



## BACKGROUND PAPER

# Green and Social Finance Development around the World

Dragon Yongjun Tang

### DISCLAIMER

This background paper was prepared for the report *Asian Development Outlook 2021: Financing a Green and Inclusive Recovery*. It is made available here to communicate the results of the underlying research work with the least possible delay. The manuscript of this paper therefore has not been prepared in accordance with the procedures appropriate to formally-edited texts.

The findings, interpretations, and conclusions expressed in this paper do not necessarily reflect the views of the Asian Development Bank (ADB), its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy of the data included in this document and accepts no responsibility for any consequence of their use. The mention of specific companies or products of manufacturers does not imply that they are endorsed or recommended by ADB in preference to others of a similar nature that are not mentioned.

Any designation of or reference to a particular territory or geographic area, or use of the term “country” in this document, is not intended to make any judgments as to the legal or other status of any territory or area. Boundaries, colors, denominations, and other information shown on any map in this document do not imply any judgment on the part of the ADB concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

# **GREEN AND SOCIAL FINANCE DEVELOPMENT AROUND THE WORLD <sup>1</sup>**

Dragon Yongjun Tang<sup>2</sup>  
HKU Business School  
The University of Hong Kong

April 2021

## **Abstract**

Green and social finance has become mainstream around the world. More than US\$1 trillion of green, social, and pandemic bonds were issued by governments, banks, and corporations in more than 60 countries. Green bonds have been embraced by market investors; stock prices reacted positively to the announcements of green bond issuances. Green and social bonds have been issued by 21 countries, while several others are planning to do so. Countries with more exports are more likely to issue green bonds, so do countries with higher carbon dioxide emissions. The culture of masculinity is associated with lower likelihood of green bond issuance. We find mixed results for determinants of social and pandemic bonds in multivariate analysis. The market is still rapidly growing; public attention to this market is associated with more positive outcomes.

## **Keywords**

green finance, social finance, financial development

## **JEL Classification**

G12

---

<sup>1</sup> I thank Abdul Abiad, Donghyun Park, Shu Tian, and participants for the Asian Development Outlook 2021 Sustainable Finance and Economic Recovery workshop for their useful comments and suggestions. I thank Yupu Zhang and Meichen Qian for their excellent research assistance. All remaining errors are my own.

<sup>2</sup> E-mail address: [yjtang@hku.hk](mailto:yjtang@hku.hk)

## I. INTRODUCTION

The rise of green and social finance since the 2008 global financial crisis is one of the most widespread and significant events in the entire history of the financial market. The google search trend for “green finance” in Figure 1 shows rising interest in those issues, especially in recent years since 2016. While there is much enthusiasm in the market and by the general public, academic research on those markets is lacking. In this study, we document the green and social finance development around the world and explore the determinants of cross-country differences in such market developments.

An impressive body of empirical evidence, dating as early as Goldsmith (1969) and as recent as Bennett, Stulz, and Wang (2020), shows how financial markets can make firms more productive and economies grow faster. However, Greenwood and Scharfstein (2013) show that much of the outsized growth of finance relative to other industries in recent history since 1980 can be attributed to asset management and the provision of household credit. There is little attention to the environmental and social aspects. Shapira and Zingales (2017) use the case of DuPont to argue that it is rational for firms to pollute the environment then pay the fine if caught afterwards, instead of investing in pollution abatement beforehand. Therefore, external forces including green and social finance are necessary to intervene in corporate activities and guide business towards better environmental and social outcomes.

Why do some countries have more developed green and social finance markets than other countries? We explore the determinants of market development from economic structure and cultural factors. We compile a comprehensive dataset covering 60 countries with green bond issuance (in 42 of them, the issuers are publicly listed companies, others have issuers from government or financial institutions) and international financial development institutions, including the World Bank. Green and social bond issuances are all over the world, in different currencies, and with different maturities. There are also many variations over time.

The coronavirus disease (COVID-19) pandemic has significantly changed the development of the green and social finance market, with the flush of pandemic bonds from the People’s Republic of China (PRC) and other parts of the world. The top two countries in terms of green

bond issuance are the United States (US) and the PRC. These two countries behaved differently before 2020. Until 2019, the issuers in the PRC are predominately banks and financial institutions, while the issuers in the US are more diverse and come from utilities, financial, and technology sectors. However, the COVID-19 pandemic seems to exert force of convergence to make the two markets look more similar.

The former president Donald Trump might have given people the impression that US is under-contributing to green and social finance development. However, the total green bond issuance in the US seems to be in goldilocks relative to its economic size. On the other hand, the PRC could have done more for green finance development. The overall market leaders are the Netherlands and France. The Russian Federation, Mexico, Turkey, and Saudi Arabia have little green and social finance development. While Poland was the first country to issue sovereign green bond, there are worries about greenwashing as there is a big coal mining industry.

We find that countries with exports counting a big fraction of total economies issue more green bonds. Countries with better economic development are also more likely to issue green bonds, especially from the public sector. Consistent with the objective of green finance to curb pollution, we find that countries with more carbon emissions issue more green bonds. The culture of the country is also associated with green bond issuance. When people demonstrate more masculinity, the country is less likely to issue green bonds. However, we find that countries with low credit ratings are as likely to issue green bonds as countries with better credit ratings. Therefore, green finance seems to be a good opportunity for issuers in countries with limited access to credit. Moreover, green bond issuance is not related to unemployment rate, suggesting that displacing current workers is not a major concern when issuing green bonds. It is also possible that green projects increase job opportunities.

The findings from social and pandemic bonds are somewhat different from green bonds. For example, countries with higher exports issued few pandemic bonds. Countries with stronger uncertainty avoidance culture also issued few pandemic bonds. The contrasting findings suggest that green bonds and social and pandemic bonds may serve different purposes. Pandemic bond is an emergency financing tool for short-term problem resulting from the

COVID-19 public health crisis. Green bonds are more for longer term considerations, especially sustainable development.

The level of green finance development varies substantially across countries, but most countries still have a low level of green penetration as green bond issuers are only a small fraction of all publicly listed companies. Government policies and actions greatly affect the green and social finance development. When the country is run by a left-wing government, it is more likely to engage in green finance. In fact, US President Joseph Biden created a new position of special climate envoy and appointed John Kerry to lead the government's climate effort.<sup>3</sup>

We can think about green finance, in which banks and other financial institutions play big role, as a new wave of market reform just like the branching deregulation that happened in the 1980s in the US. Now banks are forced to shift towards green business. Social finance can be a challenging but important issue. Better financial development reduces the reliance on religious bodies and social network (Cronqvist, Warachka, and Yu 2020). Not everyone supports green and social finance, Rajan and Zingales (2003) argue that interest groups may impede financial development in new areas to keep competition away. DesJardine, Marti, and Durand (2020) show that hedge funds can target firms that take up more social responsibility. However, there is increasing evidence that investors care about carbon risk and environmental protection (e.g., Bolton and Kacperczyk [2019 and 2020]).

We find that the market reacted positively to the news of green bond issuance. Out of the 32 countries with green bond issuance by their publicly listed companies, stock prices reacted positively to the announcement of green bond issuance in 22 of the 32 countries. The stock market reaction is positively related to public attention to green finance. Therefore, it will be useful to encourage more attention to the green and social finance market.

The remainder of this paper is organized as follows. In section II, we describe the market and data. We provide several country-level case studies and overviews in section III. Section IV

---

<sup>3</sup> John Kerry was a key person for the US to enter the Paris Agreement in 2015. He is also a senior advisor for the largest impact fund in the world: the Rise Fund of TPG.

presents the main findings of determinants of green and social finance development around the world. We provide discussions on the implications and perspectives for the market going forward in section V. Section VI concludes.

## II. MARKET BACKGROUND AND DATA

### A. Institutional Background

The attention on environmental and social issues was elevated by the publication of “*Who Cares Wins*” in 2004 by the United Nations (UN) Secretary General, UN Global Compact, and the Government of Switzerland. The UN Intergovernmental Panel for Climate Change (IPCC) provided detailed scientific information on climate issues. The European Investment Bank issued the first green bond (called climate awareness bond at that time) in 2007.

The Swedish bank Skandinaviska Enskilda Banken AB (SEB), the World Bank, and the Centre for International Climate and Environmental Research collaborated to create the first green bond. The critical role of green finance was made clearer in the 2015 Paris Agreement and 2016 Group of Twenty (G20) Summit in Hangzhou, PRC. Financial intermediaries, such as BNP Paribas and Bank of America Merrill Lynch, have played significant role in the market development. We list the top green bond underwriters in 2019 and 2018 in Appendix 3. Additionally, Climate Bonds Initiative (CBI), which is financed by the Government of the United Kingdom (UK), and the International Capital Markets Association provide principles and standards which are instrumental for market growth.

### B. Data Compilation

In describing the dataset and sample selection, we proceed as follows: (i) green bond, social bond, and pandemic bond dataset; (ii) country-level variables, including culture, legal origin, credit, and other macroeconomic variables.

**Green bond, social bond, and pandemic bond.** We construct the green bond dataset by taking the following steps: first, we merge Bloomberg-labeled green bond dataset with CBI 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. CBI 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 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 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 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.

**Country-level variables.** Macroeconomic variables, including gross domestic product (GDP), GDP per capita, GDP growth, unemployment rate, exports of goods and services, and carbon dioxide 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 rating is taken from S&P, Moody’s, and Fitch. We convert credit ratings into numbers according to Appendix 4, 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 equals or greater than 18, and zero otherwise.

