



OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

Simple but Effective: The OeNB's Forecast Model for Selected CESEE Countries

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CEEC-projections at OeNB

- 1.) internal, semi-annual expert based judgement of GDP and imports
- 2.) supported by regression analyses and elasticity estimates
- 3.) time series model for 5 countries: PL, HU, CZ, BG, HR

Motivation

- Strong involvement of all relevant Austrian commercial banks in CESEE
- Strong trade and FDI links with the region
- Background for the forecast of the Austrian economy
- Assumptions for stress-tests by the financial market analysis division
- Additional input into the agreement upon external assumptions in WGF1 (BMPE)

Model

Country-specific macromodel (AS-AD model in the fashion of Merlevede, Plasmans, Van Aarle “A Small Macroeconomic Model of the EU-Accession Countries“ in: Open Economies Review, 2003)

6 fundamentally determined equations for:

- **Private consumption**
- **Investment**
- **Exports**
- **Imports**
- **Interest rate (augmented Taylor rule)**
- **Nominal exchange rate**

Model Setup

We assume co-integrating relationships between each of the six endogenous variables and a vector of fundamental regressors:

⇒ Error correction model

$$\Delta y_t = a\Delta y_{t-1} + b' \Delta X_{t-1} + \gamma(y_{t-1} - \alpha - \beta' X_{t-1}) + \varepsilon_t$$

⇒ Necessary assumptions are fulfilled: all time series are I(1) or trend-stationary, residuals from the EC-terms are I(0)

Long-term equilibrium relationships

$$(1) \quad c_priv = \alpha_1 * gdp + \alpha_2 * (ir - cpi)$$

$$(2) \quad inv = \beta_1 * gdp + \beta_2 * (ir - ppi)$$

$$(3) \quad exp = \gamma_1 * (er * pc_ea / pc) + \gamma_2 * gdp_eu + \gamma_3 * exp_eu + \gamma_4 * gdp$$

$$(4) \quad imp = \delta_1 * gdp + \delta_2 * (er * pc_ea / pc)$$

$$(5) \quad er = \kappa_1 * (ir - ir_ea) + \kappa_2 * (m3 - m3_ea) + \kappa_3 * (gdp / er - gdp_ea)$$

$$(6) \quad ir = \phi_1 * cpi + \phi_2 * gdp + \phi_3 * er + \phi_4 * ir_ea$$

Model Estimation

- **All exogeneous variables (11) are endogenized by simple AR-processes:**
 - **Inflation in resp. country and in EA**
 - **Money supply in resp. country and in EA**
 - **GDP of EU27 and EA, exports in EU27**
 - **Interest rates in EA**
 - **Producer prices**
 - **Stock changes**
 - **Public consumption**
- **+ an identity equation for GDP**
- **Model is estimated by SUR**

Adjustment to long-run equilibrium

- **Endogeneous** adjustment: simultaneous estimation
- Adjustment parameters show the expected, in most cases significant, negative sign
- Range: -0.7 (BG: *Imp* and *Exp*) and -0.12 (CZ: *ER*)
- Sometimes insignificant adjustment par.s: *Inv*, *ER* (Hungary) and *IR* (Czech Republic)
- Croatia: adjustment par. sometimes >1
- **Exogenous** adjustment: EC-terms are estimated on historic data, Model contains the EC-residuals (results in quicker adjustment in the current situation)

