The Effects of Green and Social Finance on Firms, Markets, and the Economy

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THE EFFECTS OF GREEN AND SOCIAL FINANCE ON FIRMS, MARKETS, AND THE ECONOMY [1]

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Abstract

Firms with better access to green and social finance withstand the COVID-19 pandemic more successfully than other firms. This evidence is supported by data from 60 countries around the world, covering all the major economies. Green firms were able to issue new bonds to support corporate activities. Their stocks experienced less decline. At the macro level, green and social bonds issued in the first two quarters of 2020 led to better economic recovery in the third quarter of 2020. Although green and social finance is not intended to boost economic growth during normal times, it helps smooth economic growth and leads to lower growth volatility. We also find that country total carbon dioxide emissions decrease after the green bond inceptions. Overall, green and social finance has real beneficial effects during both the pandemic and normal times.

Keywords

green finance, social finance, financial development

JEL Classification

G2, O4, Q5

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I. INTRODUCTION

The idea that finance is important for economic development can go at least back to Schumpeter (1911 and 1942) and to a lesser extent Keynes (1936), who helped set world financial order to improve economic development, especially recovery from World War II. This idea gathered steam subsequently by Goldsmith (1969), McKinnon (1973), Shaw (1973), Greenwood and Jovanovic (1990), and King and Levine (1993). Allen, Qian, and Qian (2005) show that the People's Republic of China (PRC) can have its own model in terms of finance and growth.

Nowadays, we face a different problem. Instead of worrying about economic growth rate, the quality of growth, including negative externalities and economic volatilities, becomes a major concern. In particular, climate change and global warming are serious issues, as argued in Stern Report (2006).[3] International organizations such as the United Nations (UN) also made major effort in this area with the launch of UN Global Compact in 2000 and the publication of "Who Cares Wins" in 2004. The documentary "An Inconvenient Truth" premiered in 2006, featuring former United States (US) Vice President Al Gore, also became influential and increased public awareness on climate change. One major aim of the Paris Agreement that was adopted in December 2015 is to make financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. The Bank of England, led by former governor Mark Carney, pushed for serious analysis of climate change risk, including its risk on central banks and financial stability (e.g., Batten, Sowerbutts, and Tanaka 2016).

The role of finance in the society is under hot debates, especially after the various crises (Zingales 2015, Shiller 2012). Shapira and Zingales (2017) show that firms would knowingly choose to pollute the environment instead of investing in pollution abatement because of their own cost-benefit analysis. In this paper, we examine a new genre of finance: green and social finance. We evaluate how green and social finance affect firms, the market, and the economy

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[3] The Stern report is critically reviewed by Nordhaus (2007), which follows the seminal work of Nordhaus (1977, 1991, and 1994), and supported by scientific evidence in Manabe and Wetherald (1967). William Nordhaus received the 2018 Nobel Prize in Economics "for integrating climate change into long-run macroeconomic analysis".

at large. When people suffer from financial crisis, they resort to social network, including religion for support (Chen 2010).

It is important to study the real effects of green and social finance.[4] Little is known about market practices. Kim and Yoon (2020) cast doubt on the real effects of green finance as many asset managers seem to use UN Principles for Responsible Investment to attract flow without really improving their portfolio environmental, social, and governance (ESG) ("greenwashing"). Gibson et al. (2020) show that US mutual funds do not improve their portfolio ESG (while there is some increase for offshore funds).

We manually construct a comprehensive dataset to examine the real effects of green, social, and pandemic bonds. We have more than 40,000 firms from 136 countries. Some of the firms and countries have issued green, social, and pandemic bonds, but many of them have not yet. Therefore, we have good heterogeneity across firms and countries to discern the effects of green and social finance.

We carefully evaluate the effects of green and social finance during the coronavirus disease (COVID-19) pandemic. We define green firms as firms with green projects before the onset of the pandemic, as they have issued green bonds before. The Green Bond Principles require issues to have projects and frameworks for green developments. We show that green firms performed better than nongreen firms during this public health crisis. The stock prices of green firms hold up substantially better than other firms. Their buy-and-hold returns are higher and their maximum drawdowns are lower. This finding is consistent with several other studies that also examine stock price performance during the COVID-19 pandemic, such as Ding, Levine, Lin, and Xie (2020).

More importantly, we show that green firms are more likely to get new funding during the pandemic. If firms already have the framework and facilities for green finance, they can access the financial market more easily during the crisis. This credit supply through green bonds can be critical for survival of the firm after suffering a severe negative shock. This result is consistent with Lins, Servaes, and Tamayo (2017). They find that socially

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[4] To simplify notation, we use green finance to refer broadly to finance with green, social, and pandemic bonds.

responsible firms were better able to raise capital and survive the 2008–2009 financial crisis. At the aggregate level, we find that the issuance of green, social, and especially pandemic bonds in the first two quarters of 2020 is positively related to the economic recovery in the third quarter of 2020. The end of the first quarter and most of the second quarter of 2020 were extremely difficult for many firms and countries. Our findings reveal that, if firms were able to raise green, social, and pandemic bonds during this period, they are hit less hard by the pandemic and the country's economy recovered more quickly.

While our evidence for the COVID-19 period is clear, we have weak results for the effect of green and social bonds during normal times. We do not find any significant effects on gross domestic product (GDP) growth. This finding is expected as the objectives of green and social bonds are not to push economy grow faster. Instead, they are meant to help the economy grow more sustainably and in an environment- and society-friendly way. Consistent with this conjecture, we find that GDP growth volatility is lower after green and social bond issuance.

We also demonstrate direct environmental benefits from green bond issuance. The carbon emission level is lower after the country-issued green bonds. These results boost our confidence in the burgeoning green bond market. Besides the intended effects, we also show that there are externalities in green and social bond issuance. For example, we find that gender gap is reduced after green bond issuance. Once people become more aware of the issues and markets, they may take action to improve the overall ESG in a broad way.

One caveat for our study is that the green and social finance market is still growing fast. The market has not reached steady state yet. Therefore, the findings in this study should be read as preliminary. Once we have a bigger market and longer time series, we can reach a more concrete conclusion about their real effects.

The reminder of this paper is organized as follows. In section II, we describe the market and data. Firm-level evidence on stock market performance and capital raising activities is presented in section III. The results of green finance that are helping economic recovery from COVID-19 are presented in section IV. Section V shows the general effect of green, social,

and pandemic finance effects on macroeconomics and the environment as well as spillover effects. Section VI discusses the implications of the findings and concludes.

II. MARKETS AND DATA

A. Data Sources

We obtain individual firm stock prices from Compustat Global and firm characteristics from Datastream and WorldScope. The firm characteristics include, among others, firm size, leverage, return on assets, and cash holding. The broad dataset covers 136 countries, including 37,594 firms in 31 countries with green bond issuance.

We construct the green bond dataset by taking the following steps: first, we merge Bloomberg labeled green bond dataset with Climate Bond Initiative green bond dataset. Bloomberg labeled green bond dataset includes four types of green bonds: the Green Use of Proceeds Bond, the Green Use of Proceeds Revenue Bond, the Green Project Bond, and the Green Securitized Bond. The Climate Bond Initiative defines green bonds as instruments created to fund projects with positive environmental and/or climate benefits. Next, we manually search for green bond issuances news from Dow Jones Factiva. Our final green bond dataset is the combination of those three sources. Our green bond dataset covers the period from June 2007 to June 2020.

Our social bond dataset is from Bloomberg. Bloomberg tags bonds with the "Social Bond" label in the Use of Proceeds field when an issuer (i) markets their bond as a social bond, and (ii) clearly and transparently communicates that 100% of the proceeds will be invested in projects or activities that promote improved social welfare and positive social impact directly for the vulnerable, marginalized, underserved, or otherwise excluded or disadvantaged populations. We include all the social bonds in the Bloomberg database, but treat pandemic bonds separately.

The pandemic bonds can be seen as a subset of social bonds with the motivation of tackling the pandemic. Our pandemic bond dataset is constructed by merging two databases. For the pandemic bond issued by Chinese companies, we rely on the Wind terminal. We download

the bond called "Fight COVID-19" bond（抗疫债）in the Wind terminal. For the international pandemic bond issuances, we use the Bloomberg terminal and the data is retrieved by restricting the Use of Proceeds to pandemic criterion.