We use country-level culture measures from Hofstede (2010). This data was previously used

by, among others, Chui, Titman, and Wei (2010); Acharya, Amihud, and Litov (2011); Ahern, Daminelli, and Fracassi (2015); Hoi, Wu, and Zhang (2019); and Berger, Li, Morris, and Roman (2021). Hofstede's culture measure has five dimensions: individualism, masculinity, power distance, uncertainty avoidance, and long-term orientation. The data is constructed through psychological survey of employees' attitudes toward their work and private lives. The data was first published in 1980 and have been widely in business research, e.g., Weber, Shenkar, and Raveh (1996); and Kachelmeier and Shehata (1997). The most updated data can be accessed online.<sup>4</sup>

The culture measures have multiple aspects. Probably the most prominent component is *Individualism*, which measures whether the society emphasizes the role of individual or the role of group. Asian countries have relatively low individualism scores, while the US, Australia, and the UK have the highest individualism scores. Another dimension is long-term orientation. African countries often have low long-term orientation score. The Republic of Korea (ROK) has the highest score.

### C. Data Summary

We summarize the country-level data in Table 1. Our regression analysis is mostly based on country-quarter data. For the analysis on green penetration, we use individual firm data to calculate the fraction of green firms among all the publicly listed firms in the country. We provide variable definitions in Appendix 1.

We provide summary statistics by country of the green bonds issued from 2007 to 2020. More than 60 countries have issued green bonds. In addition, some supranational financial institutions have issued green bonds. The World Bank and the International Finance Corporation are active green bond issuers and investors. In fact, the single biggest group of green bonds were issued by those not belonging to any single country, with 480 green bonds issued so far. The PRC, the US, Sweden, France, Germany, the Netherlands, Malaysia, and Japan all have more than 100 green bonds issued by their banks, corporations (both publicly listed and private firms), municipalities, and governments. The maturity of green bonds vary across countries. On average, green bonds have longer maturity than conventional corporate

---

<sup>4</sup> It is free to download from <https://geerthofstede.com/research-and-vsm/dimension-data-matrix/>.



bonds as green projects may take longer to complete and yield results.

Panel B of Table 2 shows that the list of countries with social bond issuance is shorter. The ROK and Japan stand out as the top two countries with social bonds (out of 24 countries). France also has many social bonds. Moreover, the size of issue from France is considerably larger than other social bonds.

Panel C shows the country-by-country summary of pandemic bonds. As mentioned before, the PRC is a dominant issuer of pandemic bonds. Out of all the pandemic bonds, 55% in terms of US dollar value and 86% in terms of issues are from the PRC. Moreover, the pandemic bonds from the PRC have relatively short maturity (2.5 years, on average). The pandemic bonds from supranational have average maturity of about 5 years.

Figure 2 shows the total number and US dollar value of green, social, and pandemic bonds over time. Because of the sharp rise of social and pandemic bonds, the total market size increased substantially in 2020. We also observe many small issuers for green bonds in 2015. Figure 3 reports the green, social, and pandemic bonds by issuing currencies. Euro, US dollar, and Chinese yuan are the three major currencies for all the bonds. For green bonds, Swedish krona is another noticeable issuance currency. Japanese yen and Korean won are in the top four currencies, together with the US dollar and euro, for social bonds.

The two outstanding countries are the PRC and the US in terms of total bond value. France and Germany also have a sizeable green bond market. In contrast, the Russian Federation and most of Africa essentially do not have green bonds.

COVID-19 provides a dramatic unexpected shock to issuers, investors, and governments all over the world. Never was there a shock as widespread as this pandemic in recent history. The shock has both economic and social impacts and revealed many previously neglected issues around the world, including inequities and shortage of supplies. COVID-19 triggered an explosive growth of the social finance market, especially the pandemic bonds that are designed specifically to address issues driven by the public health crisis. Blue collar workers are substantially more affected than the white collar workers who can work from home in

front of computers.

Figure 4 compares the industry distribution of green bonds from the PRC and the US. Before the COVID-19 pandemic, these two countries look very different in terms of issuers. Most of the green bonds in the PRC were issued by banks. However, after the outbreak of COVID-19 pandemic, the PRC's green bond issuers became more diverse and look more similar to the issuers in the US.

### **III. CASE STUDIES AND OVERVIEW**

Table 3 provides the list of countries that have issued sovereign green bonds. Probably surprisingly, Poland became the first country to issue sovereign green bonds in December 2016, 1 month ahead of France, which had long planned to be the first issuer after the December 2015 Paris Agreement. However, Poland's sovereign green bond was controversial, given its heavy reliance on coal industry. Recent report from the Climate Action Network puts Poland at the bottom of carbon ambition and progress in the European Union.<sup>5</sup>

Nigeria is also one of the earliest countries to issue sovereign green bonds. It is the first sovereign green bond issuer from Africa and made its debut sovereign green bond in December 2017. Nigeria subsequently issued two more sovereign green bonds in June 2019 and February 2020. Being the largest economy in Africa, Nigeria has much need of green finance to fund its transition to renewable energy and sustainable development.

Indonesia is the first country in Asia to issue sovereign green bond. Its green bond is also a sukuk. The Hong Kong, China made a grand scheme in 2017 to become a green finance hub. It issued the first sovereign green bond in May 2019. Chile became the first American country to issue sovereign green bond in June 2019. The most recent newcomer to the sovereign green bond market is Egypt, which issued a US\$750 million sovereign green bond in September 2020. It is also the first sovereign green bond from the Middle East.

---

<sup>5</sup> <https://www.caneurope.org/docman/climate-energy-targets/3357-off-target-ranking-of-eu-countries-ambition-and-progress-in-fighting-climate-change/file>.

The world's largest economies have not issued sovereign green bonds yet. The reason for the US is arguably obvious because of the Trump administration's attitude towards climate risk. So far, Germany is the largest economy with sovereign green bonds. It issued €6.5 billion sovereign green bonds in September 2020. Most of the sovereign green bonds have maturity ranging from 5 years to 15 years. The Netherlands issued the longest tenor sovereign green bonds with maturity of 20 years in May 2019.

Currently, the most discussed sovereign green bond is the upcoming issuance by the UK. To boost its effort for green finance and better showcase its progress at the 2021 Glasgow climate summit, UK announced many green initiatives and the plan to issue sovereign green bonds. UK Prime Minister Boris Johnson, in his opinion in *Financial Times* published on 18 November 2020, puts green finance at the center of his new policy for economic recovery post- pandemic.<sup>6</sup> Prime Minister Johnson aims to turn the UK into the world's number one center for green technology and finance by investing billions of pounds into electric vehicles, and other green technology investments.

Central banks have been active in developing a green financial system. Bank of England is among the early contributors on the topic of climate change and how it can negatively impact financial stability.<sup>7</sup> Mark Carney, then Governor of Bank of England, gave a speech "Breaking the Tragedy of the Horizon-Climate Change and Financial Stability" on 29 September 2015. He asked firms to make plans for transition to the net-zero world. This speech generated much discussions and became highly influential. The Network of Central Banks and Supervisors for Greening the Financial System was launched in December 2017 during the Paris One Planet Summit.<sup>8</sup>

---

<sup>6</sup> *Financial Times*. 2020. Now is the time to plan our green recovery, Boris Johnson. 18 November.

<sup>7</sup> The Government of the UK commissioned the highly influential Stern Review on the Economics of Climate Change, which was released in October 2006.

<sup>8</sup> The eight founding members are the Banco de Mexico, the Bank of England, the Banque de France and Autorité de Contrôle Prudentiel et de Résolution, De Nederlandsche Bank, the Deutsche Bundesbank, Finansinspektionen (The Swedish FSA), the Monetary Authority of Singapore, and the People's Bank of China.

#### IV. DETERMINANTS OF GREEN AND SOCIAL BOND ISSUANCE

In this section, we explore the determinants of green and social finance development around the world. It is obvious that some countries have more active green and social markets than other countries. Finding out the determinants across countries will be useful to foster the further growth of the market as well as the healthy development of the market.

##### A. Size of Economy

In Figure 5, we plot the total green and social bonds issued in the country against its GDP. The two variables are positive and significantly correlated. The fitted line has a slope of 0.9176 and  $R^2$  of 0.3427. The first tier of green bond issuers in terms of total green bond issuances includes the US, Germany, France, and the Netherlands (ranked by issuance number). The Netherlands has issued the largest amount of green bonds relative to its GDP in a cross-sectional comparison. The US is right on the trendline. The PRC and Japan are below the line. It also seems that the Russian Federation is the least developed in terms of green and social finance, at least among the large economies such as the G20 countries.

While it may be surprising to see that the US is contributing its fair share to the green and social market development, it is even more surprising to see that the PRC is actually not contributing enough. This is contrary to the public reporting that green and social finance market is dominant in the world. There are several reasons for the PRC's underperformance. First, the PRC started late. In recent years, while the PRC had fast growth, its green bond market only started in 2015 and became active in 2016. However, other countries in Europe and the US started in 2007 and became considerably active in 2013. Second, the PRC economy is large. The PRC's GDP is almost six times of France's GDP. Therefore, the PRC has an active market only in the absolute sense, not in relative sense. Third, some of the green bonds in the PRC do not comply with international standards. The PRC and Europe have been working on the harmonization of green bond standards. In 2020, the PRC removed "clean coal" from its taxonomy of green bond categories, one step towards integration with the European standard.

