

## PLN and REER equilibrium: as cheap as it gets?

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- We attempt to model the PLN real effective exchange rate using longer-term structural macroeconomic variables. Government debt, net foreign assets, investment spending, real interest rate differentials and share of exports to the eurozone all appear to be important factors influencing long-term valuation.
- Our models indicate that the PLN is currently undervalued by about 5% on a real exchange rate basis. Historically, this is extreme, suggesting the currency appears exceptionally cheap. This calls for medium-term bullish exposure.
- That said, timing is key. The PLN has been undervalued since 2015, around the time when global growth slowed down and following the NBP reducing the policy rate to 1.50%.
- We examined a number of variables to attempt to identify the factors that have driven this wedge. Our results suggest that survey indicators of global manufacturing sentiment likely matter more than the PLN's real rate advantage, which has become less of a driver since 2012. We will be closely monitoring trends in German manufacturing business expectations.
- **Bottom-line:** The Polish zloty appears extremely cheap at current levels, warranting bullish exposure. That said, an improvement in global growth sentiment, especially for German manufacturers, would need to be seen for the PLN to appreciate. The PLN's rising real rate advantage (as some of its trading partners ease policy) will likely prove insufficient.

### 1. Putting the PLN's movements in the context of longer-term macroeconomic fundamentals

In this note, we attempt to put the Polish zloty's rally in the context of longer-term anchors of valuation based on a behavioral equilibrium exchange rate (BEER) model.

Using econometric techniques, a model is estimated based on a set of macro variables that are thought to influence the fair value of the currency over long periods of time.

For the purposes of valuing the PLN, we chose to model the trade-weighted real effective exchange rate (REER). We believe this makes sense for EM currencies, which have often undergone large shifts in their nominal exchange rate regimes.

Given that the real exchange rate can always shift through relative price affects, even with a currency peg, we believe it makes more sense to model this directly.

### 2. BEER valuation: what macroeconomic fundamentals did we include to model the real exchange rate?

For the explanatory variables, we considered a number of factors included in the relevant literature, but we finally homed in on the following macro variables:

1. the ratio of government debt to GDP (GD)
2. net foreign assets as a percentage of GDP (NFA).
3. the country's share in overall eurozone imports from the rest of the world (EURIMP),
4. the real interest rate differential between the country and its main trading partners (RIR),
5. the degree of openness (OPEN), and
6. investment as a share of GDP (INV).

We examined how well various combinations of the aforementioned macro variables assessed the fair value of the PLN's real effective exchange rate.

Specifically, we wanted the results to show whether the coefficients on the macro variables had the correct sign (according to economic theory), where the explanatory power of the regression was reasonably high and where the currency shows a clear sign of reversion to equilibrium following any divergence (or shock) from fair value. More information on this can be found in the appendix.

Overall, we came up with two feasible model specifications:

M1: GD, NFA, EURIMP, RIR and OPEN, and

M2: GD, NFA, EURIMP and INV.

### 3. What do the models tell us?

In general, all coefficients on the explanatory variables used are statistically significant and are of the correct sign (according to economic theory).

Specifically, we find that government debt (GD), the overall share in exports to the eurozone (EURIMP) and the degree of openness (OPEN) have a negative sign, thus depressing equilibrium valuations.

On the other hand, net foreign assets (NFA) have a positive sign, and serve to raise valuations. The coefficient on RIR is positive and statistically significant, but has an extremely small effect on the PLN's medium term valuation.

