Part 2: Public Debt Sustainability Framework for Market-Access Countries (MACs)

Unit 1: Structure and Learning Objectives

Video-Part 2 Introduction:

Adina Popescu: As you may already know, debt sustainability analysis plays a key role in the IMF's advice on macroeconomic policies, both in the context of IMF-supported programs and surveillance. For example, debt sustainability assessments are taken into account to determine access to IMF financing, as well as for the design of debt limits in Fund-supported programs.

To this end, the IMF has developed formal frameworks for conducting public and external debt sustainability analysis (DSA) as a tool to better detect, prevent, and resolve potential crises. In this course, we are going to look at the tools used to conduct such an analysis for public debt in market-access countries.

These are countries that have access to international financial markets, a definition covering mostly advanced and emerging economies. Keep in mind that we'll focus on public debt only. Thus we will not cover the external DSA, nor issues pertaining to low income countries.

We will also not discuss how unsustainable debt positions should be resolved. So what do are you going to learn in this part? You will get a solid understanding of the most recent framework for public debt sustainability analysis that the IMF employs for advanced and emerging economies. You will learn how to use the IMF-developed Excel template, in order to perform such an analysis.

This should enable you to better understand IMF country reports. As mentioned before, this form of analysis is currently performed for advanced and emerging economies. What should you not expect to achieve at the end of this part?

Well, it is not expected that you will become experts in using this template. Such an objective would require more time than we have available. For this reason, a deliberate choice has been made into guiding you through the key elements of this framework in a simple and intuitive way, which also means skipping some of the details. To make our analysis more interesting, along the way, we'll analyze historical country case studies. However, we will work hands on, mostly with data from an imaginary country called Debtopia, whose citizens or informed analysts, or policymakers, we will all become for a little while.

So are you ready to embark with me on this intellectual journey through the issues of assessing debt sustainability into the mysterious country of Debtopia? If so, let's jump in. First, in the next video, we will start with a brief historical excursion into how debt ratios have evolved over time.

Video-Excerpt from "A History of Debt and Growth" (IMF public video):

Narrator: Looking back we see debt ratios in advanced economies, pictured here in red, declined from 50% of GDP from 1880 to below 30% just before World War I. Debt spiked with the War and debt ratios reached almost 100% of GDP in the early 1920s.

The stock market crash in 1929 and the Great Depression took a toll, although the debt ratio was headed downwards in the late 1930s when World War II began. The debt ratio shot up dramatically with spending on the War but declined through the mid-1970s thanks to an extended period of growth in advanced economies.

Since then, advanced economy debt has been on a steady rise as growth slowed and government budgets came under increasing pressures from the cost of aging populations, as well as spending on health care and pensions. In the past forty years public debt ratios in emerging markets, pictured here in blue, have remained below 50 % of GDP but have shown considerable volatility at times, such as the Latin American debt crises in the early 1980s and the Asian financial crisis in the late 1990s.

Debt ratios in low-income countries, pictured here in yellow, rose sharply after 1980 as they experienced a period of low growth and frequent shocks and borrowed heavily often at high interest rates. Their debt ratios have come down in recent years thanks to debt relief and better institutions and policies.

Unit 2: Debt Sustainability in Market-Access Countries

Video-What is the MAC DSA?

Adina Popescu: Hi, and welcome back.

Let's just start by understanding what is the MAC DSA, an abbreviation which we are going to use extensively and which refers to the Framework for Public Debt Sustainability Analysis for Market Access Countries. The MAC DSA is part of IMF's Framework for Debt Sustainability Analysis. It has been designed and followed by the IMF to assess public debt sustainability in market-access countries in the context of both surveillance and program design and reviews.

Although the analytical underpinnings of debt sustainability have a way longer pedigree, the structured and rigorous approach of the current framework and template were first designed in 2002 and revised over the years with a view to bringing greater discipline and responding to changes in economic and financial environment. And in 2013, a reformed framework and template were introduced, and this will be the purpose and the focus of the current course.

From a practical perspective, the MAC DSA is a formal and standardized tool in the sense that all country teams apply it with some variation. And the analysis is implemented using an Excel-based template, which we are going to introduce step-by-step in the following units.

In this introductory unit, let's clarify another issue. So who are the market access countries? Market access countries, as the name suggests, are countries that have significant access to international capital markets on a durable and sustainable basis.

Let me stress here the term international capital markets. Since, for example, if a government only has access to domestic captive markets, which it can force to buy its debt, that would not really qualify as market access.

But how is this assessment done in practice? Well, one way is to look at public sector issuance or guaranteeing of external bonds in international markets over the last few years in a significant amount. Second, there are some countries that do not need to issue, for example because they have a surplus, like large commodity exporters.

For this reason, countries can also be deemed to meet the market-access criterion if there is convincing evidence that the sovereign could have tapped international markets. This would be in a case-by-case assessment, looking for example at financial market information such as sovereign credit ratings or spreads on any outstanding debt.

In practice, market access countries de facto cover all advanced economies and most emerging economies. At this stage, let's note that this presentation of the debt sustainability framework can also be applied to low-income countries if they are deemed to have durable and significant access to market financing.

However, in general, low-income countries borrow mostly on concessional terms from other sovereigns or international organizations. So they are less susceptible to changes in market sentiment than market access countries.

For this reason, a specific template has been designed for low-income countries that takes into consideration their specific circumstances. More details about the exact classification can be found in the supplementary material.

Video-Assessing Sustainability in the MAC DSA

Adina Popescu: Before starting our discussion of assessing public debt sustainability in the MAC DSA, let's recall some definitions and discuss some nuances in the revamped DSA template.

Sustainability in the MAC DSA is defined as the combination of three elements: solvency, liquidity, and realistic adjustment. I have presented these concepts metaphorically as a tree for sustainability, a piggy bank which stands for solvency and clearly captures the idea that one needs savings to pay off one's debt, the flow of water to capture the idea of liquidity, and finally realism should mean that the projected path of adjustment should ideally not include falling off a cliff or precipice.

As I will explain in detail in the next minutes, each of these elements is a necessary ingredient in order for debt to be considered sustainable.

So what is solvency? On a theoretical level, it means that the current debt stock is fully covered by the present discounted value of all expected future primary balances. This is similar to saying that the government is meeting its intertemporal budget constraint, or the so-called "No-Ponzi game" condition is satisfied.

In more common language, it also means that the government will be able to service the debt in the short, medium, and long-term without renegotiating or defaulting. However, how can solvency be assessed in practice?

It can be shown that if the debt-to-GDP ratio is on a non-explosive path—that is, it is either stable or declining-- the solvency condition is automatically met. This provides a strong rationale for evaluating solvency by looking at the projected behavior of debt ratios.

Thus, in the MAC DSA, we will assess solvency by analyzing whether debt burden indicators are projected to either stabilize or decline, both in the baseline scenario and under plausible shock scenarios. This is because it is not enough that the debt-to-GDP ratio stabilizes only in the baseline scenario.

If, for example, under plausible alternative scenarios it explodes, this endangers sustainability. So beyond solvency, a country may also face liquidity risk. That is a situation when available financing and liquid assets are not sufficient to meet maturing obligations.

In assessing illiquidity risks, the MAC DSA template looks at several elements. First, do the level and the trajectory of debt burden indicators facilitate continued market access in the sense that rollover risk is low? Second, is the debt profile well-balanced in terms of the maturity, currency composition, investor base, so as to facilitate continued market access? As liquidity is so important, the template gives a lot of importance to the evolution of the gross-financing needs-to-GDP ratio.

The third element in the definition of sustainability is if the projected levels and paths of debt burden indicators are based on realistic macroeconomic assumptions and projections for the primary balance adjustment. That is, that the government does not need to undertake policy adjustments that are implausible from an economic or political standpoint.

For example, if the required adjustment to achieve a decline in the debt ratios is such that the country will experience social and political upheaval, this is not consistent with sustainability. In practice, how to assess if the level and the trajectory of debt burden indicators are economically and politically feasible? One way to look at it is to check whether potential growth can be preserved at a satisfactory level.

The MAC DSA provides various tools to assess the realism of projections more rigorously and thus to prevent countries from falling off the cliff.

Let me conclude with a word of warning. Assessing sustainability involves probabilistic judgments about the trajectory of debt and the availability of financing on favorable terms. And while various tools can help make such assessments, it is always important to be aware of their limitations.

Thus, the DSA should not be interpreted in a mechanistic or rigid fashion. In addition, results must be assessed against relevant country-specific circumstances, including the particular features of a country's debt, as well as its policy track record and its policy space.

Video-What are the Benchmarks in the MAC DSA?

Adina Popescu: In this lecture, I will introduce you to a key feature of the MAC DSA template. That is the risk-based approach.

Let me first start by saying that this is a complex and multifaceted exercise. The framework emphasizes risks and uncertainties surrounding the central forecast. And as I mentioned, the key aspect of the revamped MAC DSA is this risk-based approach, which simply means that more analysis is required for countries with greater vulnerabilities.

The MAC DSA template classifies countries as lower or higher scrutiny on the basis of two elements: First, a set of benchmarks of debt burden and other indicators, and second, access to fund resources.

More specifically, countries are classified as higher scrutiny if they satisfy one of the following criteria:
(1) they have a current or projected debt-to-GDP ratio above 50% if classified as an emerging economy, or 60% if they are an advanced

economy, or
(2) they have current or projected gross financing needs-to-GDP above 10% if classified as an emerging economy and 15% if classified as an advanced economy, or
(3) if they have, or are seeking, exceptional access to Fund resources.
Let me clarify the last point.

"Exceptional access" refers to the fact that the IMF can lend, on a case by case basis, amounts above the normal limits. Normal limits are up to 600% of quota, cumulatively. For example, during the financial crisis, many countries facing acute financing needs have been able to tap Exceptional Access Standby Agreements (SBAs). All these countries would classify as high scrutiny. A question which may come to your mind is, where do these triggers come from?

The quantitative benchmarks are based on econometric estimates from a class of models called "early warning models." Intuitively, these models identify the level of the indicators which best predict the occurrence of a crisis, in the sense that they minimize the sum of two types of error, false alarms and missing a crisis.

Recognizing the uncertainty associated with estimating benchmarks and to be conservative, the empirical estimates were reduced by about 15% to arrive at the benchmarks employed in the template.

More details on the methodology and the results can be found in the supplementary material. A word of warning at this stage, one should recognize that debt problems may emerge at lower debt burden levels than the ones suggested above, particularly for emerging markets. And other indicators have been found to have predictive power in early warning models.

So the MAC DSA template suggests using them as well, to point to emerging vulnerabilities. Thus, some countries may still be treated as higher scrutiny cases, despite having lower debt burden indicators than the classification benchmarks if any of the following vulnerabilities is present: first, there are risks stemming from large fiscal consolidation, or volatile growth; and second, one can look at debt profile risks related to five indicators presented here.

This is just a list, and let me go into detail through each of these indicators. So a country may be treated as higher scrutiny if it projects a large fiscal adjustment. This is measured as the 3-year cumulative primary balance adjustment, exceeding 2% of GDP for both advanced and emerging economies. The cyclically-adjusted primary balance refers to the primary balance which is obtained when output is equal to potential.

Let's look at an example. So let's assume that the primary balance at times t - 2, t - 3, t - 1, and t is respectively -4% of GDP, -3%, -2%, and -1%, just to keep things really easy.

Then the 3-year cumulative primary balance adjustment is just the difference between the level at t and the level at t - 3. In this case, it is 3% adjustment, which is large enough to suggest higher risks.
So the country should classify as higher scrutiny.

The second indicator has to do with volatile growth and is measured as the coefficient of variation of real GDP growth, larger than 1 for both advanced and emerging economies. The coefficient of variation is defined as the standard deviation divided by the mean.

Both are historical statistics calculated in the template over the last 10 years. Higher scrutiny may also be warranted if the country is paying high spreads on its debt, measured as bond yield spreads over a relevant benchmark, exceeding 600 basis points, both for advanced and emerging economies. For advanced economies, the bond yield spreads are defined as the spread over U.S. or German bonds of similar maturity, while for emerging economies, one would consider

JP Morgan's EMBI or a comparable metric. One would take the average bond spread over the last three months.

Another source of risk stems from high external financing requirements, measured by the external financing requirement exceeding 25% of GDP for advanced economies and 15% for emerging economies.

External financing requirements are defined as short-term external debt, plus the amortization of medium and long-term external debt, minus the current account balance. Debt considered here is both private and public.

Also, note that the benchmark is higher for advanced economies, 25% versus 15%, reflecting their relatively higher ease in obtaining external financing, which is a strong empirical regularity.

Another indicator, a large share of public debt held by non-residents, that is, exceeding 45% of total for both advanced economies and emerging markets, may warrant closer scrutiny. So it is not only the residency that is of concern, but also the currency denomination of debt.

A large share of foreign currency-denominated debt, defined in the case of emerging economies, as exceeding 60%, is another source of vulnerability. This benchmark is not defined for advanced economies, since they overwhelmingly finance themselves in their own currency and thus do not suffer from what is sometimes called in the literature, the "original sin."

Finally, the rapid increase in short-term debt may warrant higher scrutiny. Benchmark levels here are defined as an annual increase in the share of short-term debt at original maturity, exceeding 1.5% in advanced economies and 1% in emerging economies. This is calculated, as expected, as short-term debt over total public debt, time t, minus short-term debt over total public debt at time t - 1.

If you're wondering again where all of these values come from, they are calibrated to either reflect the upper tail-- that is a 20-30% upper tail-- of historical data in advanced economies and emerging economies for the two indicators, growth and the primary balance adjustment, or are again derived from early warning models of debt distress for the other indicators, for the debt profile indicators. More details about the methodology can be found in a handout.

Video-What are the Steps in Preparing the MAC DSA?

