The Relationship Between Oil Prices and Exchange Rates: Theory and Evidence

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EIA 2017 Workshop on Financial and Physical Oil Market Linkages
September 19, 2017
Main Conclusions

- Link between exchange rates and oil prices has intensified
- Strong linkages between exchange rates and oil prices over the long-run
- Exchange rates potentially useful predictor for oil prices (and vice versa) in the short-run but effects are strongly time-varying
  - Correlation does not imply forecasting ability
- Several important avenues for future research
1. Introduction
2. Theoretical transmission
3. Empirical evidence
4. Conclusion and open questions
An evolving relationship?

Correlation vs. causality?
Four Questions

1. Direct vs. indirect transmission channels?

2. Backward ("in-sample") and forward looking ("out-of-sample") evidence?

3. Role of time-variation and nonlinearity?

4. Open questions?
Theoretical Transmission
Direct vs. Indirect Transmission Channels

Common Factors and Exogenous Shocks

- GDP
- Monetary Policy
- Stock Prices
- Expectations
- Uncertainty

Direct vs. Indirect Transmission Channels

Nominal Oil Price
- Denomination Channel
- Expectation Channel
- Portfolio Channel

Real Oil Price
- Terms of Trade Channel

Inflation

Nominal Exchange Rate

Real Exchange Rate
- Expectation Channel

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Denomination Channel: Dollar appreciation increases the price of oil which lowers the demand for oil and results in a drop of the oil price.

Supply side effect of dollar changes less clear: Pricing strategy, exchange rate regime.
What are characteristics of the oil price exchange rate link in the past?

Are oil prices useful for forecasting exchange rates?
Forward looking ("out-of-sample") perspective

Looking Back or Predicting the Future?

Out-of-sample

In-sample

What are characteristics of the oil price exchange rate link in the past?
Backward ("in-sample") perspective
Empirical Evidence
Number of publications on oil price/exchange rate link

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>3</td>
</tr>
<tr>
<td>2004</td>
<td>2</td>
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<td>2014</td>
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<td>2015</td>
<td>3</td>
</tr>
<tr>
<td>2016</td>
<td>8</td>
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</table>
Nominal vs. real Linkages

Number of publications per oil price type

Number of publications per exchange rate type
A Rich Set of Methodologies

**Granger Causality**
Informational content of lagged oil price (exchange rate) dynamics for the current exchange rate (oil price)

**Cointegration**
1. Long-run link between oil price and exchange rate?
2. Short-run reaction to the long-run deviations?

**Vektorautoregressive Model (VAR)**
Short-term response of oil price (exchange rate) shocks to exchange rate (oil price)?

**Engle-Granger Methodology:**
One long-run relationship, causality predetermined

**Johansen Procedure:**
Multiple long-run relationships, causality not predetermined

**Structural VAR:**
Identification of structural shocks based on error terms

**Copula**
Tail dependence between oil prices and exchange rates?

**Wavelet Approach**
Correlation between oil prices and exchange rates across different time-scales?

**GARCH**
Volatility spillovers between oil prices and exchange rates?

**Asymmetry resulting from different time scales or extreme events**

**Correlation between oil prices and exchange rates across different time-scales?**

**Volatility spillovers between oil prices and exchange rates?**

**Nonlinearities**

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Amano and van Norden (1998)

Stable long-run link between oil price and the US real effective exchange rate.

Oil price Granger-causes the exchange rate and not vice versa.

Chen, Rogoff and Rossi (2010):
Structural link between exchange rates and commodity prices through
Exchange rates are very useful in forecasting future commodity prices.

Alquist, Kilian and Vigfusson (2013):
Small but significant improvements in oil forecast accuracy for AUD and CAD.

Fratzscher, Schneider and van Robays (2014)
Bidirectional causality between the US Dollar and oil price since the early 2000s.