**TABLE 1: RESULTS OF REGRESSION TESTING**

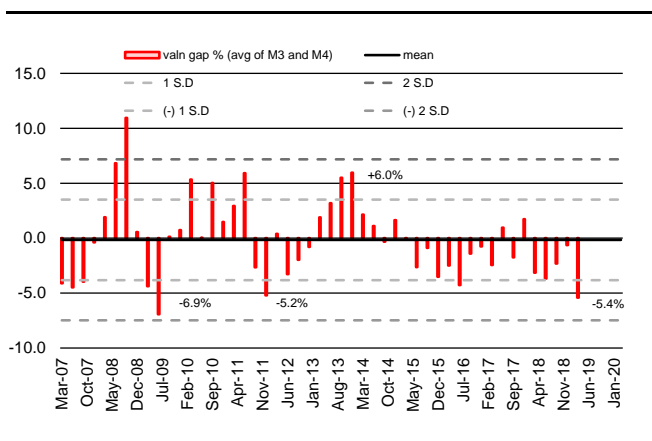
Model specification	M1	M2
C	7.58	4.44
ln(GD)	-0.63	-0.41
ln (NFA)	0.23	0.27
ln (EURIMP)	-0.24	-0.37
RIR	0.00009	
ln(OPEN)	-0.27	
ln (INV)		0.34
March - end valuation % (vs. model)	-4.3	-6.6
<b>Post 2007 valuation extremes (%)</b>		
max	12.0	9.9
min	-6.5	-7.4
<b>Post 2013 valuation extremes (%)</b>		
max	5.9	6.0
min	-4.3	-6.6

Source: UniCredit Research

The models share other desirable properties i.e. errors show no signs of autocorrelation or heteroscedasticity (table 3 in appendix), while any deviations from fair value are observed as correcting with a reasonable lag of about four quarters (see table 4 in the appendix).

Overall, the two econometrically plausible models suggest that the PLN real exchange rate is about 4% to 6% undervalued (the charts for each model can be found in the appendix). While we plan to use both models in our analysis, for a summary measure we simply take an average of the two models. Chart 1 shows the mean valuation gap.

**CHART 1: AVERAGE VALUATION FROM CHOSEN MODELS**



Source: Bloomberg, Haver, UniCredit Research

It suggests that the PLN real effective exchange rate undervalues the currency by about 5.4% – the cheapest it has been since late 2011. At the same time, while the currency appears to have been persistently cheap since 2015, the current degree of undervaluation appears stretched and has historically not persisted.

PLN undervaluation is supported by comparing exchange rates adjusted for unit labor costs to those from CEE. On this metric, the PLN is comparable only to the HUF, all other EU-CEE currencies being overvalued in comparison.

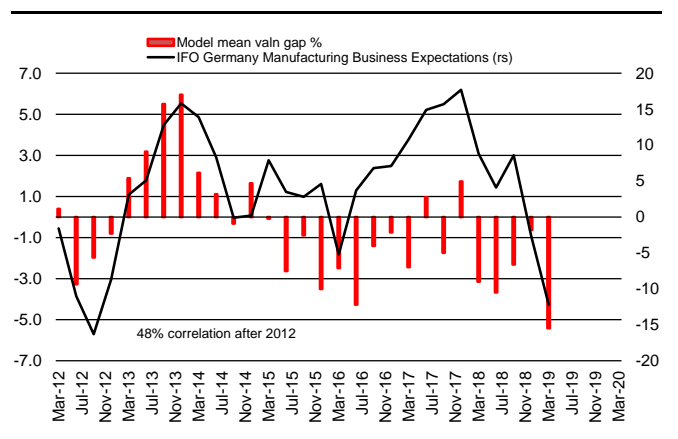
Details on our analyses using other variables can be found in the appendix.

**4. According to the model, the PLN REER has undervalued the currency since 2015. What could contribute to eliminating this?**

In order to attempt to answer this, we looked at a number of indicators such as real rate differentials (between Poland and its trading partners) as well as indicators including the CPB global trade volume growth, global PMI, German Ifo and its sub-components, EM region-wide PMIs and so on. We chose relative interest rates, bearing in mind that the NBP cut policy rates to a low of 1.50% in 2015 and has kept them unchanged since.