Adina Popescu: So in this section, let's look at how the MAC DSA template is organized. I will be giving you sort of a road map which we will follow throughout the rest of the course, without going very specifically into any of the details right now.

So the MAC DSA template prescribes several steps. The first one is called the basic DSA, and this is all the analysis that is required for lower scrutiny countries. Two further steps, risk identification and analysis, and risk reporting, are required for higher scrutiny countries.

The basic DSA involves projecting a baseline scenario for public debt, based on the assumptions underlying the macroeconomic framework, as a first step. It then tests the baseline and analyzes how the materialization of various risks would affect the public debt trajectory under two standardized alternative scenarios.

In general, no further analysis is needed for lower scrutiny countries, with the notable exception that in some of these countries, where contingent liabilities are significant, for example from highly-indebted public enterprises, or if there are off-budget items like guarantees on

public-private partnerships that pose fiscal risks and so on, such a scenario should also be included as a customized alternative scenario.

As discussed, for higher scrutiny countries, however, the analysis includes, in addition to the steps of the basic DSA, a series of tests to assess the risks surrounding the central projection.

A number of tools are provided in the MAC DSA to allow a more thorough identification and analysis of risks. In particular, there are various modules which assess first the realism of the baseline scenario, the sensitivity of the baseline scenario to macro-fiscal risks, which is assessed through a series of standardized and customized stress tests, including potentially a scenario with risks stemming from contingent liabilities, like financial sector assistance and others, and fourth, the vulnerabilities stemming from the debt profile need to be assessed, due to issues like maturity, currency composition, and the creditor base.

The final step in the analysis, which we refer to as "risk reporting," combines all the previous elements together in a diagnostic, which we will present as a heat map.

Additionally, we will present a probabilistic view of the uncertainty surrounding the baseline using fan charts. And in the end we will discuss how to prepare a final assessment or a write-up, which would emphasize key issues and also country-specific circumstances that may mitigate or amplify risks.

Does this sound a bit overwhelming? Well, do not worry, since we will go through each of these elements gradually in the following units. However, before we start working effectively on the template, we will spend a little bit of time understanding some issues related to data in the next unit.

Unit 3: Data: Coverage, Issues, Sources

Video-Data Coverage and Issues

Adina Popescu: Welcome back.

In this unit we are going to discuss several issues related to the coverage of public debt in the MAC DSA. These are the coverage of the public sector, gross versus net debt, and long-term spending pressures.

Why is the coverage of public sector a potentially important issue? One reason is that in many countries an increasingly decentralized fiscal framework has given sub-national governments greater room for creating debt.

The poor fiscal performance of sub-national governments can lead to central government bailouts at potentially large costs. Similarly, off-budget entities or peripheral sectors, like state-owned enterprises (SOEs) and public-private partnerships (PPPs), may represent contingent liabilities for the government, which can offset a country's fiscal adjustment efforts. More about contingent liabilities in a further unit.

An example is Portugal, where the reclassification of state-owned enterprises and public-private partnerships into the general government, has weighed into a sizable increase in general government debt in recent years, as can be seen from this figure.

So what are the guidelines in the MAC DSA? First, the coverage of public debt in the DSA is expected to be as broad as possible. Where data is available, the DSA should be based on the entire public sector. Also, in order to develop a conservative framework, one should try to add at least the high-risk public enterprises.

Why are we concerned about net versus gross debt? Because the assessment of sustainability may differ substantially depending on whether a gross or net debt measure is considered. There are risks associated with high levels of gross debt. However, government financial assets can be liquidated to extinguish debt and they also earn interest. Thus, a high level of financial assets can mitigate the risks arising from high gross debt.

This brings us to the following definitions. Gross debt is defined to include all liabilities held in debt instruments, such bonds or loans, while net debt, on the other hand, is derived by stripping away assets held in debt instruments from gross debt.

If you look at this picture about Japan, it shows that while net and gross debt have increased over time, the level of Japan's net debt is far lower than the level of its gross debt. This is because the Japanese government owns large amounts of domestic and foreign financial assets in the form of loans, bonds, etc.

So, which one should we use? The guidelines are that the MAC DSA should be based on gross debt. However, the level of net debt could be discussed as a complementary measure in the analysis, particularly for countries which have substantial financial assets.

In some countries, where this concept may provide an incomplete assessment of net debt, alternative measures can be used, such as net financial liabilities, relevant in advanced economies where data are most likely to be available, or debt net of highly liquid assets, relevant in countries where data constraints are more binding.

Long-term spending pressures associated with pensions and/or health systems tend to be significant in many advanced economies and increasingly so in emerging economies.

Just to give you an idea of the magnitudes, according to an IMF study, in advanced economies the combined annual spending on old-age pensions and health care is expected to increase by an average of about 4% of GDP by 2030, which is probably in excess of GDP growth. So the share of this spending in GDP will go up.

In emerging economies, spending on pension and health care is also projected to increase by about 2% of GDP on average over the next two decades. And additional pressures are likely to emerge beyond 2030.

For example, in the U.S., if current laws governing taxes and spending would remain unchanged, an assumption that underlies the Congressional Budget Office's (CBO's) 10-year baseline projections, federal debt would gradually rise in the medium and long-term, partly because of growing spending for Social Security and the government's major health care programs.

So what does the MAC DSA recommend? When relevant information is available, the DSA should reflect long-term spending pressures, especially when they are significant.

One reporting option is as a memo item in present value terms, which estimates the fiscal cost of the projected spending increase with associated pensions and health care, in the absence of reform.

Alternatively, the macroeconomic framework could also be extended beyond the five-year projection horizon to illustrate the impact of such expenditures on fiscal and debt sustainability over the long-term. More details on each of these topics are provided in separate handouts.

Video-MAC DSA Template-Intro Video

Adina Popescu: Hello and welcome back.

In this video I will introduce you to the MAC DSA template. And we will have a first look at the Debtopian data. As we are now starting to work with a template, let me mention a couple of things.

Depending on your level of familiarity with Excel, this template may seem a bit overwhelming in the beginning. It is both relatively complex and large. However, the good news is that in order to use it and to complete the assignments, you will not need to know all the details. An in-depth knowledge is not our objective.

As you will notice, opening up this spreadsheet, as I have done here, it is built with the user in mind. Thus, when you open it up, you will notice the instruction sheets in white tabs, sheets dedicated to inputs in yellow, sheets containing outputs in blue, as well as other sheets in light blue where a number of the calculations are performed.

In addition, there is a number of hidden sheets, which we will discuss as well to some extent as we go through the various parts of this course. Our starting point is the sheet "Input-Instructions." This sheet is quite a handy guide into how the input sheets should be filled. You'll notice that it starts with a discussion of the risk-based approach and the classification of countries into higher scrutiny and lower scrutiny.

The benchmarks used to classify countries into lower and higher scrutiny are also provided here for your convenience. The steps in the basic DSA as well as the further analysis required for higher scrutiny countries are also listed here, and also here.

Next follow instructions about how to populate the input sheets. We will discuss these as we go through each sheet. However, they are all listed here for your reference should you need them.

The second input sheet is called "Input 1-Basic." As throughout the rest of the template, yellow shaded cells are to be filled with information by the user. Here, first notice that one can select the country. You will notice on the scroll down menu a list of all the MACs. Here we have selected our fictional country, Debtopia. You will notice that it is an emerging economy without exceptional access.

Essentially it doesn't have a Fund program. Due to data limitations, we are going to do the DSA for the general government, and thus we will not include public guarantees.

We will also use gross debt-to-GDP and not net debt-to-GDP. And also we will not use gross debt-to-potential GDP. But you have the option to use it for countries where this is relevant or the data is available. You will notice that clicking on Column C in each of these cells brings up more detailed instructions.

Next you notice the first year of projection as well as the estimate of real exchange rate overvaluation in percent, which we're going to use later on. Further down, we have the sovereign ratings for Debtopia from the three main agencies. You'll notice that Debtopia is rated as medium grade, the lowest investment grade.

We also have here information on the 5-year CDS spreads for Debtopia, at 500 basis points on this last observation, as well as the EMBI global spread, which is actually the one which is more relevant from the perspective of this template. The last observation was 400 basis points. However, what we are going to use is the most recent three-month average, which happens to be 356 basis points.

Let's move on now to the inputs for the main macro-fiscal data. They're found in the sheet "Input 2-Data." The variables here are split in several blocks.

First, several measures of GDP are on top; real GDP, the GDP deflator, nominal GDP, potential GDP. In the second block, we have a number of variables related to the external sector, such as the current account, nominal and real exchange rates.

Next follows a block of fiscal variables, some key fiscal aggregates. And last but not least, the lower panel contains a number of variables with a more limited use. In terms of timing, notice that we have 12 years of history, which are largely populated with hard data, and six years of projections, including the current year.

Again, the yellow shaded cells are to be populated with hard data by the user. The white shaded cells contain calculations such as simple summations, while the gray shaded areas are to be filled in additional sheets.

The projections are based on the description of Debtopia which you can read in HTML format. They are made as simple as possible. However, I am only going to draw your attention to two very strong simplifying assumptions that we are making here.

First, we are assuming that over the projection period, the actual output level is exactly equal to the potential. This is an oversimplification which is going to help us later on. Additionally, we are assuming that the real exchange rate is equal to the nominal exchange rate, both the average and the end-of-period values.

Let's move on now to sheet "Input 3-Debt and Banking." This sheet contains historical debt data and its decomposition. You will notice that we distinguish between short-term debt and long-term debt, local currency versus foreign currency-denominated debt, and domestic and external debt by the residency criterion.

The lower panel contains banking sector data. In particular, banking sector assets excluding claims on government, private sector credit, bank gross foreign assets, and the loan-to-deposit ratio. Hovering over each of these cells provides you hints as to the sources of this type of data.

The other inputs sheets we will discuss in other videos. Let me move now to another instruction sheet called "Output-Instructions." This sheet provides, at the top, a list of the classification benchmarks for Debtopia. You will notice that Debtopia is classified as a higher scrutiny country.

Why is this? First, because public gross debt-to-GDP exceeds the 50% benchmark in five of the projection years—so that is why we have a "yes" here—while public gross financing needs exceed the benchmark of 10% all the time.

As a matter of fact, any of these indicators would have been sufficient to classify Debtopia as higher scrutiny. Next you notice a list of additional indicators which may warrant higher scrutiny for countries which otherwise would be lower scrutiny on the basis of the first three criteria.

While that's not the case Debtopia, let's have a quick look at these indicators. For Debtopia, the maximum 3-year cumulative primary balance adjustment over the projection horizon of 2.3% would raise warning flags. The coefficient of variation of growth, computed as the ratio of the historical standard deviation over the mean, is lower than one. So it does not raise concerns.

The EMBI global bond spread, the three most recent months average, is below the 600 basis points benchmark. So this is not a reason of concern.

The external financing requirements, computed as we discussed in the lecture-- you can find the formula attached for your convenience-- are, as you can see here, quite high.

So is the share of public debt held by non-residents, and also the public debt in foreign currency. All of these indicators raise warning flags.

Last but not least, the annual change in the share of short-term debt at original maturity, which is computed from 2011 to 2012, is not a concern. It is actually a slight negative number since the share was going down. Let me explain one additional insight into the template. For those of you curious enough, you will notice that some of this data comes from a sheet called "List-Modules-Chart-Data." This is a hidden sheet. In order to unhide it, Right-Click on the current tab and click Unhide. And then select from the drop down menu, List-Modules-Chart-Data. This will open a very large sheet.

This sheet is a sort of a master sheet behind many of the calculations in the template. Explaining it in detail goes beyond our purpose here. However, we will get back to it every now and then. And I will try to explain you the calculations which are done here. Also, please do not make changes in this sheet. Going back to "Input-Instructions," you will notice that the rest of the sheet contains detailed instructions about how to use the various output sheets.

We will go through these in detail in the following units.

Unit 4: The Baseline Scenario

Video-How to Construct the Baseline Scenario

Adina Popescu: Welcome back.

In this unit, we are going to learn how to construct a baseline scenario. The baseline scenario should be built around the macroeconomic framework, which is the most likely scenario for "surveillance" countries based on current and projected government policies, or the programmed macroeconomic adjustment for "program" countries. Here the terms "surveillance" and "program" are used in relation to IMF programs.

Let me start by reminding you the identity which decomposes the change in the debt-to-GDP ratio into automatic debt dynamics and the contribution of the primary balance and other identified debt-creating flows-- which include things like privatization receipts, recognition of implicit or contingent liabilities, bank recapitalizations-- and a residual to insure that the identity holds in practice. More about this in a couple of slides.

When the country has access to international financing, as MACs do, you may recall that the debt dynamics can be decomposed into a contribution of the effective interest rate, i(t)^w, the contribution from real GDP growth, g(t), the contribution from exchange rate depreciation, as well as the contribution of the primary balance, where we are abstracting, for brevity, from the other elements, and the residual.

Just to clarify the notation, some other key variables in this form are i^w, which is the effective interest rate and is computed as a weighted average of domestic and foreign nominal interest rates.

The weighting is given by alpha, another key variable, which stands for the share of foreign currency-denominated debt. I^f is the nominal interest rate on foreign currency-denominated debt. And epsilon is the exchange rate depreciation, where the exchange rate is defined as local currency per US dollars.

Let me note that this is not the only decomposition and that one may choose to emphasize elements differently. This may look like a complicated formula, but it is, in fact, very useful to tell an economic story about the drivers of debt dynamics. And economists always need to tell a good story in order to get the message across.

Let's take an example of a country about which, say, we have no background information. The only information is what we are presented with from the decomposition of the debt-to-GDP ratio, as the MAC DSA template presents it.

Here, the left-hand side charts represent yearly evolutions for 11 years, while the bar on the right-hand side represents cumulative contributions over this period.

