

**MODELING OF ECONOMIC POLICY, INCOME DISTRIBUTION AND POVERTY**  
(Case of Armenia)

**Abstract**

This paper introduces an approach to examine the relationships between economic policy, income distribution and poverty. We find that economic growth by itself is a necessary but not a sufficient condition for poverty reduction. In the presence of pro-poor economic measures such as income redistribution, on the other hand, growth's positive impact on poverty reduction increases significantly. Also, we examine the determinants of income growth and find that in highly polarized low-income countries like Armenia economic growth is basically stipulated by demand factors.

The paper presents a brief economic outlook for the last 10 years. The significant progress in achieving macroeconomic stability is discussed and the weak points of income distribution and poverty reduction are revealed. The article considers modeling of income distribution and poverty indications as critical points for the basis of long-term macroeconomic strategy. We develop a set of models and show how policy measures address specific objectives of pro-poor policy.

## **1. Armenia Economic Outlook**

- After declaration of independence and liberalization of economy Armenia faced deep economic decline that caused significant reduction in production volume and income level of households. The sharp decline was mainly due to macroeconomic imbalance, heritage of the Soviet economic structure and change of political system. .
- Poverty in Armenia was caused by economic decline of 1991-1993s as well as by significant increase of income polarization. While in 2002 Armenia's GDP has already reached 83.2 percent of its pre-reform level, and has equaled to it in per capita terms, Gini coefficient increased by 0.258 and became 0.528, which caused a significant increase of poverty incidence from 20 to 50.9 percent.
- Economic developments of recent years to some extent positively influenced on fiscal policy. Average deficit / GDP ratio for 2000-2002 was 3.1 percent. Concessional credits of international organizations are the main source of deficit financing while T-bills are mainly a cash flows management tool. Tax revenues and duties / GDP ratio is rather low (average of 15.1 percent for 2000-2002).
- During last years public sector shrunked significantly. Quasi-fiscal sector now includes only some utility and energy generating enterprises. Institutional developments of budget have showed visible progress in terms of budget execution and especially in terms of reforms of the treasury system. However, input budgeting is used in budget formulation process, and participation to it is still passive. Quality of social services remains rather poor.
- Armenia experienced stabilization of price variables in the middle of 1990s. Introduction of national currency in 1993 allowed for implementing independent monetary policy. Inflation is low one-digit since 1998, with some records of deflationary trends (1999-2000).
- While free floating exchange rate regime is declared in Armenia one can constitute that managed floating exchange rate policy is implemented. Annual average nominal depreciation of dram versus US dollar was 2.6 percent in 1998-2002 while average inflation was 2.0 percent.
- Real interest rates were too high (about 60 percent) until the end of 1990s. Decline of interest rates started in 2000. Currently short term T-bills rates are near 10%, while deposit and lending rates are around 5 and 20% respectively.
- Operations of current and capital accounts of balance of payments have no tariff or non-tariff restrictions. Exports / GDP ratio was 29.5 percent while imports / GDP ratio was 45.7 percent in 2002. In 2002 CAB / GDP ratio was 7.5 percent, down by 13.8 percentage points versus 1998.

## **2. The need to model policy impact on poverty, economic growth and income distribution**

While significant reforms and high economic growth of recent years is evident, in terms of welfare indicators Armenia remains well below other transition economies. Such a situation raises the problems of economic growth and inequality among researchers and policy-makers. Some economists consider long-term economic growth promoting policy as sufficient measure for poverty reduction and growth of living standards. To some extent this approach was originated in international organizations and was used in some transition countries. Nevertheless, some researches show that economic growth does not necessarily lead to poverty reduction. Moreover, poverty may transform its nature and become a structural problem even along with high economic growth.

Parallel to the rather high pace of economic growth in Armenia during recent years, income inequality deepened, causing an increase in poverty. Furthermore, depreciation of human capital causes structural poverty. The weak link between growth and poverty reduction in Armenia suggests that growth is

polarized. Thus, income distribution is fundamental to the efficiency of a growth policy targeted at reducing poverty. Consequently, the choice of policies targeted at poverty reduction should be carried out through a study of the interrelation between growth and distribution.

