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Stress Testing U.S. Leveraged Corporates in a COVID-19 World

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Prepared by Carlos Caceres, Diego Cerdeiro, Dan Pan, and Suchanan Tambunlertchai[1]

Authorized for distribution by Nigel Chalk

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Abstract

This paper analyzes a group of 755 firms, with aggregate indebtedness of US$6.2 trillion, to assess the solvency risks and liquidity needs facing the U.S. corporate sector based on projections of net income, availability and cost of funding, and debt servicing flows under different stress test scenarios. The paper finds that leveraged corporates account for most of the potential losses arising from the macroeconomic stresses associated with the COVID-19 crisis, with a concentration of these losses in the oil and gas, auto, and capital and durable goods manufacturing sectors. However, potential losses from corporate debt write-downs appear to be a fraction of banks' capital buffers and, given the size of the leveraged segment and the relatively long duration of that sector's debt, the near-term liquidity needs of these corporates appear modest. Corporate stresses could, however, amplify the current economic downturn—as firms cut investment spending and reduce employment—potentially giving rise to significant indirect losses for the financial system.

JEL Classification Numbers: C10, C50, G30, G33

Keywords: corporate; stress testing; firm value; leverage; solvency; liquidity.

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I. INTRODUCTION

In the decade following the global financial crisis, rigorous and systematic stress tests were developed for the banking system in various countries.[2] In the U.S., supervisory stress tests began being conducted on an annual basis following the global financial crisis (BIS, 2018).[3] Such stress tests inform regulators how the banks would perform under various economic shocks. The tests are done simultaneously using the same shock scenarios that facilitated comparison across banks and a systemwide understanding of vulnerabilities (Kohn, 2020). That understanding has been vital for developing safeguards to ensure financial sector stability and resilience.

The remaking of the financial sector, for a time, overshadowed the changes taking place in the nonfinancial corporate sector. Near zero interest rates, economic recovery, and investors' aggressive search for yield were fueling demand for corporate debt. Nowhere was this more evident than the leveraged finance market where investors flocked for the higher yields of riskier corporate borrowers. Creditors' demand for high yield bonds and leveraged loans allowed already highly-indebted corporates to take on more debt at historically low costs and relatively long duration. So while banks and households de-levered and repaired their balance sheets following the 2008 financial crisis, nonfinancial corporate debt was reaching new highs, with the most rapid accumulation concentrated among the least creditworthy firms. The volume of leveraged loans in particular more than doubled between 2010 and 2020.

Because the nonfinancial corporate sector has not been subject to systematic scrutiny or supervision, our understanding of the individual or collective risks that they pose to the broader system is more limited. A framework for stress testing with similar principles to that for the banking sector—with the same scenarios applied over the same time window for a large set of companies—can shed light on the impact of various economic shocks on companies' performance and viability as well as the aggregate losses they can potentially inflict. In turn, that can provide valuable information on potential losses borne by the financial system and on the range of wealth losses that may be incurred in a downside scenario. That understanding is particularly relevant at this juncture as corporate indebtedness has reached unprecedented levels and holders of this debt span the household, financial (banks and nonbanks), corporate, and public (including central banks) sectors both within the U.S. and abroad.

The purpose of this paper is twofold. First, it aims to shed light on the nonfinancial corporations whose liabilities make up the leveraged finance market. In particular, the paper attempts to understand the effects of economic shocks on the U.S. corporate sector, particularly on the income and balance sheets of leveraged companies, to estimate the

[2] The Basel Committee on Banking Supervision issued principles for sound stress testing in 2009, with an update in 2018 (BCBS, 2009 and 2018).

[3] The Supervisory Capital Assessment Program (SCAP) was conducted once in 2009. This was superseded by the Comprehensive Capital Assessment Review (CCAR) which started in 2011, and the Dodd-Frank Annual Stress Test (DFAST) in 2013.

potential losses they could inflict on the broader system. Second, the paper proposes a tractable framework for stress testing nonfinancial corporates which can be used for specific analyses or as an ongoing early warning exercise in the U.S. and elsewhere.

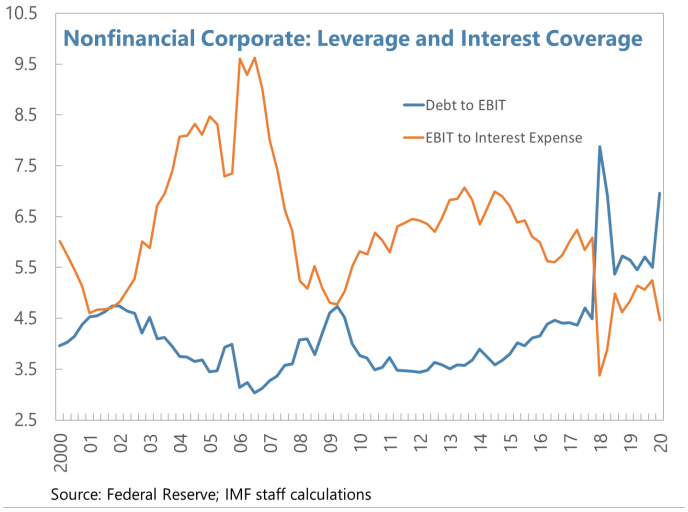
We rely on company-level data of 755 U.S. domiciled nonfinancial corporates with aggregate indebtedness of over $6 trillion.[4] This sample encompasses nearly two-thirds of total non-financial corporate borrowing by U.S. entities. Using scenario analyses, we assess the corporates' net equity and liquidity positions, and illustrate the estimated losses to the financial system arising from potential defaults. In addition, we evaluate the financing needs of the firms in our sample which provides an estimate of the amount of outstanding corporate loans and corporate bonds that would need to be re-intermediated by the financial system and the new financing needed to cover potential net cash outflows over the coming years.

The paper is organized as follows. Section II provides an overview of corporate indebtedness in the U.S. and recent developments in the leveraged finance market. Section III describes the data for the sample of firms subject to the stress tests. Section IV describes the stress testing framework and introduces the solvency and liquidity concepts and metrics used in the stress tests. Section V quantifies the potential losses resulting from stressed corporates, particularly those with negative equity, owing to net revenue losses and rising debt-servicing and funding costs. It also provides an estimation of the overall refinancing needs of the corporate sector—based on these firms' current debt maturity profile and potential cash outflows under stress. Section VI assesses the potential impact on the financial institutions exposed to these corporates through holdings of their debt and equity. It also looks at the potential impact of corporate losses on economic activity. Section VII concludes.

[4] The initial sample comprising of all the firms identified as participating in the leveraged loan market as well as the corporate bond debt market included around 2,000 firms. Of those, the firms that reported all the data necessary for conducting our different stress tests were 755 firms.

II. Leveraged Corporates in the U.S.

A. Corporate Indebtedness



Source: Federal Reserve; IMF staff calculations

Nonfinancial corporations in the U.S. have added over $4 trillion in debt since the end of 2010, bringing total corporate indebtedness to around $10 trillion or 46 percent of GDP at the end of 2019. The uptick in corporate debt over the last few years was distinguished by very rapid growth in the debt of already highly indebted firms and a loosening of underwriting standards. Debt accumulation and the associated rise in interest expense have also outpaced growth in earnings, resulting in higher leverage ratios—debt to earnings before interest and taxes (EBIT)—and falling interest coverage—ratio of EBIT to interest expense—both of which suggest eroded capacities to repay.

Credit ratings have reflected the diminished creditworthiness of the nonfinancial corporate sector. [5] While the bulk of U.S. corporate debt is investment grade, speculative grade companies are more numerous implying the latter tend to issue smaller amounts of debt. As the number of non-investment grade companies has grown, so too has the share of speculative grade (high-yield) debt in the total stock. According to S&P Global Ratings, the share of sub-investment grade instruments in the overall nonfinancial corporate debt stood at 34 percent at the beginning of 2019.[6]

Within the investment grade class, there was also a deterioration in the average credit quality. Of the $5.9 trillion investment-grade bond market, the BBB-rated firms—i.e. the lowest grade among investment grades—accounted for around 50 percent in 2019, compared to just 17 percent in 2001 (GFSR, 2019).[7] The average net leverage ratio of investment grade bond issuers also went up during the past decade, standing above 2 in 2019 compared to 1.5 in 2007 (Xie, 2019).

As of 2019, the nonfinancial corporate sectors with the highest debt levels were technology ($900 million), utilities ($855 million), and telecommunications ($753 million), in part

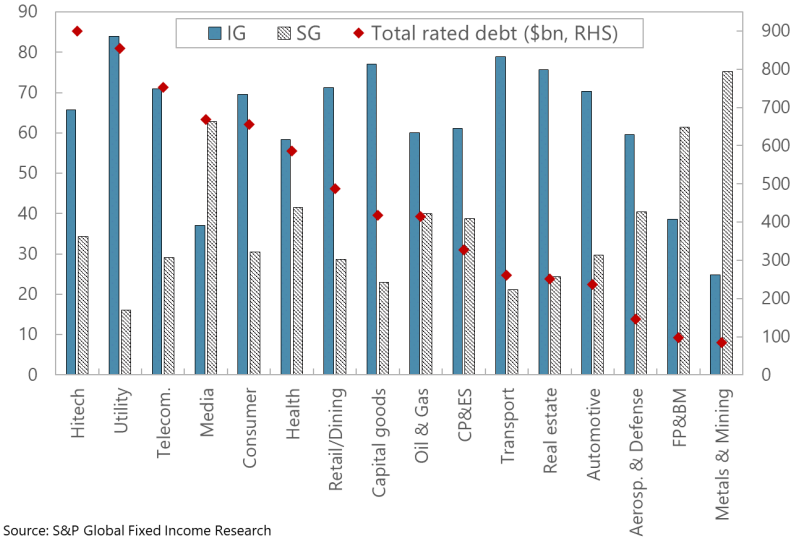
[5] Investment grade credit ratings are those above and including 'BBB-' by S&P and Fitch (or 'Baa3' by Moody's). The ratings BBB+, BBB, BBB- or the "triple Bs" are lower medium grade. Ratings below BBB- (Baa3) sub-investment grade, also referred to as speculative grade, high-yield, or junk.

[6] S&P Global Ratings (2019), "U.S. Corporate Debt Market: The State of Play in 2019."

[7] Growth in the BBB class has been due a combination of newly rated instruments, downgrades from higher ratings, and upgrades from lower ratings.

reflecting their larger roles in the economy. Sectors with the highest volumes of speculative-grade debt are media and entertainment ($420 billion), high technology ($308 billion), and health care ($244 billion). Figure 1 shows the relative shares of investment grade and speculative grade debt in each sector.

Figure 1. Nonfinancial Corporate Debt: Shares of Investment and Non-Investment Grade



Source: S&P Global Fixed Income Research
Note: CP&ES -- Chemicals, packaging, and environmental services. FP&BM--Forest products and building materials. Includes bonds, notes, loans, and revolving credit facilities rated by S&P Global Ratings.

B. The Leveraged Finance Market

The debt instruments of companies with high debt levels make up the leveraged finance market. The main instruments in this market are high-yield bonds and leveraged loans issued for the purposes of leveraged buyouts, mergers and acquisitions, recapitalization, or refinance. High-yield bonds are bonds issued by companies with sub-investment grade credit ratings. Although there is no fixed definition for "leveraged loans", these include loans of non-investment grade companies, loans of investment grade companies that were issued at high spreads, and loans of companies with high leverage ratios.[8]

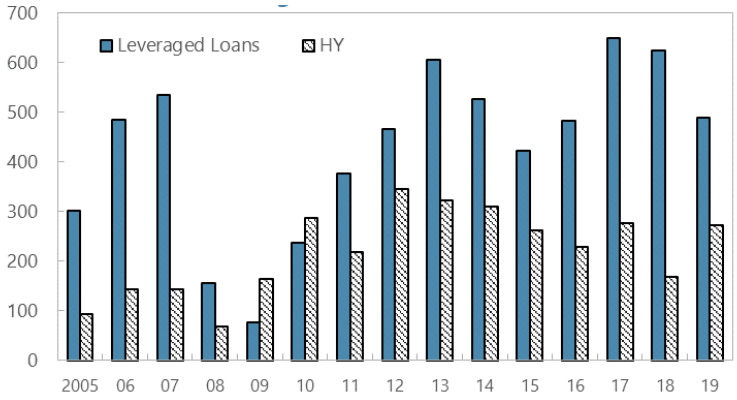
Both leveraged loans and high-yield bond issuers span the full range of industries. However, there is an apparent preference for high-yield bond issuance by the oil and gas industry and a similar preference for leveraged loans by the computer and electronics industries. While leveraged loans and high-yield bonds share many similarities including the underlying issuers, leverage loans have been more popular in recent years. Their first-lien senior-secured status put them at the top of the capital structure of the debt-issuing companies, making them senior to high-yield bonds (which are typically unsecured). Leveraged loans are also predominantly at floating rates, in contrast to the high-yield bonds' fixed coupons. The recent

[8] The most commonly used definition is that of the S&P Leveraged Loan Commentary and Data (LCD) which includes (i) loans rated BB+ or lower; (ii) unrated or investment grade loans with spreads > LIBOR +125 and secured by a first or second lien.

expectation of rising interest rates (before 2019) have contributed to investors' demand for leveraged loans. Moreover, leveraged loans can be securitized as collateralized loan obligations (CLOs) whose popularity in recent years further increased demand for leverage loans, helping this market outpace growth in high-yield bonds (Figure 2). On the other hand, high yield bonds have been repackaged in the form of exchange traded funds. At the end of 2019, the outstanding volume of high-yield bonds in the U.S. stood at $1.3 trillion while the volume of leveraged loans was estimated at $1.1 (FRB, 2020).[9]

As demand for leveraged loans increased, lending standards were loosened, and creditor protections were rolled back. For example, in 2019 nearly 90 percent of leveraged loans were issued without maintenance covenants which were previously a standard component of loan contracts that subject the risky borrowers to periodic financial tests and reporting requirements to ensure they remain creditworthy during the life of the loan (Figure 3). This shift to "cov-lite" issuances was accompanied by fewer restrictions in loan agreements which allowed borrowers to engage in previously excluded practices such as increasing leverage without existing creditors' consent, making "add-back" assumptions to adjust upward the company's earnings before interest, taxes, depreciation, and amortization (EBITDA), selling assets without any requirements to reinvest the proceeds, or transferring assets to unrestricted subsidiaries beyond creditors' reach in the event of default. The use of EBITDA add-backs was especially problematic as they distorted leverage ratios in an ad hoc and opaque manner. According to S&P's Leveraged Commentary and Data (LCD), 43 percent of leveraged loans issued in the first half of 2019 included some sort of add-back.

