HUF: No, it´s not undervalued

by Kiran Kowshik, EM FX Strategist (UniCredit Bank, London)

- In this note, we consider a macro fundamentals-based equilibrium exchange rate model for the trade-weighted real effective exchange rate (REER) of the Hungarian forint.
- We find that variables such as productivity (compared to the eurozone), net foreign direct investment and government debt (both expressed as a percentage of GDP), terms of trade (TOT) as well as real interest rate differentials (RIR) help explain past movements in the HUF REER.
- Overall, we devise four different model specifications that suggest the HUF real exchange rate is between 2% below and 1% above its equilibrium rate.
- This contrasts with some prevailing views that the forint is somewhat undervalued. Declining productivity growth (compared to its trading partners) has been an important driver weighing on the currency's equilibrium value.
- While the models signal that the currency is close to equilibrium, we find that past deviations from equilibrium are reasonably well correlated to Hungary's interest rate differential against its main trading partners and – more recently – indicators of global growth sentiment.
- **Conclusion:** We find that the HUF is more or less fairly valued, in contrast to the views of some market participants that the currency is undervalued. Over the longer term, an improvement in productivity could see the fair value improve over time. On a multi-quarter basis, we believe the stance of NBH monetary policy and global growth will be more important for the value of the currency.

1. Linking the Hungarian forint to long-term macroeconomic variables

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

Using cointegration, 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 HUF, 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. We considered 4Q00 to 4Q18 as the sample period and used quarterly data points.

2. Macroeconomic fundamentals included in modeling the real exchange rate

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

1. The ratio of CPI to PPI (CPI/PPI); the relative price of non-tradable goods to tradable goods as a proxy for the Balassa-Samuelsson effect (BS)
2. Hungary's productivity in relation to its six largest trading partners (PROD); see Table 1 in the appendix.
3. The government budget balance as a percentage of GDP (BB)
4. The country's degree of openness (OPEN) and
5. Net foreign assets as a percentage of GDP (NFA)

Using various combinations of the aforementioned macro variables, we examined their ability to assess the fair value of the HUF's real effective exchange rate. We wanted the model in question to pass three tests: coefficients to be of the correct sign (according to economic theory), a reasonably high explanatory power and a clear sign that the currency shows 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 four model specifications:

M1, which includes CPI/PPI and PROD;

M2, which includes CPI/PPI, PROD and BB;

M3, which includes CPI/PPI, PROD and OPEN; and

M4, which includes CPI/PPI, PROD and NFA.

Here is what we found:

1. The coefficient of the Balassa-Samuelsson term (BS) is positive in all four specifications. This suggests the Balassa-Samuelson effect was at play in Hungary for the period considered (4Q00-4Q18). According to this theory, if productivity in the tradable goods sector grows faster than that of the non-tradable goods sector, then the resultant higher wage pressure in the tradable sector should exert upward pressure on wages in the non-tradable goods sector. The real exchange rate then needs to appreciate to offset the resultant price pressure on the non-tradable goods sector.

TABLE 1: RESULTS OF REGRESSION TESTING

Model specification	M1	M2	M3	M4
C	4.6	4.6	3.4	4.2
ln(CPI/PPI)	1.3	1.3	0.7	1.0
ln(PROD)	0.7	0.9	1.0	0.9
BB		0.01		
ln(OPEN)			0.2	
ln(NFA)				0.09
March - end valuation %	0.0	0.3	-2.3	0.1
(vs. model)				
Post 2000 valuation extremes %)				
max	9.5	9.7	7.5	8.5
min	-16.8	-16.7	-10.3	-11.1
Post 2009 valuation extremes (%)				
max	9.5	9.3	7.5	7.6
min	-7.0	-8.9	-10.3	-10.9

Source: UniCredit Research

2. A rise in productivity relative to trading partners results in an appreciation of the currency. A rise in the government budget balance is seen as having a modestly positive influence on valuation.

3. Net foreign assets enters with a positive coefficient. This is in line with traditional real exchange rate models that predict that creditor countries with high NFA can "afford" a higher real exchange rate (and the smaller trade surpluses associated with it) while remaining solvent.

4. OPEN enters with a positive coefficient. This is counter to conventional economic wisdom, which suggests a more open economy usually requires a weaker exchange rate given its higher dependence on global trade for growth[1]. That said, the positive coefficient can be explained by the fact that Hungary's openness was built on increasing integration with the eurozone economy and investment that increased competitiveness (unlike in other EM countries).

