German Advisory Group

Institute for Economic Research and Policy Consulting

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Methodological note to presentation "Equilibrium exchange rate in Ukraine"

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Methodological note to presentation "Equilibrium exchange rate in Ukraine"

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1. Introduction

The concept of equilibrium exchange rates (EERs) plays a central role both in international economics and practical policy decisions. For fixed or managed exchange rate regimes, the importance of the EER concept is obvious, since it is needed to guide the determination of concrete numerical targets for the currency value. Notwithstanding, the EER notion is relevant for floating regimes, too. Are sharp movements in the external value of a currency an expression of changes in the respective underlying factors, or do they represent a misalignment? Such an analysis concerns the evaluation of the current level of the market exchange rate in regard of the perspectives for current account adjustments, imported inflation pressures or expected capital flows. Evidently, these topics are among the most-discussed points in open macroeconomics. Furthermore, EERs provide crucial information for the conduct of monetary policy.

This discussion clarifies the considerable significance of empirical EER calculations for policy makers. Such calculations have been carried out by Weber, Kirchner and Giucci (2009), who employed several methods to quantify the EER of the Ukrainian hryvnia. However, due to its presentation format, this work did not include much reference to theory and methodological aspects of the estimations performed. This technical note fills this gap by concentrating on the methods behind our estimations. Having explained this in more detail, in the future other applied researchers are enabled to check the validity, perform similar calculations and update the results.

The structure of the technical note is as follows: The following sections introduce and describe the different EER estimation procedures. The three approaches can be roughly classified by their time horizon: While the Purchasing-Power-Parity (PPP) concentrates on providing a long-term reference value, the External-Sustainability (ES) approach operates in a medium-term framework. In between, the Balance-of-Payments (BoP) methodology offers a medium- to long-term perspective. Section 5 provides some discussion and concludes.

2. Purchasing-Power-Parity (PPP)

The PPP is based on the "law of one price", which basically states that one US-dollar should buy the same amount of goods in all countries. This principle is based on a no-arbitrage condition: In case goods have (after currency conversion with the prevailing exchange rate) different prices in different countries, arbitrage opportunities can be exploited through foreign trade. This process will continue until the exchange rate is rebalanced in the sense that it corresponds to the ratio of nominal prices measured in the respective national currencies. Extending the "law of one price" to the case of a basket of goods, PPP can be formally expressed as

$$P = \overline{S} \cdot P^{*}, \tag{1}$$

where P is the domestic price level, P^{*} the foreign price level and $\overline{S}$ the EER in price notation (home currency units per foreign currency unit). Price levels can be taken from the International Comparison Program (ICP) of the World Bank and then updated to the current year using GDP deflators. The right hand side of equation (1) represents the price of a basket of goods traded in the foreign country after currency conversion at the EER $\overline{S}$. Logically, the latter results as

(2) $$\bar{S} = \frac{P}{P^*}.$$

A few words of caution are in order here: PPP is built on the far-reaching assumption of frictionless goods arbitrage and perfect substitutability of goods. Evidently, this can be questioned for numerous reasons, above all tariffs, transport costs, non-tariff barriers and duties as well as product differentiation across countries. These arguments can lead to deviations from PPP and should be considered when choosing a measure for the aggregate price level.

A second noteworthy point concerns the state of economic development in the countries under consideration: While it is common to assume that the prices of tradable goods are determined in the world market, the prices of non-tradable goods are not influenced by global market pressures to the same degree. Rather, the local demand and supply situation determines these prices. Therefore, they can be substantially lower in low-income countries. Without carefully correcting this effect, PPP estimates of EERs among countries with different income level usually yield unrealistic values.

If productivity grows predominantly in the tradable sectors (which are exposed to foreign competition), wages in these sectors are bound to increase in line with productivity. Furthermore, wages are likely to equalise over time across sectors through labour union power or mobility of the labour force. It follows that non-tradable prices will increase, thereby driving up the average price index (which consists of both tradable and non-tradable components) and appreciating the real exchange rate (RER), which can be defined as

(3) $$RER = S\frac{P^*}{P}.$$

This mechanism of real appreciation due to different sectoral productivity growth is known as the Balassa-Samuelson effect (Balassa 1964; Samuelson, 1964).

