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Toward a Common Methodology for Restructuring Sovereign Domestic Debt

David A. Grigorian

Abstract

The paper develops an approach to empirically estimate the *Net Debt Relief* (NDR) curve for sovereign domestic debt restructurings, a salient feature of those restructurings in recent decades, as described in normative terms in Grigorian (2023). The proposed empirical methodology builds on the stress-testing framework employed by the International Monetary Fund as part of the Financial Sector Assessment Programs, applying a combined sovereign and credit shocks. The paper lays the foundation for the toolkit for estimating the NDR curve, which could be useful for countries expected to undertake domestic debt restructurings in the future. It adds some features to the baseline treatment to mimic common regulatory treatments (i.e., risk weighting) and triggers for financial stress (e.g., deposit runs) to enhance the empirical relevance of the methodology. Finally, data from Pakistan and Egypt are used to test the methodology and draw lessons.

WORKING PAPER 720 • JUNE 2025

Toward a Common Methodology for Restructuring Sovereign Domestic Debt

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I would like to thank Carmen Reinhart, Charles Blitzer, Udaibir Das, Mark Plant, and Senior Fellows at the Mossavar-Rahmani Center for Business and Government for useful comments and suggestions at various stages of this work, as well as Daulet Cheryazdanov for exceptional research assistance.

David A. Grigorian. 2025. "Toward a Common Methodology for Restructuring Sovereign Domestic Debt." CGD Working Paper 720. Washington, DC: Center for Global Development. https://www.cgdev.org/publication/toward-common-methodology-restructuring-sovereign-domestic-debt

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I. Introduction and motivation

A. Background

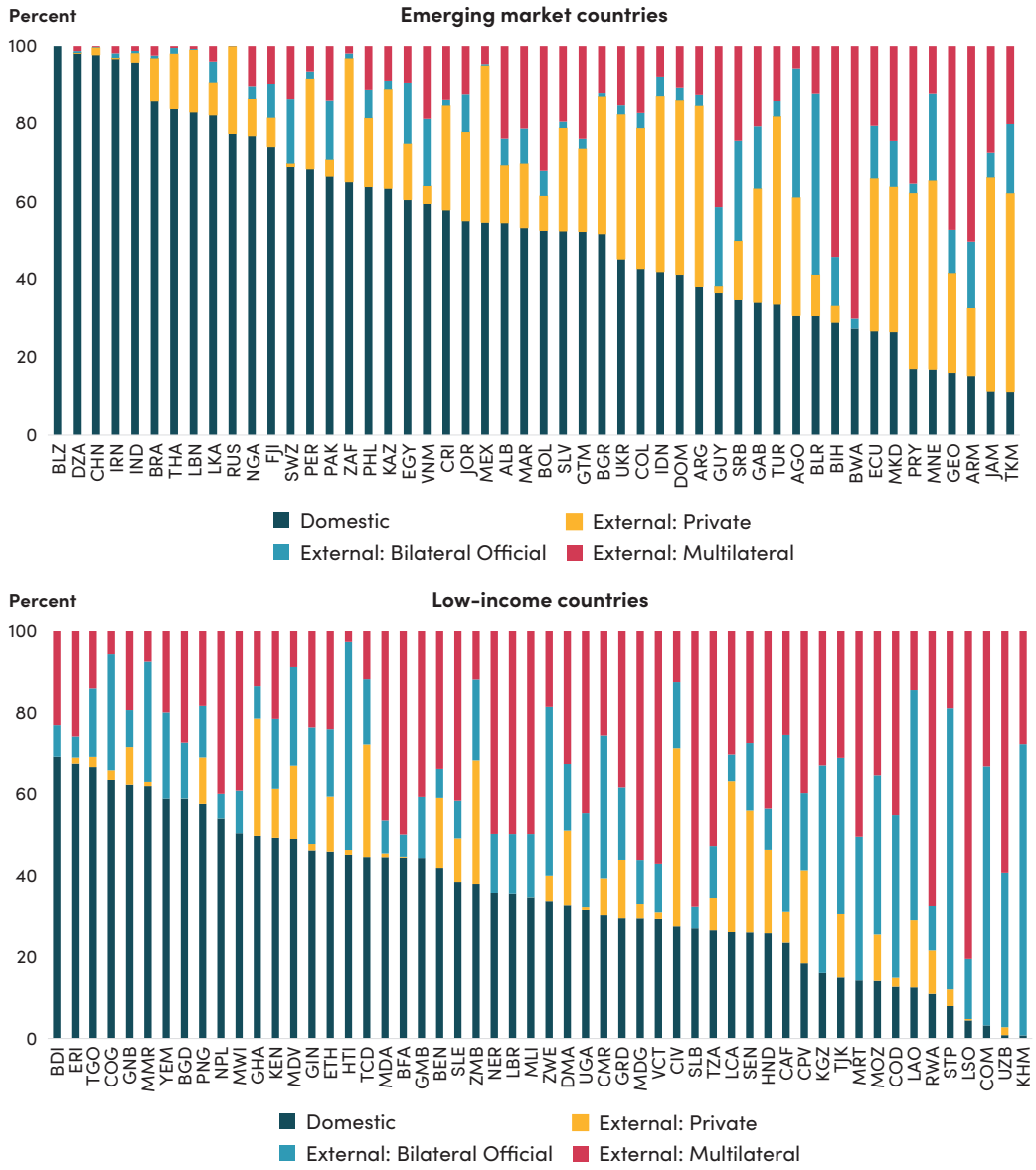
Sovereign domestic debt has until recently been largely ignored in the empirical literature on debt.[1] Reinhart and Rogoff (2008) re-directed the focus of economics profession to it. Based on a comprehensive dataset of 64 countries with data going back to 1900, they reported that: (1) domestic debt has indeed been sizable, averaging almost two-thirds of total public debt; typically carrying a market interest rate; (2) domestic debt may explain why many countries default on (or restructure) their external debts at seemingly low debt thresholds and why some governments choose inflation rates far above any level that might be rationalized by seigniorage revenues; (3) there are many cases where the hidden overhang of domestic public debt was at least the same order of magnitude as base money, and sometimes a large multiple, and (4) episodes of overt default on, and rescheduling of, domestic public debt appears to be somewhat rarer than external default, but the widely-held view that domestic residents are strictly junior to external creditors is not always true.

One of the most serious challenges facing the global economy today is the impending sovereign debt crisis in some middle- and low-income countries. The fiscal outlook in many of these countries appeared dire even before the global interest rates started climbing and COVID-19-related spending led to mounting debt. The situation is exacerbated by the fact that several countries are facing growing debt service payments in an environment in which rolling over debt is challenged by higher costs and capital outflows from the developing world. This problem touches upon the largest amount of sovereign debt and number of countries in recent history.

While COVID-19 brought domestic debt issues to the forefront of the discussion, some EDME sovereigns already had elevated levels of domestic borrowing relative to total public debt (Figure 1). Being cut from external financing and often having to spend significant amounts to address COVID-19-related emergencies, many EDMEs resorted to domestic borrowing, expanding the outstanding stock of domestic debt relative to 2019. Although a global recession has so far been avoided, many developing countries are facing a wide array of economic challenges, including high inflation, depreciating currencies, widening balance of payment deficits, dwindling foreign exchange reserves, and shortages of critical commodities and supplies. It is not surprising therefore that countries will experience sovereign debt distress, even if they had sound macroeconomic fundamentals following COVID-19 and before President Trump's recent tariff showdown and reduction of official bilateral assistance.

