

S t u d i a i A n a l i z y
S t u d i e s & A n a l y s e s

*Centrum Analiz
Społeczno-Ekonomicznych*



*Center for Social
and Economic Research*

190

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Macroeconomic Model for Ukraine

Warsaw, 1999

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This paper was prepared for the research project "Support for the Economic Transition in Ukraine" financed by the United States Agency for International Development (US AID).

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Graphic Design: Agnieszka Natalia Bury

DTP: CeDeWu – Centrum Doradztwa i Wydawnictw “Multi-Press” sp. z o.o.

ISBN 83-7178-188-1

Publisher:

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Contents

Abstract	5
1. Introduction	6
2. Data Sources	7
3. Estimates of Total Ukrainian GDP	8
4. Macroeconomic Model	13
5. Projection Methods	28
6. Alternative Scenarios for the Ukrainian Economy	31
List of Equations	44
Glossary	49

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Abstract

This paper presents the most recent version of the quarterly Macroeconomic Model of the Ukrainian economy, its assumptions and possible applications. This model represents an unorthodox approach in analysing economies in transition. It covers transactions in both official and shadow economies.

The volume and value of shadow transactions were estimated using an unconventional methodology, beginning with the analyses of overall consumer demand. This, in turn, was derived from official households surveys. The next steps included estimating cross-border trade and investment-in-kind.

Possible applications of the model are: short- and medium-run forecasts based on the whole model, projections of particular variables, and building various scenarios of policy-mix in Ukraine.

I. Introduction [1]

This paper describes the most recent version of the quarterly Macroeconomic Model of the Ukrainian economy. The development of this model is the result of research efforts during 1997–98 and was supported by the following US AID grants: CASE/HIID "Ukraine Macroeconomic Policy Program" under the Cooperative Agreement Award No. 121-A-00-97-00014-00 awarded for 1997–98 and CASE Cooperative Agreement Award No. 121-A-00-98-00623-00 awarded for 1998–2000.

The model was initially designed to analyze the macroeconomic effects of shadow economy developments in Ukraine. Subsequently, the model was extended in a number of directions, primarily for the purpose of short-term forecasting and analysis of macroeconomic policies.

The current objective of the macroeconomic project, which started in the second half of 1998, is to provide an independent, regular and consistent flow of information on quarterly macroeconomic developments. The prerequisite in all of this was the creation of a consistent framework for annual and quarterly national accounts which includes official, shadow and natural economy transactions. The next step involved using the estimates of quarterly national accounts in preparing a short-term forecast (for the next two years).

The CASE/HIID projections have been published quarterly since January 1998. They are based on both CASE/HIID's independent assessments of the Ukrainian economy and politics. A special emphasis is placed on the role of international trade and international financial linkages in order to ensure that projections are consistent with global developments forecast by major international institutions (i.e. IMF, OECD).

The following sections describe various technical aspects of the model design, applied projection methods, and the underlying statistical concepts, sources and methods. In the first section, we describe major data sources used in the project. The second section presents a detailed description of techniques used in the estimation of shadow economy activities. In the third section, we analyze basic assumptions of the macroeconomic model for the Ukrainian economy. The final section presents projection methods and analyses the recent scenarios of Ukrainian macroeconomic developments. In the Appendix, the complete listing of the most recent version of the model is given.

[1] We are grateful for critical comments and help from CASE and HIID staff, especially Janusz Szyrmer – a director of the HIID project in Ukraine – Alexandr Babanin, Pavel Kovalov, Alina Kudina, Yuriy Kuzmin and Vadym Lepetyuk. We would also like to thank Nicholas Spiro for editing the text.

2. Data Sources

The construction of a macroeconomic model requires the creation of a consistent statistical database. In Ukraine, like in any other transition economy, the data is both scarce and, in some cases, unreliable. Thus before the actual construction of the model we had to identify, collect and analyze all available data.

In this project we used a range of official sources, mostly published by government agencies, as well as various secondary publications necessary to fill gaps in official statistics. Our key sources were the following:

- (1) Statistical yearbooks (both general and for sectors of the Ukrainian economy), Derzhcomstat (Central Statistical Office),
- (2) "Quarterly estimates of the Ukrainian GDP", Derzhcomstat,
- (3) Monthly "Bulletin of Conjunction", Derzhcomstat,
- (4) Monthly NBU Bulletin, National Bank of Ukraine,
- (5) Quarterly NBU Bulletin on Ukrainian Balance of Payments, National Bank of Ukraine,
- (6) Derzhcomstat (regular and special) publications on the labor market, investment, and foreign trade,
- (7) Ministry of Finance reports on the government budget,
- (8) Foreign reports on Ukrainian foreign trade and balance of payments, IMF, Eurostat,
- (9) Macroeconomic Indicators, Ministry of Economy,
- (10) Quarterly Household Surveys, Derzhcomstat.

Most of our efforts were geared towards collecting, interpreting and constructing a consistent set of quarterly analyses. Our analyses appear every quarter following the release of official data on major economic aggregates.

Special emphasis was placed on Ukrainian national accounts. In this project, we decided to adapt procedures developed by DIW (Deutsches Institute für Wirtschaftsforschung) in Berlin and extensively used in estimating former East German Gross Domestic Product (GDP). Since 1994, these procedures have also been used in estimating quarterly GDP of Poland [see Gronicki, 1996].

The point of departure for estimates and forecasts based on these approaches is the general world economic outlook. Subsequently, the analysis focuses on the following six domestic aggregates:

- consumption
- investment
- international trade

- public finance
- labor market
- money and credit.

Estimating macroeconomic aggregates is a two-step process. Firstly, we aim to preserve an elementary, internal consistency of time series. For example, there should be a strong and positive correlation between disposable income of households and individual consumption. Secondly, we develop a system of accounts for four major sectors of the economy:

- (1) households
- (2) enterprises
- (3) government
- (4) rest of the world.

Unlike the first point, this set of accounts requires full consistency of records. The accounts – which are quite similar to SNA 1993 [see "System of National Accounts 1993", 1993] – create a closed system where the residual (solution) is the balance of payments with the rest of the world.

This set of accounts is prepared in nominal terms and, through different deflators, is translated into a consistent set of series in constant prices. In the current version of the model, we use 1997 as a benchmark year. This is because 1997 is the most recent year for which official and unofficial data are available in a consistent form.

At the current stage of the project, we make extensive use of quarterly estimates of the total Ukrainian GDP – even if they are not that reliable as we would wish them to be. The details on the procedure of quarterly estimates of the Ukrainian GDP are given in the next section.

3. Estimates of Total Ukrainian GDP

In this section we discuss preliminary estimates of the total Ukrainian GDP for the period 1995-98. The usual GDP definitions were applied:

1. Total GDP is defined as a sum of value added generated in official, shadow and natural sectors of the economy plus taxes on products minus subsidies to products.
2. Total GDP is a sum of income generated in the institutional sectors of the economy (i.e., households, general government, firms and the rest of the world).
3. Total GDP is a sum of private consumption, general government consumption, investment in fixed assets and inventories, and net exports.

In Table I at the end of this section we present estimates of the total GDP and its components.

We define the official and two unofficial (shadow and natural) sectors in the following way:

- (i) the official sector consists of economic agents which record and report transactions to the Derzhcomstat;
- (ii) the natural sector, where agents produce goods for their own consumption (this includes consumer goods like foodstuffs, alcohol and services) and make investment-in-kind (like housing);
- (iii) the shadow sector (we refer to it as the shadow economy) which consists of all other unregistered activities (with the exception of purely criminal activities like prostitution, drug trafficking and production, etc.).

The shadow economy exists in all countries regardless of their economic systems. The causes of the rapid development of the shadow economy in Ukraine are closely related to the dissolution of the old political and economic systems and, subsequently, to delayed (and never successfully implemented) economic reforms.

The official estimates of the shadow economy by Derzhcomstat claim its share is roughly 13–14% of official GDP. It should be stressed that this amount is included in official estimates. Unofficial estimates range between 30% to more than 100% of official GDP [see e.g. Kaufman and Kaliberda, 1995]. It is also believed that the shadow economy in Ukraine has been growing at a rate at least partially offsetting the decline in official GDP. Our estimates of the shadow and natural economy share in total GDP are given in Table 2. They range between 40.0% and 43.8% in 1995–98 (which is from 56.6% to 60.4% of official GDP). We observed a small decrease of this share in 1997 mostly due to stabilization of the Ukrainian economy. However, the financial crisis and return to stricter control over the official economy in 1998 caused rise of the share of unofficial transactions in total GDP.

Our analysis of the shadow economy is unconventional [for a review of conventional methods used in estimating shadow economy transactions see Shadow Economy, 1996]. Instead of starting with an analysis of employment in the shadow economy and related income flows, we decided to begin our analysis with an estimation of the volume and value of consumer demand using available quarterly households surveys.

The approach used in this paper may be summarized in the following manner:

I. Private consumption estimates

- (i) as a starting point we use official quarterly household surveys; they contain micro-data on consumption of various commodities; the quantity and value series are available both for different strata of Ukrainian households and for different locations; the sample of households is regarded as not covering the whole population but this is the only available micro-data set; moreover, the data covers natural consumption;

- (ii) we analyze this data-set and the adjusted volume of food consumption (e.g. we have to lower consumption of potatoes in villages); afterwards we constructed aggregate price indices using average 1997 prices as a base; then this data was compared with official estimates of foodstuff purchases (only for annual series);
- (iii) it is a known fact that in any household survey data on alcohol consumption is not reliable; we assume that alcohol consumption per capita was stable throughout the analyzed period and equaled average consumption of alcohol in the 1980s; we also set the seasonal pattern (quarterly) of alcohol consumption as it was in neighboring countries (Poland and Czech Republic); we use official prices of alcoholic beverages to estimate value of consumed alcohol;
- (iv) consumption of non-durable manufacturing goods was estimated using an official source for non-durables consumption and augmenting this by the level of estimated cross-border imports of non-durables; we divided consumption of durables into purchases of cars and others; car purchases are derived implicitly from car registrations while consumption of other durables was estimated using a similar approach as in the case of non-durables; value of consumption was derived using official prices of manufacturing goods;
- (v) consumption of services is based on household surveys; we differentiated between services with regulated prices (gas, electricity, rents, transportation, mail and telecommunication) and services with non-regulated prices (all others); value of consumption was estimated using officially registered prices;
- (vi) total consumption was derived as a sum of consumption of foodstuffs, alcoholic beverages, durables, non-durables and services; purchases in the shadow economy were estimated by subtracting from the total consumption officially reported purchases of goods and services as well as natural consumption of foodstuffs and investment-in-kind.

II. Households' income estimates

We use the usual definition of household disposable income, i.e.

$$DI = C + S, \tag{1}$$

where:

DI – disposable income of households,

C – consumption of households,

S – savings of households;

- (i) we again use an unconventional approach to estimate households' disposable income by estimating households' arrears (this is how much households owe for housing and related services); we also used official estimates of wage and

pension arrears and, by subtracting estimates of households' arrears, we obtained a proxy for forced savings;

- (ii) total households' savings were estimated by adding forced savings, financial savings in hryvnias and "hard currency", and "household investment" (investment in housing and the shadow economy);
- (iii) financial savings in hryvnias were calculated from official monetary statistics in the following way:
financial savings in hryvnias = change of cash stock outside banks + change of households' deposits – change of credits outstanding to households.
Moreover, we tried to estimate an increase of financial savings in "hard currency" by using the same approach as for financial savings in hryvnias (it is allowed to have hard-currency deposits in Ukraine) and adding net purchases of "hard currency"; the result was then multiplied by the average exchange rate;
- (iv) finally, we add savings and consumption to obtain a crude estimate of total households disposable income;
- (v) the crude estimates were adjusted in the national account framework described in Section I.

