Chapter 3. COVID-19 and the Corporate-Sector Outlook Online Annexes

The annexes to Chapter 3 of the October 2021 *Regional Economic Outlook* (REO)*: Middle East and Central Asia* provides an overview of the data and econometric approach of the analysis on digitalization and firm resilience and the non-financial corporate stress testing performed to assess the impact of the COVID-19 pandemic in the Middle East and Central Asia (ME&CA).

Online Annex 3.1. Digitalization and Resilience during COVID-19: Firm-Level Evidence

The COVID-19 pandemic has inflicted an unprecedented shock to the private sector. At the same time, measures to mitigate its impact have profoundly affected the region's use of digital technologies. Teleworking and e-commerce, among others, have surged across countries. These internet-based and bandwidth-intensive activities have fueled demand for high-quality connectivity and exposed existing digital divides between countries and across firms. Chapter 3 of the October 2021 REO reports a summary of the findings of a forthcoming paper studying more broadly the role of digitalization on firm resilience in ME&CA.[1]

Data Sources

Pre-pandemic firm-level data comes from the last survey (2018-20) of the EBRD-EIB-World Bank Business Environment and Enterprise Performance Survey (BEEPS). This is combined with firm-level data on business performance during the pandemic from the World Bank's COVID-19 Follow-up Enterprise Survey (ES COVID Survey2) and the Business Pulse Survey (BPS). These surveys cover 13 countries and territories in ME&CA (a sample of over 18,000 firms).3 In addition to information on business performance, the surveys include indicators that proxy different aspects of firms' digital connectivity.

Identification Strategy

We use a difference-in-differences approach to assess the role that digital connectivity plays on firm performance, taking the COVID-19 crisis as an exogenous supply shock that substantially reduced—due to containment measures—the ability of firms to sell their goods and services. The chapter estimates the following equation:

$$Y_{i,t} = \alpha + \beta_1 COVID_t + \beta_2 Digital_i + \beta_1 \text{COVID}_t * Digital_i + \Gamma X_{i,t} + FEs + u_{i,t}$$

where $Y_{i,t}$ is the logarithm of total sales of firm i at time t; $Digital_i$ is a firm-level dummy which equals one if the firm was digitally enabled before the pandemic;[4] $COVID_t$ equals one in 2020 and zero otherwise; and $X_{i,t}$ is a vector of firm-level control variables. Firm-level baseline control variables include firm size and age. All

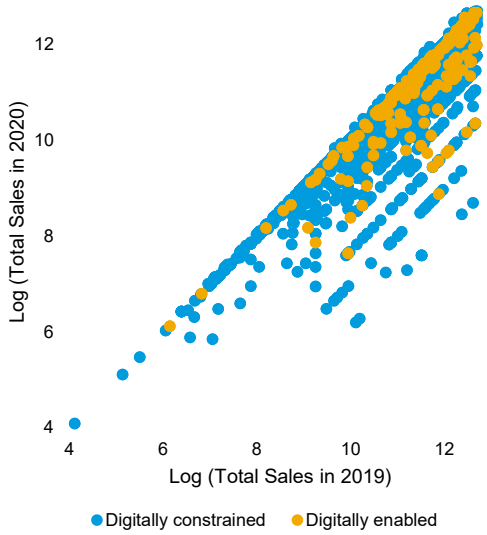
[1] See Abidi, El-Herradi, and Sakha (2021, forthcoming).
[2] The World Bank conducted a firm survey to assess the impact of the pandemic in 48 countries, available at www.enterprisesurveys.org/en/covid-19.
[3] These include Armenia, Azerbaijan, Egypt, Georgia, Jordan, Kazakhstan, Kyrgyz Republic, Lebanon, Morocco, Tajikistan, Tunisia, Uzbekistan, and West Bank and Gaza.
[4] Our digital dummy is constructed from a principal component analysis on two proxies available in the pre-pandemic surveys: internet presence (that is, the use of a website) and adoption of foreign technologies.

regressions feature country- and industry-fixed effects.

The Role of Digital Connectivity

We find that the COVID-19 crisis negatively affected the sales performance across firms. We also find that digitally enabled firms have, on average, higher sales than digitally constrained peers. Most importantly, we find that digital connectivity partly mitigated the pandemic's impact: digitally enabled firms experienced a decline in their sales that is about 4 percentage points lower than that of digitally constrained firms. These results are robust to the inclusion of variables controlling for access to credit, firm ownership, and innovation.

