Commodity Currencies and Causality: Some High-Frequency Evidence

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Abstract

I investigate the link between economic fundamentals and exchange rate adjustment to commodity price fluctuations. I overcome the traditional issue of simultaneity by exploiting the September 14, 2019 drone attack on two Saudi Arabian refineries as a natural experiment. This unanticipated event caused the largest 1-day global crude oil price shock in over a decade. Using high-frequency exchange rate data for 30 countries, I link the cross-section of currency movements around the event to country-specific economic and financial fundamentals. Crude export and import intensities were associated with appreciation (depreciation). Additionally, countries with higher policy interest rates and weaker financial positions experienced greater currency depreciation while safe haven currencies appreciated, consistent with 'risk-off' sentiment triggering carry trades to unwind. I also find that across currencies, estimated (pre-event) crude oil and VIX betas are tightly associated with oil-related and financial fundamentals, respectively. Therefore, exchange rate adjustment around the drone attack can also be explained by currency risk factors.

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1 Introduction

The complex relationship between commodity prices and exchange rates is of great interest to international economists and policymakers, especially for those focusing on resource-dependent open economies [See Edwards (1986)[6], Chen and Rogoff (2003)[4], Cashin et al. (2004)[3], and Aizenman et al. (2012)[2].]. Despite the rich literature on exchange rate adjustment to commodity shocks, establishing causality under this context remains challenging because of simultaneity: it's possible that exchange rate fluctuations cause commodity prices to adjust [Chen et al. (2010)[5]] or for commodity fluctuations to impact exchange rates under the assumption that open economies are price takers in the world commodity market[1]. Several studies report evidence of predictability or cointegration [Chen et al. (2010)[5], Lee and Chen (2014)[10], Kohlscheen et al. (2017)[9], among others.], oft considered the second-best approach when causal identification can't be achieved.

This paper takes an alternative approach to identify the causal effect of commodity prices on exchange rates. I exploit the September 14, 2019 surprise attack on two Saudi Arabian oil refineries as a natural experiment, where this completely unanticipated shock to global crude oil supplies sent world crude prices sharply higher, leading to the largest 1-day spike in over a decade. Using high-frequency data on exchange rates across 30 countries, I measure exchange rate adjustment around the window of the unanticipated oil shock and link the heterogeneity in exchange rate adjustment back to various country-specific fundamentals. Consistent with the literature, I find that both a country's trade-related oil exposure - and financial/monetary conditions - jointly explain exchange rate adjustment to the oil shock. This suggests that the drone attack caused oil prices to jump but also may have triggered risk-off sentiment. Heavier crude exporters (importers) saw greater appreciation (depreciation). Current account surpluses and greater international reserves were associated with exchange rate appreciation. Consistent with risk-off sentiment, countries with higher policy interest rates, usually observed among Emerging Market economies and carry trade candidates, saw greater depreciation. At least in the very short-run, this evidence of exchange rate adjustment goes against the conventional view that exchange rates are un-responsive to commodity supply shocks [Basher et al. (2015)[13] and Habib et al. (2016)[8]].

[1] As done in several of the mentioned papers. A reasonable assumption though with exceptions: Russia as an oil exporter, OPEC countries as a coordinating organization, China as an importer of copper, Chile as an exporter of copper, United States corn production.

Finally, under a conventional asset pricing framework, I estimate (ex ante) currency factor betas to test whether such risk factors also explain exchange rate movements around the event. Using monthly data from 2010 through August 2019 (up to but before the event), I estimate crude oil, global volatility (VIX) and U.S. Dollar betas, finding that currency-specific exposures to crude oil and global volatility together can explain nearly half of the variation in exchange rates around the drone attack, while the role of the U.S. dollar was minimal over this event. Moreover, many empirical asset pricing studies which find priced risk factors do not focus on 'what' drives risk exposure heterogeneity. Along these lines, I report evidence highlighting the tight association between the cross section of VIX betas and country financials (interest rates, current accounts and international reserves), supportive of Menkhoff et al. (2012)[11]. Estimated oil betas are strongly associated with country oil-related fundamentals.