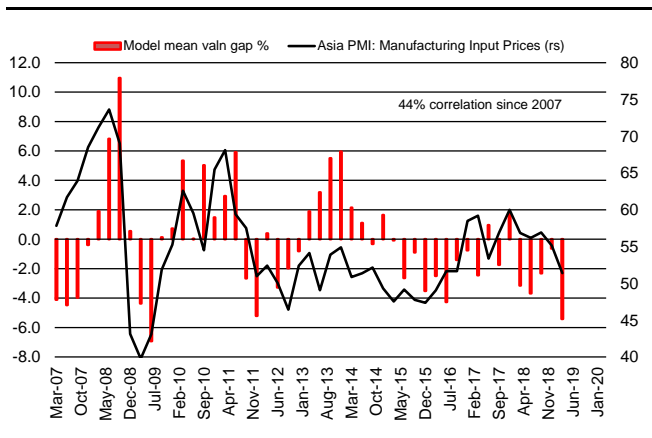
We simply looked at correlations between the mean model valuation gap (from Chart 1) and these different indicators over two samples: from 2007 to 2012 and from 2012 to present. We found that two indicators stood out: the Asian manufacturing PMI input prices sub-index and the Ifo Germany Manufacturing Business Expectations, with the latter having become more relevant in recent years (Charts 2 and Chart 3 respectively).

**CHART 2: VALUATION GAP VS. ASIAN PMI INPUT PRICES**



Source: Bloomberg, Haver, UniCredit Research

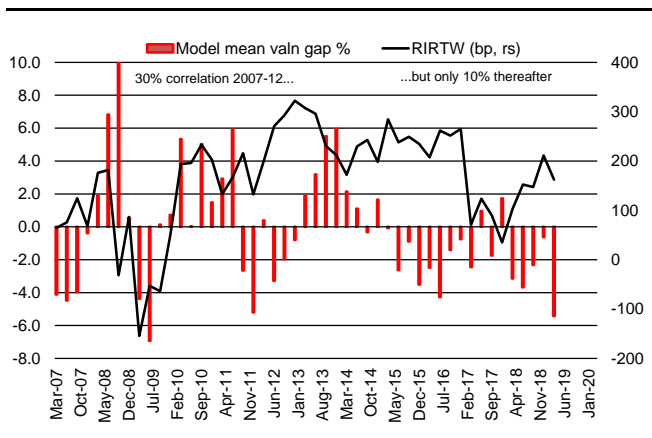
**CHART 3: VALUATION GAP VS. GERMAN MANUFACTURING SENTIMENT**



Source: Bloomberg, Haver, UniCredit Research

On the other hand, we find that the real rate differential to Poland's trading partners displays a decent relationship up until 2012, but is poorer thereafter (Chart 4).

**CHART 4: VALUATION GAP VS. POLAND'S REAL RATE ADVANTAGE:**



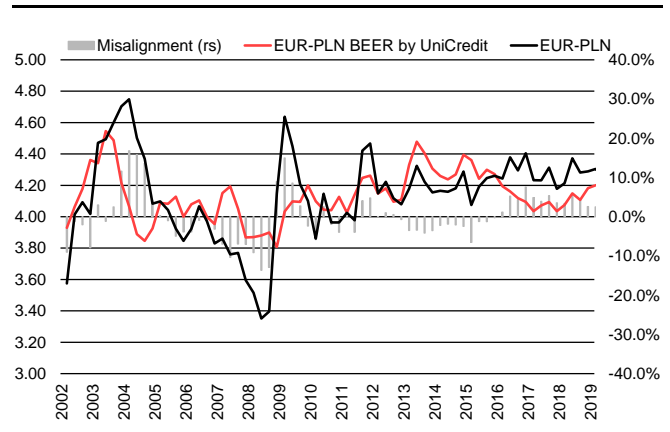
Source: Bloomberg, Haver, UniCredit Research

It is likely that a country-specific risk premium also weighed on the PLN's fair value after mid-2015 when the current government, led by the PiS party, came to power. Concerns over that path of economic policies, including doubts over the independence of institutions, culminated in rating agency S&P cutting credit ratings (from BBB+ to A- but a negative outlook) in January 2016. This likely kept the PLN undervalued in place through 2016 even though broader EM sentiment had improved over that year.