1 In this paper, "domestic" debt refers to public debt liabilities that are governed by domestic law and are subject to the exclusive jurisdiction of the domestic courts of a sovereign. Debt issued under foreign law is considered "external". Note that this definition is separate from the currency denomination or the residency of the holders of the debt, although there is a considerable overlap in practice. Consequently, "restructuring of domestic debt" refers to changes in the contractual terms of domestic debt (including amortization, coupon, maturity, and/or other terms of the original contract) to the detriment of the creditors, either through agreement with creditors and/or legislative/executive acts.

FIGURE 1. Pre-COVID-19 creditor composition of public debt in EMDEs (2019)



Source: IMF (2021).

B. Coordinated debt restructuring

As COVID-19 further strained public finances by limiting the fiscal space and resulting in rapid debt accumulation, it also triggered efforts to establish a system for streamlined resolution of public debt in low-income countries. In May 2020, G20 rolled out the DSSI, intended to provide payment flow relief for eligible low-income sovereigns.[2]

2 However, perhaps due to its limited scale and scope, DSSI generated a lackluster take-up: of 73 eligible countries, only 48 applied. The initiative also failed to secure voluntary private sector participation and expired in December 2021.

Realizing the need to address the mounting debt overhang more forcefully, in November 2020, the Paris Club (PC) members endorsed the Common Framework for Restructuring Sovereign Debt (hereafter the Common Framework; CF) at an extraordinary G20 Finance Ministers and Central Bank Governors meeting held during the Riyadh G20 Leaders' Summit. While the CF has the same eligibility criteria as DSSI, it was intended to address fundamental debt sustainability concerns through rescheduling and debt relief, allowing debt reductions in net present value (NPV) terms and even debt cancellations in exceptional circumstances.[3]

Although domestic debt was implicitly made part of the mix, its peculiarities were not explicitly accounted for in the CF (see Grigorian (2024) for details). This has largely kept the discussion on the exclusion/inclusion of domestic debt in the restructuring perimeter alive and well, without much analytical foundations as to why it should be kept in or out of comprehensive debt restructurings. For countries ineligible for CF too, the issue remains fundamentally unaddressed.

Domestic debt restructurings (DDRs) possess a distinct feature that separates them from external debt restructurings. This feature—in essence a negative externality—is that DDRs impose direct costs on the domestic financial system, potentially reducing the (fiscal) savings for the sovereign from the debt exchange. These costs are due to the existence of a typically strong nexus between sovereign and financial institutions (especially banks), which during episodes of sovereign stress could affect the balance sheet (both asset and liability side) and income of those institutions.[4] Internalizing this externality makes domestic debt restructurings inherently more complex than external debt restructuring.[5] It will also result in a smaller debt relief accrued to the sovereign, *ceteris paribus* making it less likely for a domestic restructuring (relative to an external debt restructuring) to take place.[6]

3 The CF also abandoned the voluntary approach to private sector participation, re-introducing instead the "comparability of treatment" (CoT) of all external bilateral and commercial creditors, which was a long-standing PC principle. The CoT principle—requiring that other creditors provide at least as much relief as the PC does—was intended for avoiding de facto subordination of official creditor claims. Yet, private sector creditors were expected to be price takers, not being in the same room where decision on debt relief (and contributions from all parties) were discussed.

4 The main difference between developing and developed countries in this context is that the link between the sovereign and financial sectors is much more pronounced in the former case. This is often a function of the underdevelopment of the private sector, which forces the banks to invest more of their funds in government securities rather than lend to the private sector.

5 While technically feasible, the paper does not discuss the ability of the government to restructure domestic debt by retroactively changing the legal terms of bond contracts. Countries that have used this "local law advantage" and introduced Collective Action Clauses (CACs) in their domestic law contracts prior to restructuring their debt in recent years are Greece (2012) and Barbados (2018). Similarly, in 2019, Argentina extended the maturity of its short-term local bonds through a government decree.

6 Another factor that influences the decision of what type(s) of public debt to restructure is the relative economic cost of restructuring the type(s) of debt in question, which includes political economy considerations among other factors. This issue is discussed extensively in IMF (2021).

While domestic debt is not always part of the restructuring, it is imperative that the stakeholders fully incorporate the complexities associated with domestic debt in their deliberations. An important consideration in this regard is the choice of the perimeter of debt exchange, that is, types of claims on public sector bodies (e.g., central government, central bank, state-owned enterprises, local/municipal governments, government guarantees, etc.) to be included in the restructuring. As discussed in detail in IMF (2021; pages 17–21), the scope of claims included in a restructuring will depend on the degree of debt relief needed to establish debt sustainability (e.g., by reducing contingent liabilities). Expanding the perimeter of a debt exchange will *ceteris paribus* reduce the debt relief required from other creditors to establish sustainability.

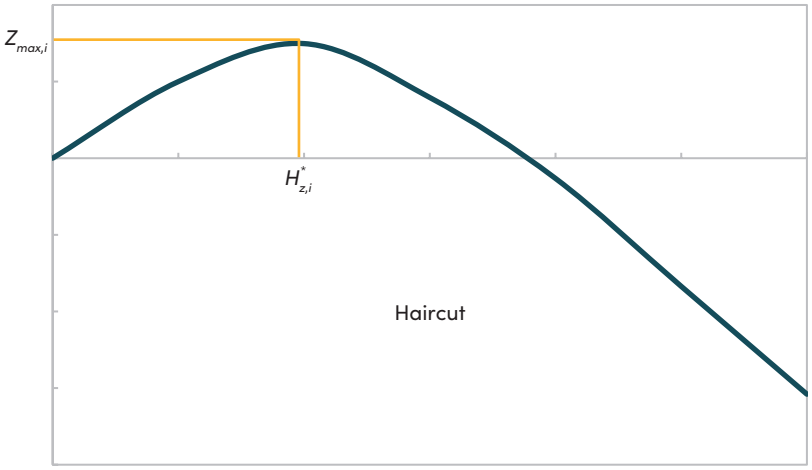
Claims that are most commonly subject to DDRs include government bonds (both local- and foreign-currency-denominated), short-term Treasury bills (T-bills), payment arrears, and financial derivatives. Including T-bills in the restructuring perimeter may have adverse effects on interbank liquidity, the central bank's ability to conduct monetary policy operations, and the government's ability to fund its short-term operations, but may be unavoidable if the outstanding volume is relatively large. To restructure claims beyond those on the central government, the legal framework governing public sector bodies (notably insolvency regimes for state-owned enterprises (SOEs) and subnational governments), will have to be carefully reviewed to avoid legal/court challenges.

It is worth noting that different types of domestic claims can be subjected to different restructuring treatments (e.g., a financial haircut) depending on their ability to absorb such a treatment without undue disruptions. A common example of such treatment is when T-bills are left out of the perimeter of the exchange (i.e., no/zero haircut is applied). In addition, different treatments can also be applied to different types of debt holders of the same type of claims. A recent example of this is Ghana's 2024 restructuring, where the authorities chose to apply segregated treatments to banks, pension funds, and retail bondholders of domestic claims (see Grigorian and Vessereau (2024) for details). Knowledge of such specifics of the restructuring design will be essential in calculating the total debt relief obtained from an exchange.

C. Net debt relief curve

If the total cost of recapitalization and safeguarding financial stability is an increasing function of present value haircut, as discussed in Grigorian (2023), there is a maximum value of haircut beyond which the gross relief obtained from increasing the haircut is outweighed by recapitalization and financial stability costs, rendering the marginal (and potentially even total) net debt relief negative. The result (as shown in Figure 2) is an "inverted U" shape relationship between haircut imposed on domestic creditors (mostly banks) and debt relief accrued to the budget, which is likely to vary in share depending on structural factors, such as share of debt held by banks and non-resident investors, maturity profile of debt, among others.

