

# FX Interventions Rules for Central Banks

## A Risk-Based Framework

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# Contributions

- ▶ Design a rule for central banks that intervene to prevent **disorderly market conditions**
- ▶ Provides guidance on **when** to intervene ("triggers")
- ▶ Appropriate for **floating exchange rate regimes** with FX risks to the economy (e.g. FX unhedged exposures)
- ▶ Consistently control **FX risk** rather than arbitrary FX volatility/level threshold
- ▶ A **risk management framework** for central banks' financial stability mandate: aligned with **industry's best practices** in FX management

## What the rule is NOT about

- ▶ Not designed to reach or to preserve a given FX level (e.g. alignment with the **equilibrium exchange rate level**)
- ▶ Doesn't prevent **appreciation/depreciation trends** to occur...
- ▶ ... but can be compatible with other approaches, e.g. discretionary FXI
- ▶ We **don't discuss the efficiency** of FX interventions from a welfare/macro point of view
- ▶ Not a guide to calibrate **FX interventions amount**
- ▶ Not a guide for the optimal **currency allocation** of FX reserves

# Key Messages

Foreign Exchange intervention rules should

- ▶ Depend on market conditions
- ▶ Objective, be anchored to a risk tolerance level rather than an arbitrary FX level threshold
- ▶ Capture FX non-linearities and asymmetries between appreciation and depreciation
- ▶ Be easily operationalizable

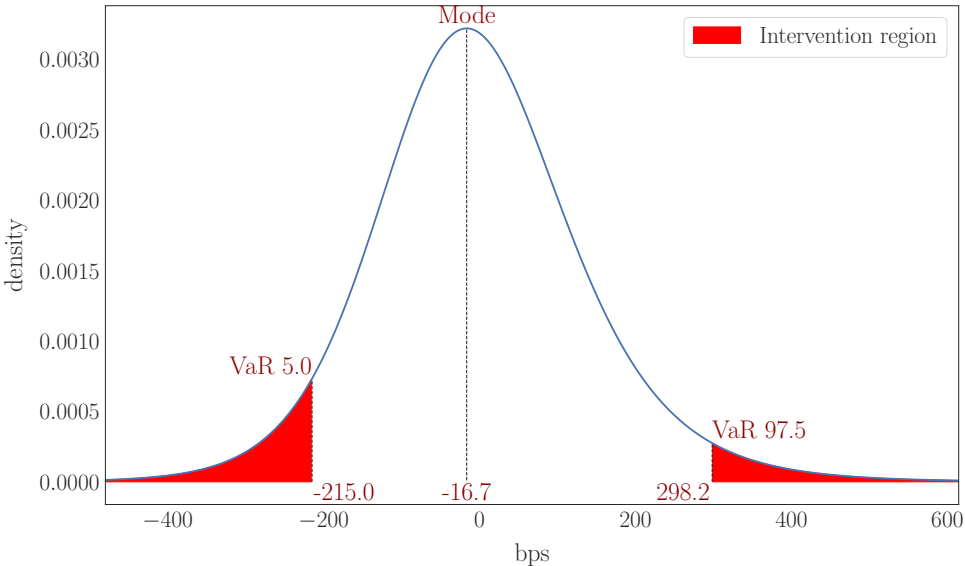
We propose an FX intervention rule based on **Conditional Value-at-Risk**

## Concept: Value-at-Risk Rule

- ▶ Rather than using a fixed volatility rule (e.g. intervene if daily exchange rate varies by more than 2%)
- ▶ Use a **risk-based rule**: intervene when the daily exchange rate log-returns are in the tails of the conditional distribution
- ▶ Measure the tail-risk via the concept of **Value-at-Risk** (the conditional quantile of the log returns distribution)
- ▶ The conditional distribution is estimated daily with a standard financial GARCH model and varies with market conditions
- ▶ The central bank decides on the **risk tolerance**: e.g. intervene in the tail at 1%, 5%, 10%, etc.