**5. How does the result stack up against other approaches?**

One of the valuation metrics we use in FX strategy is the UniCredit BEER model, which models a number of exchange rates (against the USD) with longer-term macro fundamentals in a panel data framework. It currently suggests that the BEER fair value for EUR-PLN, computed through fair values for EUR-USD and USD-PLN, stands at 4.20 (Chart5. For more information, please see [FX Perspectives – Updating our BEER model: Fundamental support for the US dollar is waning](#)).

**CHART 5: EUR-PLN EXCHANGE RATE VS. BEER ESTIMATE**



Source: Bloomberg, UniCredit Research

Accordingly, the signals sent by our REER macroeconomic fundamentals-based model are well in sync with the UniCredit BEER suite of models. We plan to use both models in our analysis.

**6. Conclusion**

In this note, we considered a longer-term structural macroeconomic model for the PLN real effective exchange rate. We found that variables such as government debt, net foreign assets, investment spending, real interest rate differentials and the share of eurozone exports are important for the valuation.

The models indicate that the PLN is undervalued by about 5% in real exchange rate terms. Historically, this is extreme, suggesting the currency appears exceptionally cheap. This calls for medium-term bullish exposure.

That said, timing is key. According to our model, the PLN has been undervalued since 2015, around the time when global growth slowed down and following the NBP reducing the policy rate to 1.50%.

We examined a number of variables in an attempt to gauge what variables have driven this wedge. Our results suggest that survey indicators such as the German Ifo manufacturing expectations as well as the Asian PMI input price sub-index share a good link. On the other hand, the PLN's real rate advantage has been less of a driver since 2012.

**Bottom-line:** The Polish zloty appears extremely cheap at current levels, warranting bullish exposure. That said, an improvement in global growth sentiment, especially for German manufacturers, would need to be seen for the PLN to appreciate. The PLN's rising real rate advantage (as other trading partners such as China, Czechia, and Russia ease rates) will likely prove insufficient on its own. That said, ongoing EU fund inflows (and the opportunistic conversion of such funds) will likely cap EUR-PLN on the upside.

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## APPENDIX

For the purposes of valuing the PLN, we chose to model the trade-weighted real effective exchange rate (REER) using a reduced-form equilibrium exchange-rate approach.

### 1) Variables used and data construction

For the dependent variable, we used the real effective exchange rate for Poland as calculated by the Bank of International Settlements (BIS).

For the explanatory variables, we considered the following:

1. the ratio of government debt to GDP (GD), 2. net foreign assets as a percentage of GDP (NFA), 3. the country's share in overall eurozone imports from the rest of the world (EURIMP), 4. the real interest rate differential for the country (RIR), 5. the degree of openness (OPEN), and 6. investment as a share of GDP (INV).

Table 2 shows the main countries and the weighting used in our analysis.

**TABLE 2: WEIGHTING USED TO COMPUTE EXPLANATORY VARIABLES FOR POLAND'S TRADING PARTNERS**

Country	Weight
EUR	73
CZK	8
CNY	7
GBP	6
RUB	6
<b>TOTAL</b>	<b>100</b>

Source: UniCredit Research

**Government debt (GD):** We used quarterly government debt/GDP figures (EUQDGPL Index) available from Bloomberg.

**Net foreign assets (NFA):** We used the quarterly international investment position (IIP) data from Haver, scaling gross foreign assets (4Q sum) as a proportion of the rolling four-quarter sum of GDP.

**Country share in total eurozone imports (EURIMP):** We used IMF DOT statistics. Specifically we divided the eurozone's imports from Poland by the eurozone's total imports. The relevant Bloomberg tickers are 995D1964 Index and 995D1001 Index, respectively.

**Real interest rate differential (RIR):** For Poland, we subtracted inflation (POCPIYOY Index) from the 3M interbank (WIBOR) rate. For the eurozone, we deducted inflation (ECCPDEYY Index) from the 3M interbank (EURIBOR) rate. The variable was a difference of the resultant two series multiplied by 100 so as to express the value in basis points. As an alternative, we also used the real interest rate differential for Poland against its main trading partners (RIRTW) using weights from table 2.

