Latam FX-Fair: Fundamental Value Models of Latam Currencies

Economics Colombia.

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In 2022 LatAm currencies responded to different shocks. The beginning of the year was constructive for currencies in the region since the conflict due to the Russian invasion of Ukraine significantly increased commodities prices, which led to solid appreciation in the region's currencies, especially in the BRL, as the country is a key soja exporter. In June, CLP and COP decoupled the region's trend, depreciating substantially amid a volatile political context in Chile due to the constitutional referendum discussion and in Colombia due to Presidential elections.

By the end of 2022, the picture was mixed. The COP was the worst performer depreciating around 16% y/y, while the rest of the currencies appreciated. The BRL was the best performing with a 5.59% y/y appreciation; the MXN, and the PEN appreciated slightly less by 5.28% y/y, and 5.13% y/y, respectively; meanwhile, the CLP closed almost flat, gaining 0.10% y/y. The previous dynamic was a contrast vs. what was observed in the world in which the DXY index gained ~8% y/y.

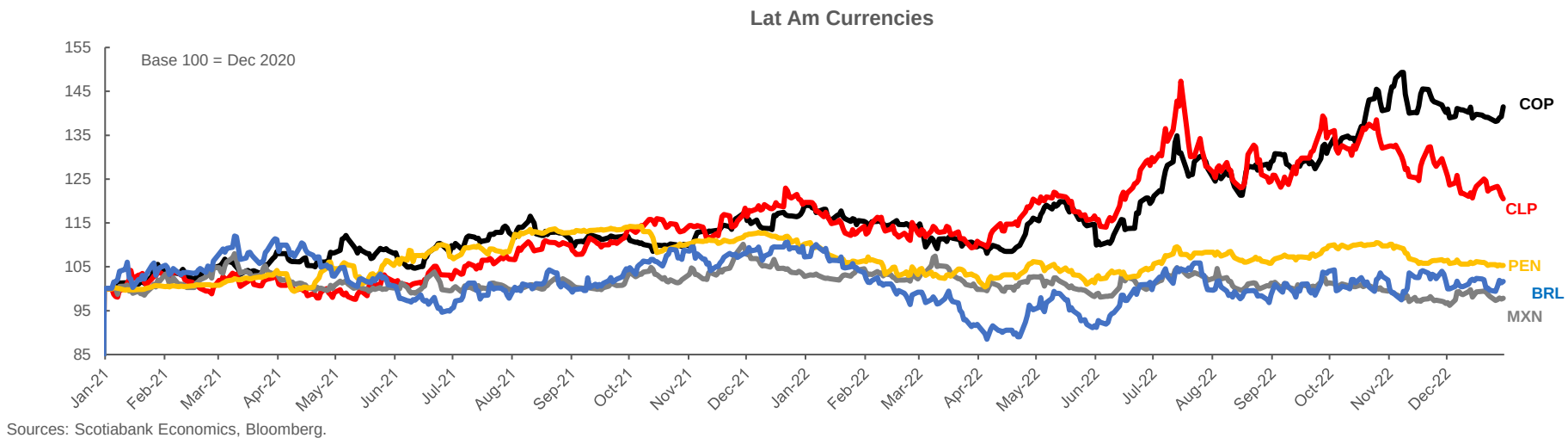
In 2023, monetary policy cycles are key for currencies' relative value. Brazil and Chile are in a wait-and-see mode, and discussing cuts is on the table. Meanwhile, Peru, Mexico, and Colombia are in the hiking cycle's final stages. In 2023, the market will be aware of a potential economic slowdown. In LatAm, the end of the hiking cycle from the Fed, the reopening in China, and idiosyncratic issues are critical for the currencies. **The differential in the monetary policy** cycles in the region **would play an important role in relative values in the forthcoming months.**

- **MXN remained overvalued from a long-term perspective and closer to its value derived from a short-term analysis.** A stable rate differential vs the US makes the currency one of the most resilient in the region. Banxico is soon expected to decouple from the Fed, but the MXN is still expected to remain broadly stable**.**
- **CLP is closer to the fundamental values indicated by both of the short and long-term models. Copper prices are playing an important supporting role in the short term.** The crowded reform agenda for 2023 could bring some volatility. However, the market believes that radical proposals are unlikely to pass; for now, the currency is reflecting this sentiment.
- **COP remains undervalued in relation to its value according to traditional long-term fundamentals. It is, however, trading better aligned with, but slightly below, its short-term fundamental value.** The short-term model indicates a higher sensitivity to oil prices, rate differential vs the US and domestic risks. The reforms agenda lasting until October's regional elections should keep volatility elevated in 2023.
- **PEN is fairly valued according to our long- and short-term models. The currency was broadly stable in December despite political chaos.** However, the PEN has started the year facing headwinds from continued social unrest. The central bank could prolong its hiking cycle if inflation remains stubbornly high.
- **BRL is close to its fair value in the two models.** Brazil was one of the preferred currencies in the region before the change of government on the back of supportive interest rates and terms of trade. BRL traders—and Brazilian assets, in general—are currently on edge on political and fiscal risks surrounding Lula's unpredictable government. Still, the BRL is generally following the broad dollar-negative mood in markets in play since November.

Main results are shown in levels and % differences (spot vs models

Table 1: Theoretical exchange rate vs current levels. **Last Update: January 16, 2022**

	Spot	Estimated Levels: Short term model	Estimated Levels: Long term model Quantile 5	Estimated Levels: Long term model Quantile 50	Estimated Levels: Long term model Quantile 95	% differences spot vs model: Short term model	% differences spot vs model: Long term model Quantile 5	% differences spot vs model: Long term model Quantile 50	% differences spot vs model: Long term model Quantile 95
MXN	**18.7791**	19.4460	19.5266	21.3248	22.7046	-3.4	-3.8	-11.9	-17.3
CLP	**822.2**	837.4	776.1	797.1	898.9	-1.8	6.0	3.2	-8.5
COP	**4682**	4742	4034	4375	5063	-1.3	16.1	7.0	-7.5
PEN	**3.8296**	3.7667	3.6417	3.7901	3.9851	1.7	5.2	1.0	-3.9
BRL	**5.1527**	5.192	4.710	5.099	5.331	-0.8	9.4	1.1	-3.3



Sources: Scotiabank Economics, Bloomberg.

Table 2: Models' specification by currency and main blocks

Latam FX-Fair is based on quantile regression under a three big variable blocks

Currency	External sector block	Rate differentials vs the US block	Risk metrics bloc
MXN	Oil (Brent)	Diff slopes 10Y-3M	CDS5Y / S&P500 / Pol Uncertainty / EM Currency Index
CLP	Cooper	Diff 3m rates	CDS5Y / S&P500 / VIX
BRL	**Soybean/Brent**	Diff 3m rates	CDS5Y / S&P500 / VIX
PEN	Cooper	Diff slopes 10Y-2Y	CDS5Y / S&P500 / VIX
COP	Oil (Brent)	Diff 3m rates	CDS5Y / S&P500 / VIX

LatAm Currency Crosses monitor.

The COP underperforms the region as its levels in the crosses sit in high percentiles on a 1, 3, and 5-year horizon. Idiosyncratic issues are impacting Colombian currency, despite macro fundamentals that are still supportive but expectations of a larger widening of its external deficit when compared to its regional peers **would result in an underperformance of the COP in the medium-term. However, monetary policy cycle divergences and a more hawkish Banrep compared to the rest of the region would act as tailwinds for the COP.**

Spot crosses levels (colors represent the closer quantile)

1 Year

BASE \ PRICE	USD	COP	MXN	PEN	CLP	BRL
USD		4852.5	19.500	3.806	850.58	5.286
COP	0.021		0.402	0.078	0.175	0.109
MXN	0.051	248.747		0.195	43.572	0.271
PEN	0.263	1274.438	5.121		223.468	1.389
CLP	0.118	5.703	2.293	0.448		0.621
BRL	0.189	917.666	3.689	0.72	160.910	
QUANTILE →		0	25	50	75	100

3 Years

BASE \ PRICE	USD	COP	MXN	PEN	CLP	BRL
USD		4852.5	19.500	3.806	850.58	5.286
COP	0.021		0.402	0.078	0.175	0.109
MXN	0.051	248.747		0.195	43.572	0.271
PEN	0.263	1274.438	5.121		223.468	1.389
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5 Years

BASE \ PRICE	USD	COP	MXN	PEN	CLP	BRL
USD		4852.5	19.500	3.806	850.58	5.286
COP	0.021		0.402	0.078	0.175	0.109
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How to read this?

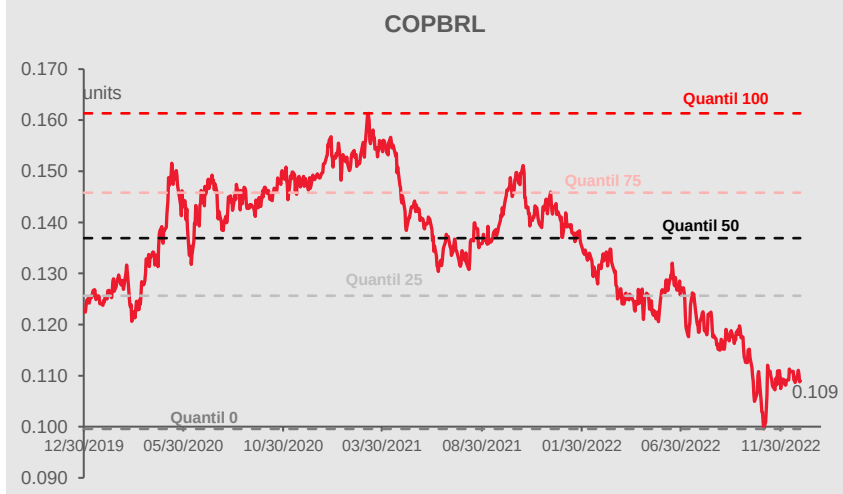
Columns represent the Price currency, while the row is base, the right way to read this is P/B = X units of Price currency (P) needed to purchase one unit of the base currency (B).

When the COP is the base, it is each currency compared with 100 Colombian pesos.

The elements that compose the matrix are denoted in the form a_{ij} , i = row and j= column. In this example the element a_{26} is composed of i = 2 and j = 6.

The data of a26 represents the COPBRL ratio, that is, how many monetary units of BRL are needed to buy 100 COP.

The graph contains the 3-year historical series of the COPBRL spot. It is observed that the last spot is below the average, this indicates that the monetary units of BRL currency needed to acquire 100 COP pesos are lower than the 3-year average paid.



Sources: Scotiabank Colpatria Economics.

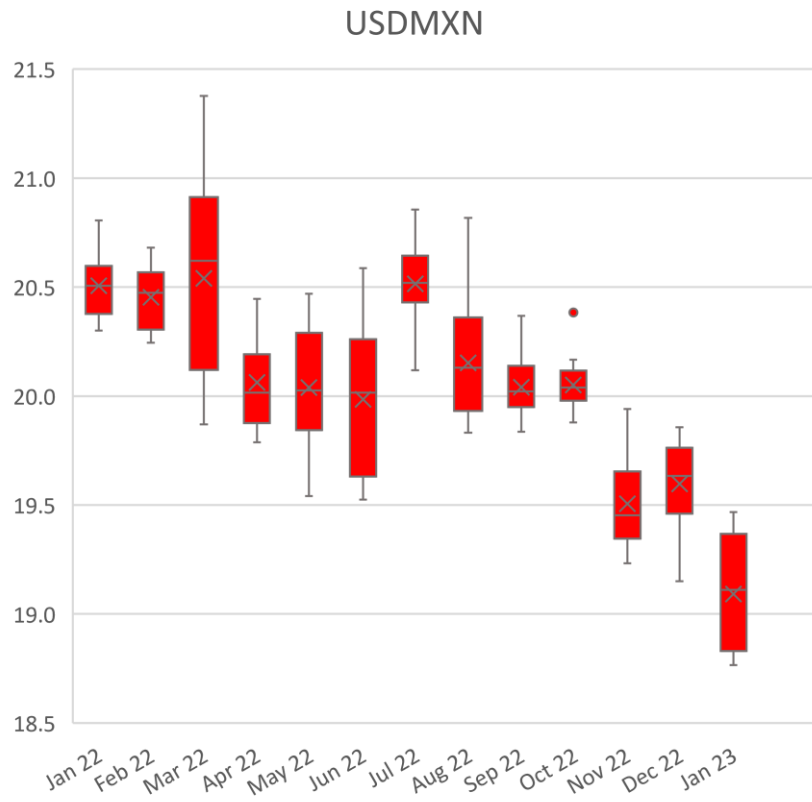
*Note that…

COPUSD - Price of 100 COP in USD
COPMXN - Price of 100 COP in MXN
COPPEN - Price of 100 COP in MXN
COPBRL - Price of 100 COP in BRL
CLPUSD - Price of 100 CLP in USD
CLPMXN - Price of 100 CLP in MXN
CLPPEN - Price of 100 CLP in PEN
CLPBRL - Price of 100 CLP in BRL

In this monitor we present the percentile positioning of Latam crosses vs a one-, three- and five-year window. In the matrix are the current values of each possible cross between MXN, CLP, COP, PEN, BRL, and USD. The price represents the monetary units that are paid for one unit of the Base currency*. The historical data were grouped into quantiles in order to see how far the current data is from the mean (quantile 50). If the last observed data is below the average, it will indicate the appreciation of the currency Price against the Base currency with respect to its historical value. If the price is above the mean, it will indicate the depreciation of the currency Price against the Base currency with respect to its history.

