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Rare disasters, exchange rates, and macroeconomic policy: Evidence from COVID-19

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Abstract

The rapid spread of the novel coronavirus (COVID-19) has had a dramatic effect on financial markets worldwide. This paper explores the association between rare disasters, macroeconomic policy, and the exchange rate, using COVID-19 as an example. Analysis of data from 27 advanced and emerging economies reveals a strong correlation between COVID-19 and time-varying risk premiums in the foreign exchange market. Moreover, the spread of COVID-19 significantly depreciates the domestic exchange rate in emerging markets, but not in advanced countries. During the COVID-19 crisis, expansionary fiscal policies and unconventional monetary policies led to an appreciation of local currencies. However, conventional expansionary monetary policies had the opposite effect, indicating that the traditional effect of monetary policy on the exchange rate takes precedence even in the event of a rare disaster.

1. Introduction

COVID-19 emerged in December 2019 and spread rapidly, posing a significant threat to public health and economic development. This disaster has raised uncertainty and risks and strongly affected financial markets. As the exchange rate is central to financial markets, this paper explores the associations between COVID-19, currency exchange rates, and macroeconomic policy.

Many studies have emphasised the importance of risk premiums in determining exchange rates in the short run. Risk premiums are subject to the influence of rare disasters. Farhi and Gabaix (2016) introduced a rare disaster model to explain the disconnect between exchange rates and fundamentals using time-varying disaster risk premiums. Because risk premiums cannot be observed directly, risk reversal using implied volatility of currency options often acts as a proxy (Farhi et al., 2015; Jurek, 2014). Park and Park (2020) studied the effect of nuclear disaster risks on the exchange rate in South Korea using data on North Korea's nuclear tests. However, the risks that they studied were country-dependent; using cross-country analysis to examine a global disaster such as COVID-19 can help us better understand the mechanism.

Expansionary macroeconomic policies are widely implemented when diseases spread. This paper investigates how macroeconomic policies affect the exchange rate during rare disasters.

Other researchers have found evidence that expansionary monetary and fiscal policies may lead to a depreciation of local currencies (e.g. Eichenbaum and Evans, 1995, Monacelli and Perotti, 2010). However, the situation may be different during a crisis period. During a rare disaster, it is possible that the implementation of expansionary policies may signal an optimistic macroeconomic outlook and thus strengthen the local currency. Therefore, evaluating which channel takes precedence can help us to understand the optimal policy transmission mechanism during a crisis.

This paper provides empirical support for a theoretical mechanism linking rare disasters, risk premiums, and exchange rates, with COVID-19 as the rare disaster. It also discusses the implications for exchange rates of macroeconomic policies implemented during a rare disaster risk period.

2. Data

Our sample included 27 emerging and advanced economies with non-fixed exchange rate regimes. Countries in the sample are listed in Table A.1.

We used the number of confirmed COVID-19 cases to represent the severity of the COVID-19 outbreak. The chosen starting point is the date on which approximately 20 cases were confirmed in each country, and the end date is 8 July 2021.

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The COVID-19 related data were obtained from Our World in Data. Data on foreign exchange rates were collected using Bar- chart.com’s US market quote. The confirmed COVID-19 cases were released around 23:59 GMT until 22 April 2020. From then on, data for the current day were released between 3:00 and 5:15 GMT the next day. Therefore, we used the foreign exchange data at 6:00 GMT to match the release time of COVID-19 cases.

However, it is possible that the confirmed cases of COVID-19 may not capture the severity of the disaster because of limited test capacity. We therefore followed Ding et al. (2021) and adjusted the measure of COVID-19 using following formula with total cases and tests data:

$$\text{Covid}_{t,1,adj} = \ln \left( 1 + \frac{\text{Case}_{t,1}}{\text{Test}_{t,1}} \right) - \ln \left( 1 + \frac{\text{Case}_{t,1-1}}{\text{Test}_{t,1-1}} \right)$$

(1)

Furthermore, the foreign exchange rate data do not include weekends and holidays. Although COVID-19 data were updated every day, it is possible that the reported data were underestimated because of limited testing during this time. We therefore dropped all observations from weekends and holidays. Other daily variables, including stock indexes, short-term interest rates, VIX, and Fed asset purchases were obtained from the Wind Economic Database, investing.com, the New York Fed, and Federal Reserve Economic Data.

