German Economic Team Moldova

Technical Note [TN/01/2010]

"Estimating the equilibrium exchange rate in Moldova"

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Berlin/Chisinău, September 2010

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The German Economic Team Moldova ("GET Moldova"), which is active in Moldova since 2010, advises the Moldovan government and other state authorities such as the National Bank of Moldova on a wide range of economic policy issues and on financial sector development. Our analytical work is presented and discussed during regular meetings with high-level decision makers. GET Moldova is financed by the German Federal Foreign Office.

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"Estimating the equilibrium exchange rate in Moldova"

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Contents

1. Introduction

The calculation 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 (2010), who employed several methods to quantify the EER of the Moldovan leu. 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 two main approaches can be roughly classified by their time horizon: While the External-Sustainability (ES) approach operates in a medium-term framework, the Balance-of-Payments (BoP) methodology offers a medium- to long-term perspective. Section 4 provides some discussion and concludes.

2. External-Sustainability Approach (ES)

The ES approach focuses 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[1].

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.

[1] 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.

- 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:

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

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

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

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 (2) is given by

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

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. (2010), we proceeded without such an adjustment, since a preliminary examination does not reveal typical business cycle patterns in Moldovan 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. (2010), we measure foreign income by the real GDPs of Moldova's major trading partners, i.e. alternatively of the European Union [2] and Russia. Furthermore, we use the

[2] We use here the Euro area in our estimations, i.e. European Monetary Union (EMU).

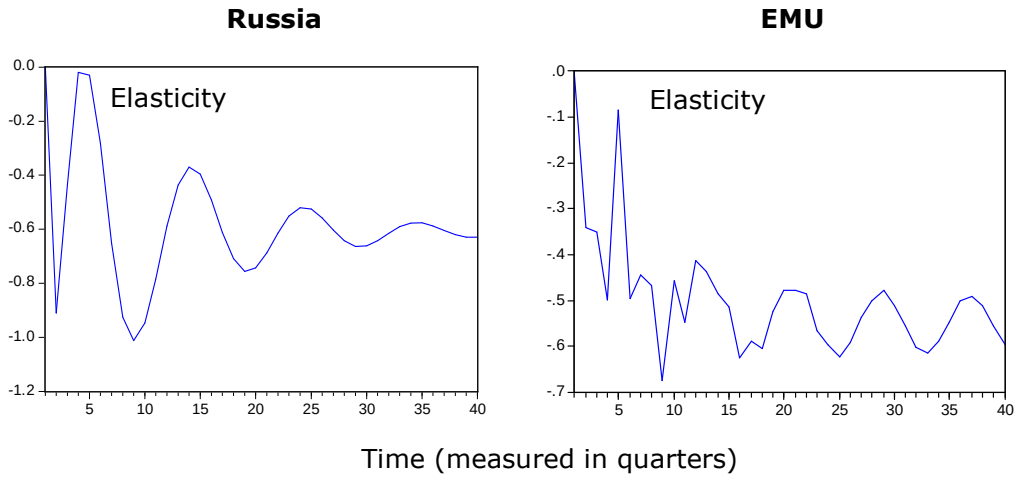
respective bilateral real exchange rate (RER), Moldovan GDP and the ratio of exports to imports, all expressed in logs. Since all these variables are found to be non-stationary, the validity of the long-run current account relationship depends on the presence of cointegration. Using a Johansen (1995) Trace test, we find indeed one cointegrating relation on the 5% significance level among the four variables.

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

$$(4) \qquad \Delta y_t = \alpha\beta y_{t-1} + c + \sum_{i=1}^{p} \Gamma_i \Delta y_{t-i} + u_t$$

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[3]. Within this system, we calculate the impulse response of the current account variable to a unit shock in the RER. 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. For both estimations (using Russia and EMU as trading partners, respectively), we arrive at very similar total elasticities that are equal to 0.61 and 0.55, respectively.

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



Source: Based on own estimations displayed in Table A.1 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.

[3] The estimation output is shown in Table A.1 in the Annex.

3. Balance-of-Payments Approach (BoP)

The BoP approach[4] 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 $\overline{cf}$:

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

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.

4. Conclusions

In this short technical note, we have reviewed the theory and methodology underlying the two EER estimation procedures that were used in Weber et al. (2010). First, the ES approach was introduced, concentrating on the compatibility of the current account balance with a stable NFA position. Second, the BoP concept additionally considered equilibrium capital flows that might balance persistent current account deficits.

