WP/20/276

IMF Working Paper

Pandemics and Firms: Drawing Lessons from History

by Serhan Cevik and Fedor Miryugin

INTERNATIONAL MONETARY FUND

 WP/20/276

IMF Working Paper

Western Hemisphere Department

Pandemics and Firms: Drawing Lessons from History

Prepared by Serhan Cevik and Fedor Miryugin[1]

Authorized for distribution by Bert van Selm

December 2020

Abstract

The global economy is in the midst of an unprecedented slump caused by the COVID-19 pandemic. To assess the likely evolution of nonfinancial corporate performance going forward, this paper investigates empirically the impact of past pandemics using firm-level data on more than 537,000 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 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.

JEL Classification Numbers: E22; F3; F34; G20; G30; G31; G32

Keywords: Pandemics; nonfinancial corporate performance; firm-level

Author's E-Mail Address: scevik@imf.org; fmiryugin@gwu.edu

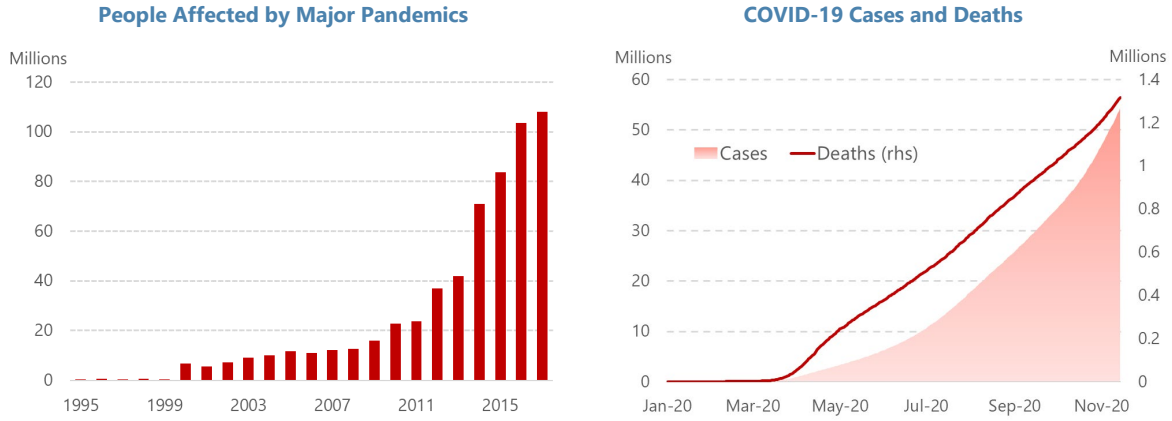
[1] The author would like to thank Pelin Berkmen, Jaime Guajardo, Jorge Roldos, and Alejandro Werner for insightful comments and suggestions. The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

Contents **Page**

I. INTRODUCTION

The COVID-19 pandemic is an unprecedented shock with far-reaching economic and financial repercussions throughout the world. As of December 10, 2020, there are over 69.3 million confirmed cases of COVID-19 in 190 countries, with more than 1.5 million deaths (Figure 1).[2] History is full of pandemics, but the coronavirus outbreak has had a greater impact on every country across the world (Figure 2). According to the International Monetary Fund (IMF), global real GDP growth is projected to contract by 4.4 percent in 2020, resulting in a cumulative loss of more than US$10 trillion over 2020-21. The synchronized nature of the downturn—driven by massive disruptions in supply networks and a collapse in private-sector demand—jeopardizes corporate profitability and depletes firms' cash buffers. At the same time, while governments and central banks have responded by providing extensive fiscal stimulus, lowering interest rates and relaxing macroprudential 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 pandemic could exacerbate corporate vulnerabilities, deepen macro-financial instability, and cause long-lasting damage to economic potential.