2 September 14, 2019 Oil Supply Shock

2.1 Crude Oil Prices

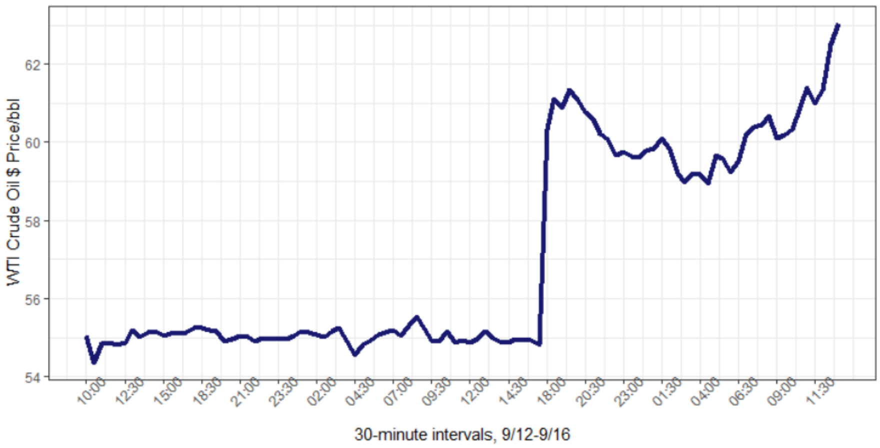
In Saudi Arabia on September 14, 2019, drones were used in a surprise attack on two of the largest Saudi Aramco oil refineries - state-owned facilities: Abqaiq and Khurais in Eastern Saudi Arabia (Figure 1). According to the Saudi Arabian interior ministry, the flames induced by the attack were put out relatively quickly, but both facilities were shut down for repairs, temporarily cutting the country's oil production (about 5 percent of global production) by about half. Despite the country communicating that it will tap into its oil reserves to buffer the supply shock, the news led to the sharpest one-day rise in global crude oil prices in over a decade.

Figure 2 shows that as the futures market opened on the subsequent Sunday evening, crude oil futures prices jumped over 10 percent from roughly \$55 per barrel to \$61, and then continued to rise through Monday to a peak of over \$63. While the drones struck when markets were closed, the opening gap largely represents the market response to the news, as no other news over the weekend were released that could have had such an unprecedented impact on crude oil prices.

Figure 1: September 14, 2019 Drone Attacks

Source: VOAnews.com

Figure 2: Intra-day WTI Crude Oil Futures Response to 9/14 Drone Attack



2.2 Exchange Rate Adjustment

Meanwhile, as foreign exchange markets around the world opened, currency responses varied widely. Naturally, many countries which do not have oil-intensive dependencies continued to operate as 'business as usual'. In contrast, exchange rates of Russia, Norway, and Canada - major oil exporters - saw sudden appreciation. Other countries observed marked depreciation, including India and South Korea - notable petroleum importers.

Interestingly, the Japanese Yen and Swiss Franc appreciated while Turkish and South African currencies realized considerable depreciation. The former (latter) countries are well known to be safe havens (financially fragile) with low (high) interest rates respectively, suggesting that the event also triggered 'risk-off' related carry trades to unwind. Figure 3 reports visually the heterogeneity observed in exchange rate responses before and after news of the oil supply shock. Figure 8 breaks down the exchange rate responses by country upon market open.

What determined the varying exchange rate responses to the oil shock? Visually, it appears that crude oil dependency is a relevant factor determining whether the exchange rate experienced meaningful adjustment. But as the theoretical literature suggests, there are other interactions which could amplify otherwise limited commodity exposure especially if the event also impacted investor risk appetite, such as a currency's inherent riskiness, or a country's net financial position, credit worthiness, monetary regime, etc.