The most prominent laggard in terms of green finance development is the Russian Federation. The Russian Federation's GDP is very close to the GDP of the ROK. However, the Russian Federation's green and social finance market size is much smaller than that of the ROK. The market is also small in absolute sense. Its first green bond was only issued in 2019. Other large economies with small green finance market include Mexico, Saudi Arabia, and Turkey.

## **B. Multivariate Analysis for Green Bond Issuance**

After demonstrating the role of economic size on green finance development, we explore the cross-country determinants of green finance development after taking into account the obvious effect of GDP size. So we scale the green bond amount by GDP.

Prior studies discuss some potential determinants of green finance. There are also some impediments for such development. For example, Rajan and Zingales (2003) show that interest group has incentives to deter financial development and maintain their advantage in current market. Ding, Levine, Lin, and Xie (2020) show that intensifying competition induces firms to increase corporate social responsibility activities. De Hass and Popov (2020) show that equity financing leads to less pollution.

Green bonds are after all bonds. Therefore, the existence and level of credit rating of the issuer can play some role. Sovereign credit rating, in turn, depends on a country's economic development such as unemployment and financial strength. Moreover, creditor rights and creditor protection, both in terms of rule of law and in terms of enforcement, can greatly affect creditor's demand of bonds. Many of such considerations can be related to the culture of a country. We use country-level culture measures from Hofstede (2010), which includes the five components.

Probably most importantly, green bonds are bonds for environmental benefits. Therefore, carbon emission or pollution level can be a motivation for green bond issuance. Further, governments seem to be a driver for green finance development. We separately consider public sector and private sector issuers.

In Table 4, we regress total green bond scaled by GDP on several explanatory variables for a set of 45 countries with complete data. We present results from three sets of analysis: total green bonds, green bonds from public sector, and green bonds from private sector. The estimation results show that exports as a share of GDP has positive and statistically significant (at the 1% level) coefficient estimate in all three specifications. This result is consistent with anecdotal evidence. France exports many goods, especially luxury goods. Maintaining a good image such as environmentally sustainable and high-quality product is very important. When the Russian Federation issued its first green bond, Yury Denisov, the chief executive officer of Moscow Exchange, said that “a driving force behind the green bond wave is a recognition from the state, issuers, and the Moscow Exchange that the Russian Federation has a special role to play, given our status as the world’s largest exporter of hydrocarbons”.<sup>9</sup>

We do not find significant effect from unemployment and credit rating. These insignificant results have implications. First, high credit rating is not a strong requirement for green bond issuance. This is understandable as the green bonds differentiate themselves from conventional bond in a significant way, especially the use of proceeds for green projects. Therefore, countries with limited access to the conventional bond market may find it easier to access the green bond market. Second, doing environment-friendly projects may not lead to unemployment, as many worried.<sup>10</sup> Green projects may even bring new job opportunities, as argued by Stock (2020) and Metcalf and Stock (2020).

The cultural measures are also associated with green bond issuance. The coefficient estimate on *Uncertainty Avoidance* in column (1) is 0.757 ( $t$ -stat=3.522). Climate change brings much uncertainty about the future. People averse to uncertainty may want to protect the environment better, and one way to do so is to issue green bonds for green projects. Countries with higher masculinity are less likely to issue green bonds, probably because such people are more confident about putting things under their control. Countries with higher indulgence and individualism also issue more green bonds.

---

<sup>9</sup> <https://focus.world-exchanges.org/articles/green-finance-comes-russia>.

<sup>10</sup> Former President Donald Trump made this explicit and strong argument about employment when he decided for the US to quit the Paris Agreement.

One important result is that countries with high carbon emission have more green bonds. The coefficient estimate in column (1) for emission/GDP is 0.036 ( $t$ -stat=2.232). This finding suggests that green finance development is at least partly supply driven. When a country faces more severe pollution problem, it has stronger incentives for environmental protection and more companies would issue green bonds.

We further split the green bond issuance by public sector such as government, and private sector such as industrial firms. The regressions results are in column (2) for public sector and column (3) for private sector. GDP growth plays a significant role for green bond issuance by public sector. Countries with better economic development are better able to issue government bonds. The  $R^2$  is considerably higher for the public sector green bond issuance than for the private sector green bond issuance. This result suggests that government initiatives are driving the market development. For example, the largest green bond issuer in the world is Fannie Mae, the government-sponsored entity in the US. France issued a €7.5 billion sovereign green bond in January 2017.

### **C. Multivariate Analysis for Social and Pandemic Bond Issuance**

We analyze the determinants of social and pandemic bond issuance separately in this section. Social bonds are fewer than green bonds both in terms of number and in terms of dollar value. This is especially the case before 2020. There is some overlap between green and social bonds and sustainability bonds are issued in this case. Pandemic bonds are mainly issued in 2020 as a fast response to COVID-19. The PRC is the dominant issuer for pandemic bonds, especially during the early phase of the pandemic in February–March 2020. Then, other countries such as the ROK followed to issue pandemic bonds.

We regress the number and the US dollar value of social and pandemic bonds on cultural variables. Table 5 reports the estimation results. Because social and pandemic bonds are fewer, we use a different model specification and explanatory variables. The coefficient estimates for long-term orientation are statistically significant at the 1% level in columns (1) and (2). The results suggest that countries with higher long-term orientation issue more social bonds. The long-term orientation effect is also positive for pandemic bonds, but not statistically significant. This result is plausible as pandemic bonds are short-term solution to

a sudden negative shock. There is little long-term consideration. Countries with German legal origin are more likely to issue pandemic bonds.

Those results are probably temporary as the pandemic is still unfolding. Some results for social and pandemic bond issuance are different from green bond issuance results. For example, uncertainty avoidance and export are negatively associated with pandemic bond issuance. One possibility is that, if a country can issue green bonds, it may not need to resort to pandemic bonds when the public health crisis hit. There could be a slight substitution between green bonds and pandemic bonds.

#### **D. Green Penetration**

One debate about the driver of the green and social finance market is whether the demand side is weak or the supply is lacking. In previous analysis, we mainly focus on the extensive margin about green bond amount in aggregate at country level. In this section we look into individual bond issuance and understand the determinants of green development.

We construct a “green penetration” measure which is the ratio of number of firms that have issued green bonds to the total number of firms. We only consider publicly traded firms as they have more publicly available information. We also construct an alternative measure based on the market capitalization instead of number. While the overall level of green penetration is low for almost all the countries, there are variations across countries.

Table 6 reports the estimation results for green penetration. Overall, we only have weak evidence on some of the determinants of green penetration. GDP growth is negatively associated with green penetration. Countries with high uncertainty avoidance also have low green penetration. Consistent with previous results, we also find that countries with more tourism have more green penetration. We find some weak evidence that countries with higher unemployment rate have slightly higher green penetration, probably because they need green firms to bring new employment opportunities.



## **E. Market Reaction to Green Bond Issuance**

Another useful consideration for green finance development is how market embrace the news of green bond issuance. Therefore, we calculate stock price reaction to green bond issuance for each firm. Stock price reaction is measured by the cumulative abnormal returns (CAR) around the announcement of green bond issuance. We then aggregate firm-level cumulative abnormal returns by country, so that we can compare the level of embracement of green finance for each country.

We plot the country-level cumulative abnormal returns in Figure 6. Turkey has the highest CAR for green bond issuance among all the examined countries. In contrast, Belgium has the lowest CAR. These results may be surprising because Turkey is not known for its enthusiasm for green finance, while Belgium is among the frontrunners of green finance. However, these results make a lot of sense from the unexpected returns perspective. Countries known for determination in green finance have little to surprise the market, while the “change of heart” for those previously distant from green finance is much more appreciated by the market.

It is also worth pointing out that there are more countries with positive CARs than countries with negative CARs for green bond issuance. This result is consistent with Tang and Zhang (2020) and Flammer (2021). Both papers find that green bonds bring benefits to the issuing firms. One caveat is that many of the countries have a small number of green bond issues. The US has the largest number of publicly listed green bond issuers, followed by the PRC, Japan, Sweden, and France. Therefore, the information content of market reaction to green bond issuance can vary across countries.

To understand the drivers of the cumulative abnormal returns for green bond issuance across countries, we plot the CAR against Google search trend in each country in Figure 7. There appears a weak positive relationship between these two. The US seems to be an outlier with the highest Google search volume but mediocre abnormal returns. The relationship between search volume, which can be a proxy for public interest in the green finance, and abnormal return would be much stronger without the US. One possible reason is that the US is very divided on this issue. While the Obama administration was a strong supporter of the Paris Agreement, former President Trump quit it shortly after he took office. However, President

Joe Biden rejoined the Paris Climate Agreement in January 2021.

## **F. The Political Economy of Green Finance**

The US illustrates the political economy of green finance. Democratic leaders such as former Vice President Al Gore and President Biden have been visible supporters of environmental protection policies. In stark contrast, former President Trump has undone almost all the progress the former Democratic presidents have made. One prominent example is Trump's choice of administrator for Environmental Protection Agency. Scott Pruitt, known for being against environmental protection, had to resign less than 5 months after taking the helm because of numerous ethics investigation.

We formally make this point of political influence on green finance development by regressing green bond issuance on incumbent party orientation. We obtain the political orientation data from Doring and Manow (2020) and construct a variable "left-wing government", which takes the value from 0 to 10 with 10 being the most leftist government. Table 7 reports the regression estimation results. We find a positive relationship between green bond issuance and left-wing government. The coefficient estimates are statistically significant at the 10% level.

