Montenegro quarterly macroeconomic econometric model

prof. Franjo Stiblar, Ph.D. assist. prof. Zan Oplotnik, Ph.D

Economic institute of the Law School Ljubljana – Slovenia (EU)

I. Short introduction and background (1)

Montenegro is semi-independent entity in Serbia and Montenegro

- population 630.000 inhabitants,
- area 15.000 square kilometers,
- GDP per capita: 2500 \$.

Parliamentary democracy with referendum on formal independence planned for February 2006.

In 2004: inflation 6%, GDP growth 3%, unemployment rate 25%, budget deficit 3% of GDP, current account deficit 4% GDP.

I. Short introduction and background (2)

De facto independent economy:

- in 1999 monetary independence with introduction of Euro as legal tender,
- one of the largest euroized economies with status between currency board and membership in European monetary union
- in 2000 custom borders established with Serbia,

After separation from Serbia macroeconomic performanceimproved sginificantly with introduction of liberal economic reforms.

Issue is social sustainability of radical reforms.

II. The Model Specification (1)

Keynesian type model cosists of 18 behavioral equations and 5 definitions covering 10 economic segments:

- activity with production functions is followed by equations for production factors labor, capital.
- receipts of hodusehold, followed by equations of elements of final demand.
- price and stock exchange equations are followed by banking sector and monetary sector.

Definitions describe:

GDP, total employment, balance of trade, budget deficit and broad money.

II. The Model Specification (2)

Special features:

- Use of € as legal tender (Euroized country) leaves only required reserves as direct monetary policy instrument, pecise determination of cash is impossible.
- Limitation to budget deficit to 3% of GDP restrict fical policy measures to tax policy and changing structure of government expenditures, not the aggregate amount.

Instruments of economic policy in the model are six:

- rate of required reserves,
- effective tax rate, effective customs rate, the tax burden rate of wages, structure of government expenditures
- growth of employment in governemnt (public) sector.

External exogeneous variable:

effective exchange rate for Montenegro of non € currency to Euro.

DATA Methodology:

- Quarterly data first differences, 20 observations for 2000-2004,
- Model variables are in rates of growth (due to unstable economy),
- some estimations of variables are made for the start or end of period,
- Simple lags up to 4 quarters,
- Variables are in €, indeces or in numbers (people),

Symbols used in model specification

AKS	Ex	active interest rate	POTD	End	house hold consumption
AKT1	End	Activity	PRUS	End	export of services
BDP	End	GDP	REV	Ex	exchange rate non€ / €
DOHD	End	household income	SETO	End	stock exchange turnover
DUK	End	deposits in banks	SOR	ExEP	rate of obligatory reserves
EFCARSTOP	ExP	effective customs rate	STED	Ex	household savings
EFPORSTOP	ExP	effective tax rate	STOPLA	ExEP	rate of tax burden of wages
GOT	End	Cash	TRB	End	balance of trade
GOV	End	government expenditures	UKPRIM	End	government receipts
INDP	End	industrial production	UVRU	End	import of goods
INV	End	investment in economy	ZAPNT	ExEP	employment non-tradable sector
IPC	End	index of producers prices	ZAPTRA	End	employment tradable sector
ITZ	End	cost of living index	ZAPUK	End	total employment
IZVRU	End	export of goods	ZARTRA	End	wages in tradable sector
KFL	Ex	bank consumer credits	МС	End	market capitalization
KID	Ex	capital expenditures of government	UKRAS	ExEP	total government expenditures
КИК	End	bank credits total	PKS	Ex	passive bank interest rate
М	End	broad money: cash + deposits			

III. Model estimation

Data mining as crucial part of project: over 140 series obtained

Estimation method:

OLS for quarterly undeseasoned variables

Regular statistical tests were made – with good results:

- for stationarity: Dickey Fuller's unit root test,
- Causality: Granger test,
- Autocorrelation in estimated equations: Durbin-Watson test,
- Multicollinearity: correlation analysis.