# VaR FXI Rule

Conditional density and intervention rule based on 2020-05-07 information



# A Risk-Management Approach to FX Interventions

- ▶ Hedging tail-risks might not be available: incomplete markets
- ▶ However, the central bank doesn't substitute to the market to provide hedge instruments in general
- ▶ This rule allows flexible exchange rate to act as a shock absorber: provides more flexibility in crisis time
- ▶ The central bank risk tolerance should be fixed in accordance with the macrofinancial risk in the economy (unhedged exposures from resident agents, degree of dollarization, etc.) as well as market resilience
- ▶ The financial stability mandate of the central bank is properly formalized and quantified via VaR metric. Aligned with industries' practice in risk management.



# Features

- 1.
2. This rule guarantees that the interventions will occur with a **fixed frequency** over the medium term
- 3.

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## Specification

Non-linear, Exponential GARCH (EGARCH) model to estimate the conditional VaR of exchange rate log-retrurns  $r_t$ ,  $Q(r_t|\Omega_{t-1}, \theta)$

**Drift AR-X(1):**  $r_{t+1} = \text{Intercept} + \rho r_t + \beta X_{t+1} + \epsilon_{t-1}$

**Exponential volatility:**  $\log \sigma_{t+1}^2 = \omega + \beta g(r_t)$  where  $g(r_t) = \alpha r_t + \gamma(|r_t| - \mathbb{E}|r_t|)$

**Error term distribution**  $\epsilon_t = \sigma_t \varepsilon_t, \varepsilon_t \sim \text{TSK}(k, v)$

- ▶ The GARCH estimation is standard and done with MLE; selection of parameters is done via AIC/BIC criteria.
- ▶ The Python package we designed allows to select the control variables, choose the lag, fit different distributions, etc.

# Exogeneous Factors

1. FX bid-ask spread (averaged over the day) => **FX microstructure**
2. Daily interest rate differential with the US Libor => **CIP**
3. The one-month forward exchange rate => **cost of hedging** on the spot market
4. The lagged amount of central bank FX intervention => **policy interventions**
5. The VIX => **global risk sentiment**
6. The EURUSD exchange rate => control for **global FX factor**

# Regression Table

	Constant	Microstructure	CIP	FXI	Baseline	Robustness
Intercept	1.09	-2.16	2.15	1.67***	1.63	1.64***
Lag FX log returns	0.09***	0.08***	0.08***	0.08***	0.08***	0.08***
Bid-ask spread abs value		0.11**	0.15***	0.14***	0.15***	0.15***
Forward points first difference		0.32***	0.32***	0.32***	0.27***	0.27***
Interbank rate vs Libor			-1.11***	-0.98***	-1.02***	-1.03***
FX intervention in USD lag				0.04	0.04	
VIX first diff					9.78***	9.79***
EURUSD log returns					0.13***	0.13***
FX intervention dummy lag						4.13
Omega	0.15***	0.14***	0.13***	0.13***	0.14***	0.14***
Alpha	0.17***	0.19***	0.18***	0.18***	0.19***	0.19***
Gamma	0.06***	0.06***	0.06***	0.05***	0.05***	0.05***
Beta	0.98***	0.98***	0.98***	0.99***	0.98***	0.98***
Nu	8.81***	9.11***	9.18***	9.15***	7.77***	7.77***
Lambda	0.13***	0.11***	0.12***	0.12***	0.1***	0.1***
R2	0.4 %	4.9 %	5.1 %	5.1 %	14.3 %	14.3 %
R2 adjusted	0.4 %	4.8 %	5.0 %	5.0 %	14.2 %	14.1 %
Number of observations	4511	4511	4511	4510	4510	4510
Significance *10%, **5%, ***1%						

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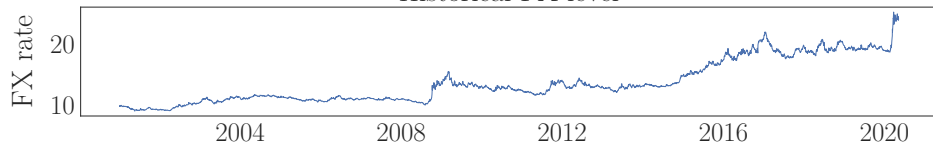
**In-sample dynamics**