Habib, Bützer and Stracca (2016)
No systematic evidence of a relationship between oil price balance and exchange rate movements following oil price shocks based on a sample of 43 countries.
Sample Choice: A Major Issue

Probability to find a causal relationship from the nominal effective dollar exchange rate to the nominal oil price

Probability to find a causal relationship from the nominal oil price to nominal effective dollar exchange rate
Evidence on Long-Run Relationships and Short Run Dynamics

- Plenty of evidence for long-run relationship between the real oil price and real effective exchange rates
- Causalities seem to change and run in both directions
- Linkages between nominal oil price and dollar exchange rates also often identified
- Short run linkages have increased
- Many results are highly sample-dependent
Evaluation of Forecasts

Research on predictability mostly based on point forecast evaluation

- **Point Forecast Evaluation**: Comparison of actual and forecasted value by model relative to a benchmark
- **Density / Utility Forecast Evaluation**: Evaluation based on risk and utility from an investor's perspective
- **Direction Forecast Evaluation**: Evaluation of directional forecast relative to a benchmark
Evidence on Predictability: A Rolling Regression Exercise

Figure 20: Oil price forecast (h=1)

<table>
<thead>
<tr>
<th></th>
<th>h=1</th>
<th>h=12</th>
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<tbody>
<tr>
<td>Broad index</td>
<td>0.7004219</td>
<td>0.5723542</td>
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<tr>
<td>Major index</td>
<td>0.6561181</td>
<td>0.5226782</td>
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Evidence on Predictability

- Weak link between in-sample and out-of-sample relationship

- Some studies find evidence for exchange rate predictability based on oil prices. However, those studies often suffer from sample dependency or wrong modelling choices

- Weak evidence for systematic oil price predictability based on exchange rates but potential role of commodity currencies
Plenty of evidence that relationship has intensified over time

Nonlinear Models

Breakpoint Models:
Dynamics change at specific points in time
September 2008

Stochastic Models
Dynamics change as a result of the unobservable factors
Technology Shocks

Endogenous Threshold Models:
Dynamics change as a result of an observable variable
Rising vs. falling oil prices
Correlation between forecast uncertainty related to oil prices and exchange rates

<table>
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<tr>
<th></th>
<th>2005-2010</th>
<th>2010-2015</th>
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</thead>
<tbody>
<tr>
<td><strong>1 month</strong></td>
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<tr>
<td>EURO</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>POUND</td>
<td>-0.11134</td>
<td>0.262277</td>
</tr>
<tr>
<td>YEN</td>
<td>-0.35374</td>
<td>0.320367</td>
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<tr>
<td>BRAZIL REAL</td>
<td>-0.26725</td>
<td>0.284328</td>
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<tr>
<td><strong>12 month</strong></td>
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<tr>
<td>EURO</td>
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<td>-0.20159</td>
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<tr>
<td>POUND</td>
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<tr>
<td>YEN</td>
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<td>0.245369</td>
</tr>
<tr>
<td>BRAZIL REAL</td>
<td>0.000</td>
<td>0.394568</td>
</tr>
</tbody>
</table>

Note: The Table provides correlation coefficients between forecaster disagreement on crude oil prices and dollar exchange rates.
Open Issues

- Addressing time-varying predictability and optimal sample choice
  - Model averaging as a possible solution?

- Identifying relevant information in various exchange rates and role of common factors
  - Factor models as a possible solution?

- Identifying expectation effects?
  - Survey data and futures contract?

- Disentangling supply and demand effects
  - Structural shocks / exchange rate pass-through
Policy Implications for Oil Exporters

- Fixed exchange rates stabilize domestic revenues
- Low oil prices and the need to prevail an exchange rate regime often resemble a negative demand shock
- IMF (2017): Some Exporters should consider depreciation and/or greater exchange rate flexibility...
Conclusions

- Link between exchange rates and oil prices has intensified

- Strong linkages between exchange rates and oil prices over the long-run

- Exchange rates potentially useful predictor for oil prices (and vice versa) in the short-run but effects are strongly time-varying
  - Correlation does not imply forecasting ability

- Several important avenues for future research
Thank you very much for your attention
Terms of trade channel: Oil prices affect exchange rates through affecting the ratio between tradable and non-tradable goods

Wealth and portfolio channel: Oil price changes affect nominal exchange rates as a result of wealth effects. Currencies of oil price exporters appreciate in the short-run.
Terms of Trade Effects

Annual Impact of Terms-of-Trade Effects by Group (in percent of GDP)

- Oil importers: 2.3%
- Oil exporters (float exchange rate regime): -2.6%
- Oil exporters (fixed exchange rate regime): -7.0%