The black line represents the change in gross public debt, the delta d. You will notice that, for the beginning of this period, the debt-to-GDP ratio was declining, with the exception of year t+3, while after year t+6, which happens to be during the financial crisis, debt started to go up. Again, with the exception of t+8.

Overall, for the entire period, debt-to-GDP fell by a small amount. This is around 3%. So basically, the consolidation gains at the beginning of the interval were reversed towards the end.

Looking at the various contributions, what can we say? For example, was the country running fiscal deficits or surpluses during the period? Most clearly, it was running primary deficits, since the contribution of the primary balance was to increase debt throughout this period, overall by more than 10% of GDP throughout the interval.

Let's now look at the real GDP growth, which is here in red. It has contributed to bringing down debt throughout the period, so growth must have been positive. Overall growth was the single most important factor bringing down debt. The real interest rate, in green, has clearly contributed to increasing debt, which is not surprising.

However, since these contributions are at times large, one can guess that the country has a large stock of debt, is paying high interest rates, or both. We notice that the country has some negative contributions from other debt-creating flows, which could be linked, for example, to privatizations.

Also, the exchange rate depreciation is a significant contributor, which suggests that the country is an emerging economy with a significant share of foreign currency-denominated debt. One can even say in which years the currency was appreciating and when it was depreciating.

It seems to have appreciated relative to the US dollar through the first part of the period, when these contributions were negative. But not in the second part of the interval, which was the period of the financial crisis. The residuals, in grey, are at times large, which may point to issues of statistical nature or more fundamental ones. But we cannot guess much more from this chart.

So overall we learned quite a lot from just one single graph-- well, actually two-- haven't we? Let me get back to the issue of the residual.

Some of the factors explaining the residual movements can be changes in gross debt arising from below-the-line operations, such as

sales or purchases of financial assets, or one-off factors affecting the stock of debt not already identified under other debt-creating flows.

In addition, residuals could reflect the use of different definitions for the stock of debt and the fiscal balance or cross-currency movements. Overall it is critical to monitor the behavior of this residual. A large residual may, in particular, signal a breach of the flow-stock identity, linking the deficit to changes in debt.

So the residual should be small, unless it can be explained by specific factors. In the following video, we shall see how the baseline scenario is implemented in practice.

Video-MAC DSA Template: The Baseline Scenario

Adina Popescu: Hello and welcome back.

In this video, we are going to talk about the sheet called "Baseline Debt." This sheet develops the baseline scenario. While we will not go through every single calculation in this sheet, the purpose of this video is first, to walk you through the sheet, through the inputs and the mechanics of it. And second, we will focus on understanding the decomposition of the drivers of debt dynamics.

Let's get started. The top part of the sheet starts with summarizing various inputs. They come essentially from three sources. First, under Nominal Public Debt, we will find the decomposition of public debt into old debt and new debt. And within each category, by local versus foreign currency debt, as well as by maturity, short-term and medium and long-term maturity debt. If available, Net Public Debt is also included.

The second block of inputs is called Nominal Gross Financing Needs. This is a good place to recall that gross financing needs are calculated as the sum of the primary deficit, from which we subtract interest receipts, add interest payments, and amortization payments. This, by the way, is the same as the overall deficit, plus amortization payments or the primary balance, plus debt service.

Projections for the gross financing needs will also depend on assumptions that we'll make how the financing needs are going to be filled, a discussion which we defer to a later section. This is simply done for teaching purposes.

So let's for now assume that Debtopia's financing needs are satisfied and we have already projected that. Let us focus now on the third set of inputs, the main macro assumptions, which are summarized under Underlying Assumptions.

Let me zoom in a bit. The data inputs include the macroeconomic framework under the baseline, from the main input sheet called "Input 2," which you can see by clicking anywhere here. For example, if we look at growth, we see that Debtopia is projected to grow at 4%, the potential growth rate throughout the period, have inflation declining from 5% to 4% at the end of the projection horizon, and the primary deficit is also expected to be reduced gradually to about 1% at the end of the projection horizon.

Let's scroll down. The most involved calculation here is for the effective interest rate. First the nominal, and then the real. For domestic currency and foreign currency-denominated debt. The formulas, I have added them to the sides, in order to clarify the calculation. And you can follow through by clicking on the respective cells.

The effective interest rate is, in general, computed by dividing interest payments by the stock of outstanding debt, composed of old debt and new debt. To get real rates one needs to divide by the rate of inflation.

It is, de facto, the weighted average of the effective interest rate in local currency and the effective interest rate in foreign currency, with the weights given by the share of their respective type of debt.

This is the key interest rate which we are going to use for the debt dynamics situation. Going back, the sheet then computes several debt burden ratios. In addition, the section Shock Calibration Statistics contains several statistics like historical averages, standard deviations for some of the key variables, which we are going to use later on.

The next panel, Public Debt as a percentage of GDP Profile-Chart Data, simply computes some key debt ratios, which are useful when visualizing the debt profile.

Finally, the key calculations I want to emphasize in this sheet are done in the following panel, Public Sector Debt Dynamics. This section computes the decomposition of the debt dynamics into its main drivers.

The row "change in gross public sector debt" contains the increase in gross public sector debt from one year to the other. The main contribution comes from the identified debt-creating flows, which are the sum of three elements: the contribution from the primary deficit, the contribution from the automatic debt dynamics, and that of other debt-creating flows.

In its turn, the contribution from automatic debt dynamics is composed from the contribution of the real interest rate, the contribution of real GDP growth, and the contribution from the exchange rate depreciation.

The formulas used in this spreadsheet are exactly the ones that we have discussed in the lecture and I have attached them to the right-hand side for your convenience. You can also find them in the footnotes to this page.

Finally, the residual is computed as the difference between the change in public sector debt and the other identified debt-creating flows. Column V presents the cumulative contributions over the projection period.

To better understand what drives debt dynamics, let's look at the chart. So let's explore the first output sheet called "Output- Basic 1." The two tables at the top give a concise view of the baseline projections.

The main inputs are summarized in the top panel, while the contributions to the changes in debt can be found in the lower panel. And they come from the sheet "Baseline Debt" so I will not discuss them.

Let's go to the bottom figure. What can we notice? For Debtopia, debt still increases in the first two years of projections, though very little compared to the recent past. And after that it starts to very modestly decline.

This reduction is driven mostly by real growth, which is in red, and by the real exchange rate appreciation, which is in purple. The contribution from the primary balance is negative, in orange, as the final consolidation is gradual. And so is the contribution of real interest rates, in green. Overall, the cumulative reduction in debt is -1.4% of GDP over the projection horizon.

Unit 5: Realism of the Baseline Assumptions

Video-How to Evaluate the Forecast Track Record

Adina Popescu: Welcome back.

In this unit, we are going to learn about tools to evaluate the realism of the baseline projections. A realistic baseline scenario for the main macroeconomic variables is absolutely crucial for a credible assessment of sustainability. And this is why it plays an important role in the revamped MAC DSA framework.

To perform this analysis, we will rely on a combination of country-specific information and cross-country experience. Let's first look at an overview of the realism tools provided by the MAC DSA. The first one assesses the realism of macroeconomic assumptions by examining the forecast track record in projecting key macroeconomic variables, like real GDP, for example.

The second one assesses the realism of the projected fiscal adjustment, should there be one, in a cross-country perspective. This is particularly critical when large fiscal adjustments are required to ensure sustainability.

Finally, the boom-bust analysis is used to evaluate growth projections in countries which may have entered a boom-bust cycle and thus may be susceptible to a potentially painful bust. We will explain how these tools function in detail in this unit.

Let's start with the first analytical tool, which assesses the realism of macro-assumptions. More specifically, the DSA template automatically will produce some charts and statistics for the forecast track record for real GDP, the primary balance, and inflation.

The tool compares for each of these variables the yearly history of forecast errors for a country to the distribution of forecast errors for other MACs. Let's see how this actually works in practice.

This chart presents the real GDP growth rate, the actual, the black line-- versus projections, the dotted lines, for a particular country. The projections come from the spring World Economic Outlook forecasts that the IMF publishes. We can see that the projections for this country are in general quite good. However, one year, t + 5, stands out. This was during the financial crisis, when the projections were clearly optimistic.

Next, one goes on to compute the forecast errors for this country, which are here in the red diamonds, plotted for a shorter sample, only starting from year t. The forecast errors are computed in the following way: the forecast error at time t is the actual or realized at time t measured at time t + 2, minus the projection for year t made at year t - 1.

Those more econometrically inclined may notice that what we are plotting here is a one year ahead forecast error, evaluated two years afterwards to take into account potential data revisions. As it was also clear from the previous figure, the largest forecast error for this particular country was made in year t + 5, the crisis year.

So here, a negative forecast error means an overoptimistic projection; that is, the projection exceeded the realization. If the same exercise is performed for all countries, then we obtain the distribution of forecast error for all market-access countries.

The median of this distribution of forecast errors is plotted as the black line here. The blue shaded interval represents the interquartile range of this distribution. So thus we are abstracting from the most extreme observations. We notice that our countries' forecast errors

are very close to the median, to the black line, thus it's forecasts are well in line with those for other countries.

This tool essentially compares the country's forecast errors with those of other countries. But why would we want to do that? Because, for example, there are periods of common shocks like the global financial crisis when most countries' forecasts were wrong.

This is not only true about the IMF, since the crisis was largely unexpected, and growth surprised on the downside. Thus, judging the quality of a particular country's forecast record can be aided by such a cross-country perspective.

To help the assessment of our country's situation, the template also calculates two summary statistics. The first one is the median forecast error for the country from the available historical projections. In this case, it is 0.06, which suggests little bias in the projections. The second statistic is the percentile rank of the median forecast error in the distribution of median forecast errors from other MACs. Here it is 46%.

How to interpret this rank? For example, for country x, a median forecast error, 46%, close to the median of the distribution and also close to 0 is good news in the sense that it does not point to significant problems in the macro-framework. However, a low percentile rank reflects a median forecast error that is relatively large compared to other countries, and may be an indication of persistent optimism in past projections.

A high percentile rank, on the other hand, may be an indication of persistent pessimism in past projections. Of course, there are also other statistical ways of evaluating the forecast errors, but the template does not go into those. How to interpret the forecast errors? Let's look at the example of a different country. Here, we notice that the projections were overly pessimistic until year t + 4.

While projections may be expected to differ from the actual outcomes in individual years due to unforeseen developments, consistently one-sided projections suggest a more systematic projection bias.

We can also notice that for this particular country, the median forecast error was 4.63, which means that actual growth exceeded forecasts by a median of 4.63, which is a large figure. Not surprisingly, the percentile rank is 99%, which means that only 1% of the countries had even more pessimistic projections than this country—which suggests that one needs to look more carefully into the source of this bias.

So what to do? In a case like this one, one may need to reexamine the baseline projections and try to uncover the source of the bias. The template repeats this exercise, as mentioned before, in addition to real GDP growth, to the primary balance, and inflation. The bottom line is that to the extent that past experience can be helpful in projecting the future, these charts are intended to help calibrate more realistic baseline projections.

Video-Evaluating the Realism of Projected Fiscal Adjustment

Adina Popescu: Let's talk now about the second realism tool.

This one assesses the realism of the projected fiscal adjustment based on both cross-country experience and country-specific information. Let's start first by looking at some historical evidence and draw some lessons.

The first lesson is that while large primary surpluses have been frequent, sustained large surpluses have been less common. For

example, this histogram shows the maximum primary balance achieved by the 87 advanced and emerging economies in this sample, ranging between the earliest, 1956, to 2009, depending on availability-- the data coming from the World Economic Outlook Database.

We notice here that while large primary surpluses in single years were common-- for example, out of the 87 countries sampled, over 40% had a maximum primary surplus exceeding 5% of GDP in at least one year.

However, if we turned to the 5-year moving average, we notice that the mass of the distribution shifts to the left. That is, large consolidations become more rare. Only 16 countries-- less than 20% of the sample--sustain surpluses exceeding 5% of GDP for five years or longer.

If we look at the 10-year moving average, we notice that self-sustained consolidations are even less frequent. Moreover, some episodes of sustained large surpluses have been linked to specific conditions that are not easily applicable to most countries, like an increase in revenue related to natural resources, etc.

The second lesson is that large fiscal corrections are usually associated with worse starting fiscal positions. This figure, for example, plots on the x-axis the 3-year average primary balance prior to the adjustment period, while on the y-axis it plots the primary balance improvement computed as the difference between the 5-year average during the consolidation, minus the preceding 3-year average.

The first thing to notice is that most of the consolidations occurred after years of lax fiscal policies and large negative primary balances, which significantly increased debt. Second, the relationship is negative, suggesting that the countries which had the weaker starting fiscal positions had to consolidate the most.

One should, however, keep in mind that correlation is not necessarily causality. However, with this historical information as a background, the MAC DSA framework suggests that the assessment of the realism of fiscal projections should consider both the adjustment in the primary balance as well as its level.

The framework indicates that close scrutiny of assumptions is warranted if the planned fiscal consolidation is located close to the right-hand tail of the cross-country distributions. Let's see how this works in these two pictures extracted from the template. In the first chart, the maximum planned cyclically-adjusted primary balance over 3 years-- over any three years during the projection horizon--the red diamond for our particular country--is plotted against a histogram of cross-country consolidation episodes.

The part of the histogram which is shaded in yellow represents consolidations larger than 3% of GDP, approximately the top quartile. And if the country is placed in this region, as it is here the case, this should raise a warning flag. The second histogram again plots, this time, the maximum 3-year average level of the cyclically-adjusted primary balance for any consecutive 3-year period during the projection horizon against a histogram of historical episodes.

