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Corporate Liquidity and Solvency in Europe during COVID-19: The Role of Policies

by Christian Ebeke, Nemanja Jovanovic, Laura Valderrama, and Jing Zhou

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Abstract

European firms are facing an unprecedented shock due to the COVID-19 pandemic, and the policy response has been equally extraordinary. Yet little is known about the effectiveness of policies already implemented in mitigating corporate stress. This paper addresses this issue by quantifying the impact of country-specific corporate sector relief measures taken in response to the pandemic on corporate liquidity and solvency risk using a simulation approach. Using detailed balance sheet and income statement data for over four million European firms, the paper finds that these policies, if implemented as designed, have significantly reduced liquidity shortfalls and helped mitigate job and output losses. Our simulations suggest that, on aggregate, policies could have saved 15 percent of employment and up to a quarter of the value added of the corporate sector in Europe. At the same time, the ability of the measures to curb the increase in solvency risks and to significantly alleviate pressures on SMEs appears more limited. Without additional equity support, some 15 million jobs are at risk. About 2 to 3 percent of GDP will be needed to close the equity gap and provide firms sufficient equity so they would no longer be in difficulty.

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I. INTRODUCTION

The spread of COVID-19, containment measures, and general uncertainty led to a sharp reduction in activity in the first half of 2020. Europe was hit particularly hard—the economic contraction in 2020 is estimated to have been among the largest in the world—with potentially severe repercussions on its nonfinancial corporations. A wave of corporate bankruptcies would generate mass unemployment, and a loss of productive capacity and firm-specific human capital. With many SMEs in Europe relying primarily on the banking sector for external finance, stress in the corporate sector could easily translate into pressures in the banking system (Aiyar et al., forthcoming).

The pandemic has hit hard companies through various channels that include lockdowns, reductions in productivity and capacity, as well as higher costs due to containment measures, a collapse in demand, supply-chain disruptions and generalized uncertainty. Some sectors that are contact-intensive—such as accommodation, food services, and entertainment—have been disproportionally affected. The crisis has also further widened the performance gap between small and medium-sized enterprises (SMEs) and very large corporations, as SMEs started with smaller buffers and limited access to credit.

But widespread corporate bankruptcies have not materialized yet. This reflects a combination of two factors. First, the European corporate sector entered the current crisis in a much better shape than a decade ago, with strengthened corporate profitability and reduced indebtedness. Initial cash buffers of companies helped stressed corporations to cushion the impact of the shock. Second, the bold, sizable, and multifaceted policy response by European institutions and especially national authorities helped maintain accommodative financial conditions and supported firms directly as well.

This paper focuses on quantifying the near-term effect of the pandemic on more than four million non-financial corporations across 26 European countries and the ability of announced policies to provide relief to the corporate sector. It proposes an analytical framework that projects country-sector shocks to firms' turnover and assesses the end-2020 liquidity and solvency situation of European companies with and without policy measures.

The key contribution of the paper lies in the construction of a new dataset on corporate policy measures designed to support the economy in the current COVID-19 outbreak across 26 European countries, the mapping between these measures and firm-level balance sheet projections at end 2020, the quantification of corporate policy effectiveness, and the assessment of firms' ability to access market funding to fill their liquidity gaps.[1] Existing studies have typically investigated only a few corporate relief measures implemented in one country (see, for example, Bank of England, 2020; Banco de España, 2020; Deutsche Bundesbank, 2020; Národná Banka Slovenska, 2020; Elenev et al., 2020 in the case of the U.S. support programs; and De Marco, 2020 who assessed the guaranteed loans program in Italy).

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[1] The significant risk of business failures posed by credit contraction has been recently examined by Gourinchas et al (2021).

Other studies have pursued a cross-country perspective, simulating the effects of hypothetical policy measures instead of the policies announced by government. Kalemli-Özcan et al. (2020), for example, examine the benefits of grant-based schemes, Diez et al. (forthcoming) simulate the merits of various approaches to equity support, while Demmou et al. (2020a) advocate the need for public intervention to reduce liquidity stress. Other cross-country studies have focused only on listed firms (Acharya and Steffen, 2020; Crouzet and Gourio, 2020; Fahlenbrach, Rageth and Stulz, 2020; Hassan et al., 2020; and Ramelli and Wagner, 2020; on the U.S., Alfaro et al., 2020; Banerjee et al., 2020; De Vito and Gomez, 2020; and Ding et al., 2020, on global listed firms) or SMEs (Kalemli-Özcan et al. 2020, Diez et al. forthcoming). This paper complements the study by Diez et al. (forthcoming), which uses a structural approach to assess the solvency risks for SMEs across a sample of advanced economies under the assumption of continued access to credit and simulating the role of alternative hypothetical equity support schemes in mitigating these risks.

We argue that a detailed assessment of the role of specific policies in cushioning the COVID-19 shock covering both SMEs and large firms is of utmost importance not only in quantifying the current health of corporates, but also in designing policies going forward. Identifying the policies that deliver the most impact can help inform the debate about how best to maintain an adequate and efficient support to the economy. Our analysis incorporates countries' specificities regarding the magnitude of the pandemic shock and various features of the policy response, such as duration, scope, scale, and conditionality, using a common analytical framework.

This paper also builds on the literature that examines the impact of the pandemic on European corporate liquidity (BIS, 2020) by providing also a granular assessment of the solvency risks at play and by quantifying the impact of each policy scheme deployed. Given the interactions between solvency and liquidity risk (Cont et al, 2020, Imbierowicz and Rauch, 2014; Morris and Shin, 2016), this paper examines the liquidity and solvency nexus, which results in the amplification of solvency risk through funding costs arising from liquidity constraints. It also projects the increase in corporate leverage as a result of both the pandemic and the policy response which may create the risk of debt overhang slowing down the speed of recovery (Demmou et al., 2020b examine the impact of higher debt levels on investment during the recovery).

Our analysis also incorporates firms' management actions to address liquidity pressures. For example, companies with a cash-flow deficit may seek to raise new debt. The ability of firms to fill their liquidity shortages depends on two factors. First, it depends on the capacity of the banking system to maintain the flow of credit to corporates supported by policies. Second, it depends on individual firms' creditworthiness—linked to their initial solvency position—and their repayment capacity proxied by turnover. Besides accessing bank loans, large firms may also be able to issue corporate bonds.

This study provides simulation results for end-2020. The reason is twofold. First, the significant uncertainty regarding the evolution of the pandemic and its economic impact argues for a short horizon for the simulations. Second, this analysis helps assess the relative effectiveness of the policy measures implemented in 2020 and can shed light on policies that may be needed going forward.

The rest of the paper is organized as follows. Section II discusses the financial situation of European non-financial corporates before the pandemic and examines the current levels of bankruptcy rates. The policy support extended to the corporate sector is described in Section III. Section IV presents the modeling framework, while Section V describes the calibration of sectoral shocks, presents the corporate dataset and explains how the policy measures were incorporated in the analysis. Section VI presents simulation results under different scenarios of credit market access but without taking into account the direct effect of corporate sector measures. Empirical results incorporating the detailed policy measures are shown in Section VII. Section VIII outlines some policy recommendations and concludes.

II.   THE EUROPEAN CORPORATE LANDSCAPE PRIOR TO THE PANDEMIC AND RECENT DEVELOPMENTS IN BANKRUPTCIES

Before the pandemic, financial vulnerabilities of the corporate sector in a number of large European economies were deemed relatively low from a cross-regional perspective. Although improvements in aggregate corporate health had been uneven across countries, corporate profitability had generally strengthened, indebtedness had fallen, and the share of European firms with potential difficulties servicing their debt had dropped significantly since the global financial and European debt crises (Figure 1).

Figure 1. Corporate Sector Indicators

Source: Orbis; authors' calculations.
Note: Panels 1 and 2 show the distribution of country-level turnover-weighted firm return on assets and debt-to-equity ratios computed from the Orbis database across advanced and emerging European economies in Europe. Boxplots include the mean (cross), median (horizontal bar), the interquartile range, and the minimum and maximum values excluding outliers (whiskers).

Despite the very sharp decline in economic activity caused by the pandemic, large-scale corporate bankruptcies have yet to materialize (Figure 2, panel 1). After a spike in mid-March, the median expected default frequency for European firms in September 2020 was only slightly above the levels at the end of 2019 (Figure 2, panel 2). This is in contrast to the persistent rise in expected default frequency observed shortly after the onset of the global financial crisis. The reason for this is the timely, decisive, and massive policy response, which we turn to next.

Figure 2. Corporate Insolvency in Europe

Bankruptcy Rate
(Index 2007 = 100)

One-Year Expected Default Frequency of
Nonfinancial Corporations (Percent)

Source: OECD Timely Indicators of Entrepreneurship; Moody's Analytics; and authors' calculations.
Note: Panel 1 shows the bankruptcy rate of NFCs in Europe, not seasonally adjusted. This rate is constructed as an index by the OECD given differences in definitions of bankruptcies across countries. Countries included are Belgium, Germany, France, Netherlands, Norway, Sweden and United Kingdom ('incorporated' enterprises) and Denmark, Finland, Iceland, Italy, and Spain (all legal forms). Panel 2 shows the one-year average expected default frequency of listed NFCs for the twenty-five European countries covered by Moody's Analytics (excluding Luxembourg, Monaco, and Virgin Islands). In both panels, the shaded area shows the interquartile range, while the solid line plots the median value.

III.   THE EUROPEAN POLICY RESPONSE

In several countries, the exceptional policy response has supported the corporate sector and limited bankruptcies, including through the provision of liquidity and easing of financial conditions. The flow of new credit to nonfinancial corporations registered robust growth and debt issuance rose sharply in 2020.

Various initiatives at the European Union level, including the full flexibility in the EU fiscal rules, the adoption of a temporary state aid framework, and the prospects of an ambitious EU recovery fund, also helped countries deploy needed support. To complement the fiscal response, central banks cut policy rates and provided emergency programs to maintain credit supply including through asset purchases, FX interventions by some central banks in emerging European economies, and longer-term refinancing operations, with financing conditional on banks extending credit to businesses. National authorities eased prudential policies including through the flexibility of the regulatory framework and the release of macroprudential buffers which helped support the flow of credit to the real economy and averted fire sales.

Countries used a wide range of aid schemes to help firms weather the COVID-19 shock. Some measures compensated firms for the containment measures enforced to close businesses or reduce economic activity. For example, government-sponsored job retention programs allowed firms to adjust working hours and reduce the wage bill, while maintaining employment. Government grants to firms were used to compensate firms for specific fixed costs such as rents or interest on loans. They often targeted smaller firms and the self-employed or firms with large revenue losses. Aid was sometimes granted in the form of tax

cuts, tax deferrals, and payment advantages particularly for hard-hit sectors. Other measures granted temporary liquidity relief by providing legislative loan repayments moratoria. To ensure access to liquidity to firms facing a sudden shortage, public guarantees on loans or official credit at subsidized rates were provided. For strategic firms whose exit would have a significant impact on the economy (e.g. national airlines), solvency support measures were also used, such as equity instruments and hybrid capital instruments (e.g. subordinated debt). For SMEs aid schemes typically involved tax deferrals (for firms or investors), subordinated loans, quasi-equity loans, or quasi-equity injections, particularly for SMEs facing significant market failures.

Figure 3. Intensity of Policy Measures

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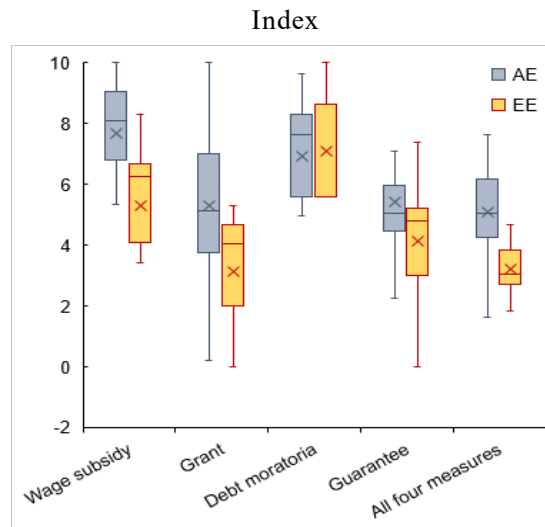
Sources: National data sources; authors' calculations.
Note: The intensity of policy measures is computed as the principal component of each policy measure, taking into account information on the size of the budgetary envelope, the duration of the measure, and the coverage of firms. The bar represents the interquartile range, median (horizontal dash), mean (cross), and the minimum and maximum values excluding outliers (whiskers).
AE=Advanced Europe; EE = Emerging Europe.

Policy responses supporting corporates, including both measures with immediate or future fiscal implications, are estimated to amount to about 11.2 percent of GDP in Europe based on information available up to August 2020[2]. This amount includes 1.4 percent of GDP of measures directly affecting the government budget balance, 1.3 percent of GDP of below-the-line of off-budget operations (e.g. loans or equity injections), and 8.5 percent of GDP of government guarantees and other contingent liabilities.[3]

Since measures differ significantly in scope, size, and conditions, a simple principal component approach (PCA) is used to summarize different aspects of measures and compare

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[2] While some countries have amended/extended policy measures in the latter part of the year, most of the schemes announced before August 2020 were designed to grant aid until December 2020 (e.g. loans and guarantees).

[3] The fiscal response to COVID-19 is highly heterogenous across Europe with corporate measures reaching 14 percent of GDP in advanced Europe and about 3 percent in emerging Europe.

policy announcements across countries. The intensity of announced measures is computed as the principal component of the measure's budgetary envelope (as share of GDP), its duration, and sectoral coverage (turnover of the covered sectors as share of total turnover in the economy). Depending on types of measures and data availability, different characteristics are taken into consideration. For instance, for labor market policies, budgetary envelope, duration of the policy, and program coverage are accounted for. For debt moratoria, key factors include the length of the moratoria period and the coverage of eligible firms (weighted by turnover). For guaranteed loans, the guaranteed rate and announced guarantee program size are examined. For grants, the budgetary envelope and coverage of eligible firms (weighted by turnover) are incorporated.

The principal component analysis reveals substantial heterogeneity in the intensity of announced measures to support the corporate sector across countries (Figure 3). First, advanced economies responded more forcefully than emerging markets in Europe. Second, advanced economies relied to a greater extent on measures with direct or indirect fiscal costs, such as wage subsidies, grants, and loan guarantees. Emerging markets, on the other hand, leaned more heavily on debt moratoria to cushion the impact of the liquidity shock. These important cross-country differences may reflect preferences and existing policy space—with some emerging markets facing limited fiscal space and large (though short-lived) capital outflows and currency depreciations in the beginning of the pandemic.

The actual take-up rates of the various measures are also vastly different, both across countries and from the headline announcements (OECD 2020; Anderson, Papadia, and Véron 2020; S&P Global 2020). Although it is still too early to identify the main drivers behind this variability, anecdotal evidence points to differences in announcement dates, implementation lags, firms' demand, program conditionality, pricing, and the size of the programs' envelope.[4] Financial and administrative constraints, expectations on the duration of the pandemic, and intertemporal policy trade-offs in the provision of aid relief have also been major drivers of cross-country variations in policy design and implementation. While take-up rates have been lower than expected in some cases, the announced measures may still provide important support to activity by boosting confidence and overall credit supply.