Notwithstanding that economic growth is the main source of poverty reduction, the policy of poverty reduction should primarily be targeted at redistributing income. The income distribution and redistribution process is also important from the viewpoint of sustainability of growth, as well as efficient distribution thereof. Traditional macroeconomics suggests that, when distribution is unequal, redistribution schemes will lead to a decline in economic growth or its pace. Moreover, economic growth may primarily facilitate an increase in inequality of distribution.

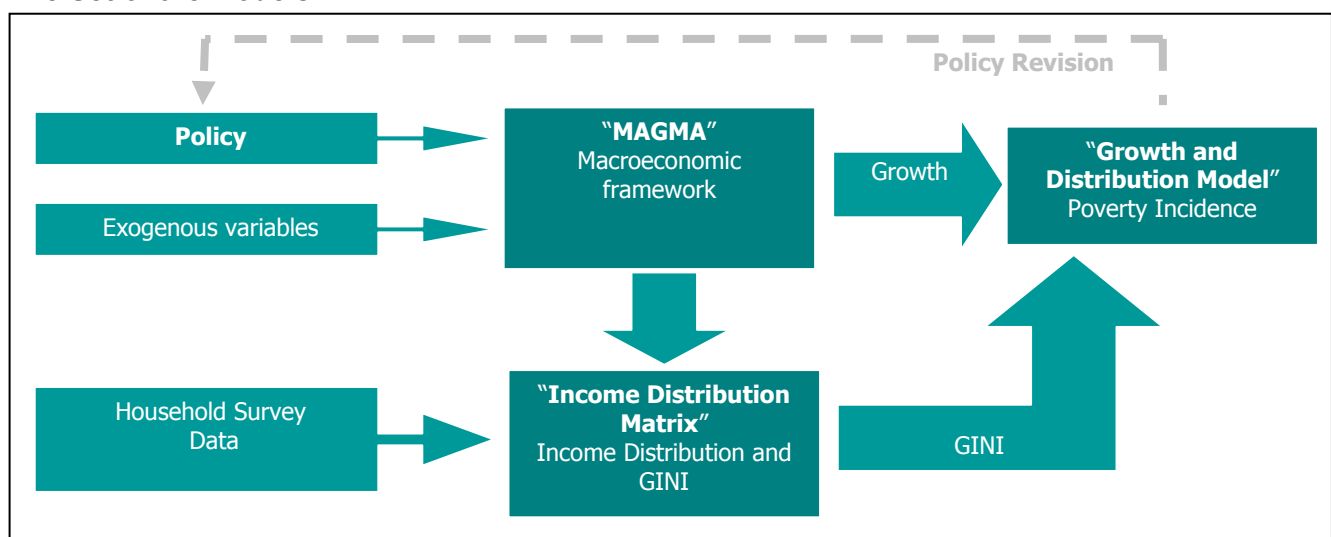
Summarizing one can say that both Armenia and other countries in transition have to pay particular attention to assessment of influence of economic policy not only on economic growth but also on income distribution, because these two factors together define the prosperity level and particularly the poverty incidence. It must be taken into account that economic growth and income distribution are interrelated variables and it is necessary to evaluate the relationship between them.

This means that not only economic growth but also the share of newly created income received by the poor and the resulting decline in poverty should be evaluated.

### 3. Theoretical Concepts of Models and Methodology

“Economic Development and Research Center” NGO (EDRC) has developed a set of macroeconomic models (Macroeconomic Adjustment and Growth Model of Armenia (MAGMA), “Growth and Distribution” model and “Income Distribution Matrix” model) for “Policy Choice for Poverty Reduction” project. The primary goal of developing a set of models was the need to provide a logical concept linking measures of macroeconomic policy and economic growth to poverty reduction and income distribution objectives. The basic model in the set is MAGMA that allows to build a macroeconomic framework, which is used in “Growth and Distribution” and “Income Distribution Matrix” models to derive income distribution of deciles’ groups (by branches of economy and type of income) and as well as Gini coefficient and poverty incidence.