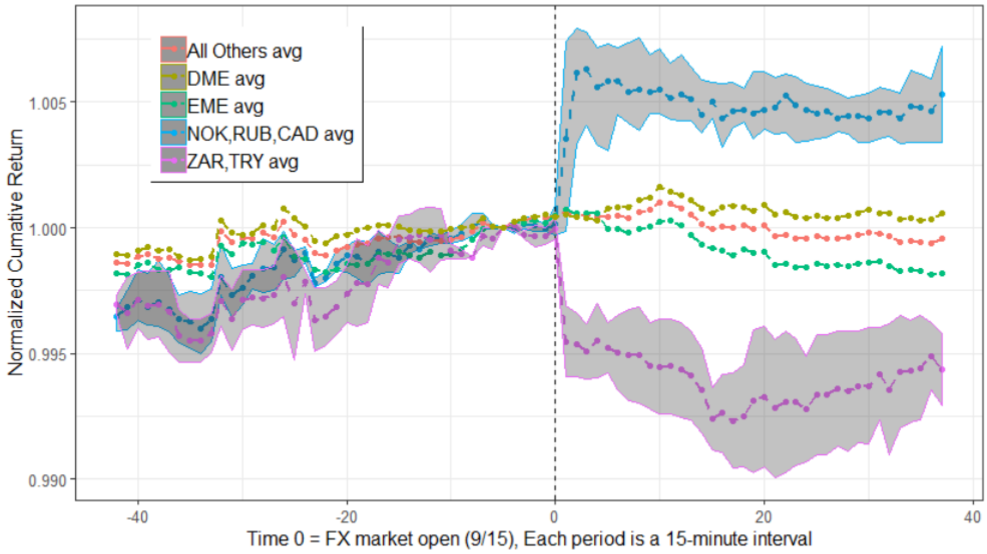
3 Empirical Strategy

3.1 Data

For a sample of 30 countries, I collect intra-day exchange rate data at the 30-minute frequency around the weekend of the Saudi refinery strike from Bloomberg. The sample contains 12 developed market currencies (including the G10 less United States), and 18 emerging market currencies. All exchange rates are vis-a-vis the USD, and a positive change implies appreciation against the U.S. Dollar.

I also compile a cross-sectional data set on country-specific trade and financial fundamentals from various public sources: UN COMTRADE, IMF, World Bank, and the CIA World Factbook. The most recent data is taken mostly from 2018/2019, but on some occasions the statistics are dated from

Figure 3: Intra-day Exchange Rate Response to 9/14 Drone Attack



15-minute frequency data. All currencies vis-a-vis the USD. Positive change is appreciation against the USD.

2017. Tables 2 and 3 report sample mean and standard deviations respectively, across all countries and for Developed Market Economies (DMEs) and Emerging Market Economies (EMEs) subgroups. China is by far, the largest country in the sample by GDP (over $12 trillion), which pulls up the average GDP of EMEs to be comparable to DMEs, though EME GDP is nearly twice as volatile. While most crude / refined petroleum trade variables are balanced across countries, DMEs import considerably more refined petroleum than EMEs. EMEs tend to have lower current count surpluses than DMEs, on average, along with larger external debt/GDP and lower public debt/GDP and international reserves/GDP. Policy interest rates are much higher and more varied among EMEs than DMEs. Many DMEs have rates pinned near the effective lower bound, explaining both their lower average level and standard deviation.

3.2 High-Frequency Identification

Truly exogenous macroeconomic shocks are rare. Therefore, the unanticipated attacks on Saudi oil refineries make for a valuable case study because the direction of causality between commodity prices and exchange rates is unambiguous. Moreover, an isolated shock to a specific commodity - crude oil - provides valuable cross-sectional heterogeneity in exchange rates, which I aim to link back to the variation in fundamentals across countries. High-frequency event studies are ubiquitous in the macro-finance literature (See Gurkaynak and Wright (2013)[7] for a survey. Aizenman et al. (2016)[1] and Neely (2015)[12] specifically look at exchange rate responses to monetary policy in an event study framework). The key identification assumption is that within the window of the event, no other news or fundamental changes occur which would impact the exchange rate. Because we are analyzing a narrow window of exchange rate responses, the assumption is reasonably satisfied. Exchange rates of several non oil-intensive countries remained relatively quiet over the event window, supporting the absence of additional market-moving macroeconomic news announcements over the event period.

Cross-country fundamentals are taken as fixed over the event window. Because country fundamentals tend to evolve slowly, and almost certainly do not rapidly vary from day-to-day, the assumption of fundamentals being exogenous over the event window is very likely to hold. Moreover, since the data on fundamentals updates with a lag, using data from 2017-2019 up until the event also ensures against any potential endogeneity.

3.3 Regression Analysis

Let the percent change in the exchange rate vis-a-vis the USD (where positive change implies local appreciation against the USD) be denoted as:

$$\Delta e_{i,ab} = \frac{E_{i,a} - E_{i,b}}{E_{i,b}}, \tag{1}$$

where $\Delta e_{i,ab}$ is the exchange rate percent return of country i from period b (before event) to period a (after event). $E_{i,a}$ and $E_{i,b}$ are the corresponding nominal exchange rate levels, before and after the event. For each country, the before-period corresponds to the exchange rate recorded at the close of 9/13. Most recorded closing values are from 16:30:00 EST, though closing times vary across FX markets[2]. Post-event exchange rates are mostly recorded on 9/15 20:00:00[3]. The constructed returns capture the percent change in exchange rates over the period of the oil supply shock.

[2]For Peru and Malaysia values are taken from 14:30:00 and 11:30:00 EST, respectively.

[3]With the exception of: India (9/15 20:30:00), Malaysia, Sweden, Hungary, and Colombia (all of which have new prints by 9/16 05:00:00).

