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Contagion of Fear: Is the Impact of COVID-19 on Sovereign Risk Really Indiscriminate?

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Contagion of Fear
Is the Impact of COVID-19 on Sovereign Risk Really Indiscriminate?

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Abstract

This paper investigates the impact of infectious diseases on the evolution of sovereign credit default swap (CDS) spreads for a panel of 77 advanced and developing countries. Using annual data over the 2004-2020 period, we find that infectious-disease outbreaks have no discernible effect on CDS spreads, after controlling for macroeconomic and institutional factors. However, our granular analysis using high-frequency (daily) data indicates that the COVID-19 pandemic has had a significant impact on market-implied sovereign default risk. This adverse effect appears to be more pronounced in advanced economies, which may reflect the greater severity of the pandemic and depth of the ensuing economic crisis in these countries as well as widespread underreporting in developing countries due to differences in testing availability and institutional capacity. While our analysis also shows that more stringent domestic containment measures help lower sovereign CDS spreads, the macro-fiscal cost of efforts aimed at curbing the spread of the disease could undermine credit worthiness and eventually push the cost of borrowing higher.

JEL Classification Numbers: F34; G12; G13; G15

Keywords: Infectious diseases; COVID-19; sovereign credit risk; CDS spreads

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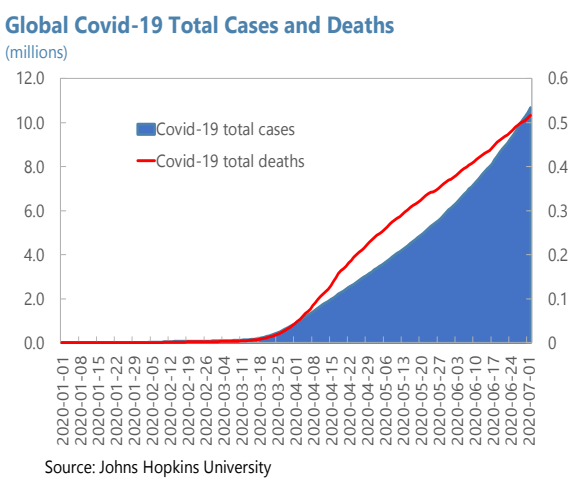
I. INTRODUCTION

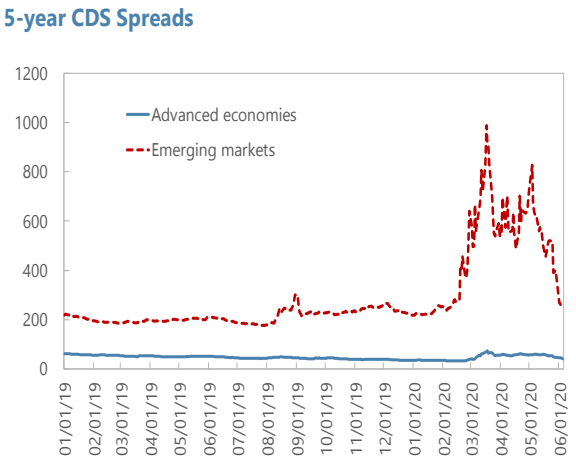
The COVID-19 pandemic has caused an unprecedented macro-financial shock and severely strained government budgets across the world. As of November 23, 2020, there are over 58.8 million confirmed cases of COVID-19 in 190 countries, with more than 1.3 million deaths.[2] Much is still unknown about the pandemic, but it is already clear that the world economy is in midst of the deepest recession since the Great Depression in the 1930s. To contain the pandemic caused by the coronavirus and protect susceptible populations, most countries imposed stringent lockdown measures that have led to an unprecedented contraction in economic activity. With weaker economic conditions, heightened risk aversion and uncertainty surrounding the COVID-19 pandemic have led to a surge in credit default swap (CDS) spreads—a market-implied comparable indicator of sovereign credit quality and default risk. On average, the cost of insuring against sovereign default over five years increased by as much as 39 basis points for advanced economies and 770 basis points for developing countries in the first half of 2020 (Figure 1).

The economic fallout from the COVID-19 pandemic could indeed trigger a cascade of sovereign defaults, but is this really an indiscriminate global shock? We think not. It is true that the deep contraction in economic activity and ensuing fall in government revenues, along with a significant increase in discretionary spending, have led to a surge in budget deficits and public debt across the world. According to the latest IMF projections, global public debt is expected to reach an all-time high, exceeding 100 percent of GDP in 2020—an increase of almost 20 percentage points from a year ago, as the average budget deficit is estimated to surge by 8 percentage points to over 10 percent of GDP in 2020. While the extraordinary fiscal fallout of the

Figure 1. COVID-19 and Sovereign CDS Spreads



Source: Johns Hopkins University



Source: Bloomberg

[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.

significant heterogeneity in how the COVID-19 outbreak affects the probability of sovereign default across countries through the extent of exposure to the pandemic and policy responses aimed at cushioning the shock.