Monthly Box and whiskers Latam Currency charts

In December, the volatility was low for most of the currencies in the region. However, the MXN fluctuated in a wide range, similar to the one observed in November. The lower liquidity due to the holiday season and the relative calm in international markets lead to these narrow ranges. In January, the action increased for MXN, CLP, COP, and BRL, which now move in wider ranges.



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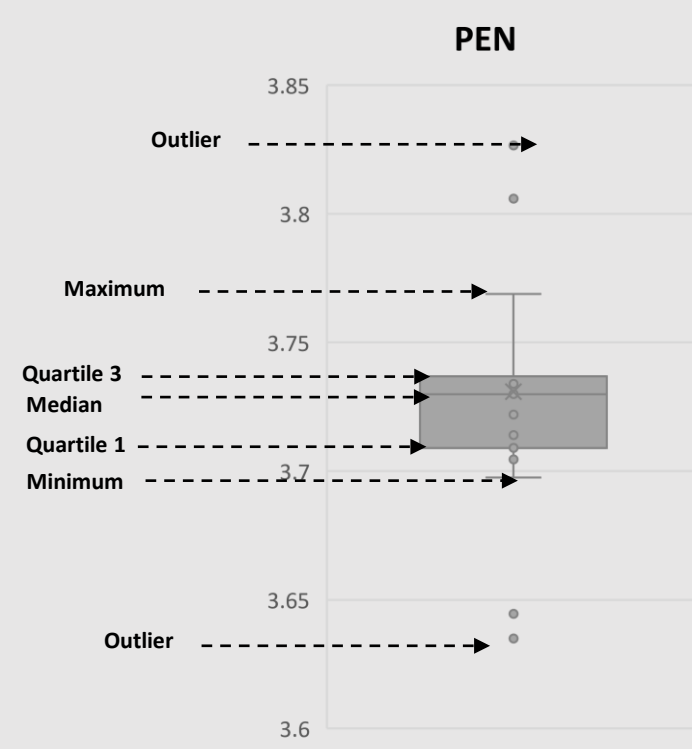
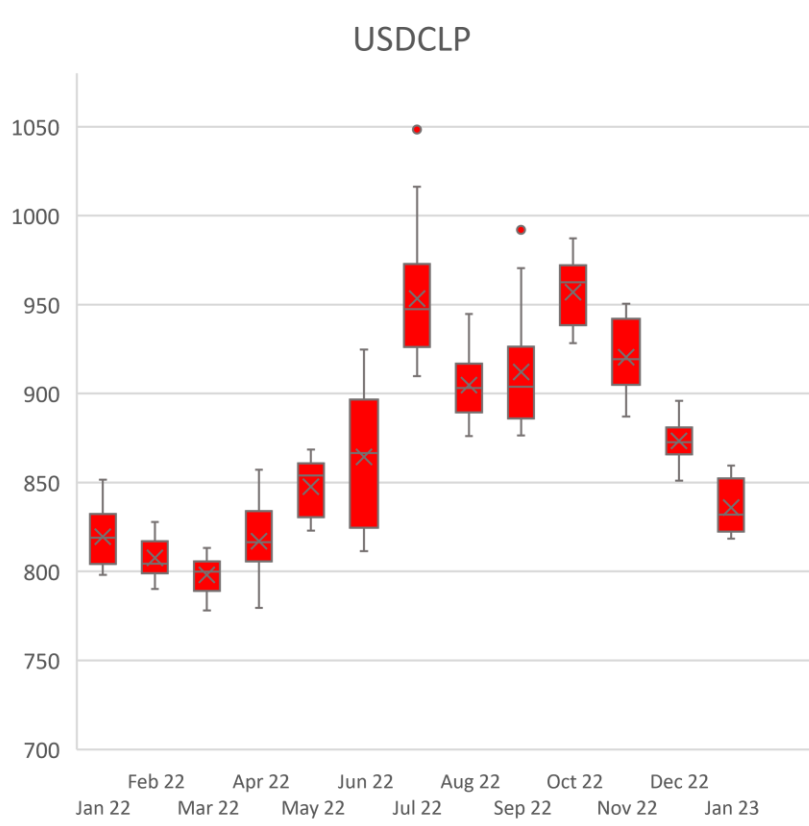
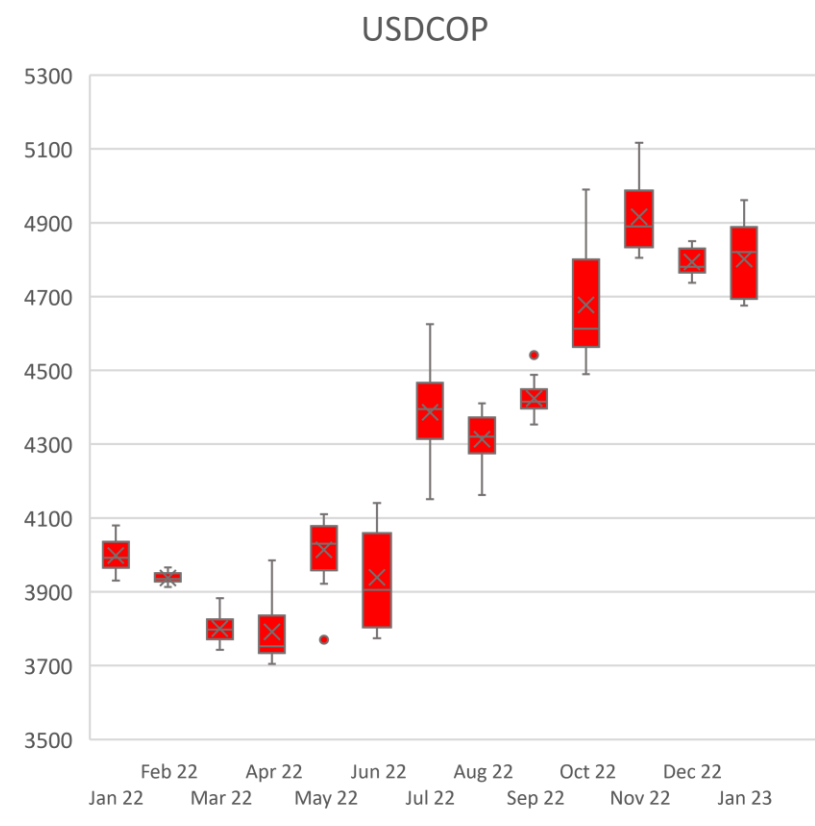
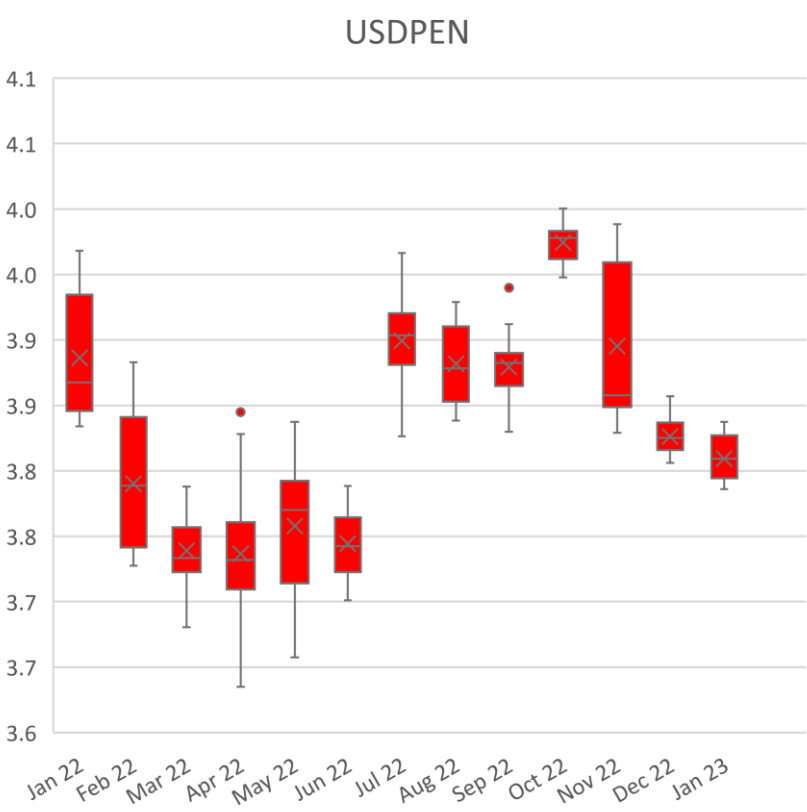
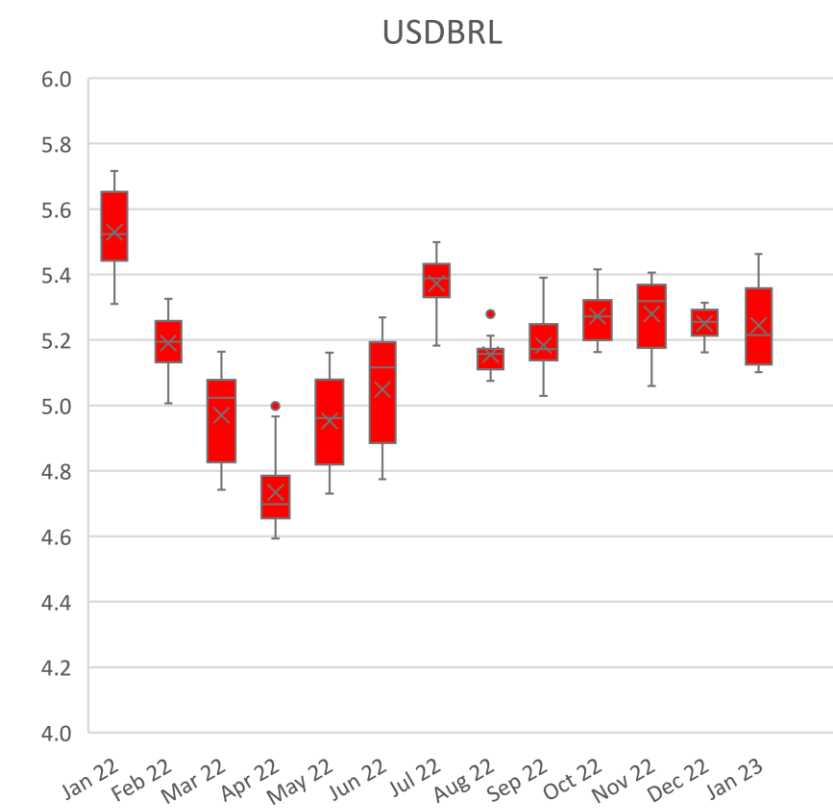