Figure 2. Issuances in the Leveraged Finance Market



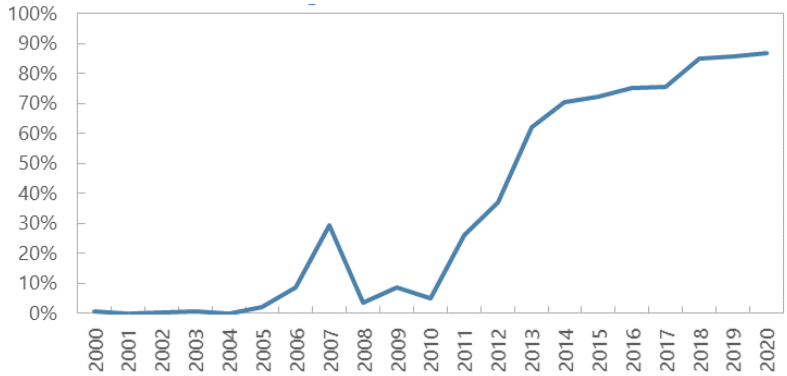
Source: LCD, an offering of S&P Global Market Intelligence

The lack of protective covenants and collateral dilution meant that leveraged loans were being structured in a way that increased the credit risk borne by the investor, even despite the

[9] As there is no standardized definition for leveraged loans, estimates of their market size vary. The commonly cited estimate of $1.1 trillion is based on the S&P's LCD definition and the loans included in the S&P Leveraged Loan Index (LLI). Some, including the Bank of England, have argued for a broader measure that accounts for loans not included in the LLI, which puts the estimated market size at $2.2 trillion (see the Bank of England's November 2018 Financial Stability Report).

collateral provided to back these loans. The lack of transparency around financial ratios created information asymmetries with investors. In this environment, leveraged companies now have longer "runways" before being considered to be in distress (which implies they are closer to funding difficulties before an investor can exercise influence over the company). As a consequence, when companies go into distress, their financials are likely to already be in a more difficult situation. Defaults become more difficult to anticipate and, when they do occur, imply lower recovery rates for investors.

Figure 3: Share of 'Cov-Lite' Leveraged Loan Issuance

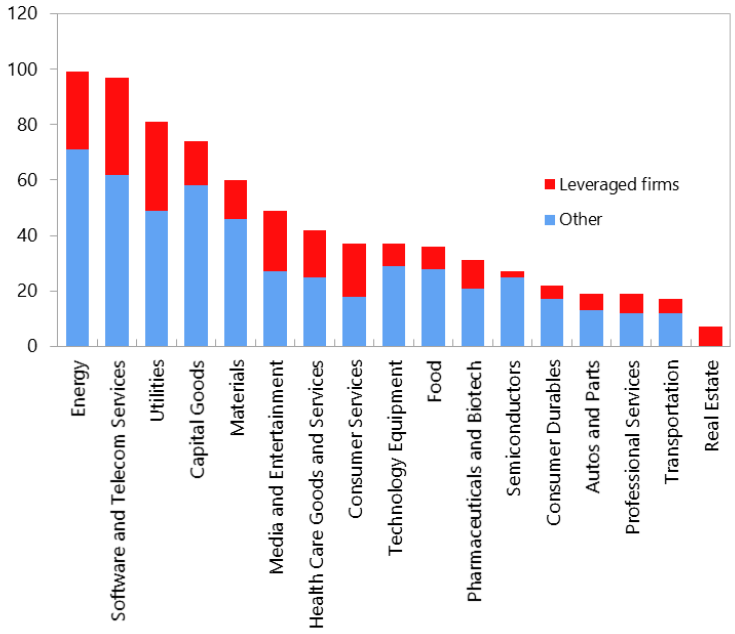


III. Data and Stress Testing Sample

Our sample draws from active borrowers in the bond and the leveraged loan market. Active borrowers in the bond market are identified from the *Bloomberg* database, which consists of 840 companies. Those in the leveraged loan market come from S&P's *Leveraged Loan Index* components, which include 1,394 companies. Historical financial data for these companies are retrieved from the *Capital IQ* database. Merging across these data sets and excluding those with missing financial data yielded 755 companies in our final stress test sample. Among these, 524 are borrowers in the bond market, 306 borrowers in the leveraged loan market, and 75 are active in both markets.

For the purposes of our exercise, we define highly leveraged firms (henceforth referred to as "leveraged firms") as those with debt-to-EBITDA ratios greater than 5. Based on this definition, 241 companies in our sample are considered leveraged. Figure 4 shows the sectoral breakdown of companies in our sample. Many companies in our sample come from the energy and utilities sectors, whose revenue and operating costs are sensitive to oil price shocks.

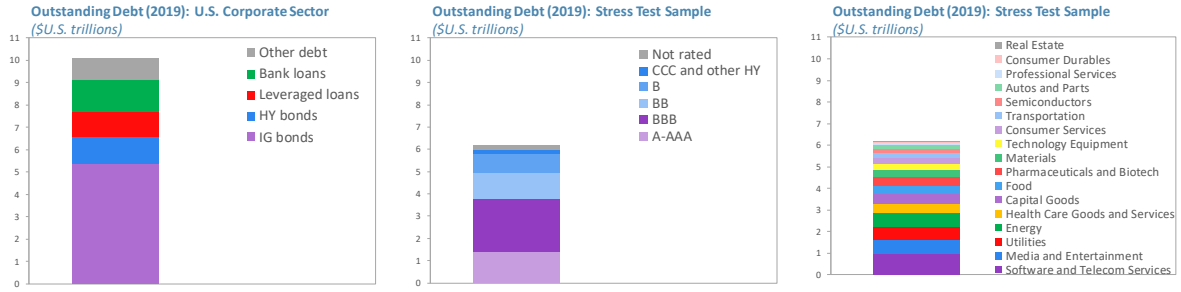
Figure 4: Number of Companies by Sector



Sources: Capital IQ; and IMF staff calculations.

Total outstanding debt for the firms in our stress test sample amounted to $6.2 trillion at the end of 2019. This compares with overall debt of the U.S. corporate sector of $10.1 trillion (Figure 5). Investment grade rated debt accounts for 60 percent of total outstanding debt in our sample—BBB-rated debt alone represents 38 percent of total debt—and the remaining is made of high yield and unrated debt. In terms of sectoral distribution, software and IT, media and entertainment, utilities, and energy sectors exhibit the largest aggregate outstanding debt amounts. Together these sectors account for $2.9 trillion (around 46 percent of total outstanding debt in our sample).

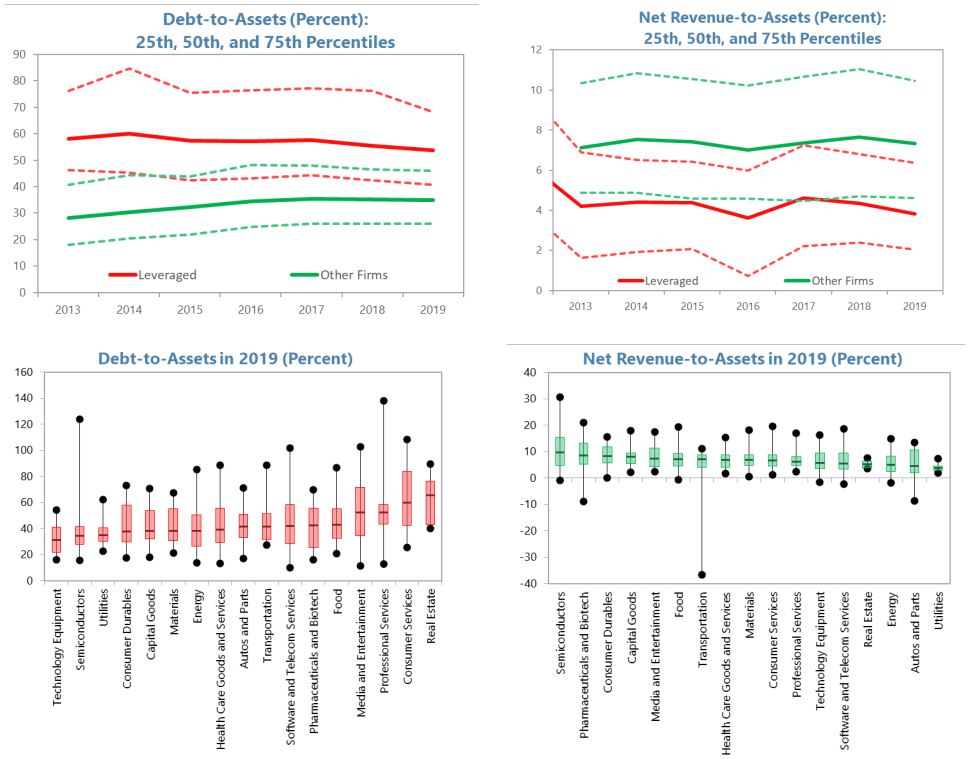
Figure 5: Outstanding Debt of the U.S. Corporate Sector and the Stress Test Sample



Sources: Capital IQ; Financial Accounts of the United States; Federal Reserve Board; and IMF staff calculations.

The median debt-to-assets ratios of leveraged firms have been declining during the past six years while there has been an upward trend in debt-to-assets ratios of the less leveraged firms, with the median mounting to 34.8 percent in 2019, albeit remaining some 20 percentage points lower than the median for leveraged firms (Figure 6). The net revenue to assets (or return on assets) of the leveraged firms in our sample is considerably lower than that of the other firms, suggesting a less efficient use of assets by the leveraged firms.[10] The median ratio for leveraged firms has dropped below 4 percent in 2019. This pattern holds across sectors, with those sectors with lower debt-to-assets ratios such as semiconductors and consumer durables generally having higher net revenue-to-assets ratios. The utilities sector also has the lowest median net revenue-to-assets ratio below 4 percent (which is likely a product of the limits placed on these firms by regulators).

Figure 6. Selected Financial Indicators—Leveraged vs Other Firms



Sources: Capital IQ; and IMF staff calculations.

[10] These dynamics do not appear to be driven by the lifecycle of the firms. Although younger firms tend to be associated with higher investment spending (in percent of assets), the age of firms does not appear to be statistically linked to their return on assets. Moreover, the higher investment of these younger firms does not seem to be linked to higher borrowing levels, given that older firms—which have been operating for longer periods of time—tend to exhibit higher leverage ratios (or lower net equity positions).

IV. Stress Testing Methodology

Against the backdrop of rising indebtedness within the nonfinancial corporate sector, stress tests can add significant value by shedding light on sectoral vulnerabilities to changes in the economic and financing conditions. In particular, stress tests would reveal the solvency, funding, and liquidity risks faced by individual nonfinancial corporates and the aggregate potential losses they may impose on the broader financial system.

In this section, we develop a framework for stress testing nonfinancial corporates. In these exercises, we distinguish between leveraged and non-leveraged corporates, with a debt-to-EBITDA ratio of 5 separating the two groups, as noted above.

A. Definition of "Solvency" and "Liquidity" Metrics

The circumstances surrounding the decision of a firm to default on its debt obligations—or to file for bankruptcy—are usually complex, dynamic, state dependent, and difficult to predict. In principle, a company with serious cash shortages can stay afloat for an extended period provided that the market is willing to fund its operations and roll over maturing debt. Likewise, a firm might be in negative equity (i.e., the value of its liabilities exceeding the value of its assets), yet it can still operate and fund itself if the market believes that future profits will eventually turn the equity position of the firm into positive territory and yield future dividends. That said, firms with weak equity and liquidity positions are certainly more vulnerable to shocks, both macroeconomic and those related to financial and funding conditions, and thus more likely to default than firms with ample liquidity and solvency buffers (see Appendix I). Indeed, persistent negative equity or weak cash positions would normally cause funding challenges, decreased corporate valuation, reduced operations, and eventual distress or even default. Thus, stress tests are mainly geared toward projecting the equity and liquidity position of firms, conditioned on macroeconomic developments reflected in the stress test scenarios.

This study considers two metrics, one to measure the equity position of firms and one to measure the liquidity position of firms, at a given point in time. These two measures are complementary in the assessment of firms' vulnerabilities, which could ultimately result in a firm's distress or default: changes in a firm's equity position provides a picture of potential solvency issues faced by the firm as well as its long-term viability, whereas the liquidity position provides a measure of potential funding needs or cash shortages that the firm can face at a given point in time. These two measures are described in detail below.

Net equity position of firms

The net equity position of a firm can be generally defined as

$$\textit{current net equity position} = \textit{starting net equity position} + \textit{cumulative retained earnings}$$

where the starting net equity position is the reported net capital of the firm (i.e., difference between the value of reported assets, including intangibles, and reported liabilities) and

retained earnings refers to the accumulation of profits (net earnings) net of taxes and dividend payments. Algebraically, this can be written as:

$$K_t = K_0 + \sum_{j=1}^{t} \left(R_j - E_j\right)\left(1 - \tau_j\right) - D_j$$

where K_0 is the reported initial equity of the firm, K_t is the net equity of the firm at time t, R_t denotes the gross revenues (sales) and E_t the gross expenditures of the firm at time t,[11] τ is the corresponding tax rate, and D_t are the dividends paid at time t.

In our stress testing setting, gross expenditures E_t are separated along three components: (i) interest expenditures, (ii) operating expenditures, and (iii) non-interest non-operating expenditures. Interest expenditure depend on the stock of outstanding debt and the prevailing effective interest rate that applies to the different types of debt held. In particular, if the interest rate changes, the new rate would only affect the portions of the debt with variable rates or those being repriced at that particular point in time. More specifically, interest payments I_t at time t can be expressed as:

$$I_t = \underbrace{D_{t-1} i_{t-1}}_{I_{t-1}} + \underbrace{\alpha^{F_t} D_{t-1}\, \Delta i_t}_{\substack{due\ to\ share\ of\ debt \\ with\ variable\ rate}} + \underbrace{\Delta D_t\, i_t}_{\substack{due\ to\ new\ debt \\ issued\ at\ time\ t}}$$

Essentially, the changes in interest rates Δi_t apply to a fraction α^{F_t} of the outstanding debt stock from the previous period D_{t-1}, and any new debt issued at time t is assumed to pay the interest rate prevailing at that time i_t.[12] Changes in interest rates—and thus in the cost of newly-issued debt—are linked to the stress test scenario as well as the creditworthiness of the firm (see next section). We assume that firms aim to roll over maturing bond debt at time t through issuance of new bonds of the same nominal amount (i.e. no changes in the stock of bond debt), and outstanding loan debt gets amortized linearly throughout the remaining maturity of the loan.

Gross revenues as well as non-interest expenditures (both operating and non-operating non-interest expenditures) are modeled as a function of macroeconomic and financial variables included in the stress test scenarios (Section IV.B).

The tax rate τ_t for each firm at time t is assumed to remain constant at the effective rate observed for that firm in the most recent year. Negative profits in a given year lead to 'negative' tax payments which can be carried forward to following period (i.e., implied negative tax liabilities are treated symmetrically relative to positive tax liabilities in terms of

[11] Expenditures E_t in the net equity position metric relate to 'accounting' expenditures, which includes non-cashflow items such as depreciation. This differs from the liquidity and financing need metrics introduced subsequently, which use cashflow-based expenditures.

[12] The computation of interest expenditures under stress allows for the quantification of potential funding risks, which are measured through the increase in interest rates (or corporate spreads) embedded in the different stress test scenarios.

the net equity position, and are thus added to the net equity position). Dividend distributions are assumed to be paid (at a rate of 50 percent) when after-tax profits are positive, and are zero otherwise. [13, 14]

Net cash position and liquidity need of firms

The liquidity or net cash position of a firm can be generally defined as

current net cash position = starting net cash position + cumulative net cash inflows

where the starting net cash position of the firm is the reported cash (and cash-equivalent assets) at the beginning of the stress test period, and the net cash inflows are the difference between gross cash inflows and gross cash outflows at each point in time during the stress testing period.