The CDS market has grown rapidly the past three decades to become one of the main financial instruments to manage credit risk. Conceptually, CDS function like insurance contracts: the buyer of CDS has the right to sell a given bond, issued by a sovereign (or a corporate, for that matter), to the seller of CDS at par upon the occurrence of a credit event (i.e., default) as specified in the contract (Hull, Predescu, and White, 2004). For such an insurance coverage, the buyer pays a premium—known as the CDS spread—to the seller.[3] Over-the-counter CDS contracts, typically adhering to the International Swaps and Derivatives Association's (ISDA) master agreement, allow faster transactions and broader coverage of corporate and sovereign, as well as on more complex financial instruments, such as mortgage-backed securities and collateralized debt obligations. As a result, the total notional amount of outstanding CDS contracts increased from US$2,2 trillion in 2002 to US$7.8 trillion in 2019 from, according to the ISDA.

There is a large body of literature on the macroeconomic and institutional determinants of sovereign CDS spreads as a market-determined indicator of default risk. However, there is nascent research looking at how the spread of infectious diseases affects CDS spreads and, in particular, the factors explaining heterogeneity in impact across countries. Accordingly, our empirical objectives in this paper are three-fold: (i) ascertaining the conventional macroeconomic and institutional determinants of sovereign CDS spreads with a standard model with fixed effects; (ii) augmenting the baseline model to investigate the impact of infectious diseases on sovereign CDS spreads; and (iii) developing a more granular analysis to focus on the COVID-19 pandemic by estimating the regression model with high-frequency (daily) data.

With a large dataset of annual observations covering 77 advanced and developing countries, we find that past epidemics had no significant effect on sovereign CDS spreads, after controlling for macroeconomic, financial and institutional factors.[4] Even so, there is still evidence of significant heterogeneity in how past infectious-diseases episodes affect CDS spreads across countries. The magnitude of this effect varies with macroeconomic conditions and institutional strength, which may in turn help determine the effectiveness of policy response to infectious-disease outbreaks. This is why we develop a more granular analysis to focus exclusively on the impact of COVID-19 with high-frequency (daily) data covering 77 countries during the first half of 2020. These results indicate that the COVID-19 pandemic has had a significant impact on sovereign CDS spreads across all countries. This adverse effect is found to be more pronounced in advanced economies, which may reflect the greater severity of the pandemic and depth of the ensuing economic crisis

[3] Ecuador was the first sovereign to trigger a CDS payment. It happened in November 2008 when Ecuador failed to make an interest payment, which was considered as a trigger event. It was decided that investors were paid the full amount (68.625 percent of the gross notional value of the CDS contracts that they had purchased since the recovery rate was equal to 31.375 percent).

[4] To capture the impact of COVID-19 at annual frequency, we use the data as of June 30, 2020 and macroeconomic projections from the IMF's World Economic Outlook (WEO) database.

in these countries, but also widespread underreporting in developing countries due to differences in testing availability and institutional capacity. Our analysis also shows that more stringent domestic containment measures help lower sovereign CDS spreads, but the macro-fiscal cost of efforts aimed at curbing the spread of the disease could undermine credit worthiness and eventually push the cost of borrowing higher.

The remainder of this study is organized as follows. Section II provides a brief overview of the related literature. Section III describes the data used in the analysis. Section IV introduces the salient features of our econometric strategy and presents the empirical results, including a series of robustness checks. Finally, Section V offers concluding remarks with policy implications.

II. A Brief Overview of the Literature

This paper draws from a major thread of the literature on determinants of sovereign risk. Most studies find empirical support to the theoretical prediction that the level and composition of government debt and other macroeconomic factors have an impact on government bond yields and spreads (Engen and Hubbard, 2004; Kinoshita, 2006; Ardagna and others, 2007; Laubach, 2009; Hischer and Nosbusch, 2010; Gómez-Puig and others, 2014). In particular, government's borrowing costs are found to depend on global risk aversion, cross-border spillovers, and country-specific macroeconomic and institutional factors (Attinasi and others, 2009; Afonso 2010; Caceres, Guzzo, and Segoviano, 2010; Poghosyan, 2012; Beirne and Fratzscher, 2013; Afonso and Nunes, 2015; Godl and Kleinert, 2016; de Grauwe, Ji and Macchiarelli, 2017; Jalles, 2019).