The following regression specification tests the effect of fundamentals on exchange rate adjustment around the shock:

$$\Delta e_{i,ab} = \alpha + \beta' X_i + \epsilon_i, \tag{2}$$

where $[OX_i, OI_i, RX_i, RI_i, CA_i, ED_i, PD_i, IR_i, r_i] \in X_i$ and OX_i and OI_i are crude oil exports/GDP and crude oil imports/GDP, respectively. RX_i and RI_i are refined petroleum exports and imports (normalized by GDP). CA_i is the current account surplus/GDP. ED_i and PD_i are external debt/GDP and public debt/GDP, respectively. IR_i are international reserves/GDP, and r_i is the nominal policy interest rate of the country. The intercept term, α, captures the average change vis-a-vis the USD across all exchange rates, or $\Delta\bar{e}_{ab}$. Because the average exchange rate return is statistically indifferent from zero, I restrict the regression intercept to equal zero to preserve degrees of freedom[4].

Table 1: Cross-section correlation, FX returns over event window and economic fundamentals

	OX_i	OI_i	RX_i	RI_i	CA_i	ED_i	PD_i	IR_i	r_i
$\Delta e_{i,ab}$	0.58	-0.37	-0.05	-0.14	0.15	0.12	0.18	0.15	-0.34

Table 1 reports sample cross-section correlations between exchange rate returns over the event period and different economic variables. Unsurprisingly, heavier exporters and importers of crude oil appreciated and depreciated on average following the supply shock. More intriguingly, exposure to refined petroleum trade is considerably weaker, and countries with higher interest rates also experienced depreciation, suggesting that potential risk-off sentiment impacted carry trade currencies - a factor which should be controlled for.

4 Baseline Results

The regression results are reported in Figure 4. Interesting interactions between a country's crude oil exposure and financial condition emerge. Refined petroleum exports and imports are not significant upon including crude oil imports and exports. Crude oil exporters and importers reacted to the oil shock as expected, by appreciating and depreciating, respectively. Though

[4] $\Delta\bar{e}_{ab}$ is equal to -0.0007, t-stat of -1.13.

the cumulative exchange rate change may have been economically small given the very short time horizon (Figure 3), this evidence of reacting to a *supply* shock - albeit in the short-run - goes against the conventional view that exchange rates do *not* react to supply shocks[5].

The first few columns of the results highlight a potential asymmetry, where importers' exchange rates were doubly sensitive to the oil shock compared to exporters. The asymmetry disappears in column 5 upon including policy interest rates which itself has significant explanatory power over exchange rate responses. Column 5 implies that a country with exports (imports)/GDP of 0.05, or 5%, would have appreciated (depreciated) by an expected +0.48% (-0.64%) in response to the oil shock[6]. Countries with higher policy rates, composed mostly of EMEs and carry trade currencies, saw their exchange rates depreciate relative to low interest rate currencies. Akin to carry trade unwinding[7], the significant explanatory power of interest rates suggests that the oil supply shock also contained a 'risk-off' component. Similarly, countries with current account deficits saw their exchange rates depreciate relative to those with surpluses, but this effect becomes insignificant after jointly including international reserves/GDP (IR) and policy rates.

Consistent with the drone attack exhibiting global risk-off sentiment, exchange rates of countries with higher IR and lower policy rates saw their currencies buffered, depreciating less. Conversely, those with lower IR and higher policy rates saw their exchange rates depreciate more. Debt variables, are insignificant, and the full specification can explain 62 percent of the cross-sectional variation in exchange rate responses around the oil shock, half of which (about 30%) is attributed to the country's crude oil exposure. Overall the results are consistent with the view that exchange rates adjusted to oil shock via both the trade channel and financial channels and that the shock contained a global risk-off component[8].

A limitation of this study is that I consider a single, specific event. Moreover, high-frequency identification comes at the cost of only obtaining short-run effect estimates. We cannot generalize these short-run claims to the long-run without making unreasonably strong assumptions. Despite this lim-

[5] Habib et al. (2016)[8], Basher et al. (2015)[13].

[6] Russia and Norway have greater than 6% exports/GDP. Singapore and Taiwan have greater than 6% imports/GDP.

[7] A carry trade is a currency investment strategy which borrows low interest rate currencies and invests in high interest rate currencies.

[8] Aizenman et al (2012)[2] and Lee and Chen (2014)[10].

itation, most studies on commodity currencies focus on the longer run, thus this approach provides a novel view of the phenomena.

4.1 Carry Trade and Safe Haven Currencies

An important finding thus far is that financial characteristics - specifically interest rates and international reserves - explain a significant proportion of variation across exchange rate responses. Specifically, high (low) interest rate countries depreciated (appreciated), suggesting that the drone attack triggered to some degree 'risk-off' sentiment driving the unwinding of currency carry trades, resulting in appreciation (depreciation) of safe haven (investment) currencies. For example, the Japanese Yen and Swiss Franc strengthened considerably, while the South African Rand and Turkish Lira depreciated relative to the U.S. Dollar (Figure 8).

