Pandemics and firms: Drawing lessons from history

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Abstract
The COVID-19 pandemic caused an unprecedented and synchronized contraction in the global economy. To assess the likely evolution of firm performance going forward, this paper investigates empirically the impact of past pandemics using firm-level data on more than 537,000 nonfinancial companies from 14 developing countries during the period 1998–2018. The analysis indicates that the prevalence of infectious diseases has an economically and statistically significant negative effect on nonfinancial corporate performance. This adverse impact is particularly pronounced on smaller and younger firms, compared to larger and more established corporations. We also find that a higher number of infectious-disease cases in the population increases the probability of failure among nonfinancial firms, particularly for small and young firms. In the case of COVID-19, the magnitude of these effects will be much greater, given the unprecedented scale of the outbreak and strict policy responses to contain its spread.

Keywords
bankruptcy, corporate performance, firm-level, pandemics

JEL Classification
E22, F3, F34, G20, G30, G31, G32
The COVID-19 pandemic is an unprecedented shock with far-reaching economic and financial repercussions throughout the world. As of May 14, 2021, there are over 161.2 million confirmed cases of COVID-19 in 190 countries, with more than 3.3 million deaths (Figure 1). While history is full of pandemics, the coronavirus outbreak has had a greater impact on every country across the globe (Figure 2). According to the International Monetary Fund, global real GDP contracted by an estimated 3.3% in 2020. Following this unprecedented drop during the first year of the pandemic, the global economy is projected to grow at 6% in 2021 and 4.4% in 2022. However, there is high uncertainty surrounding this outlook, related to the path of the pandemic, the effectiveness of policy support to provide a bridge to vaccine-powered normalization, and the evolution of financial conditions. The synchronized nature of the downturn—driven by massive disruptions in supply networks and a collapse in private-sector demand—has jeopardized corporate profitability and depleted many firms’ cash buffers. At the same time, while governments and central banks have responded by providing extensive fiscal stimulus, lowering interest rates, and relaxing prudential regulations, uncertainty surrounding the pandemic has depressed risk appetite and pushed borrowing costs higher. This is a systemic risk like no other at a time of record-breaking debt levels, especially among nonfinancial firms across the world. Consequently, a vicious cycle triggered by the COVID-19 pandemic could exacerbate corporate vulnerabilities, deepen macro-financial instability, and cause long-lasting damage to economic potential.

An important line of research in the literature investigates the determinants of corporate performance, focusing on the role of firm- and sector-specific factors, such as age, size, profitability, and asset tangibility (Baker & Wurgler, 2002; Booth et al., 2001; De Angelo & Roll, 2015; Frank & Goyal, 2009; Graham et al., 2015; Gungoraydinoglu & Öztekin, 2011; Harris & Raviv, 1991; Lemmon et al., 2008; Myers, 1984; Öztekin, 2015; Titman & Wessels, 1998). This paper, however, belongs more to a strand of the literature that connects corporate performance to country-specific macroeconomic and institutional developments, along with firm characteristics (Borio, 1990; Cevik & Miryugin, 2018; Kayo & Kimura, 2011; Rajan & Zingales, 1995). Comparatively, there is much less research on the impact of infectious diseases on nonfinancial corporate performance using cross-country firm-level data. A few studies show that large-scale pandemics can cause a persistent supply disruption—potentially extending beyond the end of the pandemic—and generate a demand-driven slump that might have
significant spillover effects on the nonfinancial corporate sector (Fornaro & Wolf, 2020; Hassan et al., 2020) as well as on household income, savings, and investment patterns (Almond, 2006; Bell & Lewis, 2004). From a theoretical point of view, Eichenbaum et al. (2020) extend the canonical epidemiology model to study the interaction between economic decisions and epidemics and show that people cut back on consumption and work to reduce the chances of being infected. These decisions in turn may reduce the severity of the epidemic, but also end up exacerbating the depth of the downturn in economic activity. More closely related to our paper is the work by Ma et al. (2020), who use data on listed firms and identify a negative effect of infectious-disease outbreaks on corporate profitability and employment.

This paper contributes to the literature by investigating the impact of past pandemics on nonfinancial corporate performance measured by sales growth, profitability and fixed investment. We use a large data set gathering more than 537,000 nonfinancial firms from 14 emerging-market economies over the period 1998–2018 and obtain a granular analysis of firm performance during pandemics across countries and over time. The empirical results confirm that pandemics, as measured by the number of confirmed infectious-disease cases scaled by population, have an economically and statistically significant negative effect on nonfinancial firm performance. This adverse impact is evident across all measures of firm performance: sales growth, corporate profitability, and fixed investment spending. We also find that infectious-disease outbreaks have a significantly greater effect on smaller and younger firms, compared to larger and more established corporations. A series of robustness checks, including dynamic estimations using the System Generalized Method of Moments (GMM) methodology, validate our baseline results showing that pandemics tend to have adverse consequences for nonfinancial corporate performance. We also investigate the quantitative impact of infectious diseases on firms’ survival prospects and find that a higher number of
infectious-disease cases in the population increases the probability of failure among nonfinancial firms in developing countries.

In the case of COVID-19, the magnitude of these effects will be much greater, given the unprecedented global scope of the outbreak. Scaling the estimated coefficient of past pandemics to the prevalence of COVID-19 as measured by the number of confirmed cases in population in the countries represented in our sample would increase the negative impact by 17.5 times to over 10% on sales growth, 1.5% on profitability, and 4.3% on fixed investment spending. Similarly, the unprecedented scale of the COVID-19 pandemic indicates that the probability of corporate failure would increase by more than 25 percentage points among nonfinancial firms during the first year.

These estimates for the impact of the coronavirus pandemic on corporate performance should be considered an upper bound as economic growth in developing countries is projected to decline by 7 percentage points in 2020 relative to 2019, while past pandemics lowered economic growth by 0.6 percentage points on average. However, exceptional policy measures, including temporary changes in bankruptcy laws, in many countries have helped shield the corporate sector by easing financial conditions and maintaining access to credit through lower interest rates and prudential measures, reducing firms’ wage expenditures and other costs while protecting employment, providing grants and supporting firms’ revenue base, mitigating firms’ liquidity pressures through debt moratoria and tax deferrals, and deferring legal action against insolvent debtors. Nevertheless, it is clear that businesses in contact-intensive sectors (such as accommodation, food services, and retail trade) and those operating in highly complex production networks (such as automotive) would suffer more from the COVID-19 pandemic than firms in less contact-intensive sectors (such as information, communication, and technology).

Following this introduction, the paper proceeds as follows. Section 2 provides an overview of the data set used in the analysis. Section 3 introduces the salient features of our econometric strategy. Section 4 presents the empirical results, including a series of robustness checks. In Section 5, we conclude and provide some thoughts on the policy implications of our results.