#### The Set of the Models



## **Sophistication**

The main emphasis in conventional recommendations on economic policies in countries with high level of poverty is on prescriptions for economic growth, which is supposed to lead to prosperity of society. In contrary to this the political economics behind EDRC modeling approach gives a superior role to income distribution. Moreover, in our model better income distribution is the main driving force behind economic prosperity and more sustainable economic growth. We believe that there is no trade-off between income distribution smoothening and sustainable high economic growth in Armenia, as well as in some other poor transition economies<sup>1</sup>. This idea of positive relationship between smoother distribution and economic growth is in direct contradiction to conventional wisdom, as traditional approach says that business incentives must be encouraged by lowering tax burden and less redistribution effects of public policies, which implies higher inequality of income distribution.

The rationale of our view is that in poor transition economies like Armenia, economic growth is mainly defined by demand factors. When poor groups of population are financially promoted, the structure of consumption preferences of different income groups (domestic production vis-à-vis imported goods) leads to higher demand for domestic goods and services, as lowest deciles of population are characterized by a larger share of domestic goods in their consumption baskets. We imply that this extra demand will lead to growth of aggregate supply as it is estimated that, in particular, for Armenia the supply curve is rather flat. The argument about the shape of supply curve is supported by empirical evidence of recent years, when only extremely substantial external demand shocks led to some moderate increases in prices, while high one digit growth rates generated just negligible price inflations.

The set of EDRC models reflects the relationship between policy variables, distribution, economic growth and poverty incidence. As a policy tool it helps to identify the best observable policy scenario that would bring to better income distribution thus to higher economic prosperity, described by high rate of pro-poor economic growth.

Disaggregation in the model is presented by decomposition of marginal propensity to consume by income group of population. Besides, "Income Distribution Matrix" model allows tracing the distribution of separate income components (wages, profit, transfers) among branches of economy and deciles groups of population.

In the MAGMA model, which defines macroeconomic framework, GDP growth is endogenous, unlike in the financial programming model (FPM). While FPM estimates GDP growth exogenously based on assumptions regarding capital and labor, and then demand components are constructed according to the level of income. MAGMA introduces our approach to model real growth endogenously using behavioral equations of different groups of population (e.g. quintile groups) and institutions (e.g. public sector). MAGMA is based on decomposition of consumption and import functions by income groups of population. Under assumption that higher income groups have higher propensity to consume imported goods and services it becomes obvious that the decrease of polarization in economy will boost economic growth.

## **"Growth and Distribution" Model**

"Growth and Distribution Model" is used to estimate the poverty incidence under certain levels of income and distribution.

"Growth and Distribution Model" is based on shares of decile groups of population in total income or expenditures. Through decile weights an  $f(x)$  function representing the Lorenz curve has been estimated.

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<sup>1</sup> We consider a range of Gini coefficient of 0.35 - 0.65. For the Armenian economy business incentives are found to be not deteriorated even if policy intervention and resulting redistribution leads to as low as 0.35 Gini coefficient (compared to 0.54 in 2001). This modeling framework does not imply lower Gini coefficients.

To choose the type of distribution function, logarithmic, exponential and combined functions and polynomials were considered. We estimate Lorents curve solving the following system.

$$F(100) = 100, F(0) = 0 \quad (1)$$

$$\int_0^{100} F(x)d(x) = 5000 - 5000 \cdot G \quad (2)$$

$$F(x)' > 0, F(x)'' > 0, x \in [0,100] \quad (3)$$

Equation (2) expresses the relation between the selected function and actual Gini index, and equation (1) is the equation satisfying the condition  $x=100; y=100$  and  $x=0; y=0$ .