FIGURE 2. A stylized net debt relief curve



Source: Grigorian (2023).

However, there is no common empirical methodology that would help assess this relationship. This paper attempts to fill in this gap. The approach proposed below builds on the stress-testing framework used by the International Monetary Fund and the World Bank in their Financial Sector Assessment Programs (FSAPs). The paper will lay the foundation for the toolkit for estimating the NDR curve for countries expected to undertake domestic debt restructuring. Calibrating the parameters of a DDR to help avoid a financial crisis is important because, as shown in IMF (2021) (see the Background paper), debt restructurings accompanied by banking crises are associated with larger output losses.

The remainder of the paper will develop an empirical approach to constructing NDR curves using Pakistan and Egypt, countries that are facing debt distress. The *normative/theoretical part* of the paper focuses on structural underpinnings of propagation for common economy-wide shocks, resulting in a co-movement of sovereign (debt) stress and private credit impairment.

The *empirical part* of the paper calibrates this relationship (between sovereign stress and private credit impairment) and uses that in a combined shock of the banks' balance sheets. This is done using commercial bank-level data containing information on banks' holdings of government securities and loans to the private sector.

II. Structural underpinnings and estimation of NDR curves

A. Modeling structural relationships

IMF (2021) offered a formal framework for conducting DDRs and introduces a decision framework, the objective of which is to "identify the type of restructuring that will restore public debt sustainability while minimizing potential economic costs and financial system disruptions." It acknowledged the existence of financial and economic costs to be factored in before a decision (of whether or not) to restructure the specific types of claims is made.

Building on that work, Grigorian (2023) provided the normative framework for thinking about those costs, which leads to an inverted U-shape relationship between haircuts imposed on domestic creditors and the debt relief accrued to the budget as a result of the restructuring. The assumption underlying the shape of the relationship—which is that the potential debt-stabilizing haircut and the loan impairment are positively correlated—hinges on the premise that the higher the haircut required to establish debt sustainability, the more severe are the prevailing conditions faced (also) by the private sector (impacting its ability to pay), thus rendering bank loans more risky and therefore worth less.

In a theoretical general equilibrium setting, the canonical model to capture financial stress and its impact on the business cycle is the financial accelerator model of Bernanke, Gertler, and Gilchrist (1999). The empirical evidence of the interconnectedness between banking and fiscal crises has a long history (see Reinhart and Kenneth (2014) and Bordo and Meissner (2016), among others). The evidence suggests that banking crises could lead to fiscal distress by reducing economic activity and government revenue. Furthermore, with deposit insurance and other forms of government guarantees becoming popular in the early 20th century, banking crises often led to expensive fiscal rescues, thus creating a direct link between the banking system and the government's balance sheet.

The impact could also go in the opposite direction. A fiscal/debt crisis can cause a financial crisis when it impinges on the banking system. Generally, fiscal stress could impact banks through two main channels: (i) on the asset side, via valuation losses on bank holdings of sovereign securities (including the inability to repo downgraded securities); and (ii) on the liability side, through an increase in bank funding costs caused by repricing of risk and credit rating downgrades. (See Das *et al.* (2010), Dell'Ariccia *et al.* (2018), and Grigorian and Manole (2017) for extensive discussions and empirical evidence on such links).

However, while causality in each direction is possible, the fiscal and financial stress could both be caused by the same set of external or domestic factors (e.g., global recessions, capital flow reversals, major fiscal or regulatory policy shifts, domestic political unrest, etc.), making them co-move. For this reason, the remainder of the paper treats the issue of causality as secondary and instead assumes that both fiscal and credit stresses contemporaneously co-vary, an assumption that helps

simplify empirical estimates of the impact of both shocks on banks' capital positions and on the optimal choice of domestic debt restructuring scenarios.

B. Empirical estimation

A typical debt restructuring will offer debtholders an opportunity to replace their old debt securities with new ones at below-market terms, often involving a face value haircut, reduction in coupon, extension of maturity, or a combination thereof. Bondholders will be given a menu of options to choose from,[7] which—depending on the specifics of the old and new instruments—could result in different haircuts relative to their original holdings.[8] This transition matrix (between old and new instruments) will be driven by debt sustainability as well as cash flow considerations (see IMF, 2021).

We use the traditional IMF-World Bank stress-testing framework (used regularly in the context of FSAPs) to assess the impact of shock scenarios on banks' capital base and modify it slightly (see below) to better fit it for the exercise at hand. A bank's entire government bond portfolio will be subject to this treatment regardless of the accounting classification of its subcomponents (i.e., held to maturity (HTM), held for trading (HFT), and available for sale (AFS) books). For simplicity, the impact on all three books—HTM, HFT, and AFS—were applied directly to capital.[9]

Calculating the impact on capital

The post-restructuring (i.e., $t+1$) regulatory capital-to-risk-weighted-assets (CAR) ratio for bank i under the debt restructuring scenario/haircut j can be presented as follows:

$$CAR_{i,j,t+1} = \frac{Capital_{i,j,t+1}}{RWA_{i,j,t+1}} = \frac{Capital_{i,j,t} - \Delta MV_{i,j,t+1} - 0.75^{*}\Delta NPL_{i,j,t+1}}{RWA_{i,j,t+1}} \quad (1)$$

where $\Delta MV_{i,j,t+1}$ is the loss of market value of government bonds and $\Delta NPLS_{i,j,t+1}$ is the increase in non-performing loans, assumed to be provisioned at 75 percent. Given that during the restructuring the economy is likely to be in recession (see IMF, 2021; Background Paper), the implicit assumption embedded in Equation 1 that banks will make zero net income during $t+1$ appears plausible but can be relaxed, if necessary.

7 See Grigorian, Alleyne, and Guerson (2012) for the example of Jamaica 2010 debt restructuring.

8 Asonuma, Niepelt, and Ranciere (2023) provide empirical evidence and corresponding rationale for *ex post* differences in treatment between debt securities along the maturity curve during sovereign restructuring episodes during 1999–2020. They find that *ex ante* creditor losses during sovereign debt restructurings are larger for short- than for long-term debt.

9 While typically the impact on HFT and AFS books are applied to income (and subsequently to capital), lumping all three together (with direct impact on capital) does not change the outcome much due to the small size of the HFT and AFS books relative to the HTM book in developing countries. However, while not advisable, regulators may choose to make exemptions depending on the accounting categories of government securities to reduce the immediate impact on capital. See Jobst and Oura (2019) for additional specifics.

We further assume no deleveraging during the debt restructuring (other than sale of assets to cover liquidity needs; see below). Hence, the risk-weighted assets in period $t+1$ (i.e., after the restructuring) will only be different from risk-weighted assets in period t (i.e., before the restructuring) if the regulator imposes non-zero risk-weighting on restructured government bonds. Otherwise, $RWA_{i,j,t+1} = RWA_{i,j,t}$.