3. Empirical results

3.1. Time-varying risk premiums and COVID-19

Uncovered interest rate parity (UIP) is a core theory of short-term exchange rate determination that states that the difference in interest rates between two countries equals the relative change in the foreign currency exchange rate over the same period. We define a deviation from UIP as a currency risk premium. According to Farhi and Gabaix (2016), such a currency risk premium is strongly affected by the time-varying risk of rare global disasters. To check whether COVID-19 status information reflects a rare disaster risk, we ran the following simple regression on UIP deviation and COVID-19:

$$\Delta Z_t = a + b \text{Covid}_{t-1} + \delta_i + \tau_i + \epsilon_{it}$$

(2)

$Z_t$ is the UIP deviation $\delta_{it} = \delta_{it}^{\text{US}} - (e_{it} - e_{it-1}),$ $e_{it}$ represents the logarithmic value of the US dollar exchange rate for country $i$, therefore an increase in $e_{it}$ means an appreciation of the local currency. $\delta_{it}$ represents the domestic short-term interest rate, and $\epsilon_{it}$ represents the US federal funds rate. Interest rates were converted into daily returns. Covid$_{t-1}$ represents the daily growth rate of confirmed cases in country $i$. We used a one-period lag because the current day information was available only at the end of the day or early the next day (see details in Section 2).

Table 1 reports the results of the panel regression with the country and time fixed effects. In columns (1)-(4), using the testing-adjusted measure, we can see that an increase in the severity of the COVID-19 crisis leads to a significant increase in UIP deviations and local currency risk premiums among emerging markets. Meanwhile, it leads to a move of UIP deviations in the opposite direction among advanced countries. Such a result means that COVID-19 may generate different impacts on the exchange rate between the two groups.

Because it is possible that these estimates may have been impacted by governments’ adoption of aggressive macroeconomic policies in March and April 2020, we ran the same regressions starting from 1 May 2020. The findings in columns (5)-(8) confirm the previous results.

Table 1: COVID-19 impact on the change in UIP deviation.

|       | Full sample |        |        | Sub-sample starting in May 2020 |        |        |
|-------|-------------|--------|--------|-------------------------------|--------|--------|
|       | Emerging    | Emerging | Advanced | Advanced                      | Emerging | Emerging | Advanced | Advanced |
| L. Covid | 0.0090      | 0.0291 | (0.0053) | (0.0161)                       | 0.0267*** | 0.0105 | (0.0070) | (0.0127) |
| L. Covid_adj | 0.3465** | -0.0084** | (0.1354) | (0.0025)                       | 0.4024*** | -0.0061** | (0.0870) | (0.0025) |

$R^2$: 0.3395 0.4090 0.4840 0.5912 0.2912 0.3239 0.5719 0.5578

N: 2580 1866 1664 1306 2279 1716 1470 1217

Clustered standard errors by country in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Exchange rate and COVID-19.

|       | Emerging | Emerging | Advanced | Advanced |
|-------|----------|----------|----------|----------|
| L. Covid | -0.0102** | -0.0014 | (0.0039) | (0.0083) |
| L. Covid_adj | -0.0045 | 0.0138 | (0.0046) | (0.0118) |
| L. Covid**_adj | -0.3326* | -0.0060 | (0.1622) | (0.0045) |
| i | 0.0001* | 0.0001 | -0.0056*** | -0.0043 |
| $p_i$ | -0.0013** | -0.0057 | -0.0044*** | 0.0011 |
| $\Delta\text{stock}$ | 0.1164*** | 0.1041* | -0.0289 | 0.0158 |
| vix | -0.0045*** | -0.0069*** | -0.0102*** | -0.0087*** |
| $\Delta\text{QE}$ | 0.1234** | 0.1333* | 0.2186 | 0.0708* |
| $r$ | -0.0000*** | -0.0000*** | -0.0000*** | -0.0000*** |
| $\text{constant}$ | 0.0160*** | 0.0243*** | 0.0367*** | 0.0329*** |

$R^2$: 0.1120 0.0971 0.0823 0.0725 2533 1814 1522 1179

Clustered standard errors by country in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.3 Another testing adjust measure is Covid$_{t,1,adj} = \frac{\Delta\text{log}e_{t,1}}{\text{log}e_{t,1}} - \frac{\Delta\text{log}e_{t,1-1}}{\text{log}e_{t,1-1}}$, our results are robust using it.
Fig. 1. Impact of fiscal and monetary policies on the average cumulative exchange rate returns. Note: Monetary policy is normalised to refer to cutting 1% of the local interest rate.