<u>Interpretative adequacy is based on:</u> Economic theory, experience with similar models, peculiarities of Montenegro economy. Graphic presentation of functional relations



Estimated model - 1

No.	EQUATION (DEPENDENT VARIABLE)	с	COEFFICIENT*EXPLANATORY VARIABLE (T-STAT)				R ²	DW	F ²	
1.	ACTIVITY (AKT1)	0.103 (1,95)	+0.197*dlog(ZAPUK(-3)) (+3,04)	+0.221*dlog(STEDr(-3)) -0.026* dlog (UKPRIMr(-1)) (+2,19) (-1,71)			0.65	1.70	7.27	
2.	INDUSTRIAL PRODUCTION (INDP)	0.024 (1,31)	-0.246* dlog (UKPRIM(-2)) (-4,58)	+0.201* dlog (INVr(-2)) (+4,74)			0.66	1.66	14.3	
3.	INVESTMENT (INV)	-0.054 (0,71)	-0.613* dlog (AKS(-1))	+1.117*dlog(INDP) +0.482*dlog(KID)			0.62	2.44	7.54	
4.	EMPLOYMENT -TRADABLE (ZAPTRA)	-0.006 (1,40)	+0.0622*dlog(INDP(-3)) (+1,86)	-0.4886*dlog(ZAPNT) (-4,88)			0.66	1.75	12.5	
5.	WAGES-TRADABLE (ZARTRAR)	0.0119 (0,69)	-1.701*dlog(STOPLA) (-2,82)	+0.074*dlog(AKT1(-2)) (+1,14)	-1.00 (-1,2	06* dlog (ZAPTRA(-2)) 29)	+0.069*dlog(KID) (+2,14)	0.56	2.14	3.86
6.	HOUSEHOLD INCOME (DOHDR)	-0.002 (0,10)	+6.404* dlog(ZAPTRA) (+7,39)	+0.219* dlog(INDP(-3)) +0.644* dlog(ZARTRA(-2)) (+1,34) (+2,47)			0.84	2.43	20.5	
7.	HOUSEHOLD CONSUM (POTDR)	-0.0089 (0,47)	+0.7167*dlog(DOHDr) (+8,61)	+0.077*dlog(KFLr(-1)) (+1,92)			0.86	2.18	47.4	
8.	BUDGET RECEIPTS (UKPRIM)	-0.00534 (0,09)	+0.11*dlog(EFCARSTOP(- 1)) (+1,58)	+0.379*dlog(EFPORSTOP(-3)) (+2,22)		+0.284*dlog(PRUS(-1)) (+4,42)		0.66	2.40	7.91
9.	EXPORT OF GOODS (IZVRUR)	0.122 (1,57)	+0.378*dlog(AKT1(-2)) (+1.39)	-2.33*dlog(REV(-3)) (-3.07)		+0.309*dlog(INVr(-4)) (+1.60)		0.45	2.12	3.25
10.	EXPORT OF SERVICES (PRUSR)	-0.168 (0,97)	+3.229*dlog(AKT1(-1)) (+5,44)	+0.6863* dlog (INVr(-3)) (+2,09)		+1.563* dlog(KUK(-1)) (+1,69)		0.75	2.32	12.8
11.	IMPORT OF GOODS (UVRUR)	0.0012 (0,02)	+0.42*dlog(INV(-4)) (+2,89)	+0.95*dlog(POTD) (+2,35)		+0.452* dlog(UKRASr(-1)) (+1,82)		0.49	1.57	3.92
12.	COST OF LIVING INDEX (ITZ)	0.0108 (2,71)	+0.1371*dlog(IPC(-1)) (4,20)	+0.0374*dlog(POTD(-1)) (1,87)		+0.0492*dlog(GOT) (4,65)		0.74	2.18	14.1

Estimated model - 2

13.	PRODUCERS PRICES INDEX (IPC)	0.0125 (1,06)	-0.0634*dlog(UVRU(-1)) (-1,77)	+0.0696*dlog(KUK(-3)) (+1,18)	+0.2345*dlog(REV(-3)) (+4,97)		0.72	1.71	10.9
14.	MARKET CAPITALISATION (MC)	-6.485 (1,58)	+0.6012* dlog(INV) (+3,02)	+1.467* dlog (INDP) (+1,65)		0.44	1.69	6.16	
15.	TURNOVER STOCK EXCHANGE (SETO)	0.240 (1,33)	+0.7067* dlog (MC) (+2,29)	-1.0533* dlog(AKS(-1)) (-2,29)	+1.273*dlog(SOR(-2)) (+1,56)		0.55	2.04	5.21
16.	BANK DEPOSITS (DUKR)	0.00331 (0,16)	+ 0.0311 [*] dlog(PKS(-2)) (+1,56)	+ 0.3599*dlog(DOHD(-1)) (+3,22)	+ 0.1989*dlog(IZVRU) (+3,28)		0.61	2.23	6.75
17.	BANK CREDITS (KUKR)	0.00272 (0,16)	- 0.0063*d(SOR(-1)) (-1,27)	+0.981*dlog(DUKr(-1)) (+2,94)	- 0.23*dlog(AKS(-1)) (-1,81)	-0.316*dlog(GOT) (-2,26)	0.51	2.66	3.37
18.	CASH (GOT)	-0.1399 (-2,13)	-0.561*dlog(AKS(-2)) (-4,50)	-0.01285*d(SOR) (-2,53)	+0.09*dlog(PRUS(-2)) (+2,02)	+6.332* dlog(ITZ(-1)) (+3,28)	0.78	2.13	10.4
19.	TOTAL EMPLOYMENT	DYMENT ZAPUK = ZAPTRA + ZAPNT							
20.	GDP BDP = POTD + INV + GOV								
21.	GOVERNMENT EXPENDITURES GOV = UKPRIM + 0.03 * BDP								
22.	BROAD MONEY M = GOT + DUK								
23.	TRADE BALANCE TRB = IZVRU - UVRU								
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V. Interpretation of estimated equations in the model