To choose the best function we should take one with minimum dispersion from actual deciles values. In case of Armenia we select the following function:

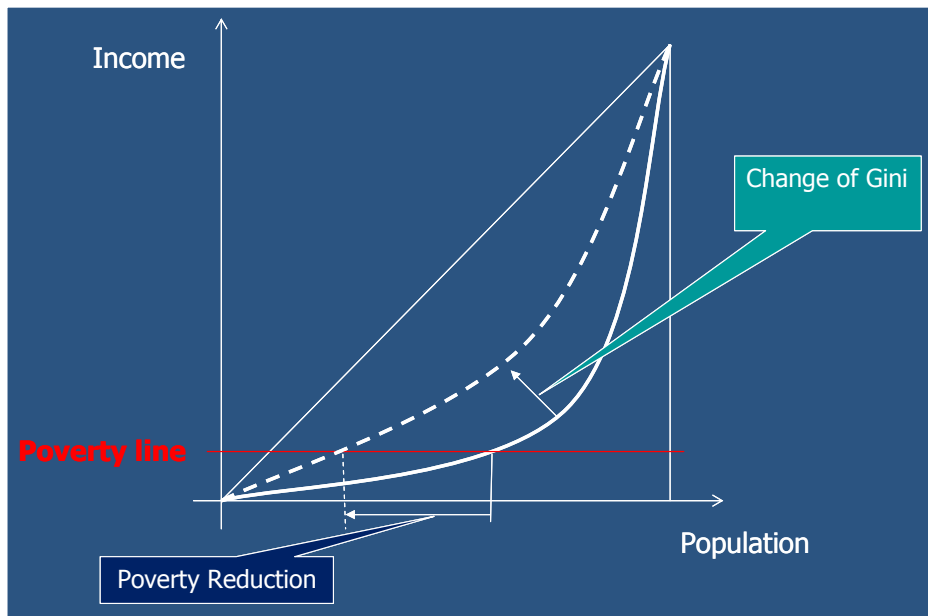
$$f(x) = \frac{ax}{1 + bx^2} \quad (4)$$

In order to determine the share of the poor in total population the function (4) needs to be differentiated, which will give following expression:

$$f'(x) = \frac{a - abx^2}{(1 + bx^2)^2} \quad (5)$$

In order to evaluate the impact of income redistribution on poverty, first we need to determine distribution curves for different patterns of distribution. That is, using the same methodology, the function (4) is estimated for different Gini indices. It is assumed that the function will not change its type in case of change of distribution and only coefficients of the function will change.

In order to assess the level of poverty for changing distributions (Gini coefficient) equation (5) is solved with respect to the poverty line.



To assess the impact of the economic growth on poverty the following equation was solved with respect to  $x$ :

$$\frac{a - abx^2}{(1 + bx^2)^2} = cg \quad (6),$$

Here the left side of the equation is a non-cumulative distribution function,  $c$  is the percentage of total income received by population gaining income lower than the poverty line  $z$ , and  $g$  is income growth

coefficient. Non-negative solutions (7) of equation (6) reflect the relation between poverty level and income growth (economic growth) under unchanged distribution:

$$x = -\frac{g}{2cb} \left( -2cgh \left( a + 2cg - (a^2 + 8acg)^{1/2} \right) \right)^{1/2} \quad (7)$$

Income deficit is equal to the area below poverty line and above function (5), which is represented by following equation:

$$D = zk - \int_0^k \frac{a - abx^2}{(1 + bx^2)^2} dx \quad (8)$$

where D is income deficit, z is the poverty line, k is the poverty level, g is the income growth index.

### “Macroeconomic Adjustment and Growth Model for Armenia”

MAGMA is developed for forecasting macroeconomic indicators for both mid-term and long-term periods. It ensures all macroeconomic identities and the balance between sectors, at the same time allowing to use the macroeconomic policy simulation approach. Thus, the model allows checking the consistency of policy targets with macroeconomic environment.

The exogenous and endogenous variables are identified in the framework of the model. Exogenous variables are divided into two groups – “free” variables and policy variables. “Free” variables are forecasted by various statistical methods and expert evaluations, while policy variables reflect the choice of policy makers. Endogenous variables are the output of the model.