Macroeconomic variables, including GDP, GDP per capita, GDP growth, unemployment rate, exports of goods and services, and carbon dioxide (CO_2) emission data are taken from the World Bank database. All variables are denominated in US dollar. Legal origin data is from La Porta, Lopez-de-Silanes, Shleifer, and Vishnny (1998), and credit right data is from Djankov, Simeon, McLiesh, and Shleifer (2007).

Country credit ratings are obtained from the major rating agencies Standard & Poor's, Moody's, and Fitch. We transfer credit rating into numeric values according to Appendix 1, and we take the arithmetic average of all three rating agencies for each country. Then we define the variable BBB and above equals to one if the rating number for a country is equal to or greater than 18, and zero otherwise.

B.   Data Summary

We summarize the firm variables in Table 1. We have a large sample of individual firms. Specific countries represented in the sample are listed in Appendix 2. We also provide variable definitions in Appendix 1.

The data is from the beginning of the market in 2008 (the first green bond in 2007 was issued by a supranational financial institution, which is not classified to any individual country) to the most recent available data in September 2020. We use different color for the depth of the market. The PRC has the most green bonds in terms of dollar amount. It is most green on the map. Other green countries include France, the US, Germany, and Spain (ranked by their relative greenness). Countries with contrasting color, those with relatively fewer green, social, and pandemic bonds, are the Russian Federation, Ukraine, Argentina, Colombia, South Africa, Namibia, Nigeria, and Kenya. Still, many countries are not covered by green finance. Most countries in Africa, many in Central Asia, the Middle East, and South America have zero green bonds.

Although most countries have not issued any green, social, and pandemic bonds (actually many countries do not even have bond market at all), the aggregate market for the entire world has grown rapidly. Figure 1 illustrates the total number of green, social, and pandemic bonds and their dollar value over time. After the first green bond in 2007, a major increase, in terms of number of bonds, occurred in 2010. In terms of issuing value, 2013–2014 seems to be a turning point. We see many small issues come to market in 2015. Another breakthrough year is 2016. After a slowdown in 2018, market size grew significantly in 2019.

Green bonds dominated the market till 2019. After the outbreak of the COVID-19 pandemic, many social, especially pandemic, bonds were issued. In fact, more pandemic bonds than green bonds were issued in 2020. The size of the social bond market also more than tripled. On the other hand, there seems to be some "crowding out" effect as green bonds issued in 2020 are less than the 2019 issuance.

When we focus on pandemic bonds, we see a clear dominance of the PRC. The PRC was the first country with known COVID-19 cases. Within days of the public announcement of the pandemic, Jointown Pharmaceutical, which is headquartered in Wuhan, issued the first pandemic bond on 6 February 2020.

Table 2 provides more detailed summary of the pandemic bonds. 769 of the 894 pandemic bonds in the world were issued in the PRC. Moreover, in February 2020, the PRC was the only country to issue pandemic bonds. In March 2020, there were one pandemic bonds from the Republic of Korea (ROK) and the US each, and two from supranationals, but the PRC issued 312 pandemic bonds. The issuance from the PRC decreased in April, especially July, when the rest of the world had more pandemic bond issuance than the PRC.

III.   FIRM-LEVEL EVIDENCE

The COVID-19 pandemic is a tremendous test for most firms. We use this setting to examine whether firms with past green bonds performed any differently from other firms during the public health crisis. Our research design is similar to Lins, Servaes, and Tamayo (2017). They focus on the 2008–2009 financial crisis, which was a shock to the trust in the market.

COVID-19 can be thought as shock to ESG, especially social and environmental issues. Hence, firms with better perceived social and environmental performance may be treated better by the market than other firms with worse past social and environmental performance.

A.   Stock Market Performance

We first examine individual firm stock performance during 2020. In Table 3, we regress stock returns on firm characteristics. The key independent variable is *green bond issuance*, which is an indicator variable equal to one if the firm has issued green bond before, and zero otherwise. The dependent variable for Panel A of Table 3 is buy-and-hold return during the first half of 2020 (from January to June). We have 63,748 observations for column (1) of Table 3 Panel A with only the *green bond issuance* as explanatory variable. We find a positive and statistically significant coefficient estimate of 0.213 (*t*-stat=3.226) for the key independent variable. This finding is robust to the controls of other firm characteristics in columns (2)–(6) when we include firm size, return on assets, leverage, and cash holding as explanatory variables. The economic magnitude of the green bond issuer effect remains plausibly high. The coefficient estimate in column (6) with all four firm characteristics as control variables is 0.154, suggesting that green firms' stock prices outperform other firms substantially during the first half of 2020.

In Panel B of Table 3, we use a different dependent variable to provide an alternative test for different stock market reactions to COVID-19 by green and other firms. We calculate the maximum drawdown, i.e., the most severe negative impact on the firm, during the COVID-19 pandemic. Larger maximum drawdown means worse performance. This measure is commonly used to measure stock or fund performance, especially for hedge funds. It is particularly relevant for stocks experiencing large negative shocks. This measure also requires more data as we cannot have missing stock prices during this period, unlike the buy-and-hold returns that we only need the beginning and ending prices. We need all consecutive stock prices to calculate the maximum drawdown. Consequently, the sample size is smaller for the maximum drawdown analysis than the buy-and-hold return analysis. Column (1) of Panel B has 33,172 observations. Therefore, the sample size is still large in absolute terms. We find negative and statistically significant coefficient estimates for all model specifications in Panel B of Table 3. The coefficient estimate in column (1) with *Green bond*

issuance as the only explanatory variable is -0.052 (*t*-stat=-5.481). The coefficient estimate in column (6) with all four control variables is -0.037 (*t*-stat=-2.677). Therefore, some of the green bond issuer effect on stock price reaction to COVID-19 is related to firm characteristics, but a bulk of the green bond issuer effect is beyond the effect of firm characteristics.

The control variables also have effects as expected. Large firms experience better stock price reaction. Firm size is positively associated with buy-and-hold returns and negatively associated with maximum drawdown. Profitable firms also have higher buy-and-hold returns and lower maximum drawdown. Firms with high leverage and low cash holdings at the onset of COVID-19 experienced worse performance, as they are relatively more negatively affected by the sudden change of economic environment. All regressions for Panel A and Panel B of Table 3 also include country and industry fixed effects.

Overall, we show robust evidence with different measures and model specifications that green firms are more resilient during COVID-19 as they experience smaller stock price drop. This finding is consistent with Lins, Servaes, and Tamayo (2017) for the 2008–2009 crisis and Ding, Levine, Lin, and Xie (2020) for the COVID-19 pandemic. The latter paper uses a broad ESG measure, while we focus on green firms. We both have a large international sample and independently reach the same conclusion.

B.   Capital Raising

To understand why green firms perform better than other firms during the first half of 2020, including the worst hit period of second quarter, we examine the capital-raising activities of firms. Capital raising is critical to firms after suffering a severe, negative economic shock. Some firms would go bankruptcy if they cannot raise new capital once their cash reserve ran out. Indeed, a record number of firms filed for bankruptcy during 2020 as a consequence of COVID-19 and after failing to get new funding from investors. We focus on green bond issuance activities to emphasize the unique role of green financing during a crisis. We regress the total green bond issuance for each firm during 2020 on firm characteristics. Our variable of interest is constructed based on green bond activities prior to the COVID-19 pandemic. Table 4 reports the regression results. We find positive and statistically significant coefficient

estimates in all model specifications for the key independent variable of past green bond issuance. In column (1) of Table 4, the coefficient estimate for green bond issue before 2020 is 0.216 (t-stat=7.603), suggesting that firms that have issued green bonds before can issue more green bonds in 2020 during the COVID-19 pandemic. The green issuer effect is robust to different model specifications. The effect of green bond issuer indicator in column (2) is largely unchanged in column (2) after controlling for the effect of firm size. Even in column (6) with full set of controls, the coefficient estimate 0.159 (t-stat=4.786) is still significant at the 1% level.