**Degree of openness (OPEN):** We calculated the sum of merchandise-goods exports and imports as a proportion of GDP.

**Investment as a share of GDP (INV):** For investment, we use a four-quarter sum of gross fixed capital formation (FCFNPLI Index) divided by a four-quarter sum of GDP (EUGNPL Index).

For our regression, we converted all variables into log-form except for those that had negative values in the series. In our example, this includes the RIR.

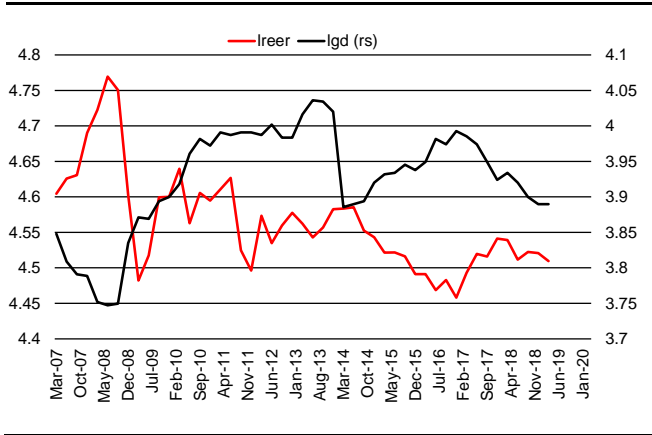
Looking at the behavior of the real effective exchange rate with each of the explanatory variables, it appears that the explanatory variable that has really been dictating the moves has been the trend in government debt (Chart 6) and here a further decline should serve to raise the fair value of the currency.

However, the recent decline in foreign assets has served to work in the other direction (Chart 7). Meanwhile, the increasing share in eurozone trade has required a lower equilibrium value also (chart 8), while the modest reduction in real interest rate spread (vs. trading partners) has lowered valuation after 2014 (chart 9).

We did try to include other explanatory variables such as productivity relative to trading partners (PROD) as well as relative terms of trade (TOT). These explanatory variables are prominent in the academic literature on fair value models and we have been able to utilize them in our REER models for the HUF, CZK and RUB. However, in the case of the PLN, we find that these variables have (intuitively) the wrong sign, given the diverging trends between these variables and the real exchange rate (Chart 10 and Chart 11).

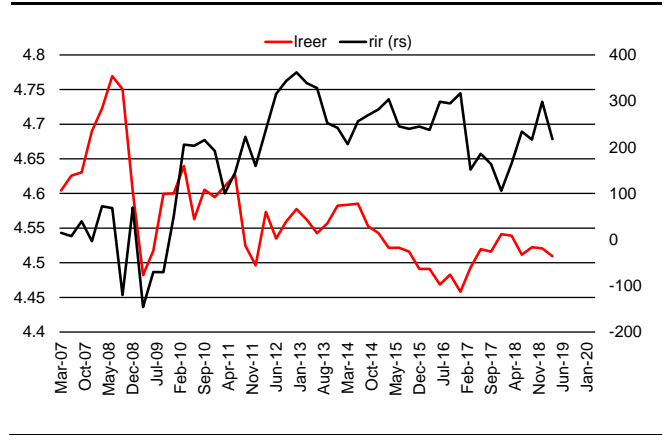
In particular, rising terms of trade and productivity is associated with a lower PLN equilibrium value, the exact opposite to what economic theory would dictate. We found this result to hold even using different sample periods. Hence, we chose not to include these variables in our analysis.

**CHART 6: VALUATION IMPROVING RECENTLY ON REDUCTION OF GOVERNMENT DEBT...**



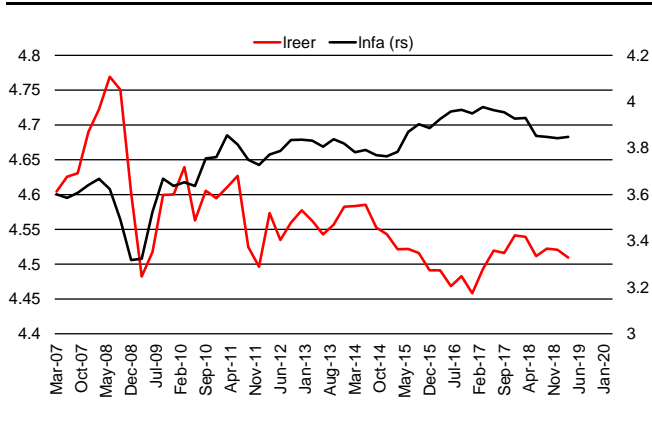
Source: Bloomberg, Haver, UniCredit Research