5. A linear combination of CPI/PPI and PROD does a decent job of explaining broad movements in the REER (model M1 in Table 1 below).

6. Adding additional variables (BB, OPEN and NFA) results in modest increases in the explanatory power (models M2, M3 and M4 in Table 1, respectively.)

7. All four models pass the standard diagnostic tests on residuals (such as those for autocorrelation and heteroscedasticity). Also, in all four models, errors tend to show a reasonably quick convergence to equilibrium of two to seven quarters (Table 3 and Table 4 in the appendix).

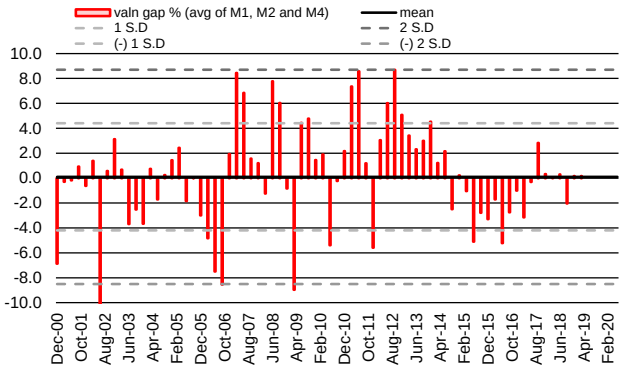
[1] Our analysis of the CZK found the degree of openness to enter with a negative sign (see FX Perspectives - CZK: Valuation not a barrier to further gradual depreciation)

3. Model results

Overall, we arrived at four econometrically plausible models that suggest the HUF real exchange rate is between 2% below and 1% above its equilibrium rate. Accordingly, the models signal the currency is close to equilibrium. The charts for each model can be found in the appendix.

We plan to use models M1, M2 and M4 for our future analysis, given that all explanatory variables enter with the correct sign. However, we choose to exclude model M3 given some uncertainty over the OPEN coefficient.

CHART 1: AVERAGE VALUATION FROM CHOSEN MODELS



Source: Bloomberg, Haver, UniCredit Research

For the purposes of inference, we take mean of the remaining three models (M1, M2 and M4). Chart 1 presents the mean valuation gap from these models.

It suggests that the HUF real effective exchange rate has been in equilibrium for the past 18 months, after having been undervalued in 2015. The currency was substantially overvalued throughout 2011-13, but the valuation excess corrected thereafter.

This contrasts with some prevailing views that the forint is undervalued. Since 2009, declining productivity growth (compared to its trading partners) has been an important driver weighing on the currency's equilibrium value (see Charts 5 and 6 in the appendix).

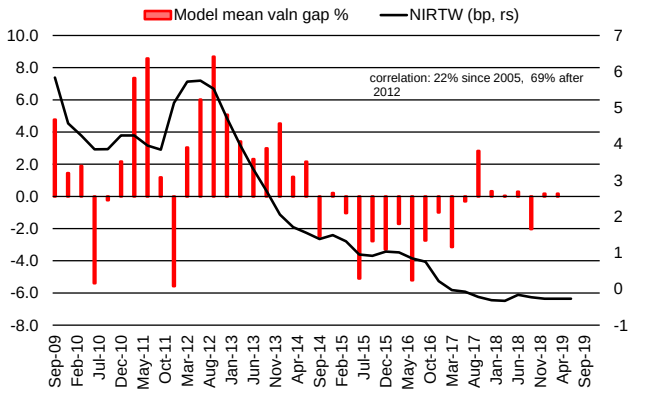
4. Other variables that may help explain deviations of the HUF from the model

We looked at a number of indicators such as nominal and real rate differentials (between Hungary and its main trading partners) as well as other indicators such as CPB global trade volume growth, global PMI, German Ifo and its sub-components, EM region-wide PMIs.

We simply looked at correlations between the mean model valuation gap (from Chart 1) and these different indicators over two samples: from 2005 to 2012 and from 2012 to present.