With regards to CDS spreads, the literature has evolved along two strands. First, the structural approach, developed by Merton (1974) and Black (1976), has defined default as an increasing function of leverage and used asset value and asset volatility to estimate the probability of default. In other words, default risk is modeled by a stochastic process standing for total value of assets of a reference entity such that default happens to be contingent upon the case that total value of entity's assets falls below its liabilities. These models establish a link between the firm's financial status and its credit quality in such a way that the credit event is generated endogenously. Structural models are more appropriate for modelling credit risk of firms as the value of firms' assets can be identified through data sources such as balance sheets. On the other hand, the sovereigns' value of assets is a vaguer concept, although there are attempts in the literature, such as Lehrbass (2000), to approximate it with stock market value. Additionally, a structural model might become complex for a portfolio including many entities since it requires identifying the linkages among the entities in terms of their exposure to different risk factors.

Other studies, on the other hand, analyze sovereign CDS spreads by estimating the impact of macro-financial factors on credit spreads. This approach has the advantage of providing more intuition on the underlying determinants of sovereign default risk as measured by CDS spreads. The disadvantage of the regression approach, however, is that it may not provide as good a fit, as there is no pricing consistency across maturities when it is estimated for each maturity separately. Focusing on a country's ability and willingness-to-service its debt in a panel of developing countries, Cantor and Packer (1996) find that per capita income, real GDP growth,

consumer price inflation, external debt, and default history have significant effects on sovereign credit risk. Likewise, Amato (2005), Baek, Bandopadhyaya, and Du (2005), and Georgievska and others (2008) show the link between sovereign risk in developing countries and macroeconomic variables such as the debt-to-GDP ratio, the fiscal balance, the current account position, and international reserves as a share of GDP. Investigating the outcome of the heterogeneous beliefs of the lender and borrower with weekly emerging market CDS spreads for eight countries, Dieckmann and Gallmeyer (2013) find that macroeconomic shocks are responsible for 40 percent of the variation in CDS spreads. Arslanalp and Liao (2014) look at the relationship between government liabilities and CDS spreads in 32 countries during the period 2006-2013 and find that a 1 percent increase in the contingent liability index raises CDS spreads by 24 basis points in advanced economies and 75 basis points in emerging markets. Focusing on the availability and transparency of fiscal information in a sample of 45 countries over the 2004-2010 period, Peat, Svec and Wang (2015) find that credit spreads tend to be lower in countries with greater government accountability and transparency. Using daily data for five large emerging markets (Brazil, India, Indonesia, South Africa and Turkey) during the 2006-2015 period, Yildirim (2016) finds significant variation in CDS spreads due to macroeconomic conditions.

The literature has given an important consideration to cross-country contagion effects. Fender, Hayo, Neuenkirch (2012) use daily data on emerging-market CDS spreads over the 2002-2011 period and find a close relationship with global and regional risk premiums, especially during periods of crisis. Similarly, Kim, Kim, and Lee (2015) show that the participation of foreign investors in equity markets has spillover effects on CDS spreads. Analyzing six Latin American countries during the period 2004-2014, Ballester and Gonzalez-Urtega (2017) observe cross-border spillover effects arising from credit rating changes in neighboring countries. Some studies also find that commodity markets can influence CDS spreads. Pavlova, Boylie, and Parhizgari (2018), for example, analyze the relationship between oil prices and CDS spreads during the period 2008-2015 and find that the volatility of oil prices has a spillover effect on CDS spreads of oil-exporting countries. Wang, Sun, and Li (2020) show that the impact of oil price shocks on CDS spreads could move beyond oil-exporting countries and influence sovereign risk premiums across a broader spectrum of countries.

Research on the financial impact of COVID-19 is nascent, but fast-developing across all asset classes. Heyden and Heyden (2020) and Ramelli and Wagner (2020) focus on equity markets in Europe and the U.S. and show that news about COVID-19 developments and monetary and fiscal policy measures have driven stock prices. Alfaro and others (2020) link aggregate equity market returns and unanticipated changes in predicted COVID-19 infections, while Schoenfeld (2020) examines buy-and-hold asset returns and finds a systematic underestimation of the COVID-19 risk in portfolio management. Using high-frequency data, ElFayoumi and Hengge (2020) show that the pandemic and associated policy responses have contributed to the large wave of capital reallocation between markets, asset classes, and industries. Focusing on the COVID-19 impact on corporate bond yields in large European countries, Ettmeier, Kim, and Kriwoluzky (2020) conclude that the pandemic has affected interest rates across the maturity profile. Using CDS spreads for 26 European countries, Andries, Ongena, and Sprincean (2020) find that higher number of cases

and deaths and public health containment responses result in a significant increase in sovereign risk premiums due to uncertainty among investors. Likewise, Esteves and Sussman (2020) show that greater exposure to the COVID-19 pandemic results in a higher cost of borrowing for emerging markets whereas advanced economies are not affected. The empirical analysis presented in our paper contributes to this emergent strand of the literature by investigating the impact of the pandemic on sovereign CDS spreads.