Here, the area of concern is if the maximum projected 3-year average cyclically-adjusted primary balance level would be over 3.5% of GDP. And this country is close to borderline. More specifically, the analysis should take into account, for any particular country: the past record of fiscal adjustment; issues like the extent of political commitment to the adjustment and to the implementation of any supporting policy measures; things like the way the authorities have designed the fiscal adjustment plans; their experience regarding budget forecast errors; as well as existing legal and institutional mechanisms to support the realistic implementation of such plans, etc.

Video-How to Use the Boom-Bust Tool

Adina Popescu: The boom-bust tool is only applied to countries that are identified to be in a boom. In the MAC DSA framework, a country is identified to be in a boom if either of the following two conditions is met.

First, the country has experienced a positive output gap during the last three consecutive years. And the second criterion is if the country has had a three-year cumulative level change in private sector credit-to-GDP ratio exceeding 15% for emerging markets, and 30% for advanced economies.

Let's recall that the output gap is defined as the difference between the level of actual output and the potential output, which would be that level of output if the economy were operating at full potential. As far as the second indicator is concerned, let's take an example. Let's assume that the level of the private sector credit-to-GDP at times T, T plus 1, T plus 2, T plus 3, is respectively 30%, 35%, 45%, and 50%. Then the 3-year cumulative level change would be the difference between 50 and 30%, that is 20%, which would trigger the boom-bust module if the country is an emerging economy, but not if it was an advanced economy.

Let me note at this stage that the second trigger, the change in private sector credit-to-GDP, will also be used later as a trigger in the contingent liability module to identify potential credit bubbles. You are probably wondering where these triggers come from. More details on this are provided in the handout.

So, how is this analysis done? Well, the boom-bust tool simply compares the gross projections for a particular country to the historical experience of boom-bust cases constructed from a database of such episodes. As you can see in this figure, the template automatically plots the country's real GDP projections—here the dotted red lines—against the distribution of growth observed during previous boom-bust episodes.

Here, the shaded area represents the interquartile range, that is, the difference between the 25th and 75th percentiles, while the black line represents again, the median. So how to interpret the situation of this country? The tool provides simply a warning that if the country were to enter a bust, its output growth may lie below the current projections. It is important to highlight the fact that the boom-bust tool only serves as a reality check for growth forecasts of countries that are potentially entering a boom-bust cycle and thus may not be able to continue to grow at the same pace. It does not mean that when this tool is triggered the growth forecast is automatically deemed to be overly optimistic, or it needs to be revised downwards.

Video-MAC DSA Template Realism Tools

Adina Popescu: Hi, and welcome back.

In this video, we are going to discuss the results of the various realism tools, which are summarized in the sheet, "Output Realism." The top panel plots the automatically generated forecast track records for Debtopia for real GDP growth, primary balance and inflation. This is done versus all other MACs which is the comparator group here, which can be set in this cell on the left-hand side.

So what do we notice? Debtopia forecasts are, in general, very close to the median for all MACs for real GDP growth and the primary balance. And they are a bit worse for inflation, as it evidenced both by the high median forecast error, as well as the percentile. Those of you curious to investigate the source of the data will notice that these charts refer to the master sheet, "List-Modules-Chart-Data," which we are going to first unhide.

And going in this sheet to Column H, and to the right of it, you'll find the forecast records for Debtopia here, as well as scrolling further down for all other countries. Going to the second panel, the first two charts assess the realism of the projected fiscal adjustment for Debtopia, placing the maximum 3-year adjustment in the cyclically-adjusted primary balance and the maximum 3-year average level of the cyclically-adjusted primary balance in a cross-country context.

Let's note that for Debtopia the cyclically-adjusted primary balance is equal to the actual primary balance, since for simplicity we have assumed that the output is exactly equal to potential for the entire projection horizon. To see how this calculation is done, let's go again to "List-Modules-Chart-Data," from Column DD to the right.

Here we can find the level of the cyclically-adjusted primary balance. The 3-year average level, which is computed at every point in time as the average between year t - 2 and t, can be found here. While the 3-year adjustment, which is computed at any point in time as year t - year t - 3, can be found on this line.

We then take the maximum over all six projection years. For Debtopia, the maximum 3-year average level is 3.3%, rounded at 3.5%. And the maximum 3-year adjustment is 2.3%, rounded as 2.5%. Going back to output realism, we note that the maximum 3-year adjustment of 2.3% is lower than the 3%, which would be the top quartile of the distribution.

The maximum 3-year average level at 3.3% is slightly lower than 3.5%, which is the cut-off point for the top quartile of the distribution. What conclusion can we draw from this? Well, neither the level nor the adjustment in the primary balance appear to be excessively high when placed in a cross-country context. Scrolling to the right in the sheet, we find there the results of the Boom-Bust analysis for Debtopia.

This tool, let's recall, is triggered automatically when output has been greater than potential for three years, or when the private sector credit-to-GDP has increased by more than 15% of GDP over the past three years, if the country is an emerging market. In order to see how this calculation is done, we go back to "List-Modules-Chart-Data," in Column DP.

Here we see the output gap for Debtopia and private sector credit-to-GDP. We notice that for the case of Debtopia, it is the second variable which triggers the boom-bust tool, since private sector credit-to- GDP has increased by 16%, in excess of 15%, which is our benchmark, while the output gap has not been positive over the past three years. Going back, what conclusion can we draw? Essentially, if Debtopia were to enter a bust, its output growth would likely lie below the 4% level of the projection.

Unit 6: Dealing with Uncertainty Part 1, Alternative Scenarios

Video-Sensitivity Analysis in the MAC DSA

Adina Popescu: Welcome back.

The MAC DSA framework assesses risks around the baseline scenario, mainly through standardized and customized sensitivity analysis. Stress tests are applied to the baseline scenario to illustrate the potential impact of adverse shocks on the debt burden indicators.

As I mentioned the sensitivity analysis in the MAC DSA is performed via a battery of standardized and customized tests. Among the standardized analysis, we will discuss the historical scenario, the

constant primary balance scenario, standardized macro-fiscal stress tests, and the financial sector contingent liabilities shock. In addition to these, the template allows one to generate also various customized scenarios to cover other sources of risk.

As mentioned in Unit 2, the basic DSA includes two standardized alternative scenarios. First, the historical scenario assumes that real GDP growth, the primary balance, and real interest rates are set at the historical average, while all other variables are the same as in the baseline. Second, the constant primary balance scenario is modeled assuming that the primary balance remains unchanged compared to the first, the current year of the projection, in percent of GDP, while all other variables are the same as in the baseline.

How to use the historical and constant primary balance scenarios? One way to use them is in order to assess whether baseline assumptions are unrealistic or overly optimistic. They are also used to judge whether policy assumptions and commitments are substantial enough to make a credible break from the past or the current trends. For example, baseline debt ratios that are much lower than those in the standardized alternative scenarios may signal unrealistic baseline assumptions and warrant further discussion.

However, in some cases optimism in projections may be justified by structural breaks or recent performance improvements that are not adequately reflected historical averages. Another example is that recent history may not be an appropriate benchmark for crisis countries that experienced a pre-crisis boom. Shocks to macro-fiscal variables could result in worsening debt dynamics. It is therefore critical to complement a baseline assessment of sustainability with an assessment that incorporates the main macro-fiscal risks.

The MAC DSA contains a module which assesses the implications for debt sustainability posed by shocks to the primary balance, real GDP growth, the interest rate, the exchange rate, and a combination of these shocks. These stress tests allow for interaction among the variables. For example, lower growth leads to lower primary balances. A worse primary balance leads to higher risk premium and thus higher interest rates.

Lower output should lead to lower inflation, et cetera. In the primary balance shock, the size and the duration of the shock is modeled in the following way: at the minimum, the shock should be equivalent to (1) the maximum of 50% of the planned cumulative adjustment in the baseline or (2) the baseline minus 1/2 of the 10-year historical standard deviation of the primary balance, whichever is greater. The default interaction modeled in this scenario is that additional borrowing costs lead to an increase in interest rates. In a real GDP growth shock, real GDP is reduced by one standard deviation for two consecutive years.

The default interactions modeled here are, first, a primary balance deterioration as the revenue-to-GDP ratio remains the same as in the baseline, but the ratio of non-interest expenditures-to -DP increases as the level of spending is kept the same as in the baseline. Second, the deterioration in the primary balance leads to an increase in interest rates. And third, the decline in growth leads to lower inflation.

The interest rate shock is modeled as an increase by the maximum of two values: (1) the difference between the average real interest rate over the projection period and the maximum real historical level or (2) 200 basis points, whichever is higher. While there is no default interaction for this shock, this should not preclude the user from including such interactions using, for example, estimates from country-specific empirical studies. In the real exchange rate shock, the real exchange rate increases by (1) the maximum of the estimated overvaluation or (2) the maximum historical movement of the exchange rate.

Let's take an example. Let's say the real exchange rate is over-valued by 5% and the maximum historical movement, say yearly changes, are 10%, a 10% depreciation. Then, in this case, we'll take the shock to be the 10% depreciation. Let me also note here that the default interaction modeled is a pass-through to inflation with default elasticities of 0.25 for emerging markets, and 0.03 for advanced economies. Let's recall that the exchange rate pass-through is the change in the domestic inflation due to a change in the exchange rate.

The combined macro-fiscal shock is based on the shock size and duration of the underlying shocks, all of the previous shocks we have discussed. Essentially, this is "worst-of-all-cases" scenario, and incorporates the largest effect of individual shocks on all the relevant variables. We have GDP growth, inflation, the primary balance, the exchange rate, and the interest rates. The macro-fiscal stress tests are designed to balance standardization and tailoring to country-specific circumstances.

Thus, the template has built in a certain degree of standardization in the size and duration of the shocks, as well as the interactions between the variables following each shock. However, it is important to keep in mind that all these elements can be tailored to reflect country-specific information and circumstances. In the following video, we shall see how these shocks are implemented in the template.

Video-MAC DSA Template: Intro to the Alternative Scenarios: The Historical Scenario and the No-Policy Change Scenario

Adina Popescu: Hello, and welcome back.

In this video, we are going to discuss the design of alternative scenarios in the MAC DSA. Let's start in the sheet called "Input 5-Scenario Design." All the alternative scenarios and stress tests in the template are controlled from this sheet. By this, I mean that the scenarios are defined here, and some of the key results are plotted. The sheet's structure can be split into inputs and outputs. Let me start with the inputs.

First, in lines 7 and 8, you will find that the level of scrutiny is determined on the basis of the debt burden indicators and exceptional access. However, the user can overwrite this in cell J8 on the basis of the additional benchmarks. As we discussed previously, Debtopia qualifies as high scrutiny.

Let's scroll down. The following lines contain a description of all the scenarios that the template produces, together with whether they are triggered, whether they are required or not for the country in case, as well as a description of the shock. As discussed in the lecture, the MAC DSA framework includes two standardized alternative scenarios-- the historical scenario and the constant primary balance. The macro-fiscal module contains five tests-- the primary balance shock, a real GDP growth shock, an interest rate shock, an exchange shock, and a combined macro-fiscal shock.

In the end, one finds the financial sector contingent liabilities shock, as well as two customized shocks, which the user has the option to call if desired. And we will discuss these in a later video. Going further down, we find the shock assumptions. Columns A and B contains variables which may be parametrized by the user. For example, Column B may be used to tailor the size of the shocks and interactions by modifying the yellow-shaded cells to reflect country-specific information. Columns D to J contains the projections for the key variables in all of the scenarios. To the right-hand side, one finds plots of the debt-to-GDP ratio and the gross financing needs-to-GDP ratio for the particular scenario relative to the baseline.

This allows one to have a quick feedback into the results of the stress tests. At the top of the sheet, you will find projections of the baseline scenario. Now, let's go to the bottom of the sheet because this is where we find the historical and constant primary balance scenarios.

Let's now look at the historical scenario for Debtopia. In this scenario, as you may recall, real GDP growth, the primary balance, and interest rates are set equal to their 10-year historical averages, starting in the year 2014, while for 2013, the baseline projection applies. You can see this, for example, here-- the historical average for GDP growth was 5.4%. The historical primary balance was -1.4%. While the interest rate-- this is defined as a shock, so this is the difference to the baseline, which is 63 basis points is the difference between the historical average and the baseline projection average. All the other figures are the same as in the baseline projection.

As I mentioned before, this is a control sheet, so the calculations are not actually done here. This sheet retrieves them from a hidden master sheet, "List-Modules-Chart-Data," which in turn, retrieves the results from hidden individual sheets for each scenario. For example, the calculations for the historical scenario are actually done in the sheet called "Historical," and so on. So let's, for example, unhide the historical scenario sheet. We do this, again, by right-clicking on the tab, clicking Unhide, looking for the historical scenario, and clicking on that particular sheet-- so open directly from the top of the sheet. The first part of this sheet, if you look carefully, is very similar to the sheet computing the baseline, "Baseline Debt," so I will not spend time explaining it. Let me just note where the differences are.

In lines 26 to 33, we find the assumptions on which the historical scenario is built. These come from the "Input 5-Scenario Design" sheet that we have already discussed. And I have highlighted for you, in pink, the variables which change relative to the baseline. What follows next in this sheet is an adjustment done to the financing structure. This is very complex. I will not go though it into detail. You don't need to worry about this.

Essentially, the gross financing needs in this scenario change relative to the baseline starting in 2014. So each one needs to be adjusted accordingly. This is done in a simple manner in the sense that the issuance is assumed to adjust proportionally to the ratio between the gross financing needs in the baseline relative to this particular shock scenario. Before looking at the results for the historical scenario-- which I prefer to do via a chart-- let's have a quick look at how the constant primary balance scenario is defined.