Figure 1. Past Pandemics and the COVID-19 Pandemic



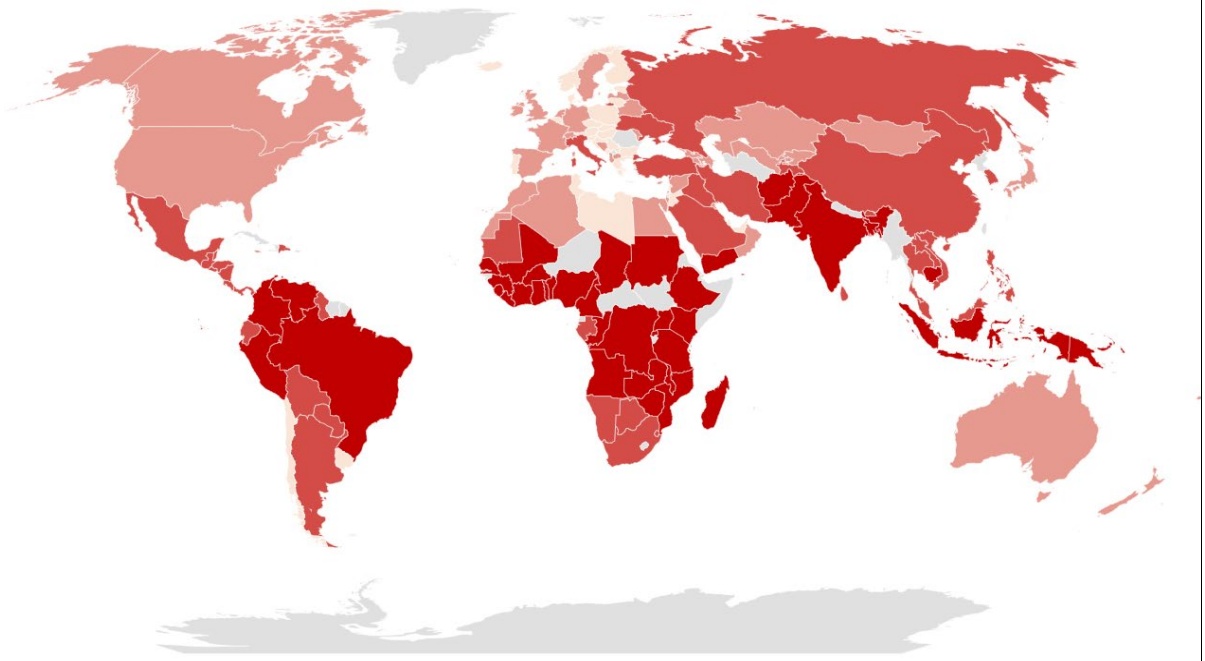
Source: EM-DAT; WHO; authors' calculations.

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 (Myers, 1984; Titman and Wessels, 1988; Harris and Raviv, 1991; Booth and others, 2001; Baker and Wurgler, 2002; Lemmon, Roberts, and Zender, 2008; Frank and Goyal, 2009; Gungoraydinoglu and Öztekin, 2011; Graham, Leary, and Roberts, 2015; De Angelo and Roll, 2015; Öztekin, 2015). 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; Rajan and Zingales, 1995;

[2] The 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.

Kayo and Kimura, 2011; Cevik and Miryugin, 2018). 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 and Wolf, 2020; Hassan and others, 2020) as well as on household income, savings and investment patterns (Bell and Lewis, 2004; Almond, 2006). Closely related to our paper is the work by Ma, Rogers, and Zhou (2020), who use data on listed firms and identify a negative effect of infectious-disease outbreaks on corporate profitability and employment.

Figure 2. Pandemics Across the World



Source: EM-DAT; WHO; authors' calculations.
Note: A darker color indicate a higher number of infectious-disease cases during the period 1995-2018.

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 dataset 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 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 percent on sales growth, 1.5 percent on profitability, and 4.3 percent 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 II provides an overview of the dataset used in the analysis. Section III introduces the salient features of our econometric strategy. Section IV presents the empirical results, including a series of robustness checks. In Section V, we conclude and provide some thoughts on the policy implications of our results.