III. DATA OVERVIEW

The empirical analysis presented in this study is based on two different panel datasets: (1) annual observations for 77 countries over the period 2004–2020 and (2) daily observations for 77 countries in the first half of 2020.[5] We use 5-year CDS spreads as a measure of sovereign default risk, which are obtained from Bloomberg. The main explanatory variable of interest is the number of confirmed infectious-disease cases (including COVID-19, Ebola, malaria, SARS and yellow fever), which are obtained from the WHO and Oxford COVID-19 Government Response Tracker databases and normalized by population to put countries on a more comparable scale. In estimations using daily data, we also introduce the number of deaths caused by COVID-19 per population as alternative to the number of confirmed COVID-19 cases.

Following the literature, we include a set of control variables, consisting of real GDP per capita, real GDP growth, consumer price inflation, budget balance as a share of GDP, government debt as a share of GDP, current account balance as a share of GDP, international reserves as a share of GDP, trade openness as measured by the ratio of exports and imports to GDP, financial development as measured by domestic credit to the private sector as a share of GDP, and a measure of institutional quality, to capture country characteristics. Also, to control for common global shocks that may affect CDS spreads across all countries, we include international oil prices and the volatility implicit in U.S. stock options (VIX index) compiled by the Chicago Board Options Exchange. These variables are assembled from the IMF's International Financial Statistics (IFS) and WEO databases, the World Bank's World Development Indicators (WDI) and Worldwide Governance Indicators (WGI) databases, and the U.S. Federal Reserve Bank of St. Louis.

Descriptive statistics for the variables used in the empirical analysis are presented in Table 1 for the annual dataset and in Table 2 for the daily dataset. There is a significant degree of dispersion in sovereign CDS spreads among advanced and emerging market economies and considerable heterogeneity in the number of confirmed infectious-disease cases per population, as well as in the level and evolution of macroeconomic, financial and institutional control variables during sample period. Furthermore, although the spread of COVID-19 cases (or deaths) may appear like a common global shock, there is significant heterogeneity in policy responses 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. The stationarity of all variables is checked by applying the Im-

[5] The list of advanced and emerging market economies is presented in Appendix Table A1.

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.

Table 1. Summary Statistics—Annual Dataset

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
CDS spreads	1,114	244.2	710.9	2	11,334
Real GDP per capita	1,343	185,057	985,265	7	11,000,000
Real GDP growth	1,264	2.6	4.7	-34.9	26.2
Consumer price inflation	1,338	79.9	1,911.8	-4.9	65,374
Budget balance	1,341	-2.2	5.9	-35.4	43.3
Government debt	1,320	54.5	38.9	0.1	344.3
Current account balance	1,334	-0.4	8.0	-28.8	45.5
Foreign reserves	1,329	19.4	19.5	0.3	126.8
Trade openness	1,335	87.8	51.7	19.5	442.7
Financial development	1,322	76.6	50.1	0.2	309.0
Institutional quality	1,343	0.5	0.9	-2.1	2.1
Population	1,343	72,600,000	208,000,000	290,000	1,400,000,000
VIX	1,343	19.0	6.8	11.1	32.5
Oil price	1,343	69.8	23.1	36.2	105.0
Infectious diseases					
COVID-19	1,343	6,901	86,123	0	2,590,552
Ebola	1,343	0	1	0	20
Malaria	1,343	221,545	1,442,610	0	18,900,000
SARS	1,343	0	0	0	0
Yellow fever	1,343	4	50	0	1,307

Source: Bloomberg; IMF; World Bank; WHO; author's calculations.

Table 2. Summary Statistics—Daily Dataset

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
CDS spreads	8,299	335.3	1,572	0	28,012
COVID-19					
Cases	12,210	35,405	155,493	0	2,686,480
Deaths	12,210	2,188	9,348	0	128,062
VIX	8,707	34.3	16	12.1	82.7
Oil price	8,629	34.4	15.4	-37.00	63.3

Source: Bloomberg; Oxford COVID-19 Government Response Tracker; IMF; authors' calculations.