In Weber et al. (2010), the various procedures provided a range of relatively similar results for the Moldovan 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 foreign debt and capital flows in the decision-making process.

[4] 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).

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Annex

Table A.1 Empirical Results for VEC Model Estimation (EMU)

Sample (adjusted): 2001Q1 2009Q3
Included observations: 35 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LOG(EX(-1)/IM(-1))	1.000000
LOG(RER_EUR(-1))	1.896771 (0.57181) [3.31712]
LOG(GDP_MOL(-1))	3.325186 (0.68005) [4.88965]
LOG(GDP_EMU(-1))	8.242601 (1.15505) [7.13615]
C	-275.9966

Error Correction:	D(LOG(EX/IM))	D(LOG(RER_EUR))	D(LOG(GDP_MOL))	D(LOG(GDP_EMU))
CointEq1	-0.307789 (0.18855) [-1.63243]	0.307123 (0.09693) [3.16853]	-0.347970 (0.07999) [-4.34994]	0.008630 (0.01147) [0.75270]
D(LOG(EX(-1)/IM(-1)))	-0.238337 (0.22002) [-1.08325]	-0.189908 (0.11311) [-1.67897]	0.154943 (0.09335) [1.65985]	-0.003206 (0.01338) [-0.23960]
D(LOG(EX(-2)/IM(-2)))	0.139416 (0.19118) [0.72925]	0.048910 (0.09828) [0.49765]	0.026514 (0.08111) [0.32689]	-0.021263 (0.01163) [-1.82894]
D(LOG(RER_EUR(-1)))	0.244465 (0.48483) [0.50423]	-1.185735 (0.24924) [-4.75732]	0.921527 (0.20570) [4.48001]	-0.055445 (0.02948) [-1.88056]
D(LOG(RER_EUR(-2)))	0.261532 (0.47539) [0.55014]	-0.892295 (0.24439) [-3.65110]	0.780280 (0.20169) [3.86867]	-0.055896 (0.02891) [-1.93352]
D(LOG(GDP_MOL(-1)))	-0.181350 (0.58890) [-0.30795]	-1.394656 (0.30275) [-4.60669]	1.183182 (0.24985) [4.73554]	-0.076212 (0.03581) [-2.12811]
D(LOG(GDP_MOL(-2)))	1.074875	-0.846357	0.882154	-0.088238

	(0.68123)	(0.35021)	(0.28903)	(0.04143)
	[1.57784]	[-2.41669]	[3.05216]	[-2.12995]
D(LOG(GDP_EMU(-1)))	-3.521300	-4.215191	0.537341	0.391442
	(2.98467)	(1.53438)	(1.26630)	(0.18150)
	[-1.17979]	[-2.74716]	[0.42434]	[2.15667]
D(LOG(GDP_EMU(-2)))	2.093290	1.217781	5.206249	-0.110392
	(3.03367)	(1.55957)	(1.28709)	(0.18448)
	[0.69002]	[0.78084]	[4.04497]	[-0.59838]
C	-0.010847	-0.015869	-0.001571	0.000596
	(0.01769)	(0.00910)	(0.00751)	(0.00108)
	[-0.61305]	[-1.74467]	[-0.20929]	[0.55433]
R-squared	0.419356	0.579107	0.703614	0.554786
Adj. R-squared	0.210324	0.427586	0.596915	0.394508
Sum sq. resides	0.209126	0.055269	0.037644	0.000773
S.E. equation	0.091461	0.047019	0.038804	0.005562
F-statistic	2.006183	3.821947	6.594377	3.461414
Log likelihood	39.94006	63.22771	69.94865	137.9391
Akaike AIC	-1.710860	-3.041583	-3.425637	-7.310805
Schwarz SC	-1.266475	-2.597198	-2.981252	-6.866420
Mean dependent	-0.011638	-0.006675	-0.001758	0.001768
S.D. dependent	0.102922	0.062146	0.061119	0.007148
Determinant resid covariance (dof adj.)		4.65E-13		
Determinant resid covariance		1.21E-13		
Log likelihood		321.8426		
Akaike information criterion		-15.87672		
Schwarz criterion		-13.92142		

Source: Own estimations