Our finding is based on a large international sample of 41,373 observations in column (1) and 35,152 observations in column (6). All model specifications in Table 4 include country and industry fixed effects. We also find that larger firms are better able to raise capital through green bonds during 2020. This finding is consistent with the conjecture that large firms have more diverse resources and can cross-subsidize within different segments within the firm, allowing them to raise new capital during a crisis.

Our findings are consistent with Lins, Servaes, and Tamayo (2017) and Amiraslani, Lins, Servaes, and Tamayo (2019). Both papers find that socially responsible firms are better able to get new finance after experiencing negative shocks. The results are also broadly in line with Cheng, Ioannou, and Serafeim (2014). They analyze the effect of corporate social responsibility on access to finance, scrutinizing the channels of agency costs and information asymmetry. We provide new evidence from a different setting and confirm the importance of social and environmental performance for issuers, especially during such a public health crisis.

Overall, green firms are more likely to get financing during COVID-19. They are significantly more likely to issue green bonds after the breakout of COVID-19. In some cases, green firms issue social and pandemic bonds instead of green bonds after the negative shock. Once we take into account other financing benefits for green issuers, the total effect of financing advantage of green and social firms can be even larger.

IV. ECONOMIC RECOVERY FROM COVID-19

Section III shows that green and social bonds help firms to resist the negative impact of COVID-19 and facilitate their new financing during the crisis period. In that analysis, we conduct firm level analysis for many individual publicly listed firms around the world. In this section, we examine the aggregate effects on the macroeconomy.

A.   The Case of the People's Republic of China

Early cases of COVID-19 were reported in Wuhan, the PRC.[5] It is natural to start with the PRC when analyzing the responses and effects of green, social, and pandemic finance. During this crisis period, social bonds, especially pandemic bonds, come to the rescue. Within 1 week of official announcement of the COVID-19 pandemic, Jointown Pharmaceutical, which is headquartered in Wuhan, issued the first pandemic bond on 6 February 2020 with CNY500 million. This debt is a short-term commercial paper with maturity of 9 months. Many other issuers followed. A total of 235 pandemic bonds were issued in February 2020. In fact, the PRC was the only country with pandemic bond issuance in February 2020. Even in March 2020, 312 out of 316 pandemic bonds were issued by Chinese issuers. On 25 March 2020, the pandemic was widespread in Europe and political leaders in Europe proposed to issue pandemic bonds to help their economy. Non-Chinese issuers started more issuances in April 2020. The early non-Chinese issuers were from the ROK, the US, Indonesia, France, and supranationals such as the World Bank. Table 2 lists the bond issuance by country during COVID-19.

The PRC dominates the entire map. Out of the 894 pandemic bonds issued in 2020, 769 were from Chinese issuers. Firms from the ROK issued 17 pandemic bonds. Other Asian countries, such as Indonesia and Japan, were also active in this pandemic bond market, with 11 and 5 each. US firms issued 10 pandemic bonds while French firms issued 8 pandemic bonds. Still, many countries had zero pandemic bond issues. According to the International Monetary Fund forecast, the PRC's GDP will expand 1.9% in 2020. The PRC is predicted to be the only major economy with a positive GDP growth for the whole year 2020, even after the first

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[5] Shan and Tang (2020) provide discussions on the timeline of COVID-19 in the PRC.

and hard hit in the first quarter of 2020.[6]

B. Other Countries

While the PRC arguably performed the best among the major economies such as the Group of Twenty (G20) in terms of issuing pandemic bonds to fight COVID-19, its market dominance and unique role of being the first to react distinguishes it from other countries. Therefore, we investigate the general relationship between green, social, and pandemic bond issuance and economic recovery for a sample covering all the major economies.

Motivated by the PRC example, we calculate the total amount of green, social, and pandemic bonds issued before COVID-19 and relate it to GDP growth rate in the third quarter of 2020. We focus on the third quarter because it is the most relevant and critical time for economic recovery after the negative shock since the end of the first quarter for many countries and into the second quarter with the outbreak of pandemic cases. Unemployment and economic costs were experienced mainly in the second quarter because of the lockdown and travel restrictions.

Figure 2 plots GDP growth in the third quarter of 2020 against the green, social, and pandemic bond issuance in the first two quarters of 2020 by each country. We scale the bond issuance by 2019 GDP so that the bond issuance is relative to the economic size of the country. We also report the fitted line, which shows the positive correlation between the two variables. The R^2 is 0.2571 and the slope is 0.4055.

Table 5 reports the regression results. We show that GDP growth in the third quarter of 2020 is positively associated with the total green and pandemic bonds issued in the first two quarters of 2020. The coefficient estimate for column (1) is 0.325 (t-stat=3.456). We scale the bond issuance by country GDP in 2019. We control for macroeconomic variables as countries are actively fighting against the pandemic with fiscal and monetary policies, which depend on country income and credit ratings. There is a major reversal from the second quarter to the third quarter of 2020.

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[6] "China Growth Limits Global Economic Damage From Pandemic, IMF Says." *Wall Street Journal.* 13 October 2020.

We find that the effects are mainly from pandemic bonds rather than green bonds. Column (2) shows insignificant, albeit positive, coefficient estimate for total green bonds issued. In contrast, column (3) shows a coefficient estimate of 0.444 (t-stat=3.534) when the dependent variable is total pandemic bonds. Indeed, pandemic bonds have been the dominant sustainable finance among the nonconventional bond issues. The findings are sensible and plausible.

Our findings are encouraging because some studies question the effectiveness of other fiscal and monetary policies. Boddin, D'Acunto, and Weber (2020), for example, argue that giving firms money did not improve the situation as firms were worried about the overall economy going forward and future demand. Instead of solving firm's financial constraints, directing funds towards social and environmental causes can be a more promising approach to counter the negative shock of COVID-19, which did not originate from the finance sector.

One important caveat is that governments around the world put in many stimulus programs to attenuate the negative shock of COVID-19 and boost the economy. There are other fiscal and monetary policies happening at the same time as the green and social bond issuance, such as the Paycheck Protection Program in the US in April 2020 (Benmelech and Tzui-Ilan 2020). However, our findings that the effects are specifically connected to pandemic bonds, but not green bonds, are encouraging. Those effects are unlikely to be correlated with the confounding effects of monetary and fiscal policies in a systematic way. Therefore, we believe the macroeconomic effects, to some extent, can be attributed to the pandemic bonds issued during this crisis period. Nevertheless, we note that the results are based on 32 countries as data are not available for many countries.

V. MACROECONOMIC EFFECTS AND EXTERNALITIES

We have documented the beneficial role of green and social finance during the COVID-19 crisis period. However, most of the time, the economy is not in crisis. Therefore, it is necessary and useful to discern the effect of green and social finance during normal economic conditions.

A.   Gross Domestic Product Growth

We first examine whether green and social finance helps spur economic growth. Green finance as part, albeit still relatively small, of total financial development may facilitate capital allocation and economic growth. Green finance can also reveal investor preference and information which can be useful for decision makers, including regulators and corporate executives. Voluminous studies have provided evidence from multiple countries about the effects of financial development and financial liberalization on economic growth (e.g., Goldsmith 1969; King and Levine 1993; Bekaert, Harvey, and Lundblad 2005; and Bennett, Stulz, and Wang 2020). We can view green finance as an extension along this line.

We follow the prior literature to use a difference-in-differences approach to identifying the effects of green finance development. First, we find the first green bond issuance for each country. Then, we construct a "*post*" indicator variable for before and after the first green bond issuance. Some countries never had green bonds during our observation window. Such countries will be the control group. Therefore, we have a difference-in-differences setting where we compare countries after green bond issuance to before green bond issuance, benchmarked against other countries that never had green bond issuance.

Table 6 reports the regression results. We examine GDP growth in columns (1) and (2) and GDP per capita growth in column (3) and (4). To better isolate the effects of confounding events, we use two data window: the 2010–2019 period for columns (1) and (3), and 3 years before and 3 years after the green bond introduction for columns (2) and (4). We also include country and year fixed effects in the country–quarter panel data regressions. The coefficient estimates in all model specifications of Table 6 are statistically insignificant, suggesting that green bond introduction has not had any material impact on economic growth.