MAGMA allows to perform endogenous modeling of economic growth, which is based on behavioral equations of different groups of population (e.g. quintile groups) or institutional units (e.g. public sector). Main macroeconomic indicators are estimated based on the following system of equations:

$$\left\{ \begin{array}{l} Y = Y_P + Y_G \quad (1) \\ Y_P = \sum_{i=1}^4 Y_{P_i} \quad (2) \\ Y_{P_i} = Y_P * d_i, \quad i = \overline{1,4} \quad (3) \\ Y_G = Rev - P - Tr \quad (4) \\ Rev = (Y - FY) * g_1 \quad (5) \\ Y = C + I_P + I_G + G + X - M + FY \quad (6) \\ C = \sum_{i=1}^4 C_i \quad (7) \\ C_i = a_i + MPC_i * Y_{P_i}, \quad i = \overline{1,4} \quad (8) \\ G = (Y - FY) * g_2 \quad (9) \\ I_G = Def + Rev - (G + P + Tr) \quad (10) \\ Def = (Y - FY) * g_3 \quad (11) \\ M = \sum_{i=1}^4 K_{C_i} * C_i + K_{I_P} * I_P + K_{I_G} * I_G + K_G * G + K_X * X \quad (12) \end{array} \right.$$

Below is the list of exogenous and endogenous variables:

Description of variables of main equations (all indicators are in real terms)	Variable	Classification of variable	
		endogenous	exogenous
Gross National Disposable Income (GNDI)	$Y$	+	
Gross National Disposable Income of Private Sector	$Y_P$	+	
Private GNDI of $i$ group	$Y_{P_i}$	+	
Private Consumption of $i$ group	$C_i$	+	
Public Consumption	$G$	+	
Private Investments	$I_P$		+
Public Investments	$I_g$	+	
Exports (goods & services)	$X$		+
Imports (goods & services)	$M$	+	
Net Factor Income and Transfers from Abroad	$FY$		+
Consolidated Budget Revenues and Grants	$Rev$	+	
Interest Payments of Government	$P$		+
Public Transfers and Subsidies	$Tr$		+
Marginal Propensity to Consume in $i$ group	$MPC_i$		+
Share of Imports in the Consumption of $i$ group	$K_{C_i}$		+
Share of Imports in the Public Consumption	$K_G$		+
Share of Imports in the Public Investments	$K_{I_g}$		+
Share of Imports in the Private Investments	$K_{I_P}$		+
Share of Export Related Imports in the Exports	$K_X$		+
Consolidated Budget Revenues and Grants / GDP	$g_1$		+
Public Consumption / GDP	$g_2$		+
Consolidated Budget Deficit / GDP	$g_3$		+
Private GNDI of $i$ group / Private GNDI	$d_i$		+
Autonomous Consumption of $i$ group	$a_i$		+

$i$  – is the number of income groups. The number of these groups in the model is assumed to be 4 in this example.

For the solution of the set of equations the software “Mathcad 11 Enterprise Edition” was used. As a result we have the following solution for GNDI:

$$Y = \frac{\left[ \sum_{i=1}^4 (a_i * (1 - K_{C_i}) + I_P * (1 - K_{I_P}) + X * (1 - K_X) - (P + Tr) * (1 - K_{I_g}) + \right. \\ \left. + FY * (1 - g_1 + g_2 * K_G - g_3 - K_{I_g} * (-g_1 + g_2 - g_3)) + (P + Tr + FY * g_1) * \sum_{i=1}^4 (MPC_i * d_i * (1 - K_{C_i})) \right]}{1 - g_1 * (1 - K_{I_g}) - g_2 * (K_{I_g} - K_G) - g_3 * (1 - K_{I_g}) - (1 - g_1) * \sum_{i=1}^4 (MPC_i * d_i * (1 - K_{C_i}))}$$

Derived solution shows that decomposition in the model is performed both by institutional groups, and by income groups.

The behavioral equation of consumption was estimated for each behavioral group. To forecast imports the shares of private and public consumption (C and G), investments (I<sub>p</sub> and I<sub>g</sub>) and export related imports in corresponding components are exogenously estimated in the model. This allows to eliminate imports in the GNDI equation.

By adding the revenues, deficit and public consumption of consolidated budget (exogenously estimated as shares in GDP) to above-mentioned expression we derive GNDI.