Forecasting

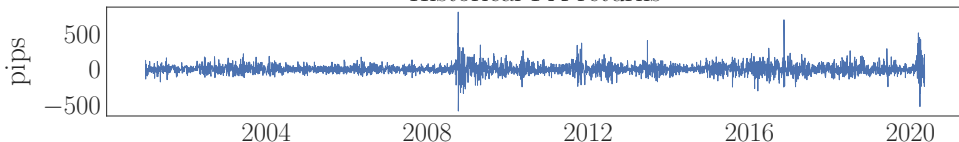
Benchmarking

# Dynamics of the Mexican Peso against USD

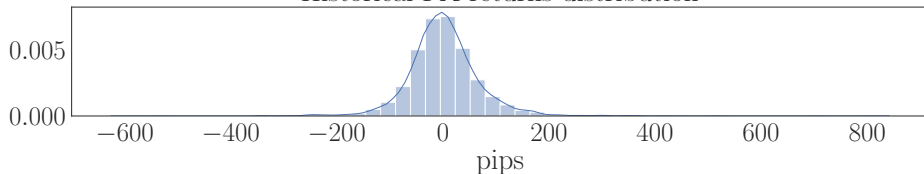
Historical FX level



Historical FX returns

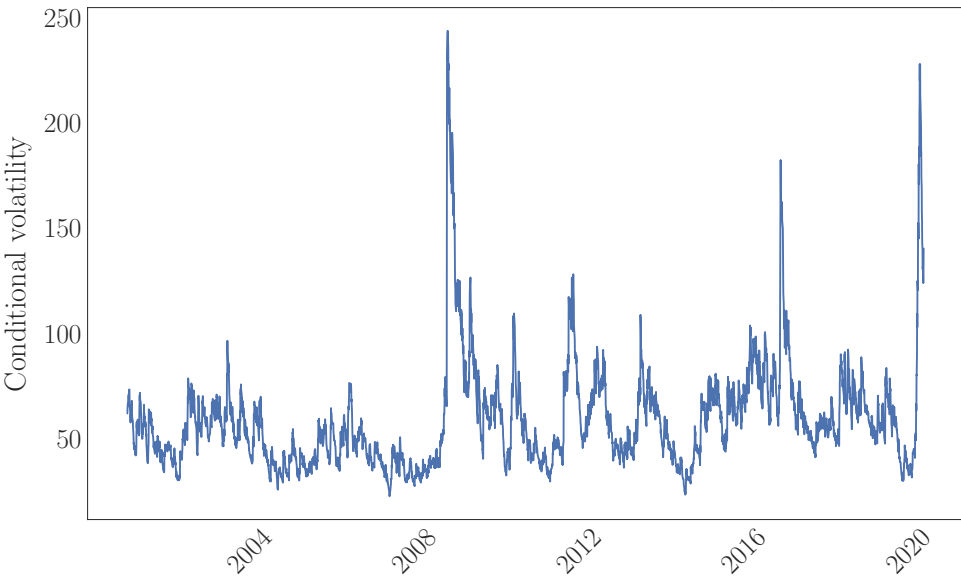


Historical FX returns distribution



# Conditional In-Sample Volatility of the Mexican Peso

In-sample FX returns conditional volatility





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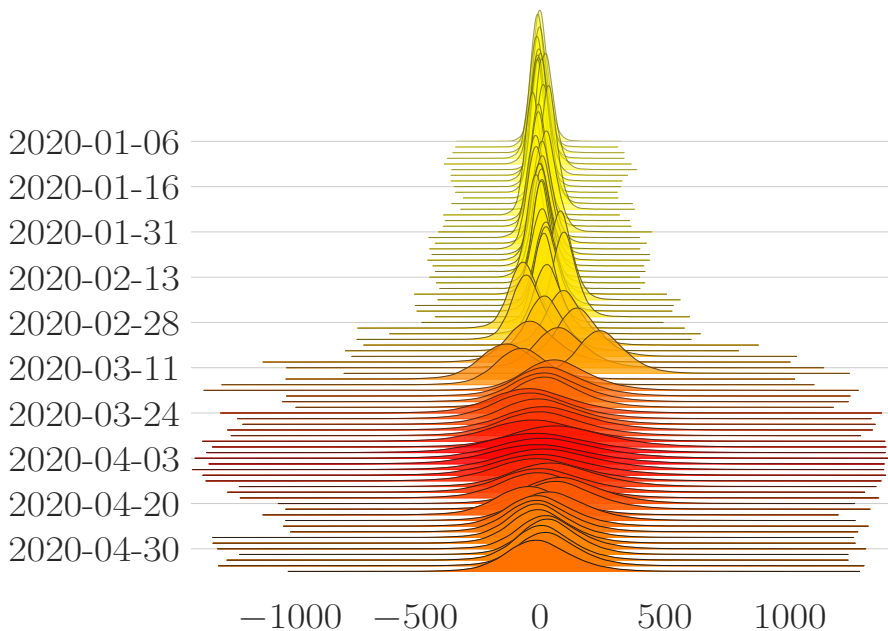
Model