III. Investment and net exports estimates

- (i) the crude estimate of investment was derived by adding estimates of "household investment" and official data on investment;
- (ii) total exports and imports were estimated adding our estimates of "cross-border" trade to official data;
- (iii) final estimates of investment and net exports were derived using national accounts.

IV. Balancing national accounts and estimating volumes

- (i) final estimates of all components of national accounts in current prices were derived within the national accounts framework and balanced on an annual basis;
- (ii) quarterly estimates were obtained in a similar way but we did not check their consistency within national accounts framework (because of insufficient data); instead, the only check was time consistency (i.e. whether a sum of quarterly estimates equals annual estimate);
- (iii) estimates of all components of national accounts were preceded by estimating deflators with the base year 1997 (as 1997 was a benchmark year);
- (iv) estimates of all components in 1997 hryvnias were obtained by dividing nominal values by appropriate deflators.

The quarterly series of total and official GDP for 1995–98 are given in Table I. These series are both in current and 1997 hryvnias. The structure of total GDP with respect to official and unofficial transactions is presented in Table 2. The GDP and its components' growth rates in constant prices are given in Table 3.

Table 1. GDP (total and its components) for 1995-98 in bn hryvnyas

	1995	1996	1997	1998
GDP Total	77.2	113.0	126.3	143.3
of which Official *	54.5	81.5	93.4	103.9
1. Private Consumption Total	50.5	74.9	83.2	98.1
of which Official	30.1	47.4	53.9	61.8
2. Government Consumption	11.6	17.7	22.3	23.6
3. Investment	17.0	22.3	24.1	26.2
of which Official	14.5	18.5	20.0	21.5
3.1. Investment in Fixed Assets	15.2	20.8	22.803	24.9
of which Official	12.8	17.0	18.7	20.3
3.2. Change in Inventories	1.8	1.5	1.3	1.3
of which Official	1.8	1.5	1.3	1.3
4. Exports	28.7	41.6	42.6	46.9
of which Official	25.7	37.2	37.9	41.4
5. Imports	30.6	43.5	46.0	51.5
of which Official	27.3	39.3	40.8	44.5

* 'Official' indicates GDP and its components based on officially published series by Derzhcomstat; they include some estimates of the shadow and natural economy transactions

Source: Official GDP and its components for 1995–98 – Derzhcomstat, others – CASE estimates

Table 2. Estimates of official and unofficial GDP for 1995–98

	1995		1996		1997		1998	
	bn Hrv	%	bn Hrv	%	bn Hrv	%	bn Hrv	%
GDP Total	77.2	100.0	113.0	100.0	126.3	100.0	143.3	100.0
Official Estimate	54.5	70.7	81.5	72.1	93.4	73.9	103.9	72.5
- <i>Shadow and Natural Sectors</i>	8.2	10.7	17.5	15.5	17.2	13.6	23.3	16.2
Unofficial Estimate *	22.6	29.3	31.5	27.9	32.9	26.1	39.5	27.5
Total Shadow & Natural Estimate	30.9	40.0	49.0	43.3	50.1	39.6	62.8	43.8

* Unofficial estimate comprises shadow and natural transactions not included in the official estimate

Source: Official GDP and its components for 1995–98 – Derzhcomstat, others – CASE estimates

Table 3. GDP and its components for 1996–1998 in 1997 hryvnyas (annual % change)

GDP Total and its components	Year		
	1996	1997	1998
GDP	-6.0	-1.7	-0.3
Private Consumption	-4.5	0.7	4.0
Government Consumption	-5.4	-2.3	-3.4
Investment	-22.4	0.4	1.2
Investment in Fixed Assets	-18.9	2.2	2.6
Exports	17.2	-4.4	-16.1
Imports	15.0	-2.1	-15.5

GDP Official and its components	Year		
	1996	1997	1998
GDP	-10.0	-3.0	-1.7
Private Consumption	-9.5	-1.6	3.4
Government Consumption	-5.4	-2.3	-3.4
Investment	-25.9	0.1	1.5
Investment in Fixed Assets	-22.4	2.2	3.2
Exports	16.9	-5.4	-17.1
Imports	15.8	-4.6	-17.0

Source: Official GDP and its components for 1996–98 – Derzhcomstat, others – CASE estimates

4. Macroeconomic Model

Macroeconomic developments reflect the interaction of many economic variables and relationships [see e.g. Agenor and Montiel, 1996]. The following paragraphs describe those which are of particular importance to CASE/HIID projections.

A traditional macroeconometric model for a transition economy is, to all intents and purposes, not feasible. Even modern macroeconometric models, such as that of Allen and Hall (1997), could not be applied easily. In the Ukrainian case, this is much more complicated due to statistical problems: official estimates of national accounts are not

very reliable, statistics on the private sector are scarce and unreliable. These require a lot of 'heroic' assumptions and the use of unorthodox methods of macroeconomic model construction [on modeling transition economy see e.g. Charemza et. al., 1997, 1998; Gronicki, 1993, 1997].

The CASE/HIID macroeconomic model of the Ukrainian economy has four major components:

- I. Econometric model – based on CASE/HIID's quarterly GDP estimates.
A current version of the model consists of 203 equations.
- II. National accounts block – income accounts.
- III. Consolidated budget block.
- IV. Balance of Payment block.
- V. Monetary block.

Basic assumptions

The model is based on neo-classical macroeconomic theory and contains two basic assumptions: the economic system moves towards equilibrium and agents optimize their behavior. More detailed assumptions on the way we specified particular equations of the model are given in appropriate subsections.

The most recent version of the model was based on the period covering the first quarter of 1995 to the fourth quarter of 1998. Given the short time series (16 observations), we could not apply sophisticated tools of econometric analysis. However, we did try – where it was possible – to estimate parameters in the best possible way and run a thorough verification of the model using available and applicable statistical tests (such as that of Fair, 1996).

We reestimate and calibrate the model each quarter using procedures incorporated in EVIEWS. Moreover, in our forecasting and simulation exercises some parameters of the model are fixed at assumed levels (reflecting our assumptions on economic policy). Conclusions of the model and forecasts are also made using EVIEWS.

Domestic demand

Two broad categories of domestic demand are distinguished: consumption and investment subdivided into various private and public sector components. Private consumption is defined as a sum of individual consumption (by households) and consumption by non-profit institutions.

Aggregate domestic demand is defined as

$$AD = C + FA + CHINV + G, \quad (2)$$

where:

- AD – aggregate demand,
- C – consumption by households and non-profit institutions,
- FA – investment in fixed assets,
- CHINV – change in inventories,
- G – government consumption.

Consumer demand

In this model we apply a simple inter-temporal theory of consumer behavior augmented by assumptions concerning parallel markets (i.e. shadow economy). We follow the Muellbauer-Deaton theory of consumer behavior [see e.g. Deaton, 1992; Muellbauer, 1994] and assume that there is a representative consumer who has preferences defined over consumption in two periods, 1 and 2. As usual, his/her tastes are represented by a utility function which he/she maximizes – subject to the inter-temporal budget constraint.

The utility function for the consumer who demands both the shadow and official good and earns income both in the shadow and official economy, and an appropriate inter-temporal budget constraint, are as follows

$$V = U(c_1) + U(c_2)/(1+a), \quad (3)$$

$$c_1 + c_2/(1+r_1) = A_1 + A_2/(1+r_1),$$

where:

- V – total utility,
- U(.) – a concave period utility function,
- a – a constant rate of time preference,
- c – real consumption,
- A – households wealth,
- R – real interest rate.

The two-period model can be easily extended to a life-cycle model. Its basic premise is to extend the two-period 'today versus tomorrow' model to many periods with consumers choosing when to spend their lifetime resources according to their needs and tastes.

The consumer choice leads to the individual consumer demand. The individual consumption typically depends on real personal disposable income, changes in the rate of inflation, monetary and financial conditions, and leading indicators of consumer confidence and retail sales. Moreover, we apply error-correction mechanisms to ensure that an equilibrating tendency is preserved [see e.g. Charemza and Deadman, 1997]. The following relations summarize the individual consumption demand:

Private Consumption [2]:

$$C97T/LTOT = ct[DIT/LTOT, DEFCT, OEV], \quad (4)$$

$$C97OFF/LTOT = coff[DI/LTOT, DEFCOFF, OEV], \quad (5)$$

$$CT = C97T*DEFCT, \quad (6)$$

$$COFF = C97OFF*DEFCOFF, \quad (7)$$

where:

- C97T, C97OFF* – private consumption in 1997 hryvnyas (in 5 categories: foodstuff, alcoholic beverages, durables, non-durables and services), total and official respectively,
- CT, COFF* – private consumption in nominal terms total and official respectively, in hryvnyas,
- LTOT* – population (period average),
- DEFCT, DEFCOFF* – individual consumption deflator,
- DIT, DIOFF* – disposable income of households, total and official respectively, in hryvnyas
- OEV* – other exogenous variables.

Households and non-profit organisations' disposable income:

$$DIT = (wG*LG + woffNG*LNG + p*PEN + ub*UN + PROFOFF + IDOFF)*(1 - itax) + (wshNG*LNG + PROFSSH + IDSH), \quad (8)$$

$$DIOFF = (wG*LG + woffNG*LNG + p*PEN + ub*UN + PROFOFF + IDOFF) * (1 - itax), \quad (9)$$

[2] Throughout the paper the following convention is applied: names in italic denote exogenous variables, otherwise endogenous.

where:

- DIT, DIOFF – disposable income, total and official respectively, in hryvnyas,
w, woff, wsh – prefix denoting average wage in *G* – budgetary sector, *NG* – non-budgetary sector official and shadow respectively, in hryvnyas,
L – prefix denoting average number of employees,
p – average pension,
PEN – average number of pensioners,
ub – average unemployment benefit,
UN – average unemployment,
 PROFF – distributed profits plus farmers' income, official, in hryvnyas,
 PROFSH – "shadow" income, in hryvnyas,
 IDOFF, IDSH – other transfers, official and shadow respectively, in hryvnyas,
itax – average personal income tax rate.

Wage and earnings assessments take into account a number of key factors. Extensive use is made of the pattern of current wage settlement as a leading indicator with productivity rates also influencing real wages. Public sector wages are generally based on announced policies.

Investment

Simulations of the macroeconomic effects of various policy measures or other exogenous shocks depend on how the components of aggregate demand respond to changes in interest rates and exchange rates. Unfortunately, the modeling of aggregate investment demand has not proven to be a highly successful endeavor in empirical economics [see e.g. a critique by Blundell et al., 1992]. This is especially difficult in any transition economy, in Ukraine in particular [see e.g. Gronicki and Piętko, 1998]. This is related, in part, to the optimal behavior of firms in pre-transition and transition economies [see Blanchard, 1997].