In principle, gross cash inflows can include: (i) gross revenues, (ii) cash obtained from new debt (bonds and loans) issuance, and (iii) cash derived from asset sales or liquidations. Gross cash outflows can include: (i) gross expenditures (both interest and non-interest cash expenditures) ─potentially including capex or investment spending─and (ii) cash outflows due to debt amortizations (including repaying maturing debt).

In practice, detailed information on non-cash asset holdings is rarely available, and it is therefore difficult to attribute a potential cash value to the firm's assets in case of liquidation. Moreover, the focus of this study is on nonfinancial corporates, whose non-cash assets are fairly illiquid and are mainly in the form of real estate, equipment, intellectual property products, and other illiquid assets.[15] Thus, our stress tests assume that firms do not engage in sales of their assets although it may well be that a diversified firm facing liquidity stress will sell components of their business to support the liquidity needs of other parts of the business.

To assess the potential liquidity needs (or surplus) of firms, our stress test centers mainly on two areas of net cash inflow needs: those required to cover potential net revenue shortages (i.e., when expenditures exceed gross revenues) ─which are dependent on the macroeconomic scenarios─and those derived from contractual debt obligations (i.e., amount of maturing debt and other debt amortizations) abstracting from any inflows from potential debt issuance. In other words, the liquidity needs (or surplus) of firms is defined as:

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[13] Sensitivity analysis using different dividend payout rates (from 0 to 100 percent) are included in Appendix II. Results show very little sensitivity to using different dividend payout rates, as firms with an initial positive net equity position can only fall into negative equity when they have (one or more periods of) negative profits which do not entail any dividend payouts.

[14] Other activities or usage of firms' proceeds─such as share buybacks, mergers and acquisitions, etc.─are not envisaged in our stress tests.

[15] At the end of 2019, these nonfinancial assets accounted for about 55 percent of U.S. nonfinancial corporates' total assets, whereas cash and deposits accounted for only about 3½ percent of total assets.

current net liquidity need = starting net cash position + net cash revenues + debt amortization

where net cash revenues equal gross revenues less gross cash expenditures,[16] and are net of tax and dividend payments computed earlier. This is similar to the computation of retained earnings above, but replacing non-interest expenditures from the P&L accounts by non-interest expenditures on a cash basis. Moreover, cash expenditures might also include capex spending or not (both cases are considered in our stress tests). Algebraically, the net liquidity need L_t of a firm can be written as:

$$L_t = L_0 + \sum_{j=1}^{t} \left[\left(R_j - E_j^{cash} \right) \left(1 - \tau_j \right) - D_j \right] + \sum_{j=1}^{t} A_j$$

where L_0 is the initial cash position (reported cash and cash equivalent) of the firm, L_t is the net cash position of the firm at time t, R_t denotes the gross revenues (sales) and E_t^{cash} the gross expenditures on a cash basis of the firm at time t, τ is the corresponding tax rate, D_t are the dividends paid during that period, and A_t is the amount of debt (bonds and loans) amortized at time t.

The net liquidity need of a firm can be seen as the amount of cash that would need to be borrowed—in the form of either bond, loan, or equity issuance—in order to keep operating. In the absence of such borrowing, the firm would exhaust its cash buffers, and could default on (some of) its obligations or file for bankruptcy protection.[17] When cash inflows from potential debt issuance are not considered, both our measures of net cash position and net liquidity needs are identical to each other in our stress tests.

B. Estimations and Projections of Balance Sheet and Profit and Loss (P&L) Items

The corporate sector stress tests consist of projecting the evolution of the two main measures introduced in the previous section—the net equity position and the net liquidity need—based on the paths for the macroeconomic and financial variables described in the stress test scenarios. Three specific components of these two measures are linked to the macro scenario variables: (i) gross revenues, (ii) interest expenditure, and (iii) other (non-interest) expenditures. In other words, the paths for these three components depend on the behavior of the macroeconomic variables described by the different stress test scenarios.

Gross revenues

[16] Cash expenditures include interest payments, non-interest expenditures on cash basis, and the amount investment spending (if any) in a given year.

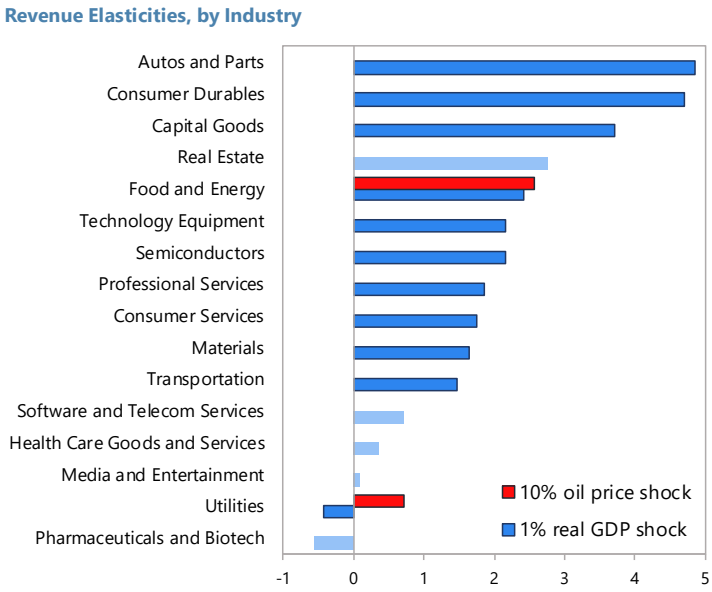
[17] While circumstances could play out differently in practice—e.g., lenders may protect their investments by continuing to fund a failing firm in hopes of a turnaround or may require firms to spin-off profitable parts of their business in order to meet debt obligations—the assumed scenario is meant to illustrate the amount of funding that may be needed during a risk-off episode or a broad-based corporate sector downturn.

Gross revenues, in percent of assets, are explicitly linked to the macroeconomic variables in the stress tests scenarios though a regression model:

$$r_{i,t}^{s} = a_0 + (\boldsymbol{\beta}_0 + \boldsymbol{\beta}_s)\boldsymbol{X}_t + \mu_i + \epsilon_{i,t}$$

where $r_{i,t}^{s}$ is the revenue-to-asset ratio of firm i operating in sector s, $\boldsymbol{X}_t$ is a vector of macroeconomic and financial variables, $(\boldsymbol{\beta}_0 + \boldsymbol{\beta}_s)$ is a sector-specific vector containing the elasticities of $r_{i,t}^{s}$ vis-à-vis the scenario variables in $\boldsymbol{X}_t$, μ_i denotes the firm-specific fixed effects, and $\epsilon_{i,t}$ is the error term. The model is intentionally parsimonious, aimed at capturing the changes in balance sheet and P&L variables—the revenue ratio in this case—that are driven by changes in the macro variables included in the stress test scenarios. In other words, the objective is not to determine all possible factors affecting firm revenues, but rather to link the latter to the finite set of macroeconomic variables underpinning the stress test scenarios.[18]

Figure 7. Elasticity of Revenue to Macroeconomic Variables



Source: IMF staff calculations.
Notes: bold bars (with dark borders) denote statistical significance at the 5 percent level.

Real GDP growth is found to be strongly related to changes in the firms' revenue-to-asset ratio for most sectors (Figure 7). A few exceptions include sectors such as healthcare, pharmaceuticals, biotechnologies, and media and entertainment—perhaps due to their lower

[18] Factors such as business climate, regulatory framework, tax regime, adoption of new technologies, or managerial talent, can have important implications for firms' revenues and profitability. However, none of these factors are included in the stress tests scenarios, and thus cannot be linked to the evolution of our equity and liquidity measures for the purposes of stress testing.

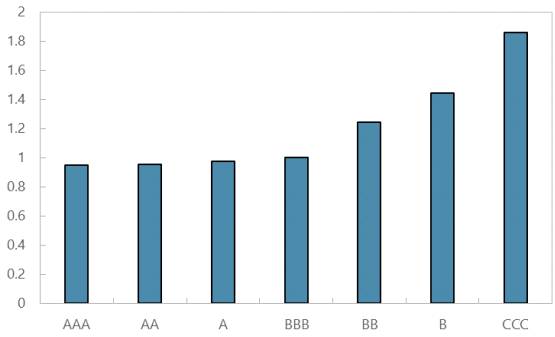
sensitivities to the business cycle.[19] Beyond real GDP growth, oil prices appear to be an important driver of revenues for firms operating in the energy and utilities sectors.

Interest expenditure

Interest expenditures are directly linked to the macroeconomic scenarios through the interest rate path. The prevailing interest rate at each point in time is applied to the portion of debt subject to repricing or with a variable interest rate, and debt issued during that period (as described in Section IV.A). Different interest rates are applied to different credit rating buckets, i.e., the corporate spread shocks in the stress test scenarios are scaled according to the firms' credit ratings (Figure 8).

Figure 8. Scaling of Interest Rate Shocks by Credit Rating

(normalized to BBB spread=1)



Source: IMF staff calculations.

Non-interest expenditure

The modeling of non-interest expenditures (excluding capex spending) is based on the concept that when gross revenue falls, companies try to reduce cost by reducing non-interest expenses, beyond variable costs that fall in line with lower units of output being produced or sold. This can be done via reducing employment, wages, and other indirect costs. The ability of firms to reduce costs in such circumstances depends on a large number of factors, including firm-specific characteristics (e.g. management skills, corporate culture, etc.) as well as characteristics of the goods and labor markets in which the firms operate.

In our stress tests, non-interest expenses are assumed to react to changes in revenues with an elasticity α_r, with value between 0 and 1.

$$\Delta e_t = \alpha_r \, \Delta r_t$$

Where r_t is the revenue-to-asset ratio at time t, and e_t is the non-interest expenditure-to-assets ratio. When $\alpha_r = 0$, firms are unable to reduce any costs in response to changes in

[19] For all other sectors, firm revenue is positively associated with real GDP growth, albeit a few cases are not statistically significant.

revenue.[20] At the other end of the spectrum, when $\alpha_r = 1$, firms can reduce costs to perfectly offset any reduction in revenue. In this case, any impact on revenue is matched by an equivalent change in non-interest expenses, rendering the net revenue acyclical to changes in the macroeconomic scenario. In our stress tests, a value of $\alpha_r = 0.5$ is used for the baseline specification. Results from a sensitivity analysis for different values of α_r are presented in Appendix II. The sensitivity analysis also includes results using the historically estimated α_r for each industry including in our stress tests.[21] Arguably, firms would react differently to a given shock depending on the nature and the magnitude of the shock, and could thus differ from their historically observed responses. To account for this possibility and the inherent uncertainty in determining the potential behavior of firms under stress, Appendix II provides a range for potential losses based on all plausible cases.

The definition of non-interest expenditures is different in the equity position relative to the liquidity position. Changes in equity are closely linked to the accounting treatment used in the income statement (P&L account), whereas changes in the liquidity position are linked to the cash accounts. The main differences relate to the treatment of expenditures—or costs—in the two accounts. In the income statement, non-interest expenditures include non-cash costs such as depreciation or valuation changes. In the cash account, expenditures include items such as investment spending—or capex—which are not fully expensed in a given year in the income statement. Thus, when computing changes in the cash position, the initial non-interest expenditure e_{t_0} derived from the income statement is adjusted to exclude non-cash items (to obtain $e_{t_0}^{cash}$).[22] In addition, cash position measures are computed including and excluding firms' capex as a sensitivity analysis.

C. Stress Tests Scenarios

The stress tests scenarios used in this study follow those in the risk assessment of the 2020 U.S. Financial Sector Assessment Program (FSAP).[23] In particular, two stress scenarios are used to assess the vulnerabilities and potential strains in the U.S. corporate sector over the next few years: a baseline scenario and an alternative (more adverse) scenario to gauge the sensitivity of the stress test results.

The baseline scenario is based on the macroeconomic projections published in the IMF's *June 2020 Update of the World Economic Outlook (WEO)*. This baseline scenario embeds

[20] This extreme case is highly unlikely in practice, as it would imply that variable costs are essentially zero, and that total costs are made of fixed costs only.

[21] Contrary to the other estimations conducted in this paper using gross revenues, this was done by estimating directly *net* non-interest revenues (that is, net revenues excluding interest expenditure) as a function of the macroeconomic variables included in our stress test scenarios.

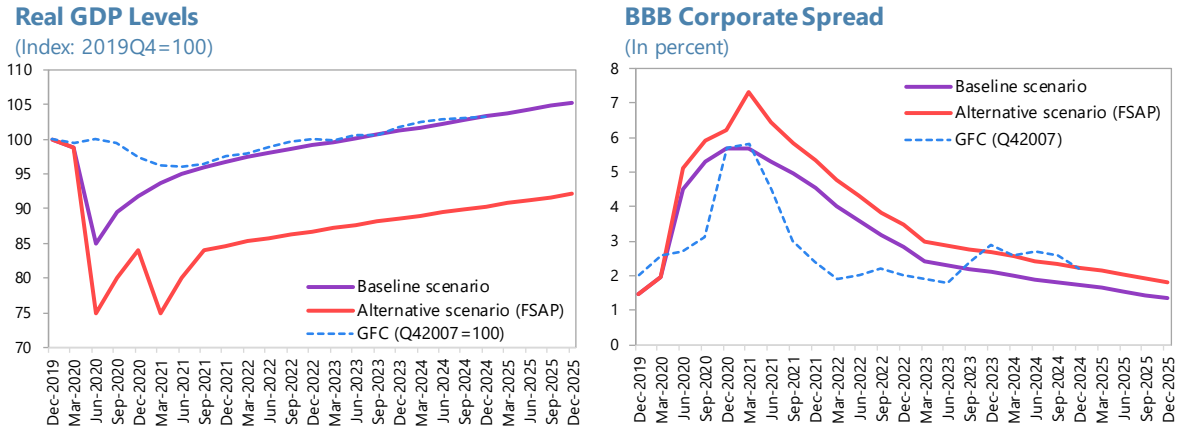
[22] The stress tests use reported data as of end-2019 as a starting value, and changes in revenue and expenditure-to-asset ratios are computed sequentially in subsequent years using the estimated elasticities linking these to the macroeconomic variables defined by the stress test scenarios.

[23] See Technical Note on Risk Analysis and Stress Testing the Financial Sector.

the contemporaneous assessment of the potential impact of the COVID-19 pandemic outbreak and related containment measures on the U.S. economy. This forecast implied a sharp contraction in economic activity in the second quarter of 2020 (Figure 9).

The alternative scenario corresponds to a scenario in which there is a second wave of COVID-19 related infections at the end of 2020, triggering another lockdown—characterized by reduced de facto mobility and social-distancing norms—in 2021Q1.[24] In addition, this alternative scenario assumes output losses of about 25 percent during any lockdown period relative to a 'normal' period (i.e., without the pandemic).[25] In other words, the U.S. economy operates at 75 percent of the pre-COVID-19 level in 2020Q2 and in 2021Q1—implying a "W-shaped" output path. Given the larger output losses relative to the baseline scenario during the lockdown period, the hysteresis losses characterizing the subsequent recovery (i.e. 2021Q2 onwards) are commensurately larger.

Figure 9. Stress Test Scenarios—Selected Variables



Sources: Bureau of Economic Analysis; Haver Analytics; and IMF staff calculations.
Notes: GFC = Global Financial Crisis; FSAP = Financial Sector Assessment Program.