IV. MODELING FRAMEWORK

A. A Balance Sheet Approach to Capture Liquidity and Solvency Risks

To measure the impact of the COVID-19 shock on the corporate sector we develop a joint framework for solvency and liquidity that incorporates the interrelations between them. The solvency-liquidity nexus is particularly relevant when we account for government policy support as many aid schemes introduced in Europe to provide firms with bridge liquidity targeted firms that were not already in difficulty pre-COVID, proxied by its solvency

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[4] For guaranteed loans, the loan amount is typically limited to the specific liquidity needs of the beneficiary. Thus, take-up rates would reflect differences in firms' liquidity deficits. Other factors behind cross-country heterogeneity in take-up rates include differences in the administrative capacity of the public sector and banks to process guaranteed loan applications, and supervisory moral suasion. The take-up rate is mechanically lower for large programs, such as the guarantee programs in Germany and Italy.

position.[5] Building on the approach introduced in Cont et al (2020), Figure 4 shows the mechanisms through which solvency and liquidity interact:

- Solvency risk determines the ability of the firm to access external funding through official credit, guaranteed loans, non-guaranteed loans and bond issuance. The equity ratio of the firm also determines the amount of government equity support to restore its pre-COVID solvency position.[6]

- Liquidity risk impacts solvency through the sale of financial investments, funding costs from new borrowing, and fire sales of illiquid assets.

Figure 4. Liquidity and Solvency Nexus
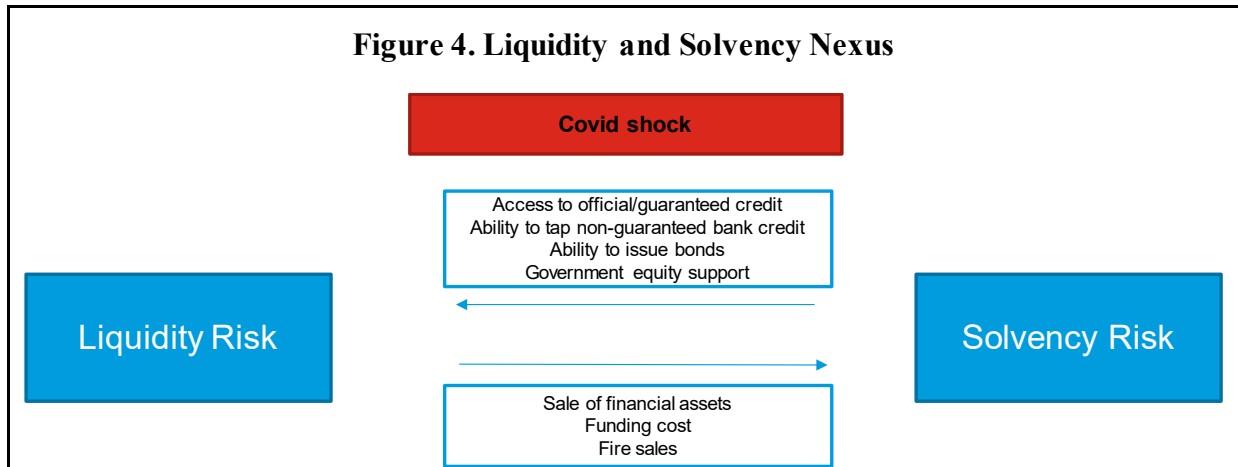
In our framework, a company is considered illiquid if its liquid assets are insufficient to cover operational net cash outflows and debt repayments. A company is considered insolvent if the book value of debt exceeds the value of assets, i.e. if it has negative equity. The reliance on the book value of equity has the advantage of expanding the coverage of the analysis beyond the group of listed firms, though it has also known limitations. The coverage of the corporate dataset is shown in Section V.

To quantify the channels through which the COVID-19 shock impacts firms' financials, we need a sufficiently granular representation of the balance sheet and income statement. In particular, we need to distinguish assets by instrument and by counterparty sector. This will allow the measurement of firms' liquidity value under normal and stressed conditions. Liabilities need to be segmented by maturity, by product, and by counterpart. This will enable the quantification of the amount granted to firms under different credit scenarios and public aid schemes.

The granular decomposition of the balance sheet is shown in Table 1. On the asset side, we distinguish:

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[5] According to Commission Regulation (EU) No 651/2014 (European Commission, 2014), a firm "in difficulty" has cumulative losses eroding at least half of its subscribed capital.
[6] For instance, in its recapitalization program, Germany considers that the amount of equity support is limited to bring the equity ratio to 15 percent of the target balance sheet which will help the firm be funded on the capital market.

- Liquid assets, which include cash and cash equivalent C; financial investments FI; inventories (raw materials, in progress, finished goods) INV; trade receivables (from clients and customers) TR; and other liquid assets (receivables from taxes, group companies) OCA;

- Fixed assets defined as the total amount after depreciation of non-liquid assets (tangible assets, intangible assets, other fixed assets), FA.

On the liability side we consider the following breakdown:

- Maturing liabilities due within the year, which include short-term debt and long-term debt payable within the year to credit institutions $BDebt$; bonds $FDebt$; trade payables (debt to suppliers and contractors) TP; and other liabilities coming due (such as pension, taxes, intragroup debt, accounts received in advance, etc.) OCL.

- Liabilities maturing beyond one year, LL.

- Equity, which is the difference between assets and liabilities, and includes issued share capital and other shareholder funds (such as reserve capital, undistributed profits, and minority interests), E.

Table 1. Stylized Balance Sheet and Income Statement of a Firm

Assets	Liabilities and equity	Profit and Loss
Liquid assets	Maturing liabilities	+ Turnover, *Sales*
(i) Cash, *C*	(i) Bank debt, *BDebt*	- Material Cost, *Mat*
(ii) Financial investments, *FI*	(ii) Non-bank financial debt, *FDebt*	- Wages, *Wages*
(iii) Inventories, *INV*	(iii) Trade payables, *TP*	- Amortization, *Amort*
(iv) Trade receivables, *TR*	(iv) Other current liabilities, *OCL*	- Other operational expenses, *OOE*
(v) Other current assets, *OCA*		+ Financial revenue, *FR*
	Long-term liabilities, *LL*	- Interest expense, *IE*
		- Other financial expense, *FE*
		- Taxation, T*ax*
Fixed assets, FA	Equity, *E*	+ Net Income, *NetInc*

Figure 5. Balance Sheet Structure and Cost Structure in Europe

Short-Term Assets
(Percent of Total Assets)

- ● Trade receivable
- ● Inventory
- ── Trade receivable
- ── Inventory
- ● Cash
- ● Other short-term assets
- ── Cash
- ── Other short-term assets

Short-Term Liabilities
(Percent of Liabilities)

- ● Trade credit
- ── Trade credit
- ● Loans
- ── Loans
- ● Other short-term liabilities
- ── Other short-term liabilities

Cost Components
(Percent of Turnover)

- ● Material cost
- ● Wage
- ● Interest
- ── Material cost
- ── Wage
- ── Interest

Source: Orbis; authors' calculations.
Note: The dots indicate median values of firms weighted by turnover in each country. Horizontal lines indicate country group averages for Advanced Europe (top) and Emerging Europe (bottom).

Table 1 also shows the disaggregation of the profit and loss account in terms of the cash-flow impact on its components and the channels through which policy measures impact the equity of the firm. In the income statement, we distinguish:

- Turnover (operating revenue including sales, stock variations, and other operating revenues) *Sales*; material cost (purchases of goods including raw materials and finished goods, excluding services) *Mat*; wages (cost of employees including wages and salaries and social security contributions) *Wages*[7]; amortization (depreciation and amortization of assets) *Amort*; other operational expenses (all costs not directly related to the production of goods sold such as commercial costs, rentals or administrative expenses) OOE; financial revenue (such as interest, income from shares) *FR*; interest expense (interest charges on debt) *IE*; other financial expense (write-off of financial assets) *FE*; and tax expenses *Tax*. Net income is defined as profit after taxation *NetInc*.

The breakdown of the balance sheet and income statement is also motivated by the structure of short-term assets and liabilities of European firms, as well as by the relative size of the individual components of their cost structure. Using firm-level data from Orbis, Figure 5 shows that trade receivables and trade payables represent the largest share of short-term assets and liabilities, respectively. By type of firm, SMEs are, on average, net trade creditors, particularly in advanced Europe (AE). Trade receivables (payables) account for 20 (12 percent) of assets (liabilities) in AE. In emerging Europe (EE), the relative shares are 22 percent and 18 percent, respectively. Material costs account for 54 percent of turnover, representing the bulk of operational costs. They dwarf interest expenses which represent only half of one percent of firm turnover on average.

B.   Balance Sheet Dynamics

We now describe the dynamics of the balance sheet components of a firm conditional on a COVID-19 scenario and a set of K policy actions $\left\{ pol_k \right\}_{k=1}^{K}$. Given the idiosyncratic nature of the pandemic and the need to incorporate public support, the model uses a structural approach based on simulations. We depict the simulation stages and credit scenarios in Figure 6.

We simulate the impact of the COVID-19 crisis on corporate balance sheets in four stages. Starting from the pre-COVID balance sheets (Stage 0), we first quantify the impact of the turnover shock (Stage 1). We then include the effect of announced policies excluding credit (Stage 2) and add other forms of support that change firms' liability structure (credit), such as repayable advances, guarantees, loans, and equity (Stage 3). Finally, we allow liquidity stressed firms to access market funding to fill their liquidity gaps (Stage 4).

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[7] Following Kalemli-Özcan et al. (2020), for countries where firms do not report labor and material costs separately, we divide the cost of goods sold according to relative size of material costs and wages at industry level derived from the countries where labor and material costs are reported separately and country coverage of revenue exceeds 40 percent (Belgium, the Czech Republic, Finland, France, Hungary, Italy, Poland, Portugal, Romania, the Slovak Republic, Slovenia, and Spain).

In the model, obligations coming due by the end of the year depend on the ability of firms to rollover maturing debt. In the pre-policy support phase (Stage 1), firms are assumed to rollover maturing trade credit, but cannot rollover bank debt due to a freeze in financial markets. This is the situation that could have prevailed before the massive policy interventions were implemented. To enrich the analysis, we also simulate the pre-policy support balance sheets under two alternative credit scenarios:

(i) '*rollover'* of maturing obligations due to banks and suppliers;
(ii) '*no rollover'* where both the banking and the trade credit market freeze.[8]

The seizing of trade credit implies that trade creditors are assumed not to rollover maturing trade credit and expect to receive back the cash related to these transactions. This would reduce the drain on liquidity of net trade creditors, as they will be able to replenish their cash buffers by drawing on trade receivables, while it would exacerbate liquidity pressures of net trade borrowers.[9]

Figure 6. Balance Sheet Simulation Stages and Scenarios
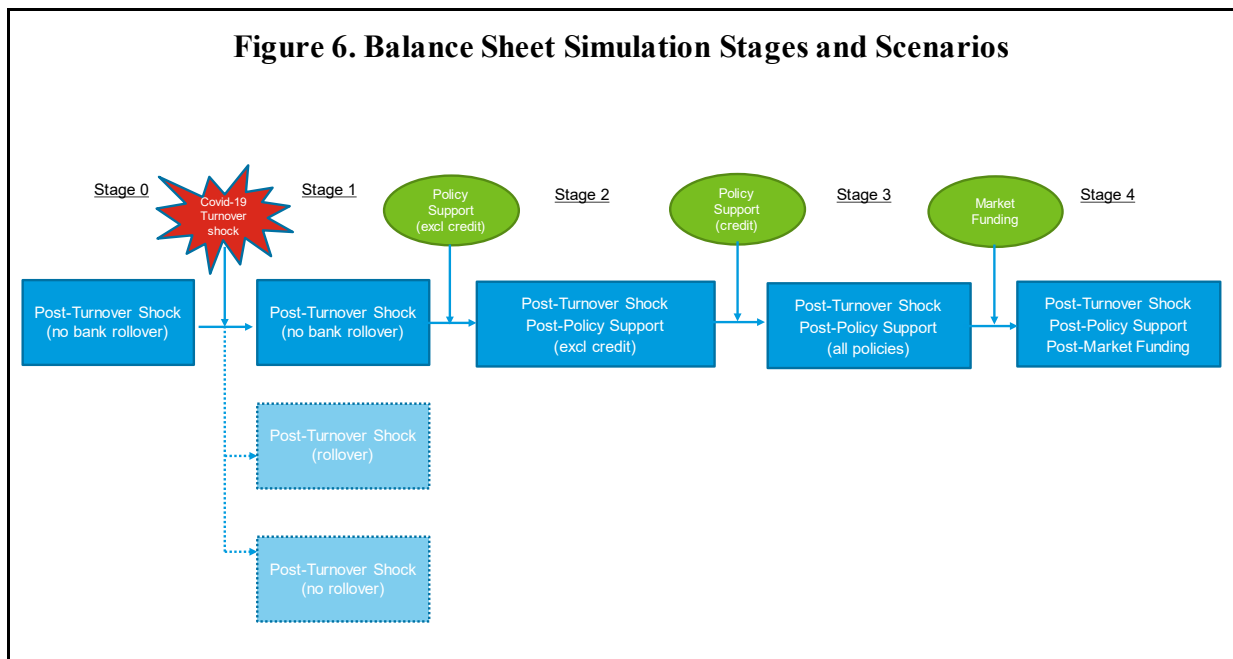
We first model the shock to turnover of firm *i* in sector *j* during week *w*. The shock depends on sector-specific sensitivities of turnover to four lockdown regimes, which we denote $\gamma_{j,r}$, with $r \in \{1,2,3,4\}$ where r=1 corresponds to a pre-lockdown phase, r=2 to a full lockdown

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[8] We could envisage a 'third scenario' whereby the trade credits and trade debits change in line with turnover shocks. This would imply that net trade creditors would benefit as they would receive payments from customers larger than the reduced payments to suppliers, while net trade debtors would face larger cash outflows (Bank of England, 2020). Rather than showing a point estimate, we provide a scenario-based estimate of the share of illiquid firms during COVID-19 which ranges between 42 (rollover) and 44 percent (no rollover) (Figure 8, panel 1). Results under the 'third scenario' would be closer to our benchmark 'rollover' scenario.

[9] BIS (2020) argues for policy intervention in trade credit markets to help firms sell their receivables or receive credit against them.

phase, r=3 to a partial lockdown phase, and r=4 to a post-lockdown phase.[10] The share of lost annual turnover is:

$$\beta_j = \frac{1}{52}\sum_{w=1}^{52}\left(\sum_{r=1}^{4}\gamma_{j,r}\mathbf{1}_{w_r \in \Psi_r}\right) \text{ (1)}$$

where Ψ_r denotes the set of weeks spent in regime r.

The turnover shock β_j reduces operational cash-flows of firms in sector j through a decline in sales. Firms are able to adjust material costs in proportion to the change in turnover.[11] However, they need to meet obligations on fixed costs, financial payments, and corporate taxes. On the revenue side, they receive financial revenue from financial investments. As a result, the operational cash flow of firm i in sector j in stage 1 is:

$$CF_{i,j,1} = (1-\beta_j)\cdot(Sales_{i,j,0} - Mat_{i,j,0}) - Wages_{i,j,0} - OOE_{i,j,0} + (FR_{i,j,0} - IE_{i,j,0} - FE_{i,j,0}) - Tax_{i,j,1} \text{ (2)}$$

The cash-flow equation assumes that firms generate cash-flows from their sales rather than trade receivables. Similarly, firms face cash outflows from the purchase of supplies rather than trade payables. Due to the price differential between sold and purchased goods, this assumption could overestimate the liquidity position of some firms. Nevertheless, aggregate results are robust to alternative trade credit rollover assumptions (Figure 8, panel 1).