Annex Figure 3.1.1. Digitalization and Firm Resilience



Annex Table 3.1.1. Digitalization and Firm Resilience: Baseline Estimation Results

Dependent Variable: (log) Sales									
	1	2	3	4	5	6	7	8	9
COVID-19	-0.167***		-0.156***	-0.159***	-0.168***	-0.170***	-0.167***	-0.168***	-0.168***
	(0.005)		(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Digital		2.266***	2.242***	1.819***	2.207***	1.793***	1.757***	1.786***	1.748***
		(0.036)	(0.036)	(0.035)	(0.036)	(0.034)	(0.035)	(0.035)	(0.035)
COVID-19*Digital			0.044***	0.038***	0.041***	0.035***	0.038***	0.033***	0.038***
			(0.013)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)
Small				-1.346***		-1.331***	-1.386***	-1.339***	-1.381***
				(0.034)		(0.034)	(0.033)	(0.034)	(0.034)
Young					-0.432***	-0.383***	-0.239***	-0.360***	-0.239***
					(0.035)	(0.033)	(0.033)	(0.033)	(0.033)
Country FE							X		X
Industry FE								X	X
Observations	18074	18074	18074	18074	18074	18074	18074	18070	18070
R-squared	0.002	0.300	0.301	0.395	0.312	0.404	0.423	0.410	0.428

Notes: This table shows the baseline results. Columns (1) and (2) separately depict the correlation between firms' sales and the COVID-19 as well digitalization, respectively.
Column (3) evaluates the joint effect of digitalization and COVID-19 on firm performance. Columns (4) to (6) introduces size and age controls. Columns (7) to (9) use country and industry fixed effects.
Robust standard errors are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Online Annex 3.2. Corporate-Sector Stress Testing

This annex presents a simple framework for assessing corporate performance under different stress-test scenarios. While our analysis relies exclusively on publicly listed firms due to data availability, the framework can be applied to a wider sample of firms. Authorities with access to richer datasets, such as from national registries or tax departments, could carry out this analysis on private firms and small and medium enterprises to get a more comprehensive understanding of the risks facing their corporate sectors.

Data and Sample

The analysis relies on firm-level data from the S&P Capital IQ (Compustat) database. Data from historical financial statements are collected for the 2002-20 period. The sample includes more than 660 publicly listed firms from 11 countries and spans a variety of industries based on the Fama-French classification system (see Annex Table 3.2.1 for country and industry coverage). The exercise is conducted at the firm-level, and the results are then aggregated by country groups (oil-importing and oil-exporting countries), sectors (high- and low-contact-intensive), and firm size (small and large firms).

Annex Table 3.2.1. Country and Industry Coverage

Country	Oil Importing	Oil Exporting
Egypt	X	
Jordan	X	
Morocco	X	
Pakistan	X	
Tunisia	X	
Bahrain		X
Kuwait		X
Oman		X
Qatar		X
Saudi Arabia		X
United Arab Emirates		X

Industry (based on Fama-French classification)	Low-contact-intensity	High-contact-intensity
Consumer Non-Durables: Food, Tobacco, Textiles, Apparel, Leather, Toys	X	
Consumer Durables: Cars, TV's, Furniture, Household Appliances	X	
Manufacturing: Machinery, Trucks, Planes, etc.	X	
Energy: Oil, Gas, and Coal Extraction and Products	X	
Chemicals and Allied Products	X	
Business Equipment: Computers, Software, and Electronic Equipment	X	
Telecom Companies: Telephone and Television Transmission	X	
Utilities	X	
Shops, Wholesale, Retail		X
Healthcare, Medical Equipment, and Drugs		X
Services		X
Transportation		X
Others		X

Empirical Strategy

To project firm-level financial indicators and derive vulnerability measures over a 3-year horizon (2021-23), we adapt Tressel and Ding's (2021) scenario-based stress-testing tool to the region. This tool relies on a set of firm-level regressions, which we estimate in two separate samples: oil-exporting and oil-importing countries. Data used to estimate the regression models ends in 2019 to ensure that the estimated coefficients are not affected by the COVID-19 shock. Accounting identities are used to project indicators not directly obtained through regression-based projections.