There are several potential explanations for the lack of effect from green finance on economic growth. First, green bond market is still small, counting less than 6% of the total bond financing in the market even in 2020 (and much lower fraction in prior years). The penetration of green and social finance is still at a low level and has not reached steady state yet. Such small amount of financing cannot practically significantly move the entire

economy, at least not in a direct way. Second, economic growth is not the primary goal of green finance. Its goal is sustainable development instead of fast development. Third, the observation period is too short and market is still evolving. It is possible that we may get different results once we have longer time series and more countries for the analysis.

B.   Gross Domestic Product Growth Volatility

While having faster growth is not the goal of green and social finance, sustainable and balanced development, as discussed by the UN Sustainable Development Goals (SDGs), is the objective of pushing for more progress in this area. Then, one straightforward consideration is the volatility of growth. It is commonly agreed that climate change will result in many unexpected weather and economic shocks. Such shocks will impose pressure on fiscal and monetary policies as governments will have to react to them. On the one hand, governments will receive less revenue after negative shocks. On the other hand, governments need to spend money for disaster relief and recovery. Hence, it is conceivable that, without green and social finance, economic growth can be more volatile when climate risk materializes. Consequently, green and social finance can help mitigate such increased volatility. For example, governments can encourage more green investments and lower local pollutions, attracting more talents to move in, and generate more stable growth.

We regress GDP growth volatility on green bond issuance in a difference-in-differences setting. The research design is similar to the one for GDP growth. We report the estimation results in Table 7, which has the same setup as Table 6. We find negative and statistically significant coefficient estimates for the variable *Green Bond Issuance*Post* in all four model specifications. These results suggest that green and social finance helps smooth economic growth and reduces growth volatility.

This finding is important and encouraging. It is the key to the SDGs as controlling volatility is essential to avoid the situation of reaching "the point of no return". Our results can be used by policy makers to put up more green finance policies and foster further market development.

C.   Carbon Emission

The most eminent concerns for environmental protection and climate change is carbon emission. Carbon emission is hard to resolve but important to achieve real progress. Many countries have put up their "carbon-neutral" target date. The PRC announced to reach peak carbon emission in 2030 and reach carbon-neutral target in 2060 during the 2020 UN General Assembly. Also, carbon emission is the first thing to come to mind for the general public. It is hard to argue for other benefits without evidence of reduction in carbon emission. Therefore, we analyze the impact of green finance on carbon emission.

We regress total CO_2 emission on green bond issuance using the difference-in-differences framework. In Table 8, we report estimation results for different model specifications. We use two samples for the panel data regression with country and year fixed effects. In column (1), we restrict the sample to be 2010–2019 as this is the sample with more relevant green bond introduction and issuance. In column (2), we use all available data. We find negative and statistically significant coefficient estimates in both specifications. The coefficient estimate for *Green Bond Issuance*Post* from the restricted sample is -0.410 (*t*-stat=- 3.608), significant at the 1% level. The findings indicate that green and social bond issuance leads to lower carbon emission at the country level.

Our findings are consistent with a study from the Joint Research Center of European Commission by Fatica and Panzica (2020). They find that green bond issuers reduce carbon intensity for their assets compared to traditional bond issuers and the effects are stronger after the 2015 Paris Agreement. Our country-level results also corroborate the firm-level evidence documented in Flammer (2020), where she finds that firms have lower carbon emissions and higher environmental scores from ESG rating company Thomson Reuters ASSET4 after issuing green bonds.

D.   Green Finance Externalities on Gender Gap

Besides the direct effects on carbon emission and growth volatility, it is also useful to think about spillover effects of green and social finance. There could be both positive and negative externalities of green and social finance. Negative ones include "crowding out" effects that drain resources from other useful and productive sectors. Positive externalities can come from the signaling effect of government determination. Investors and people can be more

confident in future policies and alter their behaviors across the board.

Gender gap has been among the most discussed social issues in recent years. Many stock exchanges or governments now require a minimum representation by female directors on the board of publicly listed companies. The gender inequality concerns were substantially elevated by the Harvey Weinstein scandal, which broke out in October 2017, and the subsequent #MeToo movement (Lins, Roth, Servaes, and Tamayo 2020). Therefore, we focus on this important issue of gender gap. Gender gap data are from the Global Gender Gap Report by the World Economic Forum. The index ranging measures gender-based gaps in access to resources and opportunities in each country.

We regress gender gap on green bond issuance in a difference-in-differences setting. The research design is similar to previous analysis on economic growth, growth volatility, and carbon emission. We report the panel regression results in Table 9. The coefficient estimates on *Green Bond Issuance*Post* are all negative and statistically significant in all specifications. We employ three different samples to show the robustness of our findings. In column (1), we use the 2006–2019 sample as the first green bond was introduced in 2007. Green bonds became more active a few years later. Further, we restrict the sample to be 5 years before and 5 years after the green bond introduction. Our results suggest that gender gap reduces after green and social finance is introduced. The reduction may not appear large in magnitude. However, gender gap is very persistent and slow-moving. Gender gap is an important part of the ESG considerations of SDG and impact investing. Overall, green finance can also have social benefits although such effects are unintended. Although the Green Finance Principles according to the International Capital Markets Association specify green projects for investment proceeds, they also help reduce gender inequality. It is important to take such externalities into account, especially when doing green finance or ESG investments can incur additional costs. When positive externalities are factored in, then it is more likely that the benefits of green and social finance will overweigh the costs.

VI.   SUMMARY, DISCUSSIONS, AND CONCLUSION

Green finance has been rapidly developing in recent years, especially after the 2015 Paris Agreement and the 2016 G20 Summit in Hangzhou. This study shows beneficial effects of green and social finance during the COVID-19 pandemic and normal period. Firms are better able to raise capital and survive crisis when they establish green and social finance access. Green and social finance helps reduce economic volatility and carbon emission, as intended.

Green bonds and green loans have become major financing instruments to combat environmental threats. Tang and Zhang (2020) show that green bonds are beneficial to the issuing firms in terms of broadening investor base. Flammer (2020) reports real environmental benefits associated with green bond issuance. Banks are also under pressure to change their traditional way of lending. Activists increasingly pressure major banks, including UBS, Credit Suisse, and Barclays, to curb lending to fossil fuel companies. Green and sustainability-linked loans have gained traction since 2019. Therefore, banks with different environmental strategies may deal with borrowers differently and may alter the debt–pollution relationship.

There is no universal definition for "green banks". There are several relevant certification schemes. The genesis of the major developments of green banking is arguably the establishment of the United Nations Environment Programme Finance Initiative (UNEP FI) in 1992 during the Rio Earth Summit. The most well-known green bank framework is probably the Equator Principles, which started in 2003 by UNEP FI and currently has 110 signatories from 38 countries. The UNEP FI also initiated the UN Principles for Sustainable Banking in September 2019, which has 185 signatories from more than 50 countries as of September 2020. The objective of the UN Principles for Responsible Banking is to provide an international framework for a sustainable banking system to help achieve the goals expressed in the UN SDGs and the Paris Climate Agreement.

Delis, Greiff, and Ongena (2020) classify "green banks" as those participating in the UNEP FI. Green banks align their business strategies with environmental principles. We expect that loans from green banks would be less harmful to the environment as the lenders are more conscious of the environmental consequences of their loans and are less exclusively profit-oriented. Results from Shan and Tang (2020) suggest the promising potential of green finance

in reducing pollution. It also reveals the importance of revolutionizing the traditional banking system. When banks are held accountable for the environmental damages of their loans, they are necessarily loosening the financial pressures on the borrowing firms and help protect the environment.

The current trend is to shift banking model towards "green financing". We provide encouraging evidence to support the green finance movement. Green banks and creditors can help reduce the pollution of their borrowers. While green loans are still a small fraction of total lending, green finance has the potential to reap environmental benefits.

The year 2020 is an important year for green and social finance. During the Climate Ambition Summit on 12 December 2020 to celebrate the fifth anniversary of the Paris Agreement, global leaders recognized the climate emergency and encouraged to increase climate finance commitments. President Xi Jinping announced that the PRC will lower its CO_2 emissions per unit of GDP by more than 65% from the 2005 level.[7] US President Joe Biden rejoined the Paris Agreement on the first day of his presidency, reversing former President Donald Trump's decision to pull the US out of it in 2017. Therefore, it is hoped that the biggest two economies and polluters, the PRC and the US, will do more on green finance and environmental protection from 2021, probably starting with sovereign green bond issuance from those two countries.