## 2 | DATA OVERVIEW

We obtain harmonized firm-level financial data, including balance sheets and income statements, on 537,392 nonfinancial firms in 14 developing countries during the period 1998–2018. Unlike other administrative firm-level databases, Orbis provides a comparable coverage of both public (listed) and private (nonlisted) firms including small and medium-sized enterprises in advanced and developing countries. The complete Orbis sample consists of more than 365 million firms from over 100 countries around the world. However, similar to any other large-scale micro data set, the Orbis data require careful management to ensure consistency and comparability across firms and countries and over time. First, we select countries with a sufficient number of observations by setting a threshold of 10,000 annual observations per country. Second, following the data cleaning principles suggested by Gal (2013) and Kalemli-Özcan et al. (2015), we drop observations where total assets, tangible fixed assets, employment, operating revenue, sales, and short-term loans and long-term debt in any given year are missing or negative, and where total assets do not equal to total liabilities and equity. Third, we winsorize the firm-level variables at the 1st and 99th percentile of the distribution to minimize the effect of possibly spurious outliers. After these steps, we obtain an unbalanced panel of
537,392 unique firms from 14 emerging-market economies with a total of 2,152,671 firm-year observations during the period 1998–2018.3

Table 1 displays the distribution of nonfinancial firms across 10 nonfinancial sectors grouped according to the statistical classification of economic activities based on the Nomenclature des Activités Économiques dans la Communauté Européenne (NACE). The majority is concentrated in Asia, accounting for 95% of nonfinancial firms covered in our sample. It is important to note that the number of firms covered in the Orbis database varies from one year to another, increasing considerably after 2004 (Appendix Table A1). In terms of sectoral coverage, the data set is based on the NACE classification of economic activities and covers nonfinancial sectors excluding agriculture, public administration and defense, activities of extraterritorial organizations and bodies, and activities of households as employers and for own use. Most of the firms in the sample operate in the retail and wholesale trade sector, accounting for about 31% of observations, followed by manufacturing with 30%, construction with 13%, and administrative and professional activities with 10%.

Descriptive statistics of all variables for the entire sample are presented in Appendix Table A3. Our dependent variables are (1) sales growth (measured by the rate of change in sales), (2) profitability (measured by the ratio of earnings before interest and tax to total assets), and (3) net fixed investment (measured by the difference between tangible assets in the current period and those in the previous period scaled by total assets at the end of the previous year). We include several key firm characteristics, such as firm age (measured by the log of years since establishment), firm size (measured as the log of total assets), leverage (defined as short-term and long-term debt over total assets), cash flow (measured by the ratio of cash flow to total assets), and asset tangibility (measured by tangible fixed assets to total assets).

Pandemics, our main explanatory variable of interest, are measured by the number of confirmed infectious-disease cases, including Ebola, malaria, SARS, and yellow fever. These series are obtained from the EM-DAT and WHO databases and scaled by population. Following the literature, we include country-specific information (real GDP per capita, real GDP growth,

| Sector                                           | No. of firms | %  |
|--------------------------------------------------|--------------|----|
| Agriculture                                      | 6760         | 1.26|
| Mining                                           | 2828         | 0.53|
| Manufacturing                                    | 158,597      | 29.51|
| Utilities                                        | 7089         | 1.32|
| Construction                                     | 67,968       | 12.65|
| IT                                               | 21,165       | 3.94|
| Other service activities, households, extraterritorial bodies | 13,585 | 2.53 |
| Wholesale and retail trade, accommodation        | 165,844      | 30.86|
| Transport and storage                            | 17,819       | 3.32|
| Real estate                                      | 21,232       | 3.95|
| Professional and administrative activities        | 54,505       | 10.14|
| Total                                            | 537,392      | 100.0|
trade openness measured by the sum of exports and imports in GDP, financial development measured by domestic credit to the private sector as a share of GDP, health spending, and measures of institutional quality) as control variables. These economic and financial statistics are drawn from the IMF’s World Economic Outlook database and the World Bank’s World Development Indicators database.

There are large variations in the corporate leverage and fixed investment ratios and firm characteristics used in the analysis across sectors and types of firms, as well as in macroeconomic and financial conditions and measures of institutional quality across countries and over time. It is essential to analyze the time-series properties of the data to avoid spurious results by conducting panel unit root tests. We check the stationarity of all variables by applying the Im et al. (2003) procedure, which is widely used in the empirical literature to conduct a panel unit root test. The results, available upon request, indicate that the variables used in the analysis are stationary after logarithmic transformation or upon first differencing.

### 3 | EMPIRICAL METHODOLOGY

The impact of past pandemics on firm performance depends on several factors, including the firm’s initial conditions, the severity of the pandemic, the sector to which the firm belongs to, and the macroeconomic context. In this paper, we estimate this impact according to the following empirical specification:

$$y_{ict} = \alpha_1 V_{ict} + \alpha_2 F_{i,c,t-1} + \alpha_3 M_{c,t-1} + \eta_i + \eta_{st} + \eta_{cs} + \epsilon_{ict}$$

in which the subscripts $i$, $s$, $c$, and $t$ denote firm, sector, country, and time, respectively. The dependent variable, $y$, denotes sales growth, profitability, or fixed investment. We measure sales growth as the rate of change in sales, profitability as the ratio of earnings before interest and tax to total assets, and net fixed investment as the difference between tangible assets in the current period and those in the previous period scaled by total assets at the end of the previous year.

$V_{ir}$ is the number of confirmed infectious-disease cases scaled by population in country $c$ at time $t$. The term $F_{i,c}$ is a vector of company-specific control variables, including firm size, leverage, cash flow, asset tangibility, and firm age. The term $M_{c,t}$ denotes a set of country-specific factors, including real GDP per capita, real GDP growth, trade openness, and financial development.

The $\eta_i$ coefficient denotes the firm-specific fixed effects capturing time-invariant unobservable factors. The $\eta_{st}$ coefficient denotes the set of sector-year fixed effects capturing unobserved time-invariant heterogeneity among firms across sectors and common shocks to firms belonging to the same sector in a given year. This helps control for aggregate and sectoral demand or policy-induced shocks, as well as cross-sectional dependence among firms in our sample. Furthermore, including sector-year fixed effects allows us to interpret the coefficient on, for example, the leverage ratio as the effect of higher indebtedness relative to a firm’s sector peers at time $t$. This is an important consideration since some sectors are more highly leveraged than others, with differing investment patterns. The $\eta_{cs}$ coefficient does the same for country-sector groups. As a result, without sector-country and sector-year fixed effects, the results would only reflect average investment patterns in more leveraged sectors. Finally, $\epsilon_{ict}$ is an idiosyncratic error term that satisfies the standard assumptions of zero mean and constant variance. Robust standard errors are clustered at the firm level to account for the fact that
observations pertaining to a firm are correlated and thus do not contain as much information as unclustered errors.