Motivated by this, an important variable to control for in the regression-based tests is the 'riskiness' of the currency which may not be properly captured by a country's financial fundamentals (policy rate, international reserves, current account). As a robustness check, I follow Menkhoff et al. (2012)[11] and define currencies as risky based on their covariance with a measure of global volatility - log changes in the VIX index[9] - thereby estimating currency-specific 'VIX betas'. I estimate these betas using time-series regressions for each currency, at the monthly[10] frequency, from January 2010 to August 2019. As such, these are ex-ante betas which do not include the period containing the drone attack:

$$\Delta e_{i,t} = \alpha_i + \beta(v)_i \Delta vix_t + \epsilon_{i,t}, \tag{3}$$

where $\Delta e_{i,t}$ are monthly log returns for the currency of country i (positive change is appreciation vis-a-vis the USD) and Δvix_t are monthly changes in the log VIX index. The estimate $\hat{\beta}(v)_i$ captures each currency's VIX beta.

Exchange rates with a positive VIX beta appreciate with the VIX, acting as hedges, while those with negative VIX betas depreciate amidst a rising VIX, thereby being pro-cyclical with respect to global risk appetite, and

[9]Menkhoff et al. (2012)[11] uses the cross-sectional average realized volatility across currencies. I use the CBOE VIX index, a model-free measure of the implied one-month ahead SP 500 volatility, often considered a gauge of global risk appetite.

[10]I choose monthly frequency for these time-series regressions to minimize estimation bias which may be present in higher frequency observations due to periods of illiquidity or asynchronous trading hours across foreign exchange markets.

hence risky. Menkhoff et al. (2012)[11] show that the performance of currency carry trades are intimately linked to global volatility, with the carry trade strategy performing most poorly during risk-off episodes amidst high volatility.

Column 6 in Figure 4 reports results upon controlling for currency-specific VIX betas. While the coefficient estimate is positive (indicative of safe haven (risky) currencies appreciating (depreciating) over the event window) it is statistically insignificant, possibly due to the the inclusion of policy interest rates and international reserves as independent variables which are already incorporating to some extent the inherent riskiness of the currency. In a regression which excludes the policy rate, the coefficient on VIX betas is positive and significant at the 7% level[11]. Excluding the policy rate, international reserves, and current account surpluses from the regression renders the VIX beta coefficient estimate significant at the 2% level. There appears to be a link between the unobserved global volatility exposure and financial fundamentals. In fact, regressing VIX betas on policy rates and international reserves yields a regression adjusted R^2 of 50%. Including the current account and allowing for interaction terms between the three variables increases the adjusted R^2 to 64% (unadjusted R^2 is over 70%). Financial characteristics explain much of the heterogeneity in currency-specific estimates of global risk exposure.

5 The Role of Currency Risk Factors

The previous analyses investigated the role fundamentals in explaining currency returns around the oil price shock. Given the link between financial fundamentals and currency exposures to global volatility, another test of interest would be to measure to what extent currency risk factor exposures explain differential returns around the drone attack compared to economic fundamentals. If currency exposures proxy for fundamentals, then they should also explain the cross-section of returns around the event window. An important question then, would be to what extent crude oil commodity exposure drove exchange rates versus exposure to global risk through the lens of an asset pricing factor model.

To address this issue, I extend the factor analysis on monthly exchange rate returns to estimate ex ante exposure to the VIX, crude oil, and the

[11] Robust standard errors. Estimates are not reported but available upon request.

broad U.S. Dollar:

$$\Delta e_{i,t} = \alpha_i + \beta(v)_i \Delta vix_t + \beta(o)_i \Delta oil_t + \beta(u)_i \Delta usd_t + \epsilon_{i,t}, \tag{4}$$

where now for each currency i, I estimate a VIX beta, a crude oil beta (using monthly WTI crude oil log returns) and a U.S. Dollar beta (using the average log return over G10 (ex. U.S.) exchange rates).

Figure 6 shows that cross-currency heterogeneity in the estimated VIX and oil betas can be well explained by select economic fundamentals. A currency's exposure to global risk (more negative VIX betas) is associated with higher policy interest rates, larger current account deficits and lower levels of international reserves/GDP. In addition, countries where the proportion of total trade which is crude or refined petroleum have higher estimated crude oil betas (correlation of 0.87). Similarly a currency's crude oil beta is strongly associated with the country's oil exports/GDP (correlation of 0.75) and imports/GDP. Figure 7 plots factor betas against the intra-day currency returns around the 9/14 drone attack. The role of the U.S. Dollar appears to not be an important factor driving currency returns around this particular shock. However, currencies with greater ex ante exposure to global volatility (negative VIX betas) realized greater depreciation, and somewhat unsurprisingly, currencies with greater ex ante exposure to crude oil saw greater appreciation. Hence, the estimated volatility and oil betas appear to capture similar features as financial and oil-related country fundamentals, respectively.