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[7] There can also be upcoming regulatory reforms. In October 2020, the city of Shenzhen passed new rules to require local financial institutions to report information on their environmental impact.

KEY TAKEAWAYS

1. During COVID-19, many countries raised much-needed capital quickly to support the combat against the virus and related issues such as job losses. GDP growth in the third quarter of 2020 is positively associated with the social bond issuance in the first half of 2020.

2. Before 2020, green bond issuance is negatively associated with GDP growth volatility, which suggests that green bonds help reduce tail risk.

3. Infrastructure and facilities for green and social finance, such as stock exchange ESG requirements, can help improve financial stability.

4. There are indirect and spillover effects associated with green and social finance. While there are preliminary evidence that green bonds have environmental and social benefits, concerns on confounding events and greenwashing are warranted.

5. We only have a short time period for analysis. Current results are preliminary. We need more market efforts (to generate data) and continuous research.

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Appendix 1: Variable Definitions

Panel A: Country Level Variables

Variable	Definition	Source
Total green/GDP	Total green bond dollar volume from 2007 to 2019 divided by GDP over the same period	Bloomberg, Factiva, World Bank
Government green/GDP	Total green bond dollar volume issued by government entity from 2007 to 2019 divided by GDP over the same period	Bloomberg, Factiva, World Bank
Private sector green/GDP	Total green bond dollar volume issued by nongovernment entity from 2007 to 2019 divided by GDP over the same period	Bloomberg, Factiva, World Bank
Number of green bond	Number of green bond issuances for each country from 2007 to 2020	Bloomberg, Factiva
Volume of green bond	US dollar volume of green bond issuances for each country from 2007 to 2020	Bloomberg, Factiva
Number of social bond	Number of green bond issuances for each country from 2009 to 2020	Bloomberg, Factiva
Volume of social bond	US dollar volume of green bond issuances for each country from 2009 to 2020	Bloomberg, Factiva
Number of pandemic bond	Number of green bond issuances for each country from January 2020 to September 2020	Bloomberg, Factiva
Volume of pandemic bond	US dollar volume of green bond issuances for each country from January 2020 to September 2020	Bloomberg, Factiva
GDP growth	GDP growth in US dollar	World Bank
GDP per capita	GDP per capita in US dollar	World Bank
Unemployment rate	Unemployment divided by total labor force	World Bank
CO2 emission/GDP	CO_2 emission (kiloton) divided by country GDP	World Bank
Export/GDP	Exports of goods and services divided by GDP	World Bank
BBB rating or above	Arithmetic mean of sovereign credit rating by Moody's, S&P, and Fitch.	Moody's, S&P, and Fitch
Long-term orientation	In a long-time-oriented culture, the basic notion about the world is that it is in flux, and preparing for the future is always needed. In a short-time-oriented culture, the world is essentially as it was created, so that the past provides a moral compass, and adhering to it is morally good	Hofstede (2010)
Indulgence	In an indulgent culture it is good to be free.	Hofstede (2010)
Masculinity	Masculinity is the extent to which the use of force in endorsed socially.	Hofstede (2010)

Uncertainty avoidance	Uncertainty avoidance deals with a society's tolerance for uncertainty and ambiguity.	Hofstede (2010)
Individualism	Individualism is the extent to which people feel independent as opposed to being interdependent as members of larger wholes.	Hofstede (2010)
Left-wing government	0-10 scale mean value in left/right dimension with data from Benoit and Laver (2006)	Holger and Manow (2019)
English origin	Equals to 1 if the country legal origin is from English common law	La Porta, Lopez-de-Silanes, Shleifer, and Vishnny (1998)
Credit right	An index aggregating creditor rights, following La Porta et al. (1998). A score of one is assigned when each of the following rights of secured lenders are defined in laws and regulations: First, there are restrictions, such as creditor consent or minimum dividends, for a debtor to file for reorganization. Second, secured creditors are able to seize their collateral after the reorganization petition is approved, i.e., there is no "automatic stay" or "asset freeze." Third, secured creditors are paid first out of the proceeds of liquidating a bankrupt firm, as opposed to other creditors such as government or workers. Finally, management does not retain administration of its property pending the resolution of the reorganization. The index ranges from 0 (weak creditor rights) to 4 (strong creditor rights), and is constructed as at January for every year from 1978 to 2003.	Djankov, Simeon, McLiesh, and Shleifer (2007)
Google search volume	Google search index for each word within country. For example, searching for "Green bond" in the United States.	Google Trend

CO_2 = carbon dioxide, GDP = gross domestic product, US = United States.
Source: Author's compilation.

Panel B: Firm Level Variables

Variable	Definition	Source
Size	Logarithm of net sales or revenues	Worldscope Item 1001
ROA	Net income divided by total assets	Worldscope Item 8326
Leverage	Total debt dived by total asset	Worldscope Item 8236
Cash holding	Cash and cash equivalents divided by total current asset	Worldscope Item 8111
Current ratio	Current asset divided by current liabilities	Worldscope Item 8106
Maximum drawdown	Maximum drawdown is the maximum observed loss from a peak to a trough of stock, before a new peak is attained, for the period from January 2020 to June 2020.	Compustat Global
Buy and hold return January 2020–June 2020	Buy the stock from January 2020 and hold until the end of June 2020, the monthly cumulative return of the stock	Compustat Global
Green bond issue before 2020	Dummy variable for whether the firm has issued green bond before 2020	Bloomberg, Factiva
Green bond issue at 2020	Dummy variable for whether the firm issued green bond during 2020	Bloomberg, Factiva

CAR = cumulative abnormal returns, ROA = return on assets.
Source: Author's compilation.

Figure 1: Green, Social, and Pandemic Bond Issuance over Time.

Panel A: Green/Social/Pandemic Bond Volume

Panel B: Green/Social/Pandemic Bond Number
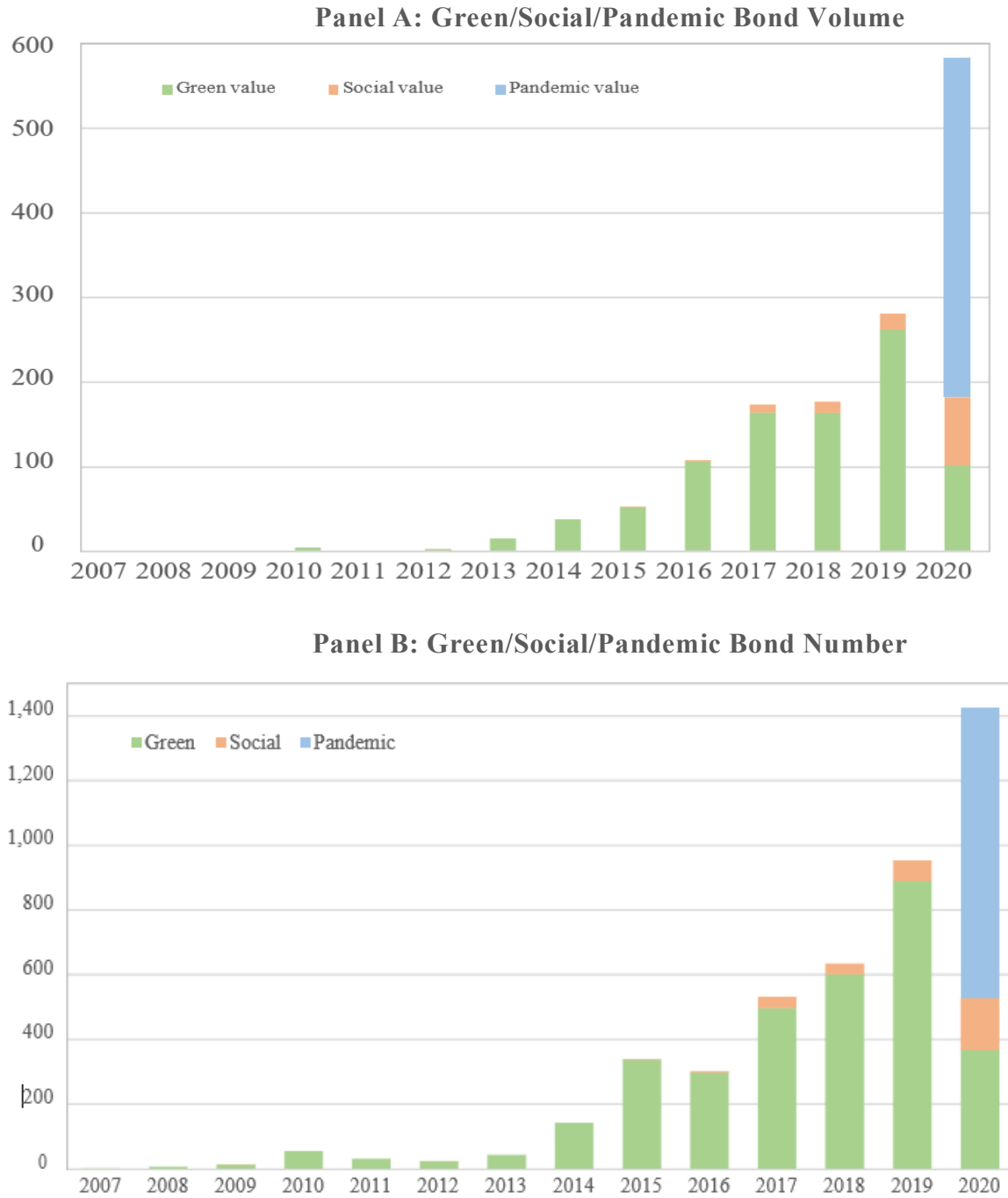
Note: Figure 1 plots dollar value (Panel A) and number of issues (Panel B) of green, social, and pandemic bonds issued globally from 2007 to September 2020.
Sources: Data are hand-collected by the author from Climate Bond Initiative, Bloomberg, and WIND.