## **V. DISCUSSIONS AND PERSPECTIVES**

2020 has been a banner year for green and social finance. Total issuance of green bonds since 2007 exceeded US\$1 trillion for the first time in September 2020 with a €6.5 billion (US\$7.7 billion) issuance from the Federal Government of Germany.<sup>11</sup> The COVID-19 pandemic might have become a game changer for the green, social, and pandemic finance market.<sup>12</sup> It is conceivable that pandemic bonds as special type and emergency solution for social bonds may fade away once the pandemic is under control. However, the public health crisis may substantially affect investors and issuer in terms of their willingness to pay and to issue green and social bonds. BNP Paribas published a report "2020: The Year of the Greenium" in

---

<sup>11</sup> <https://about.bnef.com/blog/record-month-shoots-green-bonds-past-trillion-dollar-mark/>

<sup>12</sup> Moody's forecast total 2020 sustainable bond issuance to be US\$425 billion, including US\$250 billion green bonds, US\$100 billion social bonds, and US\$75 billion sustainability bonds. S&P expects the total sustainable debt market, fueled by the rise of social bond issuance (new issuance jumped up four times from 2019 to October 2020), could exceed US\$500 billion in 2020.

November 2020. It argues that there is a 7-basis point greenium for new issues in 2020. In contrast to earlier findings, it seems clearer now that investors are more willing to pay for green, social, and pandemic bonds.

The year 2020 can be a turning point for many other reasons. During the 2020 UN General Assembly, President Xi Jinping of the PRC announced a goal of 2060 to become carbon neutral. Having such a goal can also lead to more green finance. After the 2020 Presidential Election, President-elect Biden announced to rejoin the Paris Agreement after his inauguration. Nationally determined contributions is likely an important explanatory variable for green finance development. During the Climate Ambition Summit on 12 December 2020 to celebrate the fifth anniversary of the Paris Agreement, national leaders agree to increase their goals and commitments including climate finance. Both the EU and the PRC announced to cut carbon emissions more aggressively than before. As a result, carbon futures reached historical high.<sup>13</sup> The benchmark December 20 EUA contract traded on EU Emissions Trading System reached new record high of €31.30/t, as the European Council approved a 55% emissions cut target for 2030.

The next 5–10 years can be critical. It will be a true test for many countries and we could see some promise to be kept while others to be broken. New Zealand's carbon neutrality target is 2025. Costa Rica even wants to be fully carbon neutral by 2021. However, only a few countries, including the UK and France, have set legally binding targets on achieving net-zero greenhouse gas emissions. So the commitment to green finance can be fragile. On 29 November 2020, a highly contentious proposal in Switzerland to hold companies accountable for their social responsibility, also called “world's strictest corporate responsibility initiative”, was rejected, although it had majority support of 50.7% of the popular votes.<sup>14</sup>

The honeymoon period for the green bond market is arguably over. Now it is time to deliver results. In November 2020, The Swedish bank SEB AB that brought the first green bond to the world over a decade ago asks corporate clients to prove they are clean enough to stay on

---

<sup>13</sup> *Financial Times*. 2020. Price of polluting in EU rises as carbon price hits record high. 11 December.

<sup>14</sup> <https://www.swissinfo.ch/eng/swiss-to-vote-on-holding-companies-accountable-for-supply-chain-.abuses/46184500>.

its books. If companies fail to improve their sustainability credentials, SEB will divest their green bonds. The largest lender in India, State Bank of India, is an active green bond issuer, with the third issue of US\$100 million in March 2020. It was given the award of largest new emerging markets certified climate bond issuer by CBI in 2019. However, in November 2020, Amundi threatens to divest the State Bank of India green bond because of a coal project in Australia. AXA IM already divested the State Bank of India green bonds. There are warranted concerns on greenwashing. A research report from the Bank for International Settlements shows that carbon emission does not always decrease after the firm issues green bonds (Ehlers, Mojon, and Packer 2020). We also witnessed the first green bond default in 2020 by Irrigation India as the issuer failed to make the bond payments.

## **VI. SUMMARY AND CONCLUSIONS**

The green and social finance market has grown rapidly. The total issuance since the first one in 2007 has exceeded US\$1 trillion in 2020. The COVID-19 has become an impetus for the rise of pandemic bond. While green bonds were essentially the only mainstream financial instrument for environmental projects, social and pandemic bonds experienced a dramatic growth in 2020 after the outbreak of the COVID-19 pandemic. We also observe some convergence across countries in terms of green, social, and pandemic bonds after the pandemic.

We find that countries with higher exports issue more green bonds. However, there is some substitution between green and social and pandemic bonds. Green bonds are more for long-term sustainable development while pandemic bonds are short-term solutions for the public health crisis. Green penetration is still low for almost all countries. Governments play critical role. We find that countries with left-wing governments are more likely to issue green bonds. Moreover, cultural factors affect the development of green and social finance.

This study has important policy implications. Although more than a dozen countries have issued sovereign green bonds, many more countries, including large economies such as the US and the PRC, have not issued yet. Italy and the UK have announced to issue in the near future. The US will also likely to issue under the Biden administration. The PRC has made

effort for its green bonds converge to international standard by removing “clean coal” from its taxonomy for green projects. We expect further market development and harmonization in a global setting.

## KEY TAKEAWAYS

1. There are substantial heterogeneity across countries in terms of green/social finance development. The PRC has a noticeably different, model but helped the post-2016 market growth.
2. Many governments have been very influential in leading green finance development, especially with sovereign green bond issuance and other supporting schemes.
3. A country's green bond issuance is related to its export, probably because it wants to convey a clean, high-quality image.
4. Green bond issuance is also related to individualism and long-term orientation of the nation. Green finance requires team spirit.
5. Factors affecting government's decision to issue sovereign green bond are still unclear, as we have not reached steady state yet.
6. Evidence should be interpreted as preliminary because of small sample and short time period. More market practices and research are necessary to reach more solid conclusions (e.g., greenium).

## REFERENCES

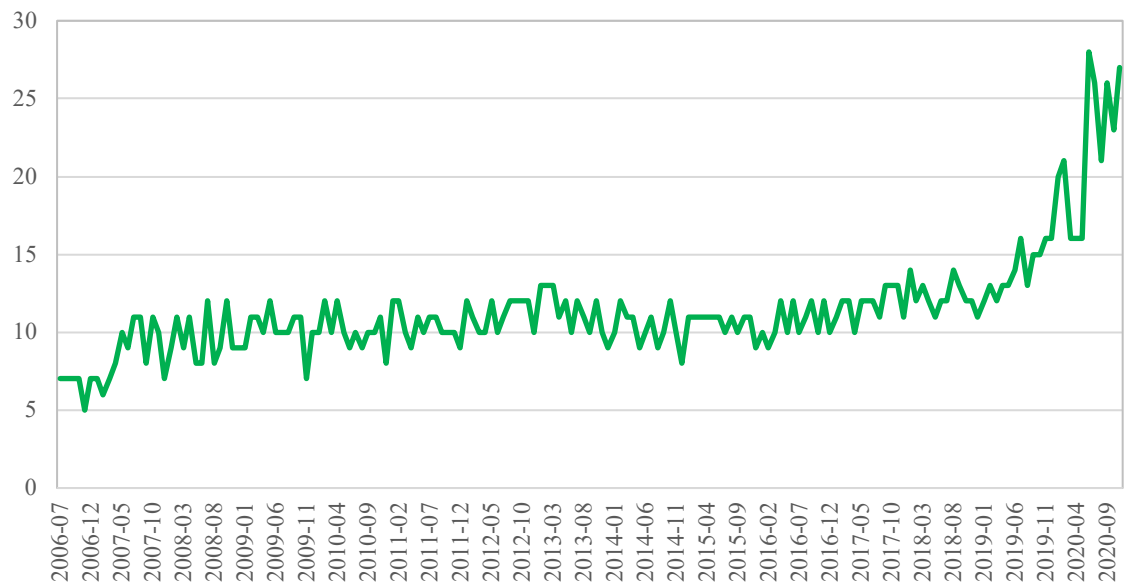
- Acharya, Viral, Yakov Amihud, Lubomir Litov. 2011. Creditor rights and corporate risk-taking. *Journal of Financial Economics* 102, pp. 150-166.
- Ahern, Kenneth, Daniele Daminelli, and Cesare Fracassi. 2015. Lost in translation? The effect of cultural values on mergers around the world. *Journal of Financial Economics* 117, pp. 165-189.
- Bennett, Benjamin, Rene Stulz, and Zexi Wang. 2020. Does the stock market make firms more productive? *Journal of Financial Economics* 136, pp. 281–306.
- Benoit, Kenneth, and Michael Laver. 2006. *Party policy in modern democracies*. Routledge research in comparative politics. Routledge.
- Berger, Allen, Xinming Li, Charles Morris, and Raluca Roman. 2021. The effects of cultural values on bank failures around the world. *Journal of Financial and Quantitative Analysis* 56, pp. 945-993.
- Bolton, Patrick and Marcin T. Kacperczyk. 2019. Do investors care about carbon risk? *Journal of Financial Economics*, forthcoming.
- Bolton, Patrick and Marcin T. Kacperczyk. 2020. Carbon Premium around the World. Working paper. Social Science Research Network: <https://ssrn.com/abstract=3550233>.
- Chui, Andy, Sheridan Titman, K.C. John Wei. 2010. Individualism and momentum around the world. *Journal of Finance* 65, pp. 361-392.
- Cronqvist, Henrik, Mitch Warachka, and Frank Yu. 2020. Does finance make us less social? Working paper.
- De Hass, Ralph and Alexander Popov. 2020. Finance and carbon emission. Working paper. European Central Bank.
- DesJardine, Mark, Emilio Marti, and Rodolphe Durand. 2020. Why activist hedge funds target socially responsible firms: The reaction costs of signaling corporate social responsibility. *Academy of Management Journal*. Forthcoming.
- Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer. 2007. Private credit in 129 countries. *Journal of Financial Economics* 84, pp. 299–329.
- Doring, Holger and Philip Manow. 2020. *Parliaments and governments database (ParlGov): Information on parties, elections and cabinets in modern democracies*.
- Ehlers, Torsten, Benoit Mojon, and Frank Packer. 2020. Green bonds and carbon emissions:

- Exploring the case for a rating system at the firm level. *BIS Quarterly Review*, September, pp. 31–47.
- Flammer, Caroline. 2021. Corporate Green Bonds. *Journal of Financial Economics*. <https://doi.org/10.1016/j.jfineco.2021.01.010>
- Goldsmith, Raymond. 1969. *Financial Structure and Development*. New Haven: Yale University Press.
- Greenwood, Robin and David Scharfstein. 2013. The growth of finance. *Journal of Economic Perspectives* 27(2), pp. 3–28.
- Hofstede, Geert. 2010. *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations*. Sage Publication.
- Hoi, Chun Keung (Stan), Qiang Wu, and Hao Zhang. 2019. Does social capital mitigate agency problems? Evidence from Chief Executive Officer (CEO) compensation. *Journal of Financial Economics* 133, pp. 498-519.
- Hsu, Po-Hsuan, Xuan Tian, and Yan Xu. 2014. Financial development and innovation: Cross- country evidence. *Journal of Financial Economics* 112, pp. 116–135.
- Kachelmeier, Steven, and Mohamed Shehata. 1997. Internal auditing and voluntary cooperation in firms: A cross-cultural experiment. *The Accounting Review* 72, pp. 407-431.
- Krueger, Philipp, Zacharias Sautner, Dragon Yongjun Tang, and Rui Zhong. 2020. The effects of mandatory ESG disclosure around the world. Working paper.
- La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny. 1998. Law and finance. *Journal of Political Economy* 106, pp. 1113–1155.
- Metcalf, Gilbert and James Stock. 2020. The macroeconomic impact of Europe's carbon taxes. *NBER Working Paper* No. 27488.
- Rajan, Raghuram. 2019. *The third pillar: How markets and the state leave the community behind*. New York, NY: Penguin Press.
- Rajan, Raghuram and Luigi Zingales. 2003. The great reversals: The politics of financial development in the twentieth century. *Journal of Financial Economics* 69, pp. 5–50.
- Shapira, Roy and Luigi Zingales. 2017. Is pollution value maximizing? The DuPont case. Working paper.
- Stock, James. 2020. Climate change, climate policy, and economic growth. *NBER Macroeconomics Annual* 34 (1), pp. 399–419.



- Tang, Dragon and Yupu Zhang. 2020. Do shareholders benefit from green bonds? *Journal of Corporate Finance* 61, 101427.
- Weber, Yaakov, Oded Shenkar, and Adi Raveh. 1996. National and corporate cultural fit in mergers/acquisitions: An exploratory study. *Management Science* 42, pp. 1215-1227.

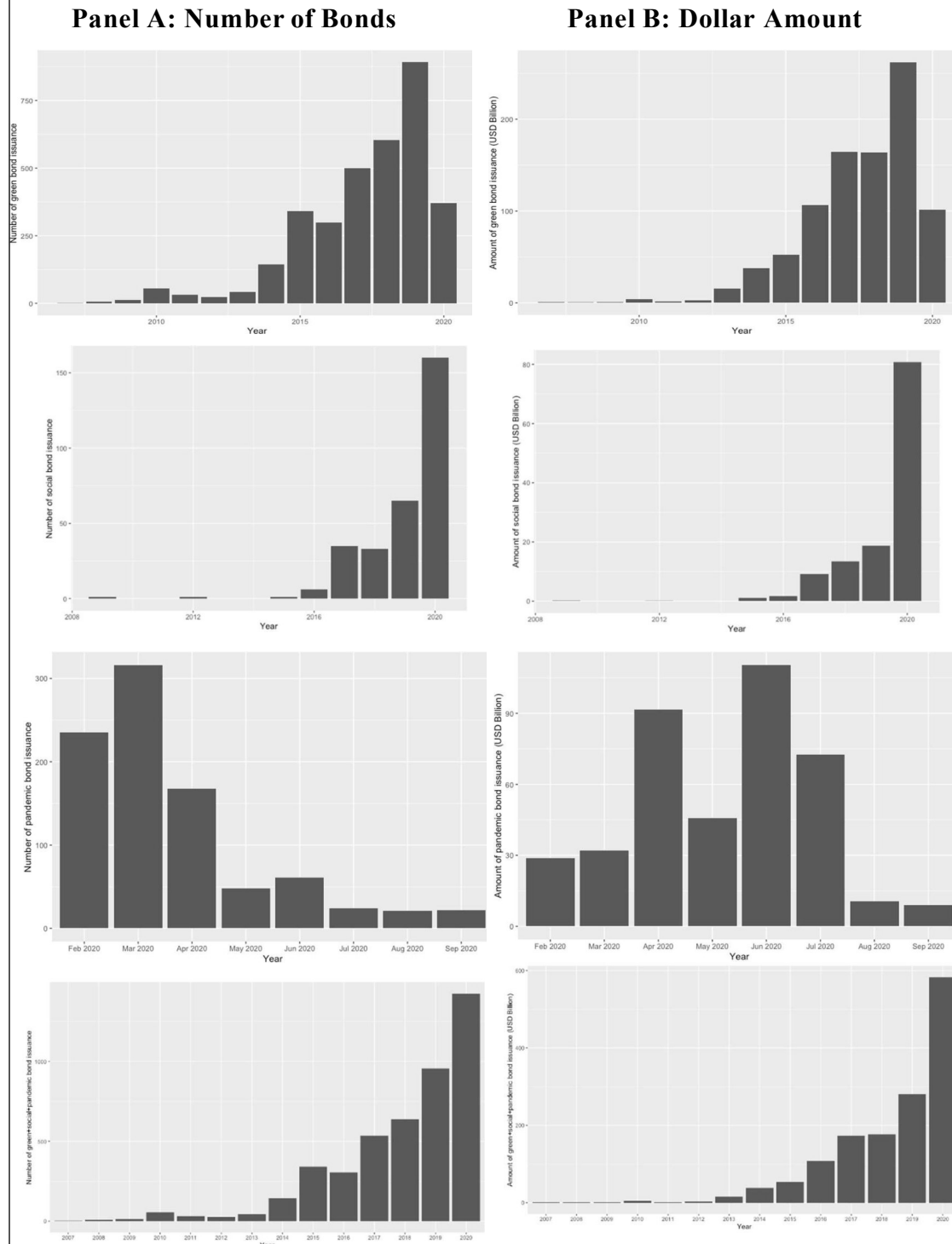
**Figure 1. Google Search Trend for “Green Finance”**



Note: Figure 1 plots the monthly google search volume for “Green Finance” from 2006 to 2020.

Source: Author’s illustration.