IV. EMPIRICAL METHODOLOGY

Using a strongly balanced panel dataset of annual observations comprising 77 advanced and developing countries over the 2004-2020 period, we estimate a standard model with sovereign CDS spreads of 5-year maturity are determined according to the following specification:

$$CDS_{it} = \beta + \alpha\, Vir_{it} + \gamma\, X_{it} + \eta_i + \mu_t + \varepsilon_{it}$$

where CDS_{it} denotes the logarithm of CDS spreads in country i at time t; Vir_{it} is the logarithm of the number of confirmed cases of infectious diseases (including COVID-19, Ebola, malaria, SARS, and yellow fever) scaled by population; and X_{it} represents a vector of control variables, including the logarithm of real GDP per capita, real GDP growth, consumer price inflation, budget balance as a share of GDP, government debt as a share of GDP, current account balance as a share of GDP, international reserves as a share of GDP, trade openness as measured by the ratio of exports and imports to GDP, financial development as measured by domestic credit to the private sector as a share of GDP, the logarithm of population, and a measure of institutional quality.[6] The η_i and μ_t coefficients denote the time-invariant country-specific effects and the time effects controlling for common shocks that may affect financial conditions across all countries in a given year, respectively.[7] ε_{it} is an idiosyncratic error term that satisfies the standard assumptions of zero mean and constant variance. To account for possible heteroskedasticity, robust standard errors are clustered at the country level.

To develop a more granular analysis with higher frequency observations and focus exclusively on the recent impact of COVID-19, we estimate the model of sovereign CDS spreads using high-frequency (daily) data for the same sample of 77 countries and territories during January-June 2020. In addition to the static fixed-effects model, we estimate the dynamic version using the Generalized Method of Moments (GMM) procedure proposed by Arellano and Bover (1995) and Blundell and Bond (1998), which helps correct for estimation biases resulting from the inclusion of the lagged dependent variable, as well as the potential endogeneity of the explanatory variables.

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

[6] Institutional quality is measured by a simple average of the "government effectiveness" and "regulatory quality" indicators from the World Bank's Worldwide Governance Indicators database.

[7] We remove time fixed effects in specifications with global variables (i.e., the VIX index and crude oil prices).

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.

V. ESTIMATION RESULTS

The empirical analysis is conducted at annual frequency with a dataset covering 77 countries and territories during the period 2004–2020 and at daily frequency with the same sample of countries and territories over the period from January 1, 2019 to June 30, 2020. Estimation results present a consistent picture across different specifications, but it is important to note that there is significant heterogeneity in how infectious diseases affect sovereign CDS spreads across countries over time. The magnitude of this effect varies with macroeconomic conditions and institutional strength, which in turn helps determine the effectiveness of policy response to pandemics.

A. Annual Data

As a baseline, we estimate the equation for the full sample of countries and territories using the standard fixed effects model and start with a parsimonious specification including only macroeconomic, financial and institutional variables in column [1] of Table 2 as a point of reference. We then introduce the number of confirmed infectious-disease cases into the regression in column [2] for the full sample, as well as for sub-samples of advanced and emerging market economies in column [3] and [4], respectively.

With regards to the explanatory power of conventional determinants of sovereign CDS spreads, we obtain estimated elasticities that are broadly consistent with previous studies in the literature. Country-specific economic, financial and institutional factors have an important role in expanding the variation in CDS spreads. While country characteristics matter everywhere, the magnitude of these effects are found to be greater in emerging market economies. Our estimation results also confirm that global developments—as captured by the VIX index and crude oil prices—have become increasingly important in determining country risk spreads.

For the main explanatory variable of interest in this study, we find that past epidemics measured by the number of confirmed infectious-disease cases per population do not have a statistically significant effect on sovereign CDS spreads at annual frequency during the period 2004–2020, after controlling for macroeconomic, financial and institutional factors. Although the coefficient

