**МЕНЕДЖМЕНТ**

# Public debt sustainability assessment models and their possible application for the RA

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## Պետական պարտքի կայունության գնահատման մոդելները և դրանց հնարավոր կիրառությունը ՀՀ-ի համար

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**Ամփոփագիր.** Հարցը, թե պետական պարտքը կայուն է (թե ոչ), առանցքային է հարկաբյուջետային քաղաքականության ցանկացած մակրոտնտեսական վերլուծության մեջ: «Պարտքի կայունություն» հասկացության վերաբերյալ միասնական ընկալում չկա և վերլուծության տարբեր մոտեցումներ տարբեր սահմանումների վրա են հիմնվում: Պետական պարտքի կառավարման հիմնական նպատակն է ապահովել, որ կառավարության ֆինանսավորման կարիքները և վճարման պարտավորությունները բավարարվեն միջին և երկարաժամկետ հեռանկարում հնարավոր ամենացածր գնով՝ համապատասխան ռիսկի պայմաններում: Ճիշտ է, կառավարությունները պետք է փորձեն նվազագույնի հասցնել պարտքի սպասարկման և լիկվիդային ակտիվների պահպանման ծախսերը, սակայն ծախսերը նվազագույնի հասցնելիս պետք է հաշվի առնել ռիսկերը: Պետական պարտքի կայունությունը մոդելավորելիս անհրաժեշտ է հաշվի առնել առնել տոկոսադրույքի, փոխարժեքի, վերաֆինանսավորման, վարկային, գործառնական ռիսկերը:
Սույն հոդվածը նվիրված է պետական պարտքի կայունության գնահատման մոդելների ուսումնասիրությանը: Հոդվածում ներկայացվել է պարտքի կայունության գնահատման հիմնական մոդելները՝ ստոխաստիկ (ֆիսկալ արձագանքի և չսահմանափակված VAR մոդելներ), շուկային հասանելիություն ունեցող երկրների դետերմինիստիկ մոդելը (MAC DSA) և պարտքի կառավարման միջնաժամկետ ռազմավարության կառուցման մոդելը (MTDS): Առանձնացվել է դրանցից յուրաքանչյուրի կիրառման սկզբունքները, առավելություններն ու թերությունները: Ներկայացվել է նաև դրանց յուրաքանչյուրի կիրառության հնարավոր Հայաստանի Հանրապետության պետական պարտքի կայունության գնահատման համար:
**Հանգուցաբառեր՝** պետական պարտք, պարտք/ՀՆԱ, պարտքի պորտֆել, առաջնային հաշվեկշիռ, տոկոսադրույք, փոխարժեք, MAC DSA, Stochastic DSA, MTDS

## Модели оценки устойчивости государственного долга и их возможное применение в РА

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**Аннотация:** Вопрос о том, является ли государственный долг стабильным (или нет), является ключевым для любого макроэкономического анализа налогово-бюджетной политики. Нет единого понимания понятия "стабильность долга", разные подходы к анализу основаны на разных определениях. Основная цель управления государственным долгом заключается в обеспечении того, чтобы потребности государственного финансирования и платежные обязательства удовлетворялись с наименьшими возможными затратами в среднесрочной и долгосрочной перспективе с соответствующим риском. Это правда, что правительства должны пытаться минимизировать стоимость обслуживания долга и поддержания ликвидных активов, но при минимизации затрат необходимо учитывать риски. При моделировании устойчивости государственного долга необходимо учитывать процентный, валютный, рефинансирующий, кредитный и операционный риски.
Данная статья посвящена исследованию моделей оценки устойчивости государственного долга. В статье представлены основные модели оценки долговой устойчивости: стохастическая (фискальный ответ и неограниченные модели VAR), детерминированная модель стран, имеющих доступ к рынку (MAC DSA) и модель построения среднесрочной стратегии управления долгом (MTDS). Выделены принципы, преимущества