For this, you need to go back to "Input 5-Scenario Design." Looking at the constant primary balance scenario, you will notice here that the primary balance is set equal to its value in year 2013 throughout the projection period while for all the other variables, the baseline projection applies. While we can also see already the results here on the right-hand side, we can also go to the sheet "Output-Basic 2" in the second panel.

These charts compare the baseline with the historical and constant primary balance scenarios. Looking, for example, at gross nominal public debt for Debtopia, we see that the baseline is slightly more conservative than the historical scenario. So the baseline projections do not appear excessively optimistic.

So why is this the case? In the baseline, you can notice that real GDP is more conservative than in the historical scenario, which outweighs the impact of the more optimistic primary balance and of the lower interest rates. Compared to the constant primary balance scenario, the baseline suggests a more ambitious consolidation. This better fiscal performance would need to be supported by credible policy actions.

Video-MAC DSA Template: The Standardized Macro-Fiscal Stress Tests

Adina Popescu: Hello, and welcome back.

In this video, we will continue discussing the macro-fiscal stress tests in the sheet "Input 5-Scenario Design." We will go through the various scenarios one by one. So let's start first with the primary balance shock. This shock is a bit more complex than others, so you need to pay a bit more attention. First of all, let's look at how the shock is calibrated. This is the primary balance. The formula here says that the primary balance under this scenario is modeled as the maximum-- that is, the worst case-- of two possible scenarios.

The first one is based on the planned adjustment. The second one is based on the 10-year historical standard deviation. For the first option-- we can look, for example, in 2014, to see how this is done-- the formula here simply says that under the shock, the primary balance is projected in the following way. If the primary balance under the baseline is improving-- this is F37 - E37 is larger than 0-- then the primary balance under the shock should be equal to the primary balance under the baseline-- F37 - B53, which is this adjustment of 0.5, so minus half the improvement in the primary balance under the baseline.

If there is a worsening in the primary balance, then under the shock it should stay the same as in the baseline. You will notice that the same formula is applied for all projection years. On the basis of this, one computes the deterioration from the baseline. And this is added up to obtain the cumulative shock impact, which happens to be 0.7.

The second option is based on the 10-year historical standard deviation of the primary balance. In this case, for two years-- namely, in our case, 2014 and 2015-- the primary balance is equal to the primary balance under the baseline, F37, minus half of the figure here-- If you check in "baseline debt," you will see that it is the 10-year historical standard deviation of the primary balance over the last 10 years.

Again, one computes the differences to the baseline, and these are added up to give us the cumulative shock impact, which happens to be 1% and which is actually equal to the 10-year historical standard deviation because we have subtracted half of it in two consecutive years. Nevertheless, which one of the two will we choose? We will choose the one with the maximum shock impact. So in this case, the 1%. So the primary balance under the shock will be equal to the primary balance under this scenario.

Now, let's see what are the modeled interactions? First, one can set the non-interest revenue-to-GDP ratio to decline by a certain proportion-- the proportion is given by the cell B45-- for every 1% deterioration in the primary balance. We can see it in the formula here. Changing the parameter in cell B45 de facto implies changing the composition of the source of adjustment between revenue and expenditure.

If you click on the comment here, you see that this figure should be set to be between 0 and 1. If is set to 0, as it is now, the non-interest revenue-to-GDP ratio is the same as in the baseline. So all changes in the primary balance will come from the expenditure side. If for example, the parameter is set to 1, then all the adjustment will come from the revenue side, and you notice that expenditure-to-GDP has not changed compared to the baseline, while revenue has changed. Of course, one can have an intermediate value in which both revenues and expenditures change.

I will be reverting back to 0 here. In addition, interest rates on new debt are assumed to increase by 25 basis points for every 1% of GDP deterioration in the primary balance compared to the baseline. We can see this in 2014 and 2015. All right-- so the 25 basis points applied

to the difference in the primary balance compared to the baseline. So essentially, this here is an interest rate shock, right? It's not interest rate level. It is the interest rate shock compared to the baseline.

Under this shock, the interest rate in these two particular years will be 12 basis points higher than in the baseline. Other variables such as GDP growth, inflation, and the exchange rate are assumed to remain unchanged compared to the baseline. However, GDP growth is highlighted in yellow, which is an indication that it may be reasonable to adjust GDP growth as well using information which you may have from other empirical or theoretical sources.

Let's move on now to the real GDP growth shock. So the real GDP growth shock is modeled as a reduction in real GDP growth by one standard deviation for two consecutive years. So we can see this in 2014 and 2015, where GDP growth is equal to the value under the baseline - B63, which is the one standard deviation, multiplied by this figure coming from "Baseline debt," which is the standard deviation of GDP growth. Let's discuss now the modeled interactions here.

First, let me start by noticing that the primary balance deteriorates for two years-- so for 2014 2015-- relative to the baseline, since the revenue-to-GDP is the same as in the baseline while non-interest expenditures-to-GDP increase as the level of spending is kept the same as in the baseline, as you can see it from here. This primary balance deterioration leads to higher interest rates, again, as in the primary balance shock, by 25 basis points per 1% of GDP deterioration in the primary balance relative to the baseline, as can be visible here.

Furthermore, the decline in growth leads also to lower inflation. This is modeled as 0.25 percentage points per 1 percentage points decrease in GDP growth. So inflation-- it is equal to inflation under the baseline minus the difference in GDP between the shock and the baseline multiplied by the 25 basis points reduction.

Let's move on now to the interest rate shock. Under the interest rate shock, the size of the stock is modeled in the following way. It is the maximum of 200 basis points and the figure here in "Baseline debt," which is the difference between the average real interest rate level over the projection period and the maximum real historical level.

Let's go "Baseline debt" to see where this calculation is done. So going to "Baseline debt" in the section on Shock Calibration Statistics, we find that the maximum historical value of the real interest rate is 4.4% while the projection average is 3.1%. Thus, the difference between the two is about 127 basis points. Since this is smaller than 200 basis points, the shock will be modeled as a 200 basis points shock.

Let's go back now to the "Input 5-Scenario Design sheet," and see indeed the shock has been calibrated as a 200 basis points increase for five years. As mentioned in the lecture, there are no built-in interactions-- so all other variables are assumed to be the same as in the baseline. However, it is very likely that one would like to adjust also other variables. For example, real GDP growth projections are highlighted in yellow as one clear candidate. But one can adjust also other variables based on other empirical or theoretical information that one may have.

Let's go now to the real exchange rate shock. The real exchange rate shock is modeled as the maximum of two elements: First, the degree of real exchange rate overvaluation, and the maximum--in what we have here-- is the historical movement of the exchange rate-- that is, the maximum annual depreciation. The value for the real effective exchange rate was hard-coded, if you recall, in "Input 1-Basic." Essentially, it has to come from other types of analysis.

For Debtopia, we calibrated it to be a 5% overvaluation. The maximum historical movement of the exchange rate, if we go to "Baseline debt," turns out to be 13%. Recall that with our definition of

the exchange rate as local currency units per US dollars, a positive change in the exchange rate creates a depreciation. So essentially, the reason why we calibrate the shock in this way is that if the currency's overvalued-- that is, depreciated relative to the equilibrium value-- one can assume that the meaningful shock would be a depreciation back to the fundamental value.

At the same time, we need to look at the history and see if the country has experienced large depreciation episodes, since that may happen in the future as well. After computing the real exchange rate shock-- which in our case, it is 13%-- we go on to derive the nominal exchange rate shock, which is computed as the real exchange rate shock over (1 minus the pass-through to domestic inflation)-- here, 0.25. Here, what we're doing is we are implicitly assuming that the purchasing power parity (PPP) holds. The nominal exchange rate moves in-sync with inflation.

You can check, for example, that the shock to nominal exchange rate minus the real exchange ratio shock is equal to about 4.4, which is also the change in inflation from 2013 to 2014. The main modeled interaction here is the pass-through to inflation with a default elasticity of 0.25 because Debtopia is an emerging economy. For an advanced economy, it would be 0.03. Since this is modeled as a one-year pass-though, inflation in the year 2014 is set to equal inflation under the baseline, plus this coefficient, this pass-through, multiplied by the nominal exchange rate shock, the 17%.

Other variables are assumed to remain the same as in the baseline. A combined macro-fiscal shock is also automatically produced. You can think about this as a "worst-of-all-worlds" scenario, in the sense that real GDP growth, inflation, and revenue-to-GDP are all set to the minimum of all previously discussed scenarios and the baseline, while expenditures-to-GDP, the exchange rate, and the interest rate are set to the maximum, again, over the preceding scenarios. The remainder of the shocks will be discussed in other videos.

Let me show you now where the results from the scenarios are best summarized. For this, open the sheet "Output-Shocks." The top panel presents the results of the macro-fiscal stress tests on gross nominal public debt as percent of GDP and as percent of revenue, and on the gross financing needs as percent of GDP. The baseline, real GDP growth shock, primary balance, real exchange rate shock, and real interest rate shock are presented in the upper panels while the combined macro-fiscal shock is presented in the lower panel.

What do we notice for Debtopia? Essentially, under all individual shock scenarios, the debt-to-GDP ratio would eventually decline, although under some shocks, it would initially increase. Only under the combined macro-fiscal shock our debt-to-GDP is stabilized at a relatively high level. As regards to gross financing needs, we notice that in all the scenarios, they increase in the short-term, but decline afterwards. And the reasons, we will discuss in another video.

Unit 7: Dealing with Uncertainty Part 2, Customized Scenarios and Fan Charts

Video-MAC DSA Template: Customized Alternative Scenarios

Adina Popescu: Hi. Welcome back.

In this video, we are going to discuss how to implement customized scenarios in the MAC DSA template. We are starting again from the sheet "Input 5-Scenario Design." As mentioned previously, the template allows the user to create additional customized shocks. And space is provided for two shocks. These could include contingent

liability shocks from non-financial sectors, or other relevant scenarios which capture country-specific risks not included in the scenarios we have discussed previously.

So first, if we want to use such a shock, we need to select "Yes" from the drop down menu in cell J25. We can also give our scenario a name. And we are going to call it "Global Financial Crisis." So clicking on this link takes us directly to the scenario. So the Global Financial Crisis scenario is modeled as an increasing risk premium and potentially a sudden stop in capital flows, which are due to spillover small financial crises in advanced economies. We are also going to assume that there are feedback loops between the sovereign and the financial sector.

So in our scenario, I output collapses in 2014 and recovers only very slowly. Inflation also declines, due to the widening output gap. The exchange rate depreciates, but its impact on inflation is outweighed by the effect of the economic slack. The interest rate is assumed to increase by 400 basis points in 2014, and then gradually decline, though it remains higher than in the baseline.

Revenues are assumed to fall, and they're 2% lower than in the baseline. Expenditures are assumed to spike in 2014, as banking sector difficulties lead to government intervention in the financial sector, costing 10% of GDP. And the primary balance deteriorates accordingly. To see the impact of this shock, we go to "Output-Shocks." Here, in the second panel, we find the impact of this shock, the global financial crisis. What one can notice is that clearly under such scenario, debt becomes explosive.

Video-Fan Charts

Adina Popescu: A simple fan chart tool is included in the MAC DSA template and is required for higher scrutiny countries. Fan charts present the possible evolution of the debt-to-GDP ratio, the frequency distribution, over the medium term. They are constructed by looking at the impact on the debt-to-GDP ratio of simulating a large number of shocks to the relevant macroeconomic variables. So fan charts provide a probabilistic view of the uncertainty around the baseline.

They show the spectrum of possible outcomes, based on the stochastic properties of the data. They incorporate interaction between macroeconomic variables, that drive the debt dynamics. And they rely on the historical data to calibrate the persistence of the shocks. Let's now try to understand how are fan charts constructed. First, country-specific historical data are collected for 4 key variables-- real GDP growth, the effective real interest rate, the exchange rate, and the primary balance.

These are used to compute sample means, mu, and the variance-covariance matrix, sigma. It is assumed then that the distribution of the variables is jointly normal with a sample mean, mu, and the variance-covariance, sigma. And then a number of draws-- actually 6000 draws-- are generated from this joint distribution, which are used to produce projections-- 1,000 projection paths, more precisely, for the debt-to-GDP ratio for 6 years, which includes the current year. And these paths are then sorted into percentiles from which confidence bands are extracted.

These are then used to produce the fan charts. Which are the types of fan charts that the template produces? By construction, a joint normal distribution of shocks, would generate a symmetric fan chart, with upside risks matching downside risks, and centered around the baseline. However, in practice a more interesting scenario may be when, say, negative shocks to debt dynamics are more likely than positive shocks. This would happen, for example, when the baseline already incorporates significant adjustment in the primary balance.

And in that case, expected underperformance of the fiscal balance is more likely than overperformance.

Such a situation would call for an asymmetric fan chart, which has higher or lower downside risks. And which is expected to capture the analyst's best assessment of the likely balance of risks. Here is an example of a symmetric fan chart, where upside risks and downside risks are equally likely.

The baseline is represented as the black line. And around it in a symmetric fan chart, one can notice the confidence bands representing the various percentiles of the distribution. We can notice that the entire chart plots the projection lines only between the 10th and 90th percentiles, thus eliminating the most unlikely outcomes. Also the increasing spread of the distribution, over the projection period is due to the increased uncertainty over time, since shocks compound over the years. This slide shows an example of an asymmetric fan chart, which are generated by cutting off either the upward or downward distribution of the shocks, in order to represent the analyst's best assessment of the likelihood of the shocks.

Essentially, one would constrain the draws to lie within certain ranges. As noted above, an example may be if negative shocks to debt dynamics will be more likely than positive shocks, such as in the case of a planned large fiscal adjustment. Another example is the case where the real exchange rate is significantly overvalued and the baseline scenario incorporates only marginal adjustment to the exchange rate. In that case, we may expect future shocks to be biased towards depreciation.