In most jurisdictions, exposure to own sovereign on banks' balance sheets is exempt from risk weighting (i.e., has zero risk weighting), *ceteris paribus* resulting in lower capital requirements. This treatment may be acceptable when the underlying sovereign is not considered risky (that is, its probability of default is zero or very low). However, the securities of a government which underwent a restructuring on non-market terms are considered distressed/risky and should be subject to risk-weighting (consistent with Basel III).[10]

The bank-level capital shortfall in nominal terms will be determined as (Equation 2):

$$Shortfall_{i,j,t+1} = \begin{cases} Reg.Min * RWA_{i,j,t+1} - Capital_{i,j,t+1} & if\ Reg.Min * RWA_{i,j,t+1} > Capital_{i,j,t+1} \\ 0 & if\ Reg.Min * RWA_{i,j,t+1} < Capital_{i,j,t+1} \end{cases} \quad (2)$$

where *Reg.Min* is the regulatory minimum in percent. As a result, the public sector resources required to recapitalize the banking system can be presented as follows (Equation 3):

$$Recap\ Need_{j,t+1} = \sum_{i}^{No.\ All\ Banks} Shortfall_{i,j,t+1} - \sum_{i}^{No.\ Failed\ Banks} Shortfall_{i,j,t+1} - Private\ Sector_{j,t+1} \quad (3)$$

where the first sum is the total capital shortfall of all banks, the second sum is the capital shortfall of the banks that will be allowed to fail (i.e., thus together representing the capital shortfall of surviving banks), and *Private Sector* is an estimate of fresh capital injection into the surviving banks that can be reasonably expected from the private sector (domestic or foreign).[11]

Finally, net debt relief from imposing a haircut/scenario *j* accruing to the budget after the restructuring can be obtained as:

$$Net\ Debt\ Relief_{j,t+1} = Gross\ Debt\ Relief_{j,t+1} - Recap\ Need_{j,t+1} \quad (4)$$

where $Gross\ Debt\ Relief_{j,t+1}$ is the weighted average haircut (in percent) times total outstanding debt subject to restructuring. Plotting values of $Net\ Debt\ Relief_{j,t+1}$ against the respective values of haircut will produce the NDR curve.

10 Basel Committee on Banking Supervision (2017) (Table 4) recommends 50 percent risk weighting for sovereigns rated between BBB+ and BBB−; 100 percent for sovereigns rated between BB+ and B−; and 150 percent for sovereigns rated below B−. A sovereign that is undergoing a debt restructuring is rated Selective Default (SD) and would, therefore, require a 150 percent risk-weighting per this metric.

11 Treating mergers and acquisitions in this framework is intuitive and should be done as the case for such activities may be. For more accurate assessment, he costs to the budget of resolving the failed banks, if any (notably any outlays from the deposit insurance fund, etc.), should also be explicitly added to Equation 3.

Calculating the market value loss of the bond portfolio

In cases where a detailed mapping of old and new instruments is known/available, calculating *ex post* loss of the market value of the bond portfolio (and therefore the haircut) would be straightforward. This could be done by calculating the present value of the new bond portfolio at an assumed (exit) yield and comparing it with the face value of the old portfolio.[12]

However, when only general parameters of the restructuring scenario are available (e.g., *ex ante* average haircut to be imposed on all domestic securities, as the policy variable for the stress-testing exercise), the average market value loss of the entire portfolio of a bank could be estimated as:

$$\Delta MV_{i,j,t+1} = Haircut_{i,j,t} * FV_{i,t} \quad (5)$$

where $Haircut_{i,j,t}$ is the projected haircut (average across all debt instruments), and $FV_{i,t}$ is the face value of the aggregate bond portfolio before the restructuring.

In general, the banks' portfolio losses will depend *ex ante* on the size of the government exposure, duration of their exposure, and the interest rate shock. Banks with longer average duration will experience higher valuation losses due to higher sensitivity to changes in interest rates.

Modeling credit losses

In addition to their exposure to the government, banks are also hit by losses on their private sector loan portfolio. A typical satellite model employed by IMF-WB stress-testers for estimating the impairment of private loan portfolio (change in non-performing loans; ΔNPL) can be presented as follows:

$$\Delta NPL_{i,t+1} = \propto + \beta_1 * \Delta NPL_{i,t} + \beta_2 * \Delta i_{i,t+1} + \beta_3 * Macro_{t+1} + \beta_4 * Controls_i + \epsilon_{i,t} \quad (6)$$

The inclusion of interest rate (Δi) and other macroeconomic variables (*Macro*) in the above regression hinges on the premise that in addition to bank-/firm-specific indicators, asset quality can be a function of macroeconomic environment. In fact, Hackbarth, Miao, and Morellec (2006) and Jacobson, Roszbach, and Lindé (2013) provide evidence for a substantial and lasting impact of aggregate fluctuations on credit risk and business default.

Fitted values of the loan impairment calculated using Equation 6 can then be inserted in Equation 1 to calculate banks' post-restructuring CAR. Some degree of nuance could be applied in estimating the impairment values for different sub-categories of private loans. For example, in choosing the macroeconomic regressors, *corporate* NPLs are likely to be sensitive to real GDP and equity prices, while *retail loan* NPLs could respond better to changes in real GDP and unemployment.

12 Most used methods of calculating haircuts on bonds are: (1) Haircut = 1 – (PV of the new debt/FV of the old debt); and (2) Haircut = 1 – (PV of the new debt/PV of the old debt). Since most debt securities on banks' balance sheets are likely to be held to maturity (and hence, at face value), the first specification is advisable.

Calibrating the combined shock

While the traditional IMF-WB stress-testing analysis provides a solid foundation for assessing the impact of single factors and macroeconomic shock scenarios on banks' capital base, it is mostly implemented without due consideration to the interrelationships between shocks that impact the fiscal sector (e.g., fiscal revenue and public debt levels) and private sector (i.e., ability of households and companies to service their loans) outcomes.

The fact that both fiscal and real sector outcomes are often subject to the same (external or domestic) shocks suggests that shock scenarios applied during stress-testing of fiscal/public and private sector outcomes should co-move. It is the same exact shock—or more precisely, its realization—that affects both the fiscal sector and the private sector outcomes. Ignoring this (and proceeding to assume two unrelated distributions of shock, one for each sector), could result in both understatement and overstatement of the impact of the stress-testing results and thus is not helpful. What is needed is a way to calibrate the shocks in the stress-testing scenarios in such a way that the shocks are related.

From a practical perspective, one way to do it is to look at historical data and calibrate the shocks in such a way that reflects the historical relationships between key factors driving both fiscal and private sector outcomes (e.g., GDP growth, interest rates, population growth, etc.). However, this approach has limitations, since the past is not always a good predictor of the future and a shock that materialized before may not be a good indicator of a shock that is about the hit an economy.

We propose a different approach that would solve this issue from a practical standpoint. We make use of a mechanical relationship between two key determinants of fiscal and private sector shocks and calibrate the combined shock based on that relationship. This way, whatever shock hits the economy in the future is likely to be propagated to fiscal and private sectors using the same structural relationship.

We do that by utilizing a mechanical relationship between a key determinant of fiscal stress, haircut applied to bonded debt—the policy variable in the model—with an important determinant of banks' loan loss impairment, the lending rate. Utilizing the definition of bond duration and rearranging the formula slightly, the change in market value of a bond as a function of interest rate shock can be presented as follows:

$$\Delta MV_{t+1} \approx Duration_t * FV_t * \frac{\Delta i_{t+1}}{1+i_t} \tag{7}$$

where $Duration_t$ is the duration of the bond portfolio before restructuring and Δi_{t+1} is the increase/shock to the government yield curve (interest rate). Noting that the market value haircut is $Haircut_t = \Delta MV_{i,t+1}/FV_{i,t}$, the implied interest rate shock associated with a level of haircut could be presented as:

$$\Delta i_{t+1} = \frac{(1+i_t)}{Duration_t} * Haircut_t \tag{8}$$

Hence, the shock to the loan portfolio consistent with the expected fiscal shock (i.e., proposed restructuring haircut) could be estimated in a 2-step process, where:

Step 1: Estimate the implied change in yield (Δi_{t+1}) using Equation 8;
Step 2: Use Equation 6 (and implied yield from Stage 1) to estimate $\Delta NPL_{i,t+1}$.