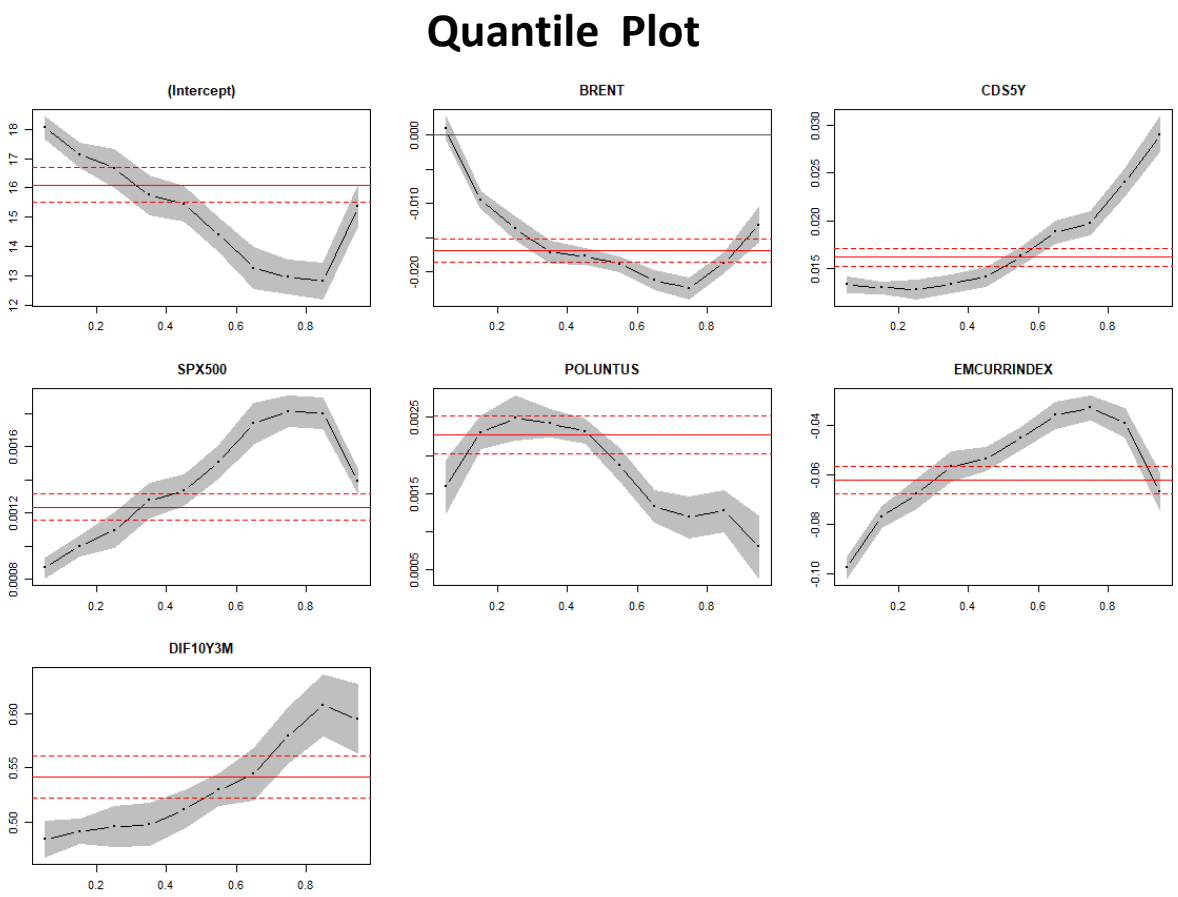


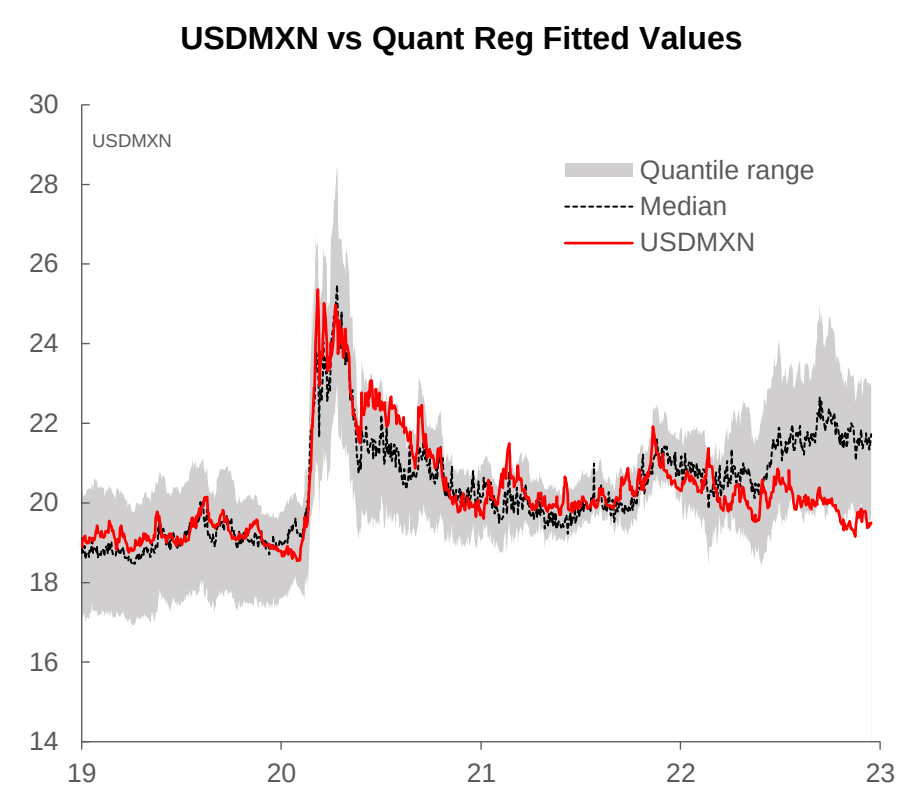




MXN: Main Takeaways

Last year, the Mexican peso traded overvalued in relation to its long-term fundamentals. The constant spread between Banxico's policy rate and the Fed's and its close link to the (strong) US economy alongside record-high remittances contributed to the currency's stability. In 2023, Banxico is expected to decouple from the Fed, deploying fewer additional hikes. Nevertheless, the Scotiabank Economics team expects overall stability in the exchange rate (19.43 by the end of 2023 vs spot around 19 pesos). The short-term model indicates that there is a more significant influence of the rate differential. Meanwhile, the remainder of its FX drivers are having a moderate impact.



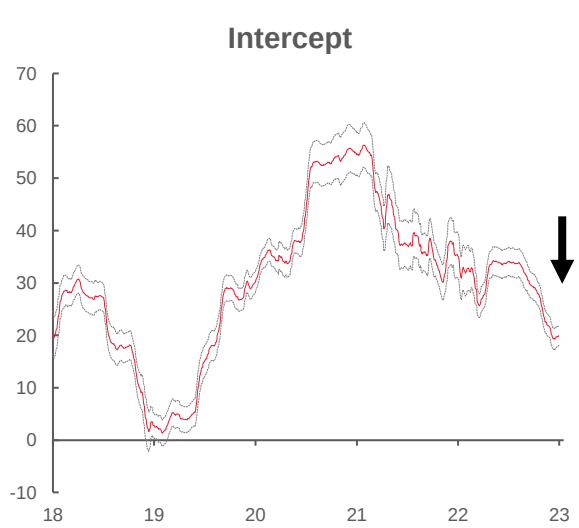


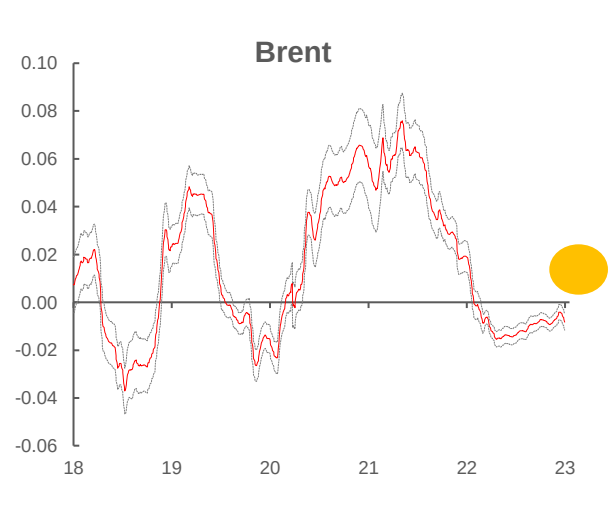
Sources: Bloomberg, Scotiabank Economics.

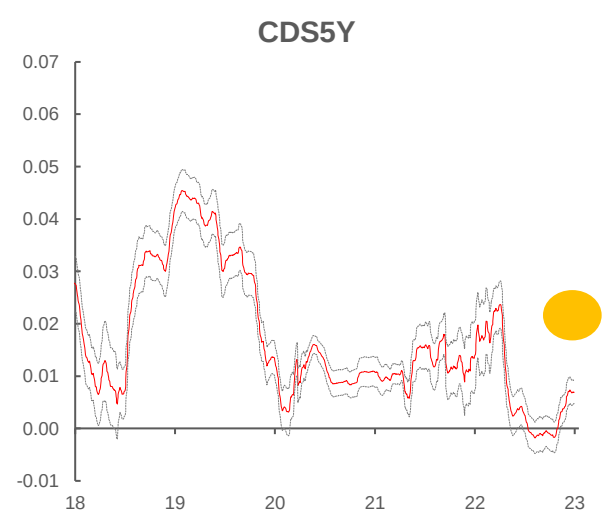
The graph to the right, shows the median of the MXN value calculated by the model (black dotted line) along with the realized value of USD/MXN (solid red line). The gray shade represents the area containing the whole range of estimates of the quantile regression from percentiles 5 to 95.

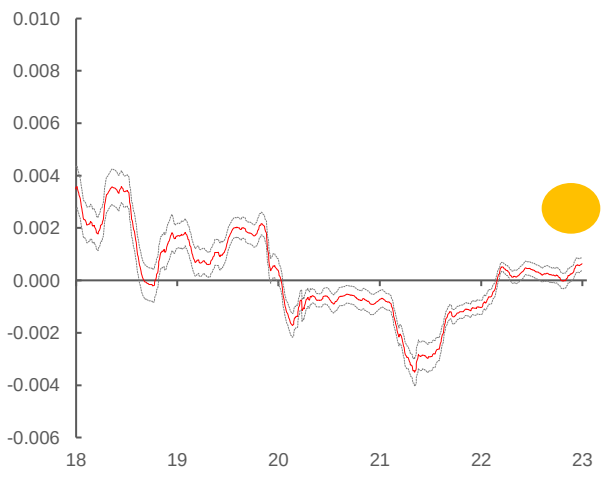
MXN Short-term / Rolling Regression Betas:

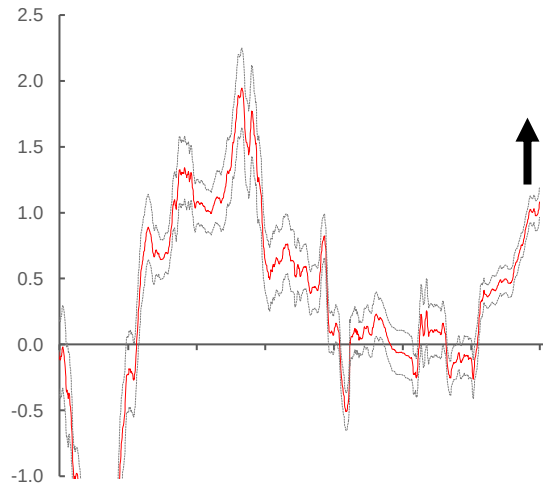
Main changes during the month are represented by the arrows ↓ **Lower sensitivity** ↑ **Higher Sensitivity** ● **Unchanged**

