Published in the Russian Federation
Sochi Journal of Economy
Has been issued since 2007.
ISSN: 2541-8114
2022. 16(2): 114-133

www.vestnik.sutr.ru

UDC 33

Model of Government Ponzi Games and Debt Dynamics under Uncertainty

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Abstract

This study examines the effects of fiscal policy on the economy under uncertainty of public debt. Fiscal policy refers to the actions of government in collecting and spending private resources. As its title suggests, the paper is concerned with the dynamic aspects of fiscal policy. These include the effects of fiscal policies on capital formation, economic growth, and intergenerational equity; the influence of long-run expectations on short-run outcomes; and the restrictions imposed by current policies on the set of feasible future policies.

Dynamic analysis has recently gained favor over static analysis in various fields of economics. It is particularly appropriate for the study of fiscal policy, which, at least in the Republic of Moldova, is frequently adjusted and altered. Such changes are often explicitly legislated in advance, but when not pre-announced they may often be surmised from current fiscal conditions. That fiscal variables are continually modified is not surprising. Current policy changes alter the course of the economy and invariably require additional policy changes in the future. But the anticipation of such future changes also alters current outcomes; indeed the current impact of fiscal decisions cannot be determined without considering the entire future time path of fiscal policy.

A dynamic perspective is also crucial in weighting the short-run benefits of particular policies (e.g., tax cuts) against long-run losses (e.g., crowding out) and in evaluating the economic efficiency of alternative policies. Economic efficiency refers to the potential for improving the welfare of some segment of society without reducing that of another. Static analysis is ill-equipped to examine economic efficiency because it ignores a vast segment of society, namely, all future generations. Dynamic analysis considers both current and future generations and permits one to distinguish policies that truly improve economic efficiency from those that simply redistribute resources across generations.

Keywords: working productivity, debt ratio, interest rate, output ratio, debt stabilization, debt sustainability, fiscal deficits, Ponzi games.

1 Introduction

The portion of needy individuals in the worldwide population has declined during late many years. As per Chen and Ravallion (2004), 33 % of the number of inhabitants on the planet resided in poverty in 1981, while the amount was 18 % in 2001 and 9 percent in 2020. The decay is registered to a great extent because of quick financial development in medium-income nations like Moldova and Romania. There are, nonetheless, surprising contrasts among nations and between districts in the creating scene. A few locales and nations, strikingly in East Europe, are quickly making up for lost time to industrialized nations. Others, particularly in Balkan countries,

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are falling a long ways behind and the portion of needy individuals in the population has even expanded in certain nations.

Modern development has played a significant part in the financial growth of nations like Slovakia, Czech Republic, Hungary, Poland, Romania and The Republic of Moldova. Alongside sped up development, neediness rates have declined in numerous countries. A few nations have figured out how to accomplish development with value, while in others imbalance has stayed high. The fundamental accentuation is on depicting their development cycles and procedures, the job of modern turn of events, the commitment and scope of strategies to development execution, and the effect of development on open obligations. The review starts with a short hypothetical conversation of the effect of modern growth and development, and the effect of development on destitution and pay for recessions and afterward continuing at the nation economic model level.

Public debt predicts the short-run yield flexibility of spending plan shortfall, for example all things considered, when result increments by one rate point. A steady relationship is a vital fixing on macroeconomics course readings, and business cycle models. However, little by little having significant awareness of whether the versatility relies upon the power driving the business cycle. For example, whether joblessness and result co-move differently in downturns set off by financial strife or an oil supply disturbance is muddled ex-risk.

The absence of proof is amazing considering stresses that the relationship separates every so often and is especially frail during recoveries from downturns established within financial market trouble (for example Gordon, 2010).

This paper proposes a basic strategy to appraise a large scale shock-specific spending plan shortfall versatility on open public debt: it measures by how much the deficiency rate falls over a specific skyline when result increments by one rate point over a similar skyline on account of a specific macroeconomic shock. Surmising depends on basic instrumental variable relapses of total shortfall on aggregate obligation. Involving information for the Republic of Moldova, we consider government spending, charge, money related approach, financial, innovation, and oil shocks. We acquire three key outcomes:

- At medium skylines (2-3 years), shortfall flexibilities are generally steady across financial shocks.

- At more limited skylines, differences are more significant. The speed at which joblessness changes comparative with yield relies upon the shock driving fluctuations. This features the significance to think about longer skylines. If not, one could inaccurately infer that the flexibility separates for certain cycles.

- The flexibility is biggest for financial shocks. Significantly, it is bigger than for financial approach and government spending shocks. We contend these findings can assist with understanding the at first "excessive shortage" recuperation following the 2007 financial emergency. Daly et al. (2013) who likewise gauge shock-specific shortfall flexibilities.

We construct the work along three aspects. In the first place, we think about a more broad determination of macroeconomic shocks. Second, we propose another one-venture way to deal with gauge the versatilities, though Daly et al. (2013) follow a two-venture system and 3-stage Klein Macroeconomic Model. This increases efficiency and simplifies the development of groups. Third, our strategy permits us to perform feeble strong induction. The last point is pivotal in light of the fact that the gauge blunder fluctuation commitment of full scale shocks to the factors of interest is many times little (Gorodnichenko, Lee, 2017), prompting frail instrument issues.

2 Literature review

The ongoing comprehension of monetary development is to a great extent founded on the neo-old style development model created by Robert Solow (1956). In the Solow model, capital gathering is a central point adding to monetary development. Efficiency development - estimated as an expansion in yield for each laborer results from expansions in how much capital per specialist, or capital accumulation (for example Fagerberg, 1994). Capital developing will go on until the economy arrives at its consistent state – a place where net speculations develop at a similar rate as the workforce and the capital-work proportion remains constant. The further economy is the beneath of its consistent express, the quicker it ought to develop (see for example Jones, 1998). In the consistent express, all per capita pay development arise from exogenous innovative change. The pace of mechanical interaction is thought to be steady and not, but affected by monetary impetuses. A few agents have observed that capital and work really make sense in just a small amount of result development and that taking into account the nature of the workforce (human

resources) just to some degree diminishes the unexplained development – or Solow leftover.

Endogenous development hypothesis, started by Romer (1986, 1990) and Lucas (1988), centers around the Solow model. Innovative change becomes endogenous to the model and is an aftereffect of the allocative decisions of monetary authorities (see Aghion, Howitt, 1998; Veloso, Soto, 2001). Mechanical advancement is driven by R&D exercises which thus are fuelled by private firms' expect to benefit from creations. Dissimilar to other creation data sources, technology and information are nonrivalrous (see Romer, 1990). In addition, new information can expand the efficiency of existing information, yielding and expanding back to scale. Along these lines, the peripheral efficiency of capital doesn't decline with expanding GDP per capita, and wages need not meet across nations.

Mechanical change and modernizations are fundamental wellsprings of underlying change. In Schumpeter's view, development lead to "imaginative obliteration", an interaction by which areas and firms related with old innovations decline and new areas and firms arise and develop (see Verspagen, 2000). More useful and beneficial areas and firms uproot less useful and less productive ones and total efficiency in the economy increments. Mechanical change is hence at the actual focus of current financial development. In light of the perception that, starting with the Industrial Revolution, innovative change occurred chiefly in the assembling area, creators like Kaldor (1970) and Cornwall (1977) have stated that the extension of this area is a main impetus for monetary development (see Verspagen, 2000). Additionally, Cornwall (1976, 1977) saw innovative change in specific manufacturing areas as a main thrust for efficiency development in a few other sectors. Syrquin (1986) sees that, when in general development speeds up, manufacturing normally drives the way and becomes quicker than different areas. At low pay levels, the portion of assembling in GDP is, notwithstanding, low and its prompt commitment to total development minor. While assembling expands its result share – frequently as a reaction to changes in homegrown interest and in relative benefit – quicker sectoral development discernibly raises the total development paces of result and work efficiency.

In created nations, innovative work (R&D) exercises are the primary driver of mechanical change. This isn't, nonetheless, the main component of innovative change. Firms and individual representatives advance by doing, expanding result and efficiency regardless of whether innovation or information sources stay unaltered (see for example Bolt, 1962). As R&D exercises in non-industrial nations are moderately restricted and nations are a long way from the mechanical wilderness, worldwide innovation dissemination is fundamental for efficiency development. Global financial relations, particularly worldwide exchange yet in addition unfamiliar direct venture, are significant channels of innovation move and expanded efficiency development. In any case, innovation dissemination must be effective assuming that the degree of HR is sufficiently high, motivating forces for mechanical improvement are solid, and foundations are generally well-working.