Impact on firms' liquidity

Firms' liquidity deficits can stem from negative operational cash flows or from the repayment of maturing liabilities which are linked to the credit scenarios. We assume that firms continue to pay maturing liabilities including non-bank financial debt and other current liabilities such as employee benefits, tax liabilities, intragroup debt, and accounts received in advance to avoid entering into insolvency. Companies that are not financially constrained pay out dividends denoted by Div.[12]

Impact of Turnover shock (Stage 1)

Cash outflows at stage 1 can be expressed as:

$$CashOut_{i,j,1} = (CF_{i,j,1})^- + (TR_{i,j,0} - TP_{i,j,0})^- \mathbf{1}_{no\,roll} + BDebt_{i,j,0}\mathbf{1}_{no(bank)roll} + FDebt_{i,j,0} + OCL_{i,j,0} + Div_{i,j,1}\mathbf{1}_{CF_{i,j,1>0}} \text{ (3)}$$

where $(X)^- = \max(0,-X)$. Cash balances increase with positive operational cash flow and net trade receivables net of dividend payouts. The ability of firms to liquidate inventories

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[10] The sectoral elasticities under each phase were calibrated using IMF Research epidemiological model.

[11] This is because the purchase of raw materials and finished goods used in the production process decrease with the volume of goods and services sold. This is also consistent with the analysis conducted by the Bank of England (2020) using an econometric analysis on changes on non-labor costs on turnover.

[12] Some corporate aid schemes deployed in Europe restrict dividend payments and share buybacks. However, given that our dividend distribution assumption applies only to firms that are not financially constrained, it does not impact the results.

depends on the scenario. Pre-pandemic, inventories are assumed to be liquid, i.e. they can be liquidated at book value. We assume that inventories become illiquid during the COVID-19 pandemic as firms struggle to sell existing inventories or post them as collateral.[13]. Firms can also draw down their portfolio of financial investments at book value.

$$CashIn_{i,j,1} = \left(CF_{i,j,1}\right)^+ + \left(TR_{i,j,0} - TP_{i,j,0}\right)^+ \mathbf{1}_{no\,roll} + INV_{i,j,1}\mathbf{1}_{pre-Covid} + FI_{i,j,1} \quad (4)$$

where $\left(X\right)^+ = \max\left(0, X\right)$. The liquidity shortfall at stage 1 is defined as:

$$\lambda_{i,j,1} = \left(CashOut_{i,j,1} - \left\{C_{i,j,0} + CashIn_{i,j,1}\right\}\right)^+ \quad (5)$$

A firm has a liquidity shortfall if its cash position is not enough to cover net cash outflows.

The aggregate economy-wide liquidity gap at time 1 is:

$$LiqGap_1 = \sum_{j=1}^{J} \sum_{i=1}^{N_j} \lambda_{i,j,1} \quad (6)$$

where J is the number of sectors and N_j the number of firms in sector j.

Impact of Policy Support Excluding Credit (Stage 2)

We assume that eligible firms receive aid through policy schemes designed by the authorities to cushion the economic damage of the containment measures and the disruptions caused by the COVID-19 outbreak. The pecking order is based on a cost-benefit analysis. First, firms benefit from fiscal measures in the form of *WageSub* (contribution to wage costs to avoid layoffs), *Grant* (direct compensation for loss in revenues), *TaxDef* (ability to defer tax obligations beyond year-end) and *TaxReb* (decrease or exemption on VAT, corporate income tax, business rates, or payroll tax), as well as from *monetary policy* interventions in the form of cuts to policy rates (decreasing interest expense on floating rate debt). Second, firms that struggle to meet debt repayments apply for a *debt moratorium* (temporary suspension of bank loan repayments). Cash outflows post-policy are defined by:

$$CashOut_{i,j,2} = \left(CashOut_{i,j,1}\right)^- - TaxDef_{i,j,2} - Tax\,Re\,b_{i,j,2} - \alpha \cdot BDebt_{i,j,0} \cdot \delta_{i,j,2} \cdot \Delta MP_2 - \frac{M_{j,2}}{12} \cdot BDebt_{i,j,0} \quad (7)$$

where α is the share of floating-rate debt, $\delta_{i,j,2}$ the pass-through from monetary policy rate change $\Delta MP_{j,2}$ to the effective lending rate, and $M_{j,2}$ the duration of the debt moratorium in sector j (in months).

On the other hand, the cash inflows after accounting for policy implementation can be expressed as:

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[13] BIS (2020) explains that the liquidity of inventories appears limited during the COVID-19 pandemic.

$$CashIn_{i,j,2} = \left(CashIn_{i,j,1}\right)^{+} + WageSub_{i,j,2} + Grant_{i,j,2} \quad (8)$$

The liquidity gap of firm i at stage 2 after using the policy measures that it qualifies for and benefits from is denoted by:

$$\lambda_{i,j,2} = \left(CashOut_{i,j,2} - \left\{C_{i,j,0} + CashIn_{i,j,2}\right\}\right)^{+} \quad (9)$$

Impact of Credit Support (Stage 3)

Faced with a liquidity shortfall, the firm is allowed to take mitigating actions from its contingency funding plan to raise cash, including by applying for a guaranteed loan, receiving public equity support or filling the funding gap through funding external to the firm (external funding) from non-guaranteed bank credit or bond issuance. The sequence of mitigating actions is determined by cost considerations.

Official/Guaranteed funding: firms which were not in financial difficulty prior to COVID-19 can receive aid in the form of guaranteed working capital loans.[14] The aid can be granted directly by government-sponsored entities or channeled through commercial banking institutions. The analysis applies the features specified in the guarantee scheme granted by the authorities. These are related to the beneficiary type (large, SME, firms with large declines in turnover); the permissible operation (refinancing, new loan), and the maximum size of the loan. For instance, under the EU Temporary Framework, the overall amount of long-term loans is capped by 25 percent of the beneficiary's turnover or double the annual wage bill, and subject to a nominal cap $cap_{i,j,3}$. When the aggregate amount of working capital loans demanded by firms exceeds the size of the envelope, the amount is re-calibrated so as not to breach the size of the overall scheme. The lending rate on official or guaranteed loans is denoted by $r_{i,j,3}^{gov}$.

Firms' access to official credit or guaranteed loans allows them to increase their cash inflows in stage 3:

$$CashIn_{i,j,3} = CashIn_{i,j,2} + \left(1 - r_{i,j,3}^{gov}\right) \cdot G_{i,j,3} \quad (10)$$

where government credit is defined as:

$$G_{i,j,3} = \min\left\{\left(\lambda_{i,j,2}\right)^{+}, \min\left(\max(0.25 \cdot Sales_{i,j,0}, 2 \cdot Wages_{i,j,0}), cap_{i,j,3}\right)\right\} 1_{E_{i,j,0}>0} \quad (11)$$

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[14] To define access to government support, the exercise identifies firms in financial difficulty as undertakings with negative equity prior to COVID-19. This is a simplifying assumption, as a firm could be in financial difficulty due to excessive leverage or high-income gearing ratio. This is, however, taken into account in Section VII where we quantify the size of the equity shortfall of those firms that entered in financial difficulty because of COVID-19.

Public equity support: firms which are targeted by governments on an individual basis due to their strategic significance, for which public schemes are insufficient to cover liquidity needs, and which are unable to find financing on the market at affordable terms, can receive recapitalization aid through equity instruments for the amount earmarked by the government denoted by $equity_{i,j,3}$.

After accounting for guaranteed credit and equity support, the liquidity shortfall is given by:

$$\lambda_{i,j,3} = \left(CashOut_{i,j,2} - \left\{ C_{i,j,0} + CashIn_{i,j,3} + equity_{i,j,3} \right\} \right)^{+} \quad (12)$$

and the aggregate liquidity gap can be expressed as:

$$LiqGap_3 = \sum_{j=1}^{J} \sum_{i=1}^{N_j} \lambda_{i,j,3} \quad (13)$$

Impact of Market Funding (Stage 4)

Firms can take on different types of non-guaranteed external financing at market conditions. Specifically, we distinguish between bank credit and bond issuance.

Non-guaranteed loans: firms with a pre-COVID-19 solvent position can also access non-guaranteed bank loans. We proceed in two steps. First, firms with existing bank credit, can rollover 80 percent of maturing loans in line with the rollover rates calibrated in the literature (Schneider and Waschiczek, 2018). Second, we project the aggregate flow of credit for non-financial corporations by country, net of projected guarantee usage and loan refinancing. The remaining credit is allocated among firms in proportion to turnover as a proxy for repayment capacity and with the maximum loan amount by borrower $cap_{i,j,4}^{bank}$ calibrated so as not to exceed aggregate credit projections.[15] The lending rate on non-guaranteed loans is denoted by $r_{i,j,4}^{bank}$.

The amount of cash that can be raised in the form of non-guaranteed loans is:

$$NG_{i,j,4} = \min \left\{ \left(\lambda_{i,j,3} \right)^{+}, 0.8 \cdot BankDebt_{i,j,0} + cap_{i,j,4}^{bank} \right\} 1_{E_{i,j,0}>0} \quad (14)$$

Bond issuance: large firms can also resort to market-based finance to fill their financing needs. The analysis projects aggregate bond issuance by country consistent with observed issuance in the first half of 2020 and forecasts for the second half of the year using statistical analysis.[16] The volume is apportioned at the firm level according to firms' liquidity needs

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[15] This is consistent with the allocation mechanism of guarantees set out in the EU Temporary Framework for state aid measures to support the economy during the COVID-19 outbreak.

[16] This is based on simple linear regressions on corporate issuance at the country/sector level conditional on financial conditions and macroeconomic aggregates.

after policies and debt repayment capacity proxied by turnover, with the calibration of $cap^{bond}_{i,j,4}$ ensuring that the aggregate amount of issuance does not exceed aggregate projections for corporate bonds in 2020. The yield to maturity on bonds is given by $r^{bond}_{i,j,4}$. The maximum amount of bond issuance is determined by:

$$Bond_{i,j,4} = \min\left\{\left(\lambda_{i,j,3}\right)^+ - NG_{i,j,4}, cap^{bond}_{i,j,4}\right\}1_{E_{i,j,0}>0} \quad (15)$$

External funding increases total cash inflows of firm i to:

$$CashIn_{i,j,4} = CashIn_{i,j,3} + \left(1 - r^{bank}_{i,j,4}\right)\cdot NG_{i,j,4} + \left(1 - r^{bond}_{i,j,4}\right)\cdot Bond_{i,j,4} \quad (16)$$

Impact on firms' solvency

The direct impact of the COVID-19 shock on solvency is through a decrease in profitability from turnover loss. The impact of government schemes on solvency depends on the form of the aid. While some policy measures help strengthen firms' capital by compensating for COVID-related losses (e.g. wage subsidies, grants), other policies do not have a direct effect on solvency (e.g. tax deferrals, debt moratoria). By contrast, policies that facilitate new borrowing, while helping firms raise cash to meet their immediate cash outflows, have a direct negative impact on equity through an increase in funding costs.

As a consequence of the pandemic shock and non-credit policy relief, the value of equity in Stage 2 can be computed as:

$$E_{i,j,2} = E_{i,j,0} + \left\{CF_{i,j,1} - Amort_{i,j,0}\right\} + \left\{WageSub_{i,j,2} + Grant_{i,j,2} + Tax\,Reb_{i,j,2} + \alpha \cdot BDebt_{i,j,0} \cdot \delta_{i,j,2} \cdot \Delta MP_2\right\} \quad (17)$$

Once we account for firms' guaranteed credit in Stage 3, the value of equity is reduced to:

$$E_{i,j,3} = E_{i,j,2} - r^{gov}_{i,j,3} \cdot G_{i,j,3} \quad (18)$$

Taking into account the impact of non-guaranteed external funding on interest expenses in Stage 4, the value of equity decreases further to:

$$E_{i,j,4} = E_{i,j,3} - r^{bank}_{i,j,4} \cdot NG_{i,j,4} - r^{bond}_{i,j,4} \cdot Bond_{i,j,4} \quad (19)$$

After accounting for policy support, firm i's equity shortfall is defined by:

$$\xi_{i,j,4} = \left(E_{i,j,4}\right)^- \quad (20)$$

and the aggregate equity gap can be expressed as:

$$EqGap_4 = \sum_{j=1}^{J}\sum_{i=1}^{N_j}\xi_{i,j,4} \quad (21)$$

A critical question in the policy debate is how to measure the effectiveness of policies. This is becoming increasingly important as the COVID-19 crisis becomes protracted and fiscal buffers are reduced, calling for more targeted support. We rank policies in the pecking order

explained above. For each policy k, we compute the liquidity gap after implementation of policies 1, …, k and denote it $LiqGap_3^k$.

The marginal contribution of policy k towards the closing of the liquidity gap is given by:

$$\theta_3^{liq,k} = \frac{LiqGap_3^{k-1} - LiqGap_3^k}{LiqGap_1 - LiqGap_0} \quad (22)$$

where $LiqGap_3^0 = LiqGap_1$. When we aggregate the effect of all policy schemes, the effectiveness of government aid to close the liquidity gap is defined by:

$$\theta_3^{liq} = \sum_{k=1}^{K} \theta_3^{liq,k} \quad (23)$$

Likewise, the marginal impact of policy k in decreasing solvency risk triggered by the COVID shock can be measured by the ratio:

$$\theta_3^{sol,k} = \frac{EqGap_3^{k-1} - EqGap_3^k}{EqGap_1 - EqGap_0} \quad (24)$$

with the ability of policies to fill the equity gap denoted by:

$$\theta_3^{sol} = \sum_{k=1}^{K} \theta_3^{sol,k} \quad (25)$$

C. Scarring and Leverage

A key element of the policy discussion is targeting. We hereby define targeting by whether policies have been effective in supporting firms that were not in difficulty pre-COVID but were hit by the outbreak. The aim is to ensure that the disruptions caused by the pandemic do not undermine the viability of pre-COVID solvent firms, and thereby preserve the continuity of economic activity during and after the outbreak limiting the extent of scarring. For instance, under the EU Temporary Framework, recapitalization support can be provided to firms that were not in financial difficulty pre-COVID but would go out of business due to the pandemic.

We therefore measure scarring by the share of firms that were solvent pre-COVID but become insolvent due to the COVID-19 shock after policies:

$$Scarring = \frac{\sum_{j=1}^{J}\sum_{i=1}^{N_j}\left(1_{E_{i,j,0\geq0}} \cdot 1_{E_{i,j,3<0}}\right)}{\sum_{j=1}^{J}\sum_{i=1}^{N_j}1_{E_{i,j,0\geq0}}} \quad (26)$$

Note that this is a different concept than simply subtracting the share of insolvent firms pre-COVID from the post-COVID post-policy share as we condition the impact of the COVID shock on the set of solvent firms pre-COVID.

To project the intensity of scarring we quantify the amount of equity needed to restore firms' solvency. The amount of recapitalization is limited to the amount necessary for the stabilization of the firm, i.e. for reestablishing its creditworthiness. This amount is determined by forecasting firms' balance sheets by end-2020 and computing the financial indicators used by the European Commission to define a firm "in difficulty".[17] This implies that, for each solvent firm pre-COVID-19 that is "in difficulty" due to the outbreak, the following two conditions hold after the equity intervention: (i) its cumulative losses projected in the end-2020 balance sheet do not exceed half of its subscribed share capital; and, (ii) its end-2020 book debt-to-equity ratio is not greater than 7.5. In our framework, the recapitalization amount needed to save otherwise viable firms pre-COVID is given by:

$$EqGap_3 - \sum_{j=1}^{J} \sum_{i=1}^{N_j} \left(\xi_{i,j,3} \cdot 1_{E_{i,j,0<0}} \right) \text{ (27)}$$

Another concern voiced by policymakers and the financial literature is the impact of COVID-19 on corporate debt overhang. The concern is that the crisis has led to a sharp deterioration in firms' balance sheets and an increase in firm leverage. Policymakers are left with the intertemporal trade-off between encouraging increased borrowing to mitigate liquidity pressures and hampering the ability of firms to tap new credit when policies expire. This is a risk particularly for SMEs that have limited financial access. For instance, some public guaranteed loan schemes note that, based on standing practices in debt capital markets, firms' EBITDA ratio should not exceed 3.0 or 3.5 to be able to regain creditworthiness and access external funding.