We present the empirical results obtained via the ordinary least squares approach method, but potential reverse causality and omitted variable problems may prevent the identification of the true extent of causal relationships. That is why we also estimate the dynamic versions of leverage and investment models using the System GMM procedure proposed by Arellano and Bover (1995) and Blundell and Bond (1998), which is appropriate given that our data set covers a large number of firms within a relatively short time dimension. Although the System GMM is a demanding estimator, especially with unbalanced observations, it helps correct for estimation biases resulting from the inclusion of the lagged dependent variable, as well as the potential endogeneity of the explanatory variables. In brief, the System GMM estimator uses internal instruments by combining variables in levels with variables in first differences, assuming that the error terms are not serially correlated and that the explanatory variables are weakly exogenous or not significantly correlated with future realizations of the error terms.

The use of all available lagged levels of the variables in the System GMM estimation leads to a proliferation in the number of instruments, which reduces the efficiency of the estimator in finite samples, and potentially leads to over-fitting. A further issue is that the use of a large number of instruments significantly weakens the Hansen $J$ test of over-identifying restrictions, and so the detection of over-identification is hardest when it is most needed. Conversely, however, restricting the instrument set too much results in a loss of information that leads to imprecisely estimated coefficients. Estimation of such models therefore involves a delicate balance between maximizing the information extracted from the data on the one hand and guarding against over-identification on the other. To this end, we follow the strategy suggested by Roodman (2009) to deal with the problem of weak and excessively numerous instruments. We also validate the System GMM identification assumptions by applying a second-order serial correlation test for the residuals and the Hansen $J$ test for the overidentifying restrictions. The values reported for AR(1) and AR(2) are the $p$-values for first- and second-order autocorrelated disturbances in the first-differenced equation. As expected, we find that there is high first-order autocorrelation, but no evidence for significant second-order autocorrelation. Similarly, the Hansen $J$-test result indicates the validity of internal instruments used in the dynamic model estimated via the system GMM approach.

We also focus on the impact of infectious-disease outbreaks on firms’ survival prospects by tracing the span of survival for each firm over the sample period. We define the survival function as the probability of failure between time $t$ and $t+1$ divided by the probability of surviving at least until $t$, for a given set of covariates. In line with the literature, we consider a firm as failed in a given year when its status is that of receivership, liquidation, or dissolved (Bridges & Guariglia, 2008; Bunn & Redwood, 2003; Helmers & Rogers, 2010). The observation period in this analysis takes into account both left truncation and right censoring since firms may remain in operation beyond the sample period. We use the year of the first appearance in the data set as the time at which a firm becomes at risk of failure and exclude observations when a firm drops out of the database. The survival function for firm $i$ at any point of time $t > 0$ and $t = 1, \ldots, T$ is assumed to take the proportional hazard form:

$$\theta_{it} = \theta(t) \times X_{it}^\prime \beta,$$

where $\theta(t)$ is the baseline hazard function and $X_{it}$ is a series of time-varying covariates summarizing observed differences among firms (Audretsch & Mahmood, 1995; Cevik & Miryugin, 2021; Cox, 1972; Cox & Oakes, 1984; Kleinbaum & Klein, 2005). In a panel setting, the discrete
time formulation of the probability of failure is given by a complementary log-log model such as:

\[ h_t(X_{it}) = 1 - \exp \left\{ -\exp \left( X_{it}'\beta + \theta(t) \right) \right\}, \]

in which \( h_t(X_{it}) \) is the hazard rate at time \( t \) for firm \( i \), \( \theta(t) \) is the baseline hazard function, and \( X_{it} \) comprises a vector of firm characteristics. This discrete time version of the Cox proportional hazard model can be extended to account for unobserved but systematic differences among firms by describing unobserved heterogeneity by a random variable \( \mu_i \) independent of \( X_{it} \):

\[ h_t(X_{it}) = 1 - \exp \left\{ -\exp \left( X_{it}'\beta + \theta(t) + \mu_i \right) \right\}, \]

where \( \mu_i \) denotes an unobserved firm-specific error term with zero mean, uncorrelated with the \( X_s \). The complementary log-log model allows us to capture the exact time of failures and deal with the potential right-censoring bias and the endogeneity problem arising from simultaneity between the dependent and explanatory variables. We control for firm-specific characteristics comprising age, size, profitability, leverage, cash flow, and asset tangibility. We include sector and country fixed effects to account for unobserved time-invariant heterogeneity. This model can be estimated using standard panel data methods for a binary dependent variable, assuming that the distribution of \( \mu_i \) is normal. Robust standard errors are clustered at the firm level to account for the fact that observations pertaining to a firm are correlated and thus do not contain as much information as unclustered errors.

4 | ESTIMATION RESULTS

The rich data set—covering more than 537,000 nonfinancial firms from 14 emerging-market economies over two decades with a total of 2,152,671 firm-year observations—provides for a comprehensive and robust empirical analysis. All specifications include firm, sector, country, and time fixed effects to capture common shocks and unobserved time-invariant heterogeneity among firms across sectors and countries. Estimation results present a consistent picture across different specifications and econometric methodologies. It is also worth noting that the introduction of country-specific macroeconomic control variables does not materially alter the magnitude and statistical significance of estimated coefficients on firm-level variables. These specifications with country-level macroeconomic variables allow us to tease out additional information on the interaction between macroeconomic dynamics and firms’ behavior in terms of debt accumulation and fixed investment spending.

In Table 2, we present the baseline estimation results for sales growth in column (1), profitability in column (2), and capital spending in column (3). Pandemics—as measured by the number of confirmed infectious-disease cases scaled by population—are found to have an economically and statistically significant negative effect on sales growth, profitability, and net fixed investment among nonfinancial firms in developing countries, after controlling for firm characteristics and macroeconomic developments. The coefficient on pandemics ranges between \(-0.083\) and \(-0.598\) depending on the measure of corporate performance, but always remaining negative and statistically significant. This means that the greater prevalence of infectious diseases in the population is associated with weaker performance among non-financial firms. The magnitude of this adverse effect is greater on sales growth than capital
spending and profitability among nonfinancial firms, as expected, since sales tend to suffer immediately during an outbreak.