In-sample dynamics

Forecasting

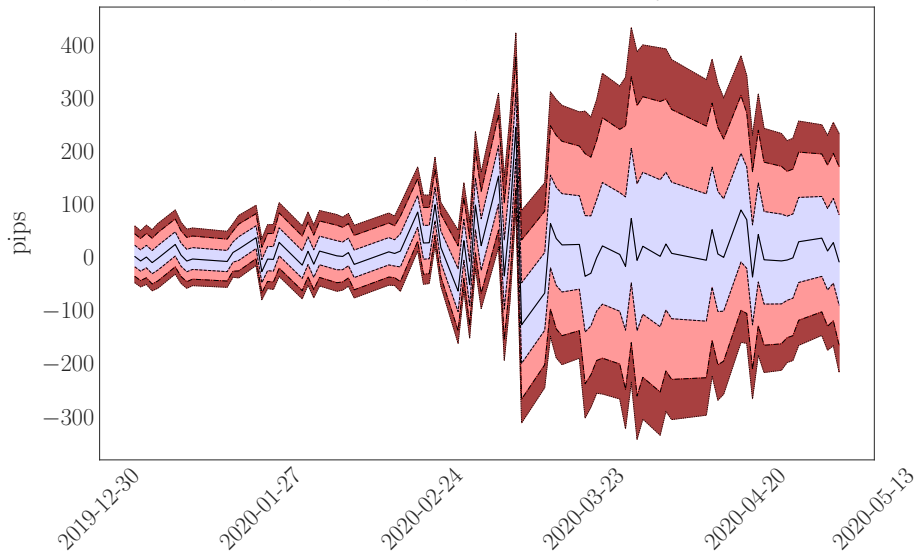
Benchmarking

# Out-of-sample conditional density



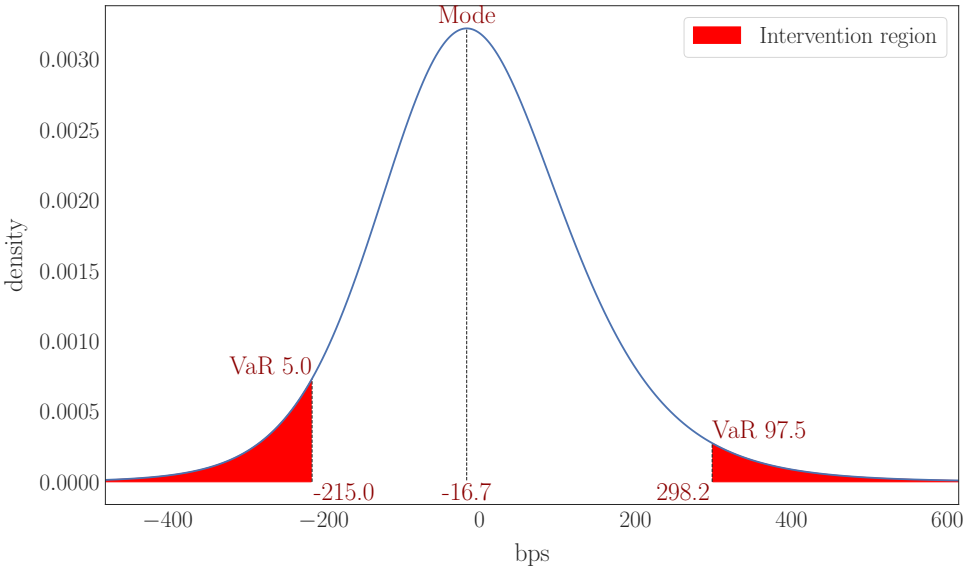
# Fan Chart

Fan chart of predictive FX log returns  
1, 5, 10, 25, 50, 75, 90, 95 Conditional Quantiles