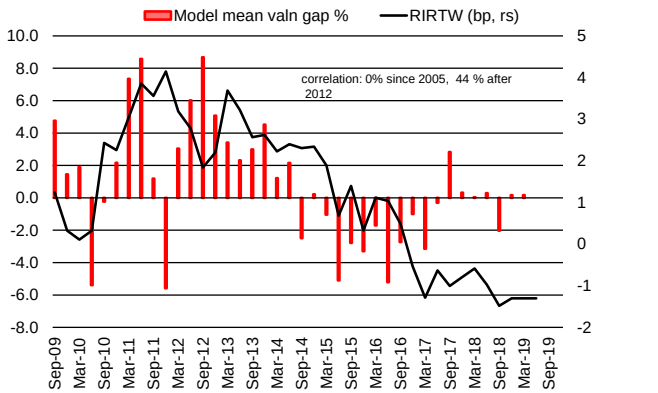
We found that two indicators, nominal and real interest rate differentials, stood out in their level of correlation with the valuation gap, particularly after 2012 (Charts 2 and 3 respectively).

CHART 2: VALUATION GAP VS. NOMINAL INTEREST RATE DIFFERENTIAL IS STRONG AFTER 2012



Source: Bloomberg, Haver, UniCredit Research

CHART 3: VALUATION GAP VS. REAL INTEREST RATE DIFFERENTIAL

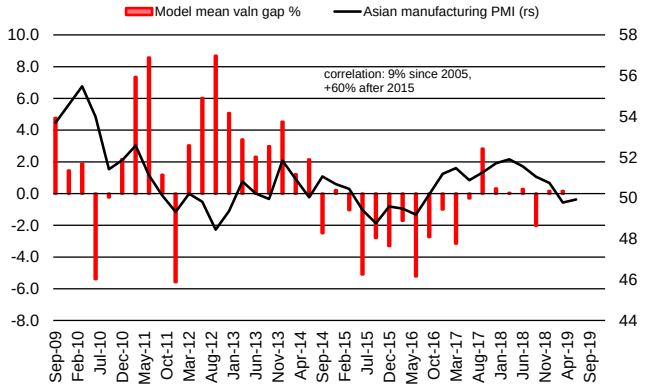


Source: Bloomberg, Haver, UniCredit Research

This suggests that the NBH's ongoing policies to loosen monetary conditions likely contributed to the HUF becoming undervalued after 2015.

That said, the sensitivity of the exchange rate valuation to these indicators has declined more recently, and indicators of global growth have taken on added importance. In particular, we found that Asian manufacturing PMI shared a high correlation with the valuation gap after 2015 (Chart 4).

CHART 4: VALUATION GAP VS. ASIAN MANUFACTURING PMI – A CLOSER LINK AFTER 2015



Source: Bloomberg, Haver, UniCredit Research

5. Conclusion

In this note, we considered a macro fundamentals-based equilibrium exchange rate model for the trade-weighted real effective exchange rate (REER) of the Hungarian forint.

We found that variables such as productivity (compared to the eurozone), net foreign direct investment and government debt (both expressed as a percentage of GDP), terms of trade (TOT) as well as real interest rate differentials (RIR) help explain past movements in the HUF REER.

Overall, we developed with four different model specifications that suggest the HUF real exchange rate is between 2% below and 1% above its equilibrium rate. This contrasts with some prevailing views that the forint is undervalued. Declining productivity growth (compared to its trading partners) has been an important driver weighing on the currency's equilibrium value.

While the models signal the currency is close to equilibrium, we find that past deviations from equilibrium are reasonably well correlated to relative rate differentials (especially after 2012), and indicators of global growth sentiment (after 2015).

We find the HUF to be more or less fairly valued, in contrast to the views of some market participants that consider the currency to be undervalued. Over the longer term, an improvement in productivity could see the fair value improve over time. On a multi-quarter basis, we believe the stance of NBH monetary policy and trends in global growth sentiment will be more important for the currency.

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APPENDIX

For the purposes of valuing the HUF, we chose to model the trade-weighted real effective exchange rate (REER) by 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 Hungary as calculated by the Bank of International Settlements (BIS). For the explanatory variables, we considered the following: **1.** the relative price of non-tradable goods to tradable goods to account for the Balassa-Samuelsson effect; we used ratio of CPI to PPI (CPI/PPI), **2.** relative productivity of Hungary vs. its top six trading partners (PROD), **3.** government debt/GDP (GD), **4.** degree of openness (OPEN) and **5.** net foreign assets as a percentage of GDP (NFA).

When computing the productivity differential term, we short-listed the trading partner countries that have at least a 5% weighting in the BIS's HUF REER. Thereafter, we re-scaled the weights so that they added up to 1. Table 2 shows the main countries and the weighting used in our analysis.