Following these steps allows one to assess the impact on banks' capital (by using Equation 1) of an appropriately calibrated (i.e., internally consistent) pair of shocks to a bank's sovereign bond and private loan portfolios ($\Delta i_{i,t+1}$, $\Delta NPL_{i,t+1}$) for every value of haircut.

For more accurate analysis, to achieve internal consistency, macroeconomic parameter inputs for Equation 6 could be calibrated based on a standard VAR model (e.g., one that links the aggregate output with real interest rates, exchange rates, monetary policy variables, demand shocks, etc.). However, the absence of such a model should not prevent an attempt to estimate Equation 6, as long as assumptions for macroeconomic inputs are all broadly consistent with a macroeconomic scenario projected for $t+1$. Any error of estimation of the credit portfolio loss resulting from lack of a well-calibrated macro model is likely to be of second order relative to the debt portfolio valuation losses. Box 1 summarized the steps discussed above for obtaining estimates of NDR curve.

BOX 1. A non-technical summary of NDR curve estimation procedures

In short, a consistent combination/pair of sovereign portfolio value loss and private credit impairment, needed for estimating banks' overall losses as a result of a DDR, could be calculated by following these steps:

1. For every value of proposed haircut—the policy variable in the model—calculate the implied shift in the sovereign yield curve (i.e., the fiscal shock) that will result in, or be equivalent with, such a market value haircut.
2. For banks, estimate credit impairment (i.e., loan losses) as a function of macroeconomic variables (including sovereign yield curve shift) and bank-specific control variables using regression analysis.
3. Apply the sovereign portfolio value loss and the loan losses to the individual banks' balance sheets to calculate the impact on bank's capital.
4. Calculate the banking sector-wide capital shortfall and the recapitalization needs for every level of haircut.
5. For every level of haircut, subtract the recapitalization needs from the gross debt relief to obtain the net debt relief. Plot values of NDR against haircut to obtain the NDR curve.

Modeling the impact of a DDR-induced bank run on bank capital

In addition to affecting banks' capital, a DDR could also have implications for banks' liquidity and access to the payment and settlement services. Banks may also face deposit withdrawals (increasing in intensity with economic/fiscal shock), potentially forcing them to liquidate some assets at fire sale prices, further strengthening the (positive) correlation between haircuts and asset impairment.

Banks rely on cash, reserves held at central banks, and government bonds to meet deposit withdrawals.[13] However, even though government securities perform a role of safe heaven during market turmoil, the banks' ability to pledge government bonds as collateral at the central bank or the interbank market may be impaired during debt restructuring episodes. Doing so will come at a higher cost (often associated with emergency liquidity) and in the form of (larger) haircut at repo facilities, assuming they remain open.

Apart from higher charges for accessing centralized liquidity facilities, banks will have to explicitly book any losses associated with the sale of illiquid assets at below book prices. In this case, the modeling assumption should be that deposit withdrawal (i.e., redemption shock) beyond the banks' stock of highly liquid assets (e.g., cash, CB deposits, and government bonds taken at the repo facility's haircut) is paid off using other assets sold at fire sale prices.[14]

$$LiquidityShortfall = Redemption\ Shock - Highly\ Liquid\ Assets \tag{9}$$

It should be noted that asset prices tend to behave non-linearly (with prices declining more steeply) during market turmoil and when the volume of assets sold on the market by other banks is high. Therefore, conservative prices/discounts should be applied to illiquid assets when assessing the likelihood of banks' ability to cover the liquidity shortfall.

Modeling the impact of a deposit run on a bank's capital can be done as follows:

$$\frac{Capital_{i,j,t+1}}{RWA_{i,j,t+1}} = \frac{Capital_{i,j,t} - \Delta MV_{i,j,t+1} - 0.75^{*}\Delta NPLS_{i,j,t+1} - LiquidationCost_{i,j,t+1}}{RWA_{i,j,t+1}} \tag{10}$$

where $LiquidationCost_{i,j,t+1}$ is the additional costs incurred for selling illiquid assets at below book values. Under such scenarios (where assets are sold to cover liquidity shortfall), the denominator too will have to be adjusted to account for the sale of assets.[15]

13 Some jurisdictions also allow the use of highly rated (e.g., AAA) corporate securities as collateral for accessing liquidity facilities, but this is rare and is typically an insignificant share of the banks' balance sheets relative to deposit base.

14 Another channel for liquidity pressure could be wholesale funding bottlenecks stemming from a crisis-driven higher utilization of corporate credit lines, with banks needing to provide liquidity to cash-strapped companies. While capping these credit facilities at the level of pre-crisis access may reduce the liquidity pressure, this is likely to worsen the financial conditions of affected borrowers, thus resulting in higher credit risk for banks.

15 Langrin (2013) (pp. 15–16) outlines a battery of stress-tests conducted by the Bank of Jamaica ahead of the 2010 domestic debt exchange to arrive at estimates of capital losses by banks and securities dealers.

III. Empirical estimation of a NDR curve

A. Data description

Given the size of the banking sector relative to non-bank financial institutions (NBFIs) in most countries and their role in propagating economic and financial shocks, our analysis focuses on banks.[16] In cases where NBFI sector is not trivial and therefore needs to be explicitly accounted for in calculating fiscal costs of a DDR, effort should be made to factor in the nature of the balance sheet of sub-sectors within NBFIs (e.g., insurance, pension, broker dealers, etc.).[17]

Public debt in countries selected for the analysis—Pakistan and Egypt—reached distressed levels in 2023 and had significant amounts of domestic public debt in total. We used individual bank-level data from Orbits Bank Focus to estimate the framework laid out above. Unfortunately, the data do not provide a breakdown of bonds by maturity buckets. The availability of more granular data would have allowed for a more precise assessment of banks' losses due to market value reduction of their bond portfolio.

We will analyze the impact of hypothetical sovereign debt restructurings on banks' capital positions and on the optimal choice of domestic debt restructuring design based on the following four scenarios:

- **Scenario 1:** Haircut is applied to all government securities (including T-bills); No risk weighting is applied to government securities; No deposit run is assumed;
- **Scenario 2:** Haircut is applied to all government securities with the exception of T-bills; No risk weighting is applied to government securities; No deposit run is assumed;
- **Scenario 3:** Haircut is applied to all government securities (including T-bills); 50 percent risk weighting is applied to government securities; No deposit run is assumed;
- **Scenario 4:** Haircut is applied to all government securities (including T-bills); no risk weighting is applied to government securities; A 20 percent deposit run is assumed.

The country-specific results presented below are meant to be illustrative and are not meant to replace the authorities' own analysis. In addition, any policy inference should be drawn up based on more granular and up to date (up to the most recent quarter) financial information, often only available to the bank supervisory authorities.

16 However, in countries with sizable non-bank financial sectors, the analysis should explicitly factor in the impact of a restructuring on balance sheet and income potential of public pension funds and insurance companies.

17 For instance, while calculating recapitalization needs of the insurance sector could be similar to that for the banking sector, the impact on pension funds' balance sheet would be easier to quantify (as it will be proportionate to the haircut).