Figure 2: The Relationship between 2020H1 Green, Social, and Pandemic Bonds and Gross Domestic Product Growth Rate in the Third Quarter of 2020

Quarterly GDP Growth in 2020 Q3 and Total Bond Value in 2020 Q1 and Q2

$y = 0.4055x + 6.5708$
$R^2 = 0.2571$
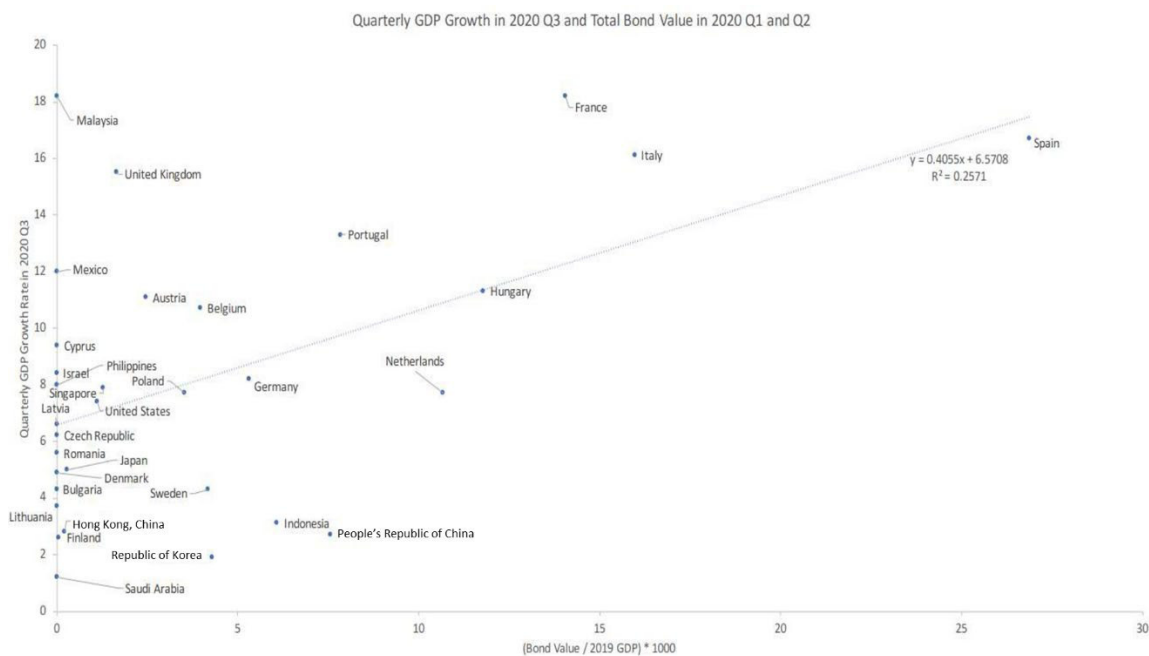
H1 = first half.

Note: Figure 2 plots the gross domestic product growth rate in the third quarter of 2020 (y-axis) against the total amount of green, social, and pandemic bonds issued in a given country scaled by the country's gross domestic product in 2019 (x-axis). The fitted line and regression relationship are also reported.

Sources: Data are hand-collected by the author from the International Monetary Fund, Climate Bond Initiative, Bloomberg, and WIND.

<p style="text-align:center">Table 1: Summary Statistics</p>

Panel A: Firm-Level Summary Statistics

Statistic	N	Mean	St. Dev.	Min	P25	P75	Max
Log(Sale)	33,150	18.200	2.492	12.253	16.870	19.892	22.259
ROA (%)	32,725	1.444	10.801	-31.455	0.232	7.171	15.964
Leverage (%)	31,506	22.230	18.917	0.000	4.736	35.566	62.438
Cash Holding (%)	28,804	35.764	25.825	2.111	13.986	53.656	88.656
Current Ratio (%)	28,814	2.350	2.010	0.457	1.099	2.763	8.428

Panel B: Country-Level Summary Statistics

Statistic	N	Mean	St. Dev.	Min	P25	P75	Max
Total green bond/GDP	46	13.366	18.083	0.000	2.831	15.517	74.747
Government green bond/GDP	46	3.643	6.358	0.000	0.000	4.980	26.527
Private sector green bond/GDP	46	9.723	15.057	0.000	1.636	12.608	74.747
GDP Growth	46	2.928	1.944	-1.973	1.567	3.679	7.694
Unemployment Rate	46	6.986	4.003	0.656	4.524	8.355	21.543
CO_2 emission/GDP	46	80.290	287.014	0.095	1.016	24.557	1,573.126
Export/GDP	46	0.548	0.458	0.114	0.278	0.719	2.055
BBB rating or above	46	0.761	0.431	0	1	1	1
Long-term orientation	46	51.457	21.995	13	33.5	66.2	100
Indulgence	46	49.326	19.900	13	33.5	65.8	97
Masculinity	46	48.065	21.113	5	34.5	64	95
Uncertainty avoidance	46	63.739	24.585	8	46.5	85.8	112
Individualism	46	50.630	24.177	13	27	70.8	91
Gender gap	732	0.711	0.055	0.569	0.672	0.747	0.850

CO_2 = carbon dioxide, GDP = gross domestic product, ROA = return on assets.

Note: Table 1 reports summary statistics of our data. Panel A reports the key statistics of firm-level variables. Panel B reports key statistics of country-level variables.

Source: Data are hand-collected by the author from the International Monetary Fund, Climate Bond Initiative, Bloomberg, and WIND.