In our framework, we define firm i's leverage after accounting for policies and external borrowing as:

$$Leverage_{i,j,4} = \frac{BDebt_{i,j,4} + FDebt_{i,j,4} + LL_{i,j,0}}{E_{i,j,4}} \text{ (28)}$$

where $BDebt_{i,j,4} = G_{i,j,3} + NG_{i,j,4}$, and $FDebt_{i,j,4} = Bond_{i,j,4}$

V. THE DATA SETS

This section describes the data sets built to implement the simulations of corporate vulnerability in Europe. They include the specific sectoral shocks implied by the projected GDP paths during COVID-19 in specific countries, firm level data of granular financial statements pre-COVID, and the announced country specific policy response of corporate relief schemes.

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[17] The analysis defines "in difficulty" following Article 2(18) of the Commission Regulation (EU) No 651/2014 (European Commission, 2014).

A. The COVID-19 Sectoral Shocks

The nature of the COVID-19 shock differs substantially across sectors and countries. This is due to the combination of two factors. First, the pandemic affects countries differently in terms of timing, intensity, and duration. The resulting shocks to economic activity also depend on the pace and severity of containment measures across essential and non-essential sectors. Second, it depends on the persistence of the reduction in economic activity depending on whether revenues are recoupable (e.g. construction sector) or not (e.g. food services), and whether they are affected by permanent shocks consumer behavior (e.g. travel). The analysis simulates the highly uneven effect of the COVID-19-induced shock across economic activities in 2020, by assuming differential impacts on firms' turnover across NACE Rev. 2 two-digit economic sectors, yielding 96 economic sectors.

Figure 7. Sectoral COVID-19 Shocks

Distribution of Output Growth Across Sectors, in 2020
(Percent)

Source: IMF Research Department tool; national data sources; October 2020 WEO; authors' calculations.
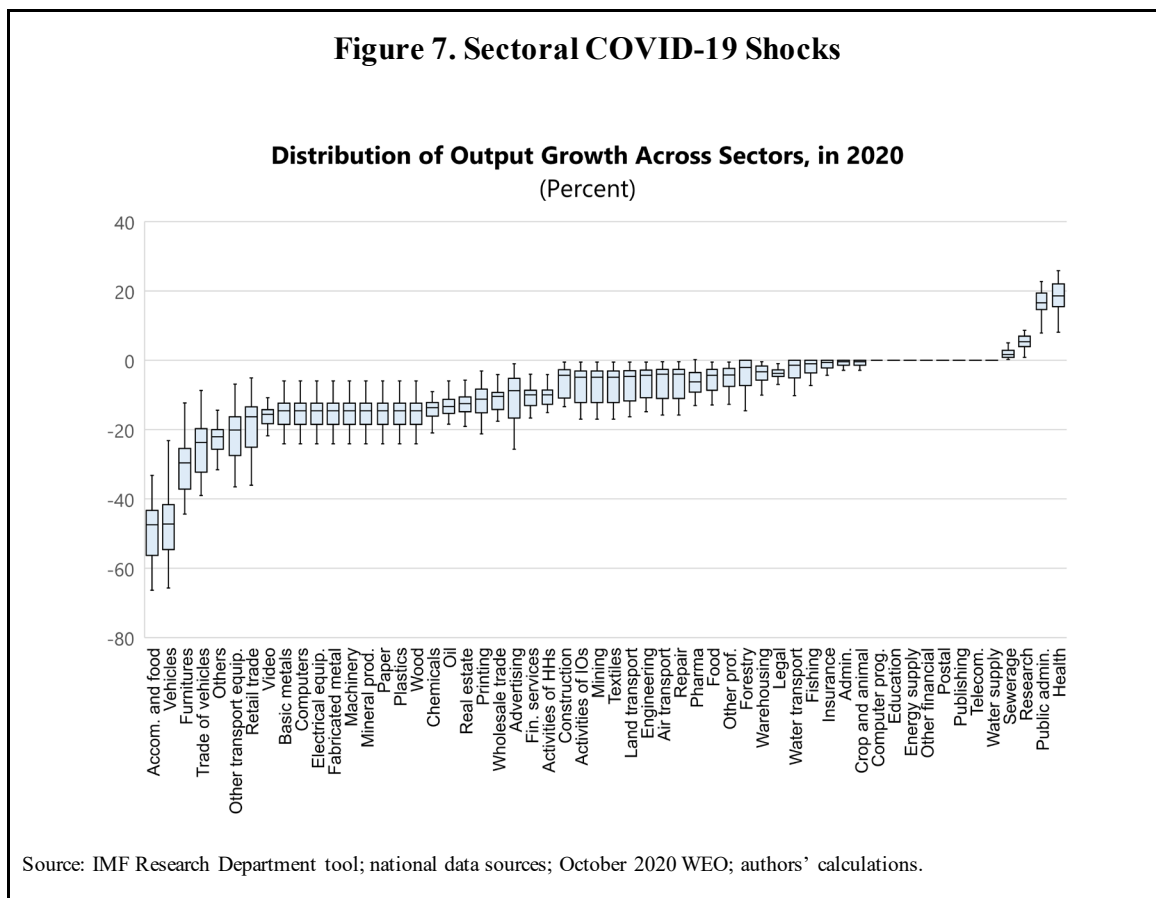
The sectoral shocks to turnover are rescaled to be consistent with country-level growth forecast in the October 2020 *World Economic Outlook,* leading to significant cross-sectoral and cross-country variation (Figure 7). For instance, the reduction in economic activity in the accommodation and food services is projected at 50 percent across countries, ranging

between 23 percent in Serbia and 66 percent in Belgium. By contrast, human health activities are projected to expand during the pandemic at an average pace of under 20 percent.[18]

B. Firm-Level Balance Sheet Data

To simulate the effects of the COVID-19 pandemic on corporate solvency and liquidity we use firm-level data on balance sheet and income statements from Orbis. Country coverage includes all European economies with a reasonable coverage in Orbis, which in this study amounts to 26 countries.[19] To get an indication of the actual coverage of our sample, we compare our sample of firms against the OECD Structural Demographics and Business Statistics in terms of aggregate turnover and number of firms. The underlying sources of this database are business registers that try to match the population of firms against domestic production.

Following the literature (Gal and Hijzen, 2016), we keep firms that satisfy each of the following criteria: i) refer to the entire calendar year (2017/2018); ii) are either unconsolidated or consolidated but without unconsolidated counterpart. We exclude firms whose consolidation status is unknown. We keep firms that report the core financial variables needed for the analysis, even if they do not report values for employment. This is to ensure adequate coverage for the analysis, particularly among microenterprises, small firms, and the self-employed which often do not report employment figures.

A thorough cleaning procedure is applied to remove duplicate identifiers, drop filing types for the same firm, exclude firms with clear reporting mistakes, drop firms with implausible financial values, remove firms with different accounting standards for the same year and drop redundant variables.

Table 2 shows that coverage of firms in terms of turnover is over 80 percent, with SMEs comprising 99 percent of firms and one-fifth of aggregate turnover. Because of limited reporting requirements, micro-firms are, on aggregate, underrepresented. There is a large cross-country variation in SME coverage in Orbis. The representativeness of firms varies depending on which firms are required to file information with business registries. Additional data requirements for the analysis, such as the availability of financial expenditure and revenue, further constrain the coverage of SMEs in some countries, e.g. for the United Kingdom. In terms of number of firms, SME coverage is around 25 percent across countries. This share is larger for Bulgaria, Croatia, Italy, Latvia, Portugal, Russia, Serbia, Slovak Republic and Sweden, and lower for Austria, Germany, Ireland, Turkey and the United Kingdom.

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[18] Turnover shocks could be calibrated at the firm level to account for within-sector firm heterogeneity. Nonetheless, while there are some market forecasts on corporate revenues that could, in principle, be used to infer expectations at the firm level, these are available only for listed firms and include the effect of policy support (see Tressel and Ding, 2021).

[19] We exclude small countries which are not representative of a sub-region in Europe.

Table 2. Firm Coverage in the Sample

	Number of Firms			Turnover (bn EUR)			Share OECD (Percent)
	Total	SMEs	Large	Total	SMEs	Large	
Advanced Europe	**2,522,835**	**2,484,867**	**37,968**	**21,070**	**3,720**	**17,550**	**83**
Austria	2,615	1,497	1,118	394	25	369	56
Belgium	26,262	24,152	2,110	866	142	724	81
Czech Republic	189,389	188,240	1,149	388	153	235	76
Denmark	6,627	5,636	991	318	24	294	61
Finland	14,698	13,917	781	391	60	332	103
France	422,746	415,843	6,903	4,440	808	3,632	119
Germany	10,334	5,117	5,217	3,139	99	3,040	48
Greece	24,757	24,300	457	170	63	107	68
Ireland	878	568	310	506	8	497	76
Italy	926,668	920,327	6,341	2,735	1,112	1,623	93
Latvia	100,734	100,590	144	56	36	21	101
Portugal	229,965	229,105	860	402	178	224	114
Slovak Republic	180,280	179,838	442	140	88	52	70
Slovenia	14,197	14,096	101	45	22	23	47
Spain	198,298	194,549	3,749	1,822	485	1,337	93
Sweden	154,254	152,421	1,833	715	200	715	89
United Kingdom	20,133	14,671	5,462	4,542	216	4,326	108
Emerging Europe	**1,959,264**	**1,947,812**	**11,452**	**4,525**	**1,631**	**2,893**	**82**
Bulgaria	314,780	314,448	332	143	90	52	108
Croatia	104,609	104,389	220	87	51	36	100
Hungary	52,405	51,758	647	241	90	151	85
Poland	47,091	45,261	1,830	622	170	451	61
Romania	11,255	10,637	618	178	59	119	64
Russia	1,040,430	1,034,609	5,821	2,586	903	1,683	97
Serbia	105,562	105,339	223	87	53	34	105
Turkey	15,863	14,645	1,218	300	73	227	31
Ukraine	267,269	266,726	543	282	142	139	89
Total	**4,482,099**	**4,432,679**	**49,420**	**25,595**	**5,352**	**20,444**	**82**

Source: Orbis; OECD structural database; authors' calculations. Note: This table shows the data coverage in the sample in terms of number of firms (columns 1-3) and turnover (columns 4-6). The last column shows the turnover of the firms in the sample relative to aggregate domestic turnover.

In terms of turnover, some large firms are overrepresented relative to national accounts, as we include domestic and foreign operations of internationally active firms.[20] While, on

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[20] The analysis assumes that capital and liquidity can be distributed within the group at the highest level of consolidation in the country of incorporation of the parent company in line with empirical evidence.

aggregate, the firms in our dataset account for two thirds of national employment, for some countries the reporting of employment is thinner.[21]

Firms are mapped to NACE Rev. 2, two-digit 96 economic sectors. We include non-financial corporates operating in all economic sectors except in K (financial and insurance), O (public administration and defense), and U (activities of extraterritorial organizations). We follow the European Commission recommendation (EC, 2003) concerning the segmentation of firms in terms of size. Firms are identified as micro, small and medium-sized enterprises (SMEs) if they have an annual turnover not exceeding 50 million euros. Within the SME category, a small enterprise is defined as a firm whose annual turnover does not exceed 10 million euros, and a microenterprise is defined as a firm whose annual turnover does not exceed 2 million euros.[22] This segmentation is important as some corporate aid schemes target firms in accordance to their size.[23]

The resulting sample includes 4.5 million firms for 26 European countries. The sample covers 17 Advanced European economies (AE) and 9 Emerging European economies (EE).[24] These countries represent 90 percent of European GDP, with a regional representation of 88 percent in AE and 97 percent in EE, respectively. The turnover of firms covered in the analysis amounts to 26 trillion euros. When some non-core variables are missing from the financial statements (e.g. amortization) we impute the missing variable using the average value reported by peer firms at the country, economic sector, and type of firm level.

Sectoral coverage is also adequate. For the non-farm, non-mining, non-financial business economy, the average sectoral share in our sample is over 90 percent relative to the sectoral share in the OECD Structural Database. Some sectors are slightly overrepresented in our sample (e.g. manufacturing at 120 percent), while other sectors are slightly underrepresented (e.g. professional services at 80 percent). Given the unbalanced nature of the data, to ensure country representativeness we re-weigh our results using national sectoral shares of firms' turnover, following Kalemli-Özcan et al. (2015). The analysis also adjusts the size of the budget earmarked by governments for each aid scheme to the firms included in the sample using an adjustment factor between in- and out- of sample firms based on turnover. A similar adjustment is performed to quantify the effectiveness of policies to fill firms' liquidity and equity shortfalls in terms of GDP.

C. Country-Specific Policy Responses

A unique contribution of this study is to carefully incorporate the key country-specific measures announced as of end-August 2020, modeling in detail all conditions and eligibility criteria in the legal basis of the measures. The analysis quantifies the effect of aid granted in the form of wage subsidies, grants, tax rebates, tax deferrals, debt moratoria, official credit,

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[21] Most notably, Serbia, the Slovak Republic, and Turkey.

[22] While EC (2003) also includes a cap on the number of employees, we do not apply this criterium given missing data on the number of employees by some firms.

[23] At the simulation stage, we apply the country-specific definition of SME if it differs from the EC recommendation.

[24] The advanced economies included in the sample comprise Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom. The following emerging European market economies are included in the analysis: Bulgaria, Croatia, Hungary, Poland, Romania, Russia, Serbia, Turkey, and Ukraine.

subsidized lending rates, policy rate cuts, guaranteed loans, and equity injections. Appendix Figure 1 shows the key policy measures incorporated in the simulations by country.

The support received by firms is simulated, taking into account conditions related to firm size, financial position, corporate type, economic sector, and turnover loss. Eligibility criteria are also applied to determine the individual amount of compensation received by each beneficiary within the overall budget envelope.

For instance, in Portugal we include the wage subsidy programs that were announced under the Short-Term Work (STW) Scheme up to end-August 2020. These include the 'simplified layoff' (until end-July 2020), the 'support for progressive recovery' (in two separate tranches, from August-September 2020, and from October-December 2020), as well as the 'support for normalization of business activity' which is a financial incentive scheme to transition workers out of the STW scheme. In Austria, we estimate the compensation scheme for companies having suffered substantial damage due to the COVID-19 outbreak, applying a two-step approach to determine the amount of compensation at the firm level. In the United Kingdom, we incorporate the impact of the targeted reduced rate of VAT from 20 percent to 5 percent to firms in the hospitality and tourism sectors through an increase in operational revenues. In the Czech Republic, we quantify the aid in the form of subsidies to firms active in agricultural primary production and in food and feed production applying the eligibility conditions laid out in the framework. In Germany, we compute the maximum amount of guaranteed loans that firms can apply for to bridge liquidity needs subject to the restrictions stated in the program, in line with the EU Temporary Framework for state aid measures to support firms during the pandemic (Box 1).

On the other hand, the analysis does not consider temporary amendments to countries' bankruptcy laws to narrow creditors' rights to pursue debtors during the COVID-19 crisis by, for instance, demanding a longer duration of "illiquidity" (Finland), suspending equity-based triggers of insolvency (Austria), or the free standing moratorium for companies in financial difficulty (UK). This is because the corporate insolvency model aims at projecting underlying corporate default risk once the temporary amendments to insolvency laws expire.