Figure 5 reports results from a regression of currency returns over the drone attack, $\Delta e_{i,ab}$, on the estimated ex ante crude oil, VIX, and U.S. Dollar betas. For interpretation and comparison of the regression coefficients, the factor beta variables have been standardized to mean 0 and unit variance. Just two factors capturing ex-ante exposure to crude oil and VIX innovations can explain almost half of the cross-sectional variation in exchange rates around the oil supply shock. While both global volatility and oil prices both influenced exchange rates, exposure to crude oil (estimate of 0.0023) was twice as strong of a driver compared to global volatility exposure (estimate of 0.0012) in determining currency movements around the event. Moreover, crude oil betas alone explain 37% of the variation in currency returns. Including VIX betas in the regression increases the adjusted R^2 by 7 percentage points to 44%. In the context of this specific event, exante exposure to the U.S. Dollar did not meaningfully drive exchange rate adjustment.

6 Conclusion

Exchange rate adjustment to commodity price fluctuations is an important topic to understand for economists and policymakers, yet causal inference remains challenging. To overcome the issue of simultaneity, I exploit the September 14, 2019 drone attack on two Saudi Arabian refineries as a natural experiment. This unanticipated event caused the largest 1-day crude oil price shock in over a decade. Using high-frequency exchange rate data for 30 countries, I measure currency returns around the oil shock, and link cross-currency return heterogeneity to country-specific trade and financial fundamentals. Trade exposure through exports and imports of crude oil, international reserves holdings, policy interest rates, and current account position together explain over half of the cross-country variation in exchange rate adjustment to the oil price shock. Along with commodity-related currency adjustment, the significant role of financial variables and interest rates suggest that the drone attack triggered risk-off sentiment affecting carry trade and safe haven currencies alongside commodity currencies. Alternative to fundamentals, ex ante estimated currency factor exposures to crude oil prices and global volatility can also explain the cross-section of currency returns around the event. These oil and global volatility factor exposures are strongly associated with cross-country crude oil-related and financial fundamentals, respectively.

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7 Appendix

Figure 4: Regression Results

	Dependent Variable: FX Returns around the 9/14 Drone Attack					
Covariates	(1)	(2)	(3)	(4)	(5)	(6)
Refined Exports/GDP	0.052					
	(0.053)					
Refined Imports/GDP	-0.032					
	(0.053)					
Crude Exports/GDP	0.065***	0.078***	0.072***	0.071***	0.096***	0.112***
	(0.021)	(0.020)	(0.021)	(0.021)	(0.025)	(0.029)
Crude Imports/GDP	-0.105*	-0.1489***	-0.167***	-0.173***	-0.128***	-0.112***
	(0.053)	(0.031)	(0.041)	(0.039)	(0.035)	(0.036)
Current Account/GDP		0.0339***	0.0371***	0.035***	0.013	0.008
		(0.010)	(0.010)	(0.012)	(0.009)	(0.010)
External Debt/GDP			-0.0003	-0.0003	-0.0005	-0.0004
			(0.0004)	(0.0004)	(0.0004)	(0.0004)
Public Debt/GDP			0.0012	0.0015	0.0014	0.0014
			(0.0011)	(0.0011)	(0.0008)	(0.0006)
Int'l Reserves/GDP				0.0011	0.003***	0.004***
				(0.0011)	(0.001)	(0.001)
Policy Rate					-0.037***	-0.034***
					(0.010)	(0.009)
VIX Beta						0.019
						(0.013)
Adj. R-2	0.30	0.52	0.52	0.50	0.62	0.62
N	30	30	30	30	30	30