In the Ukrainian economy, most investment is still autonomous investment. The role of interest rates in investment demand is small. Hence, specification of the business investment demand function is as follows:

Investment:

$$FA97OFF = FA97OFF_0 + faoff(R, GDP97OFF), \quad (10)$$

$$FA97SH = FA97SH_0 + fash(GDP97T, EXRATE/PPI, OEV), \quad (11)$$

$$FAOFF_o = faoff(DIFOFF), \quad (12)$$

$$FAOFF = FA97OFF * DEFFAOFF, \quad (13)$$

$$FASH = FA97SH * DEFFASH, \quad (14)$$

where:

- FA97OFF, FA97SH – investment in fixed assets in 1997 hryvnyas, official and shadow respectively,
 FA97OFF_o, FA97SH_o – autonomous investment in 1997 hryvnyas, official and shadow respectively,
 R – nominal interest rate,
 GDP97OFF – official GDP in 1997 hryvnyas,
 GDP97T – total GDP in 1997 hryvnyas,
 EXRATE – exchange rate,
 PPI – producer price index,
 DIFOFF, DIFSH – disposable income of enterprises (part of the operating surplus in the enterprise sector), official and shadow respectively, in hryvnyas,
 FAOFF, FASH – investment in fixed assets in nominal terms, official and shadow respectively, in hryvnyas,
 DEFFAOFF, DEFFASH – investment in fixed assets deflator, official and shadow respectively, in hryvnyas,
 OEV – other exogenous variables.

Government Consumption

Government consumption is defined as a sum of wage related and non-wage expenditures. The latter is treated as an exogenous policy variable. Government wage expenditures represents the product of government employment and the average wage in the government sector.

Government consumption:

$$G97 = VAG97 + ICG97 + REG97, \quad (15)$$

$$G = VAG + ICG + REG, \quad (16)$$

$$VAG = wG*(1 + \nu)*LG + OLCG + DG, \quad (17)$$

$$VAG97 = VAG/DEFVAG, \quad (18)$$

$$ICG97 = IC/DEFICG, \quad (19)$$

$$REG97 = REG/DEFREG, \quad (20)$$

where:

- G97, G – government consumption, in 1997 hryvnias and at current prices respectively,
- VAG97, VAG – value added in 1997 hryvnias and at current prices, respectively,
- ICG97, ICG – government intermediate consumption in 1997 hryvnias and at current prices, respectively,
- REG97, REG – residual in 1997 hryvnias and at current prices, respectively,
- wG – average wage in budgetary sector, in hryvnias,
- v – payroll rate on wages,
- OLCG – other labor costs, in hryvnias,
- LG – average employment in budgetary sector,
- DG – operating surplus in budgetary sector (depreciation of fixed assets), in hryvnias,
- DEFVAG – deflator of value added in budgetary sector,
- DEFICG – deflator of intermediate consumption in budgetary sector,
- DEFREG – deflator of residual.

Revenues of consolidated government budget (incl. Pension Fund):

$$REV = (DI/(1-itax))*itax + ind*GDP + exc*GDP + wG*v*LG + wNG*v*LNG + OTH, \quad (21)$$

where:

- REV – total revenue, in hryvnias,
- DI – disposable income of households, in hryvnias,
- itax – average (or effective) personal income tax rate,
- ind – average indirect tax rate (measured as a ratio of VAT and import duties to GDP),
- GDP – GDP, in hryvnias,
- exc – average excise rate (measured as a ratio of excise revenue to GDP),
- wG, wNG – average wage in budgetary and non-budgetary sectors, in hryvnias,
- v – payroll rate on wages, mark-up on wages,
- LG, LNG – average employment in budgetary and non-budgetary sectors,
- OTH – other revenues, in hryvnias.

Expenditure of consolidated government budget (incl. Pension Fund):

$$\begin{aligned} \text{EXPEN} = & \text{wGCASH} * (1 + v) * \text{LG} + \text{OLCG} + p * \text{PEN} + ub * \text{UN} + \\ & + \text{ICGCASH} + \text{OTHEXCASH}, \end{aligned} \quad (22)$$

where:

EXPEN	– total expenditure, paid, in hryvnyas,
wGCASH	– average wage in budgetary sector, paid, in hryvnyas,
v	– payroll rate on wages, mark-up on wages,
LG	– average employment in budgetary sector,
OLCG	– other labor costs, paid, in hryvnyas,
p	– average pension, paid, in hryvnyas,
PEN	– average number of pensioners,
ub	– average unemployment benefit,
UN	– average unemployment,
ICGCASH	– government intermediate consumption, paid, in hryvnyas,
OTHEXCASH	– other expenditures (investment, subsidies, other transfers), paid, in hryvnyas.

Budget deficit:

$$\text{BDEF} = \text{REV} - \text{EXPEN}, \quad (23)$$

where:

BDEF	– budget deficit, in hryvnyas,
REV	– total revenue, in hryvnyas,
EXPEN	– total expenditure, in hryvnyas.

Equations (21 – 23) are constructed on the cash basis. To link government expenditures with government consumption in National Accounts (which is estimated on accrual basis) we introduced a bridge equation explaining the generation of budgetary arrears.

Supply potential and output gaps

In this model we estimate equations for value added in major sectors of the Ukrainian economy (27 branches). They include manufacturing, mining, public utilities, transport and communication, trade etc. Value added in agriculture, other private services and non-market services are estimated in the National Account block using non-econometric methods. This part of the model is still under construction.

An example of estimating value added

Below we show a simplified way of estimating production function elasticities, combining data reconstruction and usual econometric techniques. We decided to use two-factor production functions, where an average employment is a proxy for labor input and an average capital stock is a proxy for capital input.

- (i) Average employment,

$$\text{Labor}(t) = \text{Labor}^l(t) + \text{Labor}^r(t), \quad (24)$$

where:

Labor – average employment in the sector,

Labor^l – official quarterly estimates,

Labor^r – estimated complementary employment,

t – time index.

The complementary employment includes CASE/HIID estimates of employment in the shadow economy and is estimated using different statistical techniques as well as applying some experts' judgement.

- (ii) Average capital stock derived from:

$$K(0) = ck * VA(0), \quad (25)$$

$$K(t) = K(t-1) * (1-d(t)) + I(t), \quad (26)$$

$$K_{avg}(t) = (K(t) + K(t-1)) / 2, \quad (27)$$

$$I(t) = I^l(t) + I^r(t), \quad (28)$$

where:

K – capital stock in 1997 hryvnyas,

ck – a constant,

VA – value added,

d – assumed depreciation rate,

I – investment in fixed assets, I^l – official quarterly estimates, I^r – estimated complementary investment.

- (iii) Quarterly estimates of investment are obtained by balancing official annual and quarterly series and through judgmental distribution of unobserved complement.

(iv) Value added has to equal factor incomes:

$$VA(t) = LaborCosts(t) + Taxes(t) - Subsidies(t) + \text{OperatingSurplus}(t), \quad (29)$$

$$VA97(t) = VA(t)/P(t), \quad (30)$$

where:

VA	– value added in nominal terms,
LaborCosts	– employees compensation,
Taxes	– taxes on production,
Subsidies	– subsidies,
OperatingSurplus	– operating surplus,
VA97	– value added in 1997 hryvnyas,
P	– value added deflator.

(v) Production function may have the following form:

$$\log(VA96(t)/Labor(t)) = f(tp, \log(K(t)/Labor(t)), \quad (31)$$

where:

tp – proxy for technological and technical progress.

(vi) A complete block should take into account that only a fraction of total statistical population is actually observed quarterly

$$Output(t) = Output^l(t) + Output^r(t), \quad (32)$$

$$Output^l(t) = Intermediate^l(t) + VA^l(t), \quad (33)$$

$$Output^r(t) = Intermediate^r(t) + VA^r(t), \quad (34)$$

$$Intermediate(t) = Intermediate^l(t) + Intermediate^r(t), \quad (35)$$

$$VA(t) = VA^l(t) + VA^r(t), \quad (36)$$

$$VA^l(t) = LaborCosts^l(t) + Taxes^l(t) - Subsidies^l(t) + \text{OperatingSurplus}^l(t), \quad (37)$$

$$VA^r(t) = LaborCosts^r(t) + Taxes^r(t) - Subsidies^r(t) + \text{OperatingSurplus}^r(t), \quad (38)$$

$$\text{Labor}(t) = \text{Labor}^l(t) + \text{Labor}^r(t), \quad (39)$$

$$\text{LaborCosts}(t) = \text{LaborCosts}^l(t) + \text{LaborCosts}^r(t), \quad (40)$$

$$\text{Taxes}(t) = \text{Taxes}^l(t) + \text{Taxes}^r(t), \quad (41)$$

$$\text{Subsidies}(t) = \text{Subsidies}^l(t) + \text{Subsidies}^r(t), \quad (42)$$

$$\text{OperatingSurplus}(t) = \text{OperatingSurplus}^l(t) + \text{OperatingSurplus}^r(t), \quad (43)$$

where:

Output – output,

Intermediate – intermediate consumption.

(vii) In the above relations

– $\text{Labor}^l(t)$,

– $\text{Output}^l(t)$,

– $\text{Taxes}^l(t)$,

– $\text{Subsidies}^l(t)$

are actually observed, the rest are CASE/HIID estimates.

Production functions are used to estimate potential output. In this paper, we estimate the potential output (proxied by the GDP) using the methodology set out in DeMassi (1997), Turner et al. (1996).

The output gap is measured as the percentage difference between actual GDP in constant prices, and estimated potential GDP. The latter is based on a production function approach, taking into account the capital stock, changes in labor supply, factor productivities and underlying non-accelerating wage rates of unemployment (in the Ukrainian case we used a sum of officially registered unemployment and an estimate of hidden unemployment).

Labor demand and supply

Employment and other labor market variables are commonly assessed in relation to changes in the levels of actual and expected output. The unemployment rate is computed from employment and labor supply estimates, with the latter assessed judgmentally on the basis of demographic trends and participation rate assumptions.

Labor demand:

$$LD = \sum Ldz, \quad (44)$$

$$Ldz = Vdz/Wdz, \quad (45)$$

where:

LD – demand for labor (employment), excluding hidden unemployment,

Ldz – demand for labor in a *dz* sector,

Vdz – value added in *dz* sector,

Wdz – labor productivity in *dz* sector.

Supply of labor:

$$LS \text{ – labor supply (exogenous).} \quad (46)$$

Unemployment:

$$UN = LS - LD, \quad (47)$$

$$UNH = UN - UNR \quad (48)$$

where:

UN – total unemployment,

UNH – hidden unemployment,

UNR – registered unemployment,

LD, LS – labor demand and supply.

Foreign trade and balance of payments

Particular attention in the model is given to ensuring the consistency of international trade volume and price, trade representing a principal channel through which developments in other economies affect the Ukrainian economy. In addition, we have developed a cross section-time series foreign trade model. It covers two-digit SITC trade categories and is a basis for trade equations in the quarterly model. Special adjustment and reconciliation procedures are involved in linking balance of payment, customs-basis foreign trade projections to the national-accounts projections.

This part of the model is still under construction and we have only been using aggregated imports and exports equations.

Volumes

The initial estimate of import volume growth for manufactured goods is derived from an equation in which the main explanatory variables are the activity variable and the lagging competitive position of the Ukrainian economy. The activity variable in the import equation is specified in such a way as to reflect the short- and long-term response of imports to a change in demand. The competitive position of the Ukrainian economy is measured by the real exchange rate (hryvnya/US dollar divided by PPI).