V. Potential Stress Losses in the Corporate Sector

Potential losses can arise when insolvent firms default on their debt obligations or go into bankruptcy proceedings. These potential losses from distressed firms are borne by the equity holders (owners or investors), the debt holders, and the real economy. In what follows, the potential impacts under the two stress tests scenarios are discussed.

[24] The alternative scenario presented here corresponds to the "Sensitivity Scenario 3" in the 2020 U.S. FSAP. In terms of severity, all other sensitivity scenarios used in the FSAP lie in between the baseline and the alternative scenario used in this paper. These two scenarios can thus be seen as the lower and upper bounds of the FSAP stress test scenarios. Results are available upon request.

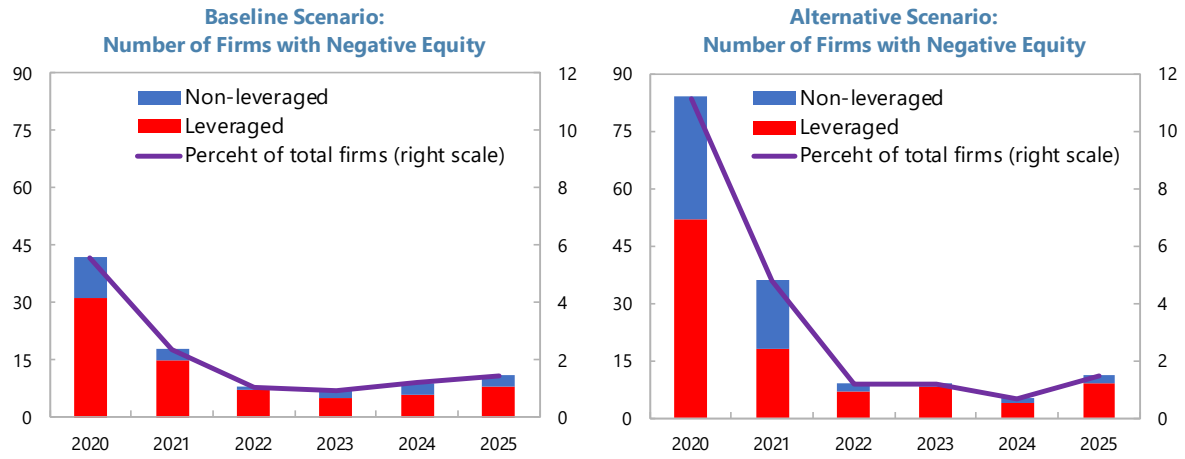
[25] In the baseline scenario, output losses during the lockdown period (in 2020Q2) are estimated to be less than 15 percent relative to a 'normal' period.

A. Solvency Stress and Firms in Negative Equity

Using the equity position metric described earlier, this subsection aims at quantifying the potential number of firms that could fall into negative equity in a given year of the stress test horizon.[26] Their outstanding debt as well as their initial equity market valuation are reported—as proxies for the upper bound of both debt holders and equity investors potential losses (since there will be some recovery value in the event these companies enter bankruptcy). Moreover, in order to assess the vulnerabilities stemming from highly indebted corporates, stress test results differentiate between the leveraged firms—i.e. those with a debt-to-EBITDA multiples higher than 5—and the rest of the sample.

Under the baseline scenario, the number of companies with negative equity reaches 5.6 percent of all the firms in our sample in 2020—the year with the largest macroeconomic losses in the scenario. Around three quarters of the firms with negative equity are leveraged corporates (Figure 10). In the outer years, the share of companies with negative equity increases moderately from just under 1 percent in 2023 to 1.5 percent in 2025. This follows the slight deceleration in real GPP growth over that period (from 2.2 to 2.0 percent), but the number of firms with negative equity remains broadly in line with the levels observed in recent years (under 2 percent) —i.e. before the COVID-19 pandemic.

Figure 10. Stress Test Results—Firms in Negative Equity



Source: IMF staff calculations.

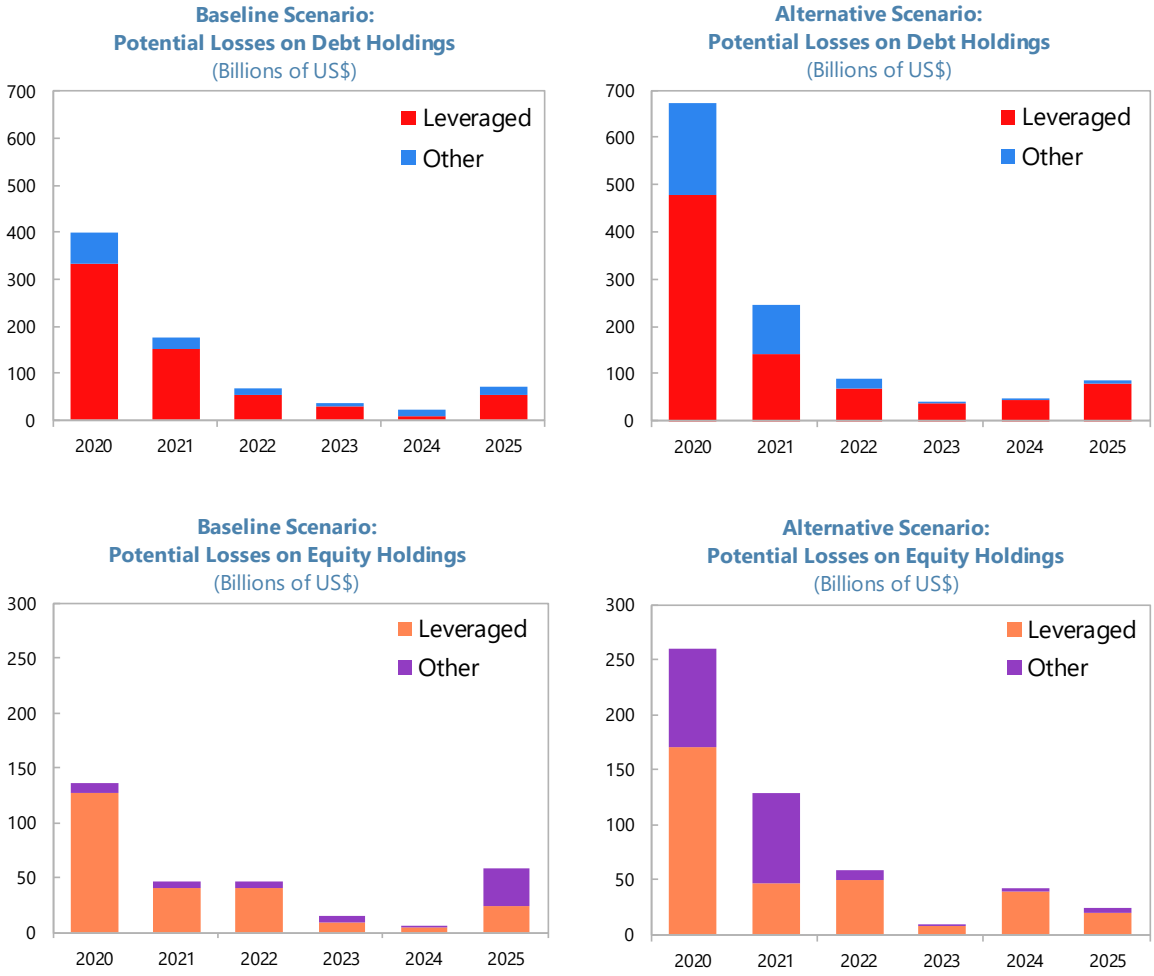
In the alternative scenario, the number of firms falling into negative equity in 2020 increases to more than 11 percent. More than 60 percent of those firms are from the leveraged segment. The number of firms with negative equity in the alternative scenario remains elevated in 2021 (4.8 percent of all firms), and this share only goes back to pre-shock levels in 2022 and

[26] Firms that fall into negative equity in a given year are not allowed to continue—with the potential of turning their net equity position back into positive territory, as the macroeconomic environment improves in the stress test scenario. Essentially, once a firm falls into negative equity, it is treated as if it drops out of the sample.

beyond, pointing to a protracted period of significant corporate stress in this scenario. At the sector level, firms with negative equity are concentrated in the capital goods, auto, energy, and IT sectors.

The initial (end-2019) equity value of the corporates with negative equity in 2020 was $136 billion in the baseline scenario (almost all of it from leveraged firms), and $260 billion in the adverse scenario (Figure 11). These amounts represent an upper bound for the potential value losses for equity holders. Keeping these corporates' equity position in positive territory would require fresh capital injections amounting to $51 billion in the baseline scenario and $231 billion in the alternative scenario.

Figure 11. Stress Test Results—Potential Losses on Debt and Equity Holdings



Source: IMF staff calculations.

The companies with negative equity in 2020 also account for $400 billion worth of outstanding debt ($334 billion by leveraged firms) in the baseline scenario, and for about

$675 billion ($480 billion by leveraged firms) in the alternative scenario (Figure 11).[27] These numbers can be interpreted as the amount of debt at risk—or potential losses for debt holders—in case these corporates with negative equity were to default on their debt obligations.

B. Firms Liquidity Needs and Net Cash Position

To complement the analysis of firms' solvency and potential losses for debt and equity holders, the liquidity position metric is used to assess these firms' potential refinancing needs over the stress test horizon. Different from the prior exercise, financing needs should not be viewed as potential losses. Instead, this metric quantifies the amount of funding that would need to be provided by the financial system—both banks and nonbank financial institutions—in order to finance the continuing operations of the nonfinancial corporate sector.[28]

Three cash position metrics are computed to assess the firms potential financing needs. The first accounts for the firms' initial cash position and the amount of debt that needs to be rolled over at any point in time—which can be interpreted as the contractual financing needs that are independent of the stress test scenario. The second metric measures dynamic (or scenario-dependent) financing needs by combining the first metric with the potential cash shortfall due to the stress test scenarios. For instance, when cash revenue falls sharply due to an adverse macroeconomic shock and the firm is unable to offset the cash losses through spending cuts, then the firm would need to borrow additional cash to fund its operations. Investment spending is assumed to be halted in this second cash position metric. Finally, the third cash position metric combines the second metric with the assumption that firms maintain their investment at the 2019 levels (in percent of assets) throughout the stress test horizon. These latter two cash position metrics can be seen as the lower and upper bounds for the firms' potential refinancing needs in the stress test scenarios. In a situation of macroeconomic stress, most firms will likely significantly cut back investment spending—for instance, in response to lower expected demand—but firms that halt capex altogether are likely to be rare. Thus, the actual financing needs will lie somewhere in between the latter two cash positions—although gauging each firm's adequate level of spending is a difficult and complex task, which is outside of the scope of the stress tests conducted in this paper.

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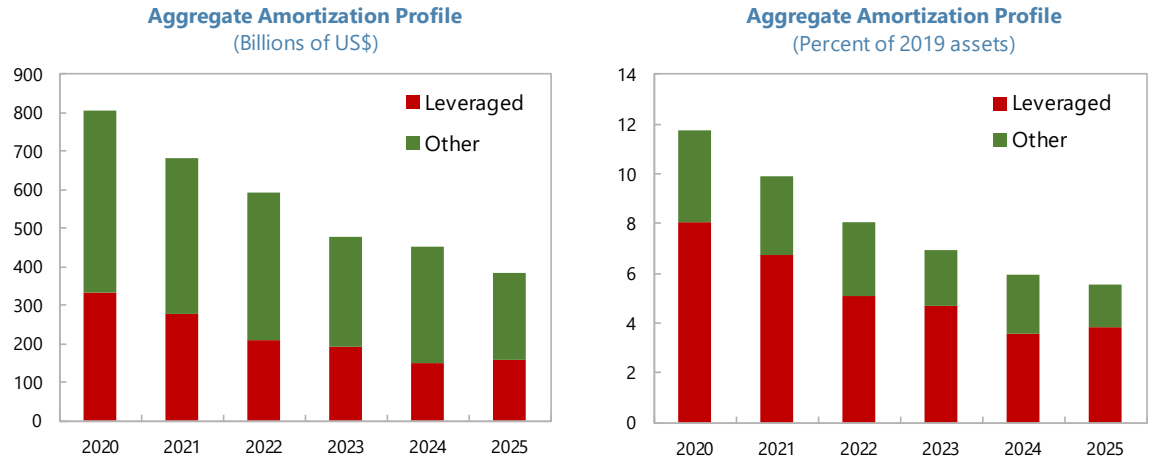
[27] Depending on the relative size—in terms of nominal outstanding debt or equity value—of these firms, the relative pattern of potential debt and equity losses across the different years of the stress test horizon differs slightly from the annual pattern observed in the number of firms with negative equity. For instance, potential debt losses appear to be lower in 2024 relative to 2023 in the baseline scenario (Figure 11), even though there is a slightly larger number of companies that fall into negative equity in 2024 (Figure 10). This is because those companies have lower aggregate debt levels than those that fell into negative equity in 2023.

[28] Note that the assessment of funding risk is explicitly embedded in the solvency metrics presented in the previous section, as changes in net equity positions include the impact from rising corporate spreads—due to e.g. funding liquidity stress—on firms' interest costs and their debt servicing capacity. In particular, stress tests assume that funding is available but at increased cost depending on the firm's credit rating and the severity of the stress test scenario.

Contractual financing needs

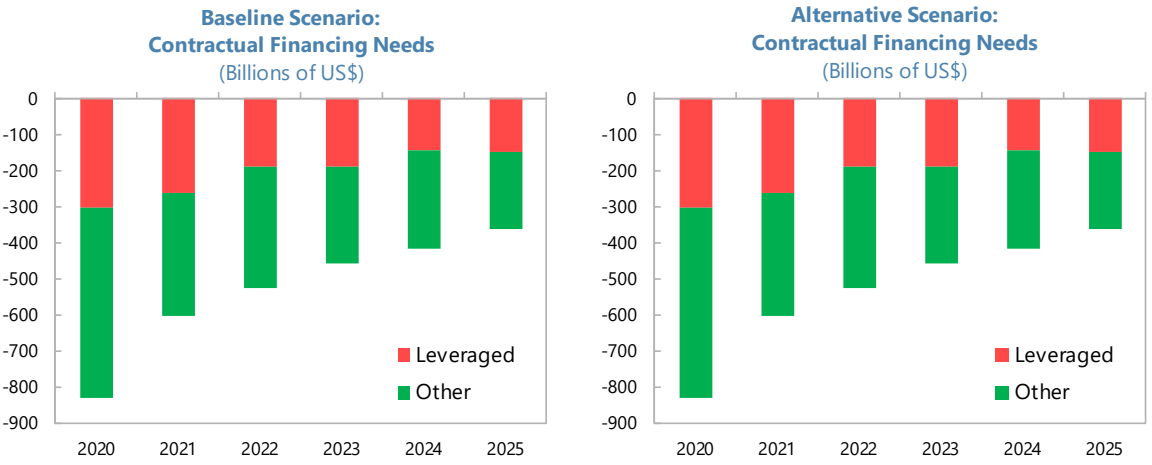
The debt amortization profile—which includes the amount of maturing bond debt as well as loan amortizations—shows that leveraged firms account for about 40 percent total amortizations (Figure 12), even though these firms represent less than a third of our stress testing sample. Moreover, normalized by their asset size, debt amortization for leveraged corporates account for over two third of aggregate debt amortizations.