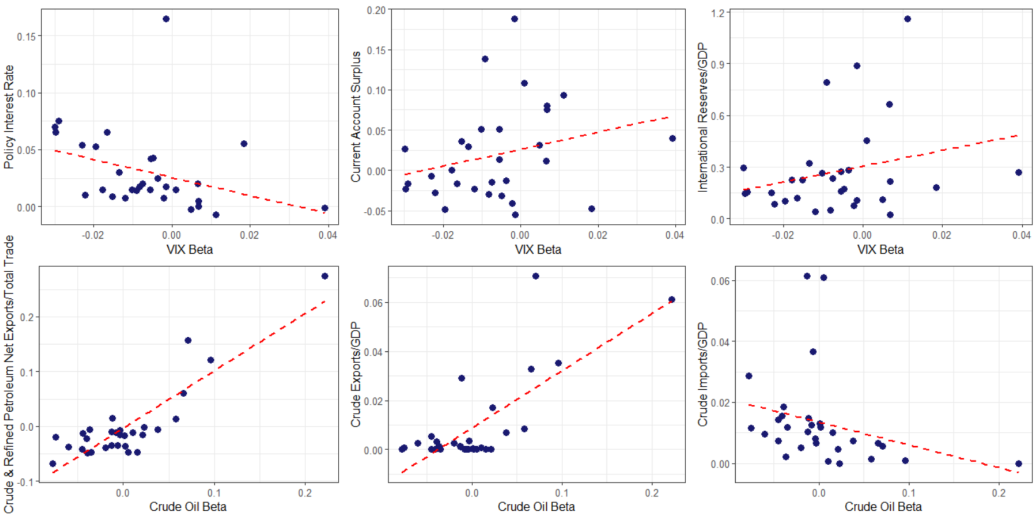
Robust standard errors in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% level, respectively.

Figure 5: Currency Factor Regression Results

Covariates	Dependent Variable: FX Returns around the 9/14 Drone Attack (1)	(2)	(3)
Oil Beta	0.0021***	0.0023***	0.0023***
	(0.0005)	(0.0005)	(0.0005)
VIX Beta		0.0012**	0.0012**
		(0.0005)	(0.0005)
U.S. Dollar Beta			0.0002
			(0.0004)
Adj. R-2	0.37	0.44	0.43
N	30	30	30

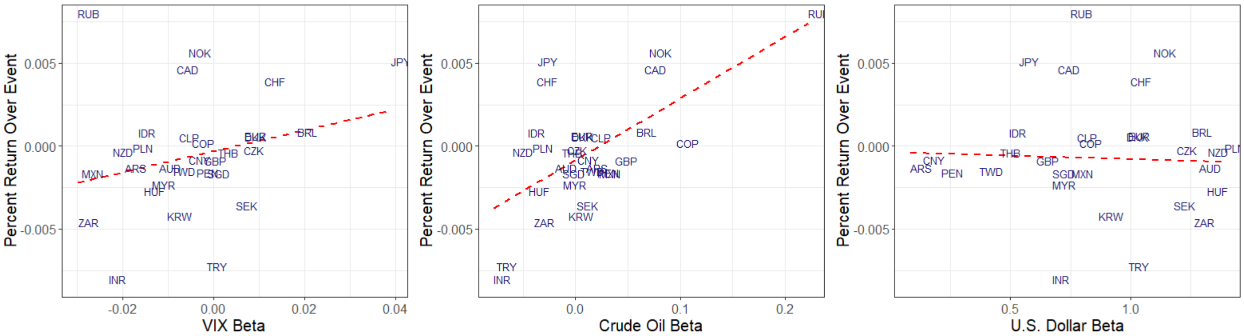
Robust standard errors in parentheses. ***, **, * indicate significance at the 1%, 5% and 10% level, respectively. Independent variables are standardized to mean zero, unit variance.

Figure 6: Ex Ante Currency Betas and Fundamentals



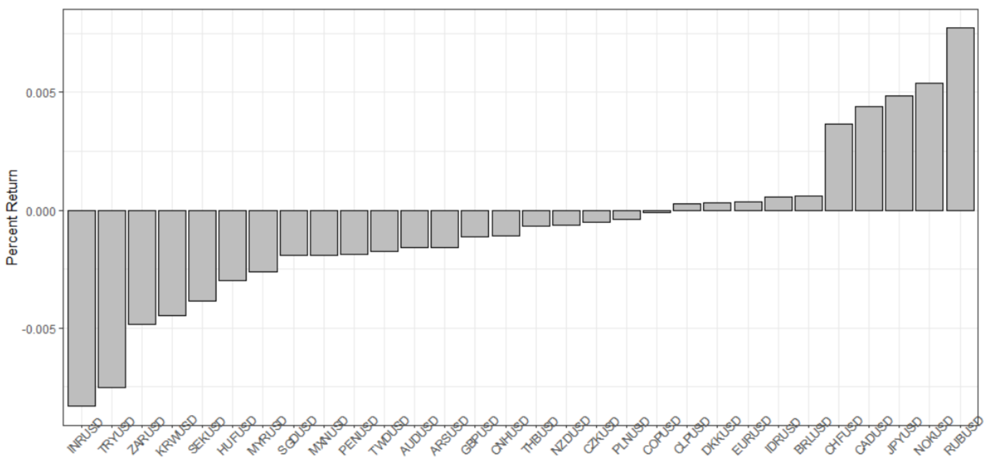
Ex ante currency betas are estimated using monthly frequency data from 2010 to August 2019. Beta estimates are taken from Equation 4.