One of the main impetuses for underlying change is the adjustment of homegrown and worldwide interest. At moderately low pay levels, people spend a huge piece of their pay on food. As pay rises, this offer will in general decay, though interest for makes rises. Also, as pay rises further, interest for produces increments at decreasing rates, while interest for administrations rises quickly. Changes will likewise influence sectoral work and result offers and effect the economy's work efficiency. Besides, exchange of goods ans services affects nations' specialization designs and on the pace of industrialization or underlying change inside businesses. Under an open exchange system, nations will more often than not spend significant time in the development of products for which they enjoy a near benefit and import items which are generally costly to locally deliver. Exchange receptiveness is additionally liable to carry unfamiliar interest into the country. This is frequently fundamental, and particularly so at beginning phases of capital creation. It is additionally liable to increment efficiency as homegrown organizations are confronting outside rivalry.

Notwithstanding, the organization of unfamiliar exchange matters as well as the open-ness of exchange (for example Amable, 2000; additionally, Rodrik in this volume). Additionally, specialization in itself doesn't be guaranteed to prompt higher development rates. This is most obvious on account of agricultural nations reliant upon commodities of primary items. As genuine worldwide costs of non-oil items have declined over the long run and are dependent upon sizeable present moment fluctuations, specialization is essential in creation only here and there – advances supported financial development (see for example Bolt, 1962). As R&D exercises in non-industrial nations are somewhat restricted and nations are a long way from the innovative wilderness, worldwide innovation dispersion is fundamental for efficiency development. Worldwide monetary relations, particularly global exchange yet, additionally unfamiliar direct venture, are significant

close of innovation moving and expanded economic development. Notwithstanding, innovation dispersion must be proficient assuming the degree of HR andsufficiently high, motivated for solid mechanical improvement, and organizations are somewhat well-working.

One of the main thrusts for underlying change is the adjustment of lossness and worldwide interest. At moderate level, people spend a huge portion of their pay on food. As pay rises, this offer will in general downfall, while interest for fabricates rises. Likewise, as pay rises further, interest for makes increments at lessening rates, though interest for administrations rises quickly. Changes popularly will likewise change sectoral business and result offers and effect the economy's work efficiency. Moreover, exchange affects nations' exceptionalization designs and on the pace of industrialization or underlying change inside enterprises. Under an open exchange system, nations will quite often represent considerable authority in the creation of products for which they enjoy a similar benefit and import items which are somewhat costly to locally deliver. Exchange receptiveness is additionally prone to carry unfamiliar interest into the country. This is frequently indispensable, and particularly so at beginning phases of createment. It is additionally liable to increment efficiency as homegrown organizations are facing outer rivalry.

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Note, in Romer, the variables k_t, y_t, c_t, etc. are defined in units of effective labor Jones defines these use the tilde: $\tilde{k}$, $\tilde{y}$, and so on. This guide will use the Romer notation to maintain consistency with the chapter. Note that the worker earns w_t for each unit of labor L_t supplied. Each effective worker earns Atwt for each unit.

3. Results and discussion

What is debt sustainability analysis

Debt sustainability analysis (DSA) asks if, under current policies, a country or a government will be able to service its debts in the medium and long run without renegotiating or defaulting, and without having to undertake policy adjustments that are implausibly large economically and politically. DSA frameworks provide an intertemporal consistency check by testing whether macroeconomic plans are viable not only from a “flow balance” perspective but also from a “stock balance” point of view. They may also help dissuade policymakers from pursuing policies that deliver short-term benefits at the cost of creating unsustainable debts in the future.

In recent years, the IMF developed an approach to debt sustainability that is now used in surveillance and lending decisions[1]. These DSAs help policymakers assess the risks associated with short-run macroeconomic forecasts and the policies on which such forecasts are based. A first risk is that projections of external or public debt may not be always grounded on sufficiently conservative assumptions. For instance, some governamental-supported programs have been based on assumptions about growth in export volumes and prices that proved to be optimistic, contributing to excessive borrowing. A second key risk to the realism of forecasts is the assumed path of the real exchange rate. Countries may be able to sustain relatively large stocks of foreign currency denominated debt through real exchange rate appreciation over the medium term.

As discussed, moreover, it may be reasonable to assume that some countries will experience secular real appreciation as an equilibrium phenomenon due to catch-up growth. While the assumption of real appreciation may be defended in some circumstances, experience in several countries that underwent substantial real depreciations following crises suggests that it is risky to base policies on the assumption that real appreciation will continue indefinitely.

DSAs also allow policymakers to identify the economic sectors responsible for excessive debt accumulation, be they the national government (as in a number of African countries in the 1990s), subnational governments and state enterprises (as in some transition economies), or the private sector (as in the Asian crisis countries).

In many emerging market countries, debt ratios may be moderate and the main risk to sustainability may arise from liquidity problems. In some cases, countries do not have sufficient liquidity to cover maturing obligations even when they can be considered solvent, i.e., have

[1] See, “Assessing Sustainability,” IMF (2002, 2003).

relatively low and declining external debt-to-GDP ratios. Concerns about liquidity may arise, for instance, if the sovereign or private sector needs to make large amortization payments to creditors in the near future and foreign exchange or government revenues are insufficient. In such cases of temporary illiquidity, much depends on the willingness of creditors to maintain or increase their exposure in the short run. Market confidence is a crucial ingredient, and the vulnerability to confidence crisis needs to be evaluated and addressed alongside long-term sustainability.

For low-income countries that do not borrow from private capital markets, the sustainability of the public debt is largely de-linked from the sentiments of the market. It depends, instead, on the willingness of official creditors and donors to continue providing positive net transfers through concessional loans and grants[2]. For low-income countries that have high debt ratios, solvency is more of a concern than liquidity. DSAs allow a study of the exposure of the IMF and other multilateral creditors to individual borrowers.

Finally, DSAs are also useful to assess the impact of—and response to—powerful

technological and demographic changes that constrain government policies in the long run. Fiscal DSAs help quantify the fiscal impact of population aging, immigration, and other long-run population changes.

The DSA framework presented in this paper is a simple quantitative model of the evolution of (external or public) debt. It is based on the intertemporal accounting identity linking external or fiscal deficit flows to the accumulation of the corresponding debt stocks over time. In building any DSA framework, analysts must make baseline assumptions about the time paths of a number of macroeconomic variables – real GDP growth, inflation, interest and exchange rates, budget and external debts and deficits. In the DSA framework, the choice of baseline is a judgment made by the country team on the basis of consultations with country authorities through the internal review process. The baseline projection is then stress-tested by subjecting it to plausible macroeconomic shocks. To be useful, stress tests must choose shocks of reasonable type, size, and cross-correlation. What "plausible" shocks are is a matter of judgment and depends on the specifics of the country's situation and outlook. To make DSAs more systematic and disciplined, the stress tests in the framework are derived from the country's past history of shocks. Sometimes the country teams complement the mechanical, history-based scenarios with alternative scenarios that assume more adverse external conditions and/or suboptimal policies.

While they are an extremely valuable tool, DSAs have certain limitations. For one thing, DSAs do not assign explicit probabilities to the likelihood of crises. While desirable in principle, probabilistic approaches are more difficult to implement, especially for countries in which limited data or rapid structural change make it difficult to estimate these probabilities. A second limitation of existing DSA approaches, is that they abstract from second-round behavioral responses of economic agents to shocks. For example, shocks to GDP do not affect the government's tax collections or spending plans. The literature has begun to incorporate such effects by estimating fiscal reaction functions that endogenize the economy's response to shocks (Celasun et al., 2006).

A third limitation of DSA analyses is that they focus mainly on debt dynamics rather than threshold levels of debt. DSAs regard debt paths as sustainable so long as the debt-to-GDP ratio declines. While this is, in principle, correct in the sense that it meets the intertemporal budget constraint, it may be problematic to assume sustainability if the debt ratio is stabilized at a high level. Clearly, stabilizing the debt-to-GDP ratio at 30 percent is different from stabilizing it at 90 percent. Some industrial countries – including Greece, Italy, Belgium, and Japan—have been able to sustain debt-to-GDP ratios that exceed 100 percent for decades without having to pay high interest rates. Developing or emerging market economies, on the other hand, often do not have such luxury. For example, in the case of Argentina during the pre-2001 crisis period, the debt-to-GDP ratio was approximately 50 percent, not high by international standards.[3]

A fourth limitation of DSAs is that they focus more on debt dynamics and less on liquidity risk. As noted earlier, the risk that maturing debt cannot be refinanced may arise even in solvent countries. The DSA templates provide gross financing needs and other information on rollover risks. On the other hand, a full evaluation of these risks requires more disaggregated – and higher frequency – data on the debt stock.