Fig. 2. Impact of unconventional monetary policies on average cumulative exchange rate returns in Japan and the US. Note: For the US exchange rate, the dollar index is used.

3.2. COVID-19 and foreign exchange rates

We have shown that COVID-19 status is closely associated with currency risk premiums and thus potentially with the determination of the exchange rate. In this section, we explore how disaster risk affects the exchange rate using the following core regression:

\[
\Delta e_{it} = \beta_0 + \beta_1 \text{Covid}_{it-1} + \beta_2 \text{Covid}^{ms}_{it} + \beta_3 \text{stock}_{it} + \beta_4 \text{VIX} + \beta_5 \Delta \text{QE}_{it} + \beta_6 t + \epsilon_{it} \tag{3}
\]

stock\(_{it}\) is the logarithmic value of the stock index, which controls potential omitted financial market information. We used the logarithmic value of the VIX index and the US Fed large-scale purchase (QE) to control other global factors. \(t\) is individual country time trend. The model was estimated using country fixed effects.

Column (1) in Table 2 indicates that a 1% increase in confirmed cases depreciates the local currency by 0.01% in emerging markets, but the impact on advanced countries’ exchange rates is weak. The results are robust with the testing-adjusted measure according to column (2) and (4). It is possible that during the crisis, international capital flowed to advanced countries that provided safer assets. Therefore, the immediate depreciation becomes weak.\(^4\)

3.3. Macroeconomic policies and the exchange rate during the pandemic

In this subsection, we use event studies to examine the impact of macroeconomic policies on the local exchange rate during the

\(^4\) We also run the same regressions with sub-sample from May 2020, results remain robust.
Table A.1
Country list.

Developed economies
Australia, Canada, Czech Republic, Iceland, Japan, New Zealand, Norway, Singapore, Switzerland, United Kingdom

Emerging economies
Argentina, Brazil, China, Colombia, India, Indonesia, Israel, Korea, Malaysia, Mexico, Philippines, Poland, Russia, South Africa, Thailand, Turkey

Table A.2
National fiscal policies responding to COVID-19.

| Market               | Date (GMT+0) | Specific measure                                                                 |
|----------------------|--------------|----------------------------------------------------------------------------------|
| Australia            | 2020/3/22 0:36 | Announced a 66.1 billion AUD stimulus package                                      |
| Brazil               | 2020/3/17 0:28 | Provided 147.3 billion BRL, mainly for employment protection, weak industrial sectors, and vulnerable groups |
| Canada               | 2020/3/18 14:47 | Announced an 82 billion CAD economic aid package                                   |
| China                | 2020/3/31 11:04 | Announced a 3 trillion CNY stimulus package                                        |
| Iceland              | 2020/3/21 2:01 | Announced a 230 billion ISK stimulus package                                       |
| India                | 2020/3/26 7:55 | Announced a 1.7 trillion INR economic rescue package                               |
| Indonesia            | 2020/3/13 3:23 | Announced a 120 trillion IDR economic stimulus plan to deal with the impact of the pandemic |
| Japan                | 2020/4/7 9:10 | Announced a stimulus package of 108 trillion JPY, including 39.5 trillion JPY in direct fiscal spending |
| Korea                | 2020/3/19 2:31 | Announced 50 trillion KRW in emergency funding for small and medium-sized enterprises and other stimulus measures |
| Mexico               | 2020/4/6 9:35 | Announced a 25 billion MXN stimulus package to revive the economy and create more jobs |
| New Zealand          | 2020/3/17 1:00 | Announced an economic stimulus package totalling 12.1 billion NZD                   |
| Philippines          | 2020/3/17 4:32 | Announced a 27.1 billion PHP fiscal stimulus plan to respond to the epidemic        |
| Poland               | 2020/4/8 12:29 | Announced a plan totalling at least 100 billion PLN to help companies              |
| Russia               | 2020/6/2 11:35 | Announced an economic recovery plan of 500 measures totalling about 8 trillion RUB  |
| Singapore            | 2020/3/26 7:53 | Announced a 48 billion SGD stimulus plan                                           |
| South Africa         | 2020/4/21 18:49 | Announced a 500 billion ZAR plan to respond to the pandemic                       |
| Switzerland          | 2020/3/13 14:30 | Provided a 10 billion CHF stimulus plan                                             |
| Thailand             | 2020/4/7 9:36 | Approved an economic relief package of 1.9 trillion THB                             |
| Turkey               | 2020/3/18 16:05 | Announced a plan of 100 billion TRY                                                 |
| United Kingdom       | 2020/3/11 12:51 | Announced a 30 billion GBP economic stimulus package                               |