Imports of goods:

$$\text{MNE97OFF} = \text{mne}[(\text{C97OFF} + \text{G97} + \text{FA97OFF} + \text{X97OFF}, \text{EXRATE}/\text{PPI}, \text{OEV}], \quad (49)$$

$$\text{MNEOFF} = \text{MNE97OFF} * \text{DEFMNEOFF} \quad (50)$$

$$\text{MNEOFF\$} = \text{MNEOFF}/\text{EXRATE}, \quad (51)$$

$$\text{M97SH} = \text{msh}(\text{EXRATE}/\text{PPI}, \text{OEV}), \quad (52)$$

$$\text{MSH} = \text{M97SH} * \text{DEFMSH}, \quad (53)$$

$$\text{MSH\$} = \text{MSH} / \text{EXRATE}, \quad (54)$$

where:

- MNE97OFF** – imports of non-energy goods and services in 1997 hryvnias, official,
- MNEOFF** – imports of non-energy goods and services in hryvnias, official,
- MNEOFF\$** – imports of non-energy goods and services in US dollars, official,
- C97OFF** – private consumption in 1997 hryvnias, official,
- G97** – government consumption in 1997 hryvnias,
- FA97OFF** – investment in fixed assets in 1997 hryvnias, official,
- X97OFF** – exports in 1997 hryvnias, official,
- EXRATE** – exchange rate of hryvnya to the US dollar,
- PPI** – PPI,
- DEFMNEOFF** – non-energy import deflator (in hryvnias), official,
- OEV** – other exogenous variables,
- M97SH** – imports in 1997 hryvnias, shadow,
- MSH** – imports in hryvnias, shadow,
- MSH\$** – imports in US dollars, shadow,
- DEFMSH** – import deflator (in hryvnias), shadow.

Energy imports are assumed to be exogenous and adjusted in the forecasting period to the level of predicted economic activity. The link to the production block of the model is still under construction.

Export volume estimates are based on developments in neighboring countries and the competitive position. The former is defined as a weighted average of real imports growth in other countries, while competition effects (in a long run) are proxied by changes in real exchange rate.

Exports of goods and services:

$$XOFF\$ = xoff\$[MWORLD, EXRATE/PPI], \quad (55)$$

$$XOFF = XOFF\$ * EXRATE, \quad (56)$$

$$X97OFF = XOFF/DEFXOFF, \quad (57)$$

$$XSH = XSH\$ * EXRATE, \quad (58)$$

$$X97SH = XSH/DEFXSH, \quad (59)$$

where:

- X97OFF, X97SH – exports in 1997 hryvnyas, official and shadow respectively,
- XOFF\$, XSH\$ – exports in US dollars, official and shadow respectively,
- XOFF, XSH – exports in hryvnyas, official and shadow respectively,
- MWORLD – volume of world imports,
- EXRATE – exchange rate of hryvnyas to the US dollar,
- PPI – producer price index,
- DEFXOFF, DEFXSH – exports deflator (in hryvnyas), official and shadow respectively.

Cross-border trade

Imports in the shadow economy are related to the real exchange rate and overall economic activity. The estimated price elasticity of imports is higher than in the official economy given the higher flexibility of agents operating in the shadow economy.

Shadow exports are assumed to be exogenous in the model.

Balance of payments

Estimates for revenues and expenditures for goods and services are derived from the exports and imports equations using special translation equations. Other items on the

current account which include investment income and foreign transfers are set to be exogenous.

Movements in external assets and liabilities are linked to capital flows which are set to be exogenous.

Prices

The assessment of domestic prices and inflation trends depends crucially on unit costs, the levels of demand and supply potential, and foreign prices. An allowance is also made for a number of special factors affecting prices like changes in taxes and subsidies and administered price regimes.

In this model we initially estimated CPI and PPI using a CASE monthly model of inflation [3]. These estimates are used in the quarterly model for adjusting forecasts.

Deflator of private consumption:

$$\text{DEFKOFF} = \text{defkoff} [\text{CPI}, \text{PPI}, \text{OEV}], \quad (60)$$

$$\text{DEFCT} = \text{defct} [\text{CPI}, \text{PPI}, \text{OEV}], \quad (61)$$

where:

- DEFKOFF, DEFCT – private consumption deflator, official and total respectively,
- CPI – consumer price index,
- PPI – producer price index,
- OEV – other exogenous variables.

Other deflators are obtained in a similar way. The initial domestic inflation impulse is first estimated through CPI and PPI indexes and then distributed to other deflators. The overall set of domestic expenditure and foreign trade prices are then combined to give total domestic demand and output deflators. The specific treatment of trade prices is discussed in more detail in the section concerning foreign trade.

Money and credit

Initial estimates of monetary aggregates are obtained using the CASE monthly model. As usual, M1 is the narrowly defined money supply, i.e. currency plus domestic demand deposits. M2 is a broadly defined money stock which add to M1 domestic currency and

[3] An outline of the model is given in de Menil et al.

foreign currency savings deposits. We assumed that there is an equilibrium on the monetary market and demand for money (credits outstanding to households, enterprises and government) depends on the domestic activity and market interest rate (in this case we use an average credit rate) with allowance for error-correction mechanism.

Money Demand:

$$M/DEFGDPOFF = M[GDPOFF, R, OEV], \quad (62)$$

where:

- M – demand for money,
- GDPOFF – gross domestic product,
- DEFGDPOFF – GDP deflator,
- R – interest rate,
- OEV – other exogenous variables.

5. Projection Methods

The model has been used extensively for forecasting and simulation of alternative economic policies. Forecasts have been published since the beginning of 1998 and simulations since the fourth quarter of 1997.

The projections in both forecasts and simulations are conditional on technical assumptions concerning exchange rates, prices controls, and the choice of economic policies – fiscal, monetary and structural:

- (i) The exchange rate regime is generally assumed to remain constant over the projected period; e.g. for 1999 baseline forecasts we follow the NBU's assumption on the devaluation rate and fixed currency band; in alternative forecasts and scenarios we assume different exchange rate developments.
- (ii) In the baseline projections, assumptions regarding regulated prices are derived from the most recent budgetary statements; otherwise, we assume different time schedule for an increase of regulated prices.
- (iii) In the baseline projections, assumptions regarding fiscal and monetary policy are generally based upon published official policies; however, official public sector expenditure and revenue projections might be altered when the inflation and interest rates deviate from the official budgetary statements; in alternative projections we assume either more or less restrictive policies.

The macroeconomic model is used to help to ensure national and international consistency, though a considerable amount of expertise and judgement underpins CASE/HIID's assessments. The following steps outline the projection technique used in constructing forecasts and scenarios:

- (i) We start each projections running a monthly model of inflation and sub-models of foreign trade and sectors.
- (ii) We assume a plausible policy-mix in Ukraine; this is the most controversial step; sometimes we had to change official assumptions when they were either inconsistent or simply unattainable.
- (iii) Finally, we assume a possible development of external business cycle.

The preliminary projections are presented to, and discussed at, the quarterly meeting of CASE/HIID where senior researchers provide their analyses and detailed comments (for projection steps see an attached chart). We used these in preparing final projections.

Assumptions on external environment

A starting point for final projections is an evaluation of the Ukrainian external position. We used selected forecasts of output, inflation, foreign trade and money for major industrial countries from the IMF and OECD (semi-annual projections) as well as from major investment banks (JP Morgan, Chase Manhattan), consulting firms (DRI) and semi-governmental institutions (DIW Berlin). Afterwards, we applied a consensus forecast to the multi-country model constructed by Ray Fair (1994) to get a consistent and balanced forecast of the world economy – especially of the largest importers of Ukrainian goods and services. This procedure is run only twice a year when the semi-annual projections of IMF and OECD are available.

Fiscal Policy

We change our assumptions on fixed budget expenditures (i.e. those excluding interest payments and government debt service) and on tax rates only twice a year: first, when a project of the budget is available and, second, when the budget is approved. Usually it concerns October and January projections.

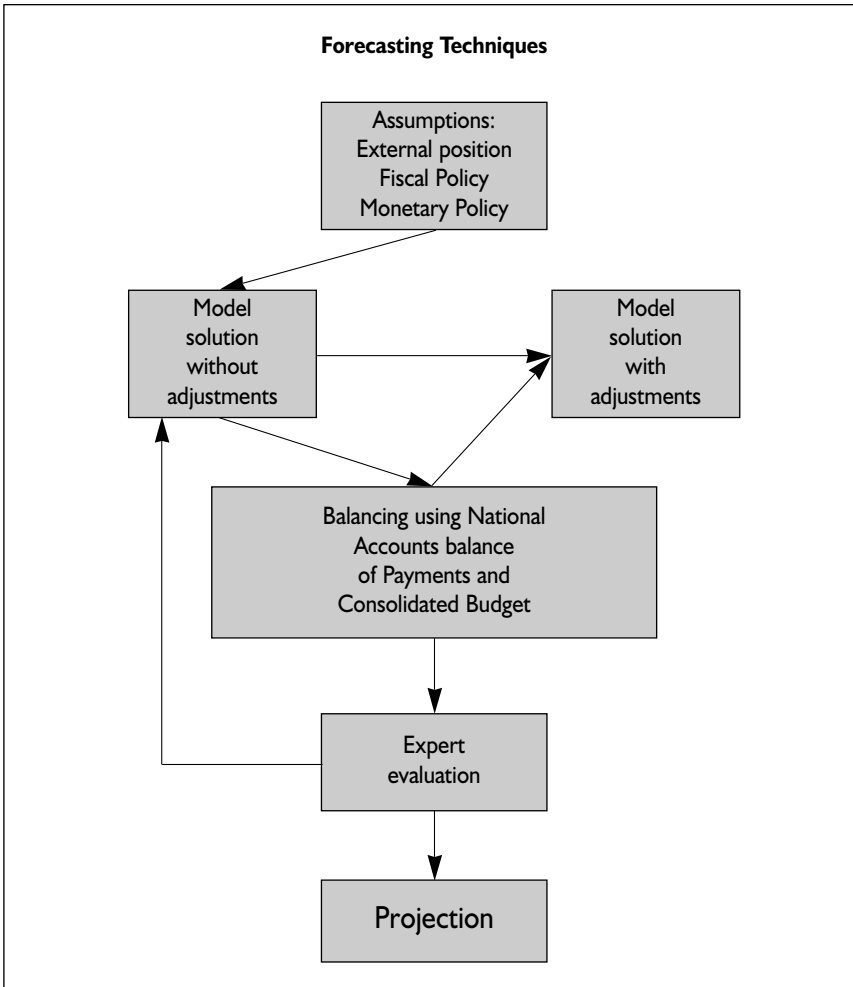
Monetary Policy

In our assumptions on monetary policy we prefer to disregard official statements and try to design our own view of future monetary policy. We therefore make use of a host

of experts' opinions on the future demand for money, NBU and commercial interest rates and exchange rate fluctuations.

Finally, in presenting quarterly demand, output and price projections, it should be stressed that all reported estimates and forecasts are not seasonally adjusted and shown in terms of percentage changes at annual rates.

An example of the application of the above projection technique is analyzed in the following section.