[2] For treatment of debt sustainability in low-income countries, see IMF (2004, 2004a).

[3] IMF (2003) takes a closer look at how these debt ratios can be interpreted, and concludes that for emerging markets a total debt above 40–60 percent of GDP leads to sharply higher crisis probabilities (the more so the more closed the country is to foreign trade).

Finally, a word of caution is in order. With the benefit of 20/20 hindsight, the path to many of the recent crises and episodes of unsustainable debt dynamics now seems obvious. And yet most observers failed to spot the initial policy mistakes that eventually led to these crises. Why is it so difficult to diagnose sustainability problems? No simple or sophisticated model will be able to predict crises well in advance while avoiding false alarms. The main problem with all approaches, including DSAs, is two-fold: first, changes in the external environment are difficult to predict beyond a short-term horizon, and a single set of policies can result in very different outcomes depending on external events; second, the reaction of domestic and foreign investors and the public is difficult to gauge, especially when information is scarce, perhaps owing to lack of policy transparency, and economic agents act in "herd-like" manner. Economists can at best prepare DSAs or other model scenarios and explore the circumstances under which crises or debt problems are more or less likely to develop.

This section examines public debt dynamics. Starting from the government's cash-flow constraint, it examines the factors affecting fiscal sustainability and shows how a stream of budget deficits can, over time, lead to unsustainable public debt levels and their macroeconomic consequences. Both the closed and open economy cases are considered.

We assume in our model:

- Technological progress. Technology grows at rate g : $A_t = (1+g)\, A_{t-1}$.

- Also Ponzi[4] games plays a significant role in the context of external national debt, the public deficit and private investment - Pay As You Go (PAYG).

- Since now, the two previous years of COVID-19[5] implications derived the capitalist market economies of the world through recurrent periods of dynamic trends. At the start of the present decade the growth rate of real GDP per capita turned negative in all of the three largest Eastern European Economies: Russia, Ukraine and Romania.

- Numerous disarrays identifying with the arrangement of strategies utilized by Monetary Policy in a specific space of study financial variables and parameters can reconsider anticipated time-arrangement and/or uncertainty in terms of model errors.

The public sector DSA template

The public area obligation format tracks the way of behaving of the gross obligation to-GDP proportion displayed in equation (9). The meaning of obligation utilized in the DSA depends on gross liabilities — that is, public area fluid or different resources are not gotten out. The inclusion of public obligation is just about as wide as could be expected and it incorporates public endeavors as well as neighborhood legislatures.

In view of equation (9), the format recognizes the various channels that add to the development of the obligation to GDP proportion, including the essential shortfall and endogenous/programmed factors connected with financing costs, development rates and swapping scale changes. The format additionally incorporates other obligation making tasks, for example, would result from the acknowledgment by the public authority of contingent liabilities, as well as obligation diminishing activities, for example, privatizations whose continues are utilized to square away open obligation.

The gross supporting necessities of the public area are characterized as the amount of the public area shortfall and all obligation developing over the accompanying a year. The format additionally works out the obligation settling essential equilibrium which would be expected to keep the obligation to-GDP proportion steady in the event that every one of the factors in the obligation elements condition stayed at the level announced somewhat recently of the projection.

[4] Charles Ponzi (1882–1949) is the first author of a fraudulent pyramid-type game that promised a 100 % win in 90 days. Fraudulent pyramid schemes of this type were later renamed the Ponzi scheme (game). The scheme mechanism provides for the payment of the current investors based on the amounts brought by the new depositors. Basically, the money of a new depositor is given to the old depositors as a gain, and he will receive his money from other future depositors. The scheme obviously works as long as there are new depositors for all the old ones.

[5] Victoria Fală (2020) "Repere pentru politica de atragere a investiţiilor şi de sporire a competitivităţii exporturilor Republicii Moldova în contextul crizei economice generate de COVID-19. (Repere pentru politica de atragere a investiţiilor şi de sporire a competitivităţii exporturilor Republicii Moldova în contextul crizei economice generate de COVID-19)". Theses of International Scientific Conference "Economic and Social Implications of the COVID-19 Pandemic: Analysis, Forecasts and Consequences Mitigation Strategies". October 23, 2020. Chisinau (Republic of Moldova)

As examine, in the IMF's public obligation manageability structure, the gauge ways of the public obligation to-GDP proportion and the factors on which it depends are projected by IMF staff in conference with country specialists. The pattern projections are restrictive as in they expect that the specialists will completely carry out the reported financial, money related, swapping scale, and underlying approaches.

In addition, the public debt sustainability template presents projections under a historical scenario. This is an alternative path of the debt ratio, constructed under the assumption that all key variables stay at their historical averages throughout the projection period. This scenario is a test of the "realism" of baseline projections: if the deviations of assumed policies and macroeconomic developments in the baseline are very different from those in the historical scenario, these will need to be justified by referring to credible changes in policies.

The template also contains a no-policy-change scenario. This is derived under the assumption that the primary balance is constant in the future and equal to the projection for the current year. The no-policy-change scenario can be modified to assume an unchanged cyclically adjusted primary position, or to make adjustments for the expiration of one-off measures, as necessary.

The baseline scenario is also stress-tested using different assumptions on key parameters. Permanent shocks equal to one-half standard deviation are applied to the baseline projections of each of the parameters, and paths of debt ratios are then derived. One-quarter standard deviation shocks are applied in the combined shock test. These shocks are applied to the interest rate, growth rate, and primary balance. In addition, the template examines the debt trajectory in the case of a 30 percent depreciation of the local currency and a contingent liabilities shock of 10 percent of GDP. The latter is presented as a rough measurement of an increase in debt-creating flows, given the difficulties in discussing contingent liabilities risk.

If better measures are available, the staff is encouraged to use them in stress tests.

Table 1. Lists the data inputs needed to calculate the debt-to-GDP ratio in the the context of DSA. Data Input Requirements for DSA

Fiscal Variables	**Macroeconomic Variables**
Public sector debt, Public sector balance, Public sector expenditure, Public sector interest expenditure, Public sector revenue (and grants), Foreign-currency denominated debt (expressed in local currency), Amortization on medium- and long-term public sector debt, Short-term public sector debt, Interest payments on foreign debt	Nominal GDP, Real GDP, Exchange rate, national currency per U.S. dollar, end of period, Exchange rate, national currency per U.S. dollar, period average, GDP deflator

It is likewise alluring to have information on privatization receipts, acknowledgment of understood or contingent liabilities, and different liabilities (e.g., bank recapitalization). While this information is a lot harder to gather, it enormously works on the nature of the benchmark projection and the pressure tests.

When input information are filled in, the gauge and stress test results are naturally adjusted and introduced in a synopsis table and in graphs addressing the results of the pressure tests, otherwise called bound tests. See Figure 3 for a model.

Figure 3 sums up the gauge situation. Lines 1 and 2 show how the obligation to-GDP proportion develops over the long run. The key macroeconomic suspicions hidden the benchmark are accounted for at the lower part of the table. The various channels that add to the advancement of the obligation to-GDP proportion are: the essential shortage (line 4), the programmed obligation elements (line 7), and other distinguished obligation making streams (line 12), which incorporate privatization receipts, acknowledgment of implied or contingent liabilities, and different commitments like bank recapitalization. These streams are expected zero in this specific model.

The programmed obligation elements, thusly, is separated into commitments from the genuine loan fee, genuine GDP development, and conversion scale. This disintegration permits an

evaluation of the significance of various variables in the development of public obligation and furthermore fills in as the reason for pressure tests, the consequences of which are summed up along with the gauge projections in Figure 2.

Changes in gross obligation emerging from other underneath the-line tasks, for example, reimbursement of obligation funded by a decrease in monetary resources, and cross-cash developments are remembered for a lingering (line 16). It is basic to screen the way of behaving of this leftover, as it might feature mistakes in carrying out the methodology. A huge lingering may, specifically, signal a break of the stream stock character connecting the shortfall to changes paying off debtors. The remaining ought to be little except if it very well may be made sense of by unambiguous variables. The gross funding needs of the public area, in percent of GDP and in billions of dollars, are likewise determined.