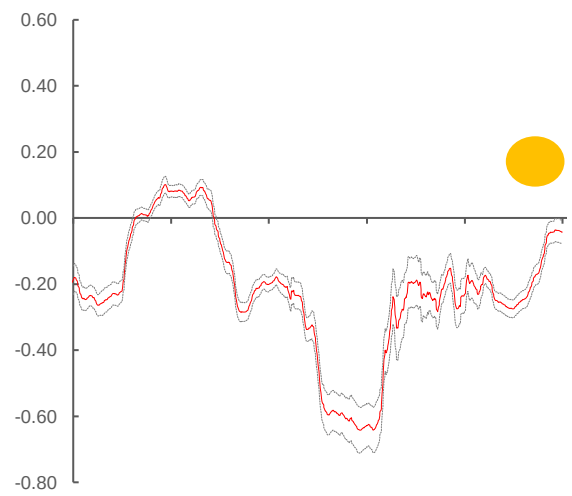


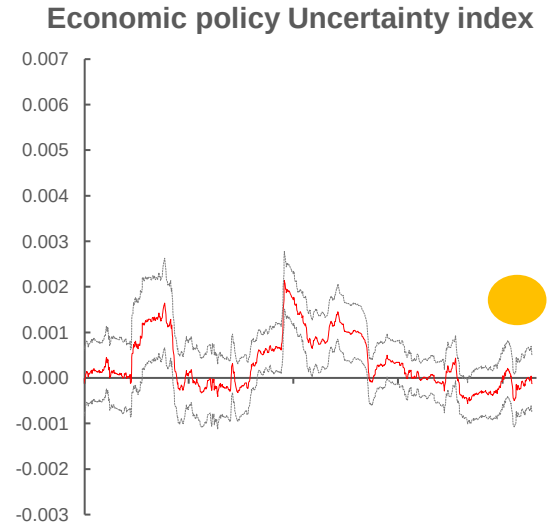








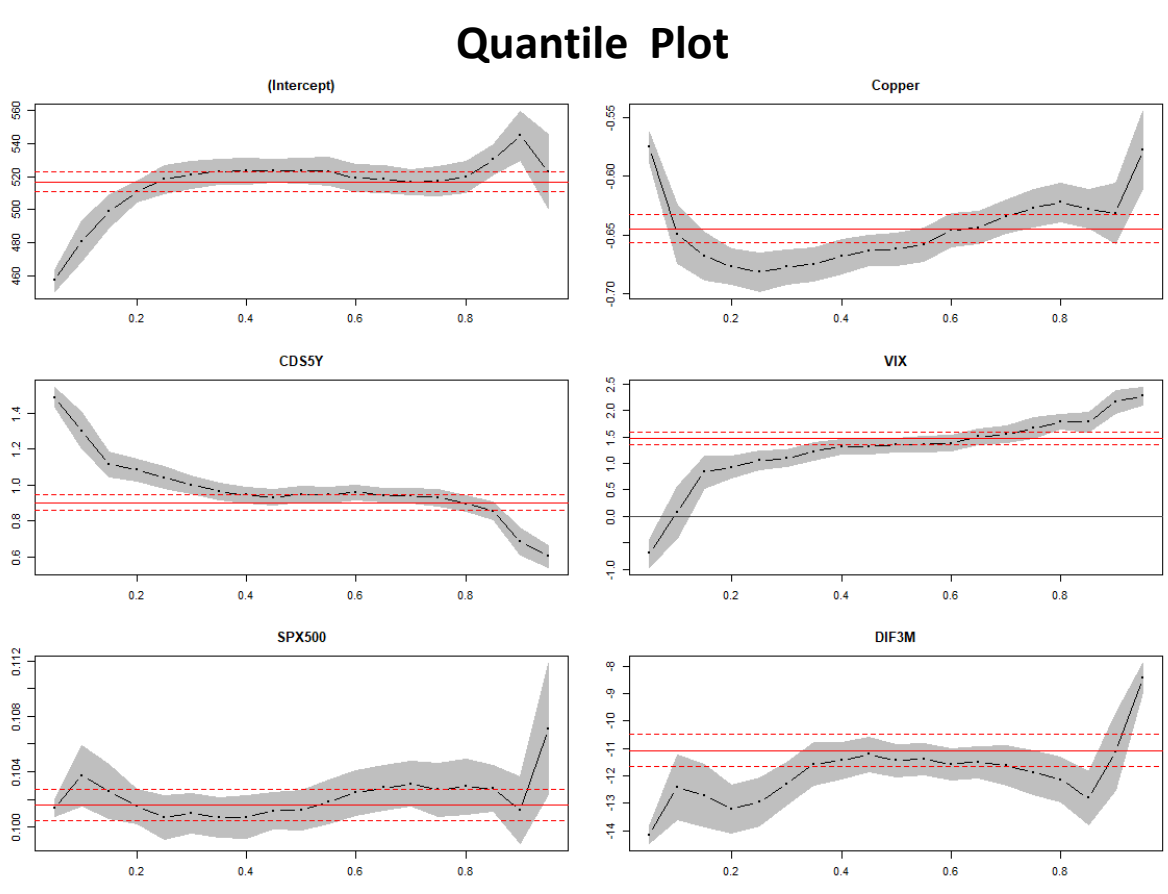


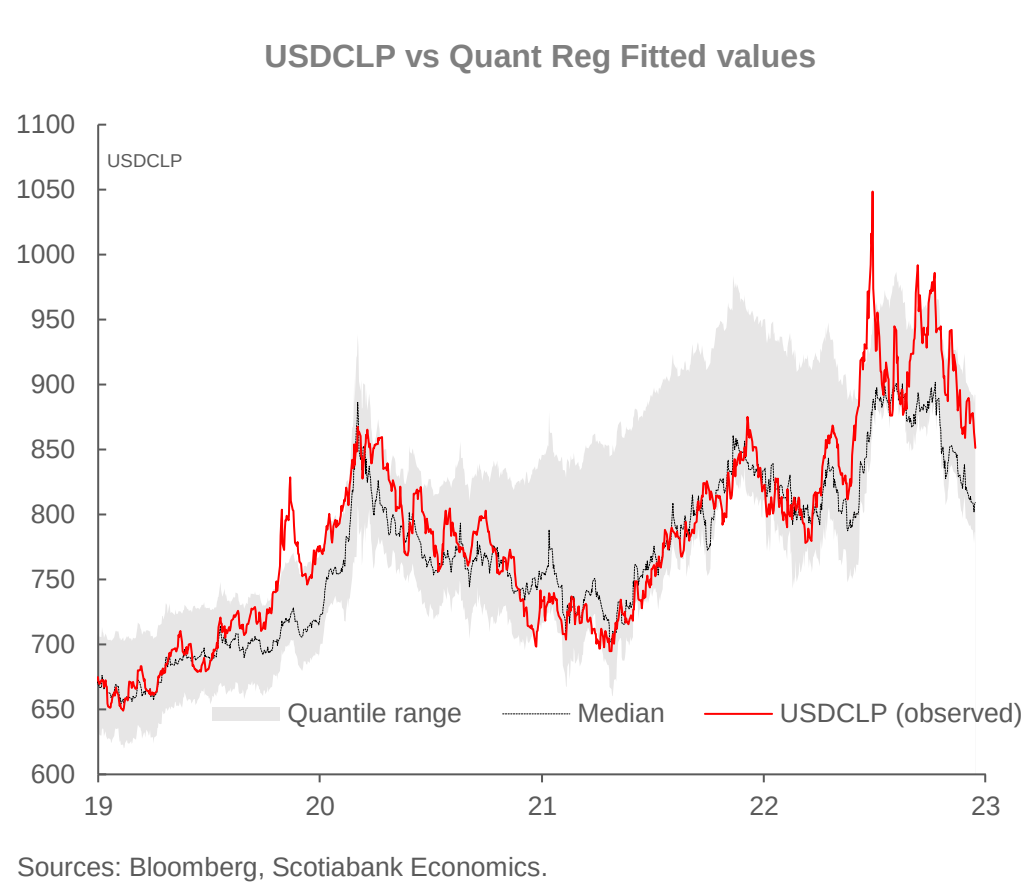


Beta + / - 2 SD

CLP: Main Takeaways

After the uncertainty triggered by the constitutional process, a more organized constitutional reform framework has eased pressures on the CLP. It was the negative political risks that called the shots for the CLP through most of 2022, as the currency traded undervalued in relation to its fundamental drivers. A crowded reform agenda for 2023 that includes tax reform, pension reform, and the new constitutional process, will likely bring some volatility to markets during the year. For now, markets reflect an expectation that there will be no extreme modifications , which should warrant some calm in the FX rate. A headwind for the currency is the chance of rate cuts from the central bank while the Fed holds a hawkish higher-for-longer message and Latam central banks keep their respective rates at elevated levels. The short-term model points to a relevant influence from commodity prices, which could support the currency amid stronger demand from China's reopening. Rate differentials are not playing a notable role for now.

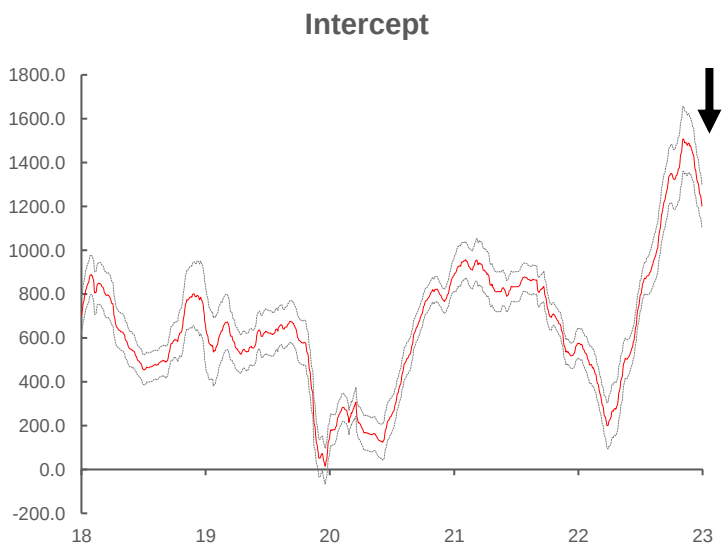


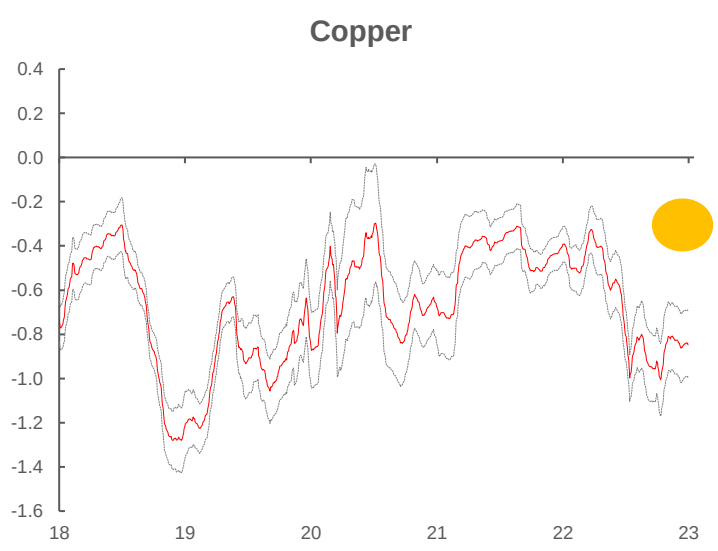


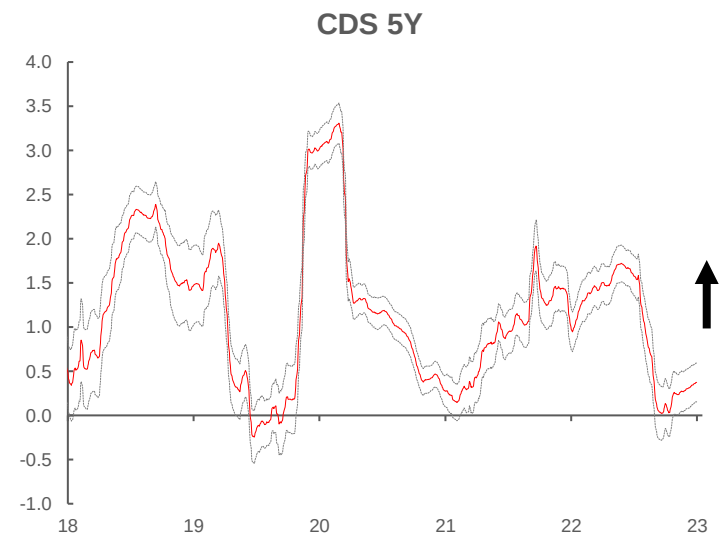
Sources: Bloomberg, Scotiabank Economics.

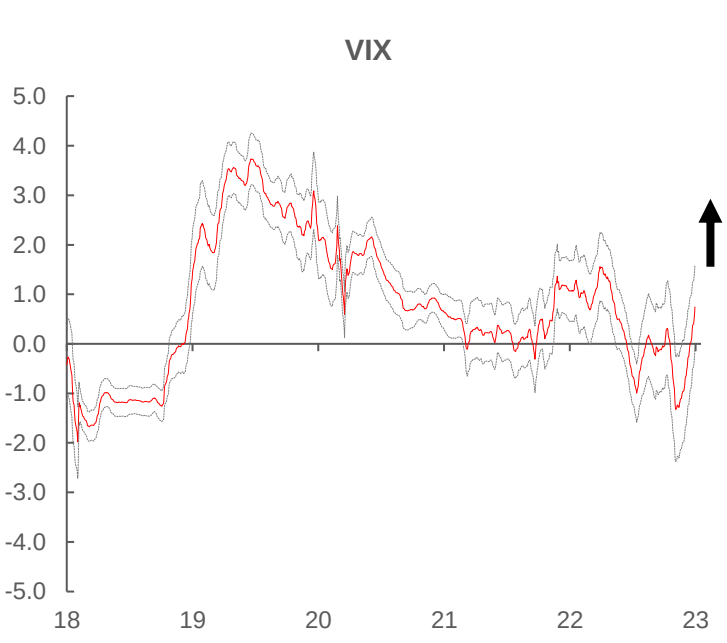
CLP Short-term /Rolling Regression Betas:

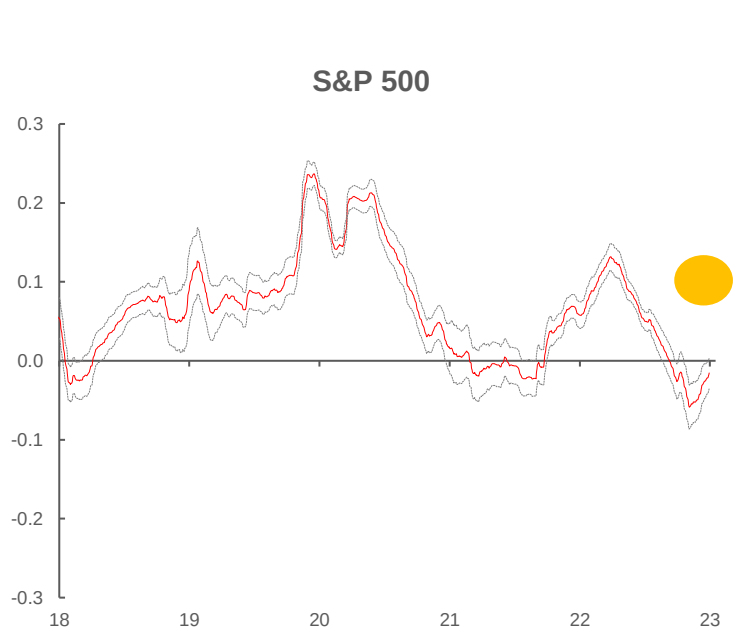
Main changes during the month are represented by the arrows ↓ **Lower sensitivity** ↑ **Higher Sensitivity** ● **Unchanged**