Table 2: Pandemic Bond Data by Categories

Panel A: Pandemic Bonds by Country

	Amount (US$ million)	Number	Amount/Gross Domestic Product	Amount/Government Debt
China, People's Republic of	220,447	769	1.54%	3.04%
Italy	32,559	4	1.63%	1.21%
Spain	29,130	4	2.09%	2.19%
France	12,441	8	0.46%	0.47%
Indonesia	11,028	11	0.99%	3.31%
Poland	10,508	2	1.77%	3.86%
Korea, Republic of	6,971	17	0.42%	1.13%
United States	6,275	10	0.03%	0.03%
Japan	2,273	5	0.04%	0.02%
Paraguay	2,000	2	5.24%	22.90%
Belgium	1,129	1	0.21%	0.22%
Thailand	960	1	0.18%	0.42%
Ivory Coast	884	3	1.50%	4.71%
Guatemala	500	1	0.65%	2.34%
Philippines	438	1	0.12%	0.28%
Slovenia	397	1	0.74%	1.12%
Luxembourg	342	1	0.48%	2.18%
Benin	219	1	1.52%	7.05%
United Kingdom	211	1	0.01%	0.01%
Senegal	171	1	0.72%	1.52%
Mali Republic	145	1	0.83%	2.05%
Burkina Faso	133	1	0.84%	3.74%
Togo	126	1	2.31%	7.84%
Hong Kong, China	92	2	0.03%	0.07%
Seychelles	85	3	5.01%	9.11%
Fiji	40	2	0.72%	1.51%
Guinea-Bissau	26	1	1.91%	5.24%
Supranational	59,172	38		
Jersey	1,500	1		

Table 2: Pandemic Bond Data by Categories — *Continued*

Panel B: Pandemic Bonds over Time for Selected Countries

Country	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	All
				Month of 2020					
All	235	316	168	48	60	24	21	22	894
China, People's Republic of	235	312	137	27	36	7	4	11	769
Supranational	0	2	15	5	7	3	2	4	38
Korea, Republic of	0	1	0	2	3	7	1	3	17
Indonesia	0	0	3	0	0	0	8	0	11
United States	0	1	0	1	4	2	2	0	10
France	0	0	2	3	3	0	0	0	8
Japan	0	0	0	0	1	0	0	4	5

Panel C: Pandemic Bonds by Industry

	Amount (US$ million)	Number
Financials	49,011	425
Industrials	10,655	80
Materials	7,536	79
Consumer discretionary	6,682	58
Consumer staples	4,736	54
Supranationals	59,172	38
Sovereigns	216,057	36
Utilities	3,499	33
Health care	3,464	32
Technology	2,282	22
Government development banks	21,611	14
Government agencies	13,112	13
Energy	972	7
Communications	1,413	5

Table 2: Pandemic Bond Data by Categories — *Continued*

Panel D: Pandemic Bond Issuance by Financial Development Institutions

	Amount (US$ million)	**Number**
International Bank for Reconstruction and Development	18,227	5
Asian Development Bank	8,500	2
Inter-American Development Bank	6,250	2
International Development Association	5,483	4
New Development Bank	4,205	3
European Bank for Reconstruction and Development	3,985	2
African Development Bank	3,350	2
Corp Andina de Fomento	1,918	7
European Investment Bank	1,898	3
Nordic Investment Bank	1,481	2
International Finance Corp	1,337	2
Council of Europe Development Bank	1,094	1
Inter-American Investment Corp	1,000	1
Asian Infrastructure Investment Bank	444	2

Note: Table 2 reports the issuance of pandemic bonds in 2020. We categorize different bonds in different panels. Panel A is for pandemic bonds by country. Panel B shows pandemic bond issuance over time for selected countries. Panel C shows pandemic bond distribution by industries. Panel D shows pandemic bond issuance by financial development institutions.

Source: Author's compilation.

Table 3: Firm Resilience during COVID-19

Panel A. Buy-and-Hold Return

			Dependent Variable:			
			Buy-and-hold return (January–June)			
	(1)	(2)	(3)	(4)	(5)	(6)
Green bond issuance	0.213***	0.117*	0.123*	0.155**	0.154*	0.154*
	(3.226)	(1.709)	(1.804)	(2.261)	(1.711)	(1.728)
Size		0.038***	0.035***	0.040***	0.040***	0.040***
		(17.139)	(14.898)	(16.445)	(15.615)	(9.341)
ROA			0.002***	0.001***	0.001***	0.001
			(6.016)	(4.834)	(4.061)	(1.009)
Leverage				-0.003***	-0.004***	-0.004***
				(-9.422)	(-9.948)	(-5.153)
Cash holding					0.001	0.001
					(0.273)	(0.535)
Observations	63,748	56,780	56,296	56,296	49,591	49,591
R-squared	0.009	0.013	0.014	0.015	0.016	0.016
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country cluster	No	No	No	No	No	Yes

Table 3: Firm Resilience during Covid-19 — *Continued*

Panel B: Maximum Drawdown

	Dependent Variable:			
	Maximum Drawdown for Year 2020			
	(1)	(2)	(3)	(4)
Green bond issuance	-0.052***	-0.021**	-0.038***	-0.037***
	(-5.481)	(-2.114)	(-2.778)	(-2.677)
Size		-1.883***	-2.186***	-2.293***
		(-9.922)	(-10.392)	(-11.275)
ROA		-0.514***	-0.478***	-0.471***
		(-13.954)	(-12.659)	(-12.226)
Leverage		12.974***	10.872***	9.370***
		(8.993)	(5.437)	(4.307)
Cash holding			-8.967***	-7.892***
			(-5.720)	(-5.476)
Current ratio				-0.422***
				(-3.215)
Observations	33,172	29,696	26,179	26,165
R-squared	0.094	0.171	0.188	0.189
Country FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country cluster	Yes	Yes	Yes	No

CO_2 = carbon dioxide, COVID-19 = coronavirus disease, FE = fixed effects, GDP = gross domestic product, ROA = return on assets.

Note: Table 3 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is firm stock return during the period of January to June 2020. Panel A is for buy-and-hold returns. Panel B is for maximum drawdown. The key independent variable is an indicator variable *Green Bond Issuer* which takes the value of one if the firm has issued green bonds in the past, and zero otherwise. Reported in the parentheses are *t*-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Source: Author's compilation.

Table 4: Corporate Financing during COVID-19

Dependent Variable:

Green Bond Issue in 2020

	(1)	(2)	(3)	(4)	(5)	(6)
Green bond issue before 2020	0.216***	0.215***	0.215***	0.215***	0.159***	0.159***
	(7.603)	(7.579)	(7.578)	(7.554)	(4.786)	(4.786)
Size		3.651***	4.021***	3.713***	3.082***	3.101***
		(4.390)	(3.714)	(4.165)	(3.326)	(3.378)
ROA			-0.138	-0.102	0.017	0.013
			(-0.848)	(-0.714)	(0.191)	(0.153)
Leverage				0.218	0.136	0.138
				(1.053)	(0.918)	(0.879)
Cash holding					0.111	0.109
					(1.132)	(1.042)
Current ratio						0.067
						(0.090)
Observations	41,373	41,179	40,672	40,672	35,177	35,152
R-squared	0.105	0.105	0.106	0.106	0.062	0.062
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country cluster	Yes	Yes	Yes	Yes	Yes	Yes

COVID-19 = coronavirus disease, FE = fixed effects, GDP = gross domestic product.
Note: Table 4 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is firm green bond during the period of January–June 2020. The key independent variable is an indicator variable *Green Bond Issuer* which takes the value of one if the firm has issued green bonds in the past, and zero otherwise. Reported in the parentheses are *t*-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.
Source: Author's compilation.

Table 5: Economic Recovery from COVID-19

Variable Q3	Quarterly GDP Growth (QoQ) in 2020		
	(1)	(2)	(3)
Total bond to 2019 GDP	0.325***		
	(3.456)		
Green bond to 2019 GDP		0.235	
		(1.055)	
Pandemic bond to 2019 GDP			0.444***
			(3.534)
2020 Q2 GDP growth (QoQ)	-0.558***	-0.588***	-0.593***
	(-6.227)	(-5.450)	(-6.768)
2019 annual GDP growth	-0.0689	0.186	-0.178
	(-0.221)	(0.517)	(-0.561)
2019 GDP per capita	1.42e-06	2.94e-06	1.10e-05
	(0.048)	(0.084)	(0.376)
2020 Q2 unemployment rate	-0.112	0.0771	-0.211
	(-0.632)	(0.384)	(-1.132)
Constant	2.319	1.030	3.022
	(1.216)	(0.464)	(1.558)
Observations	32	32	32
R-squared	0.706	0.589	0.710

COVID-19 = coronavirus disease, GDP = gross domestic product, Q = quarter.

Note: Table 5 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is GDP growth rate during the third quarter of 2020. The key independent variables are the total amount of green and pandemic bonds issued in the country scaled by the country's 2019 GDP. Reported in the parentheses are *t*-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Source: Author's compilation.