6. Alternative Scenarios for the Ukrainian Economy

Introduction

In this section, we present three scenarios of macroeconomic developments in Ukraine for the period 1999–2000 on the basis of the CASE/HIID macroeconomic model. The first is a baseline scenario where we assume the continuation of current economic policies and the maintenance of the political status quo. The second assumes more favorable external conditions for Ukraine combined with the introduction of economic reforms. Finally, the third assumes unfavorable external developments and the reintroduction of 'socialist' macroeconomic policies. We preceded the presentation of these scenarios with an analysis of recent macroeconomic developments in Ukraine.

Our analysis starts with the most dynamic period of 1996–1997 in which Ukraine achieved macroeconomic stabilization. It was widely praised by foreign experts. However it was mainly sustained by means of monetary discipline without simultaneous fiscal and structural adjustments. Thus there was low inflation relative to other economies in transition and a stable exchange rate. At the same time a significant part of the budget deficit was hidden in the form of arrears. As a result, Ukraine's credibility in the international financial markets was severely damaged. This was followed by an increase in borrowing costs and a dependence of liquidity on foreign resources. Moreover, Ukraine could not achieve an economic take-off.

The 1997 Asian financial crisis, which was followed by the Russian crisis the year after, accelerated the depletion of foreign reserves and, together with lower world demand, exposed the fragility of Ukrainian stabilization.

The starting point for all three scenarios is the beginning of the second quarter of 1999. Ukraine is experiencing a very slow recovery after the Russian crisis. A tough schedule of debt repayments in the next several years and the lack of access to foreign capital have resulted in Ukraine verging on insolvency. Presidential elections at the end of 1999 put strategic decisions on hold and increased speculation on the future of economic policy.

Assumptions, results and conclusions

None of the scenarios assume any major structural changes (radical reforms) for the next two years. We assessed the effects of different developments in world demand (including Russian economic developments), availability of financing from international institutions and commercial sources, fiscal and monetary measures as well as privatization strategy. The summary of these results is given in Table 4 at the end of this section.

Baseline Scenario

Assumptions

- Fiscal policy is simply a continuation of the policies in recent years based on cutting all budgetary expenditures barring public debt servicing; these cuts would depend on current revenues and potential sources of financing the budget gap; the budget deficit is set at 1.5% of GDP in 1999 (or 1.0% of GDP using the Ukrainian Ministry of Finance methodology which includes privatization receipts) and 0.5% in 2000 (or 0.0%).
- Monetary policy provides a soft financing of the government and leads to money base growth of 30% in 1999 and 28% in 2000.
- Real commercial interest rates remain high at 22% in 1999 and 20% in 2000 (on average).
- Hryvnya depreciates by 35% by the end of 1999, reaching the bottom of the currency corridor (4.6 UAH per USD), and by 24% by the end of 2000.
- The privatization policy and willingness to attract foreign capital still remain very tentative – foreign direct investment reaches USD 300 million in 1999 and USD 720 million in 2000; the budget receives 60% and 22% respectively.
- The world business cycle improves starting from the end of 1999. However both Russia and other CIS countries stagnate.
- World commodity prices (for imported oil but also for exported metallurgical products) rise slightly through the second half of 1999 and 2000.
- Access to foreign financing in 1999 is limited to international institutions (IMF, World Bank, EBRD, EU) or Japanese government (USD 1.9 billion total); in 2000 USD 0.5 billion Eurobonds would be issued in western financial markets; total credits might reach USD 2.4 billion.

Analysis of projection

1) Basic macroeconomic aggregates

1999 would be a year of overcoming the results of the 1997/98 world crisis, however macroeconomic aggregates would point to further economic decline. Real disposable incomes of households would be roughly at the level of 1998 and private consumption would decrease by 1.2%. A tough state budget would require a cut in government consumption by about 9%. Simultaneously, net government arrears would increase by 6% of GDP. The projected drop in investment in fixed assets by 4.7% reflects the lack of a pro-investment climate (continuing economic decline, pre-election pessimistic expectations and high interest rates) as well as structural problems (small banking system

overburdened with bad debts and unwilling to allocate resources in the real economy). A relatively smaller drop in investment in inventories would lead to a fall in overall investment by 3.6%. Unfavorable world prices and poor demand for Ukrainian products – even if improving by the end of 1999 – would result in a decrease in exports by 11%. A decline in imports would be higher (by 15%) than that which caused a devaluation of hryvnya in September 1998 as well as restrictions on the currency market. It would partially absorb the negative tendencies in all other GDP components. Overall official GDP is predicted to decrease by 1.5%.

The unofficial economy would grow due to positive dynamics of net exports. This reflects the tendency of transferring official exports to the shadow economy after currency controls introduced in the aftermath of the financial crisis in August-September 1998. Shadow imports would be falling due to a devaluation effect and stagnating real incomes of the population. Unofficial private consumption and investment are slightly declining; however at lower rates than officially reported. Thus total GDP (a sum of official and unofficial GDP) would fall by 0.1%.

2000 would bring a further (albeit smaller) fall in official GDP (by 0.7%) with growing private demand (by 1.4%) and exports (4.3%). The former would be due to an increase in real incomes by 2% and the latter to favourable external conditions. Debt servicing requirements would further cut government consumption (by 8%). This would not prevent an additional increase of net governmental arrears by 5% of GDP. Investment in fixed assets would start growing again at the end of 2000. Investment in inventories would show a similar trend. Import growth would match the rise of final demand and increase by 3.1%.

All the unofficial components of GDP would grow. Lack of structural changes, which could have placed some activities out of the shadow economy, would result in a much faster recovery of the unofficial economy. Finally the entire economy would grow by 2.7%.

2) Budget

Total revenues of the consolidated budget (excluding privatization) are supposed to reach 24% and 23% of official GDP in 1999 and 2000 respectively. The lowering tendency would not result from nominal changes in tax rates but from increasing tax evasion. In addition, a decreasing share of indirect taxes would not correspond to consumption which would grow faster than GDP. In 1999 and 2000 expenditures are set according to the assumed budget deficit at the level of 25% and 24% of GDP respectively. However, the accrued budget deficit (that is adding increases in budgetary indebtedness to paid expenditures) would account for 7% and 5% of GDP respectively. Debt servicing share in expenditures might reach 10% and 11% respectively.

Government financial requirements – a sum of budget deficit and debt repayment – would mostly be covered by domestic financing (55% in 1999 and 65% in 2000). The NBU would be the biggest purchaser of T-bills on the primary market [4] (net NBU financing at the level of UAH 2.2 billion in 1999 and UAH 4.3 billion in 2000). Foreign financing in 1999 would be limited to credits from the international institutions (World Bank, European Union and Japanese government) – USD 610 million (34% of the financial needs). In 2000, Ukraine would manage to sell USD 500 million of new Eurobonds; total amount of credits would amount to USD 800 million (29% of the financial needs). Assumed revenues from privatization would cover only 11% and 6% of financial requirements in 1999 and 2000 respectively.

3) Monetary indicators

NBU lending to the budget and unsterilized purchases of hard-currency would increase money base growth. The overall growth of the money base would reach 30% in 1999 and 28% in 2000. With monetization at the level of 13%, this would lead to significant price increases. In 1999, with an average devaluation of 63%, consumer prices would rise by 26% and producer prices – by 31%. In 2000, hryvnya would depreciate by 29%, CPI and PPI increase by 34% and 29% respectively.

4) Balance of payments

The external position of Ukraine in this period would be very difficult and strongly influenced by the tough schedule of debt repayments.

Due to huge falls in imports, the deficit in foreign trade would be negligible. At the same time, the current account/GDP ratio would be quite small reaching 1.4% in 1999 and 1.1% in 2000. On the capital account side we would expect an inflow of USD 2 billion in foreign credits in 1999. This, together with the small negative balance in portfolio investments and modest foreign direct investments (FDI), would add USD 600 million to the gross reserves of the NBU. At the end 1999, they would reach USD 1.25 billion and cover 4.1 weeks of import. 2000 would be more difficult due to large foreign debt repayments. Balance on credits would be negative. However FDI, which would return to the level of 1998 (over USD 700 million), would improve the overall capital account. Gross reserves, after some fluctuations surrounding the schedule of debt repayments, would grow by over USD 100 million and end up at the level of USD 1.37 billion which corresponds to 4.3 weeks of imports.

[4] At the time of preparing the forecast the Law on the NBU was not yet voted on. According to the new Law, the NBU is not allowed to directly finance the government (neither direct credit nor purchases of T-bills on the primary market).

Optimistic scenario

The scenario's optimism lies in an assumption of more radical budget expenditure adjustments in the face of big foreign debt repayments in 2000, serious privatization, as well as an improvement in the Russian and CIS economies.

The scenario description refers to the baseline presented above.

Assumptions

- More radical expenditure cuts, effective tax rates at the baseline level, a budget deficit at the level of 0.7% in 1999 and 0.5% in 2000 (0.0% deficit in 1999 and 3.2% surplus in 2000 in Ministry of Finance methodology).
- Starting from the second half of 1999 an accumulation of arrears in the form of hidden budget deficit financing would be forbidden.
- Tighter monetary policy (in particular NBU financing of the government); inflow of foreign exchange from credits would be sterilized; the money base would grow by 24% in 1999 and 9% in 2000.
- Growing confidence in hryvnya and the return of more reliable clients to the financial markets; real commercial interest rates would be cut from 20% in 1999 to 15% in 2000 (on average).
- Along with foreign exchange inflows and growing trust in macroeconomic policies, hryvnya would manage to be kept within the corridor until the second half of 2000, thus depreciating by 24% by the end of 1999 and 12% by the end of 2000.
- Large obligations on debt repayments (public debt as well as arrears) and poor access to non-official lenders force Ukraine to reorient its privatization policy towards selling blue-chip assets; in 1999 FDI is at the baseline level of USD 300 million, while in 2000 at the level of USD 1.6 billion of which budget revenues account for 61% and 77% respectively.
- An improvement in the world economy starting from the end of 1999; recovery in Russia and other CIS countries.
- World commodity prices are rising slightly through the second-half of 1999 and 2000 – as assumed in baseline.
- Access to foreign financing in 1999 is limited to international institutions (IMF, World Bank, EBRD, EU) or Japanese government (USD 1.9 billion total); in 2000 Ukraine could expect slightly more credits than in baseline – besides USD 0.5 billion through selling Eurobonds, it would receive more World Bank funding as well as credit lines by foreign governments (total credits amount to USD 2.6 billion).

Analysis of projection

1) Basic macroeconomic aggregates

In 1999, official GDP would fall more than in the baseline scenario (by 3%). This would be the result of contractionary policies, the effects of which would be partially absorbed by private demand and an improvement in net exports. If the government did not want to increase arrears, then it would have to fully cover debt service requirements, reduce investments and subsidies, and cut its consumption by 19.3%. Such a policy should stimulate the private sector. Improvement in the world business cycle (particularly in Russia) as well as pro-reform tendencies would result in a faster post-crisis recovery. Despite slightly higher inflation, real incomes of the population would increase marginally and private consumption would decline by only 0.6%. Investment in fixed assets would decrease at a lower rate than in baseline. Similar trends as in the baseline scenario would be observed in exports and imports.