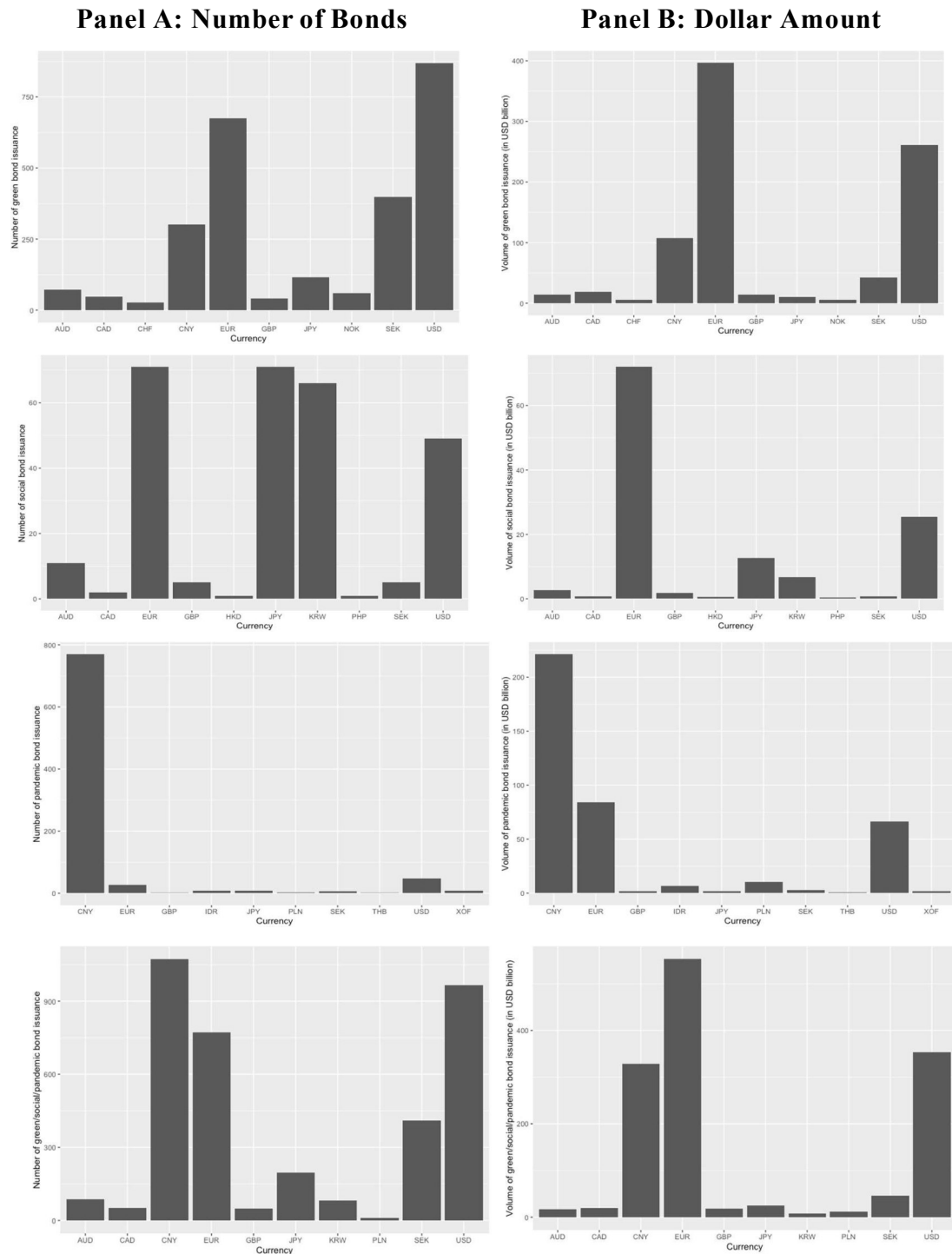
**Figure 2: Green, Social, and Pandemic Bond Issuance over Time**



Note: Figure 2 plots the number (Panel A) and dollar amount (Panel B) of green, social, and pandemic bonds issued globally from 2007 to September 2020. The fourth row is for all three types of bonds combined.

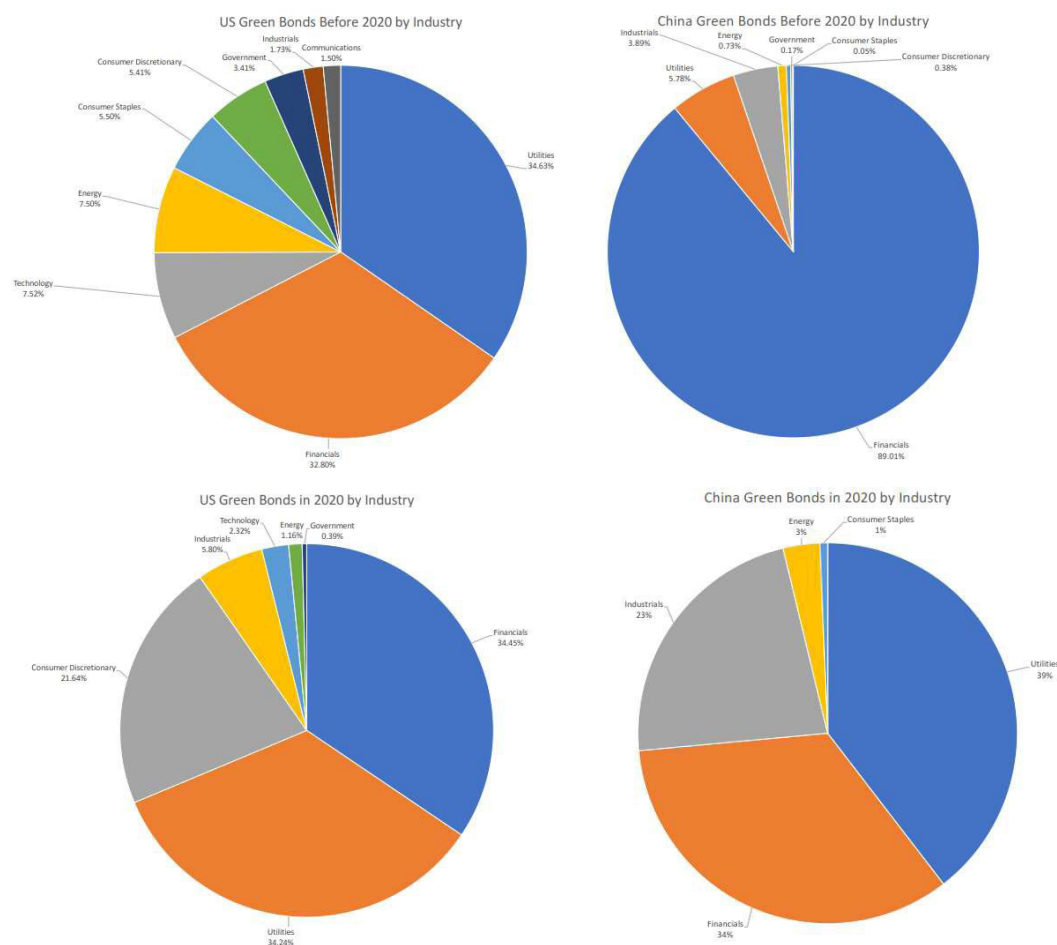
Source: Author's illustration.

**Figure 3: Green, Social, and Pandemic Bond Issuance by Currency**



Note: Figure 3 plots the number (Panel A) and dollar amount (Panel B) of green, social, and pandemic bonds issued globally from 2007 to September 2020.  
Source: Author's illustration.

**Figure 4: The Industry Composition of Green Bonds in the United States and the People's Republic of China**

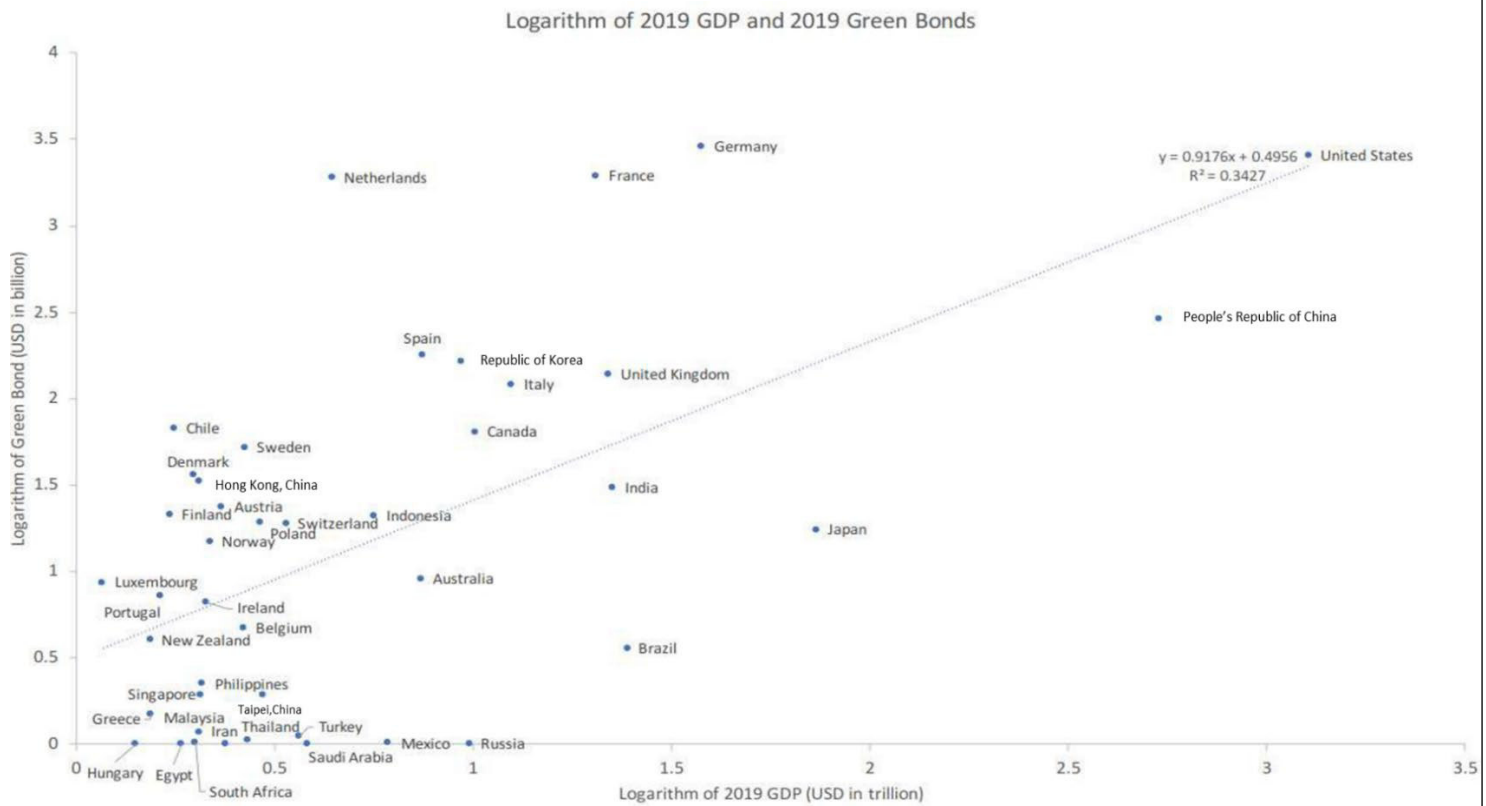


PRC = People's Republic of China, US = United States.