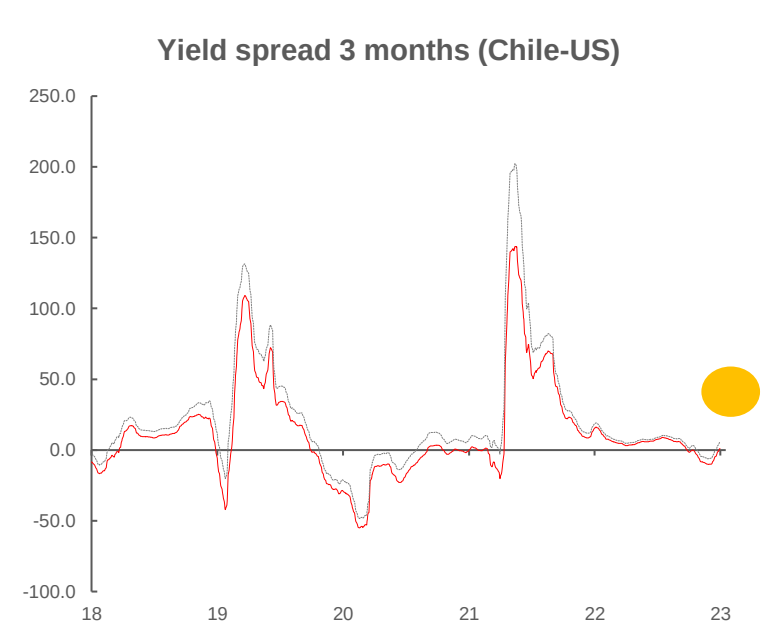








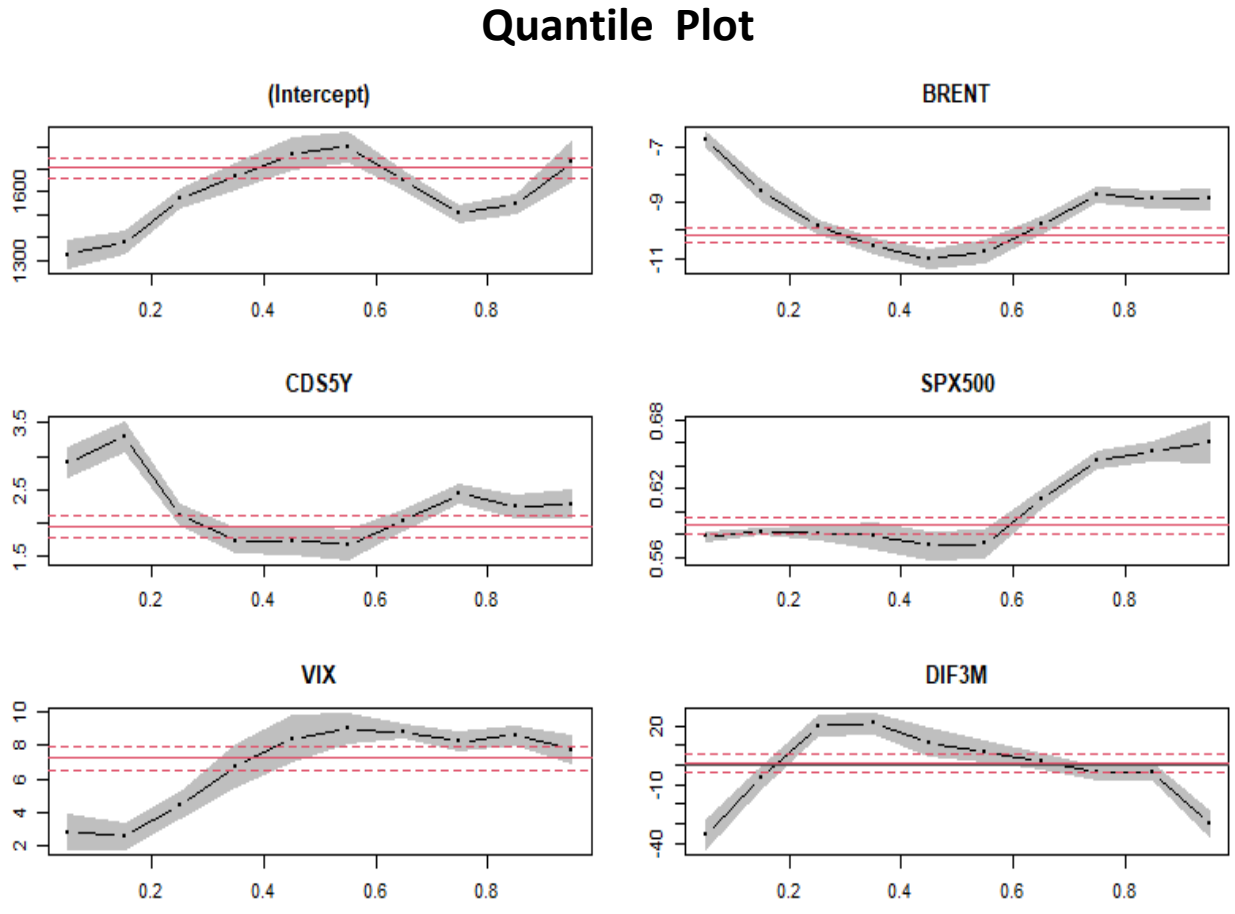


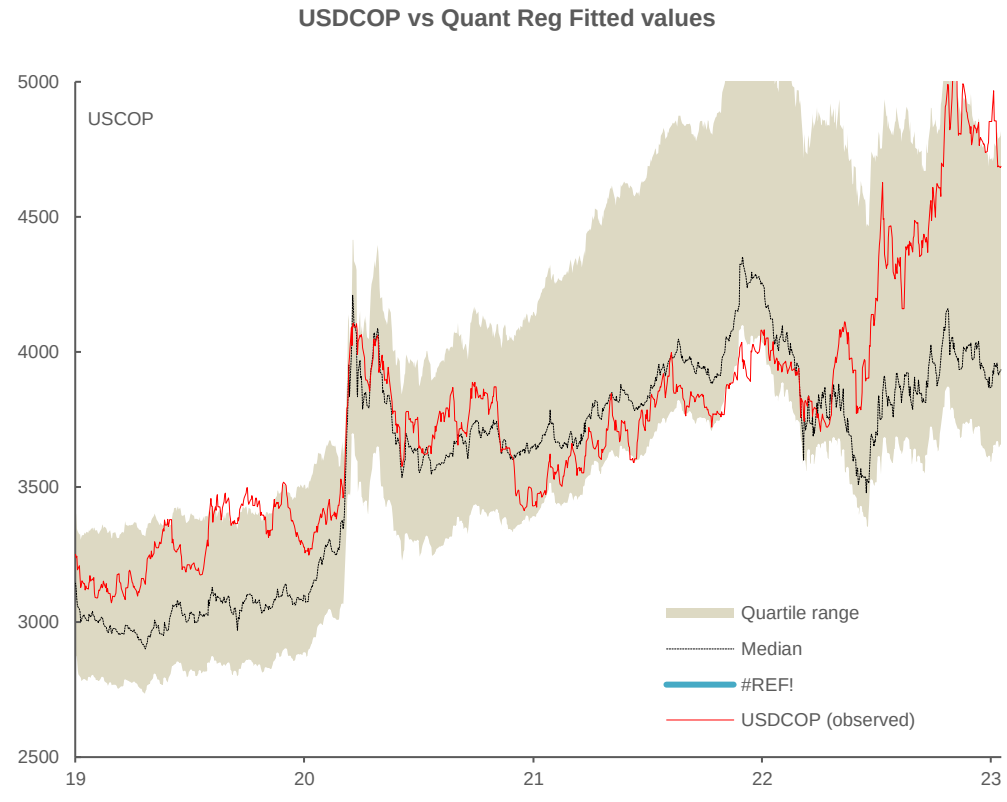


Beta + / - 2 SD

COP: Main Takeaways

The COP was the worst-performing currency in the region in 2022. Political noise around presidential elections and communication mistakes lead to increased risk premiums in local assets, including the FX. At the beginning of 2023, the currency appreciated by around 2.5%, which brought the currency closer to the short-term fair value. Discussions around health reform, the pension reform will prove the government's political support ahead of the October regional elections. However, shocking communication would also bring volatility. **For now, a supportive fundamental came with Banrep since it is expected to maintain a 100 bps in the hiking cycle vs. the slowdown expected by the Fed and other central banks in the region.**

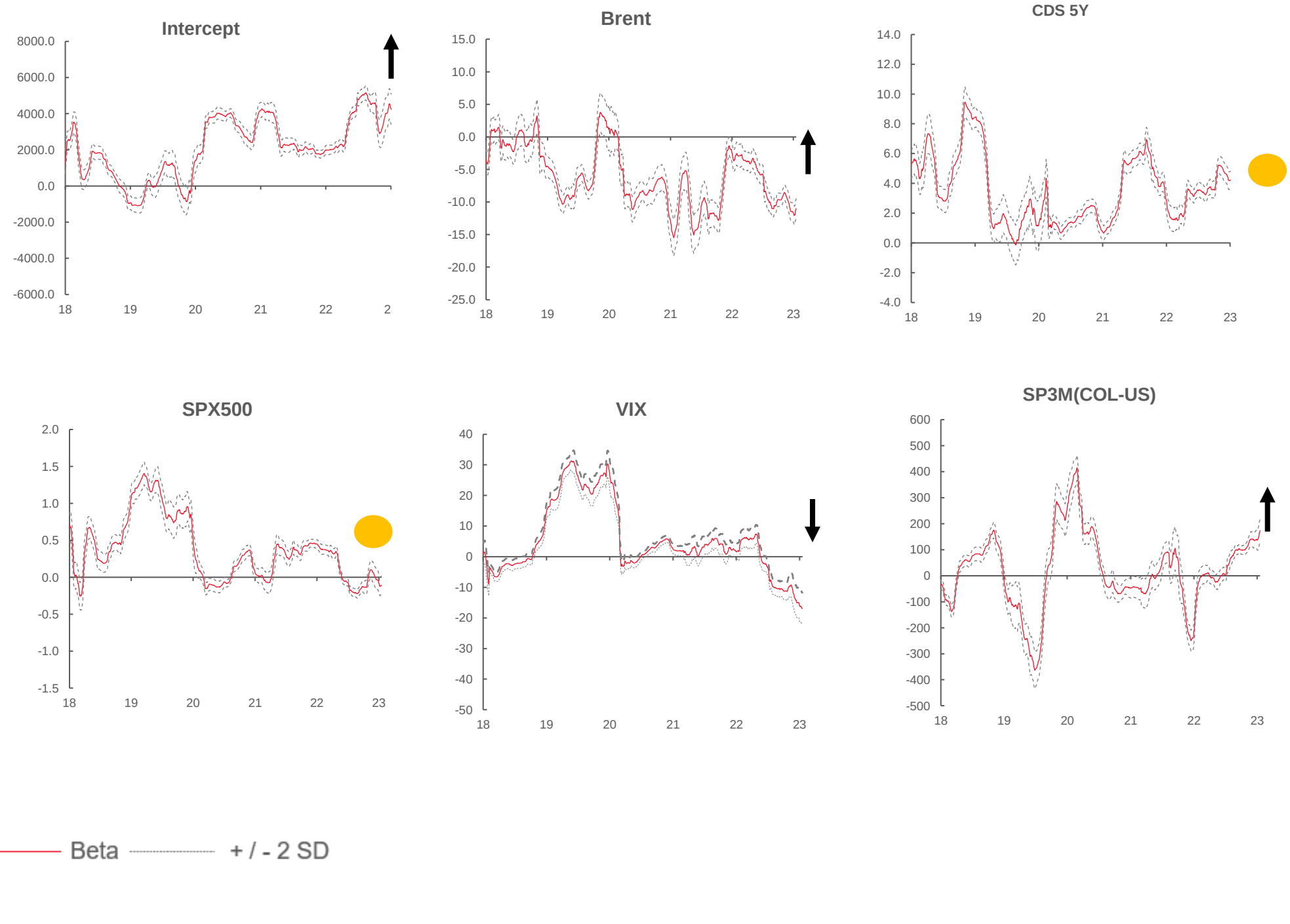




Sources: Bloomberg, Scotiabank Economics.

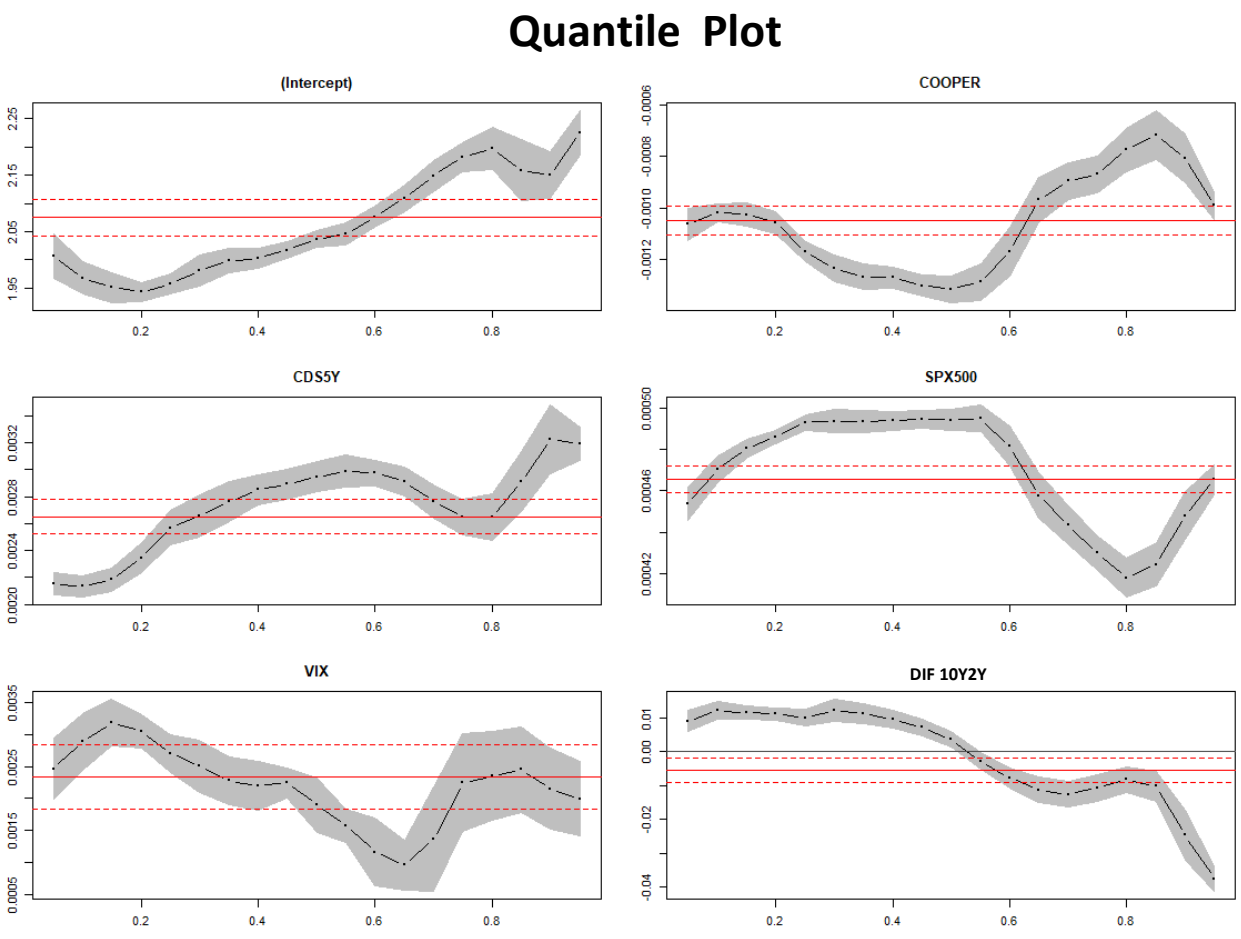
COP Short-term Drivers/Rolling Regression Betas:

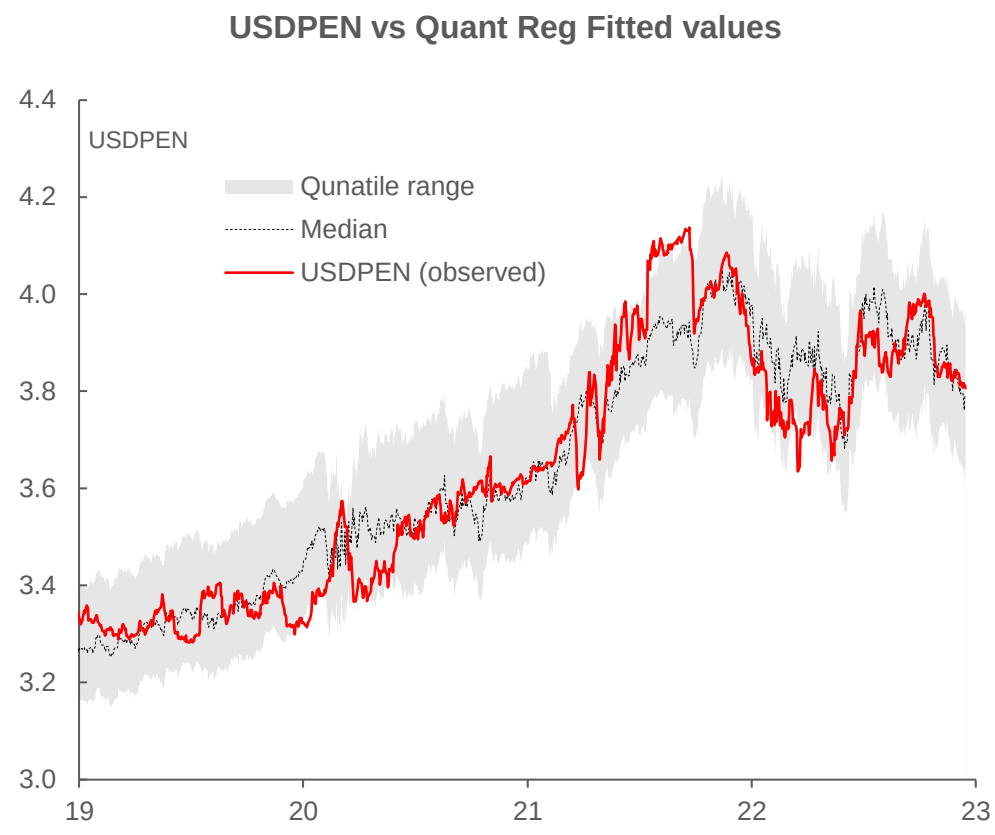
Main changes during the month are represented by the arrows ↓ **Lower sensitivity** ↑ **Higher Sensitivity** ● **Unchanged**



PEN: Main Takeaways

The PEN closed 2022 at the median of the long-term and short-term models despite the political noise around and following the president's removal. According to the short-term model, its sensitivity to international volatility decreased. It is worth noting that PEN has lost sensitivity to rate differentials vis-à-vis the US, which could explain why the PEN has remained relatively stable despite the slowing in the BCRP's hiking cycle. Political tensions are in the spotlight; in the year-to-date, the currency has depreciated around 1% in comparison to its regional peers gaining on the dollar, which would reflect a higher sensitivity to domestic risk.





Sources: Bloomberg, Scotiabank Economics.

PEN Short-term Drivers/Rolling Regression Betas:

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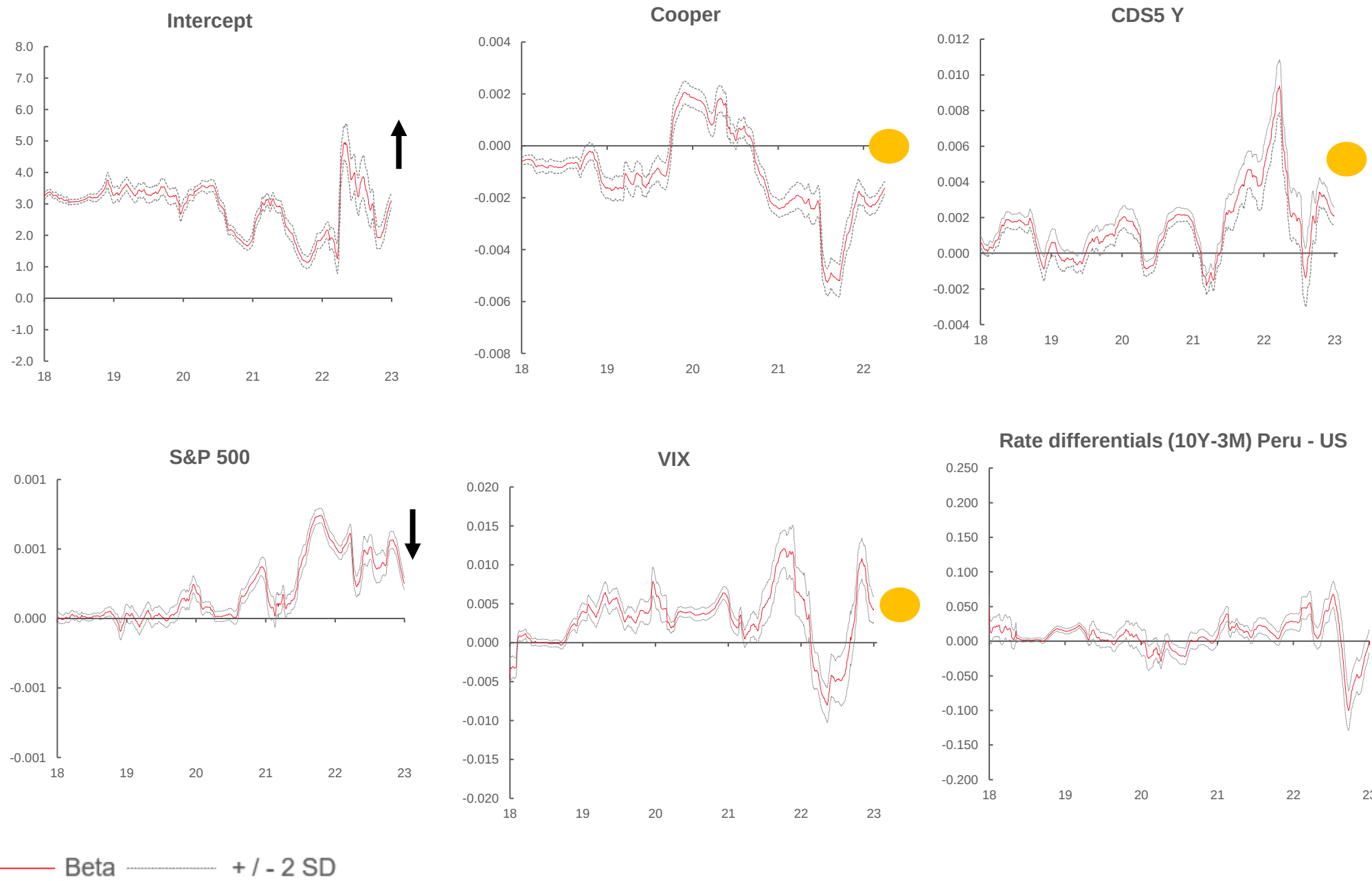
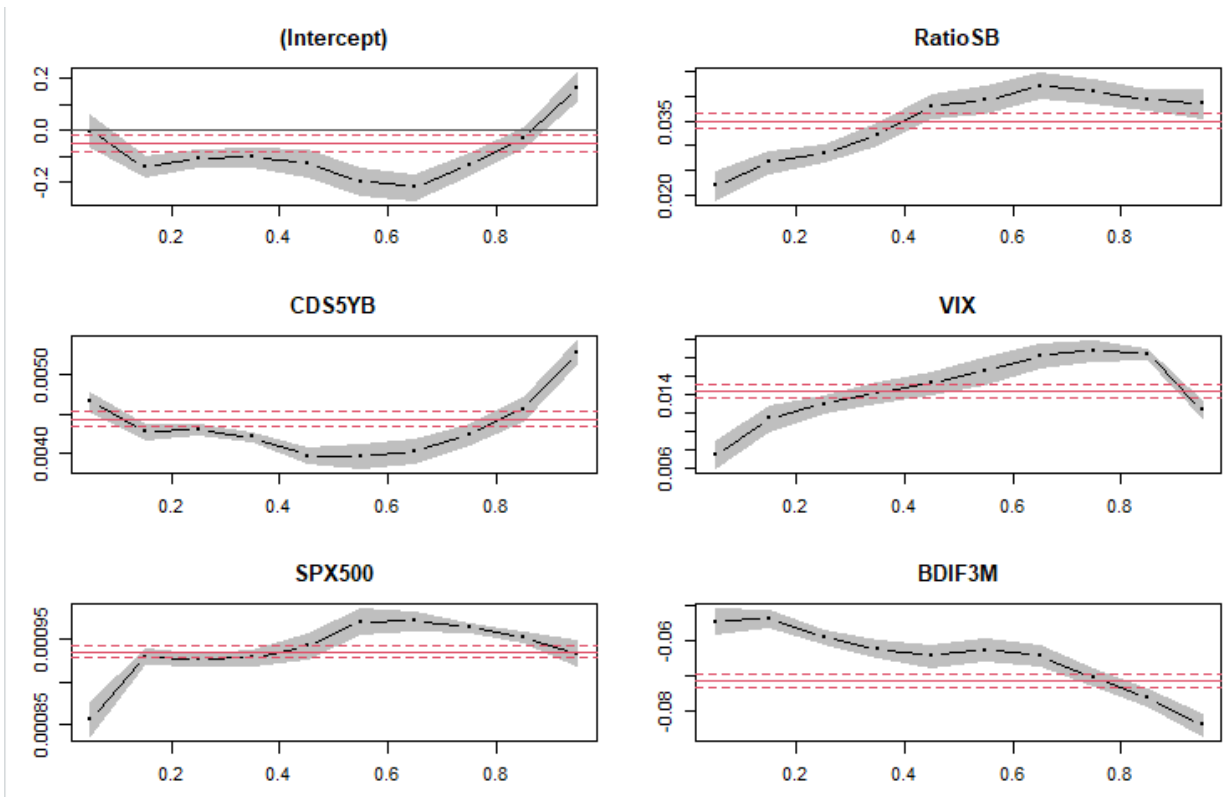
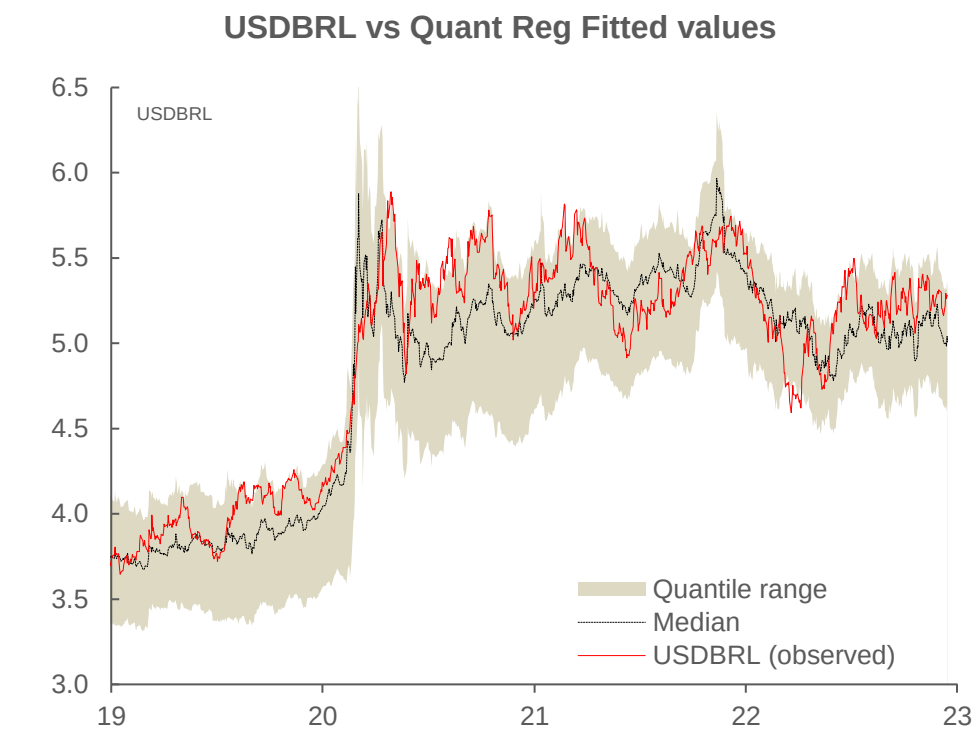


BRL: Main Takeaways

The BRL was the best performing major in 2022, gaining more than 5% vs the USD. Strength in international food prices supported the currency during the year. In the short-term model, local risk metrics and commodity prices continued to dictate the currency's path, alongside greater sensitivity to international volatility. The BCB has reached the end of its hiking cycle and, with this pause, rate differentials versus the US should narrow, limiting BRL upside in the medium term. The country's political transition is clearly on the market's radar as participants await developments on fiscal policy.