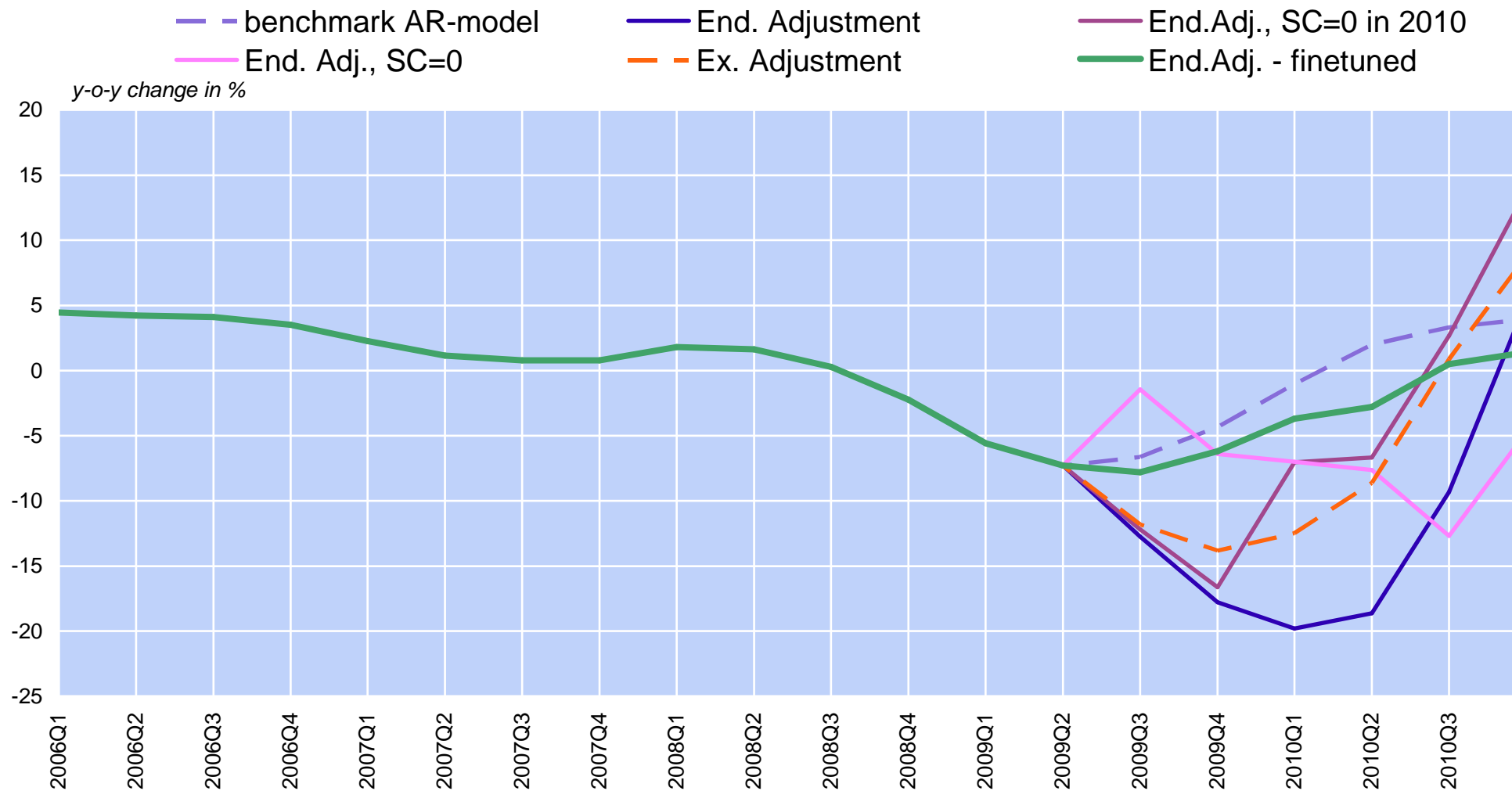
Adjustment Parameters Associated with the Equilibrium Correction Terms