A robust method to correct PPP EER estimates for the effect of income differences can be found in Rogoff (1996). In detail, the regression

(4) $$rer_{it} = c_0 + c_1 y_{it} + u_{it}$$

is estimated for a panel of countries. Therein, lower-case letters denote natural logarithms and Y_{it} stands for real per-capita income of country i relative to the base country. Income levels can again be taken from the ICP and updated by use of inflation-adjusted GDP growth rates. Since c_1 represents an elasticity, the PPP estimates for the EER can be adjusted by the factor $(1 + c_1(1/Y_{it} - 1))$. Further results are given in Frankel (2005) and Cheung et al. (2007). Since the latter authors provide econometric refinements and separate estimations for developed and developing countries, in Weber et al. (2009), we used their elasticity estimate 0.276[1].

[1] See Cheung et al. (2007), p. 20.

In general, one should be aware that deviations from PPP usually have a long half-life, thus meaning a very slow adjustment process[2]. Reasons can be found, for instance, in all types of frictions in international trade. Logically, (adjusted) PPP estimates of the EER should be understood as reference values for the long term. Notwithstanding, the target still defines the direction of appropriate foreign exchange adjustments, anchoring expectations and policy strategies. A major advantage of the PPP approach can be seen in the fact that its application is independent from current market exchange rates, which can be quite volatile.

3. External-Sustainability Approach (ES)

While the PPP approach is based on a no-arbitrage condition for trade that should eventually hold in the long run, the ES approach focuses on the counterpart of trade relations, i.e. on capital flows, and here specifically on the external asset-liability position of a country. Even if in the short term, considerable disequilibria in the capital account are not uncommon, in the medium term a country's stock of external liabilities must settle down to a sustainable level. In particular, the current account balance must be compatible with stabilising the net foreign asset (NFA) position of an economy[3].

The following steps need to be followed to arrive at an EER estimate using the ES concept:

- First, a benchmark value for the NFA position must be chosen. For instance, this might be zero or the current value.

- Second, it must be figured out which current account balance would stabilise the actual NFA position at the benchmark chosen in the medium run.

- Third, the current account balance expected to prevail over the medium run must be calculated.

- Fourth, an estimate for the necessary real exchange rate adjustment must be found, which would bring the current account to the NFA-stabilising level.

The second step requires an equation that relates the NFA position to the current account. This equation is given by expressing the accumulation of NFA as the sum of net financial flows and changes in the valuation of outstanding assets:

(5) $$\Delta NFA_t = CA_t + CG_t + R_t .$$

Here, CA_t denotes the current account, CG_t capital gains, and R_t the residual, e.g. transfers or errors. We concentrate in the following on the link between NFA and the current account, and abstract from the remaining terms. Writing ratios to GDP

[2] Figure A.1 in the Annex gives a recent overview of the relationship between market exchange rates and their corresponding PPP-values for major currency pairs.

[3] External sustainability requires that the intertemporal budget constraint of the economy is satisfied, i.e. the present value of future trade surpluses is sufficient to pay back the existing amount of outstanding external liabilities. See IMF (2006) for more on this.

in lower-case letters leads to the current account $\overline{ca}$ that stabilises the NFA position at $\overline{nfa}$:

$$(6) \qquad \overline{ca} = \frac{g + \pi}{(1+g)(1+\pi)} \overline{nfa} .$$

where g denotes the growth rate of real GDP and π is the inflation rate. Furthermore, the respective trade balance $\overline{tb}$ (goods, services, transfers) that is consistent with (6) is given by

$$(7) \qquad \overline{tb} = \frac{g - r}{1+g} \overline{nfa} ,$$

where r is the real rate of return of external assets and liabilities, which are assumed to be equal.

The third step can be assessed by taking the actual as the expected current account or by adopting some smoothing filter like a weighted arithmetic mean of the last observations. Alternatively, adjustments can be made to exclude the effect of the current state of the business cycle or other potential biases. In Weber et al. (2009), we proceeded without such an adjustment, since a preliminary examination does not reveal typical business cycle patterns in Ukrainian GDP. However, seasonal effects were eliminated by the Census-X12 procedure.

Concerning the fourth step, the question is by how much the exchange rate must change in order to achieve a given change in the current account. Evidently, the answer requires an estimate of the current account elasticity with respect to the exchange rate. In open macroeconomics, such a relationship is typically addressed within a J-Curve framework.