**CHART 9: THE PLN COULD BENEFIT FROM A RISING REAL RATE DIFFERENTIAL GOING FORWARD**



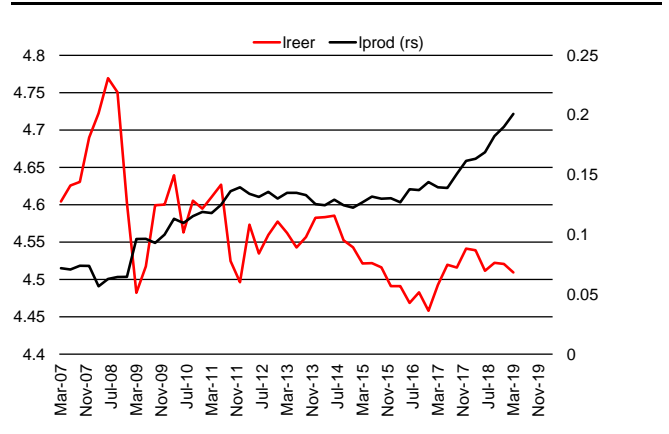
Source: Bloomberg, Haver, UniCredit Research

**CHART 7: ...BUT WEIGHED DOWN RECENTLY BY THE REDUCTION IN NET FOREIGN ASSETS**



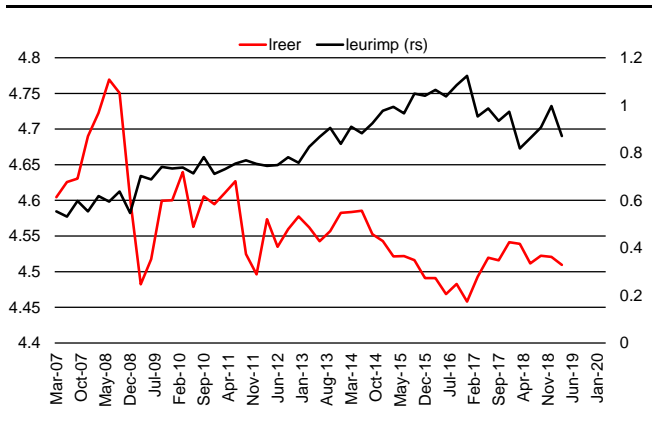
Source: Bloomberg, Haver, UniCredit Research

**CHART 10: PLN SHOWS NO RELATIONSHIP WITH POLAND'S MUCH IMPROVED PRODUCTIVITY GROWTH...**



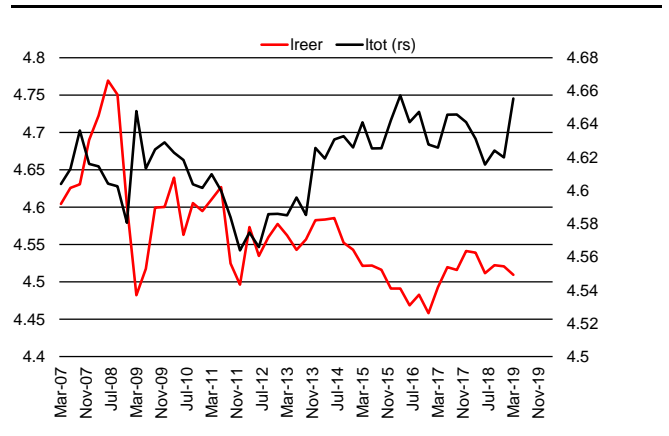
Source: Bloomberg, Haver, UniCredit Research