Note: Figure 4 plots the industry composition of green bonds issued in the United States and the People's Republic of China, both before 2020 and during 2020.

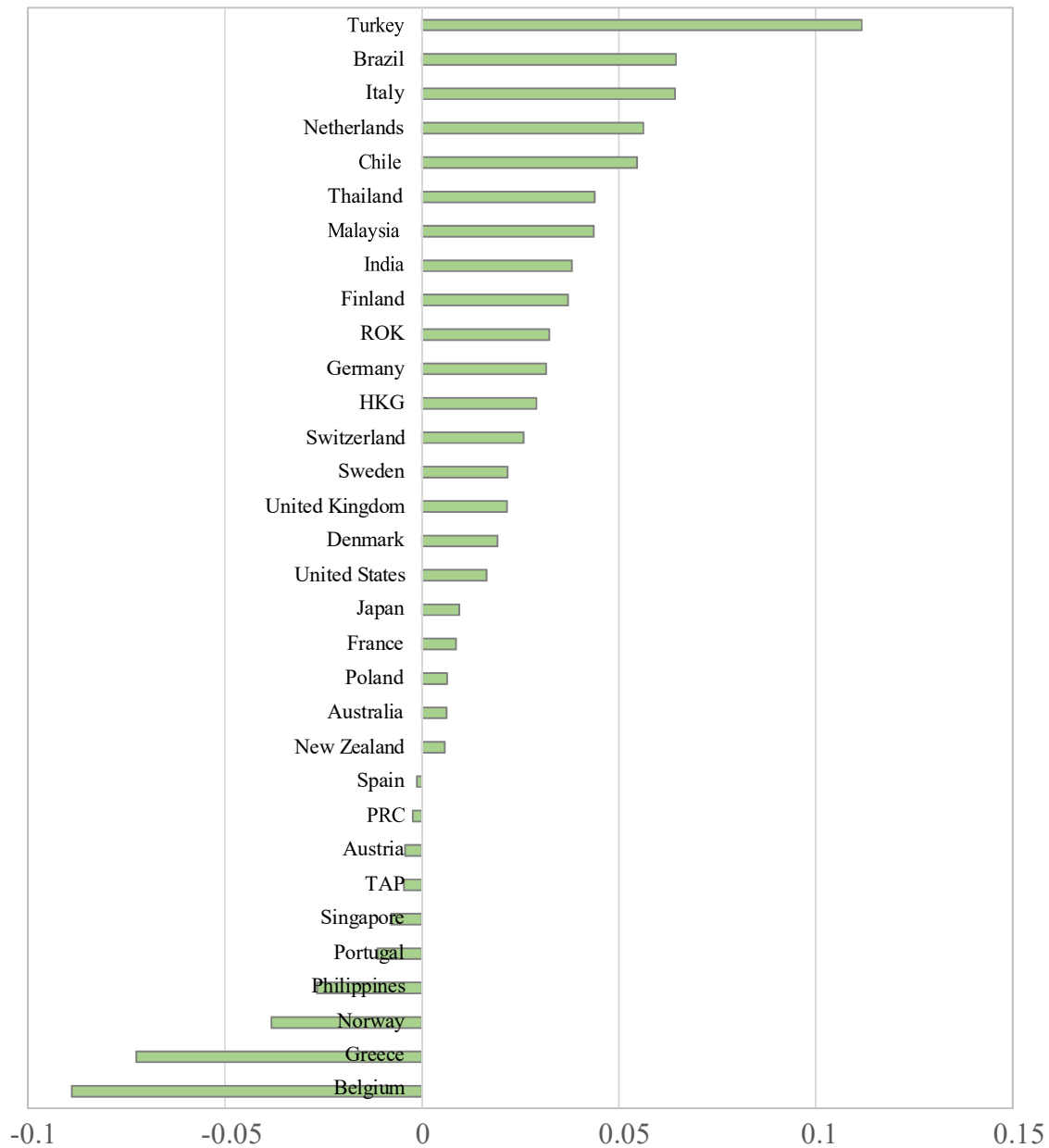
Source: Author's illustration.

**Figure 5: Relation between Country Gross Domestic Product and Green Bond Issuance**



Note: Figure 5 plots the United States dollar (US\$) amount of green bond in US\$ billion issued within a country (y-axis) against the country's gross domestic product in 2019 in US\$ trillion (x-axis). The fitted line is also plotted.  
Source: Author's illustration.

**Figure 6: Cumulative Abnormal Returns to Green Bond Announcements by Countries**

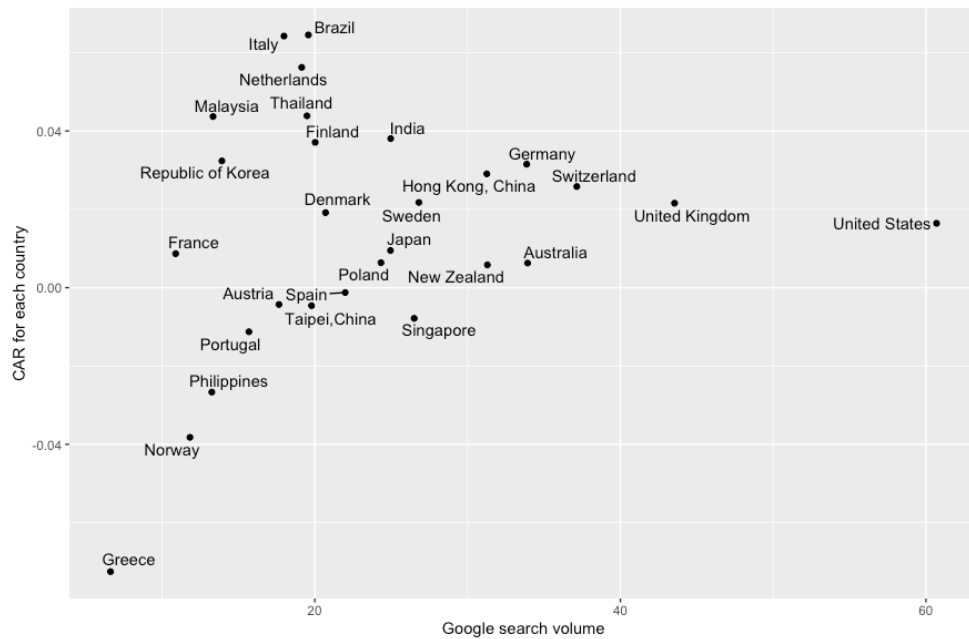


HKG = Hong Kong, China; PRC = People's Republic of China; ROK = Republic of Korea; TAP = Taipei, China.

Note: Figure 6 plots the cumulative abnormal returns around green bond issuance announcements. Firm-level returns are aggregated for each country.

Sources: Data are compiled by author from Climate Bonds Initiative, Bloomberg, and WIND. Time period is from 2007 to 2020.

**Figure 7: Attention to Green Finance and Market Reaction to Green Bond Announcement**



Note: Figure 7 plots the cumulative abnormal returns around green bond issuance announcement against the Google search trend for each country for “Green Bond”.  
Source: Author’s illustration.



**Table 1: Summary Statistics**

Statistic	N	Mean	St. Dev.	Min	25 <sup>th</sup> percentile	75 <sup>th</sup> percentile	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 <sub>2</sub> 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<sub>2</sub> = carbon dioxide, GDP = gross domestic product.

Note: Table 1 reports the country-level summary statistics for the main variables.

Macroeconomics and credit rating data are from the International Monetary Fund and [tradingeconomics.com](http://tradingeconomics.com).

Source: Cultural variables are from Hofstede studies, downloaded from

<https://geerthofstede.com/research-and-vsm/dimension-data-matrix/>

**Table 2: Green, Social, and Pandemic Bond Issuance by Country****Panel A: Green Bond Summary Statistics by Country**

<b>Country</b>	<b>Coupon</b>	<b>Maturity</b>	<b>Number</b>	<b>Amount in Million (average value)</b>
Argentina	8.825	6.2	5	187.4
Australia	2.447	15.3	60	220.7
Austria	2.825	10.4	21	364.5
Belgium	1.556	11.4	9	1270.0
Bermuda	7.747	3.7	9	229.3
Brazil	5.326	8.7	59	94.2
British Virgin Islands	3.606	7.3	16	265.1
Canada	2.690	12.9	54	430.6
Cayman Islands	5.689	7.5	27	305.7
Chile	3.500	24.4	9	903.6
China, People's Republic of	3.883	4.2	351	379.4
Colombia	7.100	5.0	1	66.4
Costa Rica	5.875	5.0	2	500.0
Côte d'Ivoire	1.438	3.0	2	279.1
Denmark	1.318	8.1	21	446.3
Estonia	NaN	6.0	1	55.9
Fiji	5.150	9.0	2	24.0
Finland	2.377	6.0	19	304.5
France	3.072	9.4	285	373.9
Germany	0.984	8.1	178	470.9
Greece	3.225	6.0	2	117.8
Hong Kong, China	2.571	6.7	31	233.8
Hungary	1.750	15.0	1	1675.3
India	5.835	7.4	34	279.0
Indonesia	4.400	8.6	11	866.0
Ireland	1.379	9.4	4	1788.4
Italy	2.145	8.1	28	436.5
Japan	0.587	8.6	121	166.9
Jersey	0.037	5.0	1	1107.8
Kenya	12.250	5.0	2	32.4
Latvia	1.700	6.7	3	54.9
Lithuania	2.769	8.8	4	199.9
Luxembourg	1.949	10.5	23	512.9
Malaysia	5.395	9.3	131	9.8
Marshall Islands	7.635	5.0	1	125.0
Mauritius	5.615	5.9	13	446.6
Mexico	5.340	13.2	15	907.1
Namibia	7.983	3.0	1	4.7
Netherlands	1.911	11.0	107	683.2
New Zealand	3.516	5.9	9	145.1
Nigeria	14.860	8.3	3	34.1
Norway	2.068	5.6	84	195.3
Peru	5.605	15.1	5	247.6
Philippines	3.586	3.0	7	149.9