B. Estimation outcomes: Pakistan

Pakistan's public debt (including IMF obligations) stood at 77.3 percent of GDP as of June 2023 (end of Fiscal Year 2023; see IMF, 2024a). Its components, the external and domestic debt, constituted 31.0 and 46.3 percent of GDP, respectively. The government of Pakistan restructured its external debt in 1999.

71 percent of total domestic debt held by the private sector is held by banks, with the rest being held by insurance companies, pension funds, and corporate/others in 5.6, 6.7, and 16.6 percent of total, respectively. The central bank held additional 5.5 percent of GDP in domestic debt securities (see State Bank of Pakistan, 2023).

At around 60 percent, Pakistan's banking sector has the largest share of government securities relative to its total assets in the world (Balibek, 2024). This strong link between the sovereign and the banking sector makes both susceptible to shocks and—as we will witness below—has significant implications for a potential DDR. An additional channel of risk is that the purchases of government bonds are being increasingly funded via short-term central bank liquidity using bonds as collateral.[18] What follows is an estimation of the NDR for Pakistan using the methodology described above.

We start by assessing both the loss of market value of government bond portfolio (Equation 5) and banks' credit losses (Equation 6). For the latter, we estimate the determinants of non-performing loans using a variant of Equation 6 and annual data for 23 banks (representing 83 percent of the total banking sector assets) for the period of 2005–23. The fixed effects panel regression estimates based on a preferred specification are reported in Table 1.[19]

TABLE 1. Pakistan: Determinants of banks' non-performing loans
Fixed-effects panel regression
(Dependent variable: Logit transformation of non-performing loan ratio)

Variable	Est. Coefficient	P-value
Const	1.486	0.414
lagged_logit_npl	0.744**	0.000
loan_share	−0.005*	0.088
log_total_assets	−0.108	0.158
lending_rate	0.030*	0.094
gdp_growth	−0.003	0.844
Inflation	0.022**	0.006
xrate_pct_change	0.005*	0.091
Fixed effect included	Yes	
R-sq.=0.785; No of observations: 275		

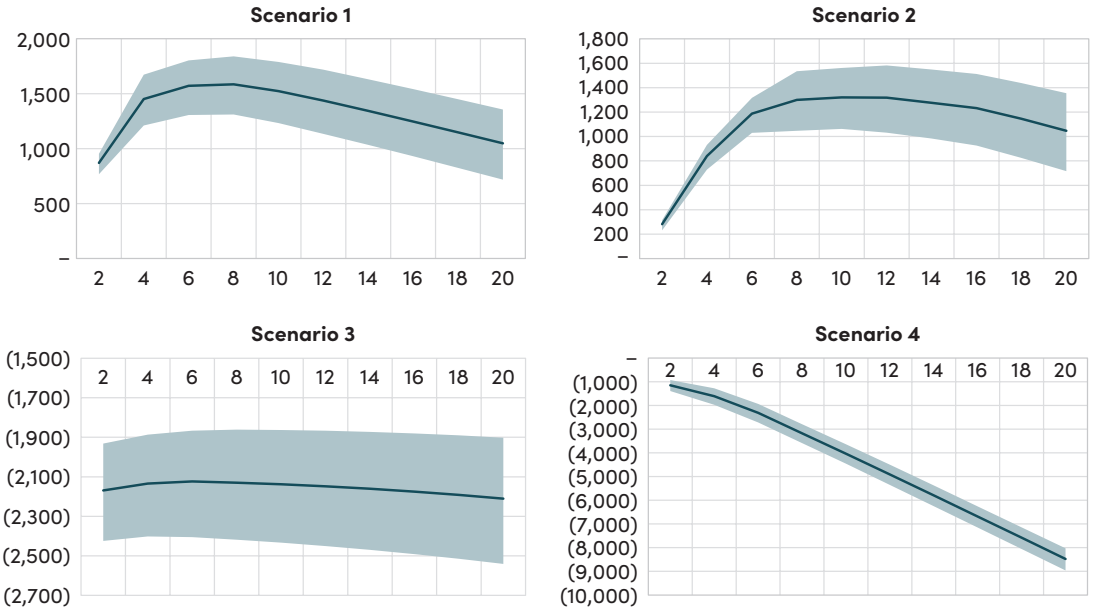
Note: ** and * – denote significance at 1 and 10 percent confidence levels, respectively.

18 See Grigorian (2025) for a discussion on how this could expose the central bank and the monetary policy conduct to the risk of a DDR.

19 The fixed effects model was chosen in favor of random effects one based on the Hausman test.

Signs of all coefficients are as predicted. A few points are worth mentioning in this regard. There appears to be a strong path dependency (measured by a positive and statistically significant coefficient on lagged NPLs on contemporaneous values of NPLs), which is expected. When it comes to loan quality, there appears to be no benefit of scale (measured by banks' asset size). However, there are positive and significant benefits of specialization (in making loans vs. holding other assets)—the higher the loan share in bank's total assets, the less is the bank's NPL ratio. While the GDP growth reduces NPLs, the effect is not statistically significant. Finally, higher lending rates, inflation, and exchange rate depreciation all increase the share of NPLs in total loan portfolio.

FIGURE 3. Estimates of NDR curve for Pakistan under scenarios 1–4
(in million USD)



Note: Haircut (in percent) is shown on X-axis; net debt relief (in million USD) is shown on Y-axis. Panels show 95 percent confidence intervals based on credit quality equation in Table 1.

Estimated credit losses (using projections based on regression in Table 1 and Equation 8 to calibrate the lending rate)[20] were then combined with the loss of market value of government bonds to estimate the capital shortfall. To determine the recapitalization needs (per Equation 3), given the nascent state of Pakistan's capital and credit markets, we assumed that no banks will be liquidated, and no private sector recapitalization funding is forthcoming, thus making the government the sole provider of recapitalization funding for all banks whose capital fell below the regulator minimum

20 Due to lack of granular data on government bonds in maturity buckets, we assumed an average duration (or life to maturity) of government securities to be 2, which is consistent with pattern of bank holdings of treasuries in emerging market economies (i.e., buy securities with less than 5-year maturity).

(of CAR of 12 percent).[21] The results of estimation based on Scenarios 1–4 (described above; with different perimeters of restructured debt and the regulatory treatment of restricted securities) are shown on Figure 3.[22]

The results in Scenario 1 treatment (upper left panel) suggest that the optimal haircut to be imposed on government securities is 8 percent, which would result in a reduction of PV of government debt (on the portion of debt held by the sample banks) by approximately $1.6 billion (or approximately 0.5 percent of GDP) after bank's recapitalization costs are accounted for. This treatment assumes a degree of regulatory forbearance that continues to treat the sovereign debt as riskless (and therefore assigns zero risk weight to it). (This assumption is relaxed in Scenario 3 below). Table 2 summarizes the results of financial stress imposed on the banks by a hypothetical domestic debt restructuring. Under the 8 percent (optimal) haircut assumption, 12 banks will become insolvent, while 6 will see their CAR drop below 12 percent regulatory minimum.

TABLE 2. Pakistan: Bank solvency dynamics under Scenario 1 treatment

	Haircut (Percent)				
	0	5	10	15	20
No. of banks w/ above min cap requirement	20	6	5	5	4
No. of banks w/ below min cap requirement (but solvent)	0	13	6	5	1
No. of insolvent banks 1/	3	4	12	13	18
Capital shortfall (USD mln.)	363	1,881	5,266	8,889	12,529
Capital shortfall (percent of GDP)	0.1	0.6	1.6	2.6	3.7
Capital loss, *of which due to*	...	4,236	7,869	11,516	15,177
Market value loss (government securities)	...	3,394	6,789	10,183	13,578
Credit portfolio loss (loans)	...	841	1,080	1,333	1,600
Memorandum item:					
Net debt relief (USD mln.) 2/	0	1,513	1,523	1,294	1,058

Notes: Based on a sample of 23 banks representing 83 percent of the banking sector's assets. The analysis assumes that all government bonds held by these banks are issued under domestic law. To the extent that banks also hold any foreign-law debt securities issued by Pakistan, which are not restructured, their losses would be less than estimated here.