We start with import and export functions, which typically have the real exchange rate and the income of the recipient country as their arguments. It follows that the current account, the difference between exports and imports, depends on domestic and foreign income and the real exchange rate. In Weber et al. (2009), we measure foreign income by the sum of the real GDPs of Ukraine's major trading partners, i.e. the United States, the European Union and Russia. Furthermore, we use the real effective exchange rate (REER), Ukrainian GDP and the ratio of exports to imports, all expressed in logs. Since all these variables are found to be non-stationary, the validity of the long-run current account relationship depends on the presence of cointegration. Using a Johansen (1995) Trace test, we find indeed one cointegrating relation on the 1% significance level among the four variables.

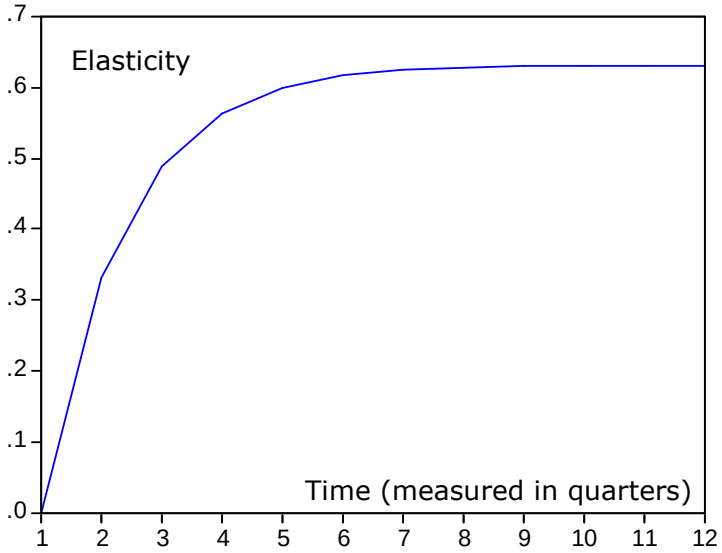
In order to determine the current account – REER elasticity, we set up a cointegrated vector autoregressive model (VAR) in vector error correction (VEC) form:

$$(8) \qquad \Delta y_t = \alpha\beta y_{t-1} + c + \sum_{i=1}^{p} \Gamma_i \Delta y_{t-i} + u_t$$

The VEC model represents both the long-run equilibrium between the endogenous variables in y_t through the cointegrating vector β and the dynamic adjustment

processes through the loadings vector α and the short-run dynamics given by the Γ_i matrices[4]. Within this system, we calculate the impulse response of the current account variable to a unit shock in the REER. That is, we suppose a hypothetical "+1"-shock in the exchange rate equation and trace the dynamic interactive effects in the system through time. The reaction of the current account can be seen in Figure 1. The total elasticity, which is reached after two years (i.e. 8 quarters), equals 0.63.

Figure 1: Response of log (EX/IM) to One-Unit log (REER) Innovation



Source: Based on own estimations displayed in Table A.2 in the Annex

In the last step, the elasticity is used to convert the required current account change, i.e. the difference between the NFA-stabilising and the actual current account balance, into the necessary adjustment of the REER. Thereby, we assume that this value applies equally to the nominal effective rate just as to the nominal bilateral rate, e.g. towards the US-dollar.

4. Balance-of-Payments Approach (BoP)

The BoP approach[5] refers to the supply and demand for foreign exchange in the medium to long run. In general, the two major magnitudes under consideration are the current and the capital account. Therefore, the BoP broadens the scope of the ES method by considering equilibrium capital flows in addition to trade flows.

The basic idea is that persistent capital account imbalances are compatible with a stable exchange rate in case equilibrium trade flows find their counterpart in sustainable net capital flows $\overline{cf}$:

[4] The estimation output is shown in Table A.2 in the Annex.

[5] This concept is closely related to the "macroeconomic balance" approach, see IMF (2006). For a more detailed description of the underlying theoretical concept, see Brook/Hargraves (2000).

(9) $\overline{ca} = -\overline{cf}$

For instance, emerging market economies are likely to receive on average positive net capital flows, attracted by higher returns on capital. Comparing $\overline{ca}$ with the actual (or some expected) current account yields the necessary change of the trade ratio. As in the ES approach, this can be converted into the required real exchange rate adjustment via the estimated elasticity.