The unofficial economy would grow faster than in baseline, driven mostly by growth in private consumption. Moreover, unofficial investment would recover closer to the end of 1999. On the other hand, unofficial exports would grow at a lower rate than in baseline due to fewer incentives to operate in the shadow economy. Total GDP would decrease by less than 1%.

In 2000 we would expect a further recovery along with a reallocation of resources. Due to the fiscal squeeze, government consumption would be cut by over 14% which would impede economic growth. However, such a reallocation of resources would support other GDP components. Real incomes of the population and private consumption would record strong growth. These would be followed by growing investment and only small increases in inventories. The investment climate would improve due to cheaper and more accessible investment credits and signs of stabilization. Stronger demand for Ukrainian goods and services, as well as a rise in world prices for Ukrainian exports, would increase exports by about 8%. Imports would follow the recovery of domestic demand and grow faster than exports.

The unofficial economy would deteriorate as part of its activities would move out of the shadow. Unofficial private consumption and exports, in particular, would grow more slowly than in baseline. Total GDP in 2000 would rise by 3.1%.

2) Budget

Total revenues of the consolidated budget (not including privatization incomes) are supposed to reach 24% and 23% of official GDP in 1999 and 2000 respectively. With the projected budget deficit close to 0% of GDP, expenditures amount to 24% and 23% of GDP in 1999 and 2000 respectively. The total increase in budgetary arrears in 1999 would appear in the first half of the year – for the rest of the

forecasting period arrears are not allowed. This would result in a complete end to subsidies, lowering transfers and serious cuts in government consumption. In 2000, debt servicing would account for 11% of all expenditures and represent a smaller burden for the economy than in baseline (2.5% and 2.7% of GDP). This would result from the smaller accumulation of public debt and lower budget deficits in 1999 and 2000.

In 1999, the financial requirements of the budget would be covered by both domestic and foreign sources. Privatization revenues would cover 14% of these requirements. In 2000, the share of domestic sources would be smaller (20%) at the expense of foreign loans (slightly higher than in baseline) but most of the requirements would be covered by privatization (46%). The NBU would still be the main purchaser of T-bills in 1999 (UAH 1 billion net). This would be reversed in 2000 as the private sector (alongside increasing trust in the solvency of the treasury and in the currency), particularly banks, would be willing to place their savings in T-bills and the NBU would not be asked to purchase them.

3) Monetary indicators

In 1999, PPI – which is linked more to the exchange rate dynamic – would grow slightly less than in baseline (30.4% on average). CPI, despite lower money base increase, would end up at a slightly higher level (28.6% Dec-to-Dec compared to 24.1 in baseline). This would be the result of eliminating price controls. In 2000, smaller growth of money base, lower depreciation of hryvnya, and positive tendencies in the economy would lead to lower inflation: CPI might grow by 26.3% and PPI by 21.2% on average.

4) Balance of payments

In 1999, faster growth in exports as opposed to imports would lead to a slightly smaller current account deficit (0.9% of GDP compared to 1.4% of GDP in baseline). However in 2000, when imports would be stimulated by growth of total demand and lower hryvnya depreciation, the current account deficit might grow to 2.2% of GDP. Capital account components might behave similarly to those in baseline and gross reserves would reach USD 1.4 billion. However in 2000 foreign direct investments would increase to USD 1.6 billion as Ukraine would open up for strategic privatizations and create a more favorable environment for foreign capital. We also envisage additional credits which would allow for an accumulation of gross reserves to USD 2.2 billion (6.5 weeks of import). Using privatization as a source of hard currency to finance big debt repayments seems the only opportunity to meet all obligations without depleting NBU reserves. Even privatization aimed at domestic investors would bring in hard currency as most assets are not kept in hryvnyas.

Pessimistic scenario

In this scenario, we assume a reversal in macroeconomic policy, that is, a reintroduction of soft fiscal and monetary policies as well as state-control over the economy. Moreover, we would expect a further economic decline in Russia and CIS countries as well as very limited access to funds from international organizations.

Assumptions

- Higher budget deficit for 2000 (2.3% of GDP or 2.0% according to the Ukrainian Ministry of Finance methodology); this allows transfers and subsidies to be kept at 1999 levels in real terms and causes an accumulation of slightly smaller budgetary arrears.
- The NBU is the only purchaser of T-bills; this would lead to money base growth by 53% in 1999 and 91% in 2000.
- Real commercial interest rates at 22% in 1999 and 20% in 2000 (on average).
- Along with low NBU reserves and growing devaluatory expectations, hryvnya would cross the bottom line of the corridor in the fourth quarter of 1999; it might even depreciate by 49% by the end of 1999 and by additional 51% by the end of 2000.
- Privatization policy would only aim to raise funds for short-term needs; this means that in 1999 privatization revenues for the budget (UAH 400 million) would be below the planned level and that FDI in Ukraine in 2000 might be lower compared to previous years (USD 200 million of which budget revenues account for 50%).
- In 2000 there would be only a slight improvement in the world business cycle and economic decline in Russia and other CIS countries would persist.
- World commodity prices (for imported oil, but also for exported metallurgical products) might rise slightly through the second-half of 1999 and 2000.
- There would be almost no access to foreign financing other than from international institutions (IMF, World Bank, EBRD, EU) or the Japanese government due to poor fulfillment of the EFF program, Ukraine would receive only minimum levels of subsequent tranches; in 1999 the whole amount would be limited to USD 1.5 billion; in 2000, only the World Bank might assign USD 300 million and the IMF might roll over its credits due in 2000.

Analysis of projection

1) Basic macroeconomic aggregates

In 1999, the decline in official GDP would be larger than in baseline (2.1%), mostly due to weaker private consumption and investment demand. Private consumption would

decrease by 2.2% and real incomes of the population would be cut by 1%. Investment in fixed assets would decline by 5.7% due to a lack of financing resources and expectations of economic crisis. Government consumption would decline at the same rate as in baseline. Exports, as a result of a deteriorating external environment, would decrease slightly more than in baseline (by 11.8%). Imports, however, squeezed by the faster depreciation of hryvnya, weaker total demand, and a low level of gross reserves would decrease by 16.6%.

The declining trend in the official economy would also affect unofficial activities. Private consumption would be the least affected and total GDP would decrease by 0.5%.

In 2000, official GDP and private consumption would decrease by 2.0%. High inflation and rapid depreciation of hryvnya, lack of foreign capital, and the poor condition of the banking system would further cut investment in fixed assets. Poor demand for Ukrainian products as well as limited access to imported production components would lower exports by 2.4%.

We project a shift from official into unofficial activities. All unofficial GDP components would increase despite the deterioration of official ones. However, total GDP growth would be slightly negative. Private consumption would be the only growing component in total GDP rising by 0.4%.

2) Budget

Revenue share in official GDP would remain roughly at the same level as in baseline. Lower than planned (and assumed in baseline) privatization revenues in 1999 would push up budget arrears by 6.5% of GDP. A higher budget deficit in 2000 would allow for less accumulation of unpaid budgetary obligations (about 3% of GDP). Financing of budgetary requirements, except limited foreign credits, would come from the NBU. Foreign financing at the level of USD 370 million in 1999 and USD 300 million in 2000 would cover 18% and 9% of the requirements respectively.

3) Monetary indicators

Faster depreciation, increase in net claims on government, as well as inflationary expectations would result in higher inflation than in baseline. In 1999, CPI would grow by 27.3% and PPI by 32.3%, on average. In 2000, inflation would accelerate and CPI would rise by 47% and PPI by 38.6%.

4) Balance of payments

In this scenario, the current account would shift from a deficit of USD 340 million in 1999 to significant surplus of over USD 1 billion in 2000. This would be offset by the negative balance on the capital account caused by a decline in FDI, limited access to foreign credits and huge debt repayments. Foreign reserves would fall USD 500 million and reach a level of over USD 700 million by the end of 2000.

Table 4. Results of baseline, optimistic and pessimistic scenarios

Items		BASELINE			OPTIMISTIC		PESSIMISTIC	
		1998	1999	2000	1999	2000	1999	2000
GDP OFFICIAL								
Current prices	bn hryvnyas	103.9	130.5	171.2	128.6	161.0	131.3	186.9
Constant prices (growth rates)	%	-1.7	-1.5	-0.7	-3.0	0.8	-2.1	-2.0
<i>Private Consumption</i>	%	3.4	-1.2	1.4	-0.6	6.1	-2.2	-2.0
<i>Government Consumption</i>	%	-3.4	-8.8	-8.4	-19.3	-14.3	-8.8	-8.4
<i>Investment</i>	%	1.5	-3.6	-1.0	-2.1	2.9	-4.6	-11.0
<i>Fixed Assets</i>	%	3.2	-4.7	-1.0	-3.6	2.7	-5.7	-11.7
<i>Exports</i>	%	-17.1	-11.1	4.3	-9.6	7.9	-11.8	-2.4
<i>Imports</i>	%	-17.0	-15.3	3.1	-14.6	10.2	-16.6	-11.7
GDP TOTAL								
Current prices	bn hryvnyas	143.3	182.4	238.5	181.1	224.6	183.1	252.1
Constant prices (growth rates)	%	-0.3	-0.1	2.7	-0.8	3.1	-0.5	0.0
<i>Private Consumption</i>	%	4.0	-1.0	3.5	0.2	6.2	-1.3	0.4
<i>Government Cons.</i>	%	-3.4	-8.8	-8.4	-19.3	-14.3	-8.8	-8.4
<i>Investment</i>	%	1.2	-3.1	0.2	-2.0	3.5	-4.0	-8.6
<i>Fixed Assets</i>	%	2.6	-4.0	0.2	-3.3	3.5	-5.0	-9.2
<i>Exports</i>	%	-16.1	-7.2	10.1	-6.6	12.4	-8.6	-0.8
<i>Imports</i>	%	-15.5	-14.9	4.6	-14.1	12.3	-16.2	-9.8
MONETARY INDICATORS								
CPI, annual change, average	%	10.6	25.7	34.4	26.2	26.3	27.3	47.0
<i>annual change, end of the period,</i>	%	20.0	24.1	35.4	28.6	18.9	34.5	52.6
PPI, annual change, average	%	13.2	31.0	28.9	30.4	21.2	32.3	38.6
<i>annual change, end of the period,</i>	%	35.4	17.8	31.3	16.7	20.3	25.7	48.4
Exchange rate, average	hryvnyas/USD	2.5	4.0	5.2	3.9	4.6	4.1	6.1
<i>annual change</i>	%	32.3	62.9	28.7	60.3	15.2	67.4	46.7
Money Base	bn hryvnyas	8.6	11.2	14.3	10.7	11.6	13.1	25.0
<i>annual change</i>	%	21.9	30.0	28.0	24.1	8.9	52.8	90.6