	BG	CZ	HR	HU	PL
Consumption	-0.5394	-0.2128	-1.1947	-0.1624	-0.3434
t-stat	(-5.9523)	(-3.9939)	(-5.16507)	(-2.7675)	(-3.6699)
Exchange rate	-	-0.1240	-0.3317	-0.1076	-0.0919
t-stat	-	(-3.3875)	(-5.0211)	(-1.5885)	(-2.2661)
Exports	-0.7731	-0.3442	-1.3453	-0.3154	-0.6410
t-stat	(-9.6034)	(-2.7979)	(-10.0714)	(-4.0128)	(-5.5351)
Imports	-0.7862	-0.1185	-0.1606	-0.0486	-0.3512
t-stat	(-5.8490)	(-1.6962)	(-1.9514)	(-1.4822)	(-3.8359)
Investment	-0.6487	-0.2240	-0.0868	-0.1476	0.1015
t-stat	(-4.2423)	(-2.9369)	(-1.0254)	(-1.5048)	(1.4551)
Interest rate	-	-0.1607	-0.3920	-0.4362	-0.1281
t-stat	-	(-1.5577)	(-3.2282)	(-4.4106)	(-2.7646)

Note: Parameters significant at the 10% level are highlighted in bold.

Authors' Calculations.

Hungary - GDP growth projections



Source: OeNB.

Fine Tuning

- **Delete highly insignificant parameters → arrive at country-specific nuances**
- **Include MPE-forecast for all EU / EA variables**
- **Fix policy variables (IR, ER, CPI, fiscal variables)**

Forecast

calculate 1- to 8-steps-ahead dynamic forecasts from these structural parameters obtained by SUR

Model Validation

- Exclude a time window of 8 quarters, which runs through the sample and use remaining data to simultaneously estimate (i) our EC model and (ii) a simple AR(1)-model (= benchmark)
- Compute 3 quality indicators for each of the 8 forecasting horizons:
 - Diebold-Mariano test: H_0 : forecasting ability of the EC model = that of the benchmark AR model ($RMSE_{EC} = RMSE_{AR}$).
 - Hit rate: percentage of cases in which the forecast movement direction of a variable relative to its current level coincides with the direction of change of the realized data for a given horizon.
 - Growth rates' sign matching: percentage of cases in which sign of y-o-y growth rate of the forecast series matches sign of the y-o-y growth rate of the realized data series.

Results of the Model Evaluation – Hungary, GDP Forecast

forecast horizon	No. of obs.	DB-test	Hit rate	Growth rates' sign matching
1	47	0.0000 (0.4965)	0.7021	1.0000
2	47	0.0000 (0.0403)	0.7872	1.0000
3	47	-0.0005 (-1.4172)	0.9574	1.0000
4	46	-0.0008 (-1.7106)	1.0000	0.9787
5	45	-0.0011 (-1.9570)	0.9778	0.9574
6	44	-0.0014 (-1.9966)	0.9773	0.9362
7	43	-0.0018 (-1.9919)	0.9767	0.9149
8	42	-0.0024 (-1.9448)	0.9762	0.8936

Results of the Model Evaluation – Poland: EC- vs AR-model

forecast horizon	No. of obs.	Diebold-Mariano test		
		GDP	IMP	ER
1	47	0.0002 (1.7399)	-0.0006 (-1.1249)	-0.0004 (-1.5348)
2	47	0.0005 (2.6867)	-0.0004 (-0.4908)	-0.0007 (-1.3767)
3	47	0.0008 (2.7561)	-0.0002 (-0.1140)	-0.0019 (-1.8728)
4	46	0.0010 (2.8986)	0.0009 (0.3555)	-0.0030 (-2.0718)
5	45	0.0010 (2.9687)	0.0019 (0.5925)	-0.0052 (-2.6300)
6	44	0.0009 (2.2149)	0.0024 (0.6268)	-0.0077 (-3.0989)
7	43	0.0006 (1.1152)	0.0011 (0.2316)	-0.0103 (-3.4557)
8	42	0.0005 (0.7063)	0.0005 (0.0975)	-0.0135 (-3.8108)

Areas for further development

- **Extend country coverage (RO, RS, MK)**
- **Integrate country models into a region-model**
- **Validate model outcome on a regular basis, extend range of tests (tests for structural breaks, ...)**
- **Estimate impulse response functions to important policy-control variables**



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