With regard to firm-level controls, the results are consistent with the literature across all specifications. The ratio of total debt to total assets—our measure of leverage—is positively related to sales growth and profitability, but has a dampening effect on fixed investment in developing countries. Cash flow appears to be associated with higher corporate profitability and lower sales growth and capital spending, while asset tangibility—capturing asset quality and

| Variables                  | (1) Sales growth | (2) Profitability | (3) Fixed investment |
|----------------------------|-----------------|-------------------|----------------------|
| Pandemics                  | −0.598***       | −0.083***         | −0.244***            |
|                            | [0.043]         | [0.013]           | [0.025]              |
| **Firm-level controls**    |                 |                   |                      |
| Leverage (lag)             | 0.210***        | 0.005             | −0.179***            |
|                            | [0.007]         | [0.004]           | [0.008]              |
| Cash flow (lag)            | −0.023**        | −0.013*           | −0.020***            |
|                            | [0.009]         | [0.007]           | [0.004]              |
| Asset tangibility (lag)    | 0.063***        | −0.035***         | −0.758***            |
|                            | [0.008]         | [0.005]           | [0.011]              |
| Firm size (lag)            | −0.103***       | −0.011***         | −0.013***            |
|                            | [0.000]         | [0.000]           | [0.001]              |
| Firm age                   | −0.097***       | −0.036***         | −0.044***            |
|                            | [0.007]         | [0.002]           | [0.006]              |
| **Macroeconomic controls** |                 |                   |                      |
| GDP per capita (lag)       | −0.162***       | −0.052***         | 0.106***             |
|                            | [0.033]         | [0.011]           | [0.022]              |
| GDP growth (lag)           | −1.383***       | 0.018             | 0.241***             |
|                            | [0.047]         | [0.021]           | [0.036]              |
| Trade openness (lag)       | −0.606***       | −0.057***         | −0.093***            |
|                            | [0.007]         | [0.003]           | [0.005]              |
| Financial development (lag)| −0.376***       | 0.011***          | −0.112***            |
|                            | [0.010]         | [0.004]           | [0.008]              |
| Number of observations     | 1,551,353       | 1,543,485         | 712,724              |
| Number of firms            | 531,252         | 529,054           | 353,724              |
| Adj. $R^2$                 | 0.053           | 0.008             | 0.088                |

Note: Robust standard errors clustered at the firm level are reported in brackets. Fixed effects included in all regressions are sector-year and sector-country. Constant included but omitted from the table. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
collateral availability—has a statistically significant effect only on fixed investment. Firm size, on the other hand, is found to have a consistently significant negative influence on sales growth, profitability, and fixed investment, which implies that large firms tend to have lower sales growth and profitability and thereby invest less relative to smaller firms. Finally, firm age appears to have a statistically significant negative effect on all three measures of nonfinancial corporate performance. That is, more mature nonfinancial firms experience lower rates of sales growth and profitability and invest less than younger corporations.

The inclusion of country-specific variables provides additional information on the impact of macroeconomic developments at the firm level during pandemics. First, the level of real income per capita has a statistically significant effect on all three dependent variables—sales growth, corporate profitability, and fixed investment—but the magnitude and direction of this effect vary across the specifications. The impact of higher income is greater on sales growth than capital spending and profitability. Real GDP growth, on the other hand, has a significant negative effect on sales growth, but a positive effect on corporate profitability. Finally, while trade openness is found to have a significant dampening effect on sales growth and profitability in emerging-market economies, while financial development has an economically and statistically significant positive impact on sales growth, profitability, and fixed investment.

We conduct a number of robustness checks to verify our baseline findings and obtain a more nuanced picture by deepening our investigation into firm characteristics. First, we introduce additional firm-level variables (liquidity and capital intensity) and country-level control variables for institutional differences (rule of law). Second, we estimate the model for the postglobal financial crisis period (2010–2018), which also has better data coverage. Third, we estimate the model separately for subsamples of small and large firms and young and old firms. These results, presented in Appendix Tables A4–A6, are consistent with our baseline findings and confirm the significant negative impact of pandemics on nonfinancial corporate performance. In the case of sales growth, for example, we find that infectious-disease outbreaks have a significantly greater effect on smaller firms, with the coefficient on our pandemics variable increasing to $-1.22$ for small firms compared to $-0.35$ for large corporations. Similarly, pandemics have a much greater negative impact on young firms with an estimated coefficient of $-0.84$ than older establishments with a coefficient of $-0.39$. We also find significantly larger effects of pandemics on profitability and fixed investment spending among small and large firms and young and older companies in our sample.

As a final check of robustness, we estimate the dynamic model with lagged dependent variables to capture persistence over time in nonfinancial firm performance. These results, presented in Appendix Table A7, are based on the System GMM estimator and confirm the negative impact of pandemics at the firm level. In the case of sales growth, for example, the magnitude of pandemics is at least twice as large as that of the coefficient in the static model.

We also investigate the impact of infectious diseases on firms’ survival prospects. These estimation results, presented in Table 3, show that pandemics have a significant influence on the survival probability of nonfinancial firms. All variables included in the model have the expected sign with a high degree of statistical significance. With regard to the main variable of interest, we find that the coefficient on pandemics exerts a positive and highly significant effect on the probability of failure. A percent increase in the number of infectious-disease cases per population is associated with an increase of 1.5% in the likelihood of failure among nonfinancial firms in developing countries. This finding is not only statistically but remains robust when we partition the sample into various subgroups. First, we find that the impact of pandemics on firm survival is much greater after the global financial crisis, which may reflect
TABLE 3  Infectious diseases and firm survival—Proportional Cox hazard model