II. 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 (non-listed) firms including small and medium-sized enterprises in advanced and developing countries.[3] The complete Orbis sample consists of more than 365 million firms

[3] All values reported in the Orbis database are in nominal US dollars.

from over 100 countries around the world. However, similar to any other large-scale micro dataset, the Orbis data require careful management to ensure consistency and comparability across firms and countries and over time. First, we select countries with 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 and others (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 in order 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.[4]

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 percent 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 dataset 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 percent of observations, followed by manufacturing with 30 percent, construction with 13 percent, and administrative and professional activities with 10 percent.

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. Following the literature, we include country-specific information (real GDP per capita, real GDP growth, trade openness measured by the sum of exports and imports in GDP, financial development measured by domestic credit to the private

[4] The list of countries in our sample and the numbers of firm-year observations per country are provided Appendix Table A2.

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 (WEO) database and the World Bank's World Development Indicators (WDI) database.

Table 1. Sectoral Distribution of Firms

Sector	Num. of firms	Percent
Agriculture	6,760	1.26
Mining	2,828	0.53
Manufacturing	158,597	29.51
Utilities	7,089	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**

There are large variations in the corporate leverage and fixed investment ratios and firm characteristics used in the analysis across sectors and type 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-Pesaran-Shin (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.

III. 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:

$$y_{isct} = \alpha_1 Vir_{ct} + \alpha_2 Firm_{isct-1} + \alpha_3 Macro_{ct-1} + \eta_i + \eta_{st} + \eta_{cs} + \varepsilon_{isct} \quad (1)$$

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.[5] Vir is the number of confirmed infectious disease cases scaled by population in country *c* at time *t*. The term *Firm* is a vector of firm-specific control variables, including firm size, leverage, cash flow, asset tangibility, and firm age. The term *Macro* denotes a set of country-specific factors, including real GDP per capita, real GDP growth, trade openness, and financial development.[6]

The η_i coefficient denotes the firm-specific fixed effects capturing time-invariant unobservable factors. The η_{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 η_{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, ε_{isct} 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 (OLS) 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 dataset 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

[5] Capital 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.

[6] As 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 business environment.

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 indicate 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 (Bunn and Redwood, 2003; Bridges and Guariglia, 2008; Helmers and 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 first appearance in the dataset as the time at which a firm becomes at risk of failure and exclude observations when a firm drops out of the database.[7] 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:

$$\theta_{it} = \theta(t) \cdot X'_{it}\beta$$

where $\theta(t)$ is the baseline hazard function and X_{it} is a series of time-varying covariates summarizing observed differences among firms (Cox, 1972; Cox and Oakes, 1984; Audretsch and Mahmood, 1995; Kleinbaum and Klein, 2005; Cevik and Miryugin, 2019). In a panel setting, the discrete time formulation of the probability of failure is given by a complementary log-log model such as:

$$h_t(X_{it}) = 1 - \exp\{-\exp(X'_{it}\beta + \theta(t))\}$$

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

[7] 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 afterwards. Since assuming that such firms as failed would lead to misleading estimations, we exclude them from the sample.

hazard model can be extended to account for unobserved but systematic differences among firms by describing unobserved heterogeneity by a random variable μ_i independent of X_{it}:

$$h_t(X_{it}) = 1 - \exp\{-\exp(X'_{it}\beta + \theta(t)) + \mu_i\}$$

where μ_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 μ_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.

IV. ESTIMATION RESULTS

The rich dataset—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). Past pandemics—as measured by the number of confirmed infectious-disease cases scaled by population—have an economically and statistically significant negative effect on sales growth, corporate profitability and net fixed investment among nonfinancial firms in developing countries, after controlling for firm characteristics and macroeconomic developments. 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 regards 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 have 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

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 an economically and statistically significant positive effect on all three dependent variables—sales growth, corporate profitability, and fixed investment—as expected. 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

Table 2. Pandemics and Firm Performance—Baseline Estimations

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-squared	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.

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 post-global 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.[8] These results, presented in Appendix Table 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 has 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 variable 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 regards 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 percent 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 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.

[8] 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.

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.