Figure 12. Amortization Profile of Firms in the Stress Test Sample



Source: Capital IQ; Bloomberg L.P.; IMF staff calculations.

Figure 13. Stress Test Results—Contractual Financing Needs



Source: IMF staff calculations.

Based on firms' initial (end-2019) cash buffers and the amount of debt that needs to be rolled over and loan amortizations in each year of the stress test horizon, the corporate sector's

contractual financing needs would be about $831 billion in 2020 (Figure 13), roughly equivalent to 12 percent of their current stock of outstanding debt. In cumulative terms, the financing required to cover all debt rollover needs over the period 2020-25 is equivalent to $3.2 trillion. In other words, almost half of their total outstanding debt would need to be refinanced by 2025.

Dynamic financing needs

In addition to the contractual financing needs, firms can experience net cash outflows during periods of stress, and would thus need additional borrowing to finance their ongoing operations. These dynamic financing needs are computed both excluding and including capex.[29] Without capex, firms' financing needs in 2020 would amount to $1.4 trillion in the baseline scenario and $2 trillion in the alternative scenario (Figure 14). If firms were to maintain capex at 2019 levels, then these financing needs would be $2.2 trillion in the baseline scenario and $2.8 trillion in the alternative scenario.

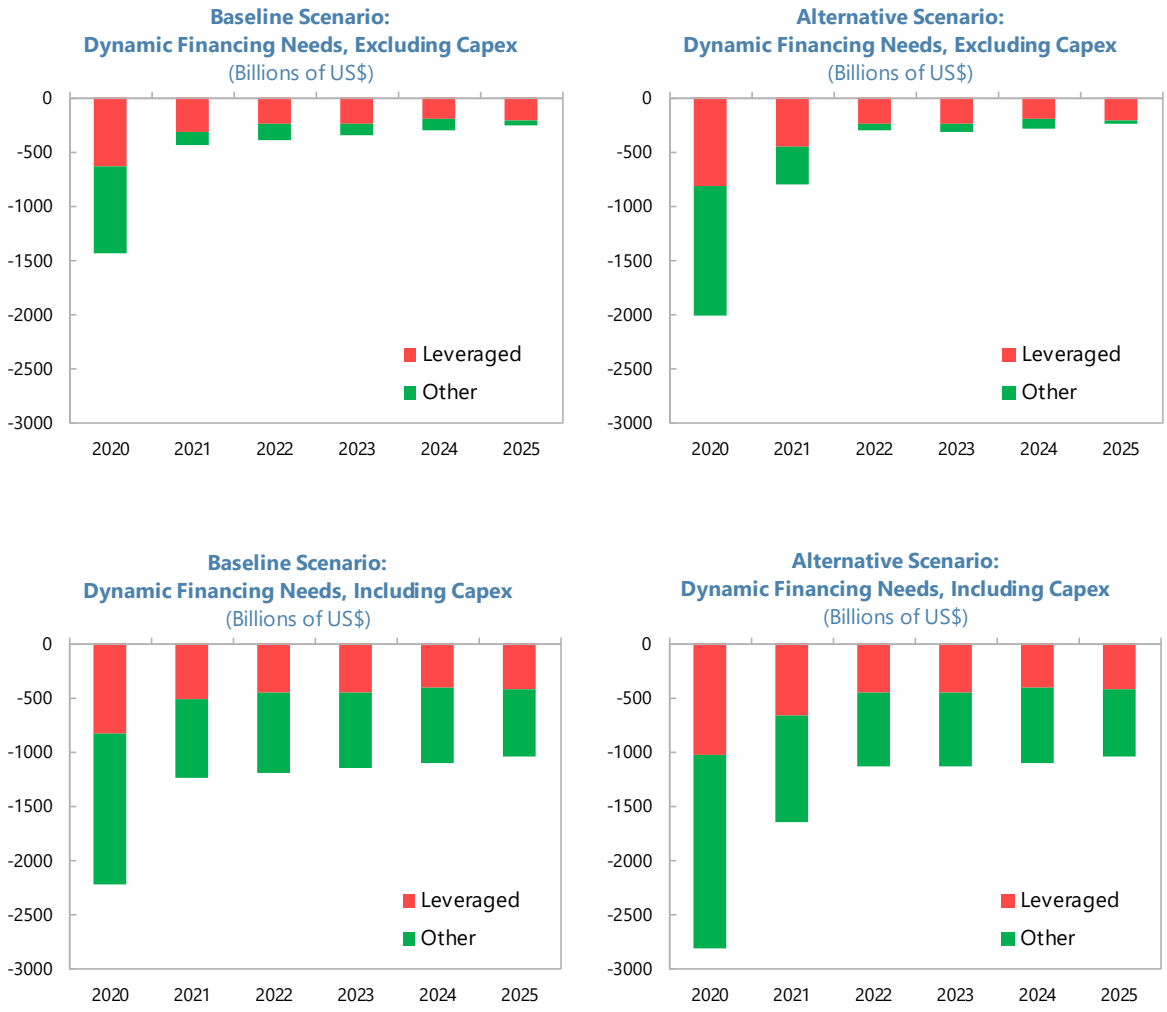
In terms of sectors, the energy sector exhibits the largest financing needs under the different stress test scenarios (Figure 15). Their estimated liquidity needs in 2020 account for a quarter of all sectors financing needs, and range from around $360 billion in the baseline scenario excluding investment spending to $700 billion in the adverse scenario and assuming these firms maintain their capex spending at pre-crisis levels.

These financing needs are also large in other sectors such as auto and durable good producers, utilities, and IT firms. Together, these sectors account for around 41-43 percent of the corporate sector financing needs in 2020. Their relative ranking in terms of financing needs depend on whether firms are assumed to maintain their investment spending at their 2019 levels. Utilities and IT companies tended to exhibit relatively higher capex spending levels (in percent of assets) relative to auto and capital goods manufacturers in recent years.

At the other end of the spectrum, sectors such as pharmaceuticals and biotech, real estate, and professional services present relatively liquidity needs. The liquidity needs in 2020 of each of these sectors are estimated to be around just 1 percent of the financing needs of all the corporates in our sample.

[29] This essentially provides a lower and upper bound for the plausible range of capex spending by firms. The case where firms set their capex levels equal to depreciation and amortization (equivalent to assuming zero new net investment) would intrinsically fall within this range.

Figure 14. Stress Test Results—Dynamic Financing Needs

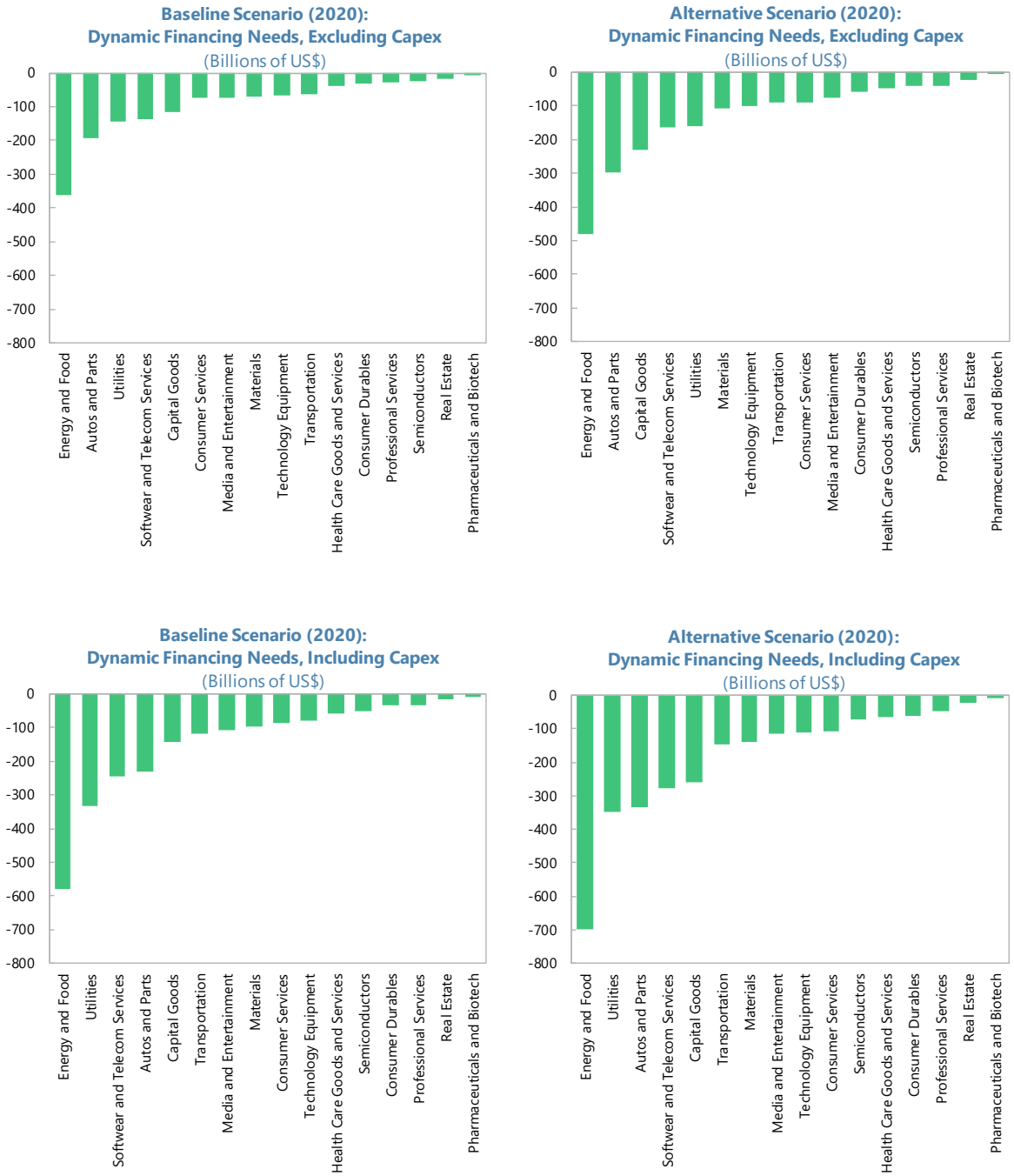


Source: IMF staff calculations.

Financing needs of solvent companies

The financing needs presented above correspond to the aggregate net negative cash position of all the firms in our sample, absent any new debt issuance. As mentioned earlier, this can be seen as the aggregate amount of funding needed in order to finance the continuing operations of the nonfinancial corporate sector. However, a number of firms will fall into negative equity, and some of them will liquidated or cease operations. Those firms would arguably no longer require any additional funding. Thus, the financing need of the firms with positive equity are separated from those that fall into negative equity in the stress tests.

Figure 15. Stress Test Results—Dynamic Financing Needs Across Sectors

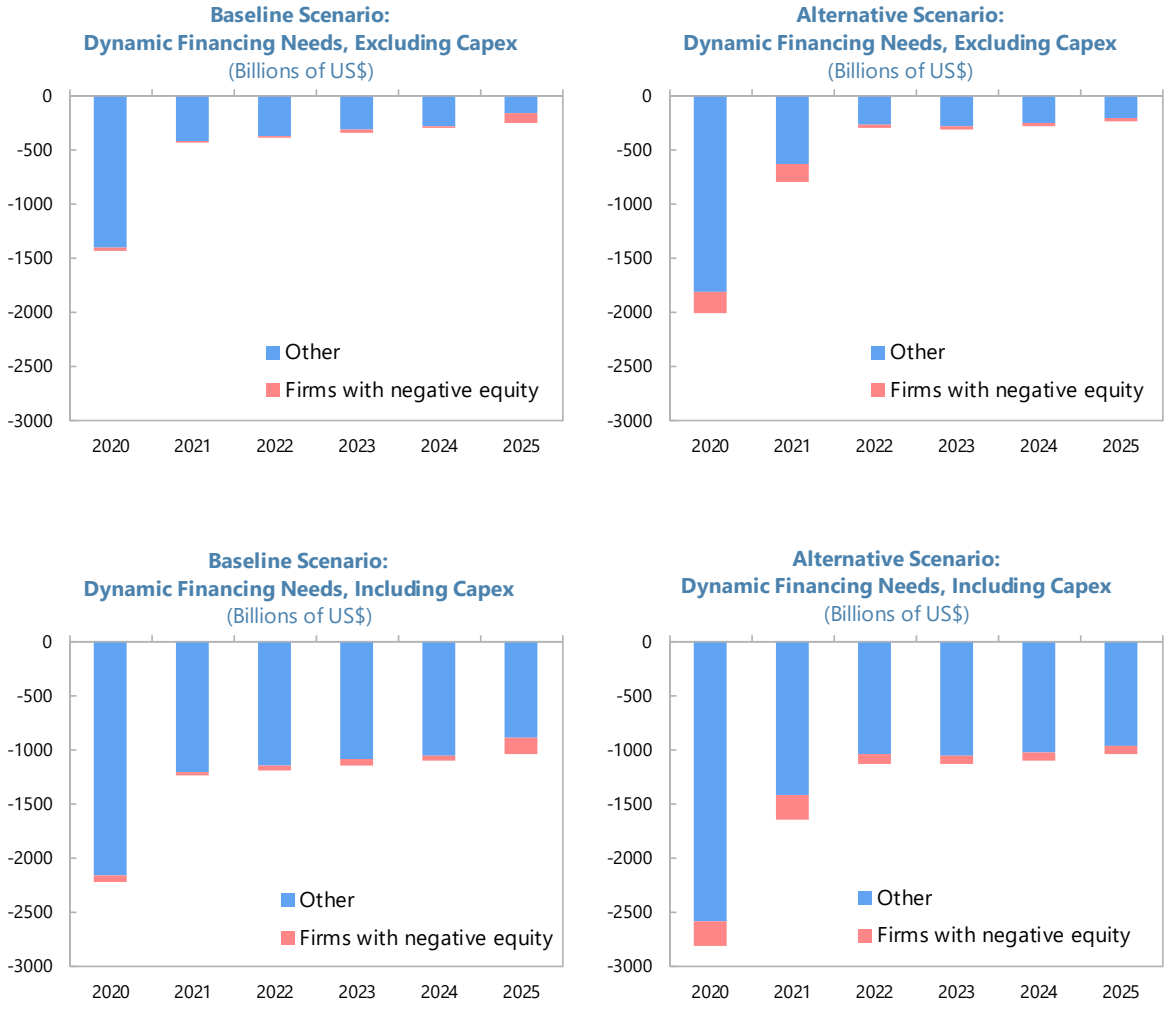


Source: IMF staff calculations.

Figure 16 shows that most of the estimated financing needs relate to firms which maintain a net positive equity position through the stress test horizon. For instance, under the baseline scenario, the dynamic financing needs (excluding capex spending) of firms with positive net equity in 2020 account for $1.4 trillion, while that of firms with negative net equity is just $44 billion. If firms are assumed to maintain investment spending at their 2019 levels, the

corresponding financing needs in 2020 are $2.2 trillion for the firms with a positive net equity position, and $60 billion for those that fall into negative equity in 2020. In other words, only a small proportion of the aggregate financing needs computed earlier accrue to companies with negative equity. This small share of liquidity challenged, and potentially insolvent firms, would arguably not have access to finance from the financial system.[30]

Figure 16. Stress Test Results—Financing Needs of Firms Along their Net Equity Position



Source: IMF staff calculations.