| Variables            | (1) All | (2) Post GFC | (3) Young | (4) Old | (5) Small | (6) Large |
|----------------------|---------|--------------|----------|--------|----------|----------|
| Dependent variable: probability of failure |         |              |          |        |          |          |
| Pandemics            | 1.450***| 3.092***     | 3.161*** | 0.054  | 4.108*** | 0.257    |
|                      | [0.391] | [0.396]      | [0.699]  | [0.770]| [0.972]  | [0.540]  |
| **Firm-level controls** |         |              |          |        |          |          |
| Profitability (lag)  | −0.543***| −0.621***    | −0.408***| −0.729***| −0.235***| −0.967***|
|                      | [0.019] | [0.024]      | [0.031]  | [0.042]| [0.031]  | [0.060]  |
| Leverage (lag)       | 0.576***| 0.563***     | 0.440*** | 0.604***| 0.355*** | 0.389*** |
|                      | [0.018] | [0.026]      | [0.030]  | [0.038]| [0.026]  | [0.060]  |
| Cash flow (lag)      | −0.001  | 0.001        | −0.096** | 0.006  | −0.055   | 0.007    |
|                      | [0.012] | [0.016]      | [0.046]  | [0.005]| [0.042]  | [0.006]  |
| Asset tangibility (lag) | −0.178***| −0.201***    | −0.160***| −0.098*| −0.224***| −0.011   |
|                      | [0.023] | [0.032]      | [0.035]  | [0.052]| [0.036]  | [0.067]  |
| Firm size (lag)      | −0.189***| −0.067***    | −0.154***| −0.210***| −0.098***| −0.247***|
|                      | [0.003] | [0.006]      | [0.004]  | [0.006]| [0.007]  | [0.012]  |
| Firm age              | −0.702***| −0.779***    | −1.862***| −4.830***| 0.013    | −0.867   |
|                      | [0.181] | [0.176]      | [0.401]  | [1.012]| [0.358]  | [0.757]  |
| **Macroeconomic controls** |         |              |          |        |          |          |
| GDP per capita (lag) | −5.521***| −5.161***    | −5.464***| −5.479***| −6.122***| −3.971***|
|                      | [0.066] | [0.095]      | [0.112]  | [0.142]| [0.108]  | [0.173]  |
| GDP growth (lag)     | 5.948***| 4.519***     | 4.420*** | 6.353***| 4.834*** | 5.157*** |
|                      | [0.268] | [0.369]      | [0.535]  | [0.528]| [0.576]  | [0.566]  |
| Trade openness (lag) | −0.092**| 1.362***     | 0.463*** | −0.275***| −0.176** | 0.060    |
|                      | [0.040] | [0.070]      | [0.078]  | [0.084]| [0.081]  | [0.097]  |
| Financial development (lag) | 1.284***| 1.794***     | 0.821*** | 1.555***| 1.437*** | 1.605*** |
|                      | [0.064] | [0.195]      | [0.118]  | [0.140]| [0.115]  | [0.153]  |
| Number of observations | 1,547,234 | 1,223,839 | 366,737 | 453,358 | 342,673 | 418,269 |
| Number of firms      | 529,912 | 484,796     | 204,326 | 142,247 | 176,973 | 109,642 |
| Number of failures   | 55,279  | 29,673      | 16,196  | 13,494  | 16,565  | 9,009   |
| Wald χ² statistics   | 17,632  | 6,077       | 6,294   | 3,410   | 7,021   | 1,380   |
| Log-likelihood       | −456,109| −229,627    | −138,477| −91,840 | −117,353| −55,211 |

Note: Robust standard errors clustered at the firm level are reported in brackets. The results are stratified by sector and country. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
weaker financial underpinnings that make nonfinancial corporate performance more vulnerable to other pandemics. Second, in line with previous research, we see that survival probability differs depending on firm age and size, with older and larger firms experiencing a lower risk of failure.

These results and the unprecedented scale of the COVID-19 pandemic suggest that the probability of firm failure in developing countries would increase by more than 25 percentage points during the first year. The adverse impact on firms’ survival prospects would reach 53 percentage points for young firms and 70 percentage points among small companies. Furthermore, these estimates should be considered a lower bound as the economic contraction is much deeper this time around than during past pandemics. As shown in our estimations, the economic shock caused by the pandemic would also amplify the impact of lower profitability and higher indebtedness on firms’ survival prospects.

5 | CONCLUSION

This paper provides novel empirical evidence of the impact of past pandemics on firm performance measured by sales growth, profitability, and fixed investment spending, and draws lessons from history for the COVID-19 pandemic. The global economy is in the midst of an unprecedented slump caused by the coronavirus outbreak across the world. A protracted downturn in economic activity—as experienced during the global financial crisis and many times in various emerging-market economies—could exacerbate corporate vulnerabilities, deepen macro-financial instability, and cause long-lasting damage to economic potential.

Using a large data set gathering more than 537,000 nonfinancial firms from 14 emerging-market economies over the period 1998–2018, we uncover several interesting patterns and obtain a granular analysis of firm performance during pandemics across countries and over time. Our empirical results, robust to a battery of sensitivity checks, confirm that pandemics, as measured by the number of confirmed infectious-disease cases scaled by population, have an economically and statistically significant negative effect on nonfinancial corporate performance, as measured by sales growth, profitability, and net fixed investment. The coefficient on pandemics ranges between $-0.083$ and $-0.598$ depending on the measure of corporate performance, but always remaining negative and statistically significant. This means that the greater prevalence of infectious diseases in the population is associated with weaker performance among nonfinancial firms. In the case of sales growth, for example, this adverse impact is particularly pronounced on smaller and younger firms, with the epidemic coefficient turning out to be four times larger among small firms compared to that for large corporations, while the difference between the coefficients for young and old firms is two times. We also investigate the quantitative impact of infectious diseases on firms’ survival prospects and find that a higher number of infectious-disease cases in the population increases the probability of failure among nonfinancial firms in developing countries. Businesses in contact-intensive sectors (such as accommodation, food services, and retail trade) and those operating in highly complex production networks (such as automotive) would suffer more from the COVID-19 pandemic than firms in less contact-intensive sectors (such as information, communication, and technology).

Scaling the estimated coefficient of past pandemics to the prevalence of COVID-19 as measured by the number of confirmed cases in population in the countries included in our sample would boost the negative impact by 17.5 times to over 10% on sales growth, 1.5% on profitability, and 4.3% on fixed investment spending. Similarly, the unprecedented scale of the
COVID-19 pandemic indicates that the probability of corporate failure would increase by more than 25 percentage points among nonfinancial firms during the first year. On the one hand, these estimates for the impact of the COVID-19 pandemic on nonfinancial corporate performance should be considered an upper bound as economic growth in developing countries is projected to decline by 7 percentage points in 2020 relative to 2019, while past pandemics lowered economic growth by 0.6 percentage points on average. On the other hand, exceptional policy measures, including temporary changes in bankruptcy laws, in many countries have shielded nonfinancial companies by easing financial conditions and facilitating access to credit, introducing prudential measures to strengthen banks’ lending capacity, reducing firms’ wage expenditures and other costs while protecting employment, providing grants and supporting firms’ revenue base, mitigating firms’ liquidity pressures through debt moratoria and tax deferrals, and deferring legal action against insolvent debtors.

Policy interventions could keep some firms with failed business models alive with no incentive for corporate restructuring, but the rise of “zombie” firms would, in turn, undermine efficiency in resource allocations throughout the economy and thereby lower potential growth. Ultimately, the resilience of nonfinancial firms during the coronavirus pandemic is closely linked to the magnitude and duration of the economic shock and how much of the economic losses are borne by the different stakeholders that interact with these firms. Therefore, the longer the heightened level of economic uncertainty lasts, the harder it will be for nonfinancial firms to withstand and survive the economic shock.

CONFLICT OF INTERESTS
The authors declare that there are no conflict of interests.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available in the World Health Organization database, the EM-DAT database, the Orbis database, the IMF’s International Financial Statistics and World Economic Outlook databases, and the World Bank’s World Development Indicators database.