Table 1 additionally reports the ways of obligation to GDP proportion under the verifiable situation and under the no-approach change situation. These situations test the authenticity of the pattern situation. At long last, the format likewise works out the obligation settling essential equilibrium (last segment of Table 1).

Foreign financial resources can be important to growing economies, as they supplement domestic savings to finance investment, help smooth income fluctuations and, in the case of direct foreign investment, facilitate technology transfer. Access to foreign finance, however, has in the past also led a number of countries to accumulate unsustainable foreign debts, which they were unable to honor in full. Although excessive debt obligations can be renegotiated with creditors in principle, the process is neither smooth nor costless in practice, not least because creditors are multiple and fragmented. Sometimes an initial round of debt reduction needs to be followed by further debt forgiveness. In the meantime, the country typically loses access to foreign financing for a sustained period, its currency depreciates strongly in nominal and real terms, and imports and other foreign spending are compressed. In some instances, balance sheet effects lead to insolvency of domestic firms and depositor runs against the banking system. The effects of financial convulsions on the real economy may be severe, with inflation, interest rates, and unemployment spiking up and output contracting.

Unsustainable foreign debts are thus costly to a country and disrupt the smooth functioning of international capital markets. However, while there is a large payoff to preventing these situations, identifying dangerous imbalances and correcting them as they are building up has proven difficult. The purpose of external debt sustainability analysis (DSA) is to help policymakers in these endeavors.

This chapter presents the analytical and operational considerations relevant to the analysis of external sustainability.

The Model

The market-access country (MAC) debt sustainability analysis (DSA) framework is based on a general and flexible identity characterizing the evolution of the stock of public debt. In its most basic form, the evolution of public debt can be characterized in the following way:

$$D_{t+1} = \frac{e_{t+1}}{e_t}(1 + i^f_{t+1}) * D^f_t + (1 + i^d_{t+1}) * D^d_t - (T_{t+1} + G_{t+1} - S_{t+1}) + O_{t+1} + RES_{t+1}) \quad (1)$$

Obligations associated with the stock of debt from the previous period

Primary Fiscal Balance

Other one-time factors

Where subscripts refer to time periods and superscript *"f", "d"*, refer to foreign-currency and domestic-currency denominated debt, respectively.

D^f_t is the stock of foreign currency as obligations-denominated debt at the end of period t.
D^d_t is the stock of domestic currency as obligations -denominated debt at the end of period t.
e_{t+1} is the stock of foreign currency as obligations -denominated debt at the end of period t.
i^f_{t+1} is the stock of domestic currency as obligations -denominated debt at the end of period t.
i^d_{t+1} is the stock of domestic currency as obligations -denominated debt at the end of period t.

T_{t+1} is the stock of taxes-denominated debt at the end of period t.
G_{t+1} is the stock of grants-denominated debt at the end of period t.
S_{t+1} is the stock of expenditures-denominated debt at the end of period t.
O_{t+1} is the stock of other one-time factors-denominated debt at the end of period t.
RES_{t+1} is the stock of other one-time factors -denominated debt at the end of period t.

For simplification, the primary balance (PB) is no longer decomposed into taxes (T), grants (G) and expenditures (S). The basis for the decomposition of the change in the debt-to-GDP ratio—the debt dynamic—is as follows:

$$D_{t+1} = (1+\varepsilon_{t+1}) * (1+i^f_{t+1}) * D^f_t + (1+i^d_{t+1}) * D^d_t - PB_{t+1} + O_{t+1} + RES_{t+1} \quad (2)$$

Where, $1+\varepsilon_{t+1} = \frac{e_{t+1}}{e_t}$

The debt-to-GDP ratio and debt dynamics

To gauge the obligation trouble, scaling the supply of obligation by a proportion of reimbursement capacity is fitting. Since the format centers around the development of the obligation to-GDP proportion, this segment presents just the decay of this proportion.

Dividing equation (2) by nominal GDP in local currency (Y) in period t+1, yields the following expression:

$$\frac{D_{t+1}}{Y_{t+1}} = (1+\varepsilon_{t+1}) * (1+i^f_{t+1}) * \frac{D^f_t}{Y_{t+1}} + (1+i^d_{t+1}) * \frac{D^d_t}{Y_{t+1}} - - \frac{PB_{t+1}}{Y_{t+1}} + \frac{O_{t+1}}{Y_{t+1}} + \frac{RES_{t+1}}{Y_{t+1}}$$

Using small caps to express contemporaneous ratios:

$$d_{t+1} = (1+\varepsilon_{t+1}) * (1+i^f_{t+1}) * \frac{D^f_t}{Y_{t+1}} + (1+i^d_{t+1}) * \frac{D^d_t}{Y_{t+1}} - PB_{t+1} + o_{t+1} + res_{t+1}$$

Let $Y_{t+1} = (1+g_{t+1}) * (1+\pi^d_{t+1}) * Y_t$, where g is the real growth rate of the economy and π is domestic inflation (as measured by the change in the GDP deflator), we can further define the previous expression:

$$d_{t+1} = \frac{(1+\varepsilon_{t+1}) * (1+i^f_{t+1}) * D^f_t}{(1+g_{t+1}) * (1+\pi_{t+1}) * Y_t} + \frac{(1+i^d_{t+1}) * D^d_t}{(1+g_{t+1}) * (1+\pi_{t+1}) * Y_t} - pb_{t+1} + o_{t+1} + res_{t+1}$$

Deducting dt from both sides, the change in the debt-to-GDP ratio (the debt dynamic) is therefore:

$$d_{t+1} - d_t = \frac{(1+\varepsilon_{t+1}) * (1+i^f_{t+1})}{(1+g_{t+1}) * (1+\pi_{t+1})} * d^f_t + \frac{(1+i^d_{t+1})}{(1+g_{t+1}) * (1+\pi_{t+1})} dd_t - pb_{t+1} + o_{t+1} + res_{t+1} - d_t$$

Let $\rho_{t+1} = (1+g_{t+1}) * (1+\pi_{t+1})$

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}} [(1+\varepsilon_{t+1}) * (1+i^f_{t+1}) * d^f_t + (1+i^d_{t+1}) * d^d_t] - pb_{t+1} + o_{t+1} + res_{t+1} - d_t$$

Isolating the contribution from the exchange rate,

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}} [(1+i^f_{t+1}) * d^f_t + (1+i^d_{t+1}) * d^d_t + \varepsilon_{t+1} * (1+i^f_{t+1}) * d^f_t] - pb_{t+1} + o_{t+1} + res_{t+1} - d_t$$

Moving the right-hand side dt inside the brackets…

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}} [(1+i^f_{t+1}) * d^f_t + (1+i^d_{t+1}) * d^d_t + \varepsilon_{t+1} * (1+i^f_{t+1}) * d^f_t - d_t * (1+g_{t+1}) * (1 + \pi^d_{t+1})] - pb_{t+1} + o_{t+1} + res_{t+1}$$

Isolating the contribution from real GDP growth,

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}} [(1+i^f_{t+1}) * d^f_t + (1+i^d_{t+1}) * d^d_t + \varepsilon_{t+1} * (1+i^f_{t+1}) * d^f_t - d_t * g_{t+1} - -d_t(1+\pi_{t+1} * g_{t+1} + \pi_{t+1}) - pb_{t+1} + o_{t+1} + res_{t+1}$$

Isolating the contribution from interest rates,

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}} [i^f_{t+1} + d^f_t + i^d_{t+1} * d^d_t + d^f_t + d^d_t + \varepsilon_{t+1} * (1+i^f_{t+1}) * d^f_t - d_t * g_{t+1} - -d_t(1+\pi_{t+1} * g_{t+1} + \pi_{t+1}) - pb_{t+1} + o_{t+1} + res_{t+1}$$

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}}[i^f_{t+1} + d^f_t \ + \ i^d_{t+1} * d^d_t + \ \varepsilon_{t+1} \ * (1 + i^f_{t+1}) * d^f_t - d_t * g_{t+1} + d^f_t + d^d_t - d_t - d_t * (\pi_{t+1} * g_{t+1} + \pi_{t+1})] \ - pb_{t+1} + o_{t+1} + res_{t+1}$$

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}}[i^f_{t+1} + d^f_t \ + \ i^d_{t+1} * d^d_t + \ \varepsilon_{t+1} \ * (1 + i^f_{t+1}) * d^f_t - d_t * g_{t+1} - d_t * \pi_{t+1}(1 + g_{t+1})] - pb_{t+1} + o_{t+1} + res_{t+1}$$