Box 1. Illustration of Country Policy Schemes Incorporated in the Simulations

This box illustrates the type of policies and the fundamental elements of the measures applied in the simulations using some country examples of aid schemes up to end-August 2020.

Wage subsidies: In *Portugal*, the authorities initially designed two subsidy schemes to compensate employers for the wage costs of unworked hours related to the spread of COVID-19, i.e. the 'Simplified lay-off' and the 'Support for progressive recovery'.[25] In the simulation, we take the observed applications of employees for the 'Simplified lay-off' scheme disaggregated by economic sector as of September 2020 and extend it to the 'Support for progressive recovery' program. For the employees covered under the scheme (1.3 million out of 4.7 million workforce), we link the number of unworked hours to the turnover shock by month at the sectoral level. We compute the impact on firms' wage expenses applying the eligibility constraints laid out in the description of the measure and the caps on the maximum reduction of working hours (see table below). Using an iterative approach, we re-calibrate the sensitivity of unworked hours to turnover shocks to match the implied subsidy projected in the simulation to the official budget allocation announced for each program. We apply exemptions on social security contributions with the conditionality criteria of the government policy as described below.

	Simplified lay-off		Support for progressive recovery			
	Mid_March-July	Aug-Dec	Aug-Sep		Oct-Dec	
Eligibility	Closed or billing losses above 40%	Closed due to government restrictions	Losses≥40%	Losses≥60%	Losses≥40%	Losses≥60%
Measure	Contract suspension or reduction of working hours	Reduction of working hours	Reduced working hours up to 50%	Reduced working hours up to 70%	Reduced working hours up to 40%	Reduced working hours up to 60%
Social Security Contributions	Full exemption		Large companies: 50% reduction SME: full exemption		Large companies: no reduction. SME: 50% reduction	
Salary	Hours worked paid in full		Hours paid in full			
	2/3 of hours not worked (paid 70% by SS, 30% by employer)		2/3 of hours not worked (paid 70% by SS, 30% by employer)		4/5 of hours not worked (paid 70% by SS, 30% by employer)	
Social Security Contributions	70% for hours worked and not worked		0 for hours worked and 70% for hours not worked			
Worker's wage	Min {max (66%*gross wage, MW of 635 euros), 3*MW}		Min {max (66%*gross wage, MW of 635 euros), 3*MW*share of unworked hours}			

Grants: In *Austria*, the government implemented a compensation scheme for companies having suffered substantial damage due to the COVID-19 outbreak. We applied a two-step approach for applying eligibility

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[25] The "Support for progressive recovery" regime was revised in mid-October. The amendments include the extraordinary support to firms with a 25 percent fall in turnover. The summary of the amending decree-law No. 90/2020 is available in https://dre.pt/web/en/home/-/contents/145714398/details/8/normal. The changes implemented in October are not included in the simulations as the cut-off date for policies is end-August.

and calculating the amount of compensation. First, we projected the loss of revenues of firms between mid-March and mid-September 2020 compared to the reference period corresponding to the second quarter of 2019. Second, we applied the progressive scale specified in the scheme; namely for a decline in turnover between 40-60 percent, the maximum level of compensation, in percent of firms' fixed cost was set at 25 percent. For a loss of turnover between 60−80 percent, the maximum level of compensation reached 50 percent. For a loss of turnover exceeding 80 percent, the compensation was set at 75 percent of fixed costs. We applied the scheme to firms that were not already in difficulty within the meaning of the General Block Exemption Regulation as of end 2019. We also applied a nominal cap of EUR 90 million per firm and re-calibrated the individual allocation per borrower so as not to breach the budget envelope of EUR 8 billion.

Tax reduction: The *United Kingdom* announced a targeted reduced rate of VAT to provide relief to firms in the hospitality and tourism sectors that were particularly affected by the COVID-19 pandemic. The VAT rate was cut to 5 percent from July 2020 to January 2021 from 20 percent. The items included food and non-alcoholic drinks in cafes and restaurants as well as to supplies of hotel and accommodation services. For the firms in these sectors, we estimated VAT receipts from financial statements, linked to turnover, and deducted estimated VAT expenses linked to material costs. We then applied the reduction in the VAT rate to the net amount and estimated the impact on operational profits.

Sectoral aid: The *Czech* government provided aid in the form of a subsidy program to micro firms, SMEs or large firms active in agricultural primary production and in food and feed production. Specifically, we identified firms that experienced a decrease in operating profits of at least 25 percent in March−May 2020 under our scenario relative to the same period in 2019 and applied the cap of CZK 200,000 per beneficiary. We re-calibrated the maximum amount per borrower to satisfy the overall budget allocation of CZK 10 billion.

Guarantee schemes: In *Germany*, the Federal government deployed numerous state aid measures. Together with state governments they announced guarantees of around EUR 820 billion. This envelope includes the provision of guarantees on debt instruments for EUR 400 billion and subordinated loans, equity instruments, and hybrid capital instruments for large firms and certain medium-sized firms for EUR 100 billion. We applied the beneficiary conditions stated in the program to firms with at least EUR 50 million in turnover and other firms in strategic sectors according to the German regulation. For guaranteed loans, we applied the maximum risk coverage of 90 percent of the underlying loan and assumed that the maturity extended to beyond December 2020. The amount of the guarantee could not exceed EUR 5 million and was capped by double the annual wage bill of the firm or 25 percent of the firm's total revenue in 2019. In line with the EU Temporary Framework, we allocated guarantees to firms that were not already in difficulty in December 2019, except for micro and small enterprises provided they were not subject to collective insolvency proceedings. Additional loans provided by the KfW were incorporated into the analysis.

VI. THE IMPACT OF THE PANDEMIC WITHOUT ACCOUNTING FOR POLICY MEASURES

Figure 8 presents the share of illiquid firms (unweighted and weighted by turnover) and the size of the liquidity gaps as a share of GDP, respectively, before and after the COVID-19 shock under the three alternative credit scenarios described in Section IV.

Under the 'no bank rollover' scenario, the share of illiquid firms and the magnitude of the liquidity gap as a share of GDP could almost triple relative to pre-pandemic levels, when firms had full access to credit markets. The share of value added generated by illiquid firms would quadruple. Although we lack data to compute precisely the potential job destruction,

tentative estimates indicate that the share of jobs at risk would rise fivefold.[26] The increase of the liquidity gaps is particularly more pronounced in EE than in AE. For the median emerging market economy in our sample, the liquidity shortfalls as a share of GDP could almost quadruple relative to pre-COVID-19 levels.

However, continued access to credit could significantly alleviate liquidity challenges, as shown in the 'benign' scenario. If banks refinance outstanding loans, the pandemic-induced widening of liquidity gaps would be two thirds as large. Extension of new credit beyond what is needed to roll over maturing debt (as is happening in several countries) would further reduce liquidity needs as quantified in the next section.
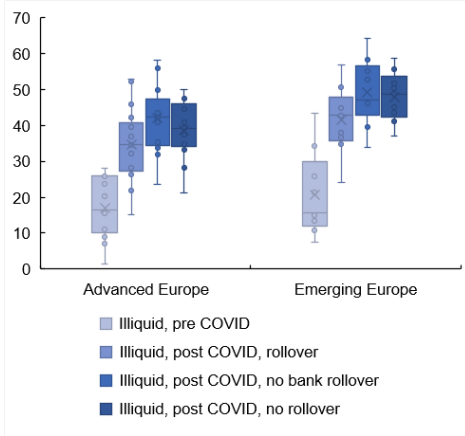
The COVID-19 shock would also erode firms' capital (Figure 8, panels 3 and 4). The share of insolvent firms could rise by 11 percentage points to 20 percent in the median advanced economy and by 14 percentage points to 30 percent in the median emerging market economy in the sample. Overall, the share of value added in firms that may turn insolvent during the pandemic would account for over 13 percent of total value added, with the value added at risk rising almost fourfold relative to pre-COVID levels.

The simulated impact of the COVID-19 shock varies across different types of firms (Figure 9). SMEs account for a larger share of the widening liquidity gaps, reflecting their prevalence in the corporate sector and greater financial constraints (Berger and Udell 1998; Muelier, Schoors, and Merlevede 2016; Blanco et al. 2020). The liquidity and equity gaps of SMEs could rise by 7 percentage points and 2.5 percentage points of GDP at the 75th percentile compared with about 4 percentage points and less than 1 percentage point of GDP for large firms, respectively.

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[26] Orbis does not include the full population of firms. Moreover, not all firms covered in Orbis report employment or value added. The analysis proceeds in two stages. First, employees or value added are apportioned to each firm in-sample in line with turnover at the sector or type of firm (SME, large) level. Second, out-of-sample projections are performed applying the simulated paths for illiquidity or insolvency at the sector or type of firm level to the remaining firms in the population using national statistics. The granularity at the sectoral or type of firm level allows accounting for differences in job or value-added intensity across sectors and type of firms.

Figure 8. Liquidity and Solvency Projections without Policy Measures

Share of Illiquid Firms (Percent)

- Illiquid, pre COVID
- Illiquid, post COVID, rollover
- Illiquid, post COVID, no bank rollover
- Illiquid, post COVID, no rollover

Liquidity Gap (Percent GDP)

- Illiquid, pre COVID
- Illiquid, post COVID, rollover
- Illiquid, post COVID, no bank rollover
- Illiquid, post COVID, no rollover

Share of Insolvent Firms (Percent)

- Insolvent, pre COVID
- Insolvent, post COVID

Equity Gap (Percent GDP)

- Insolvent, pre COVID
- Insolvent, post COVID
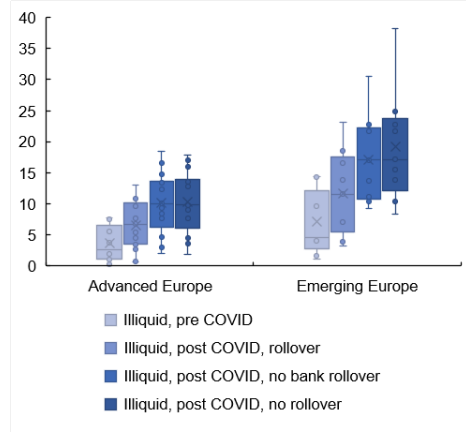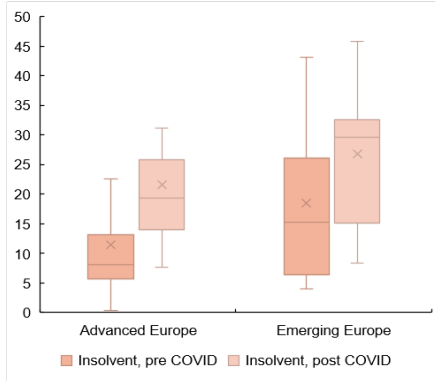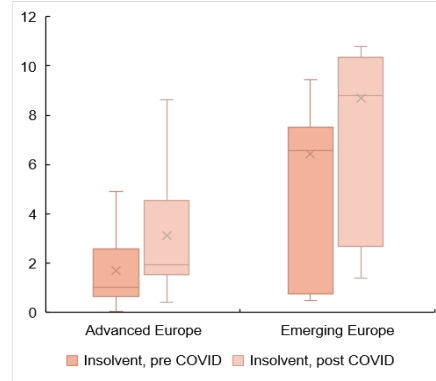
Share of Illiquid Firms, Weighted (Percent)

- Illiquid, pre COVID
- Illiquid, post COVID, rollover
- Illiquid, post COVID, no bank rollover
- Illiquid, post COVID, no rollover
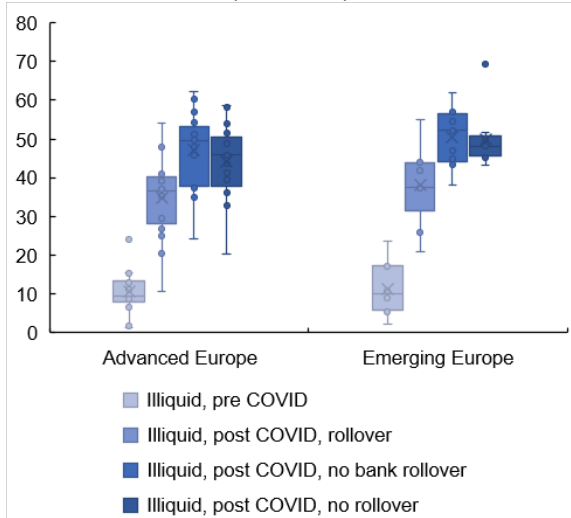
Share of Insolvent Firms, Weighted (Percent)

- Insolvent, pre COVID
- Insolvent, post COVID

Figure 9. Liquidity and Equity Gaps, by Firm Type

Liquidity Gap (Percent of GDP)

. Equity Gap (Percent of GDP)

Sources: Orbis; authors' calculations.
Note: Panel 1 (Panel 2) shows the distribution of the aggregate liquidity (equity) gap post-COVID-19 (wide boxplot) relative to pre-COVID-19 values (narrow boxplot) by firm type. Panel 1 sums negative cash-flows across illiquid firms. Panel 2 sums negative equity values across insolvent firms. Nominal values are shown as percent of GDP. Boxplots include the interquartile range (with the horizontal bar indicating the median). SMEs are firms with annual turnover below 50 million euro, following the definition of the European Commission.

Figure 10. Share of Financially Distressed Firms in Selected Sectors

Illiquid Firms (Percent)

Insolvent Firms (Percent)

Sources: Orbis; authors' calculations.
Note: Panel 1 (Panel 2) shows the distribution of the share of illiquid (insolvent) firms post-COVID-19 (wide boxplot) relative to pre-COVID-19 values (narrow boxplot) for select economic sectors as a share of firms in their group. Boxplots include the interquartile range (with the horizontal bar indicating the median).

Certain production sectors are also affected more than others. As documented in other studies (European Commission, 2020), firms in contact-intensive sectors (such as accommodation and food services, trade) and in complex production networks (such as motor vehicles) would suffer more from the COVID-19 shock than firms in less contact-intensive sectors (such as information and communication). While the increase in the share of insolvent firms would reach 40 percent in the accommodation and food service sector and one quarter in the motor vehicle industry, it would be much lower in the information and communication industry at under 5 percent (Figure 10).