Specifically, the empirical framework is based on a dynamic OLS panel-data regression model represented as follows:

$$Y_{i,j,c,t} = \alpha_c + \alpha_j + \beta_1 Y_{i,j,c,t-1} + \Gamma X_{i,j,c,t-1} + \delta_1 G_{c,t} + \epsilon_{i,j,c,t}$$

where the dependent variable to be projected for firm *i*, in industry *j*, in country *c*, and year *t*, $Y_{i,j,c,t}$, can be either a measure of profitability (return on assets, ROA) or annual sales growth. $X_{i,j,c,t-1}$ is a vector of lagged firm-level control variables, including firm size, asset tangibility, sales turnover, leverage, sales growth, and ROA (see Annex Tables 3.2.2 and 3.2.3 for description of variables and summary statistics, respectively). $G_{c,t}$ represents annual real GDP growth in country *c*, in year t. α_c and α_j are sets of country- and industry-fixed effects, respectively. $\epsilon_{i,j,c,t}$ is a residual term.

Annex Table 3.2.2. Description of Variables and Sources

Variable	Description	Source
Real GDP Growth	Country-level annual growth of real GDP	IMF World Economic Outlook
ROA	Pre-tax net income to total assets	Capital IQ and IMF Staff calculations
Leverage	Total debt to total assets	
Sales Growth	Annual growth rate of sales revenues	
Firm Size	The natural logarithm of total assets	
Asset Tangibility	Fixed assets to total assets, a measure of firm efficiency in using assets to generate sales	
Asset Turnover	Annual sales revenues to total assets	

Annex Table 3.2.3. Panel A
2019 Summary Statistics: Oil Importers Subsample

Variables	1st Quartile	Median	3rd Quartile	Mean	Standard Deviation
Real GDP Growth (%)	1.91	1.91	5.55	2.89	1.65
ROA (%)	0.25	5.31	10.33	5.5	9.66
Leverage (%)	7.48	25.35	40.82	26.34	20.59
Sales Growth (%)	-5.41	6.89	20.11	7.88	26.73
Firm Size	6.54	8.14	9.42	7.88	2.11
Asset Tangibility (%)	23.63	38.87	55.35	40.62	22.26
Asset Turnover (%)	0.48	0.8	1.11	0.85	0.54

Annex Table 3.2.3. Panel B
2019 Summary Statistics: Oil Exporters Subsample

Variables	1st Quartile	Median	3rd Quartile	Mean	Standard Deviation
Real GDP Growth (%)	0.33	0.33	0.43	0.52	0.64
ROA (%)	-0.39	3.13	7.57	3.22	8.08
Leverage (%)	7.45	21.57	36.22	24.22	18.6
Sales Growth (%)	-10.47	1.12	12.43	2.68	24.56
Firm Size	5.54	7.18	8.27	6.95	2.09
Asset Tangibility (%)	27.12	46.44	60.57	44.0	22.35
Asset Turnover (%)	0.26	0.43	0.75	0.53	0.39

In projecting ROA and sales growth, the precrisis values (that is, 2019 values) of structural firm-level characteristics—firm size, leverage, asset tangibility, and turnover—are used. The projected value of ROA for 2021, for example, is calculated using the regression estimated coefficients ($\hat{\beta}_1, \hat{\Gamma}, \hat{\delta}_1$), precrisis values of structural firm-level variables, the 2020 actual values- of ROA and annual sales growth, the 2021 real GDP growth forecast, and the estimated country- and industry-fixed effects ($\hat{\alpha}_c, \hat{\alpha}_j$):

$$\widehat{ROA}_{i,j,c,2021} = \hat{\alpha}_c + \hat{\alpha}_j + \hat{\beta}_1 \widehat{ROA}_{i,j,c,2020} + \hat{\Gamma} X_{i,j,c,2020/19} + \hat{\delta}_1 G_{c,2021}$$

As for 2022, ROA is calculated using the regression estimated coefficients, precrisis values of structural firm-level variables (that is, 2019 values), the 2021 projected ROA and annual sales growth, the 2022 real GDP growth forecast, and the estimated country- and industry-fixed effects. We then feed the 2022 ROA projections into the same model to generate 2023 projections.

Having projected ROA and annual sales growth over 2021-23, we exploit the following accounting identities to generate projections for cash (liquidity) needs, the change in debt, the interest coverage ratio, and firms' equity positions under the baseline scenario and an adverse scenario:

$$\text{Cash Balance}_{t+1} = \text{EBIT}_{t+1} - \text{Interest Expenses}_{t+1} - \text{Taxes}_{t+1} + \text{Cash Balance}_{t}$$

where a projected negative value indicates that the firm would have a liquidity shortage and need to rely on external financing to meet its cash outflows.

$$\text{Debt}_{t+1} = \text{Debt}_{t} - \text{Cash Balance}_{t+1} \text{ if Cash Balance}_{t+1} < 0; \text{ equal to Debt}_{t} \text{ otherwise}$$

$$\text{ICR}_{t} = \text{EBIT}_{t} / \text{Interest Expenses}_{t}$$

$$\text{Equity}_{t+1} = \text{Equity}_{t} + \text{Retained Earnings}_{t+1}$$

where retained earnings equal net income under the assumption that firms raise no new equity and pay no dividends during the years of analysis.