Table 3. Infectious Diseases and Sovereign CDS Spreads

Annual Data, 2004-2020				
(Dependent variable: Log of 5-year CDS Spreads)				
	[1] All	[2] All	[3] Advanced	[4] Developing
Real GDP	0.071	0.313	-0.879	0.634
	[0.242]	[0.379]	[2.228]	[0.456]
Real GDP growth	-0.004	-0.004	0.018	-0.004
	[0.008]	[0.013]	[0.029]	[0.015]
Inflation	0.015	0.018	0.002	0.020
	[0.006]	[0.011]	[0.022]	[0.012]
Budget balance	-0.033***	-0.019	-0.011	-0.007
	[0.009]	[0.010]	[0.014]	[0.017]
Government debt	0.024***	0.011	0.013	0.014
	[0.003]	[0.005]	[0.015]	[0.006]
Current account balance	-0.035***	-0.010	-0.002	-0.013
	[0.010]	[0.011]	[0.041]	[0.013]
Foreign reserves	0.009	0.009	0.012	0.013
	[0.005]	[0.007]	[0.019]	[0.007]
Trade openness	-0.003	-0.005	-0.030	-0.004
	[0.003]	[0.004]	[0.034]	[0.004]
Financial development	0.009*	0.003	0.011	0.001
	[0.003]	[0.004]	[0.006]	[0.005]
Institutional quality	-1.157***	-1.599***	-0.814	-1.728***
	[0.293]	[0.441]	[1.105]	[0.478]
Population	-0.304	-1.634	-1.899	-2.471
	[0.417]	[1.219]	[3.828]	[1.464]
VIX	0.026***	0.023***	0.004	0.024***
	[0.003]	[0.004]	[0.014]	[0.004]
Oil price	0.014***	0.003	0.002	0.003
	[0.001]	[0.001]	[0.006]	[0.001]
Infectious diseases		-0.053	-0.005	-0.067
		[0.022]	[0.050]	[0.035]
Number of countries	77	74	39	35
Number of observations	1,045	358	58	294
Fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.48	0.37	0.42	0.39

Note: Robust standard errors clustered at the country level are reported in brackets. A constant is included in each regression, but not shown in the table. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

on infectious diseases remains statistically insignificant across all country groups, the results still indicate considerable heterogeneity among advanced and developing countries. These estimations with annual data, however, should be treated with caution, as the movement in sovereign CDS spreads may not be adequately captured at annual frequency and the number of infectious-disease observations is limited during the sample period, especially when we partition the countries into income groups.

We conduct several robustness checks for the full sample of countries and territories: (i) truncating the dataset at the 5th and 95th percentiles to exclude potential outliers; (ii) estimating the model for the post-global financial crisis period (2010-2020); and (iii) using the pseudo poisson maximum likelihood (PPML) method to estimate the model for the whole period as well as the post-global financial crisis period (2010-2020). These results, presented in Appendix Table A2, reaffirm that infectious-disease episodes do not have a significant effect on sovereign CDS spreads when estimated at an annual frequency. It is important note that the coefficient on infectious diseases turns positive in the post-global financial crisis period, albeit still statistically insignificant. More importantly, however, the COVID-19 pandemic is an unprecedented infectious-disease outbreak in terms of its global scope, at least since the Great Influenza Pandemic of 1918. Therefore, we develop a more granular analysis with daily data focusing exclusively on the impact of COVID-19 on sovereign CDS spreads.

B. Daily Data

We estimate both the static and dynamic versions of the empirical model with high-frequency data to focus exclusively on the impact of COVID-19 cases on sovereign CDS spreads. Lacking macroeconomic data at daily frequency, we account for concerns associated with omitted variables by including a set of fixed effects and dynamic controls, along with global economic and financial conditions proxied by the VIX index and crude oil prices. In this setting, we also study how the interaction between COVID-19 infections and containment measures, as reflected in the stringency of the domestic lockdown, affect sovereign CDS spreads.

The results using daily data, presented in Table 4, show that the COVID-19 pandemic has had an economically and statistically significant effect on sovereign CDS spreads across all countries in our sample. The elasticities derived from the baseline specification in column [2] imply that a 10 percent increase in the number of COVID-19 infections leads to 40 basis point increase in sovereign CDS spreads.[8] This adverse impact of the pandemic remains positive and statistically significant when we estimate the model separately for sub-samples of advanced and developing countries. Furthermore, the estimated coefficient on COVID-19 infections is found to be larger in the case of advanced economies, which may be a reflection of the greater severity of the pandemic and macro-fiscal enormity of the ensuing economic crisis in the developed world, at least during the initial stage of the global coronavirus outbreak. However, the gap between the estimated disease coefficients for advanced and emerging market economies could also be a

[8] The estimation results remain unchanged when we use the number of deaths caused by COVID-19 instead of the number of COVID-19 cases.

result of widespread underreporting in developing countries due to differences in testing availability and institutional capacity (Lau and others, 2020).

The dynamic model with lagged dependent variable to capture persistence over time in sovereign CDS spreads confirm the adverse impact of the COVID-19 pandemic across all countries as well as in sub-samples of advanced and emerging market economies. These dynamic estimation results via the System GMM approach, presented in Table 5, confirm that the intensity of domestic COVID-19 outbreak is a stronger factor in determining sovereign credit risk as measured by 5-year CDS spreads, especially in advanced economies. The estimated coefficient on COVID-19 cases reaches 0.062 for the sample of developed countries, compared to 0.042 for emerging market economies. Finally, we consider the interaction between COVID-19 infections and the stringency of domestic containment measures. The coefficient on the interaction is negative and statistically significant, which indicates that the impact of COVID-19 infections on sovereign CDS spreads is lower in countries with more stringent containment measures. However, it is an open question whether the relationship between stringent containment measures and CDS spreads remains negative or turn positive over a longer period. While policies aimed at curbing the spread of the disease has helped smooth the generative shock of the COVID-19 pandemic on sovereign CDS spreads so far, the macro-fiscal cost of stringent measures has also contributed to a significant increase in public debt as a share of GDP. Therefore, the erosion of credit worthiness could eventually push the cost of borrowing higher.