[30] The combined outstanding debt of these firms with negative equity that might not have access to new financing accounts for about $130–300 billion (depending on the scenario), equivalent to 2–5 percent of total outstanding debt in the sample.

Complementary analysis on short-term liquidity needs in light of the COVID-19 outbreak

Given the rapidly evolving macroeconomic and financial environment following the COVID-19 outbreak, and in light of policy measures taken to contain financial market strains in the corporate credit markets, complementary high-frequency stress tests were conducted to assess the vulnerabilities of the U.S. corporate sector over the coming months. In particular, the stress test framework presented in this paper was used to assess the nonfinancial corporate sector's short-term liquidity needs (next 12 months or so) in the context of a sharp revenue shock and the liquidity support provided by the U.S. government (Box 1).

Overall, results suggest that the corporate sector could face significant liquidity needs following the sharp fall in revenue following the COVID-19 outbreak. In particular, the energy sector—which is particularly affected by the significant fall in oil prices—account for a large proportion (70 percent) of the liquidity needs of investment-grade corporates (i.e. those eligible to benefit from Fed liquidity support). However, in the non-investment grade segment (which are non-eligible to Fed liquidity support), there could be a substantial increase in insolvencies, even though the liquidity needs of this segment are relatively small by virtue of their small share of the corporate bond debt market.

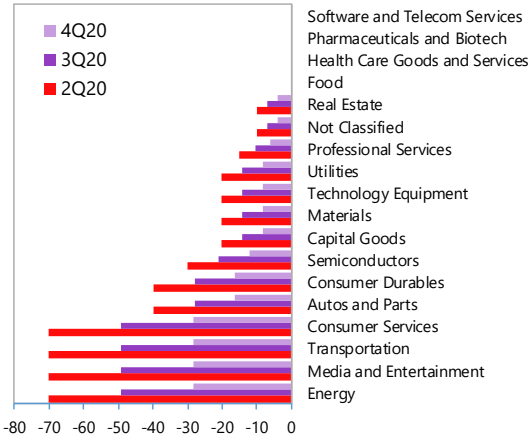
Box 1: Short-term liquidity needs following the COVID-19 outbreak

In the first quarter of 2020 there was a rapid spread of the COVID-19 virus across the world, including the U.S., causing governments to issue stay-at-home orders and mandate closures of places of gathering. The lockdown coincided with a collapse in oil prices. What followed was a period of significant financial market strains, with sharp corrections in equity markets as well as widening corporate spreads. The U.S. authorities took several measures in response to the crisis, including unprecedented fiscal packages and the establishment of credit facilities by the Federal Reserve under Section 13(3) to provide liquidity support to the financial and corporate sector.

The annual stress test framework was adapted to assess the nonfinancial corporate sector's short-term liquidity needs (next 12 months or so) in the context of the shock and the liquidity support provided by the government. Real GDP losses projected in the June 2020 WEO Update were mapped into sectoral losses (for 18 sectors). Using contractual details of outstanding debt and assumptions on revenue and expenditure items, corporates' liquidity (net cash) and solvency (net equity) positions were projected forward. Similar to the annual exercise, the firm's cash position at the end of each month takes into account the initial cash position, net revenue flows, and the amount of bond debt being amortized or rolled over.[31]

The stress test assumes that gross revenue flows fall sharply in the near term and start recovering in 2020Q3. The impact on revenues is expected to vary significantly across industries based on a calibrated sensitivity to the economic shutdown by sector. Companies are assumed to be able to reduce their non-interest expenditures in the near-term by one-half of the decline in gross revenues. Given that nonfinancial corporates eligible for Fed liquidity support are those with investment-grade (BBB-rated or higher) as of March 22, 2020, the sample is split accordingly in those two sub-segments.

Revenue loss by industry
(in percent, relative to 1Q20)



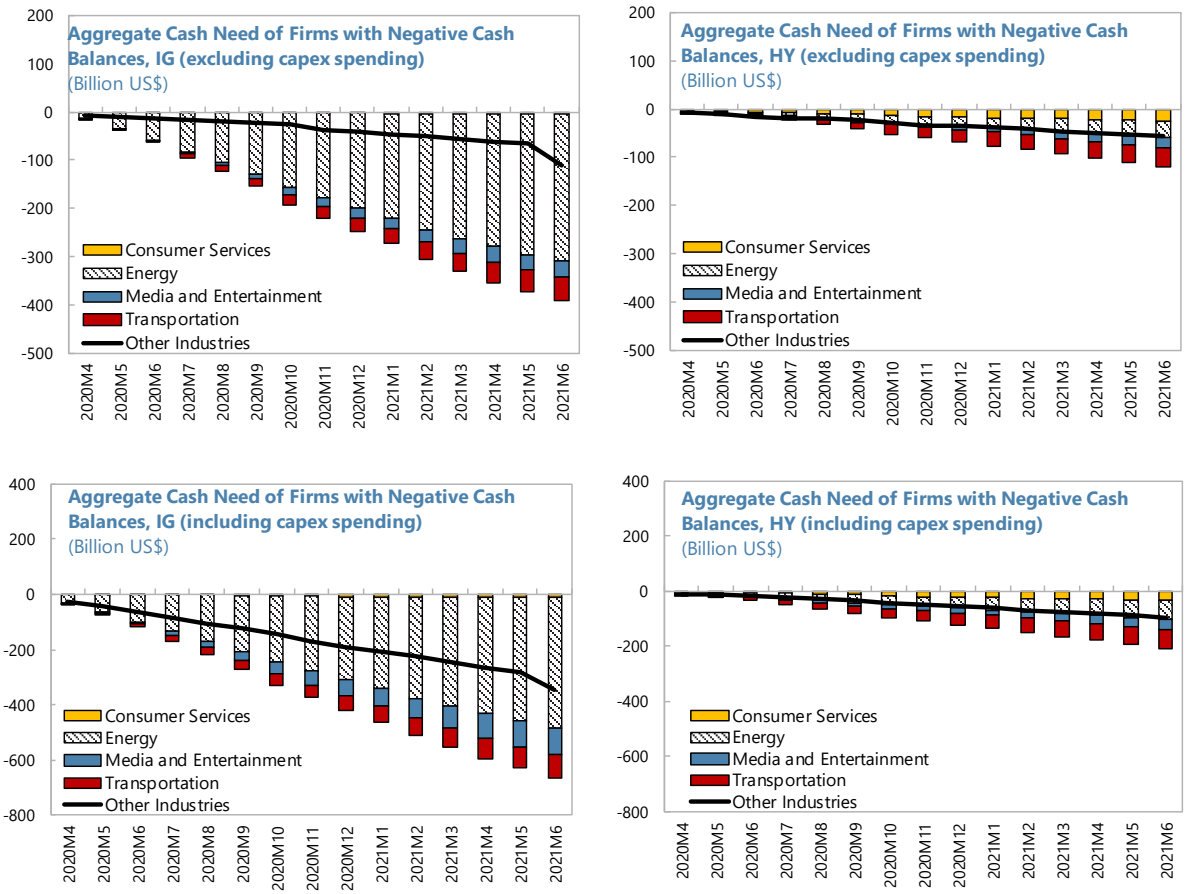
Among those eligible for Fed liquidity support, the largest share of estimated liquidity needs accrues to the energy sector (Box Figure 1). The sector's total outstanding debt is US$580 billion, accounting for 10 percent of investment grade loans and bonds, and almost 70 percent of total investment grade firms' liquidity needs through 2020. If these energy firms were unable to issue debt, over 80 percent of the outstanding debt stock would hit a binding liquidity constraint by year-end. For the other sectors, the estimated liquidity needs amount to US$290 billion by end-2020. However, if these firms were to maintain their pre-crisis investment levels, and outstanding debt that needs to be rolled over through end-2020 were included, then their financing needs would be much larger (US$610 billion).

Given the relatively small share of high-yield firms' stock of outstanding bond debt relative to that of investment-grade firms (more than 4½ times larger), the resulting liquidity needs of the former are relatively small. However, a significant proportion of non-investment grade firms could face substantial

[31] High-frequency data on loan amortization are not readily available, and thus the liquidity needs computed in this box are smaller than the broader annual liquidity need measures presented earlier.

solvency risks, particularly in sectors hit hard by the crisis. Around 15 percent of the debt of non-investment grade non-energy firms (US$485 billion) are estimated to have negative equity by end-2020. These firms are mostly concentrated in entertainment, technology, and transportation and would presumably end up in bankruptcy. Debt issuance needs by the remaining high-yield firms (i.e. those that end 2020 with positive equity) are estimated at an additional US$90 billion (US$140 billion if maintaining pre-crisis investment spending) during the course of 2020.

Box Figure 1. Short-term Financing Needs Following the COVID-19 Pandemic



Source: IMF staff calculations.

VI. Implications For Financial Stability And The Real Economy

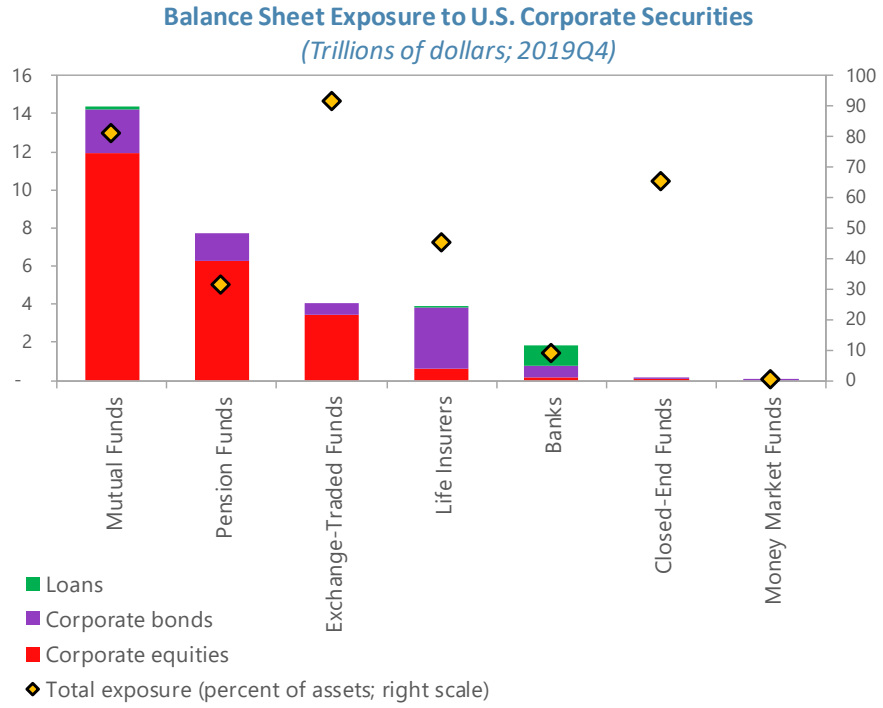
A. Implications for Financial Stability and the Financial System

Section V.A. estimated the potential losses ensuing from nonfinancial firms that would fall in distress—i.e. those with a negative equity position. When firms default on their debt

obligations (bonds and loans), these translate into potential losses for their creditors.[32] Similarly, when a company goes into bankruptcy, its owners or shareholders suffer losses on their equity investment. Distress on a broad scale can also pose risks to the broader financial system.

Banks' direct exposure to the corporate sector remains limited. Based on flow of funds data, bank loans to the corporate sector amounted to $1 trillion at the end of 2019 (Figure 17). Bank holdings of corporate bonds are even smaller at about $650 billion. This is largely due to limitations imposed by regulatory changes included in the Dodd-Frank Act following the global financial crisis. Combined, all these exposures represent less than 10 percent of bank assets. Moreover, overall potential losses on corporate debt were estimated to range from $400 billion in the baseline scenario to $675 in the alternative scenario—only a fraction of which would be borne by banks. This compares to banks capital buffers in excess of $1 trillion.[33] Potential losses to the banking system stemming from their direct exposure to the U.S. nonfinancial corporate sector therefore appear to be a priori contained.

Figure 17. Exposure of Selected Financial Institutions to the U.S. Corporate Sector



Source: Financial Accounts of the United States (Flow of Funds); and IMF staff calculations

[32] The actual losses for creditors from a defaulted asset would depend not only on the nominal amount of the defaulted debt instrument, but also on the recovery rate (or loss given default). Estimation of recovery rates under stress is an integral part of the stress test of financial institutions, but is beyond the scope of this paper.

[33] Common equity Tier 1 (CET1) capital for the 34 banks analyzed in the 2020 U.S. FSAP (accounting for 98 percent of total banking system assets) amounted to $1.2 trillion in 2020Q1, and their Tier 1 capital amounted to $1.4 trillion.

Certain nonbank financial sub-sectors and institutions appear to have significant exposures to the U.S. corporate sector. At the end of 2019, mutual funds' holdings of corporate bonds amounted to $2.3 trillion (13 percent of assets) and investments in corporate equities of almost $12 trillion (68 percent of assets). Direct exposures were also large for pension funds ($7.7 trillion, 32 percent of assets), exchange-traded funds ($4 trillion, 92 percent of assets), and life-insurers ($3.8 trillion, 45 percent of assets). Other types of investors present small nominal exposures to corporate securities, but these exposures remain large relative to their own balance sheet size—for instance, closed-end funds (with their corporate sector exposure representing 65 percent of assets).

Certainly, some of these relatively high exposure levels reflect the business model of some of these financial sub-sectors. For instance, certain mutual funds specialize in corporate bonds or corporate loans—with some funds specifically targeting high-yield debt. However, in a situation of severe stress in the corporate sector, these nonbank financial institutions will likely face the lion's share of the losses.[34] To illustrate this, if we assume that the 11 percent of the corporates which fall into negative equity in the alternative scenario were to default on their debt obligation and go into bankruptcy, then 11 percent of debt and equity holdings of these financial institutions would be *at risk*: this would amount to $1.6 trillion for mutual funds, $850 billion for pension funds, and $425 billion for life-insurers—but only about $200 billion for banks.[35]

B. Potential Implications for Activity and the Real Economy

Beyond the impact on financial stability through potential losses on financial system balance sheets, stress in the corporate sector can have broader adverse macroeconomic consequences. Distressed firms can potentially reduce their investment spending as well as scale back their operations—thus reducing output an employment. This individual behavior of distressed firms can translate into a collective reduction in economic activity and demand, exacerbating the effects from the initial (exogenous) shock.

The aggregate amount of investment spending by the firms included in the stress testing sample amounted to $686 billion in 2019, largely concentrated in the utilities, energy, and IT service sectors (Figure 18). This compares with an aggregate investment of nonfinancial corporates of about $2.1 trillion in the flow of funds accounts,[36] and a corresponding corporate capital consumption allowance—that is, the amount of money a country has to spend each year to maintain its present level of economic production—of about $1.7 trillion.