If adverse shocks would be more likely, such as low real GDP growth or low primary balance, et cetera-- then the baseline would evolve along the lower bands of the fan chart's distribution, such as pictured here in an asymmetric fan chart. Overall, the fan chart tool provides a probabilistic view of the evolution of the debt-to-GDP ratio over the medium term.

However, to keep the computational requirements manageable, shocks are drawn taking into account only the contemporaneous correlation between variables. Thus the tool does not take into account intertemporal correlations between variables, or the potential autocorrelation of the individual variables.

Video-MAC DSA Template: Fan Charts

Adina Popescu: Hi, and welcome back.

In this video, we will see a hands-on demonstration of how fan charts are constructed. In order to do this, we need to open the sheet "Fan Charts." As I have explained in the lecture, fan charts are generated based on the calculations of historical averages, variances, and covariances for the following four key macroeconomic variables-- real GDP growth, the effective real interest rate, the primary balance, and the exchange rate depreciation. The historical data can be found scrolling to the right, here. In the box, Moments Calculated Based On Historical Data, you see means of these variables based on the available historical data.

Underneath, we find the variance-covariance matrix for the four variables. As a default, the averages and the variance-covariance mmatrix are calculated from the same historical data as the rest of the DSA-- the last 11 years. However, when data is available, longer time series can be used, by populating the yellow-shaded cells in the top of the screen. Let's now see how symmetric fan charts are generated.

This will look a bit small, but I'm trying to capture as much as possible of the screen. You will notice a blue button here, which is what is

called a "macro"-- essentially a program-- which is generating the draws from the joint normal distribution. For this to work, you will need to have macros enabled in your Excel sheet. If you click on it, notice that a new set of 6,000 random draws from the joint normal distribution is drawn in columns B to E from line 68 downwards. So you see as I click, these draws change.

Scrolling down, you see that we have exactly 6,000 draws for each of the four variables. How do we use these draws? We cannot use them directly to predict debt, because we are interested in adding shocks to our baseline, and these are the draws for our four variables. We get the shocks by subtracting from the draws the mean of each variable. You can see this done here, where from each variable we are subtracting the mean.

Further, you will notice that the 6,000 draws are grouped in six years, so we retain 1,000 draws for each year, given that we need to populate six years of projections. For example, columns H to M contain the shocks to growth. Columns N to S contains the shock to the real effective exchange rate, and so on. And we have 1,000 shocks for each of these variables.

Moving to the right, we notice that for each of these draws, the debt-to-GDP ratio is derived for each of the 1,000 shocks every single year. This is done here, and it is simply done by adding the shock for each of the variables to the baseline. The formula which is employed here has been inserted here for your convenience. You have seen this version of the debt dynamics equation in Part 1.

These projections are then sorted in percentiles. This is done in the table here, and then represented in the familiar symmetric fan chart. Going up again, you may notice the tables containing the moments, means, and variance-covariance computed based on the draws, as well as the difference between the moments computed based on the historical data and those based on the random draws-- which should be as close to zero as possible, as they are here.

The fan chart tool allows a couple of other experiments. So first individual shocks can be turned off using cells B42 to B45. This allows us to focus on only certain sources of uncertainty. In addition, one can generate asymmetric fan charts by placing restrictions on the magnitude of "good" shocks in cells D42 to D45. So what is a "good" shock for debt dynamics? It is essentially a positive growth shock or a negative interest rate shock, a positive primary balance shock or a real appreciation shock.

Let's take the example mentioned in the lecture, of a situation in which we believe that negative shocks to the primary balance are more likely than positive shocks, for example because the baseline already incorporates an ambitious fiscal adjustment. How can we model this? Well, we can restrict the primary balance shock not to exceed zero by inputting zero in cell D44. We click on the blue button to generate a new set of draws.

While the draws themselves are not restricted, the restriction is imposed when the shock is calculated. So for the asymmetric fan charts, the shocks can be found in columns AO to BL. Let's check the primary balance shock. We notice that the shocks are zeros or negative numbers, just as we wished. Under this restriction, we obtain again 1,000 different projection plots for debt, which are then sorted and plotted as an asymmetric fan chart.

As expected, because this scenario is more pessimistic than the unrestricted version, the distribution of the projections has more mass above the baseline. Thus, the baseline appears optimistic in this view. Let me also note that these charts are also reported in the sheet "Output-Heat Map" in the middle panel.

Unit 8: Contingent Liabilites

Video-What are Contingent Liabilities?

Adina Popescu: Welcome back.

In this unit, we are going to understand what are contingent liabilities and how they're treated in the MAC DSA template. In essence, contingent liabilities are government financial interventions which arise out of explicit or implicit guarantees to various entities, such as public entities, like sub-national governments, state-owned enterprises, state banks; some public-private partnerships; to depositors, such as deposit insurance schemes; or private companies, in the case of support for private companies who are deemed too big to fail, et cetera.

As mentioned, contingent liabilities can be explicit or implicit. While explicit contingent liabilities are common, implicit contingent liabilities historically have accounted for the bulk of the so-called hidden deficits, that is, increases in public debt that are not explained by the headlined fiscal balances. So what is the difference between the two?

Well, explicit liabilities are recognized by law or by contract. So they include examples like state guarantees for non-sovereign borrowing and obligations issued by sub-national governments or other public or private sector entities. Also include state guarantees for various types of loans. Think about it as mortgage loans, student loans, agricultural loans, small business loans, et cetera, or private investments. They also include trade and exchange rate guarantees and state insurance schemes, such as deposit insurance, medical insurance programs, et cetera. What are implicit contingent liabilities?

Implicit guarantees do not stem from any legal obligations, but instead are assumed, due to public and interest group pressures. Some examples here. For example, the government may issue other entities' liabilities in the case of defaults on non-guaranteed debt of sub-national governments, public and private enterprises, et cetera. This may be done in order to avoid reputational problems or credit risk reappraisal by ratings agencies, et cetera.

Another example, is a bailout of the financial system, when entire banks are rescued rather than only depositors. This is done in order to avoid a systemic crisis with potentially very large economic costs. Another example are corporate sector bailouts, like in the US, a famous example is the bailout of General Motors in 2009, carried out to save jobs, or the clean-up of liabilities of entities being privatized, or implicit insurance for disaster relief. This is because very often it is pressure for a government to act in such situations. Contingent liabilities can be significant.

Let me show you some data. The chart on the left shows outstanding government-guaranteed bonds issued by private and public banks and financial institutions with a state guarantee for a number of advanced economies. First, we notice that they can be significant, and figures around 5% of GDP are not unusual. And also for many of these countries, this type of liabilities have increased between 2008 and 2012 as a consequence of the financial crisis.

The chart on the right shows debt of government-related enterprises, that is, bonds issued by both financial and non-financial institutions. What do we notice here? These debts can be considerable, and they reach up to 50% of GDP, for example, in the case of the US, which reflects obligations of the government-sponsored enterprises related to the mortgage market, such as Fannie Mae and Freddie Mac. And the other thing to notice is that in this chart, again, there's been an increase in these liabilities between 2008 and 2012.

The DSA envisages several types of contingent liabilities shocks. First, shocks stemming from guaranteed debt of state-owned enterprises and private-public partnerships. Second, contingent liabilities stemming from natural disasters. And third, stemming from banking or financial crisis. The non-financial sector contingent liabilities stemming from the first two types of shocks should be analyzed in the MAC DSA through customized scenarios.

The MAC DSA does not provide a standardized shock, but rather recommends relying on country-specific circumstances. For the financial sector contingent liabilities shock, on the other hand, the DSA has a built-in financial contingent liabilities scenario, which is standardized but can also be customized by the user, and which we are going to discuss in a following unit.

Video-Contingent Liabilities Stemming from A Financial Crisis

Adina Popescu: Government assistance to the financial sector can be particularly costly and undermine sustainability. For example, an IMF study which identifies 147 banking crises over the period 1970 to 2011 estimates that median gross fiscal cost, net of subsequent recoveries, of banking crises were about 13% of banking system assets.

Also, if one looks at this chart, which stems from the same source, one can notice that fiscal costs as a share of banking system assets were higher for the median of emerging markets, more than 20% of financial system assets, and about 10% of GDP. Also, there appears to be a substantial variation in the fiscal cost of financial crises across countries. Here, plotted are some significant episodes from individual advanced economies.

These empirical findings motivate the calibration of the financial contingent liabilities shock in the MAC DSA. As mentioned previously, the template includes a standardized shock involving contingent liabilities from banking crises. This shock is triggered when at least one of two quantitative triggers is breached. The first trigger is the cumulative change in private sector credit-to-GDP ratio over the past three years, which we encountered when studying boom-bust cycles. The benchmarks are set, as before, to 15% of GDP for emerging markets and 30% for advanced economies.

The second trigger is the loan-to-deposit ratio where the benchmark is set to 1.5 for emerging markets and 1.5 as well for advanced economies. This is defined as the ratio of gross loans to total customer deposits for the current year. The trigger implies that loans should not exceed deposits by more than 50%, which means that other sources of financing, which may be less stable than deposits, should not be too large.

Additionally, in advanced economies, one should look at the rapid increase in house prices. This is because there is evidence that the annual increase in nominal house prices over the preceding five-year period in excess of 7.5% is a useful indicator and can predict banking crises in advanced economies. If a quantitative trigger is breached, or if other financial vulnerabilities are identified-- for example, the IMF conducts for member countries what are called "financial system stability assessments," which could inform the identification of other vulnerabilities-- then standard financial contingent liabilities shock, assuming a size of 10% of banking sector assets, is automatically generated in the MAC DSA template.

So this is modeled as a one-time increase in non-interest government expenditures. The size of the shock is informed by the study mentioned earlier. However, it can be calibrated to match past banking crisis or other specific circumstances of a particular country. Many studies have also shown that contingent liability shocks are associated with significant output losses. For this reason, the standardized contingent liability shock also includes a negative shock

to growth, a resulting deterioration in the primary balance, an increase in interest rates on account of the higher risk premium now that government debt is higher, and also a decrease in inflation due to the larger negative output gap now that growth is lower.

Video-MAC DSA Template: The Financial Contingent Liabilities Shock

Adina Popescu: Hi, and welcome back.

In this video, we are going to see how financial sector contingent liabilities shock is triggered and modeled. We're going to start again from "Input 5-Scenario Design" in the top part of the sheet. As we know from the lecture, a financial sector contingent liability stress test is automatically triggered when the 3-year cumulative increase in private sector credit-to-GDP exceeds 15% for an emerging market, or the loan-to-deposit ratio is larger than 150%, or 1.5. We notice here that this shock is triggered for Debtopia, and to see why, we need to go to "List-Modules-Chart-Data."

So going to "List-Modules-Chart-Data", column CA, and to the right, we can find here the data for the private sector credit-to-GDP, and the three-year level change for Debtopia is computed to be 16.4%. Thus, it exceeds the benchmark. While the loan-to-deposit ratio in 2012 is 142, which is slightly below the benchmark. So for Debtopia, this shock is triggered by the first criterion, on credit-to-GDP. Going back now to "Input 5-Scenario Design," we notice that if the shock is not automatically triggered, but the analyst decides to include it, if other vulnerabilities not identified by the default indicators are present-- such as, we have mentioned housing prices for advanced economies or other indicators-- one can override the default selection by clicking yes in cell J23.

Clicking on the scenario brings us to the description, which is right here. So as discussed in the lecture, this scenario is modeled as a one-time increase in non-interest expenditures to GDP in 2014, equivalent to 10% of banking sector assets. So we can see here that expenditures-to-GDP are the value in the baseline, plus cell B106, which is the 10% impact on expenditure, multiplied by the figure here, which are banking sector assets.

In addition, the modeled interactions here are the following. There is a real GDP growth shock, a negative growth shock, in that real GDP is reduced by 1 standard deviation for 2 consecutive years. In addition, there is a corresponding decline in inflation, which is due to lower growth, again modeled as a 25 basis point decline in inflation for every 1 percentage point decrease in GDP growth.

And furthermore, the deterioration in the primary balance leads to higher interest rates, again by 25 basis points for every 1% of deterioration in the primary balance, which leads to a shock of 170 basis points in 2014. In order to see the outcome of the shock, let's go again to "Output-Shocks."

So what we find for the contingent liability shock is significant deterioration in the debt burden indicators, comparable only to the combined macro-fiscal shock. However, after the first year, the debt burden indicators seem to be on the declining path. Nonetheless, if the effects of the shock were more persistent than we have modeled, the conclusion could have been quite different.

Unit 9: Vulnerabilities Stemming from the Debt Level and Financing Profile

Video-Vulnerabilities Stemming from the Level of Debt

Adina Popescu: Welcome back.

In addition to the projected path of the debt burden indicators, their level is also highly relevant in the MAC DSA. For instance, a modestly increasing debt ratio from a low initial level may well entail less risk than an stable, but high, debt ratio. The difficulty lies, of course, in defining high and low. Some countries have run into difficulties at relatively low levels of debt, while others have been able to sustain high levels of indebtedness for prolonged periods of time without experiencing debt distress. Let's start out by reviewing why high debt is an issue.

One reason is because high debt requires large primary surpluses to service it, and to decrease it. And as we have seen previously, sustained high primary surpluses for several years can be difficult. Another reason is because high debt increases the vulnerability of an economy to shock. And it also leaves less room for countercyclical fiscal policy, which may result in deeper recessions. High debt also exposes a country to higher risk of a rollover crisis, which increases the sovereign's vulnerability to market risk.

Finally, there is also evidence that high levels of debt may be detrimental to economic growth. While economic growth is a concern in itself, it also feeds into worsening the debt dynamics. So in other words, high debt makes it a more difficult balancing act, as this figure suggests. Benchmarks for the debt burden indicators in the DSA are based on the early warning models, which we mentioned in Unit 2 when we discussed triggers for high scrutiny in the MAC DSA. As mentioned then, for classification purposes, the indicative early warning benchmarks were reduced by about 15%.