RESULTS:

Statistical significance of estimated equations is satisfactory:

- Coefficient of determination is close to 50% or above,
- Autocorrelation is almost absent (few indetermined cases),
- T- and F- statistics are siginficant.

Economic substance of estimated equations:

- is also satisfactory with better results obtained for real sector, worse for financial sector and nominal variables.
- weaker are trade equations and equations for banking, fiscal and monetary sector. It can be explained by turbolence in Montenegro economy.

ACTIVITY:

Cobb-Douglas type production functions with low labour (0.19) and capital (0.22) and, in addition, negative impact of government receipts.

PRODUCTION FACTORS:

Investments influenced by interest rate, GDP growth and government expenditures.

Employment tradeable influenced by industrial production, and employment in public sector (negatively).

Total employment is defined as sum of employment in tradeable and non-tradeable sector.

HOUSEHOLD SECTOR:

Wages influenced by tax burden on wages, activity, employment growth and government capital expenditures. Household income influenced by employment, industrial production and wages in tradeable sector Consumption influenced by household income (0.71) and consumer loans.

GOVERNMENT

State receipts influenced by effective tax rate, effective custom rate and export of teourist services. State expenditures limited by Maastricht's criteria to budget deficit of 0.03% of GDP GDP is defined as sum of domestic final demand components (should be expanded by trade balance).

EXTERNAL SECTOR

Exports influenced by activity, exchange rate. Imports influenced by investments, government expenditures and consumer expenditures. Trade balance is defined as exports minus imports.

PRICES

Cost of living index influenced by producer prices, consumer expenditures and cash. Producer prices influenced by imports (negatively), bank loans and effective exchange rate.

STOCK EXCHANGE

Market capitalization influenced by investments and industrial production.

Turnover influenced by market capitalization, rate of required bank reserves, active bank interest rates (negatively).

BANKING SECTOR

Bank deposits influenced by bank pasive interest rate, household income and exports.

Bank loans influenced by rate of required reserves, bank active interest rate, cash and bank deposits.

MONETARY SECTOR

Cash depends on bank active interest rate (negatively), rate of required reserves, export of services and cost of living index. Broad money is defined as sum of cash and bank deposits.

VI. Simulations of the model

Ex-post dynamic and deterministic simulation within observation period I/2000 – IV/2004 is made for dependent variables.

Fit of model generated to actual values would be better, if absolute values for dependent variables were calculated from estimated equations instead of current presentation in rates of growth.

Figure 1: AKT1, INDP,INV, ZAPTRA



Figure 2: ZARTRA, DOHD,POTD, UKPRIM



VII. Implications of results

Illustration:

The role of monetary sector and monetary policy in specific conditions of Euroized economy in Montenegro

- it is impossible to determine the exact volume of cash in circulation in Montenegro,
- the right policy value of rate of required reserves: with cash and broad money growth given (5% with 5% GDP gorwth rate, for instance) growth rate of bank deposits is determined. Elasticity of bank deposits to rate of required reserve is 0.144.
- the interest rate for Governent bonds is replacing non-existent discount rate as interest policy insrtrument, as central ban kis not allowed issuing securities (emmission).
- as repayment of foreign debt affects money aggregates, the way to neutralize it is: by refinancing old debt with new, selling of foreign debt with discount or swap of foreign debt with domestic debt through issuing government securities.