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}}\left[d_t * \left(\frac{i^f_{t+1} * d^f_t}{d_t} + \frac{i^d_{t+1} * d^d_t}{d_t}\right) - d_t * \pi_{t+1} * (1 + g_{t+1}) + \varepsilon_{t+1} \ * (1 + i^f_{t+1}) * \ d^f_t \ - d_t * g_{t+1}\right] - pb_{t+1} + o_{t+1} + res_{t+1}$$

$$d_{t+1} - d_t = \frac{1}{\rho_{t+1}}[d_t * i_{t+1} - d_t * \pi_{t+1} * (1 + g_{t+1}) + \varepsilon_{t+1} \ * (1 + i^f_{t+1}) * \ d^f_t \ - d_t * g_{t+1}] - pb_{t+1} + o_{t+1} + res_{t+1}$$

Effective nominal interest rate (weighted average)

Where it+1 is the effective nominal interest rate (weighted average)

Where i_{t+1} is the effective nominal interest rate (weighted average)

$d_{t+1} - d_t = \frac{1}{\rho_{t+1}}[d_t * (i_{t+1} - * \pi_{t+1} * (1 + g_{t+1})) + \varepsilon_{t+1} \ * (1 + i^f_{t+1}) * \ d^f_t \ - d_t * g_{t+1}] - pb_{t+1} + o_{t+1} + res_{t+1}$ (36)

Contribution of effective interest rate	Contribution of the exchange rate	Contribution of real GDP growth	Contribution of primary balance and other factors

This can also be expressed in terms of real interest rates and real exchange rates:

$$d_{t+1} - d_t = \left(\frac{1}{1 + g_{t+1}}\right) * \left(d_t * \left[r^d_{t+1}\frac{d^d_t}{d_t} + r^f_{t+1}\frac{d^f_t}{d_t}\right] - d_t * g_{t+1} + d^f_t * \xi_{t+1} * (1 + r^f_{t+1})\right) - pb_{t+1} + o_{t+1} + res_{t+1}$$

Contribution of effective interest rate	Contribution of the exchange rate	Contribution of real GDP growth	Contribution of primary balance and other factors

Where,

$$(1 + i^d_{t+1}) = (1 + r^d_{t+1}) * (1 + \pi^d_{t+1})$$

$$(1 + i^d_{t+1}) = (1 + r^f_{t+1}) * (1 + \pi^f_{t+1})$$

$$1 + \xi_{t+1} = \frac{e_{t+1}}{e_t}\left(\frac{1 + \pi^f_{t+1}}{1 + \pi^d_{t+1}}\right)$$

Debt Dynamics in a Closed Economy

Consider first an economy that does not trade with the rest of the world. Denote by Y_t the economy's real GDP in year t and P_t the GDP deflator. Nominal GDP is the product $P_t\ Y_t$.

Let π_t denote the rate of increase in prices between years $t-1$ and t, expressed as $\pi_t \ = \frac{P_t}{P_{t-1}}$ - 1

Similarly, let g_t denote the real growth rate of output, expressed as $g_t \ = \frac{Y_t}{Y_{t-1}} \ - 1$.

Let M_{t-1} denote the stock of money at the end of year $t-1$ and assume, for simplicity, that all interest-bearing government debt has one-year maturity. Denote by D_{t-1} the stock of one period

government bonds outstanding at the end of year $t-1$.The average nominal interest rate on government debt issued at $t-1$ is i_t. The government's expenditure in year t consists of two components, non-interest spending, denoted G_t, and interest payments on the debt, $i_t D_{t-1}$.

Next consider the government's cash-flow constraint in year t. As a matter of accounting, government expenditure must be financed by raising tax and nontax revenues net of transfers to the private sector, denoted R_t, through money issuance, $M_t - M_{t-1}$ ($=\Delta M_t$), and by issuing interest-bearing securities, $D_t . - D_{t-1}$.

$G_t + i_t D_{t-1} = R_t + (D_t - D_{t-1}) + (M_t - M_{t-1})$ (3)

The government's overall budget balance is the difference between revenue and expenditure, $R_t - (G_t - iD_{t-1})$. The primary budget balance, PB_t, is the difference between revenue and noninterest expenditure, $R_t - G_t$. As we are interested in the evolution of the stock of interestbearing public debt, we solve (3) for D_t, yielding

$$D_t = (1 + i_t)D_{t-1} - (PB_t + \Delta M_t) \quad (4)$$

To derive an expression for the stock of public debt in relation to GDP, we divide equation (4) by nominal GDP:

$$\frac{D_t}{P_t Y_t} = \frac{(1+i_t)D_{t-1}}{P_t Y_t} - \left(\frac{PB_t}{P_t Y_t} + \frac{\Delta M_t}{P_t Y_t}\right) = \frac{(1+i_t)}{(1+g_t)(1+\pi_t)} \frac{D_{t-1}}{P_{t-1} Y_{t-1}} - \left(\frac{PB_t}{P_t Y_t} + \frac{\Delta M_t}{P_t Y_t}\right) \quad (39)$$

Denote by lower-case letters the stock of debt, primary balance, and seignorage expressed as shares of GDP: $d_t \equiv D_t / P_t Y_t, d_{t-1} \equiv D_{t-1} / P_{t-1} Y_{t-1}$, $pb_t \equiv PB_t / P_t Y_t$, and $\mu_t \equiv \Delta M_t / P_t Y_t$. The parameter multiplying d_{t-1}, denoted φ_t, is key in debt sustainability analysis. Use the Fisher equation linking the nominal and real interest rate,

$1 + r_t \equiv (1 + i_t)/(1 + \pi_t)$, to write φ_t as the ratio of one plus the real rate of interest on government debt over one plus the real rate of GDP growth:

$$\varphi_t \equiv (1 + i_t)/[(1 + g_t)(1 + \pi_t)] = (1 + r_t)/(1 + g_t) \quad (5)$$

With this notation, the government budget constraint can now be rewritten as:

$$d_t = \varphi_t d_{t-1} - (pb_t + \mu_t). \quad (6)$$

We can draw equation (6) in a phase diagram as shown in Figure 2 to examine how the debt-to-GDP ratio evolves over time. The horizontal axis plots the debt-to-GDP ratio in year t-1, d_{t-1}, while the vertical axis shows the resulting value of d_t in year t. The 45° line shows debt-to-GDP ratios that do not change over time. Suppose, for simplicity, that the parameters φ_t, pb_t , and μ_t, respectively, so that d_t and d_{t-1} have a linear relationship.

Whether the public debt-to-GDP ratio is explosive or not depends on the value of the parameter. The non-explosive case $\varphi < 1$ is shown on the left-hand side panel of Figure 1. In this case, the initial level of debt-to-GDP ratio d_o, eventually falls to d^* and stays at that level forever. The explosive debt case $\varphi > 1$ is shown on the right-hand side panel of Figure 1. Here, the real interest rate r_t, which the government pays on its debt exceeds the real GDP growth rate g_t. Starting from any positive initial level of debt-to-GDP ratio $d_o > d^*$ in year 0, the debt to GDP ratio grows without bound, which is obviously unsustainable.

The speed at which debt can explode in realistic cases is surprisingly fast. Suppose the public debt-to-GDP ratio is initially d_o = 50 percent. Assume a nominal interest rate, i =14 percent, real GDP growth rate g = 4.0 percent, annual inflation π = 4.3 percent, primary deficit pb = -2.7 percent of GDP, and seignorage, μ= 1.1 percent of GDP. Applying the Fisher equation, the real interest rate is 9.3 percent (= (1.14/1.043-1)x 100 percent), which exceeds real GDP growth, implying $\varphi > 1$. The debt-to-GDP ratio is explosive (see Figure 2) and reaches 80 percent of GDP – sometimes considered the threshold for "severe" indebtedness – in about five years.