Table 3. Infectious Diseases and Firm Survival—Proportional Cox Hazard Model

	(1) All	(2) Post GFC	(3) Young	(4) Old	(5) Small	(6) Large
Variables	***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***	-1.868***	-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 chi2 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.

V. CONCLUSION

This paper provides novel empirical evidence of the impact of past pandemics on nonfinancial corporate performance measured by sales growth, profitability and fixed investment 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 dataset 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. 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 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 percent on sales growth, 1.5 percent on profitability, and 4.3 percent 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, 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.

ANNEX

Appendix Table A1. Breakdown by Year

Year	Num. of obs.
1998	558
1999	631
2000	758
2001	1,107
2002	2,474
2003	8,947
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***

Appendix Table A2. List of Countries

Country	Num. of obs.
Algeria	4,959
Brazil	12,578
China	155,204
Colombia	87,716
Kazakhstan	9,357
Korea	1,246,595
Morocco	128,606
Mexico	2,728
Malaysia	10,873
Philippines	14,349
Russia	28,739
Singapore	10,441
Thailand	276,229
Vietnam	164,297
Total	***2,152,671***

Appendix Table A3. Summary Statistics

Variable	Unit	Min	p25	p50	p75	Max	Average	Std. dev.	Num. 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

Appendix Table A4. Robustness Checks: Infectious Diseases and Sales Growth

Variables	(1) Additional controls	(2) Post-GFC period	(3) Small firms	(4) Large firms	(5) Young firms	(6) 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-squared	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.

Appendix 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-squared	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.

Appendix 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					
	[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-squared	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.

Appendix Table A7. Infectious Diseases and Sales Growth—Dynamic Estimations

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	0.141	0.055	0.244
AR (2) p-value	0.270	0.514	0.203
Hansen J-test p-value	0.710	0.078	0.287
Number of instruments	57	61	46

REFERENCES

Almond, D., 2006, "Is the 1918 Influenza Pandemic Over? Long-Term Effects of In Utero Influenza Exposure in the Post-1940 U.S. Population," *Journal of Political Economy*, Vol. 114, pp. 672–712.

Arellano, M., and O. Bover, 1995, "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, Vol. 68, pp. 29–51.

Audretsch, D., and T. Mahmood, 1995, "New Firm Survival: New Results Using a Hazard Function," *Review of Economics and Statistics*, Vol. 72, pp. 97-103.

Blundell, R., and S. Bond, 1998, "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics*, Vol. 87, pp. 115–143.

Baker, M., and J. Wurgler, 2002, "Market Timing and Capital Structure," *Journal of Finance*, Vol. 57, pp. 1-32.

Bell, C., and M. Lewis, 2004, "The Economic Implications of Pandemics Old and New," *World Economics*, Vol. 5, pp. 137–174.

Borio, C., 1990, "Leverage and Financing of Nonfinancial Companies: An International Perspective," BIS Economic Papers No. 27 (Basel: Bank for International Settlements).

Booth, L., V. Aivazian, A. Demirgüç-Kunt, and A. Maksimovic, 2001, "Capital Structures in Developing Countries," *Journal of Finance*, Vol. 56, pp. 87-130.

Bridges, S., and A. Guariglia, 2008, "Financial Constraints, Global Engagement, and Firm Survival in the U.K.: Evidence from Micro Data," *Scottish Journal of Political Economy*, Vol. 55, pp. 444-464.

Bunn, P., and V. Redwood, 2003, "Company Accounts Based Modelling of Business Failures and the Implications for Financial Stability," Bank of England Working Paper No. 210 (London: Bank of England).

Cevik, S. and F. Miryugin, 2018. "Does Taxation Stifle Corporate Investment? Firm-Level Evidence from ASEAN Countries," *Australian Economic Review*, Vol. 51, pp. 351-367.

Cevik, S. and F. Miryugin, 2019. "Death and Taxes: Does Taxation Matter for Firm Survival?" IMF Working Paper No. 19/78 (Washington, DC: International Monetary Fund).