Interest Rate (commercial)	%	55	54	61	52	45	55	76
Real interest rate	%	40	22	20	20	15	22	20
BUDGET								
Revenues (excl. privatization)	bn hryvnyas	28.0	31.2	39.9	30.7	37.0	31.4	43.6
as % GDP official	%	26.9	23.9	23.3	23.9	23.0	23.9	23.3
Expenditures paid	bn hryvnyas	30.5	33.1	40.8	31.4	37.4	33.1	48.0
as % GDP official	%	29.4	25.4	23.8	24.4	23.3	25.2	25.7
Budget Balance	bn hryvnyas	-2.5	-2.0	-0.8	-0.7	-0.5	-1.7	-4.4
as % GDP	%	-2.4	-1.5	-0.5	-0.6	-0.3	-1.3	-2.3
as % GDP, if privatization incl. into revenues *	%	-2.0	-1.0	0.0	0.0	3.2	-1.0	-2.0
Financing of budget deficit and debt repayments	bn hryvnyas	13.3	6.2	14.1	4.9	12.3	6.0	18.2
Domestic	bn hryvnyas	5.8	3.4	9.2	2.1	2.4	4.5	16.0
Foreign	bn hryvnyas	7.0	2.1	4.1	2.1	4.3	1.1	1.7
Privatization	bn hryvnyas	0.5	0.7	0.8	0.7	5.6	0.4	0.6
Increase in budget arrears, net	bn hryvnyas	4.3	7.7	8.5	4.1	-0.3	8.4	6.2
BALANCE OF PAYMENTS								
Current account	bn USD	-1.421	-0.447	-0.362	-0.307	-0.781	-0.340	1.035
Exports of goods and services	bn USD	17.6	15.7	16.3	15.9	17.2	15.5	15.2
Imports of goods and services	bn USD	18.8	15.9	16.4	16.1	17.7	15.7	13.9
Capital account	bn USD	0.792	0.962	0.484	0.962	1.611	0.542	-1.255
Foreign Direct Investments	bn USD	0.8	0.3	0.7	0.3	1.6	0.3	0.2
Portfolio Investments	bn USD	0.1	-0.2	0.0	-0.2	0.0	-0.2	0.0
Credits and others	bn USD	-0.1	0.9	-0.2	0.9	0.0	0.5	-1.4
Errors & Omissions	bn USD	-0.606	0.044	0.000	0.044	0.000	0.044	0.000
Change in reserves (-, decrease)	bn USD	-1.397	0.559	0.122	0.699	0.830	0.246	-0.221
Gross Reserves. end of period	bn USD	0.686	1.245	1.367	1.385	2.215	0.932	0.712

* according to the Ukrainian Ministry of Finance methodology

Source: Historical data (excluding GDP components in constant prices estimated by CASE) – Derzhcomstat and NBU; Scenarios – CASE calculations

Conclusions

1) Monetary policy, even if successful in keeping stable exchange rates and controlling money, cannot assure macroeconomic stability without fiscal adjustment.

2) The fiscal adjustment that cuts the total budget deficit (i.e. including budget arrears), lowers the size of the budget and removes government participation from domains of non-public expenditure is an essential reform. Without such a reform, maintaining macroeconomic stability is impossible.

3) Low inflation is crucial for stabilization. There seems to be an important inflation "turning point" or barrier. Inflation below this level tends to lead to even lower inflation in subsequent years. Inflation above this point, however, tends to lead to even higher inflation in subsequent years due to inflationary expectations.

4) The optimistic scenario is closest to the measures which CASE advocates.

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LIST OF EQUATIONS

National Accounts

1. GDP identities

$$\begin{aligned} \text{gdpoff} &= \text{coff} + \text{ioff} + \text{g} + (\text{xoff}-\text{moff}) \\ \text{gdp97off} &= \text{c97off} + \text{i97off} + \text{g97} + (\text{x97off}-\text{m97off}) \\ \text{gdp} &= \text{ct} + \text{it} + \text{g} + (\text{xt}-\text{mt}) \\ \text{gdp97t} &= \text{c97t} + \text{i97t} + \text{g97} + (\text{x97t} - \text{m97t}) \end{aligned}$$

2. Private consumption

$$\begin{aligned} \text{C97off} &= c (C_0, \text{C97off}(-t), \text{Dloff/CPI}, \text{DIOFF}(-t)/\text{DEFCCOFF}(-t), \\ &\quad \text{ECM}, \text{OEV}) \\ \text{Coff} &= \text{c97off} * \text{defcoff} \\ \text{C97t} &= c (C_0, \text{C97t}(-t), \text{Dlt/Defct}, \text{Dlt}(-t)/\text{Defct}(-t), [\text{LOG}(\text{C97t}(-4)) - \\ &\quad \text{LOG}(\text{Dlt}(-4)/\text{Defct}(-4))], \text{OEV}) \\ \text{ct} &= \text{c97t} * \text{defct} \\ \text{dioff} &= \text{dioff}(-4) * \text{defcoff}/\text{defcoff}(-4) * (1 + \text{rdioff}) \\ \text{di97off} &= \text{dioff} / \text{defcoff} \\ \text{dit} &= \text{dit}(-4) * \text{defct}/\text{defct}(-4) * (1 + \text{rdit}) \\ \text{di97t} &= \text{dit} / \text{defct} \end{aligned}$$

3. Government consumption

$$\begin{aligned} \text{g97} &= \text{g97}(-4) * (\text{gdynamic} + 1) \\ \text{g} &= \text{g97} * \text{defg} \end{aligned}$$

4. Investment

$$\begin{aligned} \text{ioff} &= \text{faoff} + \text{chinv} \\ \text{i97off} &= \text{fa97off} + \text{chinv97} \\ \text{FA97off} &= \text{fa} (\text{FA}_0, \text{GDP97off}, \text{FA97off}(-t), \text{GDP97off}(-t), \text{R}(-t), \text{OEV}) \\ \text{faoff} &= \text{fa97off} * \text{deffaoff} \\ \text{chinv} &= \text{chinv97} * \text{deffaoff} \\ \text{it} &= \text{fat} + \text{chinv} \\ \text{i97t} &= \text{fa97t} + \text{chinv97} \\ \text{FA97sh} &= \text{fa} (\text{GDP97t}, \text{FA97sh}(-t), \text{GDP97t}(-t), \text{Exrate/PPI}, \\ &\quad \text{Exrate}(-t)/\text{PPI}(-t), \text{OEV}) \\ \text{fa97t} &= \text{fa97off} + \text{fa97sh} \\ \text{fat} &= \text{fa97t} * \text{deffat} \end{aligned}$$

5. Exports

x97off	= xoff / defxoff
xoff	= xoff\$ * Exrate
xt\$	= xoff\$ / xoff\$xt\$
x97t	= xt / defxt
xt	= xt\$ * Exrate

6. Imports

m97off	= me97off + mne97off
me97off	= meoff / defmeoff
meoff	= meoff\$ * Exrate
MNE97off	= mne (MNE ₀ , MNE97off(-t), (C97off+FA97off+X97off+G97), (C97off(-t)+FA97off(-t)+X97off(-t)+G97(-t)), Exrate/PPI, Exrate(-t)/PPI(-t), OEV)
mneoff	= mne97off * defmneoff
moff	= m97off * defmoff
moff\$	= meoff\$ + mneoff\$
mneoff\$	= mneoff / Exrate
m97t	= m97off + m97sh
M97sh	= m (Msh ₀ , M97sh(-t), Exrate/PPI, Exrate(-t)/PPI(-t), Dlt(-t)/CPI(-t), OEV)
mt	= m97t * defmt
mt\$	= mt / Exrate

Money and Prices

I. Prices

CPI	= cpi (PPI(-t), Mbase, GDP97off, OEV)
PPI	= ppi (PPI(-t), Exrate, Exrate(-t), OEV)
defcoff	= defcoff (c, defcoff(-t), CPI, CPI(-t), PPI, PPI(-t), OEV)
defct	= defct (c, defct(-t), CPI, CPI(-t), Exrate(-t), OEV)
defg	= defg (defg(-t), CPI, CPI(-t), PPI, PPI(-t), OEV)
deffaoff	= deffaoff (deffaoff(-t), deffat, defft(-t), OEV)
deffat	= deffat (deffat(-t), PPI, PPI(-t), OEV)
defxoff	= defxoff (Exrate)
defxt	= defxt (Exrate)

defmoff	= defmoff (Exrate)
defmeoff	= defmeoff (Exrate)
defmneoff	= defmneoff (Exrate)
defmt	= defmt (Exrate)
defgdpoff	= gdpoff / gdp97off
defgdpt	= gdpt / gdp97t

2. Money Base

Mbase	= NFA + NDA
NFA	= NFA(-1) + [Chr - (IMF - IIMF - IMFrepay)] * Exrate
NDA	= NCG + NCMB + OIN
NCG	= NCG(-1) + [tbillNBU - (iddNBU + ddrepayNBU) - dgovdep]
NCMB	= NCMB(-1) + d(NCMB)
OIN	= OIN(-1) + d(OIN)

3. Interest rates

R	= (100+Rr) * cpi/cpi(-4) - 100
yieldnm	= (100+yieldrnm) * cpi/cpi(-4) - 100

Consolidated Budget

1. Revenues

Rev	= Pit + Indtax + Excise + Oth
Pit	= efr_pit * GDPoff
Indtax	= efr_ind * GDPoff
Excise	= efr_exc * GDPoff
Oth	= efr_oth * GDPoff

2. Budget Deficit

Bdef	= Bdef_target * GDPoff
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3. Expenditures

Expen	= Rev - Bdef
Gcash	= Expen - (lg + idd + idf + Tr + Arrepay + Sub)
lg	= lg97 * deffaoff
idd	= iddold + iddnew
iddold	= iddoldnbu + iddoldres + iddoldnres

$$\begin{aligned}
 \text{iddnew} &= \text{iddnewnbu} + \text{iddnewres} + \text{iddnewnres} \\
 \text{idf} &= \text{idf\$} * \text{Exrate} \\
 \text{idf\$} &= \text{idf\$old} + \text{idf\$new} \\
 \text{idf\$new} &= \text{credit\$(-t)} * \text{IntF(-t)} \\
 \text{Tr} &= \text{Tr97} * \text{CPI} \\
 \text{Bdebt} &= \text{G} - \text{Gcash} \\
 \text{Bdebtnet} &= \text{Bdebt} - \text{Arrrepay}
 \end{aligned}$$

4. Financial requirements

$$\begin{aligned}
 \text{Finreq} &= (-\text{Bdef}) + \text{ddrepay} + \text{fdrepay} \\
 \text{ddrepay} &= \text{ddrepayold} + \text{ddrepaynew} \\
 \text{ddrepayold} &= \text{ddrepayoldnbu} + \text{ddrepayoldres} + \text{ddrepayoldnres} \\
 \text{ddrepaynew} &= \text{ddrepaynewnbu} + \text{ddrepaynewres} + \text{ddrepaynewnres} \\
 \text{fdrepay} &= \text{fdrepay\$} * \text{Exrate} \\
 \text{fdrepay\$} &= \text{fdrepay\$old} + \text{fdrepay\$new} \\
 \text{fdrepay\$new} &= \text{credit\$(-t)}
 \end{aligned}$$

5. Financing

$$\begin{aligned}
 \text{Tbill} &= \text{Finreq} - \text{Credit} - \text{Priv} \\
 \text{Credit} &= \text{Credit\$} * \text{Exrate}
 \end{aligned}$$

6. T-bill sales

$$\begin{aligned}
 \text{TbillRes} &= \text{Resf} * \text{Tbill} \\
 \text{TbillNres} &= \text{Nresf} * \text{Tbill} \\
 \text{TbillNBU} &= (1 - \text{Resf} - \text{Nresf}) * \text{Tbill}
 \end{aligned}$$