ENDNOTES
1The latest figures can be found at John Hopkins University’s Center for Systems Science and Engineering: https://www.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6.
2All values reported in the Orbis database are in nominal US dollars.
3The list of countries in our sample and the numbers of firm-year observations per country are provided in Appendix Table A2.
4Capital spending can be measured on a net or gross basis. The net investment rate is a better indicator than gross investment, as it gauges the change in a firm’s stock of physical capital, excluding the fraction of capital that depreciates each year.
5As part of our robustness checks, we also include a measure of institutional quality (the rule of law) that is found in the literature to matter for the business environment.
6In dynamic specifications estimated via the system GMM approach, all explanatory variables except the lagged dependent variable are taken as “IV-style” instruments or treated as exogenous. The lagged dependent variable is specified as a “GMM-style” instrument due to a potential endogeneity issue and all available lags are used as separate instruments.
The coverage of nonfinancial firms in the Orbis database is not consistent over time. A firm may be in the database as an operating entity in one year, but not recorded again afterward. Since assuming that such firms failed would lead to misleading estimations, we exclude them from the sample.

Small and large firms are defined as those whose total assets are below 25th percentile or above 75th percentile threshold, respectively. Likewise, young firms are defined as those with age below 25th percentile, while old firms are those with age above 75th percentile.

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**How to cite this article:** Cevik, S., & Miryugin, F. (2021). Pandemics and firms: Drawing lessons from history. *International Finance*, 1–22. https://doi.org/10.1111/infi.12392
## APPENDIX A

### TABLE A1 Breakdown by year

| Year | No. of Obs. |
|------|-------------|
| 1998 | 558         |
| 1999 | 631         |
| 2000 | 758         |
| 2001 | 1107        |
| 2002 | 2474        |
| 2003 | 8947        |
| 2004 | 51,039      |
| 2005 | 78,169      |
| 2006 | 78,691      |
| 2007 | 78,010      |
| 2008 | 90,215      |
| 2009 | 85,913      |
| 2010 | 91,095      |
| 2011 | 97,241      |
| 2012 | 94,003      |
| 2013 | 105,171     |
| 2014 | 146,978     |
| 2015 | 190,693     |
| 2016 | 307,744     |
| 2017 | 386,486     |
| 2018 | 256,748     |
| Total| 2,152,671   |
### Table A2  List of countries

| Country      | No. of Obs. |
|--------------|-------------|
| Algeria      | 4959        |
| Brazil       | 12,578      |
| China        | 155,204     |
| Colombia     | 87,716      |
| Kazakhstan   | 9357        |
| Korea        | 1,246,595   |
| Morocco      | 128,606     |
| Mexico       | 2728        |
| Malaysia     | 10,873      |
| Philippines  | 14,349      |
| Russia       | 28,739      |
| Singapore    | 10,441      |
| Thailand     | 276,229     |
| Vietnam      | 164,297     |
| Total        | 2,152,671   |

### Table A3  Summary statistics

| Variable               | Unit     | Min  | p25   | p50   | p75   | Max    | Average  | SD      | No. of Obs. |
|------------------------|----------|------|-------|-------|-------|--------|----------|---------|-------------|
| **Firm-level controls**|          |      |       |       |       |        |          |         |             |
| Sales growth           | Ratio    | -1.00| -0.18 | 0.03  | 0.26  | 10.00  | 0.13     | 0.81    | 2,152,671  |
| Profitability          | Ratio    | -17.95| 0.00  | 0.05  | 0.11  | 103.5  | 0.07     | 0.37    | 2,142,705  |
| Fixed investment       | Ratio    | 0.00 | 0.00  | 0.03  | 0.09  | 10.00  | 0.13     | 0.41    | 985,404    |
| Leverage               | Ratio    | 0.00 | 0.00  | 0.14  | 0.42  | 2.36   | 0.24     | 0.29    | 2,147,786  |
| Cash flow              | Ratio    | -0.66| -0.03 | 0.00  | 0.04  | 281.6  | 0.03     | 0.77    | 2,110,783  |
| Tangibility            | Ratio    | 0.00 | 0.03  | 0.14  | 0.41  | 0.99   | 0.25     | 0.27    | 2,144,689  |
| Size                   | Log      | 0.00 | 12.94 | 14.27 | 15.74 | 31.88  | 14.54    | 2.95    | 2,151,541  |
| Age                    | Log      | 0.00 | 1.95  | 2.40  | 2.77  | 4.61   | 2.35     | 0.65    | 2,152,671  |
| Liquidity              | Ratio    | 0.00 | 1.03  | 1.67  | 3.66  | 211.6  | 5.69     | 16.20   | 2,109,932  |
| Capital intensity      | Ratio    | -5.00| -0.19 | -0.09 | -0.04 | 0.00   | -0.20    | 0.39    | 2,129,255  |
| **Macroeconomic controls**|        |      |       |       |       |        |          |         |             |
| Pandemics              | Ratio    | 0.00 | 0.00  | 0.00  | 0.04  | 0.66   | 0.04     | 0.10    | 252        |
| GDP per capita         | Log      | 6.86 | 8.23  | 8.97  | 9.31  | 10.97  | 8.86     | 0.90    | 252        |
| GDP growth             | Ratio    | -0.08| 0.03  | 0.05  | 0.07  | 0.15   | 0.04     | 0.03    | 252        |
| Trade openness         | Ratio    | 0.16 | 0.51  | 0.71  | 1.30  | 4.37   | 1.05     | 0.91    | 252        |
| Private credit         | Ratio    | 0.12 | 0.34  | 0.71  | 1.14  | 1.61   | 0.76     | 0.43    | 252        |
| Rule of law            | Index    | 1.00 | 2.50  | 3.50  | 4.50  | 6.00   | 3.47     | 1.215   | 252        |
### TABLE A4  Robustness checks: Infectious diseases and sales growth