VII. THE IMPACT OF THE PANDEMIC AFTER ACCOUNTING FOR POLICY MEASURES

This section seeks to quantify the extent to which policies—as designed—can dampen corporate liquidity and solvency risks. Using highly-detailed data on the key corporate support measures announced in each of the 26 countries in the study, the analysis projects
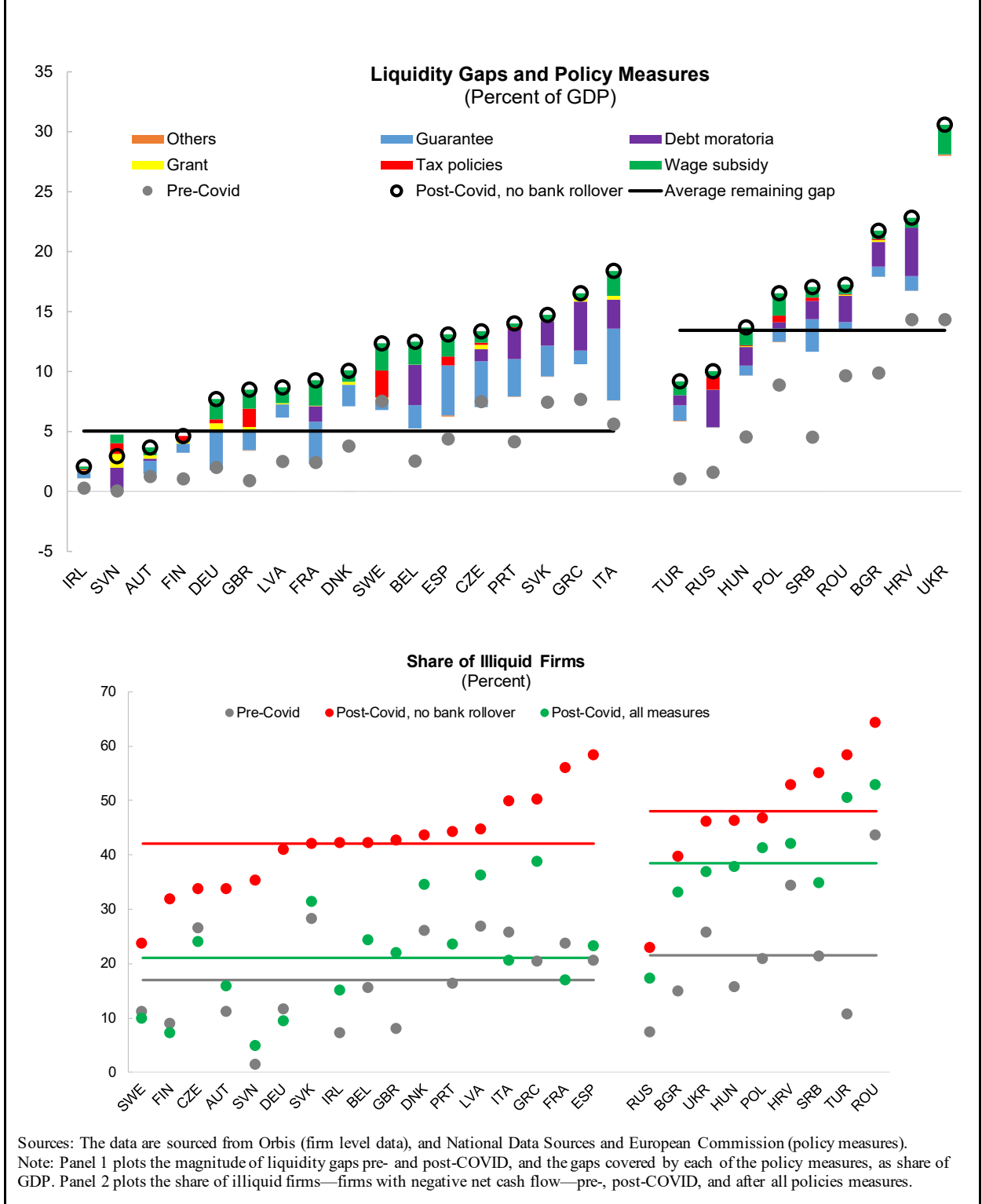
firms' liquidity needs and solvency gaps, assuming that firms take maximum advantage of the measures they are eligible for.[27] This approach does not use information on the actual take-up rates of the various programs, given the limited data on take-up rates so far. Should program implementation or other constraints lead to low take-up, our findings may overestimate the ability of policies to mitigate liquidity and solvency risks. The simulations thus assess the potential effectiveness of the policy packages as *designed* (rather than as *implemented*) by policymakers, assuming that companies apply for and obtain support from the programs for which they are eligible. In our simulations, some policy packages are not exhausted because of strict eligibility criteria at the firm level, related to the type of beneficiary and maximum amounts. This is particularly the case for large loan guarantee schemes with strict limits on maximum amount per beneficiary. The average take-up rate of loan guarantee programs is estimated under 50 percent by end-2020, with large cross-country variation. Another caveat to the cross-country comparison relates to the differential coverage of SMEs in our data set as shown in Section V. Given than SMEs are often more vulnerable than large firms, results may be biased for countries with better coverage of SMEs. This concern is partly addressed by reweighing the size of the liquidity and equity gap by firms' share in domestic turnover.

Simulation results suggest that policies—if implemented as designed—could mitigate liquidity risks by end-2020 substantially, particularly in advanced Europe. Figure 11 presents the pre- and post-COVID 19 liquidity deficit of firms by country. It also depicts the extent to which policy measures could reduce liquidity shortfalls, relative to the 'adverse' post-COVID-19 scenario of partial credit market freeze. The announced policy packages in advanced economies could reduce the pandemic-induced liquidity gap by four-fifths to about 5 percent of GDP, slightly higher than the 3.6 percent of GDP pre-COVID-19 gap. The overall impact of policies in emerging markets is smaller, reducing liquidity gaps by two-fifths to 13 percent of GDP, almost double the pre-COVID-19 level. Overall, public support could fill 60 percent of European firms' liquidity needs triggered by the COVID-19 shock.

The effectiveness of policies varies across countries and metrics used to capture liquidity risk (Figure 12). For AE, policies could offset the increase in the share of illiquid firms and the increase in liquidity gaps compared to pre-COVID in several countries (e.g. Sweden and Slovenia). In contrast, for most emerging economies, policies would fall short in eliminating the increase in the share of illiquid firms or the increase in liquidity gaps. Moreover, there are countries with a large rise in the share of illiquid firms but a less significant increase in liquidity gaps (e.g. Turkey) and vice versa (e.g. Ukraine) relative to peer countries. This asymmetry is more pronounced in EE.

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[27] Simulations do not include firms' optimization behavior across multiple funding options (some of which come with strings attached) and ignore operational risk in implementation of corporate programs.

Figure 11. Liquidity Gaps Covered by Policies

Liquidity Gaps and Policy Measures
(Percent of GDP)

Legend: Others, Grant, Pre-Covid, Guarantee, Tax policies, Post-Covid, no bank rollover, Debt moratoria, Wage subsidy, Average remaining gap

Countries (Panel 1): IRL, SVN, AUT, FIN, DEU, GBR, LVA, FRA, DNK, SWE, BEL, ESP, CZE, PRT, SVK, GRC, ITA, TUR, RUS, HUN, POL, SRB, ROU, BGR, HRV, UKR

Share of Illiquid Firms
(Percent)

Legend: Pre-Covid, Post-Covid, no bank rollover, Post-Covid, all measures

Countries (Panel 2): SWE, FIN, CZE, AUT, SVN, DEU, SVK, IRL, BEL, GBR, DNK, PRT, LVA, ITA, GRC, FRA, ESP, RUS, BGR, UKR, HUN, POL, HRV, SRB, TUR, ROU

Sources: The data are sourced from Orbis (firm level data), and National Data Sources and European Commission (policy measures).
Note: Panel 1 plots the magnitude of liquidity gaps pre- and post-COVID, and the gaps covered by each of the policy measures, as share of GDP. Panel 2 plots the share of illiquid firms—firms with negative net cash flow—pre-, post-COVID, and after all policies measures.

Figure 12. Increase in Liquidity Gap Versus Increase in Share of Illiquid Firms, after accounting for policies
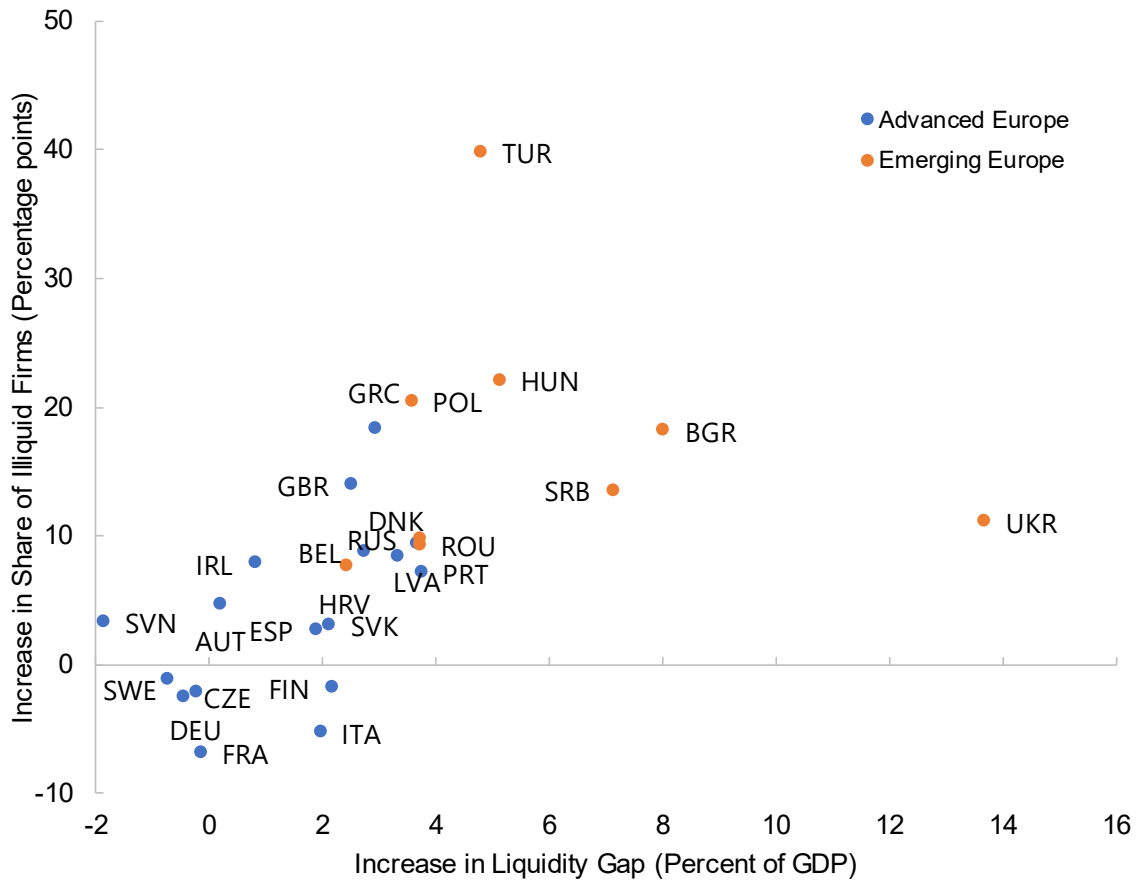
Sources: The data are sourced from Orbis (firm level data), and National Data Sources and European Commission (policy measures).
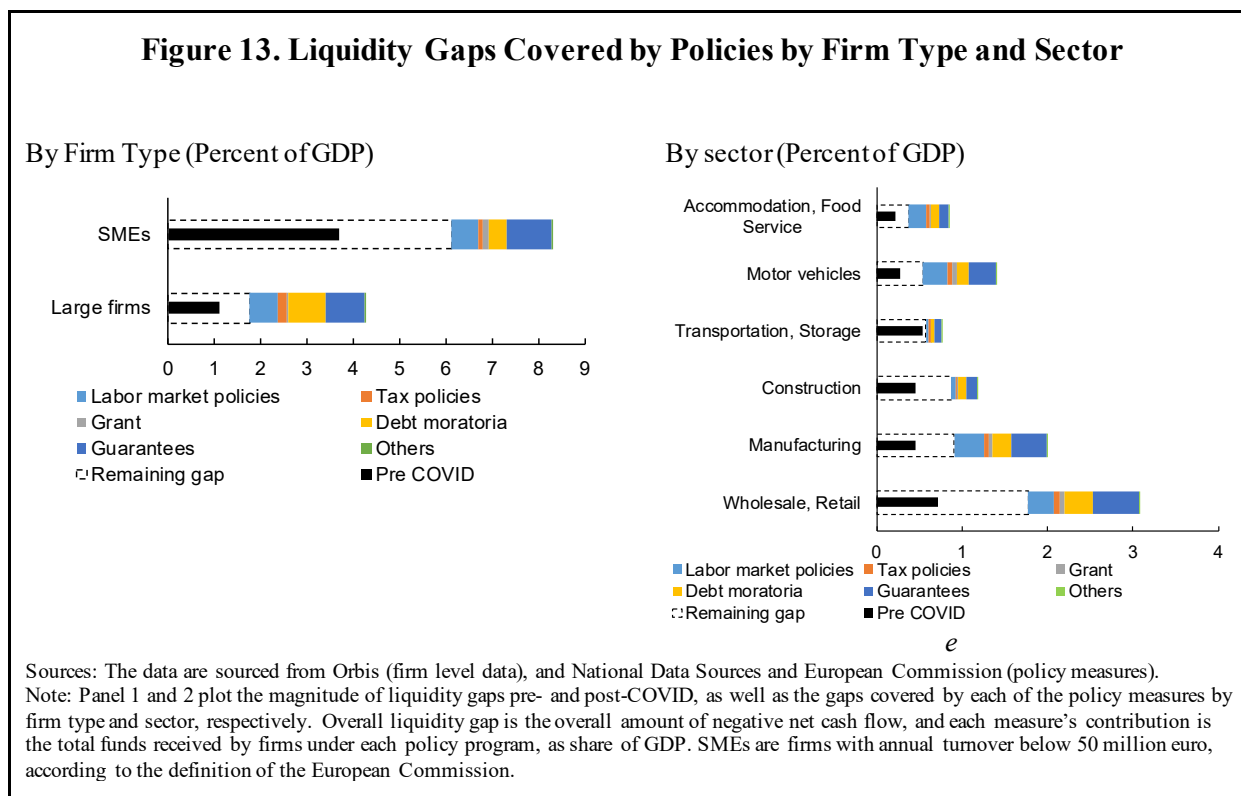Note: The chart plots the increase in liquidity gaps as share of GDP and the increase in share of illiquid firms, post-COVID after all policy measures are accounted for compared with pre-COVID.

Policies could also help mitigate job losses and output destruction. Focusing on employment and value added by firms that would have become illiquid but did not due to policy support, our simulations suggest that, on aggregate, policies could save 15 percent of employment and almost a quarter of value added in Europe. [28]

Among the policy measures, guaranteed loans, job-retention programs, and debt moratoria contribute the most to lowering the liquidity gap. This reflects their large size and broad coverage.

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[28] These estimates could be an upper bound as distressed firms that fail due to their inability to meet their payments obligations could seek M&A solutions to avoid bankruptcy. Conversely, firms with a net positive cash flow position by end-year could fail due to intra-year fluctuations in turnover and debt repayments.

However, the capacity of policies to address liquidity gaps across types of firms and sectors varies. Whereas policies could help reduce the number of firms with a liquidity deficit by around two-thirds (both for large and SMEs), they could mitigate only half of the rise in liquidity shortfalls attributed to SMEs but about three quarters of the rise in large firms (Figure 13, panel 1).