It needs to be noted, that only real indicators are produced, and after making exogenous assumptions on corresponding deflators we derive nominal values.

CPI inflation is an exogenous variable, as it is the result of policy choice. As for nominal exchange rate, it is derived based on assumptions on real exchange rates and CPI inflation of trade partners.

As for GDP measured by value added of branches of the economy, the value added of industry is endogenous, and is derived as a difference of GDP (at factor prices) and the sum of value added of all other branches. Net taxes are derived from data on public sector.

The value added in agriculture is calculated based on real growth in the branch and agriculture deflator, which are exogenous.

The value added in construction is based on the investment growth rate and investment deflator (both are exogenous).

Value added in trade and services is calculated based on exogenous assumptions on unit weights of these branches in GDP.

The wage component of the GDP by income is a residual. Capital stock consumption and net profit and mixed income are calculated using their exogenous unit weights in GDP.

Based on above mentioned indicators, the economic growth, as well as real and nominal structure of GDP is forecasted.

**Population and Employment.** The population of a given year is calculated based on estimations of population growth and migration. Forecast of employment is based on value added in the economy (in real terms, by branches) and estimations of productivity growth.

**Fiscal Sector.** Fiscal sector represents revenue and expenditure sides of the state budget, as well as deficit financing. The share of budget revenues and deficit in GDP are exogenous variables as they are policy tools. These indicators may be derived from other models.

Total budget expenditures are endogenous, while its structure is based on policy choice. Each type of expenditures is calculated as a product of total expenditures and its weight in latter.

The deficit / GDP ratio is also a policy tool, and the model estimates the structure of its financing.

**External Sector Indicators.** The forecasts of exports of goods and non-transport services are based basically on exogenous assumptions of economic growth in partner countries.

Factor income is equal to the sum of interest and other incomes. Forecast of interest payments is based on estimations of external debt and an exogenous assumption on debt-servicing interest rate. Other incomes and private transfers are estimated based on forecast of growth in the countries where main centers of Armenian Diaspora are located.

Direct investments are estimated exogenously simultaneously with estimations of investments in GDP. Investments in t-bills are the product of share of non-residents in t-bills and overall t-bill portfolio. Private portfolio investments are estimated exogenously. Other investments are estimated on the basis of changes in external debt stock.

#### **“Income Distribution Matrix” model**

This model enables to assess the influence of economic policy on income distribution and to estimate Gini coefficients corresponding to the given economic situation. “Income Distribution Matrix” introduces distribution of types of income (wages, profit, transfers) among branches of economy and decile groups of population.

The cells of the Matrix show the share of total income that a particular decile group received from given branch in the form of a specific type of income. The Matrix enables to assess income distribution among decile groups, which makes it possible to forecast the Lorenz curve and estimate the Gini coefficient.

Data of households’ surveys implemented by National Statistical Service of RA, the outputs of MAGMA model and some expert estimates were used to build the “Income Distribution Matrix” model.

#### **4. Usefulness for Poverty Reduction Policy**

Policy measures suggested in the framework of PRSP development are usually based on macroeconomic framework forecasts. At the same time, the models used to build this framework need to include an explanation of the links between economic policy and poverty.

Disaggregation by income groups presented in MAGMA and “Income Distribution Matrix” provides valuable information for development of macroeconomic policy measures aimed to improve income distribution and lower the poverty incidence. In particular, this disaggregation makes it possible to see the potential impact of policy intervention on resource redistribution.

Easy manipulation of the values of policy variables allows to model different scenarios of macroeconomic policy. The three models enable to trace the policy impact on income level, income distribution and, as a result, poverty level. “Growth and Distribution” model shows possible poverty incidences derived by combinations of GDP real growth rates and Gini coefficients.

#### **5. Accessibility**

Visually and functionally MAGMA is very similar to RMSM-X and other relevant models. Software support for all models is MS Excel for Windows. This software application is one of the most widespread so the models can be used by a very wide range of economists, policy-makers and other researchers without requiring special training. All variables and links are visible, which makes it easier to interpret policy measures, results and transmission mechanisms.