Quantile Plot



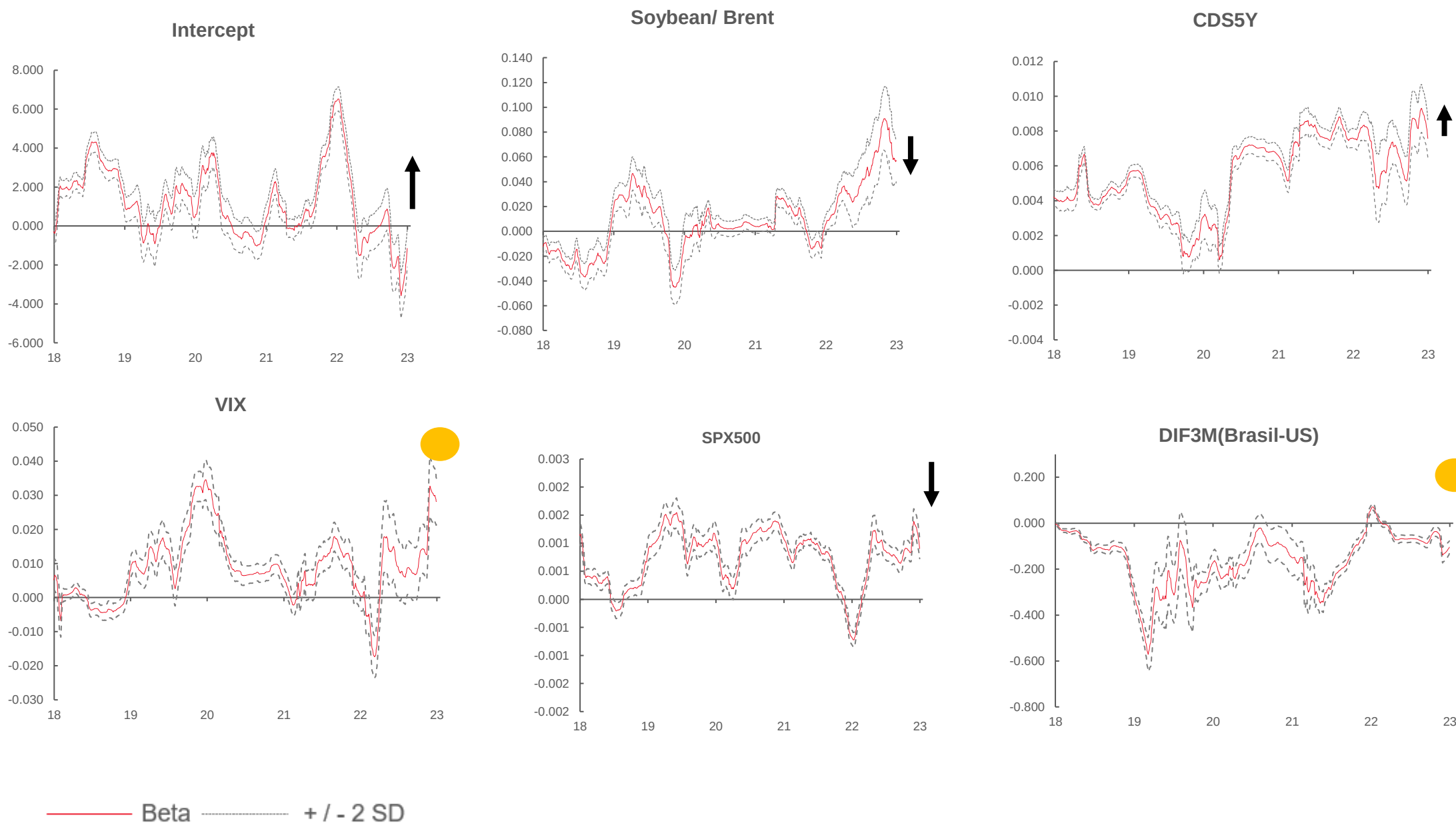


Sources: Bloomberg, Scotiabank Economics.

BRL Short-term drivers/Rolling Regression Betas:

Main changes during the month are represented by the arrows ↓ **Lower sensitivity** ↑ **Higher Sensitivity** ● **Unchanged**

Rolling Regression Betas:



ANNEX: Extended Results and References

Model specification after variable selection:

Variable selection was conducted through stepwise methods, verifying the correlation structures among the variables. The initial pool of variables included traditional explanatory variables from the literature, such as interest rate differentials, as well as variables related to the yield curve, liquidity, and risk factors. In the end, our common framework has three big variable blocks: the first is related to the external sector (often a commodity price), the second is related to a nominal interest rate differential, and the third is related to risk metrics. **For every currency pair we analyze , we used linear regressions to choose the explanatory variables that would go into the model.** Our data set starts in 2010, which leaves out the significant noise of the great financial crisis of 2008.

$$\boldsymbol{USDMXN = \alpha + \beta_1(\tau)Brent + \beta_2(\tau)5yCDS + \beta_3(\tau)S\&P500 + \beta_4(\tau)POLUNTUS + \beta_5(\tau)EMCURRINDEX + \beta_6(\tau)Dif10Y3M}$$

*POLUNTUS: Economic Policy Uncertainty Index

*EMCURRINDEX: JP Morgan Emerging Market Currency Index

*Dif 10Y3M: Slope 10Y-3M Mexico – Slope 10Y -30M US

$$\boldsymbol{USDCLP = \alpha + \beta_1(\tau)Cooper + \beta_2(\tau)5yCDS + \beta_3(\tau)S\&P500 + \beta_4(\tau)VIX + \beta_5(\tau)Dif3M}$$

*Dif 3M = Spread Yield 3M Chile - Yield 3M US

$$\boldsymbol{USDCOP = \alpha + \beta_1(\tau)Brent + \beta_2(\tau)5yCDS + \beta_3(\tau)S\&P500 + \beta_4(\tau)VIX + \beta_5(\tau)Dif3M}$$

*SP3M = Spread Yield 3M Colombia - Yield 3M US

$$\boldsymbol{USDPEN = \alpha + \beta_1(\tau)Cooper + \beta_2(\tau)5yCDS + \beta_3(\tau)S\&P500 + \beta_4(\tau)VIX + \beta_5(\tau)Dif10Y2Y}$$

*Dif 10Y3M = Yield curve slope 10Y-3M Peru - Yield curve slope 10Y-3M US

$$\boldsymbol{USDBRL = \alpha + \beta_1(\tau)Soybean/Brent + \beta_2(\tau)5yCDS + \beta_3(\tau)VIX + \beta_5(\tau)S\&P500 + \beta_5(\tau)DIF\ 3M}$$

*DIF 3M = Spread 3M Brazil - Yield 3M US

ANNEX: Extended Results and References

Relationship between the variables in the model

	USDMXN
Brent	The relationship with oil is negative, which means that on average, the higher the price per barrel, the stronger the MXN. The results indicate that for conditional percentiles below 50, the correlation with MXN is lower than what the linear regression would imply. The strongest correlation with MXN appears to be around the 70 percentile of conditional distribution.
CDS	The relationship with the 5Y CDS is positive, which means that on average, the higher the credit-risk perception, the weaker the currency. In this case, the correlation between the variables increases in higher percentiles.
S&P	The results of the study show that despite the negative relationship that prevails in the current regime, where risk off cycles mean depreciation of MXN along with losses in the stock market, the structural relation between the S&P and MXN is statistically positive within our sample. This means that on average, the higher the S&P the weaker the MXN tends to be, which is in line with the predominantly positive correlation between the S&P and the DXY.
Poluntus **(Economic Policy Uncertainty Index)**	The sign of the coefficient confirms the intuitive relationship between both variables, where on average, the higher the political noise, the weaker the MXN.
Emcurrindex **(JP Morgan Emerging Market Currency Index)**	The negative sign indicates that on average, the stronger the EM currencies are, the stronger MXN is too, denoting that the currency is positively correlated with the broad sentiment and risk appetite prevailing in the market.
DIF10Y3M **(10Y-3M Mexico – Slope 10Y -30M US)**	We found that the steepness of the Mexican curve, relative to the steepness of the US curve had a stronger explanatory power than the interest rate differential by itself. The positive sign means that on average, the steeper Mexican curve is relative to the Treasury curve, the weaker the currency. This could be explained by the fact that in periods of stress mostly explained by idiosyncratic factors, such as inflation risk or higher perception of vulnerability in the fiscal accounts, the longer end of the local curve tends to suffer more, dragging down the MXN with it.

ANNEX: Extended Results and References

Relationship between the variables in the model

	USDCLP	USDPEN
Cooper	The relationship with copper is negative, which means that on average, the higher the price per ton, the stronger the CLP. The results indicate that for conditional percentiles below 60, the correlation between CLP and copper is slightly lower than what the linear regression would say. The strongest correlation with CLP appears to be around the 90th percentile of the conditional distribution.	The relationship between copper and USD/PEN is negative, as it would be intuitively expected. The negative sign of the coefficient means that on average, the higher the price per ounce of copper, the stronger the PEN. The results indicate that for conditional percentiles below 50, the correlation with PEN is lower than what the linear regression would suggest. The strongest correlation with PEN is around the 80th percentile of the conditional distribution.
CDS	The relationship with 5-year CDS is positive, which means that on average, the higher the perception of credit risk, the weaker the currency. In this case, the correlation from the 30 to the 70 percentile is similar to that of a linear regression	The relationship with 5-year CDS is positive, which means that on average, the higher the perception of credit risk, the weaker the currency. In this case, the correlation is highest at the 90th percentile.
S&P	The relationship with the international risk component is positive and at the 90th percentile it coincides with the linear regression. Interestingly, the results of the study show that despite the negative relationship that prevails in the current regime, where risk off cycles mean depreciation of EM currencies along with losses in the stock market, the structural relation between the S&P and CLP is positive within our sample. This means that on average, the higher the S&P the weaker the CLP tends to be, which is in line with the predominantly positive correlation between the S&P and the DXY.	The relationship with the international risk component is positive and at the 90th percentile it is explained as a linear regression. Although between the 30th and 50th percentiles there is a higher correlation. Interestingly, the results suggets show that despite the negative relationship that prevails in the current regime, where risk off cycles mean depreciation of EM currencies along with losses in the stock market, the structural relation between the S&P and PEN is statistically positive within our sample. This means that on average, the higher the S&P the weaker the PEN tends to be, which is in line with the predominantly positive correlation between the S&P and the DXY.
VIX	We use the VIX as a proxy of sentiment and/or risk aversion in the global markets. The quantile regression shows that there is a positive relationship between the VIX and CLP, such that, on average, the higher the volatility, the weaker the Chilean Peso, which is in line with the intuitive relationship. For this variable, a positive and stronger relationship is presented from the 70th percentile.	We use the VIX as a proxy of sentiment and/or risk aversion in the global markets. The quantile regression shows that there is a positive relationship between the VIX and PEN, such that, on average, the higher the volatility, the weaker the Peruvian Sol, which is in line with the intuitive relationship. For this variable, the 60th percentile has the lowest level of correlation.
DIF10Y2Y		The steepness of the Peruvian curve, relative to the steepness of the US curve has a stronger explanatory power than the rate differential. The positive sign means that on average, the steeper the local curve is relative to the USTs, the weaker the currency. This could be explained by the fact that in periods of stress mostly explained by idiosyncratic factors such as inflation risk or higher perception of vulnerability in the fiscal accounts, the longer end of the local curve tends to suffer more, and PEN depreciates.
DIF3M	In the case of Chile, we found that the short-term rate differential with the US had a larger explanatory power than the relative shape of the curves. The negative sign means that on average, the wider the differential, the stronger the CLP, probably because it gets more attractive from a carry perspective.	