Figure 13. Liquidity Gaps Covered by Policies by Firm Type and Sector

Sources: The data are sourced from Orbis (firm level data), and National Data Sources and European Commission (policy measures).
Note: Panel 1 and 2 plot the magnitude of liquidity gaps pre- and post-COVID, as well as the gaps covered by each of the policy measures by firm type and sector, respectively. Overall liquidity gap is the overall amount of negative net cash flow, and each measure's contribution is the total funds received by firms under each policy program, as share of GDP. SMEs are firms with annual turnover below 50 million euro, according to the definition of the European Commission.
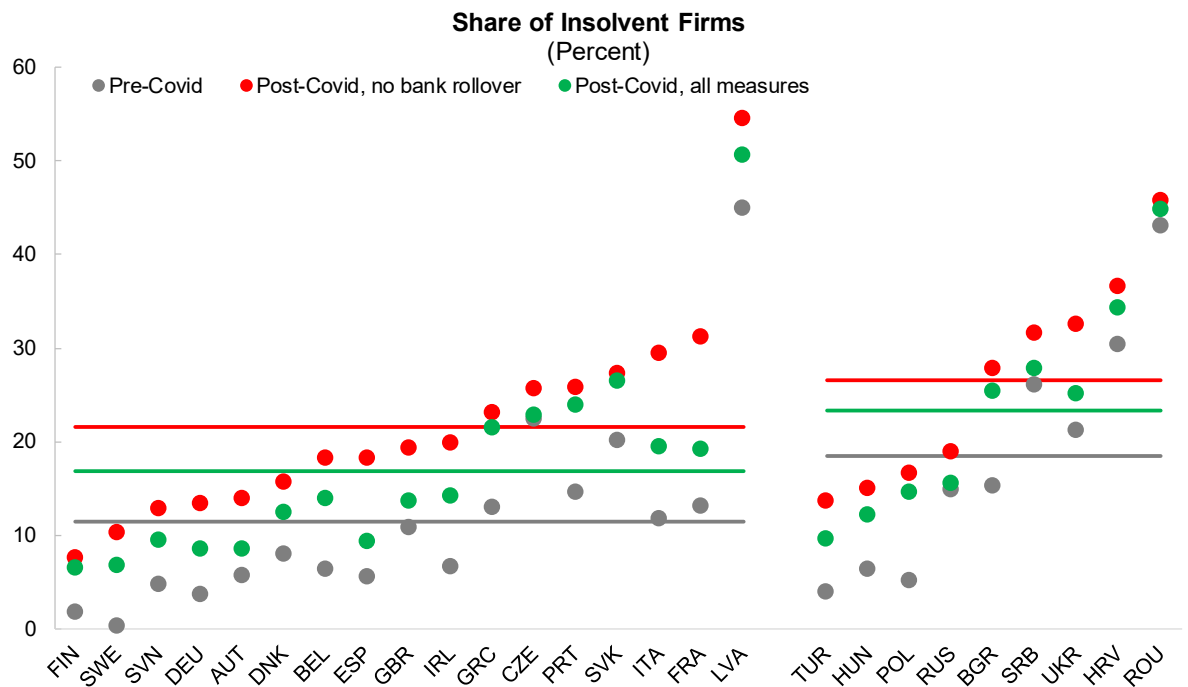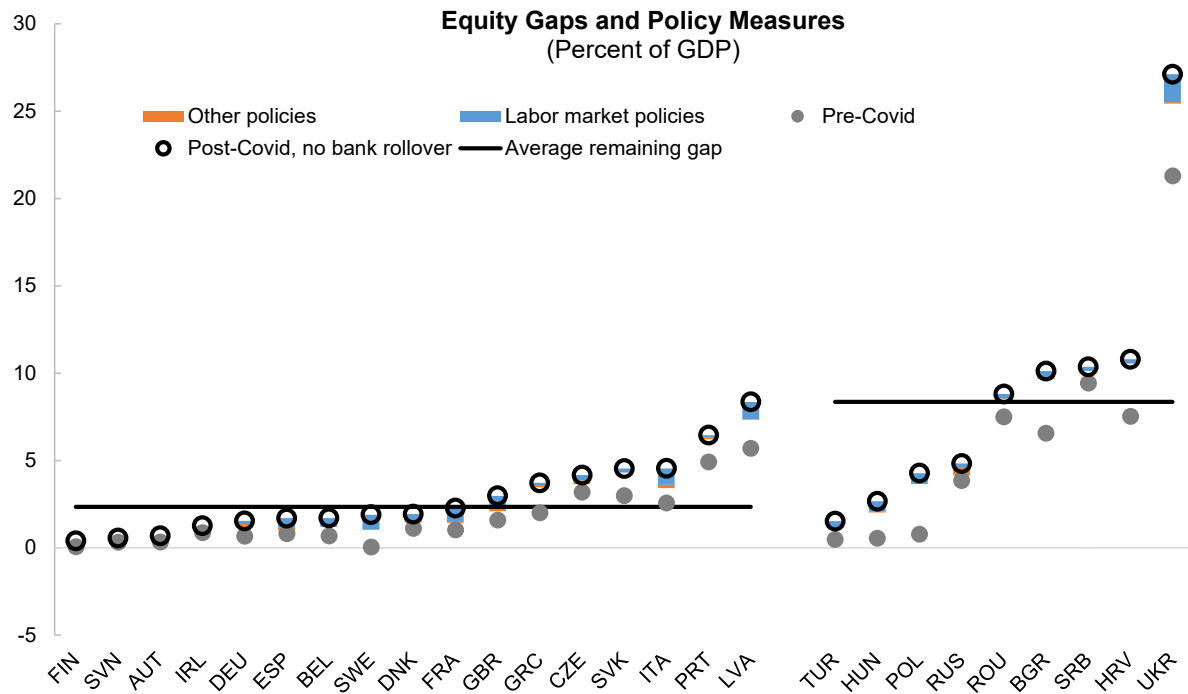
Even after accounting for policy support, liquidity shortfalls are concentrated in the wholesale and retail trade sector and manufacturing—among the sectors most disrupted by lockdowns and supply-chain interruptions, despite the fact that several policies were aimed at those sectors (Figure 13, panel 2).

Policies appear less effective in addressing solvency gaps (Figure 14). This is not surprising as many of the announced policy measures, such as debt moratoria, tax deferrals, and guaranteed loans, address only liquidity strains. In AE, less than two-fifths of the increase in solvency gaps is estimated to be covered by policies (versus four-fifths for liquidity gaps). Similarly, in EE, about a quarter of the solvency gaps are estimated to be covered by policies (versus two-fifths for liquidity gaps). Across Europe, public support could cover 30 percent of the rise in the equity gap generated by the pandemic. As a result, even with the policies implemented as designed, the share of insolvent firms would increase by 6 percentage points to 17 percent in AE and by 5 percentage points to 24 percent in EE.

Across all countries, the share of insolvent firms and equity gaps increase even after accounting for all policy measures, compared with pre-pandemic. Unlike liquidity risks— where there is a significantly positive correlation between the increase in liquidity gaps and the increase in the share of illiquid firms, the increase in the share of insolvent firms is often more diverse than that in the equity gaps, particularly in EE (Figure 15).

Figure 14. Equity Gaps Covered by Policies

Equity Gaps and Policy Measures
(Percent of GDP)

Legend: Other policies | Labor market policies | Pre-Covid | Post-Covid, no bank rollover | Average remaining gap

Categories (x-axis): FIN, SVN, AUT, IRL, DEU, ESP, BEL, SWE, DNK, FRA, GBR, GRC, CZE, SVK, ITA, PRT, LVA, TUR, HUN, POL, RUS, ROU, BGR, SRB, HRV, UKR

Share of Insolvent Firms
(Percent)

Legend: Pre-Covid | Post-Covid, no bank rollover | Post-Covid, all measures

Categories (x-axis): FIN, SWE, SVN, DEU, AUT, DNK, BEL, ESP, GBR, IRL, GRC, CZE, PRT, SVK, ITA, FRA, LVA, TUR, HUN, POL, RUS, BGR, SRB, UKR, HRV, ROU

Sources: The data are sourced from Orbis (firm level data), and National Data Sources and European Commission (policy measures).
Note: Panel 1 plots the equity gaps pre- and post-COVID, as well as the gaps covered by policy measures as percent of GDP. Panel 2 plots the share of insolvent firms pre- and post-COVID, and after all the policies measures are accounted for.

Figure 15. Increase in Equity Gap Versus Increase in Share of Insolvent Firms, after accounting for policies
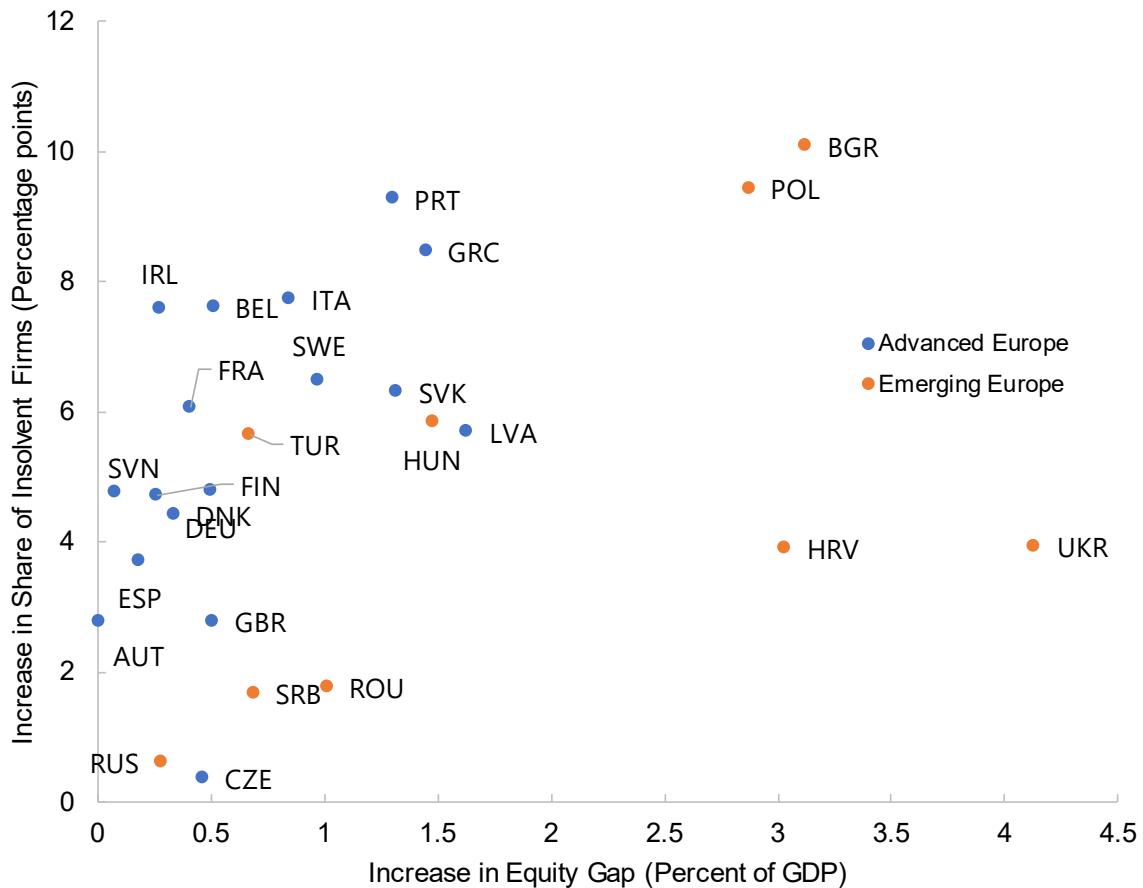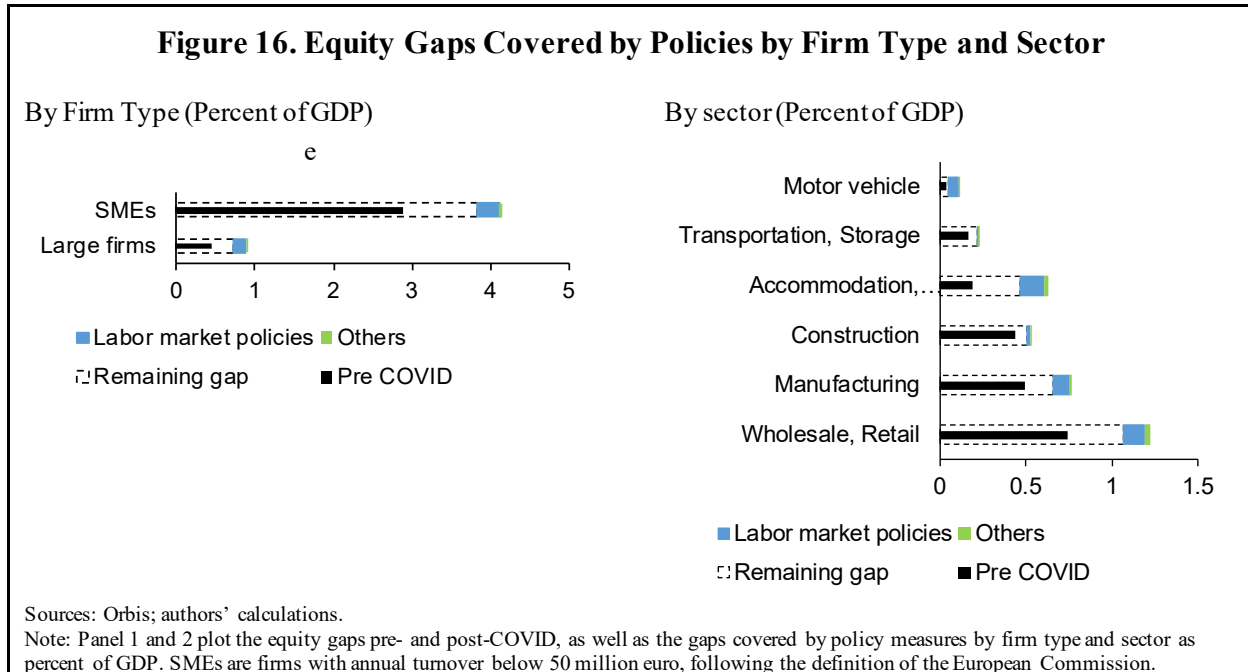

Sources: The data are sourced from Orbis (firm level data), and National Data Sources and European Commission (policy measures).
Note: The chart plots the increase in equity gaps as share of GDP and the increase in share of insolvent firms, post-COVID after all policy measures are accounted for compared with pre-COVID.

Also, the effectiveness of policies at addressing equity shortfalls differs across types of firms and sectors (Figure 16). Whereas policies could offset over two fifths of the increase in the equity shortfall of large firms, they could absorb only one quarter of the rise in SMEs' equity shortfalls. Across sectors, equity gaps are concentrated in the wholesale and retail trade sector and manufacturing, similarly to sectoral results found for liquidity gaps. In addition, firms face large equity gaps in the accommodation and food services sector, while this sector fared relatively better in the cash flow deficit analysis shown in Figure 13 above.

One of the most pressing questions is the economic costs of the COVID-19 pandemic. To reduce the persistent effects of the COVID shock on the corporate sector, a number of government measures were announced to support businesses that were not in financial difficulty before the pandemic to ensure that they would not go out of business. Focusing on firms that were solvent before the pandemic, simulation results suggest that, despite all of the policies, the COVID outbreak would turn 7 percent and 8 percent of those firms insolvent in

AE and EE, respectively (Figure 17, panel 2). This helps gauge the magnitude of the scarring effect of the COVID-19 pandemic as defined in Section IV and suggests that further recapitalization efforts may be needed to avoid massive bankruptcies. To support this pool of firms, the equity injection needed to bring their equity level to the minimum threshold above which firms are not considered "in difficulty" is estimated at about 2 to 3 percent of GDP..[29] This is in addition to the policies already deployed. Furthermore, this assessment does not embed shocks to the structure of the economy from changes in consumer behavior or permanent adjustments to production structures or global value chains.

Figure 16. Equity Gaps Covered by Policies by Firm Type and Sector

By Firm Type (Percent of GDP)

By sector (Percent of GDP)

Sources: Orbis; authors' calculations.

Note: Panel 1 and 2 plot the equity gaps pre- and post-COVID, as well as the gaps covered by policy measures by firm type and sector as percent of GDP. SMEs are firms with annual turnover below 50 million euro, following the definition of the European Commission.