и недостатки каждого из них. Также было представлено возможное применение каждого из них для оценки устойчивости государственного долга Республики Армения.
**Ключевые слова:** государственный долг, долг/ВВП, долговой портфель, первичный баланс, процентная ставка, обменный курс, MAC DSA, Stochastic DSA, MTDS

There are three main approaches to debt sustainability analysis: deterministic, stochastic and alternative. Deterministic models are based on debt accumulation formulas, shock simulations on individual elements, and debt burden thresholds. The basis of stochastic models is the interaction of debt-forming factors, and patterns that are projected onto the The stochastic approach also uses the debt accumulation formula to perform debt simulations. Alternative approaches include the assessment of the "equilibrium debt / GDP" threshold, the assessment of the "fiscal area", the assessment of the "fiscal response function", and other methods of econometric analysis. In contrast to the deterministic approach, stochastic and alternative approaches require time series with sufficient parameters for econometric analysis. Most often, these approaches do not replace, but complement each other. Particularly stochastic and other approaches complement the results of deterministic analysis by considering an additional set of risk assessment tools [**7**].

**The deterministic DSA**

In the deterministic model of debt sustainability analysis, simulations of the baseline scenario and various shocks are performed, with the help of which the risks of that scenarios are identified. Such analyzes are usually carried out using the methodology developed by the International Monetary Fund and The World Bank [**9**]. It is embedded in two tools developed by the latter: the Low Income Countries Debt Sustainability Analysis Model (LIC DSF) and the MAC-Market Access Countries Debt Sustainability Model (MAC DSA). Low-income countries (LICs) provide their debt financing needs mainly through concessional loans. Market-accessible countries (MACs) have stable and significant access to international capital markets and provide debt financing requirements through market-based borrowing [**1**].

One of the advantages of the tools is that the analysis does not require time series of the same quality as is required for most stochastic and alternative analysis methods. The tools are built into the Microsoft Excel software environment. The model distinguishes between developing and developed countries and different levels of indicators are used for each. The vulnerability rates of the country are compared with the pre-defined thresholds to determine the depth of the study. The countries are classified as Lower Scrutiny and Higher Scrutiny Countries. The Country is classified as Higher Scrutiny if any of the above occurs [**2**, p. 6].

**Table 1.** *Indicators' thresholds for classification*

| Indicators | AEs | EMs |
|---|---|---|
| Debt/GDP | > 60% | > 50% |
| Public gross financing needs/GDP | > 10% | > 15% |
| Is the country seeking or does it currently have exceptional access to Fund resources | | |

Source: IMF

As debt problems may arise when the country's debt burden is low, additional indicators have been proposed to determine the depth of the study.

**Table 2.** *Potential Indicators for Additional Analysis in Lower Scrutiny Countries*

| Indicators | AEs | EMs |
|---|---|---|
| 3-year cumulative primary balance adjustment (percent of GDP) | >2% | >2% |
| Coefficient of variation of real GDP growth | >1 | >1 |
| Bond yield spreads or EMBI global spreads (basis points) | >600 | >600 |
| External financing requirements (percent of GDP) | >25% | >15% |
| Public debt held by non-residents (share of total) | >45% | >45% |
| Public debt in foreign-currency (share of total) | - | >60% |
| Annual change in the share of short-term public debt at original maturity | >1.5% | >1% |

*Source*: IMF

The basic DSA includes two standardized alternative scenarios [**2**, p.13]

- ***Historical scenario***: real GDP growth, the primary balance, and real interest rates are set at their historical average. Other variables are the same as in the baseline
- ***Constant primary balance scenario***: the primary balance is assumed to remain unchanged compared to the first (current) year of the projection (in percent of GDP). Other variables are the same as in the baseline

The model also includes additional scenarios for "HIGHER SCRUTINY" cases [**2**, p. 22]

- ***Primary balance***
- ***Real GDP growth***
- ***Interest rate***
- ***Exchange rate***
- ***Combined shock***
- ***Additional shocks*** added by the researcher

Armenia meets all the necessary conditions for using the model.