6a. NBU portfolio

$$\begin{aligned}
 \text{Tbill3mnbu} &= 3_nbu * \text{TbillNBU} \\
 \text{Tbill6mnbu} &= 6_nbu * \text{TbillNBU} \\
 \text{Tbill9mnbu} &= 9_nbu * \text{TbillNBU} \\
 \text{Tbill12mnbu} &= 12_nbu * \text{TbillNBU} \\
 \text{Tbill15mnbu} &= (1 - a_nbu - b_nbu - c_nbu - d_nbu) * \text{TbillNBU} \\
 \text{ddrepaynewnbu} &= \text{Tbill3mnbu(-1)} + \text{Tbill6mnbu(-2)} + \text{Tbill9mnbu} \\
 &\quad (-3) + \text{Tbill12mnbu(-4)} + \text{Tbill15mnbu(-5)} \\
 \text{idd1newnbu} &= (\text{tbill3mnbu(-1)} * \text{yield3m(-1)}/4 + \text{tbill6mnbu} \\
 &\quad (-2) * \text{yield6m(-2)}/2 + \text{tbill9mnbu(-3)} * \text{yield9m} \\
 &\quad (-3) * 3/4 + \text{tbill12mnbu(-4)} * \text{yield12m(-4)} + \\
 &\quad \text{tbill15mnbu(-5)} * \text{yield15m(-5)} * 5/4
 \end{aligned}$$

6b. Residents' portfolio

$$\begin{aligned}
 \text{Tbill3mRes} &= 3_res * \text{TbillRes} \\
 \text{Tbill6mRes} &= 6_res * \text{TbillRes} \\
 \text{Tbill9mRes} &= 9_res * \text{TbillRes} \\
 \text{Tbill12mRes} &= 12_res * \text{TbillRes} \\
 \text{Tbill15mRes} &= (1-a_res-b_res-c_res-d_res) * \text{TbillRes} \\
 \text{ddrepaynewres} &= \text{Tbill3mres}(-1) + \text{Tbill6mres}(-2) + \text{Tbill9mres} \\
 &\quad (-3) + \text{Tbill12mres}(-4) + \text{Tbill15mres}(-5) \\
 \text{idd1newres} &= (\text{tbill3mres}(-1) * \text{yield3m}(-1))/4 + \text{tbill6mres} \\
 &\quad (-2) * \text{yield6m}(-2)/2 + \text{tbill9mres}(-3) * \text{yield9m} \\
 &\quad (-3) * 3/4 + \text{tbill12mres}(-4) * \text{yield12m}(-4) + \\
 &\quad \text{tbill15mres}(-5) * \text{yield15m}(-5) * 5/4
 \end{aligned}$$

6c. Non-residents' portfolio

$$\begin{aligned}
 \text{Tbill3mNres} &= 3_nres * \text{TbillNres} \\
 \text{Tbill6mNres} &= 6_nres * \text{TbillNres} \\
 \text{Tbill9mNres} &= 9_nres * \text{TbillNres} \\
 \text{Tbill12mNres} &= 12_nres * \text{TbillNres} \\
 \text{Tbill15mNres} &= (1-a_nres-b_nres-c_nres-d_nres) * \text{TbillNres} \\
 \text{ddrepaynewnres} &= \text{Tbill3mnres}(-1) + \text{Tbill6mnres} \\
 &\quad (-2) + \text{Tbill9mnres}(-3) + \text{Tbill12mnres} \\
 &\quad (-4) + \text{Tbill15mnres}(-5) \\
 \text{idd1newnres} &= (\text{tbill3mnres}(-1) * \text{yield3m}(-1))/4 + \text{tbill6mnres} \\
 &\quad (-2) * \text{yield6m}(-2)/2 + \text{tbill9mnres}(-3) * \text{yield9m} \\
 &\quad (-3) * 3/4 + \text{tbill12mnres}(-4) * \text{yield12m}(-4) + \\
 &\quad \text{tbill15mnres}(-5) * \text{yield15m}(-5) * 5/4
 \end{aligned}$$

Balance of Payments

$$\begin{aligned}
 \text{CA} &= (\text{Xoff\$} - \text{Moff\$}) + \text{BI} + \text{BT} \\
 \text{BI} &= \text{idf\$} + \text{Bo\$} \\
 \text{KA} &= \text{FDI} + \text{PI} + \text{CR} \\
 \text{PI} &= [\text{Tbillnres} - (\text{ddrepaynres} + \text{iddnres})] / \text{Exrate} \\
 \text{CR} &= (\text{Loan\$} - \text{fdrepay\$}) + (\text{IMF} - \text{IMFrepay}) + \text{BoC\$} \\
 \text{CHR} &= \text{CA} + \text{KA} \\
 \text{GrossR\$} &= \text{GrossR\$}(-1) + \text{CHR}
 \end{aligned}$$

GLOSSARY

<i>V97</i>	– a variable "V" expressed in prices of 1997
<i>V</i>	– "V" expressed in current prices
<i>V(-t)</i>	– "V" lagged
<i>Off</i>	– official denoting official economy
<i>Sh</i>	– shadow denoting unofficial economy
<i>T</i>	– total (including unofficial economy)
<i>\$</i>	– expressed in USD
<i>d(V)</i>	– $[V-V(-1)]$
<i>old</i>	– debt payments according to the schedule as of the begging of the forecasted period
<i>new</i>	– payments on debt accrued throughout the forecasting period
<i>nbu</i>	– the NBU e.g. <i>iddnbu</i> – interest payments on debt against the NBU <i>Tbillnbu</i> – T-bills purchased by the NBU
<i>res</i>	– residents
<i>nres</i>	– non-residents
GDP	– gross domestic product
C	– private consumption
G	– government consumption
I	– investment
X	– exports
M	– imports
C₀	– autonomic consumption
DI	– disposable income of households
CPI	– consumer price index
ECM	– error correction mechanism
OEV	– other exogenous variables
Defc	– deflator of private consumption
Rdi	– real annual dynamics of disposable income of households
Gdynamic	– real annual dynamics of government consumption
Defg	– deflator of government consumption
FA	– investment in fixed assets
Chinv	– change in inventories
FA₀	– autonomous investment in fixed assets
R	– commercial credit interest rate

Rr	– real commercial credit interest rate
DefFA	– deflator of investments in fixed assets
Exrate	– exchange rate
PPI	– producer price index
Defx	– deflator of export
Xoff\$xt\$	– share of official export in total export
Me	– import of energy products
MNE	– import of non-energy products
MNE ₀	– autonomous import of non-energy products
Defm	– deflator of import
Msh ₀	– autonomous unofficial import
Mbase	– money base
NFA	– net foreign assets
NDA	– net domestic assets
Chr	– change in gross reserves of the NBU
IMF	– new credit from IMF, in USD
IIMF	– interest payments towards IMF
IMFrepay	– principal payments towards IMF
NCG	– net claims on government
NCMB	– net claims on money banks
OIN	– other items net
TbillNBU	– purchases of t-bills by the NBU
IddNBU	– interest payments on t-bills purchased by the NBU
DdrepayNBU	– principal payments on t-bills purchased by the NBU
Govdep	– government deposits in accounts at the NBU
Rev	– consolidated budget revenue
Pit	– personal income tax
Indtax	– VAT & foreign trade duties
Excise	– excise taxes
Oth	– other government revenues
Efr_pit	– effective rate of personal income tax, incorporated from the monthly model
Efr_ind	– effective rate of indirect taxes, incorporated from the monthly model
Efr_exc	– effective rate of excise tax, incorporated from the monthly model
Efr_oth	– effective rate of other taxes and payments, incorporated from the monthly model
Bdef	– consolidated budget deficit

Bdef_target	– planned budget deficit as % of GDP
Expen	– consolidated budget expenditures
Gcash	– government consumption paid
Ig	– government investment
Idd	– interest payments on domestic debt
Idf	– interest payments on foreign debt
Tr	– social transfers
Sub	– subsidies
Credit	– foreign loans for the budget needs financing
IntF	– interest rate on foreign loans received during the forecasted period
Bdebt	– increase in budgetary arrears (both social and against the providers of goods and services)
Arrepay	– repayments of arrears
Bdebtnet	– increase in budgetary arrears net
Finreq	– financial requirements of the budget
Ddrepay	– principal payments on domestic debt
Fdrepay	– principal payments on foreign debt
Priv	– budget revenues from privatization
Tbill	– sales of T-bills by the government
Resf	– fraction of T-bills purchased by residents
Nresf	– fraction of T-bills purchased by non-residents
Tbillnm	– T-bills with n-months redemption period
n_	– share of Tbillnm in the given investor's portfolio purchased in the current quarter
CA	– balance on current account
BI	– balance on interest
BoI	– balance on other interest
BT	– balance on transfers
KA	– balance capital account
FDI	– balance on foreign direct investments
PI	– balance on portfolio investments
CR	– balance on credits
Loan	– all foreign loans (including for the budget financing needs)
IMF	– credits received from the IMF
IMFrepay	– principal payments on the IMF loans
BoC	– balance on other credits
CHR	– change in gross reserves of the NBU
GrossR	– gross reserves stock

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- 174 Роберт Брудзыньски, Марек Домбровский, Роман Могилевский,
Экономический кризис в Кыргызстане в конце 1998 года. Причины и пути
выхода
-
- 175 Mateusz Walewski, A Short Play on the Idea of the Laffer Curve in Transition
Economies
-
- 176 Марек Гура, Михал Рутковски, В поисках реформы пенсионной системы
в Польше: «Безопасность в разнообразии»
-
- 177 Georges de Menil, Stephane Hamayon, Mihai Seitan, Romania's Pension System:
The Weight of the Past
-
- 178 Katarzyna Zawalińska, Agriculture of the Czech Republic, Hungary and Poland in
Perspective of Joining Common Agricultural Policy – with Some Fiscal Remarks
-
- 179 Казимеж Клѐц, Банковские системы Украины, Кыргызстана и Грузии
в 1991–1998 годах. Институциональный анализ
-
- 180 Pavel Stepanek, Ondrej Schneider, Present and Future Fiscal Policy Problems in
the Czech Republic
-
- 181 Krzysztof Polomski, Tax System in Selected Transition Economies. An overview
-
- 182 Stanisław Gomułka, Comparative Notes on Pension Developments and Reforms
in the Czech Republic, Hungary, Poland and Romania
-
- 183 Eugeniusz Kwiatkowski, Paweł Kubiak, Leszek Kucharski, Tomasz Tokarski,
Procesy dostosowawcze na rynku pracy jako czynnik konsolidacji reform
rynkowych w Polsce
-
- 184 Mateusz Walewski, Restrukturyzacja tradycyjnych branż przemysłowych w krajach
Europy Zachodniej – wybrane przykłady
-
- 185 Katarzyna Zawalińska, Asset and Liabilities Management
-
- 186 Małgorzata Jakubiak, Paweł Kaczorowski, Joanna Sivińska, Tomasz Tokarski,
Private, Public and Foreign Savings
-
- 187 Barbara Liberda, Household Saving in Poland
-
- 188 Wojciech Maliszewski, VAR-ing Monetary Policy in Poland
-
- 189 Urszula Sztanderska, Jacek Litwiński, Koszty pracy w Polsce
-
- 190 Mirosław Gronicki, Katarzyna Piętka, Macroeconomic Model for Ukraine
-