5. Conclusions

In this short technical note, we have reviewed the theory and methodology underlying the three EER estimation procedures that were used in Weber et al. (2009). Probably the most popular approach is given by PPP, requiring the exchange rate to equalise domestic and foreign price levels when expressed in a common currency. This value was adjusted for differences in non-tradable sector productivity. Second, the ES approach was introduced, concentrating on the compatibility of the current account balance with a stable NFA position. At last, the BoP concept additionally considered equilibrium capital flows that might balance persistent current account deficits.

In Weber et al. (2009), the various procedures provided a range of relatively similar results for the Ukrainian EER. However, substantial deviations cannot be excluded, underlining the need of carefully assessing the scope and plausibility of the estimates. Taking these caveats into account, the discussed approaches can nevertheless provide valuable guidance for policy decisions by systematically incorporating information on goods markets, trade, foreign debt and capital flows in the decision-making process.

References

Balassa, B. (1964): The Purchasing-Power Parity Doctrine: A Reappraisal, The Journal of Political Economy, Vol. LXXII, No. 6, p. 584-596.

Brook, A.-M. / D. Hargreaves (2000): A macroeconomic balance measure of New Zealand's equilibrium exchange rate, Reserve Bank of New Zealand Discussion Paper Series DP2000/09.

Cheung, Y.-W. / M. D. Chinn / E. Fujii (2007): The Overvaluation of Renminbi Undervaluation, NBER Working Paper 12850.

Frankel, J. (2005): On the Renminbi: The Choice between Adjustment under a Fixed Exchange Rate and Adjustment under a Flexible Rate, NBER Working Paper 11274.

Goldstein, M. (2004): Adjusting China’s Exchange Rate Policies, IIE Working Paper 04-1. Washington: Institute for International Economics.

IMF (2006): Methodology for CGER Exchange Rate Assessments, IMF Research Department.

Maslova, S. / M. Vogel (2008): EMEA FX: Finding new equilibria in a deleveraging world, Barclays Capital Client Research Note

Rogoff, K. (1996): The Purchasing Power Parity Puzzle, Journal of Economic Literature, 34, 647-68.

Samuelson, P. A. (1964): Theoretical Notes on Trade Problems, The Review of Economics and Statistics, Vol. XLVI, No. 2, p. 111-154.

Weber, E. / R. Kirchner / R. Giucci (2009): Equilibrium exchange rate in Ukraine: Quantitative assessment and policy implications, German Advisory Group on Economic Reforms in Ukraine, presentation.

Annex

Table A.1 Equilibrium Exchange Rate in Ukraine: Overview of Results

Method	Value	Time horizon
Purchasing-Power-Parity (PPP)	8.22	Long
External-Sustainability Approach (ES)	9.85	Medium
Balance-of-Payments Approach (BoP)	8.19	Medium/Long

Source: Own estimations from our presentation "Equilibrium exchange rate in Ukraine: Quantitative assessment and policy implications" (March 2009)

Table A.2 Empirical Results for VEC Model Estimations (J-Curve Framework)

Sample (adjusted): 1999Q2 2008Q3
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