Cox, D., 1972, "Regression Models and Life Tables," *Journal of the Royal Statistical Society*, Vol. 34, pp. 187-202.

Cox, D., and D. Oakes, 1984, *Analysis of Survival Data* (London: Chapman and Hall).

De Angelo, H., and R. Roll, 2015, "How Stable Are Corporate Capital Structures?" *Journal of Finance*, Vol. 70, pp. 373-418.

Fornaro, L., and M. Wolf, 2020, "Covid-19 Coronavirus and Macroeconomic Policy," CEPR Discussion Paper No. DP14529 (London: Centre for Economic Policy Research).

Frank, M., and V. Goyal, 2009, "Capital Structure Decisions: Which Factors Are Reliably Important?" *Financial Management*, Vol. 38, pp. 1-37.

Gal, P., 2013, "Measuring Total Factor Productivity at the Firm Level Using OECD-ORBIS," OECD Economics Department Working Paper No. 1049 (Paris: Organization for Economic Co-operation and Development).

Graham, J., M. Leary, and M. Roberts, 2015, "A Century of Capital Structure: The Leveraging of Corporate America," *Journal of Financial Economics*, Vol. 118, pp. 532-551.

Gungoraydinoglu, A., and Ö. Öztekin, 2011, "Firm- and Country-Level Determinants of Corporate Leverage," *Journal of Corporate Finance*, Vol. 17, pp. 1457-1474.

Harris, M., and A. Raviv, 1991, "The Theory of Capital Structure," *Journal of Finance*, Vol. 46, pp. 297-355.

Hassan, T., S. Hollander, L. van Lent, and A. Tahoun, 2020, "Firm-Level Exposure to Epidemic Diseases: Covid-19, SARS, and H1N1," NBER Working Paper No. 26971 (Cambridge, MA: National Bureau of Economic Research).

Helmers, C., and M. Rogers, 2010, "Innovation and the Survival of New Firms in the UK," *Review of Industrial Organization*, Vol. 36, pp. 227-248.

Im, K., M. Pesaran, and Y. Shin, 2003, "Testing for Unit Roots in Heterogeneous Panels," *Journal of Econometrics*, Vol. 115, pp. 53–74.

Kalemli-Özcan, Ş., Sorensen, B., Villegas-Sanchez, C., Volosovych, V., and S. Yeşiltaş, 2015, "How to Construct Nationally Representative Firm-Level Data from the ORBIS Global Database," NBER Working Papers No. 21558 (Cambridge, MA: National Bureau of Economic Research).

Kayo, E., and H. Kimura, 2011, "Hierarchical Determinants of Capital Structure," *Journal of Banking and Finance*, Vol. 35, pp. 358-371.

Kleinbaum, D., and M. Klein, 2005, *Survival Analysis: A Self-Learning Text* (New York: Springer).

Lemmon, M., M. Roberts, and J. Zender, 2008, "Back to the Beginning: Persistence and the Cross-Section of Corporate Capital Structure," *Journal of Finance*, Vol. 63, pp. 1575-1608.

Ma, C., J. Rogers, and S. Zhou, 2020, "Global Economic and Financial Effects of 21st Century Pandemics and Pandemics," *COVID Economics*, Issue. 5, pp. 56–78.

Myers, S., 1984, "The Capital Structure Puzzle," *Journal of Finance*, Vol. 39, pp. 575–592.

Öztekin, Ö., 2015, "Capital Structure Decisions Around the World: Which Factors Are Reliably Important?" *Journal of Financial and Quantitative Analysis*, Vol. 50, pp. 301-323.

Rajan, R., and L. Zingales, 1995, "What Do We Know About Capital Structure? Some Evidence from International Data," *Journal of Finance*, Vol. 50, pp. 1421-1460.

Roodman, D., 2009, "How to Do xtabond2: An Introduction to Difference and System GMM in Stata," *Stata Journal*, Vol. 9, pp. 86–136.

Titman, S., and R. Wessels, 1998, "The Determinants of Capital Structure Choice," *Journal of Finance*, Vol. 43, pp. 1-19.