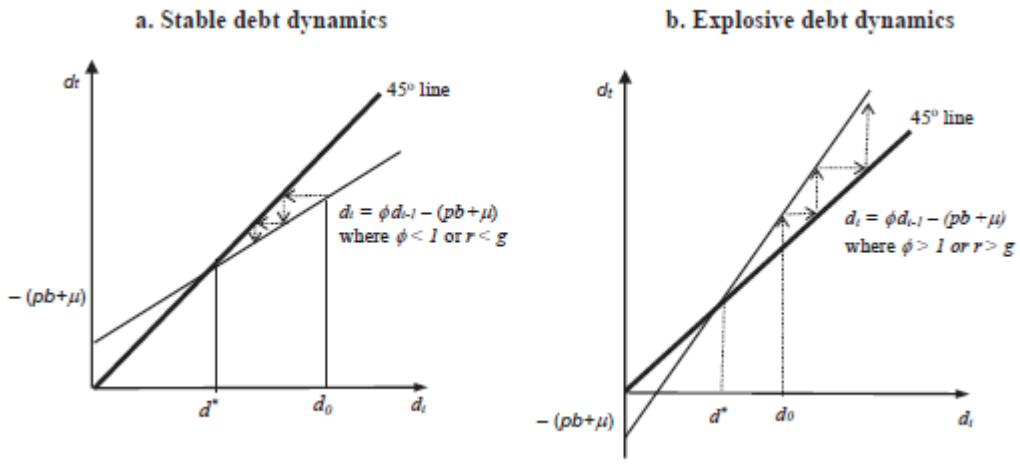

Fig. 1. Debt Dynamics

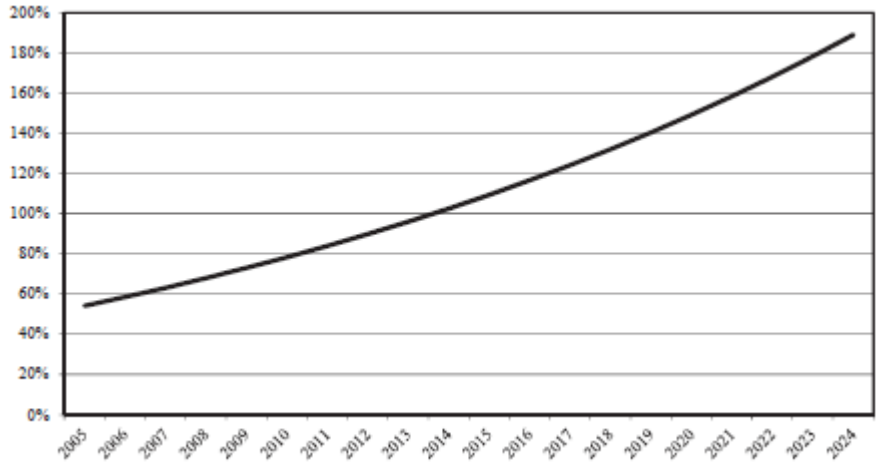

Fig. 2. The Debt-to-GDP Ratio in a Closed Economy

The explosive nature of the government's debt dynamics can also been seen by differencing equation (7) to calculate the change in the debt-to-GDP ratio, $\Delta d_t = d_t - d_{t-1}$. Subtracting d_{t-1} from both sides of equation (7) yields the following

$$\Delta d_t = (\varphi_t - 1)d_{t-1} - (pb_t + \mu_t) \qquad (7)$$

Equation (7) underscores the factors that affect the change in the debt-to-GDP ratio: the size of the primary budget balance pb_t, seignorage μ_t , and the built-in momentum of debt, $(\varphi_t - 1)d_{t-1}$. If the real interest rate on government debt exceeds real GDP growth, debt becomes explosive. Primary surpluses are then needed to offset the automatic debt dynamics. The size of the primary surplus in relation to GDP, b_t , is a good indicator of the government's fiscal adjustment effort[6]. Equation (8) is useful in calculating the primary surpluses needed to achieve specific objectives, such as stabilizing the debt at its existing level or even reducing it to a lower level, as needed, for example, to meet the criteria of the Maastricht Treaty for European Union member countries.

As a first step to fiscal sustainability, the authorities may pick fiscal targets with a view to halt further increases in the public debt to GDP ratio. This requires raising the primary balance to GDP ratio sufficiently to stabilize the debt-to-GDP ratio. To obtain the debt-stabilizing primary balance, set $\Delta d_t = 0$ in equation (8) to obtain:

$$pb_t = (\varphi_t - 1)d_{t-1} - \mu \qquad (8)$$

[6] The government can manipulate the money growth rate to increase revenue from money creation or seigniorage. But raising money growth and inflation leads to currency substitution, which places limits on the amount of real resources the government can obtain from seigniorage.

Continuing with our earlier example, if the country is to avoid the ever-rising debt path shown in Figure 2, the primary balance surplus needs to be at least 1.45 percent of GDP {[((1.093 – 1.04)/1.04) x0.5] – 0.011} x100 percent instead of 2.7 percent of GDP in deficit.

The debt-stabilizing primary balance depends on several factors. First, if the existing level of debt is large, large primary surpluses are needed to prevent it from growing further. Second, if the difference between the real interest rate and real GDP growth is large, then the primary surplus also needs to be large. Third, if seignorage or other sources of government finance are available (such as privatization receipts), these can be used to pay off the debt and will result in lower debt-stabilizing values for the primary surplus. Of course, many countries likely would like to reduce their stock of debt relative to GDP, rather than just stabilize it. Those countries must then achieve a primary surplus in excess of the debt-stabilizing level.

Debt Dynamics in an Open Economy

The analysis of public debt sustainability is similar when the government can borrow from international financial markets to cover part of its budget deficit. Under these conditions, public debt sustainability depends on the path of the nominal and real exchange rate and foreign interest rates.

When the government borrows abroad, a distinction needs to be made between domestic currency-denominated debt D_t^h and foreign-currency denominated debt D_t^f. Letting e_t be the nominal exchange rate (local currency per unit of foreign currency), the debt stock is

$D_t = D_t^h + e_t D_t^f$ and the government budget constraint can be written

$D_t = (1 + i_t^*)D_{t-1} - (PB_t + \Delta M_t)$ (9)

In equation (8), i_t^* , the effective nominal interest rate, is a weighted sum of the domestic and foreign interest rates i_t^h and i_t^f , and also depends on the exchange rate

$i_t^* = ((1 - \alpha)i_t^h + \alpha i_t^f) + \alpha\varepsilon_t(1 + i_t^f)$, (11)

where $\alpha = (e_t D_t^f)/D_t$ is the portion of foreign currency denominated debt, and ε_t is the rate of depreciation of the currency. It can be shown that the public debt to GDP ratio evolves according to the following equation, which is analogous to (41):

$d_t = \varphi_t^* d_{t-1} - (pb_t + \mu_t)$, (12)

In equation (7), $\varphi_t^* = (1 + i_t^*)/[(1 + g_t)(1 + \pi_t^*)]$ is analogous to φ_t, and π_t^*, the GDP deflator, depends on domestic inflation π_t^h , foreign inflation π_t^f , and exchange rate movements:

$\pi_t^* = ((1 - \beta)\pi_t^h + \beta\pi_t^f) + \beta\varepsilon_t(1 + \pi_t^f)$ (13)

where$\beta = (e_t P_t^f Y_t^f)/P_t Y_t$ is the output share of tradables in GDP.

The intuition discussed in the closed economy case still holds: Debt dynamics are explosive if the real interest rate $r_t^* = (1 + i_t^*)/(1 + \pi_t^*) - 1$ is greater than real GDP growth g_t. In the open economy the interest rate relevant for the DSA calculation depends on domestic and foreign interest rates and inflation, on exchange rate movements, and on the size of foreign borrowing and foreign trade.

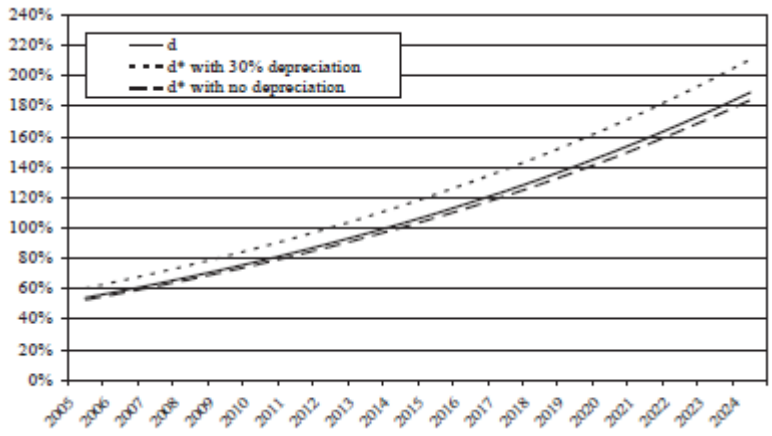

Fig. 3. The Debt-to-GDP Ratio in an Open Economy

In terms of our earlier example, suppose $i^d = 14$, percent, $i^f = 8$ percent, α=0.5, β=0, and ε=0. Then the effective nominal interest rate i^* is 11 percent = (0.5 x 14 percent + 0.5 x 8 percent) +

0.5 x 0 x 1.08), and the effective real interest rate r^* is 6.4 percent (= (1.11/1.043-1) x100 percent), which is greater than the real GDP growth rate of 4.0 percent. As in the closed economy case, the debt-to-GDP ratio is explosive (see Figure 3). Moreover, if the exchange rate depreciates by 30 percent, the effective nominal interest rate and the effective real interest rate become as high as 27.2 percent and 22.0 percent. The debt-to-GDP ratio rises much more rapidly and exceeds the 80 percent threshold in less than 5 years, assuming a crisis does not force an adjustment first (see Figure 3). The debt stabilizing primary balance in this case rises to 7.6 percent of GDP (= (22.0 percent – 4.0 percent)/1.04 x 0.5– 1.1 percent).