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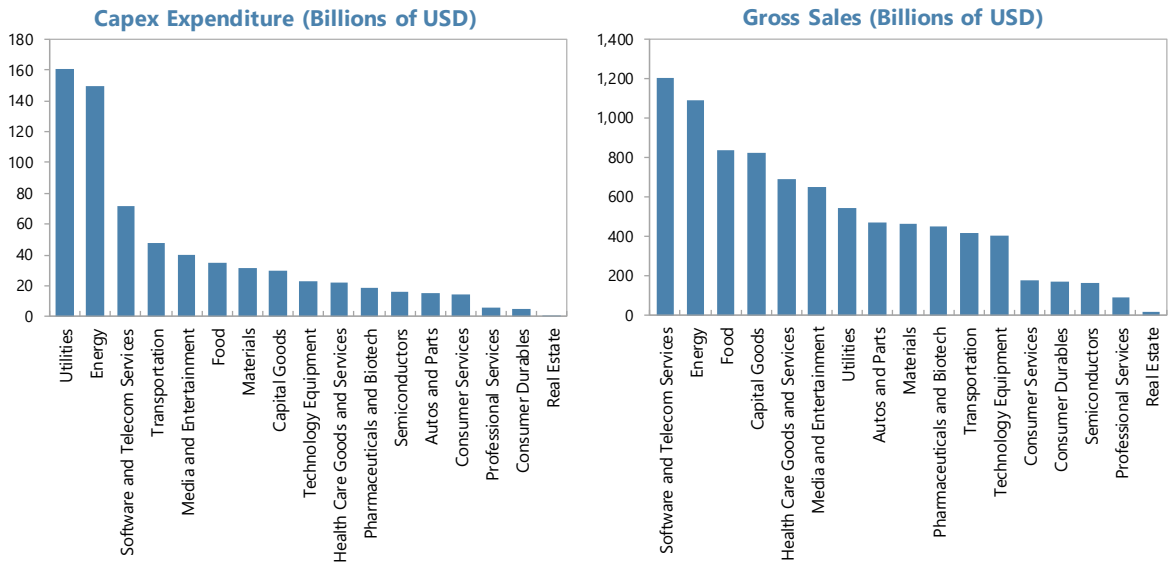
[34] More detailed analyses on the potential impact on banks, mutual funds, and insurance companies were conducted within the stress test setting of the 2020 U.S. FSAP. See Technical Note on Risk Analysis and Stress Testing the Financial Sector.

[35] Expected losses would be smaller than these 'exposures at risk', crucially depending on their corresponding recovery rates.

[36] Officially known as the *Financial Accounts of the United States*.

Our stress tests suggest that the amount of investment spending at risk—corresponding to the capex spending of firms that fall into negative equity—would account for close to 8 percent of total capex spending in our sample under the baseline scenario (13 percent in the adverse scenario).

Figure 18. Investment Spending and Gross Sales of Firms in the Sample in 2019



Source: IMF staff calculations.

Revenue from gross sales of the firms in our sample amounted to $8.7 trillion in 2019. This compares with total gross output of the nonfinancial private sector of around $30 trillion in the U.S. national accounts.[37] Stress test results suggest that the amount of gross sales corresponding to those companies that are projected to fall into negative equity in 2020 account for about 7 percent of total gross sales (or 9 percent of total gross sales cumulatively over the period 2020-25) in the baseline scenario. These amounts would increase to 11 percent and 12 percent of total gross sales, respectively, in the adverse scenario. These numbers could be perceived as the share of corporate sector gross output that would be at risk if the firms that fall into negative equity were to close down or stop operating.

Data gaps regarding wage bill-related spending by the firms in our sample are important, with data missing for a large number of companies in our sample. The aggregate wage bill for the corporates in our sample amounted to about $1.9 trillion. This compares with a total amount of wage and salary income of about $6.8 trillion within personal income in the national accounts, corresponding to the nonfinancial private sector. Nevertheless, stress tests suggest that the firms that would fall into negative equity for which wage bill data are available account for about 6 percent of the aggregate wage bill in the baseline scenario in 2020 (9 percent cumulatively over 2020-25). In the adverse scenario, the wage bill share of

[37] The nonfinancial private sector includes other sub-sectors, such as the noncorporate business sector as well as households and nonprofit organizations.

firms with negative equity would increase to 11 percent in 2020, and 17 percent cumulatively over the period 2020-25.

VII. Conclusion

The paper analyzes the potential vulnerabilities of the U.S. corporate sector using stress tests and scenario analysis. In particular, the study aims to quantify the potential losses stemming from corporates falling in distress across hypothetical stress scenarios.

Solvency of firms is measured using net equity position metrics. Although the voluntary or involuntary decision of a firm to default on its debt obligations or to go into bankruptcy is complex and hard to predict, we use the firms' net equity position as an objective proxy for quantifying the likelihood a firm will face distress and the resulting potential losses that may be borne by debt and equity investors. These potential losses relate to the firms' outstanding debt (bonds and loans) as well as changes in equity valuations (for the owners of the firm's capital or shareholders).

In addition to providing a measure of the firms' solvency stance as well as potential debt and equity losses, the analysis also provides a quantification of these firms' expected financing needs over the coming years. Several liquidity metrics are computed, taking into account the firms initial cash position, contractual details on debt maturing and rollover needs, as well as changes in firms' cash inflows and outflows (depending on the severity of the scenario), and accounting for whether firm cut or maintain their investment spending levels.

Overall, the paper finds that a significant number of firms could fall into negative equity in the stress test scenarios, ranging from about 5 percent of the firms in the baseline scenario to about 11 percent in the alternative scenario. The corresponding amounts of outstanding debt—which could be at risk of default—for these corporates range from $400 billion to $675 billion in these two stress test scenarios. Equity holders could experience potential valuation losses in their equity holdings of around $136 billion in the baseline scenario, and double that amount in the alternative scenario. These losses are likely to be relatively concentrated in the autos, capital goods and durable goods manufacturers, and energy (oil and gas) sectors. In terms of financing needs, the energy sector appears to have the largest short-term liquidity needs (accounting for the largest share of investment grade financing needs).

Leveraged firms—those with a debt-to-EBITDA ratio higher than 5—represent only a small proportion (32 percent of the firms in our sample; accounting 33 percent of outstanding debt), but account for the largest share of companies falling into distress (ranging from 62 to 74 percent depending on the scenario), as well as for the largest share of potential debt and equity losses. Given their relatively small size and recent extensions to their debt maturity profiles, their liquidity needs appear to be moderate. However, in a situation of market pressure and funding liquidity strains, riskier corporates could experience significant challenges.

In terms of potential risks to financial stability, expected losses on the financial system resulting from its direct exposure to the corporate sector appear to be broadly manageable

given existing buffers in the financial system. There is, however, an important heterogeneity between banks and nonbank financial institutions. Banks have relatively small direct exposures to the U.S. corporate sector, with corporate loan and debt holdings accounting for less than 10 percent of bank assets and the estimated potential losses appear relatively small compared to bank capital buffers. However, other segment of the financial system, notably mutual funds, pension funds, and life-insurers, exhibit larger exposures to the U.S. corporate sector in their balance sheets. In a situation of severe stress, some of these nonbank financial institutions could face significant potential losses as well as redemption pressures and market strains (although are not subject to the same maturity transformation and run risks as the banks with the investors in these instruments largely facing a mark-to-market of the losses).[38]

In addition to financial system losses, stress in the corporate sector could also have broader macroeconomic implications through reduced output and aggregate demand. In particular, distressed firms could be forced to reduce their investment spending as well as cutting other costs, such as labor costs. This could in turn further reduce demand and exacerbate the economic downturn (creating a broader feedback loop that could have important implications for both bank and nonbank institutions). Stress tests results suggest that the firms that could fall into negative equity would account for a sizeable proportion of aggregate investment, employment, and output. Corporate sector gross output could be affected significantly if these distressed corporates were to be forced into bankruptcy or were to stop operating altogether.

[38] See Technical Note on Risk Analysis and Stress Testing the Financial Sector for more details.

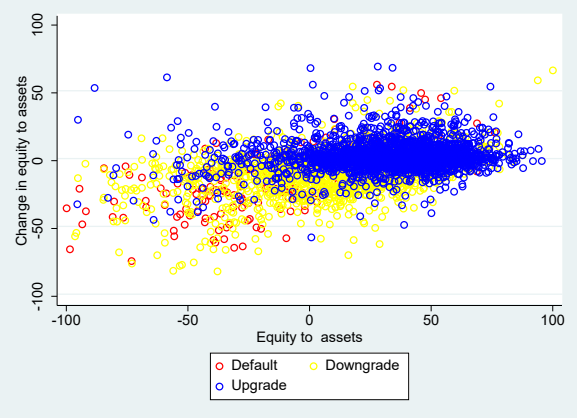
APPENDIX I: RELATIONSHIP BETWEEN EQUITY AND LIQUIDITY POSITIONS AND HISTORICAL CREDIT DOWNGRADES AND DEFAULTS

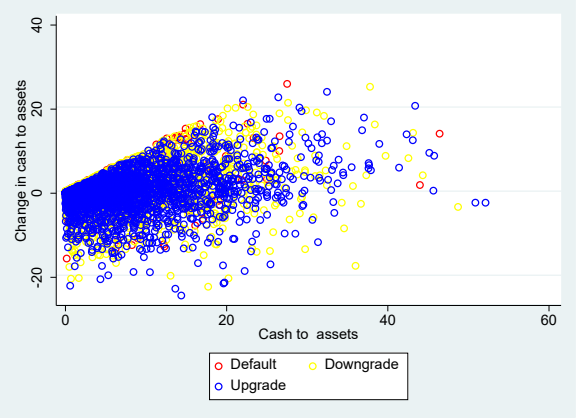
While the focus of the paper is on estimating equity and liquidity positions under stress, these variables can of course also be the drivers of credit rating changes and default events.

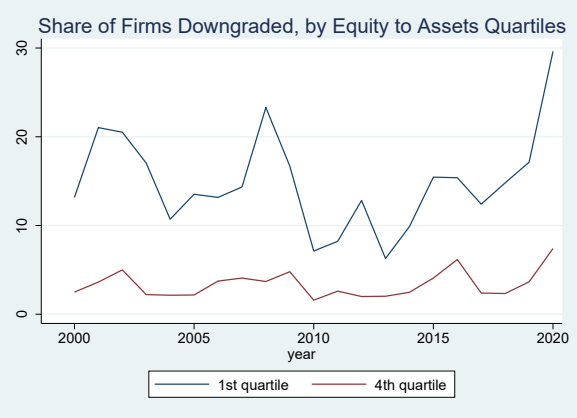
Figure A1 plots the firms' equity and cash positions against their changes, and show whether each firm-year data point corresponds to an upgrade, a downgrade, or a default event (top charts). Firms experiencing downgrades or defaults tend to be those that have fallen into negative equity positions. In other words, credit downgrades and defaults are associated to weaker equity positions. This pattern, however, does not hold when looking at cash positions. This distinction between equity and cash positions remains when looking at the time dimension (middle charts). The figures show the share of firms downgraded in different quartiles of the equity and cash distribution of each year. While weaker equity positions (1st quartile) distinctively saw a greater share of downgrades, this pattern is less clear when looking at liquidity positions.

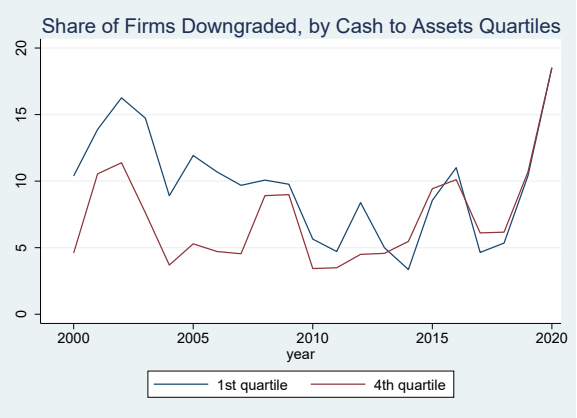
Controlling for equity positions, however, firms' liquidity conditions appear as important in their association with credit rating downgrades. This is shown in Figure A1 (bottom charts), which also plots the estimated downgrade probability from a probit model with year fixed effects. Both equity and cash to asset ratios are statistically significant in the probit. With equity positions evaluated at their means, the bottom-right chart illustrates the steady decline in the estimated downgrade probability as cash to assets increase. In other words, if the goal were to estimate downgrades, both cash and equity positions would be important determinants to consider. In contrast, a probit with default as the dependent variable shows a statistically significant relationship with equity, but not with cash positions. This result may reflect the fact that insolvent firms are likely to end up in default while it is likely that illiquid but solvent firms are typically able to maintain access to financing, and continue operating.

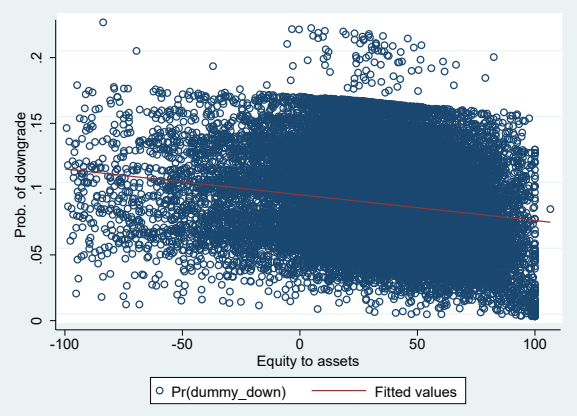
Figure A1. Equity and liquidity positions, downgrades, and defaults

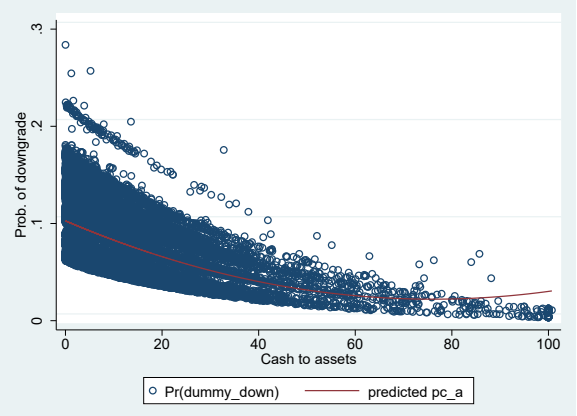












Source: IMF staff calculations.

APPENDIX II: SENSITIVITY ANALYSIS

This appendix provides a sensitivity analysis of the main results presented in the paper. A key parameter in the stress test is the elasticity α_r, which determines the ability of firms to cut costs when revenues fall. Another parameter whose value is assumed in this paper relates to the dividend payout rate. This section shows the evolution of the main numerical results when the values of these parameters are allowed to vary within their entire possible range.

Sensitivity of expenditures in response to changes in revenue

The elasticity α_r, determines how non-interest expenses react to changes in revenues. This elasticity can, in principle, vary from zero to one, where $\alpha_r = 0$ implies firms are unable to reduce any costs in response to changes in revenue. $\alpha_r = 1$ implies firms can reduce costs to perfectly offset any reduction in revenue, thus making net non-interest revenues independent of macroeconomic shocks.

Figure A2 shows the estimated number of firms with negative equity—under both the baseline and the alternative scenarios—when we allow the values of the elasticity α_r to vary from 0 to 1 (top charts). In addition, the corresponding amount of outstanding debt at risk owed by these firms in negative equity as well as their initial (end-2019) equity value—which represent the potential debt and equity losses for creditors and equity investors—are also computed for different values of α_r (bottom charts).