- Has significant and stable access to the international capital market :
- The share of concessional loans in the government debt portfolio tends to decrease
- There is sufficient data coverage for both the historical and the forecast period. The macroeconomic data required for the model is mainly available in the publications of the Statistical Committee of Armenia and Central Bank of Armenia, and the indicators related to the state budget and government debt are available in the statistical bulletins of the RA Ministry of Finance and in the public debt reports:
- It is considered a market access country by the IMF and the WB. The IMF and The WB regularly publishes member states' debt sustainability analyzes to make decisions about lending programs with those countries, as well as to assist those countries in their policy decisions. In this context, the analysis of Armenia's debt sustainability has been carried out in recent years using the MAC DSA model. The latest such analysis is available in an IMF report published in 2021 [**3**].

**The stochastic DSA**

One of the shortcomings of the deterministic model of debt sustainability assessment is that it does not take into account the fiscal responses of the state. In countries where it is possible to use digital series of the required length and quality, debt susttability can be assessed in a stochastic way.

Stochastic assessment is divided into several main parts / blocks [**6**].

The ***first block*** refers to the fiscal response or behavior. As it is mainly reflected in the draft state budget, we take annual data. If we look at the fiscal behavior of a particular country, we must understand that we need data for many years, at least 20 years, which we may not have. If we consider the average fiscal behavior of several countries, in this case we will have panel data. Data from different countries for several years. The main advantage of panel data is that the amount of data increases, which increases the degree of freedom, which is very important in econometric analysis. We consider the primary balance as fiscal behavior. Based on the annual data of the selected countries, the dependence of the primary balance on various factors is estimated. The model under consideration is as follows.

$$p_{i,t} = \alpha_0 + \rho d_{i,t-1} + \gamma y gap_{i,t} + X_{i,t}\beta + \eta_i + \varepsilon_{i,t}, \quad t = 1, \dots, T, \ i = 1, \dots, N \qquad (1)$$

Where:

$p_{i,t}$ is the ratio of the primary balance to GDP in country i and year t;

$d_{i,t-1}$ is the public debt-to-GDP ratio observed at the end of period $t-1$;

$ygap_{i,t}$ is the output gap(the difference between potential GDP and actual GDP);

$\eta_i$ is an unobserved, country fixed effect;

$X_{i,t}$ is a vector of control variables(For example, political factors, there are countries that act differently before polotical elections)

The ***second block*** is the economic block, during which we focus on the shocks that affect debt sustainability. An unrestricted VAR model is used to analyze them. An unrestricted VAR model is estimated for each country, which contains non-fiscal factors influencing the public debt (quarterly data are used for estimation).

$$Y_t = \gamma_0 + \sum_{k=1}^{p} \gamma_k Y_{t-k} + \xi_t \qquad (2)$$

Where:

$Y_t = (r_t^{us}, r_t, g_t, z_t)$, and $\gamma_k$ is a vector of coefficients;

$r_t^{us}$ denotes the real foreign interest rate;

$r_t$ denotes the real foreign interest rate;

$g_t$ the real GDP growth rate;

$z_t$ the (log of the) real effective exchange rate

$\xi_t$ is a vector of well-behaved error terms. $\xi_t \sim N(0, \Omega)$:

With the help of VAR model we can get 1000 series of data with random normal distribution for 5 (20 quarters) years for each shock. Then we use the VAR to make 1000 predictions for the Y vector. The obtained results are quarterly, we must make them on an annual basis. It turns out that fiscal behavior has no effect on the real interest rate, GDP growth, real exchange rate forecast. This is a serious limitation. On the other hand, since we had a factor such as the GDP gap in the response function, we can include macroeconomic shocks in the response function and, consequently, in the primary balance.