# VaR FXI Rule

Conditional density and intervention rule based on 2020-05-07 information



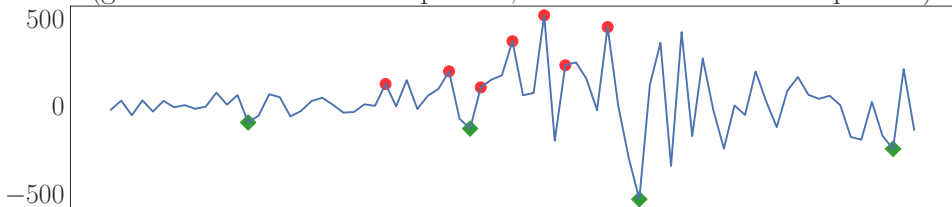
# Conditional Cumulative Distribution Function

Conditional cumulative distribution function and intervention thresholds

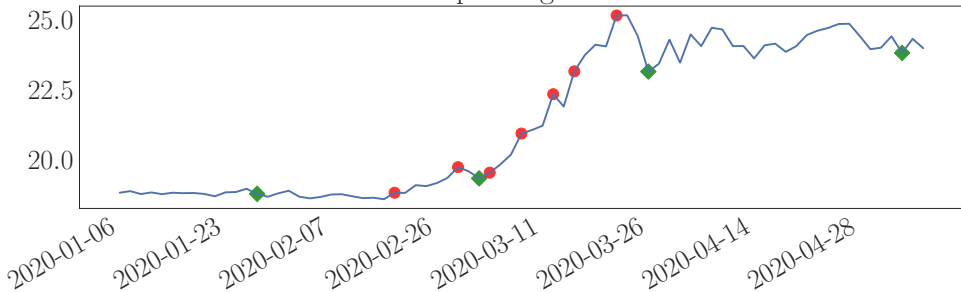


# Conditional Exceedance

Log returns and conditional VaR exceedance at 5 percent  
(green dot: below VaR 2.5 percent, red dot: above VaR 97.5 percent)