However, now in order to differentiate countries within the high scrutiny group for the purpose of risk assessment, the debt-to-GDP benchmarks derived from the signal approach are increased by about 20% to 70 for emerging economies, and 85 for advanced economies. This brings us to the following summary table.

The table shows the proposed benchmarks for the gross debt-to-GDP ratio and the gross financing needs-to-GDP ratio, which capture two important concepts related to debt sustainability--namely, solvency, and liquidity. You will notice that the benchmarks are higher for advanced economies than emerging markets, which is hardly surprising. The particular values are embedded in the spreadsheet. So, you do not need to memorize them.

An additional discussion on how they are derived is provided in the supplementary material. It is important to understand that these benchmarks should not be construed as levels beyond which debt distress is likely or inevitable. Rather, they serve to indicate the presence of vulnerabilities and suggest that further analysis is needed-- for example, with respect to the debt structure-- to come to a final assessment of risks.

Video-The Assessment of Debt Profile Risks in the MAC DSA

Adina Popescu: In addition to the trajectory of debt and the level of debt, the MAC DSA emphasizes the importance of the structure of debt to assess prospects for market access and thus debt sustainability.

Numerous crises have illustrated the problems that sovereigns can experience when international financial markets close while a country is faced with high rollover requirements. When talking about risks stemming from the debt financing profile, we refer to debt structure

characteristics such as maturity, the currency composition, and the creditor base of debt.

An unfavorable structure can create vulnerabilities, leading to illiquidity, potential insolvency, and overall threatening sustainability. For example, a high share of foreign currency-denominated debt increases the vulnerability to exchange rate adjustment and can put pressure on exchange rates reserves. Also, a high share of short-term debt at original maturity, which may reflect the inability of certain sovereigns to issue long-term debt, or a high share of debt held by nonresidents, increases the vulnerability to rollover and interest rate risks.

In general, the nature of the creditor base-- for example, whether it is diversified, whether it is captive, whether it is domestic or foreign-- also is very important for rollover risk. This discussion motivates the selection of the five indicators for debt profile vulnerabilities in the MAC DSA. We have seen these indicators-- discussed them in the beginning of the course-- as additional criteria in the classification of countries as higher scrutiny. I have already briefly mentioned why the last three indicators are relevant. Let me mention also why the first two have been included.

Bond yield spreads and, where available, CDS spreads, tend to increase before debt distress episodes. So they can be very useful warning indicators. Also, external financing needs, which increase the pressure on existing foreign exchange reserves, also tend to rise before episodes of sovereign debt distress. Analysis using the early warning signal methodology mentioned before found that these indicators are useful predictors of debt stress and the benchmark levels which best signal debt distress are called "indicative benchmarks" in the MAC DSA.

However, in order to provide an early warning of emerging risks, and to err on the side of caution, two further benchmarks are computed. First, an upper benchmark, which is calculated as 75% of the indicative benchmark. And second, a lower benchmark, which is derived as 25% of the indicative benchmark for emerging markets and 50% of the indicative benchmark for advanced economies. Risks are deemed to be low when the indicators are below the lower benchmark.

They are medium when they are between the lower and the upper benchmark. And they are high when they are above the upper benchmark. The next two slides show the benchmarks adopted for emerging markets and for advanced economies. First, for emerging economies, you will notice in the first data column the values for the various indicative benchmarks. You can also notice here the lower and the upper benchmarks, set at, respectively, 25% and 75% of the indicators.

No need to worry about remembering the particular figures, since they are embedded in the MAC DSA template. This slide presents the similar benchmarks for advanced economies. Let me draw your attention to three differences, compared to emerging economies.

First, only four indicators are listed. Foreign currency-denominated debt is not relevant for advanced economies, since they finance themselves overwhelmingly in their own currency. Second, the levels of the indicators are in some cases--highlighted in red-- higher than for emerging economies, due, in general, to easier market access of advanced economies. And third, the lower benchmark is set to 50% of the indicative benchmark. Again, due to the fact that advanced economies are more able to sustain riskier debt profiles. Thus, a sample reporting of debt profile risks may look in the following way in the MAC DSA template.

For each indicator, you can see the lower early warning benchmark and the upper early warning benchmark. And here you can see, for a particular country, the values for three of these indicators where data

is available. All three happen to suggest moderate risks in this particular case. One should note that the analysis of risks arising from the debt profile need not be confined to these indicators and the associated benchmarks.

Other factors, such as the exchange rate regime, the role the central bank can play in mitigating short-term liquidity needs, the capacity of the market to absorb debt, and so on, have a bearing on the analysis. The underlying reasons for debt profile vulnerabilities, such as contagion, incomplete credit markets, weak debt management practices, and so on, may also be important in this regard.

Video-MAC DSA Template: Financing Assumptions and the Debt Profile

Adina Popescu: Hello, and welcome back.

You may recall that so far we have deferred the discussion on how the sovereign is able to finance its fiscal needs. In this video, we're going to see where and how in the template our gross financing need's covered. Let's start from the key input sheet for financing assumptions, which is "Input 4-Forecast." This sheet contains the forecast of how the fiscal financing needs are going to be filled. As I have mentioned before, the careful modeling of the structure of debt is one of the key improvements in the revamped MAC DSA template. So let's see how this is done.

This sheet is divided into two basic parts. First, the calculation of the gross financing needs based on the fiscal assumptions in the top part, and the financing assumptions in the lower part. Let's start with the block Macro and Debt Service Forecast. It starts with some key macro and fiscal variables for which the projections come from the "Input 2" sheet, which we have already discussed. The important new elements come next.

You'll notice that the sheet distinguishes between existing debt, disbursed debt-- that is, outstanding-- and new debt, which is debt to be issued over the projection period. This is important for capturing roll-over risks and interest rate risks. First, we have in lines 24 to 28 the debt service on the outstanding debt stock, on existing debt. This includes interest expenditures on existing debt, both local and foreign currency-denominated debt, as well as amortization payments. These are required to be input as hard numbers in the yellow-shaded lines. The breakdown between local and foreign currency-denominated debt is important for capturing exchange rate risks. You may be wondering, where does this data come from? Ideally, it should come from the authorities' debt management office.

It may also be computed from a loan-by-loan breakdown of outstanding debt, available from databases like Bloomberg, Datastream, Dealogic, and so on. Next in this sheet follow interest and principal payments on new debt, both local and foreign currency-- with the exception of the first year-- which needs to be populated by the user based on existing estimates. The subsequent years are actually computed in a separate sheet called "baseline," which we are going to go through later in this video.

All these inputs are used in line 37 to calculate the gross financing requirements, which, as we discussed in the lectures, are computed in the following way-- they are the sum of public sector non- interest expenditures, plus interest and principal payments on existing debt, plus the recognition of implicit contingent liabilities, if any, plus interest and principal payments on new debt, minus public sector revenues, non-interest and interest. Scrolling a bit down, you'll notice that the template uses another concept-- financing needs to be filled with new issuance.

These are obtained from gross financing needs after adjusting for possible financing factors. More precisely, if, from the gross financing requirements, we subtract the change in domestic arrears and in

external arrears, debt relief and privatizations, which would be reducing financing needs, and possibly add things like bank recapitalizations-- which are increasing financing needs-- we obtain the financing needs to be filled with new issuance.

Let's go now to the second part of the sheet. The data in the block Issuance of New Debt to Fill Fiscal Needs does exactly what it says-- it distributes the financing needs identified above as new debts into the yellow-shaded cells in rows 54 to 85. Note that only the yellow-shaded cells should be overwritten by the user. The white-shaded cells are totals.

Notice that the template allows one to differentiate between domestic and external debt, and within each category, between short-term and long-term debt, as well as further by currency-- local and foreign currency-- as well as potentially by instrument. Here, Type 1, Type 2, Type 3 are various types of debt instruments, essentially various bonds. The template allows one to carefully model various types of debt instruments, including zero coupon bonds, and to specify for each of them the key parameters-- the interest rate, the maturity, the grace period, and frequency of payments.

Note that not all the debt instruments need to be filled in. This information may not be available in every country. In principle, only a few instruments can be used as an approximation, and this is what we have actually done for Debtopia. For Debtopia, we have used a number of simplifying assumptions. First, we have assumed that all new domestic issuance is denominated in local currency and all new external debt is denominated in foreign currency.

For both domestic and external debt, we have assumed just one type of short-term debt and one type of long-term debt. Thus essentially we are filling the financing needs with just four instruments, and this is just an oversimplification. For example, looking at the figures, you'll notice that we are assuming that a significant part of the financing needs are going to be filled with short-term debt, both in domestic and foreign currency.

Debtopia has a problem accessing long-term financing, and this is a major source of vulnerabilities. However, towards the end of the projection period, we're assuming that they are able to increase their issuance of medium and long-term debt, both in domestic and foreign currency, and this should improve their debt profile. Scrolling to the right hand side, we can see the terms of this debt. Here you find information for more types of bonds than we have actually used for Debtopia.

These are just examples and should not concern you, as they will not enter the calculations. However, what enters the calculations are, for example, the characteristics of the types of debt that we have mentioned the Debtopia will issue. For example, for this short-term debt denominated in local currency, we can specify here the maturity. It is going to be one year. Grace period, also one year, and the fact that coupon payments will be semi-annual. Further, you can find the interest rate.

Since this is a one-year bond, for the debt issued in 2013, this interest rate will be applicable, for the debt issued in 2014, this interest rate will be applicable, and so on. Going further down to the medium-term bond that we are assuming that Debtopia is issuing, you'll notice that have specified it as having a five-year maturity, and also a five-year grace period.

This is what is called a "bullet" bond. Interest payments are specified to be annual, and here you can see also the interest assumptions that we are making. A similar structure is also specified for the external debt. Going back to the left hand side to line 89, we notice that residual financing needs are calculated here, as the difference between the financing needs to be filled with new issuance and the new issuance.

This residual is assumed to be filled with domestic financing and should be minimized, as it does not assume any interest or amortization payments in the year of disbursement, and also should be kept positive, since a negative number would imply an accumulation of deposits arising from debt issuance in excess of the projected financing needs. As I promised you, let's quickly visit now the sheet "baseline."

We find this towards the end. We will not go in detail through this sheet, since you do not need to make any changes in this sheet. Everything is computed automatically here. Let me just briefly mention that this sheet calculates the interest expenditures and principal payments on new debt. I have highlighted for you in pink the cells where this is done. The calculations take into account all the information which we have provided regarding the financing instruments.

Notice that they are copied here for your convenience, and they come from the "Input 4" sheet, which have already discussed. Let me give you an example of how this calculation is done. You may recall that in 2013, we have assumed that Debtopia is issuing 220 billion of a domestic currency short-term bond, which was a one-year bond with an interest rate of 5%. Going to further to the right, we find that this bond is going to be repaid in 2014, as expected. And it is going to generate interest payments in 2013 and 2014, since the coupon payments are semi-annual. And the coupons every year can be easily computed as the 5% interest rate applied to the 220 face value of the bond, and divided by two because we have two semiannual coupons. And this would yield 5.5 billion in every single year.

Essentially, this type of calculation is done further down here for all the instruments that we have specified. Let's now go back to see the implications of these financing assumptions for the structure of Debtopia's debt over the projection horizon. This is plotted in the top panel of the sheet "Output-Basic 2.

The first plot presents the decomposition of public debt by maturity, and the second one by currency denomination during the history and the projection years. Notice that for Debtopia, we are projecting an improvement, both in terms of lengthening the maturity of debt and then an increase in the share of medium and long-term debt, as well as a decrease in the share of foreign currency-denominated debt. Thus, we're projecting a reduction in these vulnerabilities for Debtopia going forward.

Unit 10: Assessment and Write-Up

Video-The Heat Map

Adina Popescu: Welcome back.

This is the final unit, so we are nearly there. In this video, we will discuss how to summarize risks to debt sustainability in the MAC DSA using the heat map. The heat map is intended to convey, in a standardized way, the risks to debt sustainability from the various modules in the template. So how do we turn the benchmarks from Unit 9 for the debt burden indicators into an assessment of low, moderate, or high risk?

This is done in the following manner. Macro-fiscal and contingent liabilities risks are measured by their impact on the debt burden indicators under both the baseline and the stress scenarios. If the baseline debt burden indicator is above the benchmark in the current or any projection year, this high risk would necessarily carry over for all stress tests. So the stress test would also be above the benchmark.

This would be represented as red in the heat map. If the debt burden indicator is below the benchmark in the baseline, but above it in the stress test in any projection year, this would translate into a moderate risk and would be represented by yellow in the heat map.

Finally, if the debt burden indicator is below the benchmark under both the baseline and the stress tests for all the projection years, then this would translate into low risks and would be represented as green in the heat map. For debt profile risks, the assessment depends on a comparison of the latest data available to the benchmarks discussed in Unit 9. This slide presents the benchmarks for emerging economies and should look familiar.

A country is deemed to be high risk, with respect to a particular indicator-- and that is red-- when the recent data are above the upper benchmark for that indicator. Countries are deemed to be low risk in green, when the recent data are below the benchmark for that indicator. And finally, countries are deemed to be moderate risk for values in between--that would be marked as yellow. This table pertains to advanced economies. And the analysis is entirely similar as for emerging markets, with the exception of the fact that the benchmarks are slightly different.

Let's now put together all the elements in the heat map. This is a picture taken from the MAC DSA template showing the heat map for a particular country. As discussed, the reported risks can be classified as high in red, moderate in yellow, low in green, and not triggered or not applicable in white. The first and the second rows of the heat map present the impact from macro-fiscal shocks-- real GDP growth, primary balance, real interest rate, exchange rate, and the contingent liability shock-- on debt burden indicators, the debt-to-GDP ratio and the gross financing needs-to-GDP ratio.