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

Country	Weight
Eurozone	68
Slovakia	7
China	7
Poland	7
Czech Republic	6
Romania	6
TOTAL	**100**

Source: UniCredit Research

Inflation: We used the CPI and PPI data for Hungary as released by the IMF. The relevant Bloomberg tickers are 9446639 Index and 9446629 Index respectively.

Relative productivity (PROD): We used quarterly data from Haver on output per employed person (2010=100). Only annual data are available for China, so we linearly interpolated to obtain quarterly values. We formed a weighted average of trading-partner productivity using the TW weighting. We then calculated the ratio of Hungary's productivity to trading-partner productivity.

Terms of Trade (TOT): We used the terms of trade data indices (SA, 2010=100). Given the limited data on Russia's terms of trade (available only after 2003 and with a 3-4 month lag), we used the Citi terms-of-trade index (which has a longer history) to estimate values from 1998-2006. This seemed to be acceptable, considering the strong correlation between the two indices (66% on data since 2005).

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.

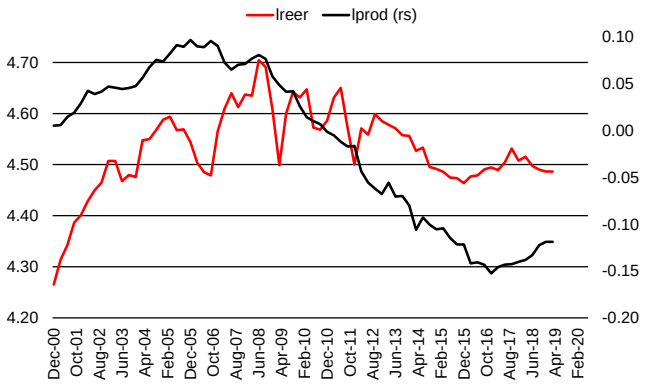
Degree of openness (OPEN): We calculated the sum of merchandise-goods exports and imports as a proportion of GDP.

Budget balance (BB) and government debt (GD): We used quarterly government budget balance (EHBBHU Index) and government debt-to-GDP figures (EUQDGHU Index) available on Bloomberg.

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 as though the explanatory variable that has really been reducing the equilibrium value is Hungary's deteriorating trend in productivity growth vis-à-vis its main trading partners (Chart 2).

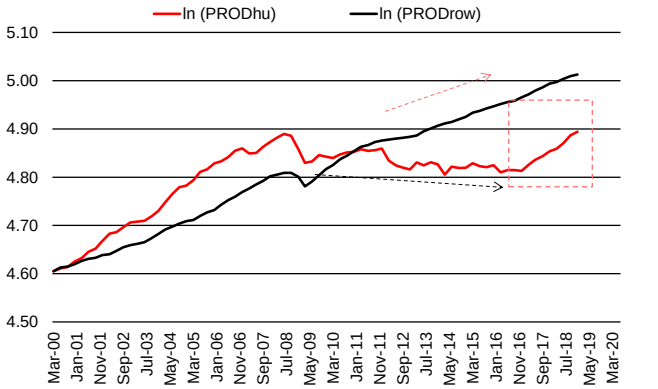
CHART 5: VALUATION LOWERED BY PRODUCTIVITY GROWTH…



Source: Bloomberg, Haver, UniCredit Research

This, in turn, has been driven by a continued acceleration of productivity growth in the main trading partners compared with a stagnation for Hungary, particularly after 2009 (Chart 3).

CHART 6: …WHERE HUNGARY HAS LAGGED BEHIND ITS MAIN TRADING PARTNERS

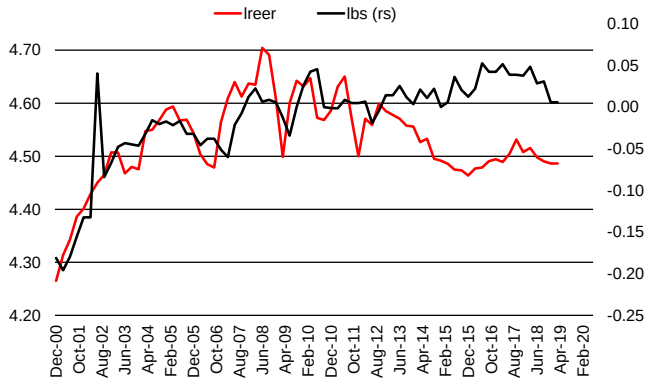


Source: Bloomberg, Haver, UniCredit Research

However, since 2018 productivity growth appears to be recovering. This is something that would need to be monitored and could result in improving the equilibrium value of the forint going forward.