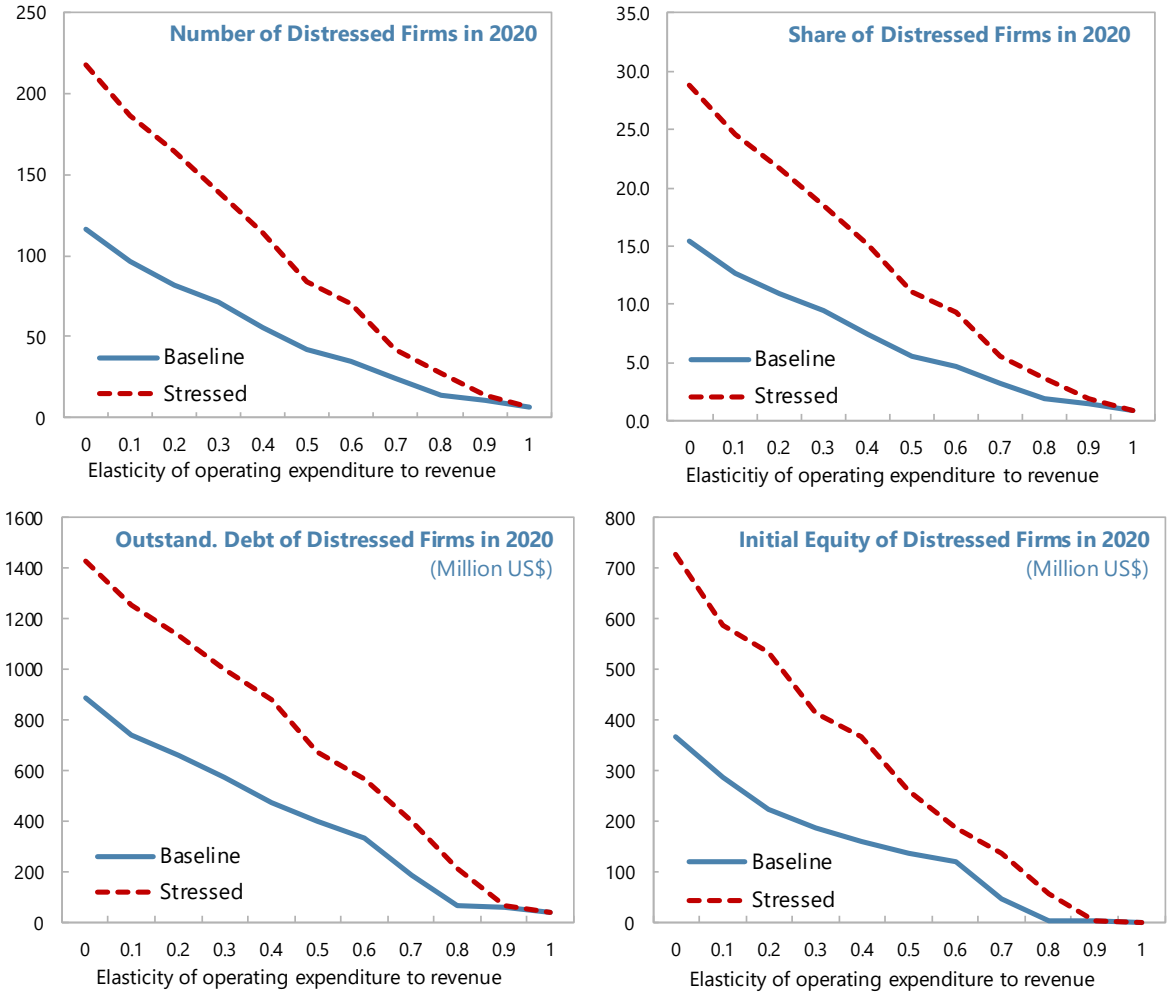
These sensitivity tests show that, as expected, potential losses increase as the ability of firms to reduce non-interest costs in response to a decrease in revenue is lower (i.e. low values of α_r). For low values of α_r, the share of companies that fall into negative equity in 2020 ranges from about 15 percent of all firms in the baseline scenario to about 28 percent in the adverse scenario. This compares with 5.6 percent and 11.1 percent in the baseline and alternative scenarios, respectively, when using our central case value of $\alpha_r = 0.5$. In addition, the corresponding amount of debt at risk (i.e. outstanding debt of firms with negative equity) for low values of α_r ranges from around $890 billion in the baseline scenario to around $1.4 trillion in the alternative scenario. Although these potential losses are large relative to the central case ($\alpha_r = 0.5$), the main qualitative findings—for instance, in terms of implications for financial stability—remain broadly the same.

At the other end of the spectrum, when $\alpha_r \approx 1$, the results become essentially the same for both scenarios, as expected. In that case, only 1 percent of the firms in the sample fall into negative equity in 2020. This level is not too far from the pre-shock level, as effective firms are able to accommodate the macroeconomic shock with little impact on net revenues. The corresponding amount of debt at risk remains modest at less than $50 billion. It is worth noting, however, that for values α_r lower than 0.8, these potential losses start increasing rapidly, and vary almost linearly as α_r decreases from 0.8 toward 0.[39]

[39] Historical estimates of the elasticity α_r at the sectoral level suggest that for most industries α_r is in the range from 0.2 to 0.7 (with several of them having an elasticity near 0.7). Thus, in weighted average terms, the

(continued…)

Figure A2. Sensitivity of the Stress Test Results to the Elasticity α_r



Source: IMF staff calculations.

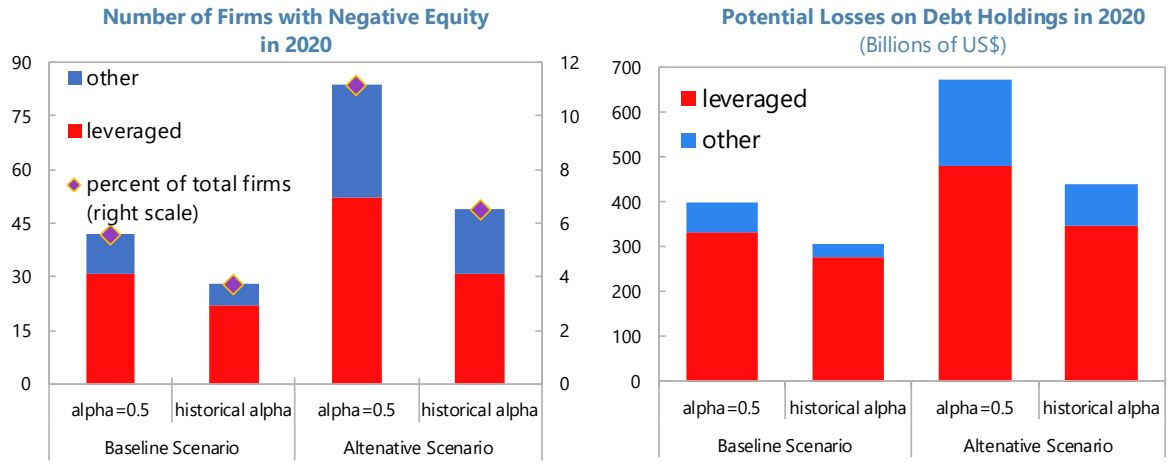
To complement the above sensitivity analysis, stress tests were also conducted using the historically estimated α_r for each of the industries included in the analysis, using annual data over the period 2000-19. Essentially, instead of regressing gross revenues on the macroeconomic variables included in the stress test scenarios, *net* revenues (excluding interest expenditure) were regressed on these variables. Thus, projections of net revenues implicitly embed the historically observed α_r at the industry level, which is—by construction—assumed to remain constant across time.

Figure A3 shows the number of potentially distressed firms under each stress scenario using the historically observed parameter α_r as well as the corresponding potential losses to debt

potential losses using the central case value of $\alpha_r = 0.5$ are slightly higher than when using historical elasticities.

holders, and compare these to the stress test results assuming $\alpha_r = 0.5$ for all sectors. Overall, the number of firms that would fall into negative equity is smaller when using the historical α_r relative to the central case $\alpha_r = 0.5$. For instance, in the baseline scenario, about 5.6 percent of the firms in the sample would fall into negative equity throughout 2020 using $\alpha_r = 0.5$, whereas this share would be about 3.7 percent of all firms when using the historical α_r. Accordingly, expected losses for debt and equity holders are estimated to be larger in all scenarios when assuming that $\alpha_r = 0.5$. Given the inherent uncertainty regarding the potential behavior of firms under a hypothetical and relatively more severe—in historical terms—stress situation, using a slightly more conservative assumption on α_r than its historical average over the period 2000-19 would seem to be more prudent.

Figure A3. Sensitivity of the Stress Test Results to the Elasticity α_r



Source: IMF staff calculations.

Sensitivity to the dividend payout rate

In the parametrization used in our central case, dividends are assumed to be paid out of positive after-tax profits with a factor of 0.5 (i.e. 50 percent of net after-tax profits).[40] Conceptually, this parameter could also vary from 0 to 1. When the dividend payout rate is zero, then any positive after-tax profits are retained to build up capital buffers. When the dividend parameter is equal to 1 (i.e. 100 percent payout rate), all after-tax profits are distributed in the form of dividends to shareholders.

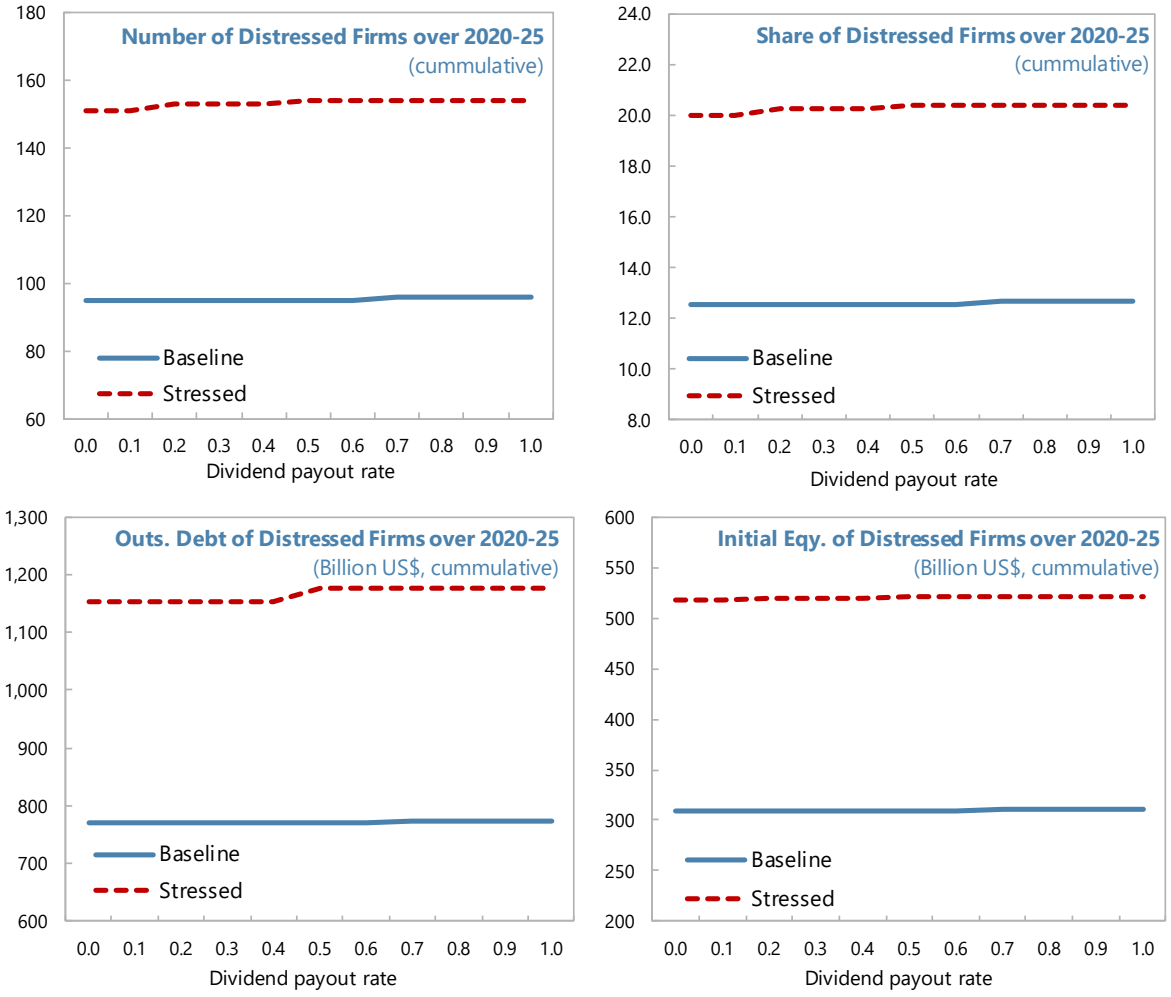
In particular, note that the number of firms that fall into negative equity in 2020 (the first year in the stress test horizon) —and thus the potential debt and equity losses—are unaffected by the assumed value of the dividend payout rate. This is because the only way that a firm that had an initial positive equity position in 2019 would fall into negative equity 2020 is when the firm records a negative net after-tax profit (i.e. a loss) in 2020. In that case, firms

[40] When net after-tax profits are negative, this parameter is always set to zero in our stress tests. Firms are only allowed to pay a fraction (which could be zero) of their after-tax profits when the latter are positive.

with negative profits do not pay any dividends, and the dividend payout rate only affect companies with positive after-tax profits (for which the net equity position can only improve from 2019 to 2020). However, this is not necessarily the case in subsequent years (2021 onwards), as firms that retain a higher share of their after-tax profits would have larger capital buffers to sustain any subsequent shock and/or loss of income.

Figure A4 shows the estimated cumulative number of firms with negative equity over the period 2020-25—under both the baseline and the alternative scenarios—when we allow the values of the dividend payout parameter to vary from zero to one (top charts).

Figure A4. Sensitivity of the Stress Test Results to the Dividend Payout Rate



Source: IMF staff calculations.

Overall, the sensitivity analysis suggests that the results—in terms of estimated number of companies with negative equity and potential losses (to both debt and equity holders) —show very little sensitivity to varying the assumed dividend payout rate. This is mainly due to the fact that most of the losses in the stress tests happen in 2020 (i.e. the year with the largest

macroeconomic shock in the stress test scenarios). As explained earlier, the stress test results in 2020 are invariant to the dividend payout rate. The minor differences observed in the sensitivity results in Figure A4 are driven by a few companies that manage to 'survive' the initial shock in 2020, but through smaller capital accumulations in subsequent years, fall into negative equity when the economy decelerates slightly in our stress test scenarios in the outer years (2023-25).

In fact, even in the alternative scenario, the cumulative number of firms falling into negative equity over the entire stress test horizon is equal to 151 firms when the dividend payout rate is zero, and 154 firms when the dividend payout rate is 100 percent (i.e. a difference of just 3 firms). In the baseline scenario the difference is only one additional firm with negative equity over the period 2020-25. Accordingly, the estimated outstanding debt at risk amounts to $772 billion—cumulatively over the period 2020-25—in the baseline scenario ($1.15 trillion in the alternative scenario) when the dividend payout rate is zero, and $774 billion ($1.18 trillion in the alternative scenario) when that payout parameter is set equal to one.

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