**CHART 8: THE RISING SHARE IN GLOBAL EXPORTS TO THE EUROZONE HAS REQUIRED A LOWER EQUILIBRIUM PLN VALUE**



Source: Bloomberg, Haver, UniCredit Research

**CHART 11: ...AND TERMS OF TRADE DO NOT APPEAR TO SUPPORT THE PLN AS ECONOMIC THEORY SUGGESTS**



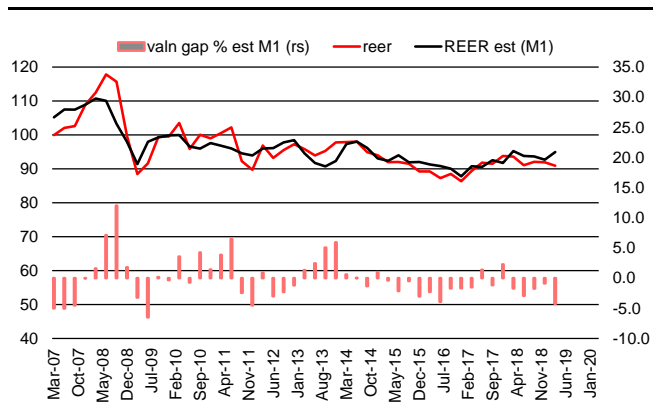
Source: Bloomberg, Haver, UniCredit Research

## 2) Diagnostic testing

In conducting our analysis, we found that most of the variables were non-stationary but became stationary upon differencing i.e. they are I(1) while others are I(0). Overall, the results are conducive to applying a co-integration analysis.

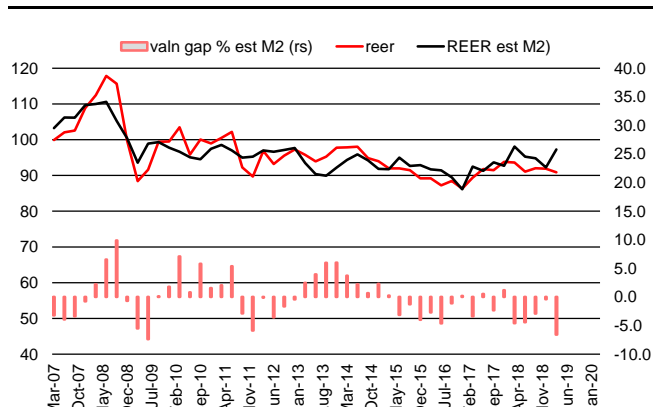
For the model selection, we looked at various combinations of variables and filtered them on the basis of the following conditions holding (in order of preference): **1.** the residuals of the regression are stationary (as per the methodology used by Engle and Granger<sup>1</sup>), **2.** explanatory variables are of the correct sign and statistically significant (at 10% level) and **3.** the explanatory power of the regression is reasonably high.

**CHART 12: MODEL M1: GD, NFA, EURIMP, RIR AND OPEN**



Source: Bloomberg, Haver, UniCredit Research

**CHART 13: MODEL M2: GD, NFA, EURIMP AND INV**



Source: Bloomberg, Haver, UniCredit Research

**TABLE 3: EXPLANATORY POWER AND DIAGNOSTICS**

Model specification	M1	M2
adj. R2	0.68	0.65
S.E. of regression	0.04	0.04
<b>Residuals tests (p-values)</b>		
Ho: residuals are I(1)	0.00	0.00
Ho: autocorrelation LM(6)	0.01	0.02
Ho: homoscedasticity	0.01	0.06
Ho: normality	0.12	0.68

Source: UniCredit Research

**TABLE 4: CONVERGENCE BACK TO FAIR VALUE (VECM)**

Model specification	M1	M2
error correction term		
coefficient	-0.27	-0.23
p-value	0.08	0.09
VECM lag length	3	1
Interpretation		
Valuation gap corrects? (Y/N)	Y	Y
How fast does it correct? (in quarters)	4	4.4

Source: UniCredit Research

<sup>1</sup> see "Co-integration and error correction: representation, estimation and testing", *Econometrica*, 1987.



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