COVID-19 crisis, starting from the relatively strong expansionary monetary and fiscal policies in the early stage. Information related to the policy announcements for each country are provided in Tables A.2 and A.3.

To evaluate the policy impacts, we focused on cumulative abnormal exchange rate returns. We used the 180-minute average pre-announcement returns as the constant normal return and calculated abnormal returns each minute after the announcement by determining actual returns minus the normal return. Fig. 1 reports the cumulative group average abnormal returns after the announcement. The 90% error bands is calculated following Boehmer et al. (1991).

The results show that fiscal policy appreciates the local currency while monetary policy leads to an initial appreciation followed by a significant depreciation. Thus, an expansionary monetary policy may provide a positive signal to the market that the government is stimulating the economy, but the traditional channel dominates the results later. The results also indicate that policies have a stronger impact on the exchange rate in emerging markets.

Lastly, we examined how unconventional monetary policies affected the exchange rate during the crisis. Focusing on Japanese and US monetary policy meeting announcements starting from April 2020, we found that unconventional monetary policy significantly appreciates the local currency, indicating that signal effects may dominate (see Fig. 2).

Table A.3
National conventional monetary policies in response to COVID-19.

| Market               | Date (GMT+0) | Reduced the interest rate by |
|----------------------|--------------|------------------------------|
| Australia            | 2020/3/3 3:30 | 25 bp                        |
| Brazil               | 2020/3/18 21:07 | 50 bp                        |
| Canada               | 2020/3/4 15:00 | 50 bp                        |
| China                | 2020/3/13 9:17 | 50 bp                        |
| Czech Republic       | 2020/3/16 15:32 | 50 bp                        |
| Iceland              | 2020/3/11 8:30 | 50 bp                        |
| India                | 2020/3/27 4:39 | 75 bp                        |
| Korea                | 2020/3/16 7:50 | 50 bp                        |
| Mexico               | 2020/3/20 19:03 | 50 bp                        |
| New Zealand          | 2020/3/15 19:02 | 75 bp                        |
| Norway               | 2020/3/13 7:30 | 50 bp                        |
| Philippines          | 2020/3/19 6:07 | 50 bp                        |
| Poland               | 2020/3/17 14:57 | 50 bp                        |
| Russia               | 2020/4/24 10:30 | 50 bp                        |
| South Africa         | 2020/3/19 13:02 | 100 bp                       |
| Thailand             | 2020/3/20 14:17 | 25 bp                        |
| Turkey               | 2020/3/17 11:06 | 100 bp                       |
| United Kingdom       | 2020/3/11 7:00 | 50 bp                        |

4. Conclusion

This paper reported the impact of rare disasters on the exchange rate based on data from the COVID-19 pandemic. It is found that COVID-19 significantly depreciates the local currency in emerging markets, but not in advanced countries. Furthermore, an expansionary fiscal policy or an unconventional monetary policy alleviates the downward pressure of COVID-19 on the exchange rate. However, a conventional expansionary monetary policy may have the opposite effect.
Appendix

See Tables A.1–A.3.

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