The third row summarizes the likelihood of risks from the debt profile vulnerabilities: the bond spread, the external financing requirements, the share of short-term debt, the share of debt held by foreigners, and the share of foreign currency debt. In particular, for this country, we notice that the level of debt is not a major issue. However, the level of gross financing needs, is raising serious red flags. Gross financing needs could be high for various reasons: a high primary deficit, high interest rate payments, or higher amortization payments coming up.

These risks seem to be confirmed by some of the debt profile vulnerabilities also flashing red. Let me emphasize that the heat map in the MAC DSA does not produce an overall debt rating. Indeed, the purpose is to summarize in one place the results from the tools used in the DSA for assessing the risks to debt sustainability. This should be combined with a write-up and with the fan charts, and should be interpreted in conjunction with country-specific factors to provide an assessment of risks to public debt sustainability.

In the following video, my colleague Natalia Novikova, from the Debt Policy division of the IMF, the division which has primarily designed this framework and template, will provide you a quick insight into how the final assessment of risks to debt sustainability is made in the MAC DSA.

Video-The Write-Up and Risk Assessment

Natalia Novikova: This course covered a wide variety of tools, including the IMF Framework for Debt Sustainability Analysis in advanced or emerging economies. These tools allow for comprehensive assessment of debt-related risks in a particular country. The next step is to present the outcomes of the analysis in a clear and transparent manner.

DSA results are displayed in standardized charts and tables, which facilitate cross-country comparison. At the same time, the final assessment of debt vulnerabilities is expected to reflect judgment

and country-specific context. Therefore, where relevant, particularly in higher scrutiny cases, DSA outputs are accompanied by a Write-Up to provide country-specific details, explain main assumptions, and discuss factors that may amplify or mitigate certain risks.

Let us have a look at a few examples of how the write-up could be used to provide more insights to the assessment of risks. In the case of Ireland, the heat map and fan charts indicate that Ireland faces high risks to debt sustainability. The upper row of the heat map is red. This means the debt burden benchmark, which is 85% of GDP for advanced economies, is exceeded already under the baseline. This suggests that Ireland's debt level is highly vulnerable under all scenarios regardless of the extent to which a shock increases debt.

At the same time, gross financing needs are vulnerable to a contingent liability shock. The debt profile is also subject to high risks from external financing requirements and debt held by non-residents. Meanwhile, the write-up explains why the debt ratio is projected to decline under the baseline. In particular, it refers to planned reduction of the accumulated cash buffer used to finance debt amortization.

The write-up also identifies some other factors not captured under baseline assumptions. "Debt reduction from asset sales present an upside risk. Current baseline assumptions do not incorporate proceeds from state asset disposal of up to 3 billion euros." The next example shows how the write-up could help to add granularity in interpretation of the heat map.

Two heat maps presented here suggest low risks to the debt level in both Belarus and Mexico. All cells in the upper row of the heat map are colored green, which means the debt level remains below 70 percent benchmark for emerging markets under the baseline and the stress tests. In the case of Belarus, however, the write-up highlights high risks associated with large contingent liabilities and quasi-fiscal operations.

With regard to debt profile, factors that may be reflected or highlighted in the write-up are high total external financing requirements, which may point to high vulnerability to changes in market perceptions, or a declining share of non-residents. It may reduce the roll-over risk attributable to international investor worries, but exacerbate domestic sovereign-bank links, or sensitivity of debt indicators and economic growth to changes in interest rates. Where relevant, the write-up may discuss why a large planned fiscal adjustment is feasible.

The list of factors can be very long. It is crucial, however, that the write-up allows capturing country-specific circumstances and integrating them into the overall assessment together with the standard DSA outputs. I hope these examples have given you a flavor of what the write-up is about.

Video-MAC DSA Template: The Heat Map

Adina Popescu: Hi. Welcome back.

In this video, we're going to discuss the Heat Map. This can be accessed through the sheet, "Output-Heat Map." As you can see, this sheet includes a presentation of the overall risk assessment including the heat map, the fan charts, and the debt profile vulnerabilities. Let's start with the top panel, on the heat map, which is the key element in the presentation of the overall risk assessment. This table is automatically filled on the basis of the stress tests and the benchmarks applicable for our country.

What do we notice? First, the level of debt does not seem to be an issue in Debtopia. This is because all macro-fiscal stress tests, for all of them, this cell is highlighted in green. This means that the debt

burden benchmark of 70% is not to exceeded under any shock nor under the baseline. However, if we look at the gross financing needs, we see that for all macro-fiscal stress tests, and the contingent liabilities shock, these cells are highlighted in red.

This implies that the benchmark of 15% of gross financing needs-to-GDP are exceeded under the baseline, and thus under any stress test. This is not surprising, given the high share of short-term debt in Debtopia, implying very high roll-over risks. I am now going to hide the fan charts, as we have discussed them previously. What about the debt profile vulnerabilities? Here the picture is more mixed. The data for this chart is computed automatically on the basis of information we have provided, and refers to the most recently available data, as we have discussed in an earlier video.

The EMBI global bond spread average for the last three months of 356 basis points for Debtopia qualifies as moderate risk because it lies between the lower and upper warning benchmarks. Thus, it is marked in yellow. The external financing requirement at 23% of GDP implies a very high risk. Thus, it is marked in red. The annual change in short-term public debt as original maturity, computed to be -2.1% qualifies as low risk. Thus, the color green.

Public debt held by non-residents and public debt in foreign currency both exceed the upper warning benchmarks, and thus suggest high risk and are colored in red. All of these elements that we have discussed should be part of a comprehensive assessment of risks. A brief conclusion one can draw is that Debtopia faces significant risks and that vulnerabilities stem mostly from the structure of debt rather than the level of debt and in particular from the share of short-term debt, of foreign currency-denominated debt, and of debt held by non-residents.

However, in addition, one should add to this analysis any mitigating or amplifying risks which we have not talked about in the template.

Video-Final Remarks

Adina Popescu: Let me start by congratulating those who made it this far. This course is now coming to an end. Let me try to review the key messages of what we have learned. This course has offered you a preview into the latest IMF Debt Sustainability Analysis Framework for market-access countries and the associated Excel template.

While expertise in the template was not our goal, this course should allow you to have a better understanding of how this analysis is conducted by the Fund, and also to potentially be confident users of these tools. You can now go ahead and apply this analysis to any country of your choice, should you wish so. At various stages during the course, I have tried to emphasize the key elements and innovations of the revamped MAC DSA template.

First, the risk-based approach with the use of benchmarks and various levels of depth in the analysis; second, the importance placed on assessing the realism of baseline projections; third, the attention given to vulnerabilities associated with the level of debt and the debt profile; fourth, the focus on alternative scenarios, stress tests, and fan charts to capture the uncertainties surrounding the baseline; fifth, the careful modelling of risks stemming from financial sector vulnerabilities.

You have also seen throughout this course, and in particular in this last unit, that the assessment of debt sustainability is often a complex exercise. Projections are surrounded by uncertainty and based on numerous assumptions. In addition, our analysis is bound to be incomplete and many developments may invalidate our forecasts. In spite of these caveats, the tools in the revamped MAC DSA should help make the analysis of public debt sustainability more rigorous. I hope you have found our intellectual journey as interesting as it was useful. Let me wish you the best of success in your further studies.

Supplementary Video-The Benchmarks in the MAC DSA

Adina Popescu: Hi. The MAC DSA template relies on a number of benchmarks. In this video, I will provide an overview about where the different benchmarks come from, how they are derived, and how they relate to each other. Let's first briefly discuss the methodology through which these benchmarks were obtained. The benchmarks are derived using the signal-approach methodology, also called early-warning models.

These models aim to find the level of an indicator that best predicts an event-- in our case, a subsequent debt crisis based on past experience. For any given threshold, x, a signal is considered to have been sent if the indicator in that year is greater than x. Whether a signal was sent is then compared to whether the country experienced a debt crisis in the subsequent year.

Thus, for each country there are four possible outcomes, labeled A to D. In this matrix, A are instances when the indicator issues a good signal. B are those when the indicator issues a bad signal, or, a false alarm. C are occasions when the indicator failed to issue a signal, which would have been a good signal-- that is, a missed crisis. And D captures the cases in which the indicator refrained from issuing a signal, which would have been a bad signal. A perfect indicator would only produce observations that belong to the A and D areas, while errors in prediction are represented by the cells, B, false alarm, and C, missed crisis.

Of course, in practice, no indicator is perfect. The matrix is a useful reference to assess how close or how far each indicator is from that objective. Intuitively, one needs to strike a balance between the risk of having many false signals, which would happen if a signal is issued at the slightest possibility of a crisis, and the risk of missing many crises, which would happen if a signal is issued only when the evidence is overwhelming.

The early-warning benchmarks are derived by varying the threshold, x, to minimize the noise-to-signal ratio, which is defined as the number of bad signals, B, as a share of the number of possible bad signals-- that is, the same as non-crises, B plus D-- divided by the number of good signals, A, as a share of all possible good signals. That is also the number of crises, A plus C. Note that by defining this function in terms of the percentage of crises, the division over A plus C, and percentage of non-crises, the model makes missing a crisis observation more costly than issuing false alarms, since there are fewer crises.

That is, A plus C is smaller than B plus D. When the noise-to-signal ratio is less than 1, crises are more likely when the indicator signals than when it does not. Indicators with noise-to-signal ratios equal or above unity are not useful in anticipating crises. Also, the lower the number, the better. You may also, on occasion, find this defined in terms of type-1 and type-2 errors, where type-1 errors are missed crises, C, as a share of total crises, A plus C. And type-2 errors are defined as false alarms, as a share of the total number of non-crises, B plus D. So the noise-to-signal ratio would be equal to the number of type-2 errors, divided by (1 minus type-1 errors).

This estimation is done in several steps. First, the countries that experienced debt distress in the past are selected, and then the optimal debt benchmark is derived. Through this methodology, the MAC DSA framework derives what are called indicative benchmarks. You may also find them referred as signal-approach benchmarks or early-warning benchmarks.

They can be thought of as the levels of the indicators which best predict the occurrence of a crisis. Such indicative benchmarks are derived both for the debt-burden indicators and for the debt-profile

indicators. These signal-approach, or, indicative benchmarks are then used in the MAC DSA in two ways-- first as benchmarks for classification of countries into lower- versus higher-scrutiny, and second, as benchmarks for assessing risks in the heat map.

The treatment is slightly different, depending on the indicator. Let us start with the debt-burden indicators-- that is, the debt-to-GDP and gross financing needs-to-GDP ratios. For classification purposes, the indicative benchmarks for the debt-burden indicators are reduced by about 15%. This is because we want to have on the radar countries before these indicators reach critical levels. The results are further approximated and rounded.

To arrive at the higher-risk benchmarks used in the heat map, however, the debt-to-GDP indicative benchmark is increased by 20% approximately. This transformation is not done for the gross financing needs-to-GDP ratio, since this indicator is noisier, and this was not deemed necessary.

Here we see how we get to the benchmarks for a classification for the debt- to-GDP ratio, respectively, the 50%, 60%, and also the benchmarks for higher risk in the heat map, respectively 70%, 85%. In this slide, we'll see how we get to the benchmarks for the 10% and 15% for the gross financing needs-to-GDP ratio. And as mentioned previously, the high-risk benchmark is the same as the indicative benchmark for this particular indicator.

Putting together all the information, here is a summary of the benchmarks used for the debt-burden indicators. You do not need to worry about remembering these, since they can be found in the template in the hidden-sheet "Benchmarks." How does this translate into benchmarks for the heat map? In the heat map, for all the macro-fiscal and contingent liabilities alternative scenarios, a cell is highlighted in green if the debt-to-GDP benchmark of 70%, respectively, 85% is not exceeded under neither the shock scenario nor the baseline. It is a marked in yellow if it is exceeded under the shock scenario, but not under the baseline, and in red, if it is exceeded under the baseline, and therefore, also under the shock. A similar logic applies to the gross financing needs- to-GDP benchmark of 15%, respectively, 20%. For the debt profile vulnerabilities indicators, the analysis is done differently. Namely, two benchmarks are being computed.

The early-warning lower benchmarks represent 25% of the indicative benchmark for emerging markets, and 50% for advanced economies. This is because advanced economies have been found to be able to sustain higher levels of these indicators, without getting into significant problems. On the other hand, the upper early-warning benchmarks are set at 75% of the indicative benchmark, both for advanced and emerging economies.

In addition, these upper early-warning benchmarks may also be used in the classification phase, since, if debt vulnerabilities indicators exceed these upper early-warning benchmarks, this may point to the need to classify the country as higher-scrutiny. How are the benchmark for the debt profile vulnerabilities used for the purpose of the heat map?

This slide shows you the general principle. For each indicator, countries are deemed to be low-risk-- that is, in green-- when recent data are below the lower benchmark levels, which are 25% for emerging markets, and 50% for advanced economies. Risks are considered to be moderate-- and that is marked in yellow-- when the recent data are between the lower and the upper benchmarks.

And they are deemed to be high, which is marked in red, when the upper benchmark of 75% is exceeded, and this is also the case when the indicative benchmark is exceeded, of course. A summary of the various benchmark levels for the five debt profile vulnerabilities indicators is presented in this table. In practice, you do not need to

worry about remembering these benchmarks, since they can be found in the template in the hidden-sheet "Benchmarks," and their use is also automatized.

The most important thing is to understand the role they play. In particular, let me emphasize again that these benchmarks should not be interpreted as levels beyond which debt distress is likely or inevitable. They should used to identify vulnerabilities, which would call for more in-depth analysis.