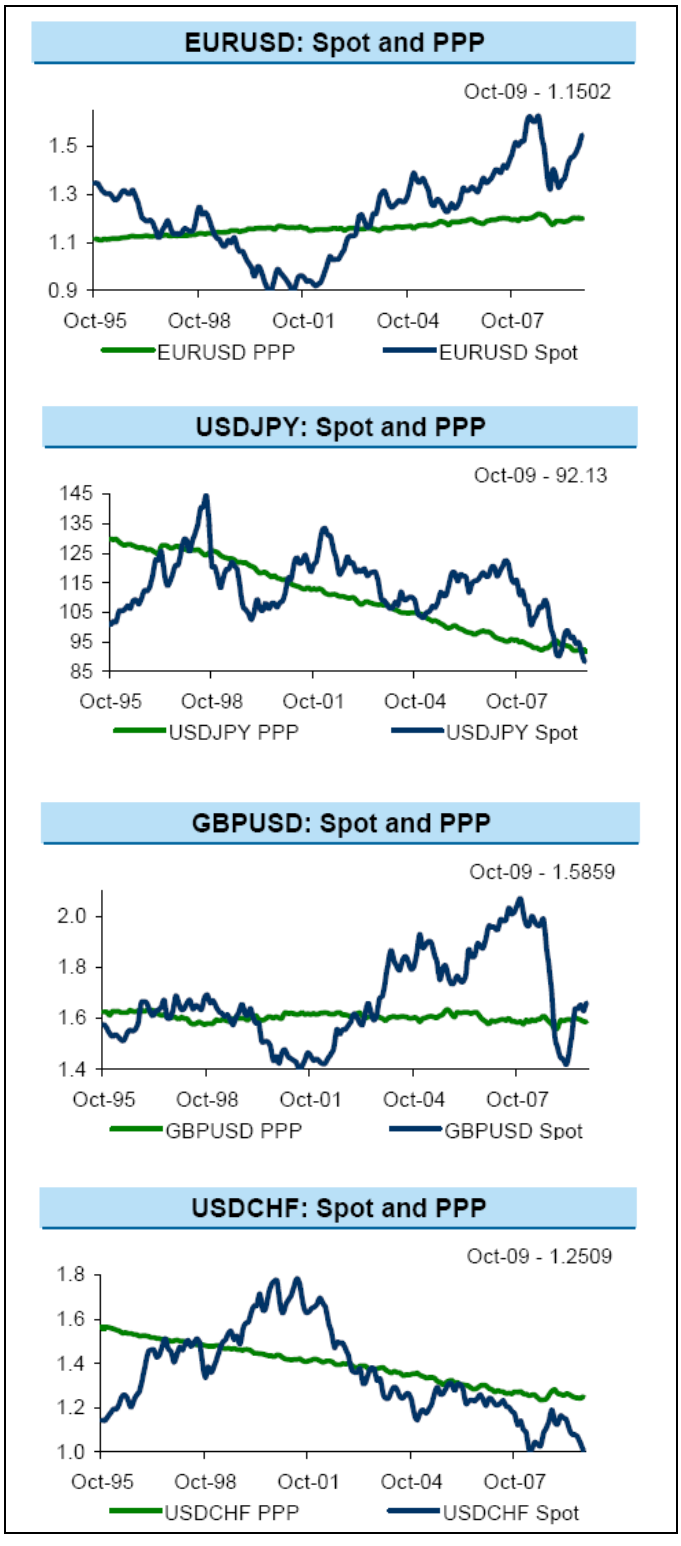
Cointegrating Eq:	CointEq1
LOG(EX(-1)/IM(-1))	1.000000
LOG(REER(-1))	-1.796600 (0.32894) [-5.46182]
LOG(GDP(-1))	-2.666018 (0.37931) [-7.02853]
LOG(WORLDGDP(-1))	4.947916 (0.60976) [8.11455]
C	-37.34733

Error Correction:	D(LOG(EX/IM))	D(LOG(REER))	D(LOG(GDP)	D(LOG(WORLDGDP))
CointEq1	-0.184711 (0.11432) [-1.61578]	-0.153932 (0.04180) [-3.68229]	0.188646 (0.05221) [3.61337]	-0.023178 (0.02266) [-1.02300]
C	-0.002806 (0.01386) [-0.20243]	-0.004165 (0.00507) [-0.82164]	0.013013 (0.00633) [2.05532]	0.009429 (0.00275) [3.43171]
R-squared	0.067617	0.273597	0.266151	0.028249
Adj. R-squared	0.041717	0.253419	0.245767	0.001256
Sum sq. resids	0.262913	0.035157	0.054835	0.010327
S.E. equation	0.085458	0.031250	0.039028	0.016937
F-statistic	2.610743	13.55924	13.05644	1.046527
Log likelihood	40.57719	78.80501	70.35948	102.0809
Akaike AIC	-2.030378	-4.042369	-3.597867	-5.267415
Schwarz SC	-1.944189	-3.956180	-3.511678	-5.181226
Mean dependent	-0.002806	-0.004165	0.013013	0.009429
S.D. dependent	0.087299	0.036167	0.044939	0.016948

Determinant resid covariance (dof adj.)	1.58E-12
Determinant resid covariance	1.27E-12
Log likelihood	304.7301
Akaike information criterion	-15.40684
Schwarz criterion	-14.88971

Source: Own estimations

Figure A.1 Market and PPP Exchange Rates for Major Currency Pairs



Source: BNP Paribas FX Research

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