| Variables | (1) Additional controls | (2) Post-GFC period Small firms | (3) Large firms | (4) Young firms | (5) Old firms |
|-----------|-------------------------|--------------------------------|----------------|----------------|--------------|
| Pandemics | −0.372***               | −0.630***                     | −1.221***      | −0.350***      | −0.841***    | −0.387***    |
|           | [0.050]                 | [0.057]                       | [0.174]        | [0.063]        | [0.222]      | [0.064]      |
| Firm-level controls |                   |                                |                |                |              |              |
| Leverage (lag) | 0.188***             | 0.282***                      | 0.177***       | 0.199***       | 0.463***     | 0.146***     |
|           | [0.007]                 | [0.009]                        | [0.019]        | [0.013]        | [0.021]      | [0.011]      |
| Cash flow (lag) | −0.053***             | −0.027*                       | −0.030         | 0.006          | −0.097***    | −0.015***    |
|           | [0.014]                 | [0.015]                        | [0.019]        | [0.010]        | [0.017]      | [0.005]      |
| Tangibility (lag) | 0.058***              | 0.141***                      | 0.196***       | 0.014          | 0.088***     | 0.081***     |
|           | [0.008]                 | [0.011]                        | [0.027]        | [0.014]        | [0.024]      | [0.015]      |
| Size (lag) | −0.097***              | −0.207***                     | −0.227***      | −0.081***      | −0.182***    | −0.088***    |
|           | [0.001]                 | [0.003]                        | [0.004]        | [0.001]        | [0.002]      | [0.001]      |
| Age       | −0.052***              | −0.062***                     | −0.002         | −0.217***      | −0.014       | −0.059       |
|           | [0.007]                 | [0.011]                        | [0.029]        | [0.010]        | [0.104]      | [0.045]      |
| Liquidity (lag) | 0.001***              |                                |                |                |              |              |
|           | [0.000]                 |                                |                |                |              |              |
| Capital intensity (lag) | 0.041***             |                                |                |                |              |              |
|           | [0.001]                 |                                |                |                |              |              |
| Macroeconomic controls |                   |                                |                |                |              |              |
| GDP per capita (lag) | 0.464***             | 2.173***                      | −1.369***      | 0.418***       | −0.232       | 0.572***     |
|           | [0.038]                 | [0.075]                        | [0.164]        | [0.039]        | [0.263]      | [0.066]      |
| GDP growth (lag) | −1.347***             | −1.793***                     | 0.917***       | −1.974***      | 0.489        | −2.039***    |
|           | [0.087]                 | [0.108]                        | [0.187]        | [0.143]        | [0.314]      | [0.128]      |
| Trade openness (lag) | −0.340***             | −0.446***                     | 0.069          | −0.365***      | −0.791***    | −0.304***    |
|           | [0.014]                 | [0.025]                        | [0.049]        | [0.019]        | [0.071]      | [0.022]      |
| Financial development (lag) | 0.056***             | −0.308***                     | 0.074          | −0.168***      | 0.293***     | −0.033**     |
|           | [0.015]                 | [0.024]                        | [0.064]        | [0.023]        | [0.095]      | [0.020]      |
| Rule of law (lag) | 0.105***              |                                |                |                |              |              |
|           | [0.010]                 |                                |                |                |              |              |
| Number of observations | 1,296,133             | 998,991                       | 205,413        | 394,373        | 287,104      | 433,376      |
| Number of firms   | 290,248                | 257,698                       | 72,955         | 69,550         | 105,016      | 98,281       |
| Adj. $R^2$       | 0.076                  | 0.021                         | 0.032          | 0.035          | 0.044        | 0.035        |

Note: Robust standard errors clustered at the firm level are reported in brackets. Fixed effects included in all regressions are sector-year and sector-country. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
### TABLE A5  Robustness checks: Infectious diseases and profitability

| Variables                      | (1) Additional controls | (2) Post-GFC period | (3) Small firms | (4) Large firms | (5) Young firms | (6) Old firms |
|--------------------------------|-------------------------|---------------------|-----------------|-----------------|----------------|--------------|
| Pandemics                      | −0.040***               | −0.025**            | −0.163**        | −0.041**        | −0.101**       | −0.018**     |
|                                | [0.015]                 | [0.019]             | [0.137]         | [0.019]         | [0.079]        | [0.020]      |
| **Firm-level controls**        |                         |                     |                 |                 |                |              |
| Leverage (lag)                 | 0.008**                 | 0.032***            | 0.094***        | −0.027***       | 0.096***       | −0.009       |
|                                | [0.004]                 | [0.006]             | [0.017]         | [0.003]         | [0.014]        | [0.005]      |
| Cash flow (lag)                | −0.012                  | −0.013              | −0.017          | 0.001           | −0.096*        | −0.005       |
|                                | [0.007]                 | [0.010]             | [0.011]         | [0.006]         | [0.053]        | [0.004]      |
| Tangibility (lag)              | −0.036***               | −0.024***           | 0.030           | −0.041***       | −0.062***      | −0.019**     |
|                                | [0.003]                 | [0.007]             | [0.030]         | [0.004]         | [0.016]        | [0.008]      |
| Size (lag)                     | −0.011***               | −0.052***           | −0.057***       | −0.010***       | −0.029***      | −0.009***    |
|                                | [0.000]                 | [0.002]             | [0.004]         | [0.000]         | [0.001]        | [0.000]      |
| Age                            | −0.029***               | −0.026***           | −0.015          | −0.054***       | −0.050**       | −0.015       |
|                                | [0.002]                 | [0.004]             | [0.020]         | [0.003]         | [0.022]        | [0.012]      |
| Liquidity (lag)                | −0.000***               |                     |                 |                 |                |              |
|                                | [0.000]                 |                     |                 |                 |                |              |
| Capital intensity (lag)        | −0.001***               |                     |                 |                 |                |              |
|                                | [0.000]                 |                     |                 |                 |                |              |
| Macroeconomic controls         |                         |                     |                 |                 |                |              |
| GDP per capita (lag)           | −0.007                  | 0.318***            | −0.923***       | 0.061***        | −0.269*        | 0.004        |
|                                | [0.011]                 | [0.023]             | [0.112]         | [0.011]         | [0.141]        | [0.013]      |
| GDP growth (lag)               | 0.030                   | −0.218***           | 0.521***        | −0.066          | −0.109         | −0.121**     |
|                                | [0.039]                 | [0.050]             | [0.129]         | [0.041]         | [0.199]        | [0.051]      |
| Trade openness (lag)           | −0.041***               | −0.106***           | −0.047          | −0.045***       | −0.115***      | −0.051***    |
|                                | [0.007]                 | [0.011]             | [0.039]         | [0.013]         | [0.040]        | [0.012]      |
| Financial development (lag)    | 0.072***                | 0.018               | 0.020           | 0.028***        | 0.120***       | 0.062***     |
|                                | [0.006]                 | [0.013]             | [0.038]         | [0.008]         | [0.040]        | [0.008]      |
| Rule of law (lag)              | −0.001                  |                     |                 |                 |                |              |
|                                | [0.004]                 |                     |                 |                 |                |              |
| Number of observations         | 1,289,260               | 996,279             | 205,064         | 389,143         | 286,531        | 429,205      |
| Number of firms                | 288,846                 | 256,942             | 72,830          | 68,533          | 104,786        | 97,435       |
| Adj. $R^2$                     | 0.006                   | 0.010               | 0.008           | 0.015           | 0.016          | 0.004        |