On the other hand, the variable which appears to have provided an offsetting support to the forint's equilibrium value is the term capturing the Balassa-Samuelsson effect.

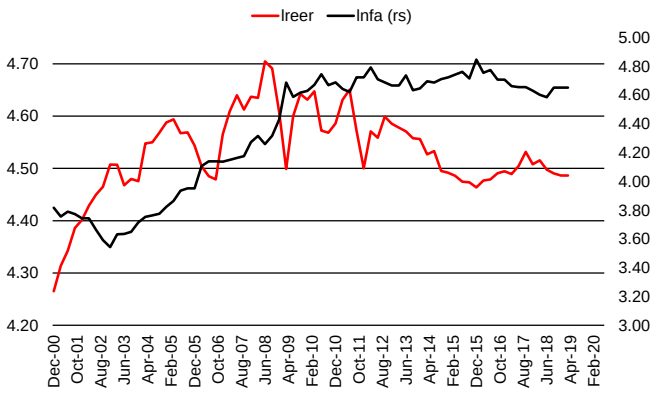
CHART 7: …BUT HELD UP BY THE BALASSA-SAMUELSON EFFECT…



Source: Bloomberg, Haver, UniCredit Research

The other explanatory variable that has improved the equilibrium value of the forint has been the improving external balance which has allowed Hungary to accumulate foreign assets after 2009.

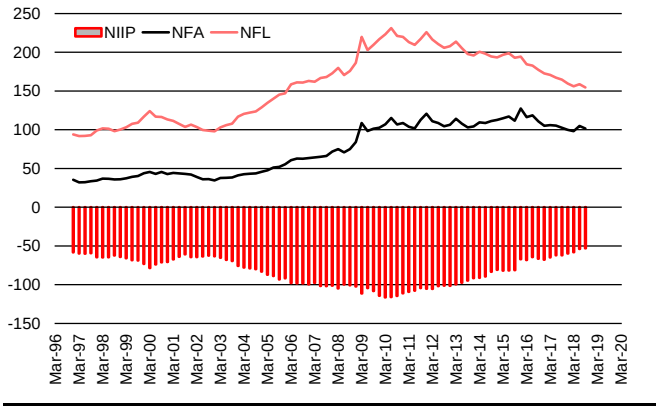
CHART 8: …AS WELL AS THE ACCUMULATION OF ASSETS ABROAD AFTER THE C/A TREND IMPROVED



Source: Bloomberg, Haver, UniCredit Research

That said, it is worth underlining that Hungary remains a net debtor, with its net foreign liabilities far higher than its net foreign assets, thus resulting in a large net international investment deficit (Chart 6). Since the 2008 global financial crisis, the external imbalance has improved steadily.

CHART 9: DESPITE THE IMPROVED FOREIGN ASSET POSITION, THE NET INTERNATIONAL INVESTMENT DEFICIT REMAINS LARGE



Source: Bloomberg, Haver, UniCredit Research

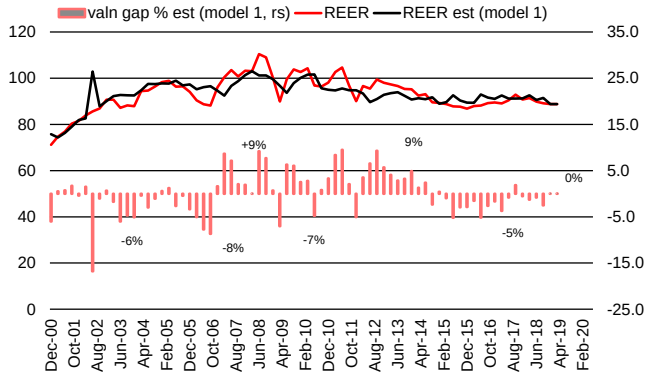
We did try alternative specifications by replacing NFA with the net international investment position as well as the current account balance (both expressed as a proportion of GDP). However, the econometric results were quite poor: both specifications resulted in several co-integrating vectors and the error correction period was north of 25 quarters, indicating a rather unstable relationship.

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.