Combining the results of the fiscal response and VAR forecast, we will get the following debt formula

$$d_t \equiv (1+g_t)^{-1}\left[(1+r_t^{us})(1+\Delta z_t)d_{t-1}^{*} + (1+r_t)\tilde{d}_{t-1}\right] - p_t, \ t = 1, \dots, T, \qquad (3)$$

Where:

$d_t^*$ captures the foreign currency–denominated debt

$\tilde{d}_t$ designates the public debt in domestic currency

So to predict the debt we need the estimated value of the primary balance, which we can get as follows:

$$\hat{p}_{i,t+\tau} = \Lambda_{i,t+\tau} + \hat{\rho} d_{i,t+\tau-1} + \hat{\gamma} ygap_{i,t+\tau} + \varphi_{i,t+\tau}, \quad t = 1, \dots, T, \ \tau = 1, \dots, \bar{T} \quad (4)$$

Hats show estimated or predicted values

$d_{i,t+\tau-1}$is the debt at the end of last year

$ygap_{i,t+\tau}$ is the GDP gap that we have got as a result of various shocks affecting GDP growth

$\varphi_{i,t+\tau}$ is an accidental shock received regardless of the normal distribution and this random shock is independent of the shocks received via VAR

$\Lambda_{i,t+\tau}$- is the initial value of the primary balance, which is calculated as follows

$$\Lambda_{i,t+\tau} = \hat{p}_{i,t} - \hat{\rho} d_{i,t-1} + \hat{\gamma} ygap_{i,t} + \kappa_{i,t+\tau} \quad (5)$$

In other words, in order to calculate the initial value of the primary balance, we take into account the effect of the public debt and the GDP gap on the primary balance($\hat{p}_{i,t}$) estimated by the model for the year preceding the forecasts.

$\kappa_{i,t+\tau}$ is the forecast error of the model year t. If it is permanent, ie it will be preserved in future forecasts, then its value is often taken as 0. And if it is temporary, then they assume that $\kappa_{i,t+\tau} = \widehat{\varepsilon_{i,t}}$. Thus, it is assumed that fiscal policy during the year *t* is conducted as it should be according to the model.

Let's highlight the two main disadvantages of stochastic model [**4**]

- Quite long series are required for stochastic simulations
- If we try to model the relationship between all the factors influencing the dynamics of debt, we can fall into the "black box" effect. The beauty of stress tests is that we can see the impact of a change in one factor on debt dynamics And in the case of stochastic simulations, when all the variables are shocked at the same time, we can not understand exactly what causes the uncertainty of the predictions:

So the sustainability of the RA public debt can be assessed using the stochastic DSA. However, this is only possible with a quarterly VAR model and a panel data model with annual data from other countries. Which, as we have mentioned, can complicate the economic interpretation of the results.

**Medium-term debt management strategy (MTDS)**

Drawing on experience, the World Bank and International Monetary Fund have developed a systematic and comprehensive framework to help countries develop an effective medium-term debt management strategy (MTDS). The development of this framework has benefited from consultation with a number of regional and international bodies engaged in capacity building in public debt management, and collaboration and input from debt management officials in a number of developing countries [**8**]. The steps involved in designing the MTDS are summarized below [**5**]

1. Identify the objectives for public debt management and scope of the MTDS
2. Identify the current debt management strategy and analyze the cost and risk of the existing debt
3. Identify and analyze potential funding sources, including their cost and risk characteristics
4. Identify baseline projections and risks in key policy areas — fiscal, monetary, external, and market
5. Review key longer-term structural factors
6. Assess and rank alternative strategies on the basis of the cost-risk trade-of
7. Review implications of candidate debt management strategies with fiscal and monetary policy authorities, and for market conditions
8. Submit and secure agreement on the MTDS

As we have mentioned, different types of models do not replace but complement each other. So the macro data used in the MTDS model and the public debt forecast should be consistent with the data used in the stochastic and MAC DSA models. The MTDS model can be used to assess Armenia's public debt, but it should be taken into account that it will require a lot of data, which can be obtained from either the Central Bank or the Ministry of Finance. At the same time, its application will be more effective if the researcher cooperates with the structure responsible for public debt management. In conclusion, we can say that all models of debt sustainability assessment are applicable (with some restrictions) for Armenia, but they will be more effective if applied simultaneously

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