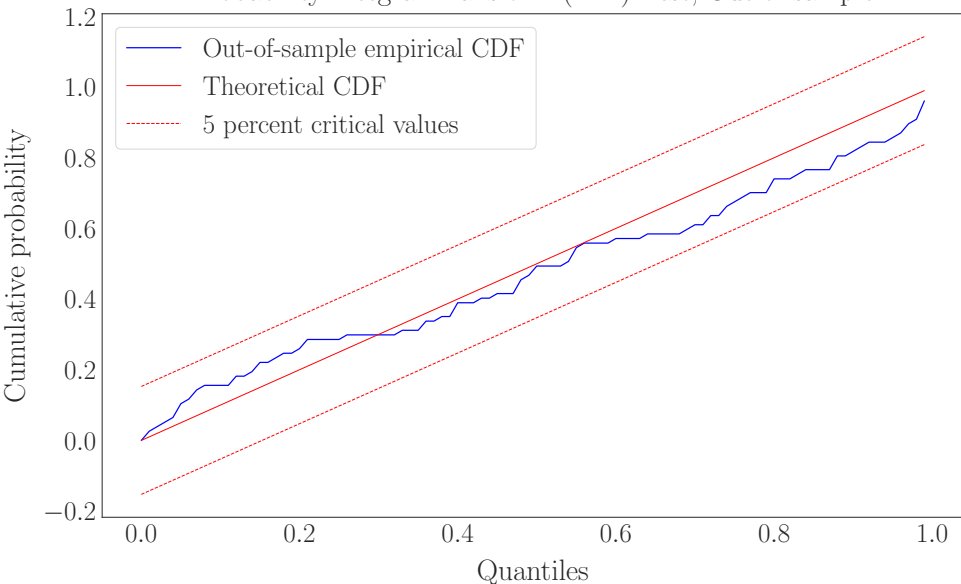


Corresponding FX level



# Density Evaluation

Probability Integral Transform (PIT) Test, Out-of-sample



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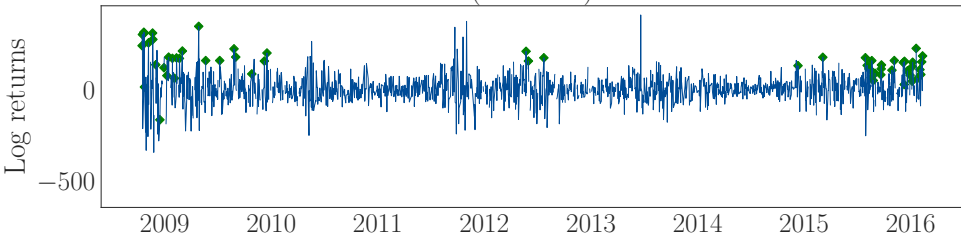
Forecasting

Benchmarking



# Rule-Based Benchmarking

FX interventions and FX log returns with minimum price  
(sell USD)

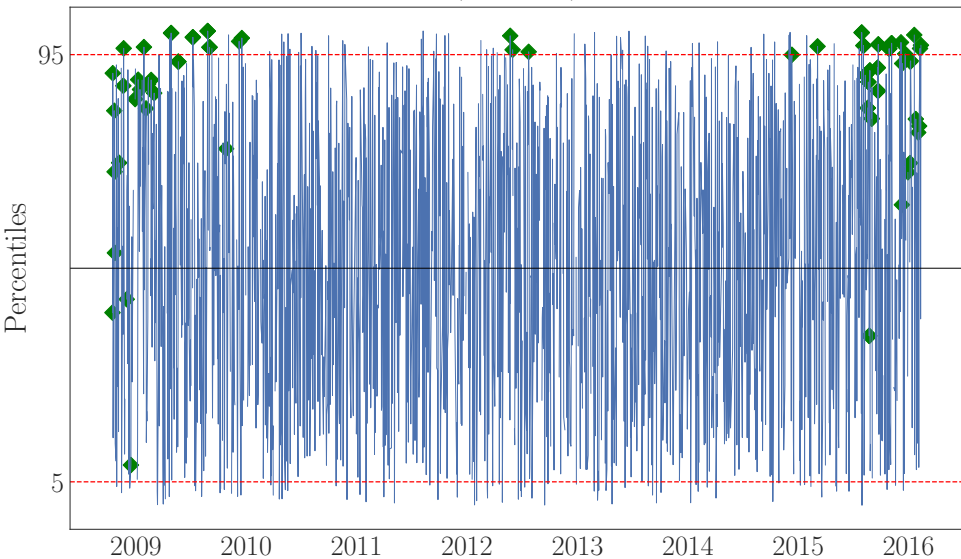


FX interventions and FX level (sell USD)



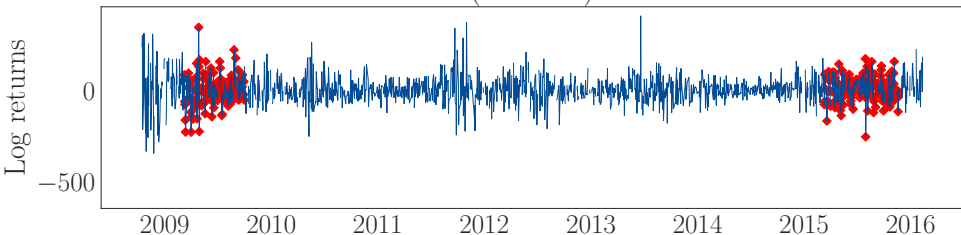
# Rule-Based Benchmarking: Risk-Level

Conditional CDF of FX interventions with minimum price  
(sell USD)



# Discretion-Based Benchmarking

FX interventions and FX log returns with no minimum price  
(sell USD)



FX interventions and FX level (sell USD)



# Discretion-Based Benchmarking: Risk-Level

Conditional CDF of FX interventions with no minimum price  
(sell USD)

