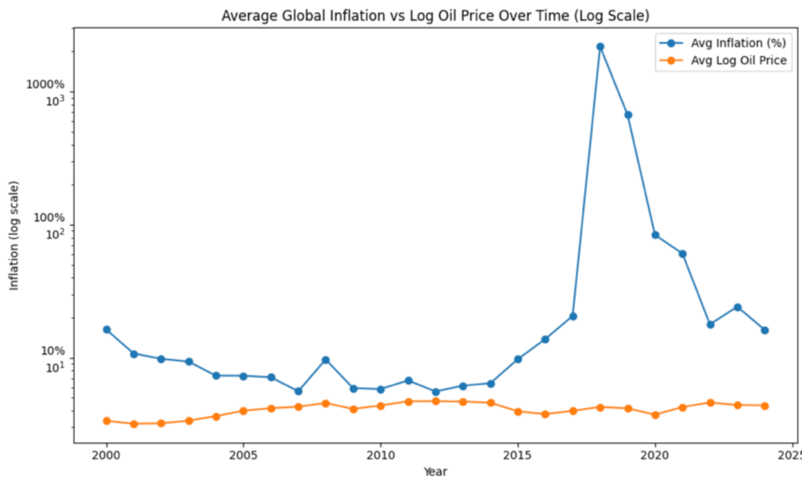

Figure 4. Line plot reveals that a divergence between the price of Brent oil and inflation, suggesting that other macroeconomic factors played a more dominant role in driving inflation than price alone.

6. Conclusion

This project set out to empirically assess the relationship between oil price shocks and inflation across a panel of 30 countries from 2000 to 2024, with a focus on disentangling the complex interactions between global commodity prices and macroeconomic indicators. While previous literature—especially early studies—emphasized a strong, direct link between oil price increases and inflation, more recent research, such as that by Kilian and Zhou (2023), highlights the importance of differentiating between types of oil shocks and considering broader economic contexts.

The results of this analysis demonstrate that although oil prices continue to be a significant factor in the inflation equation, their individual statistical significance has diminished in recent decades, which is in line with the evolution in the literature. Despite being positive and consistent with cost-push inflation theory, the coefficient for Brent crude oil failed to reach statistical significance at standard levels. Likewise, the war dummy variable lacked statistical robustness while having a strong positive coefficient.

Nonetheless, the model's combined importance, which is backed by a highly significant F-statistic, demonstrates that oil prices and related macroeconomic variables still have a considerable impact on how inflationary dynamics are shaped internationally. These findings highlight the impact of additional structural factors including exchange rates, real GDP growth, and monetary policy regimes, supporting the larger scholarly movement away from crude one-to-one mappings between oil prices and inflation.

In contrast to previous research that used time-series or SVAR models in single-country settings, this panel-based method made it possible to incorporate various covariates and cross-country heterogeneity. Although it added instability to the projections, the inclusion of nations with extremely difficult economic situations, like Venezuela, also illustrates how difficult it is to accurately anticipate global inflation patterns in practice.

The study's findings ultimately demonstrate the decreased and conditional nature of oil price shocks' influence in recent years, even as it affirms their significance in the global inflation narrative. The results suggest that inflation cannot be fully understood without accounting for broader geopolitical, monetary, and structural economic factors—highlighting the need for continued research using more dynamic models and alternative approaches, such as SVAR or nonlinear techniques, to better capture the evolving inflationary landscape.

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