Table 4. Infectious Diseases and Sovereign CDS Spreads: Static Estimations

Daily Data, January-June 2020				
(Dependent variable: Log of 5-year CDS Spreads)				
	[1] All	[2] All	[3] Advanced	[4] Developing
VIX	0.005***	0.007***	0.007***	0.007***
	[0.001]	[0.008]	[0.008]	[0.001]
Oil price	-0.014***	-0.008***	-0.005***	-0.009***
	[0.001]	[0.001]	[0.001]	[0.001]
COVID-19		0.040***	0.044***	0.041***
		[0.004]	[0.005]	[0.006]
Number of countries	75	72	29	43
Number of observations	8,191	6,379	2,753	3,626
Fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.58	0.62	0.70	0.52

Note: Robust standard errors clustered at the country level are reported in brackets. A constant is included in each regression, but not shown in the table. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 5. Infectious Diseases and Sovereign CDS Spreads: Dynamic Estimations

Daily Data, January-June 2020				
(Dependent variable: Log of 5-year CDS Spreads)				
	[1] All	[2] All	[3] Advanced	[4] Developing
Lagged CDS spreads	0.422***	0.401***	0.401***	0.401***
	[0.041]	[0.041]	[0.041]	[0.055]
VIX	0.004***	0.004***	0.003***	0.005***
	[0.001]	[0.001]	[0.001]	[0.001]
Oil price	-0.001	-0.000	0.000	-0.000
	[0.001]	[0.001]	[0.001]	[0.001]
COVID-19		0.050***	0.062***	0.042***
		[0.006]	[0.009]	[0.009]
Number of countries	74	72	29	43
Number of observations	4,801	3,725	1,617	2,108
Fixed effects	Yes	Yes	Yes	Yes
AR (1) p-value	0.000	0.000	0.000	0.000
AR (2) p-value	0.682	0.176	0.801	0.195
Hansen J-test p-value	0.225	0.210	0.186	0.205

Note: Robust standard errors clustered at the country level are reported in brackets. A constant is included in each regression, but not shown in the table. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 6. Infectious Diseases and Sovereign CDS Spreads: Policy Interactions

Daily Data, January-June 2020			
(Dependent variable: Log of 5-year CDS Spreads)			
	All	Advanced	Developing
VIX	0.007***	0.007***	0.008***
	[0.001]	[0.001]	[0.001]
Oil price	-0.007***	-0.005***	-0.007**
	[0.001]	[0.001]	[0.001]
COVID-19	0.047***	0.048***	0.059***
	[0.004]	[0.005]	[0.007]
COVID-19 * Stringency	-2.839*	-1.185*	-1.258*
	[1.381]	[4.431]	[5.969]
Number of countries	72	29	43
Number of observations	6,138	2,672	3,466
Fixed effects	Yes	Yes	Yes
Adjusted R^2	0.60	0.71	0.56

Note: Robust standard errors clustered at the country level are reported in brackets. A constant is included in each regression, but not shown in the table. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

VI. Conclusion

This paper investigates the impact of infectious diseases on sovereign CDS spreads, using a panel dataset covering of 77 advanced and emerging market economies from 2004 to 2020. Estimations at annual frequency indicate that infectious-disease episodes have no discernible effect on market-implied sovereign credit risk, after controlling for macroeconomic and institutional factors. However, our granular analysis using high-frequency (daily) data indicates that the COVID-19 pandemic has had a significant impact on sovereign CDS spreads across all countries. This adverse effect is found to be more pronounced in advanced economies, which may reflect the greater severity of the pandemic and depth of the ensuing economic crisis in these countries, at least during the initial stage of the global outbreak. However, it is also important not to overlook the widespread underreporting in developing countries due to bureaucratic and medical constraints.