Under the baseline scenario

The projected pre-tax net income (EBIT minus Interest Expenses) is obtained by multiplying the projected ROA by the 2019 total assets. Taxes are projected based on the 2020 effective income tax rate. To project equity, retained earnings are calculated as net income after interest expenses and taxes (projected ROA multiplied by 2019 total assets minus projected taxes).

Under the adverse scenario

This scenario is characterized by a subdued recovery and policy support that is withdrawn symmetrically across firms (for simplification) starting from 2022. Real GDP growth is assumed at one standard deviation below the IMF's *World Economic Outlook* forecast. Withdrawal of policy support is modeled as a return to precrisis effective income tax rates and a rise in the effective interest rate by 200 basis points relative to 2020 rates.

Vulnerability Indicators

The analysis relies on a range of indicators used in the assessment of corporate vulnerabilities, as in IMF (2021), Tressel and Ding (2021), and Banerjee and Hoffman (2020).

Liquidity stress is defined as firms facing negative cash balances, as these would have to borrow or make other adjustments to avoid defaulting on their liabilities. Insolvency risk is identified based on firms' equity positions. A negative equity position indicates that a firm's liabilities are larger than its assets.

The projected cash balances and equity positions are used to estimate the share of "firms at risk" (firms with cash balances or equity below zero) and "debt at risk" (the debt of firms at risk as a fraction of total non-financial corporate debt). These are estimated at the country and industry levels as well across country and firm groups. For instance, "firm at risk" and "debt at risk" metrics for firms with negative cash balances are calculated as follows:

$$firm\ at\ risk_{g,t} = \frac{\sum_{i=1}^{i=N_g} 1\left(Cash\ Balances_{i,t} < 0\right)}{N_g}$$

$$debt\ at\ risk_{g,t} = \frac{\sum_{i=1}^{i=N_g} 1\left(Cash\ Balances_{i,t} < 0\right) * D_{i,t}}{\sum_{i=1}^{i=N_g} D_{i,t}}$$

where N_g is the number of firms in group g, i denotes individual firms, and 1(.) is an indicator variable which equals one if cash balance is negative and zero otherwise. Debt at risk is defined as the total debt associated with companies that are at risk of liquidity shortages in group g in year t.

Regression Results

Annex Table 3.2.4 reports the results of OLS regressions of ROA and sales growth on firm- and country-level variables in both oil-exporting and oil-importing countries' samples. As expected, the findings suggest that real GDP growth is positively and significantly associated with both ROA and sales growth across the

two country groups. A one percentage point increase in real GDP growth is associated with a rise in firm profitability by 0.14 and 0.25 percentage point in oil exporters and oil importers, respectively. Likewise, a one percentage point rise in real GDP growth is associated with an additional growth in sales of 1.6 and 1.1 percentage points in oil exporters and oil importers, respectively. The results also point to a large persistence of shocks to ROA, as the estimated coefficient on lagged ROA is about 0.7 in both sub-samples. This implies that shocks to firms' profitability tend to be persistent over time and feed-through future profits. Other firm-level controls have expected signs and are statistically significant.

Annex Table 3.2.4. Panel Data ROA and Sales Growth Regressions

Dependent variable	ROA		Sales Growth	
Sample	**Oil Exporters**	**Oil Importers**	**Oil Exporters**	**Oil Importers**
Real GDP Growth	0.139***	0.246***	1.55***	1.074***
	-4.71	-4.08	-11.08	-4.96
Lagged ROA	0.723***	0.663***		
	-35.54	-38.45		
Lagged Sales Growth	0.011**	-0.003		
	-2.33	-0.81		
Lagged Leverage	-0.022**	-0.037***		
	-2.55	-5.87		
Lagged Firm Size	0.133	0.410***	-1.390***	-0.933***
	-1.32	-4.7	-2.96	-3.62
Lagged Asset Turnover	1.588***	0.855***	-3.47***	-3.417***
	-4.08	3.740	-2.72	-4.26
Lagged Asset Tangibility	0.018***	-0.0009	0.02	0.018
	-3.25	-0.17	-0.7	-0.83
Country Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,593	5,378	2,817	5,991
R-squared	0.637	0.568	0.077	0.02

*Note: t-statistics are in parentheses. ***, **, * indicate statistical significance at the 1, 5 and 10 percent level, respectively.*