Note: Robust standard errors clustered at the firm level are reported in brackets. Fixed effects included in all regressions are sector-year and sector-country. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
### TABLE A6 Robustness checks: Infectious diseases and fixed investment

| Variables                     | (1) Additional controls | (2) Post-GFC period | (3) Small firms | (4) Large firms | (5) Young firms | (6) Old firms |
|-------------------------------|-------------------------|---------------------|----------------|----------------|----------------|--------------|
| Pandemics                    | -0.083***               | -0.255***           | -0.218**       | -0.015*        | -0.166*        | -0.064*      |
|                               | [0.028]                 | [0.032]             | [0.099]        | [0.034]        | [0.101]        | [0.034]      |
| Firm-level controls           |                         |                     |                |                |                |              |
| Leverage (lag)                | -0.175***               | -0.162***           | -0.051***      | -0.121***      | -0.290***      | -0.115***    |
|                               | [0.008]                 | [0.010]             | [0.019]        | [0.012]        | [0.026]        | [0.013]      |
| Cash flow (lag)               | -0.020***               | -0.000              | 0.005          | -0.028***      | -0.030***      | -0.037**     |
|                               | [0.004]                 | [0.004]             | [0.004]        | [0.008]        | [0.008]        | [0.015]      |
| Tangibility (lag)             | -0.753***               | -0.863***           | -0.613***      | -0.608***      | -1.569***      | -0.570***    |
|                               | [0.011]                 | [0.014]             | [0.043]        | [0.017]        | [0.039]        | [0.020]      |
| Size (lag)                    | -0.018***               | -0.126***           | -0.146***      | -0.022***      | -0.091***      | -0.015***    |
|                               | [0.001]                 | [0.004]             | [0.010]        | [0.001]        | [0.004]        | [0.001]      |
| Age                           | -0.040***               | 0.048***            | 0.126***       | -0.126***      | -0.073         | -0.065**     |
|                               | [0.006]                 | [0.009]             | [0.024]        | [0.008]        | [0.072]        | [0.028]      |
| Liquidity (lag)               | 0.000                   |                     |                |                |                |              |
| Capital intensity (lag)       |                         |                     |                |                |                |              |
|                               | -0.003***               |                     |                |                |                |              |
|                               | [0.000]                 |                     |                |                |                |              |
| Macroeconomic controls        |                         |                     |                |                |                |              |
| GDP per capita (lag)          | 0.028                   | 1.343***            | 0.038          | 0.106***       | 0.060          | 0.151***     |
|                               | [0.023]                 | [0.071]             | [0.124]        | [0.021]        | [0.204]        | [0.044]      |
| GDP growth (lag)              | -0.079                  | -0.568***           | 0.114          | 0.032          | -0.020         | 0.057        |
|                               | [0.078]                 | [0.085]             | [0.146]        | [0.084]        | [0.241]        | [0.093]      |
| Trade openness (lag)          | -0.072***               | -0.088***           | 0.063*         | -0.114***      | -0.354***      | -0.061***    |
|                               | [0.011]                 | [0.023]             | [0.037]        | [0.014]        | [0.051]        | [0.015]      |
| Financial development (lag)   | 0.007                   | -0.186***           | -0.072         | 0.060***       | 0.013          | -0.032**     |
|                               | [0.012]                 | [0.018]             | [0.046]        | [0.014]        | [0.064]        | [0.016]      |
| Rule of law (lag)             | -0.017***               |                     |                |                |                |              |
|                               | [0.006]                 |                     |                |                |                |              |
| Number of observations        | 503,723                 | 374,951             | 54,030         | 180,479        | 93,488         | 164,753      |
| Number of firms               | 149,813                 | 124,177             | 21,234         | 45,657         | 40,584         | 49,387       |
| Adj. $R^2$                    | 0.088                   | 0.132               | 0.067          | 0.091          | 0.206          | 0.053        |

Note: Robust standard errors clustered at the firm level are reported in brackets. Fixed effects included in all regressions are sector-year and sector-country. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.
| Variables                        | (1) Baseline | (2) Additional controls | (3) Post-GFC period |
|---------------------------------|-------------|-------------------------|-------------------|
| Pandemics                       | −1.238**    | −1.507**                | −1.930**          |
|                                 | [0.589]     | [0.656]                 | [0.961]           |
| **Firm-level controls**         |             |                         |                   |
| Sales growth (lag)              | −1.291      | −1.544***               | −1.552            |
|                                 | [0.832]     | [0.768]                 | [1.250]           |
| Leverage (lag)                  | −0.014      | −0.034                  | −0.031            |
|                                 | [0.035]     | [0.029]                 | [0.052]           |
| Cash flow (lag)                 | 0.100       | 0.159*                  | 0.113             |
|                                 | [0.069]     | [0.095]                 | [0.096]           |
| Tangibility (lag)               | −0.084      | −0.108**                | −0.114            |
|                                 | [0.053]     | [0.043]                 | [0.081]           |
| Firm size (lag)                 | −0.020***   | −0.020***               | −0.011*           |
|                                 | [0.007]     | [0.007]                 | [0.006]           |
| Firm age                        | −0.185*     | −0.215**                | −0.229            |
|                                 | [0.098]     | [0.089]                 | [0.145]           |
| Liquidity ratio (lag)           |             | −0.001*                 |                   |
|                                 |             | [0.001]                 |                   |
| Capital intensity ratio (lag)   |             | 0.002                   |                   |
|                                 |             | [0.007]                 |                   |
| **Macroeconomic controls**      |             |                         |                   |
| GDP per capita (lag)            | 0.179*      | 0.450**                 | 1.422***          |
|                                 | [0.092]     | [0.196]                 | [0.533]           |
| GDP growth (lag)                | −1.279***   | −1.740***               | −2.604*           |
|                                 | [0.450]     | [0.470]                 | [1.517]           |
| Trade openness (lag)            | 0.244**     | 0.268***                | 0.125             |
|                                 | [0.096]     | [0.099]                 | [0.090]           |
| Financial development (lag)     | −1.033**    | −1.172***               | −1.327*           |
|                                 | [0.487]     | [0.437]                 | [0.800]           |
| Rule of law (lag)               |             | 0.136***                |                   |
|                                 |             | [0.036]                 |                   |
| Number of observations          | 1,551,353   | 1,521,948               | 1,227,343         |
| Number of firms                 | 531,252     | 516,063                 | 486,050           |
| AR (1) p value                  | .141        | .055                    | .244              |

(Continues)
TABLE A7  (Continued)

| Variables          | (1) Baseline | (2) Additional controls | (3) Post-GFC period |
|--------------------|--------------|--------------------------|---------------------|
| AR (2) p value     | .270         | .514                     | .203                |
| Hansen J test p value | .710        | .078                     | .287                |
| Number of instruments | 57          | 61                       | 46                  |

Note: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.