The pandemic has led to a large-scale fiscal expansion in most countries that is by and large financed by increasing public debt during a period of deep contraction in economic activity. According to the latest IMF projections, the COVID-19 pandemic will push government debt levels up by almost 20 percentage points on average in 2020—almost double the damage during the global financial crisis in 2008. While these macro-fiscal developments undermine the quality

of sovereign credit, it is important to emphasize appropriate policy response to the pandemic, including higher social spending and economically costly containment measures, would help better deal with the socioeconomic consequences of the COVID-19 pandemic. Indeed, our empirical analysis show that more stringent domestic containment measures are associated with lower CDS spreads. However, it should be noted that the macro-fiscal cost of efforts aimed at curbing the spread of the disease could undermine credit worthiness and eventually push the cost of borrowing higher.

The results presented in this paper have two important policy implications. While global macro-financial conditions and investors' risk appetite are important factors in determining sovereign credit risk, country-specific factors and in particular fiscal health are far more critical. When policymakers underestimate fiscal risks, market participants adjust sovereign CDS spreads, particularly for countries with a poor track record in fiscal discipline. This can in turn lead to more elevated debt service costs and higher policy uncertainty. Likewise, there is abundant empirical evidence that institutional factors help shape financial markets' perception of sovereign credit risks (Butler and Fauver, 2006; Baldacci, Gupta, and Mati, 2011; Acemoglu and Robinson, 2012; Camba-Méndez and Serwa, 2016). Accordingly, not only countries with poor political stability and weak institutions signal their potential lack of commitment to sound economic policies to the markets, but high political risk per se may result in lower capital inflows, suboptimal investment levels and ultimately lower economic growth.

Appendix Table A1. List of Advanced and Emerging Market Economies

Algeria	Hungary	Philippines
Argentina	Iceland	Poland
Australia	India	Portugal
Austria	Indonesia	Qatar
Bahrain	Ireland	Romania
Belgium	Italy	Russia
Brazil	Israel	Rwanda
Bulgaria	Japan	Saudi arabia
Canada	Kazakhstan	Serbia
Chile	Korea	Slovak Republic
China	Kuwait	Slovenia
Colombia	Latvia	South africa
Costa rica	Lebanon	Spain
Croatia	Lithuania	Sri Lanka
Cyprus	Malaysia	Sweden
Czech Republic	Mexico	Switzerland
Denmark	Mongolia	Thailand
Egypt	Morocco	Tunisia
El Salvador	Netherlands	Turkey
Estonia	New zealand	Ukraine
Finland	Nicaragua	United states
France	Nigeria	United kingdom
Germany	Norway	Uruguay
Greece	Pakistan	Venezuela
Guatemala	Panama	Vietnam
Hong Kong SAR	Peru	

Appendix Table A2. Infectious Diseases and Sovereign CDS Spreads (Robustness Checks)

Annual Data, 2004-2020				
(Dependent variable: Log of 5-year CDS Spreads)				
	Truncated sample	Post-GFC period	PPML estimator	
			2004-2020	Post-GFC period
Real GDP	0.109	-1.486***	0.003	0.004
	[0.403]	[0.438]	[0.003]	[0.004]
Real GDP growth	0.009	0.005	0.005	0.009**
	[0.012]	[0.010]	[0.003]	[0.003]
Inflation	0.030*	0.019	0.006*	0.005
	[0.011]	[0.010]	[0.002]	[0.002]
Budget balance	-0.011	-0.016	-0.005	-0.006*
	[0.011]	[0.010]	[0.014]	[0.002]
Government debt	0.015**	0.007	0.001***	0.001***
	[0.003]	[0.004]	[0.000]	[0.000]
Current account balance	-0.004	-0.021	0.002	0.003
	[0.011]	[0.009]	[0.003]	[0.003]
Foreign reserves	0.012	0.015*	-0.001	-0.002
	[0.007]	[0.006]	[0.001]	[0.001]
Trade openness	-0.007	-0.004	-0.001**	-0.001
	[0.004]	[0.002]	[0.000]	[0.000]
Financial development	0.004	0.008	0.000	0.000
	[0.004]	[0.005]	[0.000]	[0.000]
Institutional quality	-1.166**	-0.557**	-0.237***	-0.228***
	[0.293]	[0.303]	[0.024]	[0.021]
Population	-1.067	-0.272	-0.048***	-0.047***
	[0.417]	[1.190]	[0.010]	[0.012]
VIX	0.021***	0.002	0.004***	0.001
	[0.004]	[0.004]	[0.014]	[0.001]
Oil price	0.002	-0.003*	0.001	0.000
	[0.001]	[0.001]	[0.000]	[0.000]
Infectious diseases	-0.048	0.008	-0.004	0.002
	[0.022]	[0.015]	[0.004]	[0.004]
Number of countries	72	74	74	74
Number of observations	342	277	358	277
Fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.3368	0.4125	0.4263	0.4263

Note: Robust standard errors clustered at the country level are reported in brackets. A constant is included in each regression, but not shown in the table. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

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