Table 6: Green Bond Issuance and Gross Domestic Product Growth

	GDP Growth Growth		GDP Per Capita	
	2010–2019	**[-3,3]**	**2010–2019**	**[-3,3]**
	(1)	(2)	(3)	(4)
*Green Bond Issuance*Post*	-0.0005	0.004	-0.002	0.003
	(-0.147)	(1.373)	(-0.739)	(0.985)
Observations	562	353	562	353
R-squared	0.501	0.713	0.448	0.694
Adjusted R-squared	0.435	0.640	0.375	0.617
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

FE = fixed effects, GDP = gross domestic product.

Note: Table 6 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is GDP growth rate. The key independent variable is the indicator variable for green bond-issuing countries after the first green bond issuance. Reported in the parentheses are *t*-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Source: Author's compilation.

Table 7: Green Bond Issuance and Gross Domestic Product Growth Volatility

	GDP Volatility			
	2010–2019 OLS	**2010–2019 FE**	**[-3,3] OLS**	**[-3,3] FE**
	(1)	(2)	(3)	(4)
Green Bond Issuance*Post	-0.008 ***	-0.005 ***	-0.004 **	-0.003***
	(-5.700)	(-7.532)	(-2.376)	(-5.938)
Observations	556	556	336	336
R-squared	0.055	0.849	0.017	0.932
Adjusted R-squared	0.054	0.832	0.014	0.918
Firm FE	No	Yes	No	Yes

FE = fixed effects.

Note: Table 7 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is gross domestic product growth rate volatility. The key independent variable is the indicator variable for green bond-issuing countries after the first green bond issuance. Reported in the parentheses are t-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Source: Author's compilation.

Table 8: Green Bond Issuance and Carbon Emission

	Dependent Variable:	
	Carbon Dioxide Emissions (metric tons per capita)	
	2010-2019	**2000-2019**
	(1)	(2)
Green Bond Issuance Post*	-0.374***	-0.771***
	(-2.771)	(-4.305)
Observations	374	914
R^2	0.985	0.964
Adjusted R^2	0.982	0.961
Country FE	Yes	Yes
Year FE	Yes	Yes

FE = fixed effects.

Note: Table 8 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is carbon dioxide emissions. The key independent variable is the indicator variable for green bond-issuing countries after the first green bond issuance. Reported in the parentheses are *t*-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Source: Author's compilation.

Table 9: Green Bond Issuance and Gender Gap

	Gender Gap		
	2006~2019	2010~2019	[-5,5]
	(1)	(2)	(3)
Green Bond Issuance*Post	-0.005**	-0.005**	-0.006**
	(-2.562)	(-2.254)	(-2.463)
Observations	732	528	472
R^2	0.943	0.948	0.954
Adjusted R^2	0.937	0.941	0.946
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

FE = fixed effects.
Note: Table 9 reports the coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variable is gender gap for the country. The key independent variable is the indicator variable for green bond-issuing countries after the first green bond issuance. Reported in the parentheses are *t*-statistics. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.
Source: Author's compilation.

Appendix 2: Firm Sample Coverage

Country	Unique Public Firms	Country	Unique Public Firms	Country	Unique Public Firms
United States	7057	Mexico	166	Slovenia	30
China, People's Republic of	5004	Kuwait	162	British Virgin Islands	29
Japan	3,995	Netherlands	162	Isle of Man	29
India	3,276	New Zealand	156	Montenegro	29
Canada	2,865	Romania	140	Ghana	26
Korea, Republic of	2,328	Bangladesh	137	Iceland	25
Australia	1,977	Belgium	133	Botswana	24
Taipei,China	1,954	Nigeria	132	Latvia	23
United Kingdom	1,678	United Arab Emirates	129	Syria	22
Hong Kong, China	1,665	Oman	112	Estonia	21
Viet Nam	1,181	Guernsey	110	Macau, China	18
Malaysia	1,037	Cyprus	107	Venezuela	18
Thailand	809	Argentina	97	Czechia	16
Sweden	783	Bosnia and Herzegovina	95	Tanzania	16
Germany	742	Ireland	94	Monaco	15
France	709	Mauritius	90	Slovakia	15
Indonesia	694	Bermuda	89	Malawi	11
Singapore	694	Croatia	82	Puerto Rico	11
Russian Federation	644	Tunisia	77	Namibia	10
Poland	538	Austria	75	Lebanon	9
Israel	529	Morocco	72	Panama	8
Turkey	401	Colombia	70	Uganda	8
Brazil	387	Ukraine	70	Bahamas	6
Italy	386	Iraq	69	Costa Rica	6
Pakistan	351	Cayman Islands	68	Gibraltar	5
South Africa	310	Luxembourg	66	Dominican Republic	4
Switzerland	297	Kazakhstan	64	Ecuador	4
Philippines	266	Serbia	62	Papua New Guinea	4
Sri Lanka	247	Portugal	56	Rwanda	4
Spain	246	Kenya	54	Anguilla	3
Norway	236	Jersey	50	Barbados	3
Chile	215	Qatar	47	Bolivia	3
Jordan	211	Bahrain	43	Faroe Islands	3
Egypt	208	Hungary	40	Mongolia	3
Saudi Arabia	196	Malta	40	Belize	2
Bulgaria	195	North Macedonia	38	Liechtenstein	2
Greece	193	Jamaica	34	Senegal	2
Denmark	173	Côte d'Ivoire	31	Togo	2
Finland	169	Palestinian Territories	31	U.S. Virgin Islands	2
Peru	167	Lithuania	30	Other 17 Countries	1

Source: Author's calculation.

Appendix 3: Third Quarter 2020 Gross Domestic Product Growth in 32 Countries

Country	2019 GDP (USD billion)	2020 Q3 Quarterly GDP Growth (%)	Green Bond (US$ million)	Pandemic Bond (US$ million)	Green to 2019 GDP	Pandemic to 2019 GDP
Austria	446	11.1	1096	0	2.46	0.00
Belgium	530	10.7	823	1280	1.55	2.41
Bulgaria	68	4.3	0	0	0.00	0.00
China, People's Republic of	14,343	2.7	1188	107352	0.08	7.48
Cyprus	25	9.4	0	0	0.00	0.00
Czech	246	6.2	0	0	0.00	0.00
Denmark	348	4.9	0	0	0.00	0.00
Finland	269	2.6	18	0	0.07	0.00
France	2,716	18.2	12717	19500	4.68	7.18
Germany	3,846	8.2	16834	0	4.38	0.00
Hong Kong, China	366	2.8	84	0	0.23	0.00
Hungary	161	11.3	1899	0	11.79	0.00
Indonesia	1,119	3.1	2500	4300	2.23	3.84
Israel	395	8.4	0	0	0.00	0.00
Italy	2,001	16.1	644	28974	0.32	14.48
Japan	5,082	5	748	643	0.15	0.13
Latvia	34	6.6	0	0	0.00	0.00
Lithuania	54	3.7	0	0	0.00	0.00
Malaysia	365	18.2	0	0	0.00	0.00
Mexico	1,200	12	0	0	0.00	0.00
Netherlands	909	7.7	7212	0	7.93	0.00
Philippines	377	8	3	0	0.01	0.00
Poland	592	7.7	65	2025	0.11	3.42
Portugal	238	13.3	1870	0	7.86	0.00
Romania	250	5.6	0	0	0.00	0.00
Saudi Arabia	793	1.2	0	0	0.00	0.00
Singapore	372	7.9	477	0	1.28	0.00
Korea, Republic of	1,642	1.9	1158	2100	0.71	1.28
Spain	1,394	16.7	5684	31732	4.08	22.76
Sweden	531	4.3	2222	0	4.18	0.00
U.K.	2,827	15.5	3124	0	1.11	0.00
U.S.	21,428	7.4	17604	4750	0.82	0.22

GDP = gross domestic product, Q = quarter, UK= United Kingdom, US = United States.
Note: Appendix 3 provides the country-level data for 2019 GDP (US$ billion), annualized quarterly GDP growth rate for the third quarter of 2020, green bond issuances in the first half of 2020, pandemic bond issuance in the first half of 2020.
Source: Data are from Organisation for Economic Co-operation and Development website.