Monetary Shocks Unleashed: Deciphering the Dynamics of U.S. Production and OPEC+ Exports

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Methods

- Data Collection and Preparation: Collected Employment, Interest Rates, and Inflation from FRED, along with Oil Production and Imports from EIA.
- Vector Autoregression (VAR) Model: Estimate a VAR model using data on employment, inflation, interest rates, and crude oil prices to generate residuals for monetary shocks, supply shocks, and price shocks.
- Identification of Monetary Shocks: Identify monetary shocks based on a predefined threshold for changes in interest rates and add them to the main `oil_data` data frame.
- ARIMA Models for OPEC and Production: Determine the optimal orders for the OPEC and production ARIMA models using ACF and PACF plots and the `auto.arima` function.
- Incorporating Shocks into the Models: Include monetary shocks and price shocks as exogenous variables in the OPEC and production ARIMA models to assess their impacts.
- Model Evaluation: Evaluate the models using error metrics like MAE, MSE, RMSE, and MAPE, and conduct the Diebold-Mariano test to compare the forecast errors of the two models.

OPEC and Production Models

	Dependent variable:	
	OPEC Model	Production Model
	(1)	(2)
ar1	-0.409	0.460**
	(0.344)	(0.198)
ma1	-0.112	-1.106***
	(0.346)	(0.183)
ma2	-0.155	0.427***
	(0.185)	(0.097)

Data

- Brent Crude Oil Prices: International benchmark price; reflects global economic conditions and geopolitical events.
- US Domestic Production: Measures total volume of US crude oil production; impacts oil prices and market dynamics.
- OPEC+ Imports: Alliance of oil-producing countries; coordinates production to stabilize prices; affects global oil market.
- Inflation: Rate of general price increase; impacts purchasing power, production costs, and investment in oil market.
- Interest Rates: Cost of borrowing money; influences investment, production, and consumption in oil market.
- Oil Field Employment: Number of workers in oil and gas extraction; indicates industry health and regional economic impact.

What are the effects on U.S. Oil Production and OPEC+ Exports after monetary policy shocks?

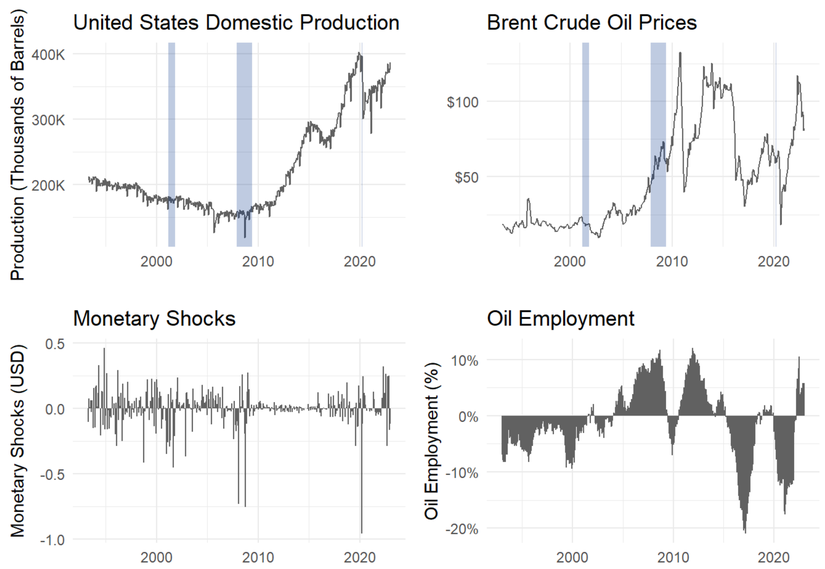

Figure 1: 2021 Wage Inflation at the Parish Level

Results

Based on the graphs above it can be observed that during the normal business cycle Oil Employment can be affected negatively during times of economic slowdown. With this the Fed may ease rates to relieve financial pressure on industries with high overhead. If the response is not fast enough it could result in large amounts of layoffs even with rising prices in the oil market. This didn't appear to aid the U.S. as it was in the beginning stages of becoming energy independent with relaxed regulations and the growing profitability of Shale Operations.

The Production Model demonstrates significant coefficients for AR1 (0.460, $p < 0.05$), MA1 (-1.106, $p < 0.01$), and MA2 (0.427, $p < 0.01$), indicating a stronger model than the OPEC Model, which does not have any significant coefficients. However, the Diebold-Mariano test results reveal no significant difference between the forecast errors of the two models, as evidenced by a p-value of 0.629.

Even with the increase in U.S. Production, employment has not achieved sustained growth due to the collapse of prices in 2016. However it becomes clear that there is a strong correlation between Monetary Shocks and Oil Employment.

Monetary and Price Shocks

	Dependent variable:	
	OPEC Model	Production Model
	(1)	(2)
Constant	-1,089.963	1,761.645**
	(860.060)	(874.778)
Residual Std. Error (df = 357)	16,273.100	16,551.580

	Dependent variable:	
	OPEC Model	Production Model
	(1)	(2)
Constant	-1,091.409	1,756.531**
	(859.850)	(875.135)
Residual Std. Error (df = 357)	16,269.130	16,558.330

Conclusion

In conclusion, our analysis comparing the OPEC and Production Models revealed that the Production Model exhibited a stronger performance, with significant coefficients for AR1, MA1, and MA2. Nevertheless, the Diebold-Mariano test indicated no significant difference between the forecast errors of the two models. This suggests that, while the Production Model may provide more insight into the relationships within the data, the practical forecasting implications of these models may not differ significantly. This study serves as a foundation for further exploration into the complex interactions between oil production, exports, and various macroeconomic factors, with the ultimate goal of improving our understanding and forecasting capabilities in this critical domain.

References

Sab, Randa. (2016). Economic Impact of Selected Conflicts in the Middle East: What Can We Learn from the Past? IMF Working Paper, WP/16/86. Retrieved from https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Economic-Impact-of-Selected-Conflicts-in-the-Middle-East-What-Can-We-Learn-from-the-Past-41639

Lahn, G., & Fattouh, B. (2022). Oil market stability under a new geopolitical order. Nature Energy, 7(3), 211-216. https://doi.org/10.1038/s41560-022-01053-2