1/ Banks with negative CAR.

2/ Net debt relief (the difference between gross debt relief and capital shortfall) reaches maximum of $1,585 at haircut of 8 percent, not shown in the table.

21 This assumption can be relaxed if specific amounts of private funding can realistically be secured to recapitalize failing banks and if a decision has been made to let the failing banks (or a portion thereof) to be liquidated. On the latter issue, however, implications for the credit to the private sector post restructuring should be carefully analyzed and internalized before a decision is made.

22 As mentioned above, the model makes a conservative assumption that injection of public funding would be a loss, with zero recovery rate in the future. This assumption too could be relaxed and a non-zero recovery rate assumed in the future, which would boost the value of net debt relief.

Under Scenario 2 treatment (upper right panel), the optimal haircut could go slightly higher (at 10 percent), because of a smaller restructuring perimeter (i.e., T-bills are excluded from the restructuring). However, as expected, excluding T-bills also results in lower savings accrued to the budget (approximately $1.3 billion).

Scenario 3 (lower left panel) shows that any restructuring of domestic debt that treats the public debt securities as impaired (by assigning a conservative 50 percent risk weighting to those securities) would create a large hole in the banking sector's balance sheet requiring sizable amounts of capital injection that would in turn generate negative NDR irrespective of the level of the haircut.

Finally, under Scenario 4 (lower right panel), a 20-percent deposit run would—under the assumption that (1) government securities are no longer liquid and hence cannot be sold to meet deposit withdrawals and (2) 30 percent fire-sale discount on illiquid assets to meet those deposit withdrawals—generate sizable losses for the banks. As expected, potential recapitalization costs grow rapidly, turning the net debt relief accrued to the budget negative even at low levels of haircut.

All in all, the above estimates suggest limited scope for domestic debt restructuring in Pakistan. Even if financial stability can be preserved (i.e., bank runs avoided) and regulatory forbearance can be applied (to allow a phased-out built up on capital by banks themselves and to avoid imposing risk weighting on government bonds), the net savings from the restructuring are not large enough to justify a restructuring. Besides, even if some public funding used in the process of recapitalization can be recovered in the future (when the state divests its equity holdings in banks), any sizable injection of public capital into the banks would initially have the undesirable optics of nationalizing (a large chunk of the) banking sector (i.e., over a dozen banks even under the assumption of 10 percent haircut; see Table 2).

This also casts a shadow over *any* debt restructuring in Pakistan as a way of reducing the country's debt burden. This is because the remainder of Pakistan's "restructurable" public debt—the debt not owed to multilateral creditors, (at roughly $60 billion or 20 percent of GDP in 2023)—is not large enough to allow meaningful reduction of the debt burden. Fiscal tightening, favorable macroeconomic (especially exchange rate and interest rate) dynamics, and active liability management should instead be pursued to reduce the risks associated with debt distress and return the country firmly into debt sustainability.

C. Estimation outcomes: Egypt

Egypt's general government debt amounted to 96 percent of GDP in June 2023 (FY2022/23 outcome; see Table 4, IMF, 2024b), composed of 42 percent of foreign debt (on residency basis, which includes non-resident holdings of T-bills; see Table 1, IMF, 2024b) and 54 percent of domestic debt. Debt servicing imposes a sizable burden on Egypt's public finances, with interest payments reaching 50 percent of all budgetary revenues in March 2024, up from 40 percent a year prior (see Central Bank of Egypt, 2024; p. 26).

Prior to the exchange rate unification in March 2024, Egypt relied heavily on short term T-bills for much of its domestic financing (IMF, 2024b).[23] The budget also relied on overdraft facility of the Central Bank of Egypt, at times even breeching the statutory norm. With the return of confidence (following the exchange rate unification), the issuance of longer maturities has resumed, which reduced the rollover risk of domestic debt. Nevertheless, Egyptian banks on average held 33 percent of government securities as a share of their total assets as of end-2023 (see Central Bank of Egypt, 2024; p. 24), a level that is nearly half of that in Pakistan.

The remainder of this section discusses the estimation process for the NDR curve for Egypt. The fixed effects panel regression estimates based on annual data for 21 banks (representing 87 percent of Egypt's total banking sector assets) for the period of 2005–23 using a preferred specification are reported in Table 3.[24]

TABLE 3. Egypt: Determinants of banks' non-performing loans
Fixed-effects panel regression
(Dependent variable: Logit transformation of non-performing loan ratio)

Variable	Est. Coefficient	P-value
Const	1.742	0.398
lagged_logit_npl	0.761***	0.000
loan_share	−0.011***	0.006
log_total_assets	−0.096	0.303
lending_rate_lag	0.023**	0.055
gdp_growth_lag	−0.029	0.122
Inflation_lag	−0.009*	0.076
Fixed effect included	yes	
R-sq.=0.727; No of observations: 260		

Note: ***, **, and * – denote significance at 1, 5, and 10 percent confidence levels, respectively.

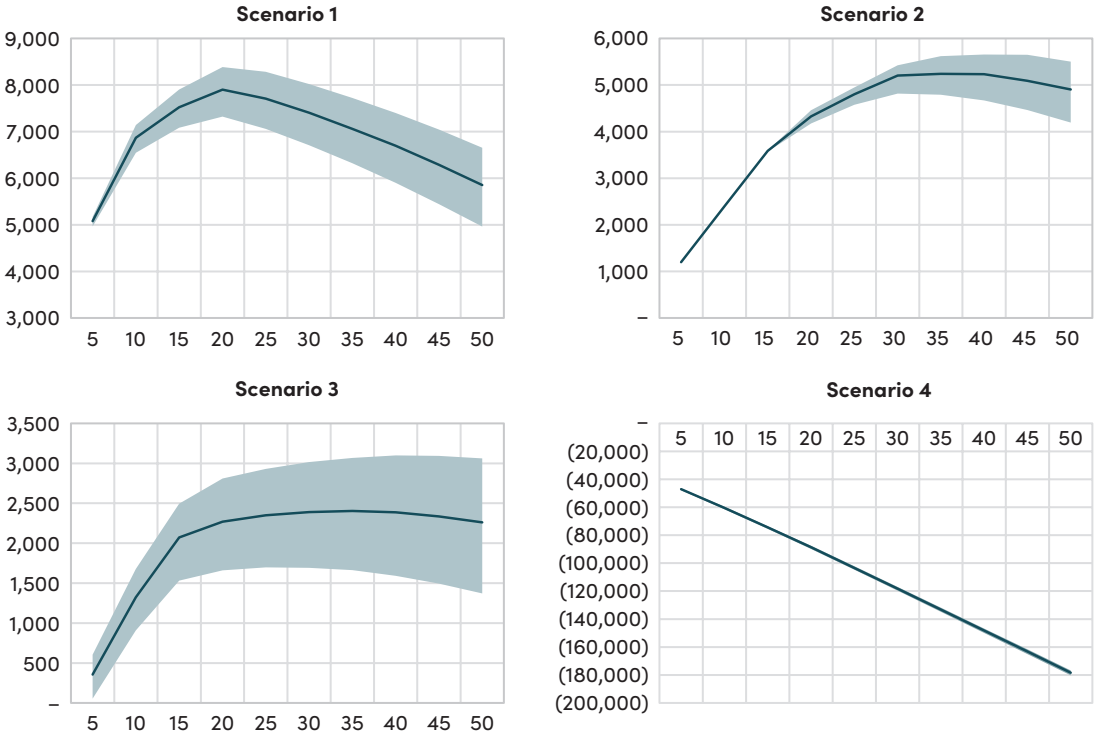
Signs of coefficients are largely as predicted. Similar to results reported in Table 1 for Pakistan, there appears to be a strong path dependency in NPL dynamics in Egypt. Like in Pakistan, there is no benefit of scale (measured by banks' asset size) in Egypt, but there are positive and significant benefits of specialization, measured by a positive effect of the loan share in bank's total assets on the quality of loan portfolios. While the GDP growth reduces NPLs, the effect is not statistically significant. As expected, higher interest rates increase the share of NPLs in banks' loan portfolios. Interestingly, and contrary to the results reported for Pakistan, inflation appears to improve loan portfolio quality of Egyptian banks.