Another objective often stated in policy relief schemes is to ensure the liquidity of firms that were financially sound pre-COVID to avoid that they face serious difficulties to maintain their operations. Figure 17, panel 1 shows that 20 percent of firms in AE and 39 percent of firms in EE would have cash-flow deficits by end 2020, post policy measures. However, a large share of these firms, 80 percent in AE and 50 percent in EE, were already illiquid pre-pandemic due to COVID-unrelated liquidity shortages or standard fluctuations of liquidity. If we restrict attention to firms that were solvent pre-COVID, 14 percent of such firms in AE and 31 percent in EE could face liquidity shortfalls, with some of these firms also being insolvent. Overall, one-tenth of firms in AE and one-quarter in EE would post liquidity shortfalls and have positive equity position (Figure 17, panel 2). These firms will need to

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[29] The analysis defines firms "in difficulty" following Article 2(18) of the Commission Regulation (EU) No 651/2014 (European Commission, 2014). This implies that, for each solvent firm pre-COVID-19 which turns to be "in difficulty" due to the outbreak, the following two conditions hold (i) its cumulative losses projected in the end-2020 balance sheet do not exceed half of its subscribed share capital; and, (ii) its end-2020 book debt to equity ratio is not greater than 7.5. Results are robust to a book debt to equity ratio equal to the 90th percentile ratio in the median country in the sample. The size of the equity injection varies between 1.6 percent of GDP to bring firms' book equity to zero and 3.7 percent to ensure that firms are not "in difficulty".

obtain in the market the financial resources necessary to ensure their liquidity. In other words, the current set of policies seems to be insufficient to cover the liquidity needs of all firms that face liquidity shortages because of the pandemic, although policies are more effective at dealing with liquidity rather than solvency risks.

Figure 17. Distribution of Firms by Liquidity and Solvency Position

All firms; Unconditional Distribution post-COVID-19 (Percent)
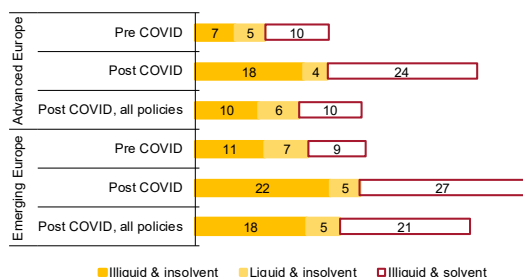
Set of Firms that were Solvent pre-COVID-19; Conditional Distribution post-COVID-19 (Percent)

Sources: Orbis; authors' calculations.
Note: Panel 1 plots the ex-post distribution of firms post-COVID-19, irrespective of their financial vulnerability pre-COVID-19 (unconditional distribution). Panel 2 plots the ex-post distribution of those firms that were solvent pre-COVID-19 (conditional distribution). It then isolates the effect of the COVID-19 shock on solvent firms pre-COVID-19. Panel 1 shows the distribution for pre-, post-COVID, and after all policy measures accounted for. Panel 2 shows the distribution for post-COVID, and after all policy measures accounted for.

Although the announced policies help firms cope with liquidity shortages, the resulting increase in indebtedness raises concerns for solvency risks and investment prospects in the future. The simulations suggest that leverage ratios in the corporate sector are likely to rise substantially, especially in advanced economies and for the already highly-leveraged firms (Figure 18). After all policies are accounted for, the share of liquid but insolvent firms could also increase in AE because of the financial costs of the newly taken credit (Figure 17, panel 1).

Without greater visibility on the structural transformations that will be needed in the post-COVID-19 future, assessing the implications of these findings is not straightforward. However, the results are suggestive of the need to recalibrate the budget, duration, and conditionality criteria of measures to take into account both the financial soundness of firms before the shock (as currently stipulated in many countries) and a forward-looking assessment of firms' position. In other words, the targeting would need to become more stringent and pivot towards considering firms' future prospects,

While in normal times, government support should benefit illiquid but solvent firms, such a criterion is likely to generate a number of bankruptcies well beyond what is socially desirable in the current situation (Blanchard, Philippon, and Pisani-Ferry, 2020). Hence, firms' viability—including after the health crisis is contained—will have to be taken into account and public support extended to viable but currently vulnerable firms.[30] Nevertheless, it will

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[30] In this discussion, we adopt the Blanchard, Philippon and Pisani-Ferry (2020) definition of viability. A firm is considered viable if the present value of its profits exceeds its recovery value. A firm is considered solvent if the present value of its profits (i.e. its equity) exceeds its debt.

be difficult for governments to undertake such a viability assessment for a large number of firms, so private creditors and financial intermediaries will need to have a key role.

Figure 18. Leverage Ratio of Pre-COVID-19 Highly Leveraged Firms
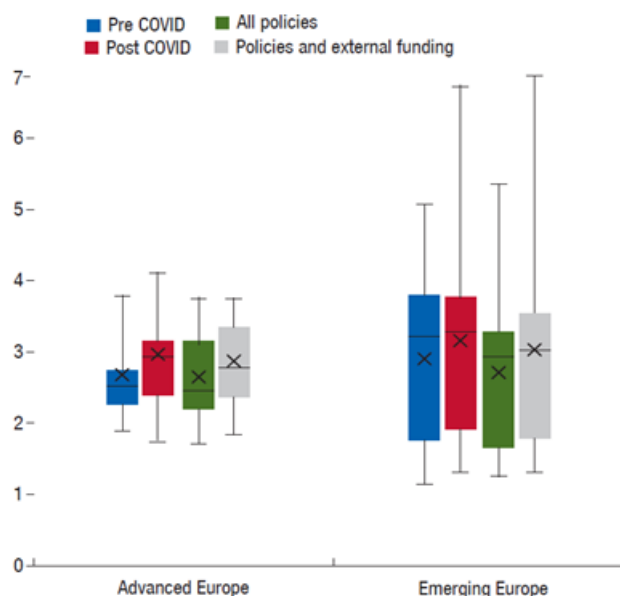
Sources: Orbis; authors' calculations.
Note: Leverage is calculated as the ratio of total liability over book equity. Highly leveraged firms are the 75th percentile of all firms. Boxplots include the mean (cross), median (horizontal bar), the interquartile range, and the minimum and maximum values excluding outliers (whiskers)

VIII. POLICY IMPLICATIONS AND CONCLUSION

The simulations presented in this paper suggest that the COVID-19 shock could have resulted in sizable liquidity and equity shortfalls in Europe's corporate sector by end-2020. The extent of the damage, however, depends crucially on firms' initial positions, and their ability to access policy programs put in place by the authorities and to tap credit markets. In that regard, the strong policy actions taken across Europe have so far provided an important cushion for firms in most European countries.

Our results suggest that policies announced by country authorities, if fully implemented as designed, could significantly lower liquidity risks. In advanced economies, in particular, announced policy measures could potentially reduce COVID-19-induced liquidity shortfalls by four-fifths on average. In emerging economies, however, the simulations reveal sizable remaining liquidity shortfalls with policies covering only two fifths of increased liquidity shortfalls. Policies could also help mitigate job losses and output destruction. Focusing on employment and value added by firms that would have become illiquid but did not due to policy support, our simulations suggest that, on aggregate, policies could have saved 15 percent of employment and almost a quarter of value added of the corporate sector in Europe. Among the policy measures, guaranteed loans, job-retention programs, and debt moratoria

contribute the most to lowering the liquidity gap. This reflects their large size and broad coverage.

However, the capacity of policies to address liquidity gaps across types of firms and sectors varies. Whereas policies could help reduce the number of firms with a liquidity deficit by around two-thirds (both for large and SMEs), they could mitigate only half of the rise in liquidity shortfalls attributed to SMEs versus about three quarters of the rise in large firms. Liquidity shortfalls remain more prominent in sectors characterized by contact-intensive business models and complex value chains, namely trade, manufacturing, construction, and motor vehicles.

The ability of policy measures implemented so far to reduce the increase in solvency risks appears more limited compared to their alleviation of liquidity risks. The effectiveness of policies to reduce solvency risk is, on average, half of that to mitigate liquidity risk. While public support is estimated to have filled 60 percent of European firms' increased liquidity needs, it has covered only 30 percent of the rise in equity gaps. Even with this scale of support, the share of insolvent firms could increase by 6 percentage points across the region. The COVID-19 outbreak could put at risk the jobs of workers in insolvent firms amounting to more than 8 percent of the workforce in the region. Moreover, the projected rise in corporate indebtedness raises concerns about solvency and investment in the future.

Also, the capacity of policies to curb equity shortfalls is highly heterogenous across types of firms, with the effectiveness of aid schemes supporting SMEs estimated at half of that for large firms. Even accounting for all policies, the simulation results reveal that solvency gaps could be particularly prominent in certain sectors. In addition to trade, manufacturing, and construction, the accommodation and food services sector is particularly affected.

As the simulations suggest, 8 percent of companies (or almost 3 million firms) that were solvent pre-COVID would have become insolvent in 2020 even if all available policy measures were implemented. Without additional equity support, some 15 million jobs are at risk. About 2 to 3 percent of GDP will be needed to close the equity gap and provide firms sufficient equity so they would no longer be in difficulty, focusing only on the firms that were solvent before COVID-19. Both private and public sector action is required.

It is important to emphasize that the results should be interpreted with caution, given data limitations on the coverage of firms and the assumption that all firms will rely on available programs in full. Also, results are based on a partial equilibrium model which does not account for positive externalities of policy intervention through the supply chain. Moreover, liquidity and solvency risks do not necessarily imply the opening of insolvency proceedings, although they increase the likelihood of bankruptcy. The analysis is also limited to 2020, given the sizable uncertainty surrounding economic forecasts and the policy outlook upon the expiration of current measures.

Our results suggest that European firms will need more equity to address solvency risks, which have risen significantly. While equity financing can come from several sources, in the current situation of high uncertainty and stretched balance sheets of many actors in the economy, governments will need to contribute to this effort, including via various incentives

for private sector involvement. This is so also because of the presence of externalities, due to private agents not fully internalizing the costs of mass bankruptcies. Where fiscal space is available, support for systemic firms could take the form of direct but temporary equity injections (or junior claims), with appropriate conditionality and safeguards to limit moral hazard. In the case of SMEs, taking equity stakes by the government is more challenging because of the large number of SMEs, and the difficulties related to targeting support, implementation and governance. Consideration could be given to strengthen SMEs' capital structure with the use of hybrid capital (i.e. preferred capital, subordinated loans) and debt restructuring (including the conversion of an amount of guaranteed loans). Banks' involvement is likely to be key given detailed knowledge of their clients, which best positions them to assess firms' future prospects. Other proposals envision grants to SMEs matched by higher future taxes (Blanchard, Philippon, and Pisani-Ferry 2020). Such an approach would require a strong tax culture to be successful.

Looking ahead, policymakers will face complex trade-offs between delivering support to firms to minimize unwarranted bankruptcies and save jobs, containing fiscal costs, and encouraging resource reallocation toward the firms that will be viable in the post-pandemic economy. Continued policy support will be needed during the highly uncertain and possibly incomplete recovery to limit mass bankruptcies and associated job losses and economic scarring, and to avoid the cliff effects that a sudden withdrawal of measures may precipitate. However, public resources are limited in several countries, and the pandemic will likely lead to long-lasting changes in the structure of the economy that are still difficult to predict. A delayed economic recovery will make these trade-offs even more difficult to navigate. These considerations call for a more targeted approach that focuses on firms that are viable in the longer term. Nevertheless, identifying viable firms remains a formidable challenge. Higher public investment in vaccination and testing could help alleviate some of these trade-offs by limiting the effect of the pandemic on the economy.

It will be important thus to rely on a more forward-looking approach, incentivize private co-participation in equity and quasi equity injections, help foster agreements with private creditors to restructure the debt of those firms that can be saved, and to facilitate the orderly exit of firms that are unlikely to succeed in the post-pandemic economy.

Targeting policy support in practice, however, may be very challenging to design and implement, given the sheer number of firms and political economy constraints. Strong incentives will need to be put in place to encourage firms with solid pandemic-proofed business plans to take advantage of policy support while discouraging the uptake by firms that are on a structural path to failure or those that could manage on their own—especially when fiscal room to maneuver is thin. Financial intermediaries should play a key role in the delivery of such support, given their knowledge of the firms.

It will be crucial that targeted support be delivered in a transparent and accountable manner. Systems and procedures should be put in place to carefully monitor the implementation of measures and assess their effectiveness. Using a data-driven approach would enable policymakers to adapt strategies promptly if necessary, while transparency and clear communication to stakeholders could help maintain political support for interventions that will have clear winners and losers. Understanding the reasons behind the relatively low take-

up of certain measures to date can deliver important insights to policymakers and inform the design of more effective support in the future.

Orderly and timely debt restructurings would facilitate capital injections in firms that are viable, including after the health crisis is contained. Also, liquidation of unviable firms will be important to redeploy resources promptly to sectors that are likely to expand. Enhanced bankruptcy procedures and out-of-court restructurings will facilitate the process. In summary, the design of effective, efficient, and affordable policies to support firms will remain a key challenge for policymakers in the coming years.

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Appendix Figure 1: Policy Measures Incorporated in the Simulations by Country

	Main Policy Measures				Other Policy Measures					External Funding	
	Wage subsidies	Grants	Debt moratorium	Guarantees	Tax deferral to 2021	Tax rebate	Equity injection	Subsidized rates	Policy rate	Bank credit	Debt Issuance
Advanced Europe											
Austria	Medium	High	Medium	Medium						✓	✓
Belgium	Medium	Medium	Medium	Medium			✓			✓	✓
Czech Republic	High	Medium	Medium	Medium		✓			✓	✓	✓
Denmark	Medium	High		Low			✓			✓	✓
Finland	Medium	Medium		Medium	✓	✓	✓			✓	✓
France	Medium	Medium	Medium	High		✓	✓			✓	✓
Germany	High	High	Medium	Medium		✓	✓			✓	✓
Greece	Low	Medium	High	Medium				✓		✓	✓
Ireland	Medium	Low	Medium	Medium	✓					✓	✓
Italy	High	Medium	Medium	High			✓			✓	✓
Latvia	Medium	Low		Medium			✓			✓	✓
Portugal	Medium		High	Medium	✓	✓		✓		✓	✓
Slovak Republic	High		Low	Medium	✓			✓		✓	
Slovenia	Medium	Low	High	Medium	✓					✓	
Spain	Medium	Medium		Medium		✓	✓			✓	✓
Sweden	Medium	Medium		Medium	✓		✓			✓	✓
United Kingdom	High	High		High	✓	✓			✓	✓	✓
Emerging Europe											
Bulgaria	Medium			Medium						✓	
Croatia	Medium		Medium	Medium	✓	✓		✓		✓	
Hungary	High	Medium	High	Low		✓		✓	✓	✓	
Poland	Low	Medium	Medium	Medium	✓	✓	✓			✓	
Romania	Medium	Low	High	Medium	✓	✓			✓	✓	✓
Russia	Low	Low		Medium	✓	✓		✓	✓	✓	✓
Serbia	Low		Medium	Medium	✓				✓	✓	✓
Turkey	Low		Medium	High		✓			✓	✓	✓
Ukraine	Medium			Low				✓	✓	✓	✓

Legend:
- High intensity
- Medium intensity
- Low intensity

Sources: National data sources and IMF staff calculations.

Note: The left nine columns reference the form of the direct aid scheme granted to corporates, i.e. wage subsidies (contribution to wage costs to avoid layoffs), grants (direct compensation for loss in revenues), debt moratorium (moratorium on bank loan repayments), guarantees (loan support through guarantees channeled through financial institutions and official loans), tax deferral (ability to defer tax obligations to 2021) tax rebates (decrease/exemption on VAT, corporate income tax, business rates, or payroll tax), equity injections (individual recaps), subsidized rates (on new loans), and policy rate (effective pass-through of policy rate cuts to lending rates). The first four columns (main policy measures) are color-coded to reflect policy intensity taking into account granular information on budget, duration, and firm coverage, relative to peer countries. The rightmost two columns show the external funding sources included in the simulation, i.e. (non-guaranteed) bank loans (for all firms) and debt issuance (for large firms).