The External Sustainability Template

The template summarizes the DSA's baseline assumptions and its implications for external debt dynamics[7]. The starting point is the accounting identity linking the economy's transactions with the rest of the world. The starting point is the accounting identity linking the economy's transactions with the rest of the world.

Let TB be the sum of the non-interest current account balance, NITB, and non-debt generating capital inflows. Also let D_t denote the stock of external debt at the end of year t and i_t^w the nominal effective foreign-currency interest rate the country pays on its external debt. The increase in the stock of external debt over time is

$$D_t\text{-}D_t = i_t^w D_{t-1} - TB_t, \qquad (14)$$

which is equivalent to

$$D_t = (1 + i_t^w)D_{t-1} - TB_t \qquad (15)$$

It is useful to express the stock of a country's external liabilities in relation to GDP. This requires that we obtain the foreign currency value of the country's GDP where for purposes of illustration, we assume that the foreign currency in which debt is denominated is the U.S. dollar. Let P denote the GDP deflator, Y denote GDP, and let e define the exchange rate in units of domestic currency per U.S. dollar. Then GDP in U.S. dollar terms can be written as PY/e. Dividing both sides of (10.1) by PY/e yields the external debt-to-GDP ratio. The country's external debt dynamics becomes

$$\frac{D_t}{(P_tY_t/e_t)} = (1 + i_t^w)\frac{D_{t-1}}{(P_{t-1}Y_{t-1}/e_{t-1})}\frac{(P_{t-1}Y_{t-1}/e_{t-1})}{P_tY_t/e_t} - \frac{(P_t^xX_t - P_t^mM_t)}{(P_tY_t/e_t)} + \frac{OI_t}{(P_tY_t/e_t)}, \quad (16)$$

where P^x is the price of exports, X is exports, P^M is the price of imports in foreign currency, and M is imports.

The above equation can also be expressed as

$$d_t = \frac{(1+i_t^w)(1+\rho_t)}{(1+\pi_t)(1+g_t)}d_{t-1} - tb_t \qquad (17)$$

where d is the debt-to-GDP ratio, π is the growth rate in the GDP deflator, g is the real GDP growth rate, ρ is the rate of nominal exchange rate appreciation, and tb is the debt-creating component of the balance on goods and non-interest services in percent of GDP. The baseline medium-term projection of external sustainability is obtained by extending this equation to project the growth rates and balance of payments several years into the future.

To compute the evolution of the debt to GDP ratio, we need starting values for the initial stock of public and private external debt, its maturity profile and schedule of interest payments. To compute future interest payments, an estimate of future external interest rates must be made. The standard practice is to assume one interest rate that applies to both public and private external

[7] External debt obligations should include public sector external debt, non-financial private external debt, and financial sector external debt.

debt. An alternative approach would be to use a separate interest rate for the public and private sector and interpret the external interest rate as the weighted average external interest rate. Forecasts of growth rates of real exports and imports, along with forecasts of their relevant nominal price growth in foreign currency are needed to compute the relative contribution of the trade balance to external resource needs. Finally, to compute external debt to GDP ratios, we need forecasts of the path of real GDP growth, the GDP deflator, and the nominal exchange rate. Table 1 provides an example of the standard template for external sustainability analysis.

The baseline scenario for external sustainability should be constructed with a reasonable set of forecast variables. In other words, the baseline scenario should not achieve sustainability by assuming abnormally high growth rates, abnormally low interest rates, or unreasonable rates of appreciation. The economic performance of the country during the last five to ten years is important in making realistic assumptions. The underlying assumptions should be transparent, and optimism or pessimism can be incorporated by subjecting the baseline projection to a set of alternative assumptions. A separate program scenario that includes an active policy response can then be constructed in a separate step, allowing the authorities to evaluate sustainability under active and passive policy stances.

Determinants of external debt accumulation

Equation (14) is composed of two parts. The first component is the effect of changes in economic variables on the existing external debt-to-GDP ratio. This component is the automatic debt dynamics since the changes in the economic variables are automatically applied to the pre-existing stock of external debt. The external debt-to-GDP ratio rises if the nominal external interest rate rises or if the domestic currency depreciates vis-à-vis foreign currencies. An increase in interest rates causes debt service costs to rise, some of which may be rolled over into additional new debt. A depreciation reduces the foreign-currency value of domestic GDP. However, increases in the growth rate of the GDP deflator and/or real GDP itself cause the external debt-to-GDP ratio to decline.

The second component of external debt dynamics is the debt-creating component of the balance on goods and non-interest services. In the external sustainability template, the starting point is the current account deficit, excluding interest payments. The current account deficit, excluding interest payments, is then adjusted by the level of net non-debt creating capital inflows from the balance of payments. The non-debt-creating capital flows are net foreign direct investment and other net equity investment by firms and households. Net positive inflows on non-debt creating capital flows reduce the need for external resources and are, therefore, recorded as a negative value in the template.

The evolution of external debt over time is influenced by many factors, including decisions of the government and the private sector. Government can clearly control its own rate of external debt accumulation. But its policies must also target actions and expectations of the private sector and aim at overall economic stability. The external balance, for instance, is affected by the private sector's demand for imports and the rest of the world's demand for exports, the real exchange rate, competitiveness considerations, and domestic and foreign income and demand. The evolution of external debt is also influenced by the volume of non-debt inflows, principally FDI and equity investment. The volume of these inflows is determined by international investors who look at the marginal productivity of domestic projects relative to the return available in other markets, the country's business climate, and other considerations. Thus, several sectors jointly help determine the size of the current account balance and the level and composition of capital inflows that finance it. A loss of confidence that results in rising interest rates and exchange rate depreciation could negatively influence the external debt dynamics of the economy.

External debt stabilization and threshold levels of debt

As in the analysis of fiscal sustainability, we may calculate the non-interest primary balance needed to stabilize the external debt to GDP ratio. Setting dt=dt-1 in (46) yields

$$tb_t = \left[\frac{(1+i_t^w)(1+\rho_t)}{(1+\pi_t)(1+g_t)} - 1\right] d_{t-1}, \qquad (18)$$

which is the level of non-interest CAB and non-debt generating inflows needed to keep the external debt to GDP ratio from rising. Improvements in the public finances can help improve the external current account and arrest the accumulation of external debt. These must normally be complemented by structural measures and financial sector reforms, with the aim of improving the

supply side of the economy, raising the efficiency of intermediation, deepening local capital markets, and attracting more non-debt inflows.

Deeper local capital markets increase the amount of domestic currency financing available and help reduce the dependence on foreign currency finance. Improving the currency composition of public and private sector balance sheets and increasing the types of securities available, including derivatives and options, allows private sector borrowers to better hedge currency fluctuations.

Policy may need to do more than stabilize external debt ratios. The authorities may target a "safe" level of external debt and increase international reserves and fiscal cushions to deal with liquidity shocks. They may also improve the structure of the public sector's external debt profile, either by substituting domestic currency borrowing for external borrowing or by lengthening the maturity of external debt. If policy is not successful in stabilizing the external debt dynamics, then the public sector may need to restructure the debt profile to restore sustainability.

The external DSA template was applied recently to Moldova (see Table 1). In the baseline, the external debt-to-GDP ratio was projected to decline from 26.1 percent in 2003 to 23 percent in 2009. Despite a slight moderation in GDP growth assumed in the baseline, the sound public finances and healthy non-debt creating capital inflows were expected to cover Moldova's external resource needs. Hence, Moldova's external debt position appeared sound under the baseline.