23 Rather unusually, Egypt's IMF-supported program had an Indicative Target (a soft form of performance criteria) on the average maturity of gross local currency debt issuance fixed at 0.56 years, which was narrowly missed (due to the reliance on very short maturities for issuance).

24 The fixed effects model was chosen in favor of random effects one based on the Hausman test.

Armed with these regression results and combining them with the loss of market value of government bonds, we move to estimate the banks' capital losses. As in the case of Pakistan, to determine the recapitalization needs (per Equation 3) for Egypt, we assumed that no banks will be liquidated, and no private sector recapitalization funding is forthcoming. This makes the government the sole provider of recapitalization funding for all banks whose capital fell below the regulator minimum. The estimation results based on Scenarios 1–4 (as outlined above) are shown in Figure 4.

FIGURE 4. Estimates of NDR curve for Egypt under Scenarios 1–4
(in million USD)



Note: Haircut (in percent) is shown on X-axis; net debt relief (in million USD) is shown on Y-axis. Panels show 95 percent confidence intervals based on credit quality equation in Table 3.

The NDR curve under the Scenario 1 treatment (upper left panel) reaches maximum at 20 percent haircut, resulting in a reduction of PV of government debt (on the portion of debt held by the sample banks) by $7.9 billion (or approximately 2 percent of GDP) after bank's recapitalization costs are accounted for. As hypothesized, imposing a haircut greater than 20 percent will reduce the net debt relief generated by the restructuring. Table 4 summarizes the results of financial stress imposed on the banks by a hypothetical domestic debt restructuring. Under the 20 percent (optimal) haircut assumption, one bank becomes insolvent while 14 banks will see their CAR drop below the regulatory minimum of 12 percent.

Under Scenario 2 treatment (upper right panel), which excludes T-bills (taken at 36 percent of all government securities held by the sample banks; see Central Bank of Egypt (2024), p. 29) the optimal haircut would still be at 30 percent, generating just over $6.2 billion in net debt relief for the fisc. While resulting in less debt reduction, Scenario 2 treatment is likely to secure a smoother/ uninterrupted access of the budget to domestic debt market (at least its shorter end) during and after the restructuring.

Scenario 3 treatment (lower left panel)—with a 50-percent risk weighting for all government securities—suggest an optimal haircut of 32 percent but generates much less net debt relief (approximately $2.4 billion) as a result to significantly larger recapitalization needs of the banks.

TABLE 4. Egypt: Bank solvency dynamics under Scenario 1 treatment

	Haircut (Percent)				
	10	20	30	40	50
No. of banks w/ above min cap requirement	15	6	2	2	1
No. of banks w/ below min cap req. (but solvent)	6	14	15	12	11
No. of insolvent banks 1/	0	1	4	7	9
Capital shortfall (USD mln.)	5,110	16,058	28,533	41,223	54,045
Capital shortfall (percent of GDP)	1.3	4.1	7.2	10.4	13.7
Capital loss (USD mln.), *of which due to*	13,733	26,382	39,114	51,938	64,862
Market value loss (government securities)	11,979	23,959	35,938	47,917	59,897
Credit portfolio loss (loans)	1,753	2,423	3,176	4,020	4,965
Memorandum item:					
Net debt relief (USD mln.)	6,889	7,901	7,405	6,695	5,852

Notes: Based on a sample of 21 banks representing 87 percent of the banking sector's assets. The analysis assumes that all government bonds held by these banks are issued under domestic law. To the extent that banks also hold any foreign-law debt securities issued by Egypt, which are not restructured, their losses would be less than estimated here.
1/ Banks with negative CAR.

Finally, under Scenario 4 treatment (lower right panel), a 20 percent deposit run would—under the assumption that (1) government securities are no longer liquid and hence cannot be sold to meet deposit withdrawals and (2) 30 percent fire-sale discount on illiquid assets to meet those deposit withdrawals—generate significant losses for the banks, turning the net debt relief accrued to the budget highly negative even at low levels of haircut.

The above estimates paint a markedly different story for Egypt compared to that for Pakistan. Assuming financial stability can be preserved (i.e., bank runs avoided) and regulatory forbearance can be applied (to allow a phased-out built up on capital by banks themselves and to avoid imposing risk-weighting on government bonds), the above estimates suggest that a case can be made for the use of domestic debt restructuring as a way of reducing the burden of public debt in Egypt.

Needless to say, the above estimates of net debt reduction should be viewed in the context of the debt relief that would be required to return Egypt's debt to sustainable levels, potential savings from an external debt restructuring, and the relative economic costs of external vs. domestic restructuring (as discussed in IMF, 2021). Furthermore, given the number of banks that will come under stress during a hypothetical domestic debt restructuring, measures to contain financial risk should be baked into the design of the debt exchange. These may include setting up a financial stability fund for participating banks (and insurance companies) and updated rules for contingency planning and crisis management. Some regulatory forbearance too could be considered to lessen the stress on banks in the immediate run. Finally, to succeed any restructuring should be accompanied by a degree of burden sharing by the budget in the form of some fiscal tightening, more efficient use of public funding, and liability management.

IV. Conclusion

Public debt sustainability is a forward-looking concept, which depends not only on the current stock of debt but also on macroeconomic conditions in the future. A debt restructuring haircut that aims to make sovereign debt sustainable thus depends in part on future macroeconomic conditions. The same set of future conditions also affect the financial sector, including the (forward-looking) measures of loan quality and hence banks' net worth. This link between debt-stabilizing haircut and banks' future net worth is essential in understanding the concept of net debt relief for domestic debt restructuring, which explicitly factors banks' losses due to debt restructuring and adverse future macroeconomic conditions that accompany such restructurings.

This paper attempted to operationalize such a link using data from two countries and a basic quantitative framework. We make several simplifying assumptions to circumvent lack of granular data, while discussing the implications of relaxing most of those assumptions. A degree of familiarity with the IMF-WB stress testing analysis would arguably make it easy for the reader to digest the empirical section of the model but is not necessary.

The paper shows that designing domestic debt restructurings that would avoid triggering a financial sector crisis requires care and full accounting of the fiscal-bank nexus. It also highlights the range of factors that are important for properly assessing the net debt relief, a key factor for deciding whether to undertake a domestic debt restructuring. The case studies on Pakistan and Egypt have shown how some of those factors played out in quantitative simulations using actual data. More research will certainly be needed to finetune the above framework (and perhaps to also extend it to the NBFIs) to help sovereigns avoid costly mistakes.

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