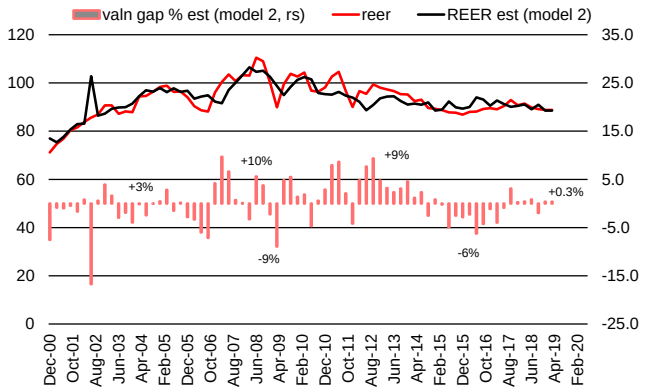
For the model selection, we looked at various combinations of variables and filtered them on the basis of the following conditions holding (in order of preference): **1.** the residuals of the regression are stationary (as per the methodology used by Engle and Granger[2]), **2.** explanatory variables are of the correct sign and statistically significant (at a 5% or 10% level denoted by ** and * respectively) and **3.** the explanatory power of the regression was reasonably high.

CHART 10: MODEL M1: CPI/PPI AND PROD



Source: Bloomberg, Haver, UniCredit Research

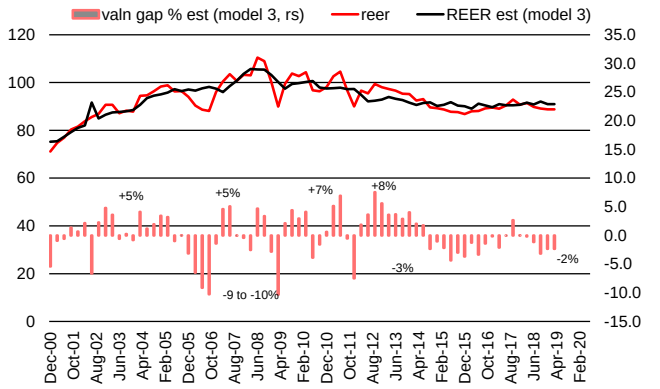
CHART 11: MODEL M2: CPI/PPI, PROD AND BB



Source: Bloomberg, Haver, UniCredit Research

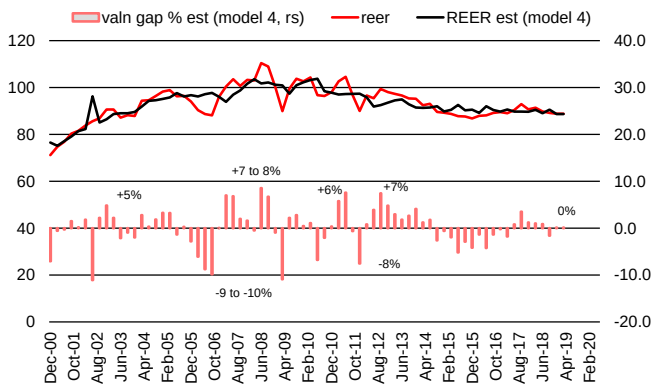
[2] see "Co-integration and error correction: representation, estimation and testing", *Econometrica*, 1987.

CHART 12: MODEL M3: CPI/PPI, PROD AND OPEN



Source: Bloomberg, Haver, UniCredit Research

CHART 13: MODEL M4: CPI/PPI, PROD AND NFA



Source: Bloomberg, Haver, UniCredit Research

TABLE 3: EXPLANATORY POWER AND DIAGNOSTICS

Model specification	M1	M2	M3	M4
adj. R2	0.64	0.67	0.76	0.71
S.E. of regression	0.05	0.05	0.04	0.04
Residuals tests (p-values)				
Ho: residuals are I(1)	0.00	0.00	0.00	0.00
Ho: autocorrelation LM(6)	0.00	0.01	0.00	0.02
Ho: homoscedasticity	0.05	0.12	0.07	0.05
Ho: normality	0.00	0.00	0.03	0.02

Source: UniCredit Research

TABLE 4: CONVERGENCE BACK TO FAIR VALUE (VECM)

Model specification	M1	M2	M3	M4
error correction term				
coefficient	-0.28	-0.14	-0.33	-0.42
p-value	0.10	0.09	0.11	0.11
VECM lag length	1.00	0.00	1.00	1.00
Interpretation				
Valuation gap corrects? (Y/N)	Y	Y	Y	Y
How fast does it correct? (quarters)	3.6	7.0	3.0	2.4

Source: UniCredit Research

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