Figure 7: Ex Ante Currency Betas and Intra-day Exchange Rate Response to 9/14 Drone Attack



Ex ante currency betas are estimated using monthly frequency data from 2010 to August 2019. Beta estimates are taken from Equation 4. LHS correlation estimate equals 0.27 (t= 1.48). Center correlation equals -0.62 (t= 4.23), RHS correlation equals -0.04 (t=-0.23).

Figure 8: Intra-day Exchange Rate Response to 9/14 Drone Attack



Percent change in exchange rate from 9/13 close to 9/15 open. All currencies vis-a-vis the USD. Positive change is appreciation against the USD.

Table 2: Economic Fundamentals, Sample Mean

Sample Mean	All	DMEs	EMEs
GDP	1454.1000	1433.0000	1468.1667
Exports	342.5167	363.6083	328.4556
Imports	289.2667	336.2917	257.9167
Oil Exported	9.0135	8.8872	9.0977
Refined Exported	10.2014	10.4762	10.0182
Oil Imported	17.4621	16.2467	18.2724
Refined Imported	9.1934	12.4512	7.0215
Crude/GDP	-0.0042	-0.0069	-0.0024
Crude/Trade	0.0002	-0.0033	0.0025
Trade Openness	0.6326	0.6440	0.6250
Current Account/GDP	0.0194	0.0481	0.0002
External Debt/GDP	1.0050	1.7775	0.4900
Public Debt/GDP	0.5814	0.7501	0.4689
Int'l Reserves/GDP	0.2755	0.3234	0.2435
Policy Rate	0.0306	0.0069	0.0464
N	30	12	18

Values (first 7 rows) in USD ($ Billions). Data taken from various public sources: UN COMTRADE, IMF IFS, CIA World Factbook and World Bank. All Statistics are from 2018/2019 or latest available date.

Table 3: Economic Fundamentals, Sample Standard Deviation

Sample Standard Deviation	All	DMEs	EMEs
GDP	2318.0396	1521.1746	2769.1932
Exports	466.3483	352.5479	538.5630
Imports	324.2887	302.0441	343.1659
Oil Exported	20.2255	16.7850	22.7048
Refined Exported	14.2736	12.0371	15.9282
Oil Imported	30.7564	17.4262	37.6225
Refined Imported	9.4871	12.0207	6.8958
Crude GDP	0.0310	0.0347	0.0292
Crude Trade	0.0701	0.0583	0.0785
Trade Openness	0.4371	0.4526	0.4395
Current Account/GDP	0.0590	0.0718	0.0404
External Debt/GDP	0.9814	1.1615	0.2608
Public Debt/GDP	0.4074	0.5774	0.1839
Int'l Reserves/GDP	0.2664	0.3922	0.1373
Policy Rate	0.0346	0.0083	0.0366
N	30	12	18

Values (first 7 rows) in USD ($ Billions). Data taken from various public sources: UN COMTRADE, IMF IFS, CIA World Factbook and World Bank. All Statistics are from 2018/2019 or latest available date.

Table 4: Country List

	Country	EME/DME	FX
1	Argentina	EME	ARSUSD
2	Australia	DME	AUDUSD
3	Brazil	EME	BRLUSD
4	Canada	DME	CADUSD
5	Chile	EME	CLPUSD
6	China	EME	CNHUSD
7	Colombia	EME	COPUSD
8	Czech	EME	CZKUSD
9	Denmark	DME	DKKUSD
10	Euro	DME	EURUSD
11	Hungary	EME	HUFUSD
12	India	EME	INRUSD
13	Indonesia	EME	IDRUSD
14	Japan	DME	JPYUSD
15	Malaysia	EME	MYRUSD
16	Mexico	EME	MXNUSD
17	New Zealand	DME	NZDUSD
18	Norway	DME	NOKUSD
19	Peru	EME	PENUSD
20	Poland	EME	PLNUSD
21	Russia	EME	RUBUSD
22	S. Korea	EME	KRWUSD
23	Singapore	DME	SGDUSD
24	South Africa	EME	ZARUSD
25	Sweden	DME	SEKUSD
26	Switzerland	DME	CHFUSD
27	Taiwan	DME	TWDUSD
28	Thailand	EME	THBUSD
29	Turkey	EME	TRYUSD
30	United Kingdom	DME	GBPUSD