ANNEX: Extended Results and References

Relationship between the variables in the model

	USDBRL	USDCOP
Brent or Soybean/Brent ratio	The relationship with oil is negative, which means that on average, the higher the price of a barrel, the stronger the BRL. The results indicate that for conditional percentiles below 50, the correlation with BRL is slightly lower than what linear regression would imply. The strongest correlation with BRL appears to be around the 80th percentile of the conditional distribution.	The relationship between COP and oil is negative, which means that on average, the higher the price per barrel, the stronger the COP. The results indicate that for conditional percentiles below and above 50, the correlation with COP is lower than what the linear regression would imply. The strongest correlation with COP appears to be around the median of conditional distribution.
CDS	The relationship with 5-year CDS is positive, which means that on average, the higher the perception of credit risk, the weaker the currency. In this case, the correlation between the variables increases at the 70th percentile.	The relationship of the currency with the 5Y CDS is positive, which means that on average, the higher the credit-risk perception, the weaker the currency. In this case, the correlation between the variables is higher close to the median.
S&P	The relationship with the US equity market is positive, which means that on average, the higher the S&P the weaker the BRL tends to be, which is in line with the predominantly positive correlation between the S&P and the DXY but differs from the currency regime where equities and EMFX tend to move in the same direction. The strongest correlation occurs at the 60th percentile.	The results show that despite the negative relationship that prevails in the current regime, where risk off cycles mean depreciation of COP along with losses in the stock market, the structural relation between the S&P and COP is statistically positive within our sample. This means that on average, the higher the S&P the weaker the COP tends to be, which is in line with the predominantly positive correlation between the S&P and the DXY.
VIX	With the volatility indicator, there is a positive relationship and from the 50th percentile on, it is higher than what the linear regression would imply.	We use the VIX as a proxy of sentiment and/or risk aversion in the global markets. The quantile regression shows that there is a positive relationship between the VIX and COP, such that, on average, the higher the volatility, the weaker the Colombian Peso, which is in line with the intuitive relationship. For this variable, the 50th percentile has the highest level of correlation.
DIF3M	In Brazil, the short-term rate differential with the US had a larger explanatory power than the relative shape of the curves. The negative sign means that on average, wider the differential, the stronger the BRL, probably as it gets more attractive from a carry perspective.	the short-term rate differential with the US had a larger explanatory power than the relative shape of the curves. Interestingly, the sign of the coefficient fluctuates along the different quantiles, while the OLS “beta” is zero. The negative sign of the coefficients on the highest and lower percentiles of the conditional distributions mean the that on average, the wider the differential, the stronger the COP probably as it gets more attractive from a carry perspective. For almost all quantiles in between, the relationship is positive, which might be the case when the widening of Colombian rates IS more related with a worsening idiosyncratic story (e.g. the deterioration of the fiscal accounts) that is negative for the currency.

A little more about quantile regression: The plots

To illustrate the advantages of quantile regression, **chart 1 shows the relation between the USDCLP and copper prices, with each of the lines representing a different quantile of the distribution.** Traditional regression analysis would not accurately capture the relationship between the variables, given that there are at least two distinct sets in the sample. In contrast, the method of quantile regression describes the whole set of data by dividing the conditional distribution in percentiles.

Chart 2 shows the quantile plot for CLP and copper and illustrates the parameter estimates and the 95% confidence range for each quantile. It shows clearly how the coefficients (the betas describing the relation between the CLP and cooper prices) change across the quantiles of the conditional distribution.

The red line in Chart 2 represents the beta of a traditional OLS method (which doesn't change across quantiles), and the dotted red lines are the corresponding confidence intervals at 95%.

As for **the interpretation**, the negative sign on the Y-axis in Chart 2 implies that, on average, the higher the price per ounce of copper, the lower the level of USD/CLP (stronger CLP). Looking a bit closer, the results indicate that in lower quantiles (which coincide with CLP prices below 700 according to chart 1) there is a "more negative" association between the USD/CLP and copper, compared to what the linear regression would imply (red line in chart 2). In percentiles above ~65, however, the correlation with the currency starts to fade, until it is close to zero. Empirically, we could explain this by noting that the transition between 700 and 800 in CLP was mostly explained by idiosyncratic factors (the protests in 2019, the constitutional assembly, etc.) that had no empirical association with copper prices (see percentile 80 charts 1).

Finally, **chart 2.1** shows the median of the CLP value calculated by the model (black dotted line) along with the realized value of USD/CLP (solid red line). The gray shade represents the area containing the whole range of estimates of the quantile regression from percentiles 5 to 95.

Comparison of Linear Regression and Quantile Regression

Linear Regression	Quantile Regression
Predicts the conditional mean E(Y|X)	Predicts conditional qunatiles Qτ(Y|X)
Applies when n is small	Needs sufficient data
Often assumes normality	Is distribution agnostic
Does not preserve E(Y|X) under transformation	Preserves Qτ(Y|X) under transformation
Is sensitive to outliers	Is robust to response outliers
Is computationally inexpensive	Is computationally intensive

Source: Robert N. Rodriguez and Yonggang Yao, SAS Institute Inc. Paper SAS525-2017

*To learn more about quantile regression, please see the Original paper and this Link for applications

Capturing short-term effects

Mindful that deviations from theoretical values can be persistent, we supplement the "structural fair value" results with the analysis of rolling coefficients to perform a shorter-term examination of the relative importance of each explanatory variable at different points in time. This will help to identify the regime we are in and hence, to guide the approach we should take to better interpret the results.

Chart 3 shows an example of the rolling coefficient analysis. The solid red line represents the beta coefficient through time and the gray dotted lines delimit the area between +/- 2 standard deviations. When zero is within that range, the variable is statistically no significant.

There is an important caveat that we wish to highlight: the aim of this piece and its subsequent updates is to provide a reference and input to more complete analysis of the currencies in the Pacific Alliance. **It is not intended as a trading tool that translates directly into specific trade ideas.**

Chart 1: Regression Model for Quantile Levels
0.05 , 0.25 , 0.50 , 0.60, 0.70, 0.80 and 0.95

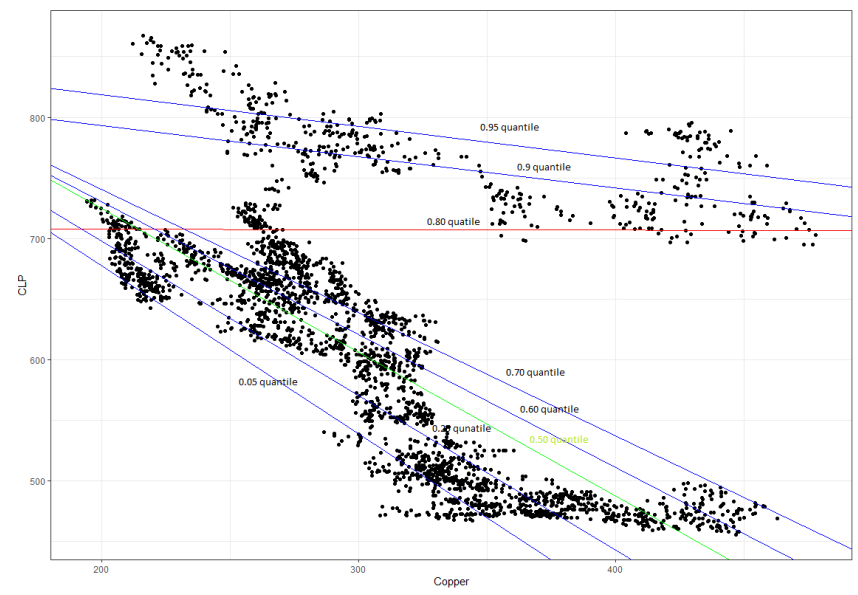


Chart 2: Quantile Plot
CLP = f(Copper)

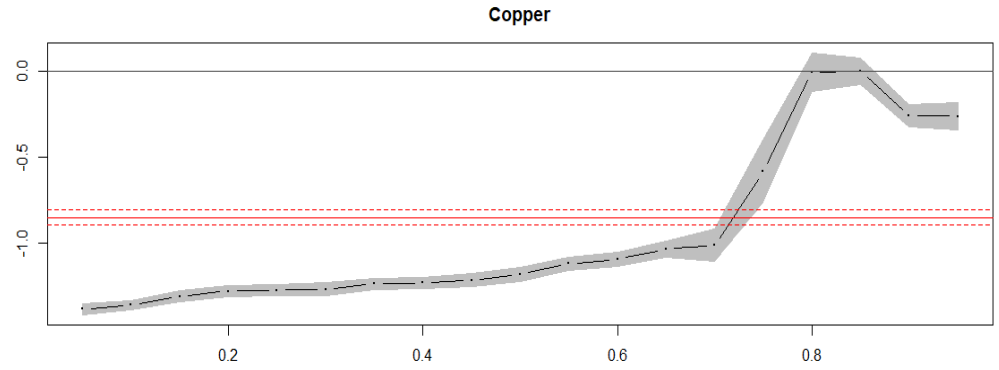
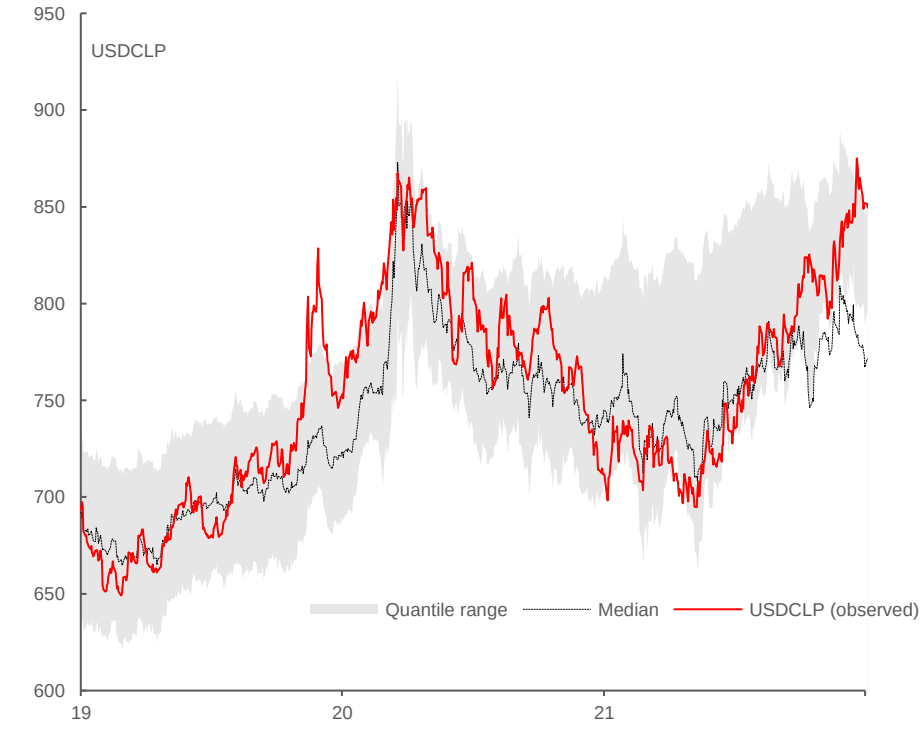
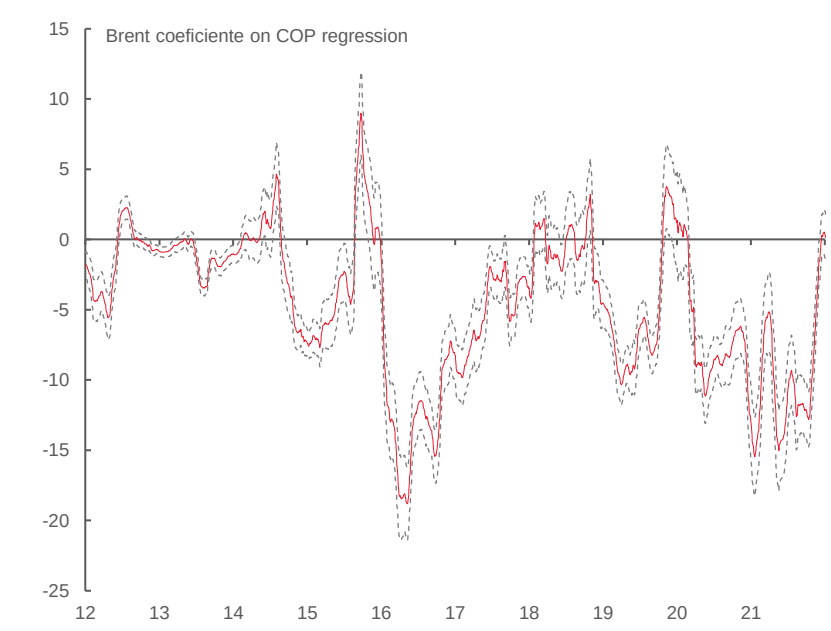


Chart 2.1: USDCLP vs Quant Reg Fitted values



Sources: Bloomberg, Scotiabank Economics.

Chart 3: Example of the Rolling coefficient analysis. Brent coeficiente on COP regression



Sources: Scotiabank Economics.

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