Moldova's external vulnerability remains low in the higher interest rate-lower oil price scenario. The external debt-to-GDP ratio remains in the 23–26 percent of GDP range throughout the forecast period. The outcome of the stress tests is different under an extreme combination of shocks, namely a peso depreciation by two standard deviations, or 24 percent in 2005 and 2006, and a mix of higher nominal interest rates, lower GDP growth rates, and exchange rate depreciation by one standard deviation. In this scenario, Moldova's external situation would worsen dramatically. External debt would approach 40 percent of GDP.

Data

The data series used in the empirical analysis have a quarterly frequency and were obtained from the National Bureau of Statistics for the Economy of the Republic of Moldova, as well as from the Area Wide Model (AWM) database (for more details see Fagan et al., 2005 as well as the website – https://eabcn.org/page/area-wide-model). The analyzed periods are 2000: 1–2021: 1. Regarding the determination of potential GDP, the HP filter was used to estimate it. As primary references or used two sources mainly as follows: https://www.mathworks.com/help/econ/hpfilter.html but also the article by Robert J, Hodrick and Edward C. Prescott (Hodrick, Prescott, 1997) from 1999. Phillips used in its unemployment rate model, however lately, the output gap is being used more and more frequently due to the problems encountered by measuring NAIRU, the natural unemployment rate, this being the reason why we used the production gap. We assumed that there are different models of dynamic Phillips Curve (PC)- price adjustment in a common framework. The system draws intensely on the model of exogenous ostensible inflexibility and the model of inflation targeting. Time is discrete. Each period, incompletely competitive firms deliver output utilizing labor as their as it were input. As within, the production function is one-for-one; in this way total output and total labor input are rise to. The model excludes government purchases and worldwide exchange, total consumption and total output are equal. Households maximize utility, taking the ways of the real wage and the real interest rate as given. Firms, which are claimed by the households, maximize the present discounted value of their profits, subject to constraints on their price-setting (which shift over the models we'll consider). At last, a central bank decides the way of the real interest rate through its conduct of money related arrangement.

4. Conclusion

For the nations examined here, modern advancement has been a significant reason for monetary development. Yield extension has been related with send out advancement, expanded exchange opening, monetary progression and a better business environment in the majority of the nations. Nonetheless, import security and particular government intercession have been utilized too.

As neediness in many emerging nations is an overwhelmingly provincial issue, expanded agrarian efficiency is much of the time a key to destitution decrease at the beginning of monetary turn of events. This has been the case for example in Moldova and Indonesia. Nations that have begun their monetary changes - as Moldova did

- with farming change or generally underscored provincial improvement have – toward the start – commonly experienced declining disparity because of a diminishing of country destitution. In Korea and Taiwan, because of land changes of prior many years, pay appropriation was

moderately in any event, when quick industrialization started. In Indonesia, oil rents were utilized in supporting rustic turn of events.

After the beginning phases of monetary turn of events, development in the modern area is, in any case, fundamental for supported long-run development and neediness reduction. In the nations contemplated, the development of the assembling area has created work potential open doors outside farming and, as assembling in large numbers of these nations has been – essentially toward the start – concentrated in incompetent work, the poor have benefited. In certain nations, similar to Korea, development during specific periods has obviously been supportive of poor, with the poor benefiting relatively more than the non-poor. There are, nonetheless, massive contrasts between nations to the extent that the effect of industrialization on the poor is concerned. In Moldova, for instance, the development of the assembling area in the last part of the 1980s and mid 1990s helped gifted specialists to a more prominent degree than incompetent ones. Frequently, financial development has been joined by expanding imbalance over certain periods, regardless of whether neediness in outright terms has declined - as shown by the new involvement with Moldova.

The degree to which modern advancement successfully diminishes neediness and imbalance relies upon the example of industrialization. Enterprises which utilize a high extent of untalented specialists and additionally utilize homegrown data sources and natural substances delivered with work escalated advancements can decidedly affect livelihoods of poor people. In Taiwan, for instance, during the beginning stages of modern turn of events, the interest for incompetent workers expanded comparative with that for gifted laborers, which diminished imbalance and destitution. At later stages, interest for gifted laborers fundamentally expanded, alongside an adjustment of Taiwan's commodity and assembling structure. At that point, Taiwan had made significant interests in human resources, so the impact on pay circulation of changing ability requests was moderately muffled. The Republic of Korea has followed a comparable way. In Brazil and India, then again, producing has would in general be somewhat capital concentrated, setting out moderately unassuming work open doors for poor people. Additionally in India, the help area has been a significant supporter of late development, yet the powerful assistance enterprises like programming and administrative center handling have given not many positions to the untalented straightforwardly. In any case, with solid development execution for the beyond 15-20 years, the neediness rate in India has altogether declined.

5. Acknowledgements

This article is a result of the grant (general budgetary fund[8]) “ASEM doctoral grants for the period 2019–2023” – contract number: ASEM-2019/11/05/NR/89/ST; financing from the state budget during the doctoral studies, but also value-added as an post-planned activity I carried out as a scientific researcher at the National Institute for Economic Research (NIER) in Chisinau, Moldova – between May 2019 and December 2019.

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Notes:

1. It is important to notice, however, that technological change is not only relevant to manufacturing, but similarly has significant impacts in other sectors of the economy. A good example of this is increased productivity in agriculture, which has been essential for accelerated economic growth in many developing countries.
2. According to some analysts, the distribution of income among all people in the world has become more equal over the last two decades.
3. It has also had negative impacts on income distribution. During the 1970s, for instance, demand for skilled workers in heavy and chemical industries pushed up domestic wages and increased wage differentials between skilled and unskilled workers.
4. The validity of official inequality measures has been questioned, however.
5. These included reduction in tariff levels, tariff dispersion and elimination of major non-tariff restrictions.
6. Moldova is on the other extreme, having increased its openness to trade five times between the early eighties and the first years of the current decade.
7. Job creation has shifted towards the private services sector, in both highly remunerated activities (financial services, telecommunications, etc.) and activities with low barriers to entry, such as informal commerce and personal services (UN ECLAC, 2004a).
8. In 2000, income levels in the informal sector were 72 per cent lower than those prevailing in the formal sector on average in the region, up from a 59 per cent differential in 1990.

УДК 33

Модель схем Понци в государствах и динамика долга в условиях неопределенности

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Аннотация. В исследовании рассматривается влияние налогово-бюджетной политики на экономику в условиях неопределенности государственного долга. Налогово-бюджетная политика относится к действиям правительства по сбору и расходованию частных ресурсов. Как следует из названия, статья посвящена динамическим аспектам фискальной политики. К ним относятся влияние налогово-бюджетной политики на формирование капитала, экономический рост и соблюдение принципа равноправия между поколениями; влияние долгосрочных ожиданий на краткосрочные результаты; и ограничения, налагаемые текущей политикой на набор возможных будущих стратегий.

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Динамический анализ в последнее время получил преимущество перед статическим анализом в различных областях экономики. Это особенно подходит для изучения фискальной политики, которая, по крайней мере, в Республике Молдова, часто корректируется и видоизменяется. Такие изменения часто четко прописываются в законодательстве заранее, но когда этого не происходит, они часто могут быть предположены, исходя из текущих финансовых условий. Неудивительно, что финансовые переменные постоянно изменяются. Текущие изменения в политике изменяют курс экономики и неизменно требуют дополнительных изменений в политике в будущем. Но ожидание таких будущих изменений также изменяет текущие результаты; действительно, текущее влияние фискальных решений не может быть определено без рассмотрения всего будущего временного пути фискальной политики.

Динамическая перспектива также имеет решающее значение при сопоставлении краткосрочных выгод конкретной политики (например, снижения налогов) с долгосрочными потерями (например, вытеснения) и при оценке экономической эффективности альтернативных стратегий. Экономическая эффективность относится к потенциалу повышения благосостояния одного сегмента общества без снижения благосостояния другого. Статический анализ плохо подходит для изучения экономической эффективности, поскольку он игнорирует обширный сегмент общества, а именно все будущие поколения. Динамический анализ учитывает как нынешние, так и будущие поколения и позволяет отличать политику, которая действительно повышает экономическую эффективность, от политики, которая просто перераспределяет ресурсы между поколениями.

Ключевые слова: рабочая производительность, коэффициент долга, процентная ставка, коэффициент выпуска, стабилизация долга, устойчивость долга, дефицит бюджета, схема Понци.