*Panel A continuation*

<b>Country</b>	<b>Coupon</b>	<b>Maturity</b>	<b>Number</b>	<b>Amount in Million (average value)</b>
Poland	1.591	9.5	8	592.5
Portugal	2.580	33.5	4	714.5
Russian Federation	7.750	1.0	1	3.3
Singapore	4.840	7.5	17	147.8
Slovenia	0.500	5.0	1	85.3
South Africa	7.658	8.0	8	72.6
Korea, Republic of	2.324	5.3	47	323.4
Spain	1.327	7.2	47	458.4
Sweden	1.311	5.3	370	100.7
Switzerland	0.573	6.9	27	170.9
Taipei, China	0.827	7.6	30	95.6
Thailand	3.071	5.9	11	66.8
Turkey	7.075	7.6	2	50.0
United Arab Emirates	2.115	6.8	3	219.0
United Kingdom	2.430	16.7	54	332.4
United States	3.044	12.6	438	202.7
Viet Nam	7.550	15.0	1	135.0
Not Applicable	3.076	6.4	480	201.6

**Table 2: Green, Social, and Pandemic Bond Issuance by Country — *Continued***

**Panel B: Social Bond Summary Statistics by Country**

<b>Country</b>	<b>Coupon</b>	<b>Maturity</b>	<b>Number</b>	<b>Amount in Million (average value)</b>
Australia	2.14	8.9	5	242
Austria	0.50	4.5	2	174
Belgium	1.05	20.1	1	1129
Canada	2.25	6.7	2	420
Chile	3.15	6.0	2	38
China, People's Republic of	2.85	4.7	3	286
Ecuador	7.25	15.0	2	400
Finland	0.05	15.0	1	593
France	0.61	8.3	19	1982
Germany	0.32	9.5	11	464
Guatemala	5.38	12.0	1	500
India	6.00	3.3	3	349
Italy	1.41	6.4	7	652
Japan	0.34	12.0	64	187
Luxembourg	0.57	12.5	3	300
Mauritius	11.00	3.0	2	170
Mexico	4.73	5.0	1	228
Netherlands	0.90	11.0	14	960
Philippines	3.05	1.7	1	438
Singapore	5.65	4.0	1	8
Korea, Republic of	1.22	5.0	88	192
Spain	0.54	5.0	10	682
United Kingdom	1.96	13.4	8	344
United States	2.44	14.6	11	280
Supranational	1.95	5.2	40	337

Note: Table 2 provides the list of green bond issuer countries, including the amount of bonds issued throughout June 2020. Panel A is from green bonds. Panel B is for social bonds. Panel C is for pandemic bonds.

Sources: Data were compiled by the author from Climate Bond Initiative, Bloomberg, and WIND.

**Table 2: Green, Social and Pandemic Bond Issuance by Country — *Continued***

**Panel C: Pandemic Bond Summary Statistics by Country**

<b>Country</b>	<b>Coupon</b>	<b>Maturity</b>	<b>Number</b>	<b>Amount in Million</b> (average value)
Belgium	1.05	20.06	1	1129
Bermuda	3.38	5.00	1	144
Cayman Islands	2.70	0.79	5	114
China, People's Republic of	3.25	2.48	333	1088
Fiji	6.50	17.51	2	20
France	0.43	8.81	8	1555
Guatemala	5.38	12.01	1	500
Hong Kong, China	0.86	1.01	2	46
Indonesia	3.91	13.01	11	1003
Italy	1.51	6.26	4	8140
Japan	0.63	7.34	5	455
Jersey	0.91	5.00	1	1500
Luxembourg	0.86	7.00	1	342
Paraguay	4.95	11.01	2	1000
Philippines	3.05	1.75	1	438
Poland	1.56	6.00	2	5254
Seychelles	9.67	5.00	3	28
Slovenia	0.12	5.00	1	397
Korea, Republic of	0.93	4.62	17	410
Spain	0.75	6.37	4	7037
Thailand	1.58	15.34	1	960
Togo	0.00	0.25	1	126
United Kingdom	0.00	9.75	1	211
United States	1.98	16.75	10	628
Supranational	1.03	4.95	38	1557

Source: Author's compilation.

**Table 3: Sovereign Green Bond Issuing Countries**

<b>No.</b>	<b>Country</b>	<b>First Issue</b>	<b>Bond Type</b>	<b>Amount (million)</b>	<b>Currency</b>	<b>Maturity (years)</b>
1	Poland	2016-12-12	Green	750	Euro	5
2	France	2017-01-24	Green	7,500	Euro	22
3	Fiji	2017-11-01	Green	100	Fiji dollar	5 and 13
4	Nigeria	2017-12	Green	10,700	Naira	5
5	Belgium	2018-02-27	Green	4,500	Euro	15
6	Indonesia	2018-03-01	Green	1,250	US dollar	5
7	Lithuania	2018-05-03	Green	20	Euro	10
8	Ireland	2018-10-10	Green	3,000	Euro	12
9	Seychelles	2018-10-29	Blue	15	US dollar	10
10	Netherlands	2019-05-21	Green	5,980	Euro	20
11	Hong Kong, China	2019-05-21	Green	1,000	US dollar	5
12	Chile	2019-06	Green	861	Euro	12
13	Korea, Republic of	2019-06-12	Green	500	US dollar	5
14	Ecuador	2020-01-31	Social	400	US dollar	15
15	Guatemala	2020-04-24	Social	500	US dollar	12
16	Hungary	2020-06-08	Green	1,500	Euro	15
17	Sweden	2020-09-01	Green	20,000	Swedish krona	10
18	Germany	2020-09-03	Green	6,500	Euro	10
19	Mexico	2020-09-14	Green	750	Euro	7
20	Thailand	2020-09-24	Green	10,000	Baht	15
21	Egypt	2020-09-29	Green	750	US dollar	5

US = United States.

Note: Table 3 lists the countries that have issued sovereign green bonds by the order of issuance time.

Sources: Data were compiled by the author from Climate Bond Initiative and Bloomberg.

**Table 4: Determinants of Green Bond Issuance**

	<b>Total Green Bond/GDP</b>	<b>Public Sector Green Bond/GDP</b>	<b>Private Sector Green Bond/GDP</b>
	(1)	(2)	(3)
GDP growth	1.664 (0.604)	1.974* (1.826)	-0.303 (-0.152)
Unemployment rate	-0.776 (-0.720)	-0.169 (-0.413)	-0.592 (-0.759)
Emission/GDP	0.036** (2.232)	0.012* (1.976)	0.023* (2.012)
Export/GDP	48.742*** (5.181)	20.557*** (5.572)	28.219*** (4.145)
BBB or above	2.580 (0.269)	1.847 (0.513)	0.892 (0.129)
Long-term orientation	0.130 (0.612)	0.006 (0.075)	0.122 (0.794)
Indulgence	0.661*** (2.783)	0.256*** (2.747)	0.406** (2.363)
Masculinity	-0.425** (-2.449)	-0.131* (-1.954)	-0.292** (-2.326)
Uncertainty avoidance	0.757*** (3.522)	0.368*** (4.389)	0.387** (2.491)
Individualism	0.506*** (2.881)	0.223*** (3.228)	0.283** (2.226)
Observations	45	45	45
R <sup>2</sup>	0.551	0.559	0.474
Adjusted R <sup>2</sup>	0.419	0.433	0.319

GDP = gross domestic product.

Note: Table 4 reports coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variables are green bonds scaled by gross domestic product of the country. The independent variables are country-level macroeconomic variables and cultural features. Variable definitions are provided in Appendix 1.

Reported in the parentheses are t-statistics. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance level.

Source: Author's compilation.

**Table 5: Determinants of Social and Pandemic Bond Issuance**

	<b>#Social Bonds</b>	<b>\$Social Bonds</b>	<b>#Pandemic Bonds</b>	<b>\$Pandemic Bonds</b>
	(1)	(2)	(3)	(4)
Long-term orientation	0.318*** (3.146)	0.007*** (2.940)	0.472 (1.605)	0.007 (1.348)
Individualism	-0.036 (-0.456)	0.003* (1.766)	-0.495** (-2.156)	-0.005 (-1.156)
Uncertainty avoidance	0.074 (0.725)	0.001 (0.357)	-1.033*** (-3.482)	-0.012** (-2.264)
Export	-8.299 (-1.522)	-0.030 (-0.246)	-48.712*** (-3.077)	-0.649** (-2.335)
German origin	-0.359 (-0.059)	-0.091 (-0.673)	34.678* (1.977)	0.613* (1.991)
French origin	-3.281 (-0.651)	0.169 (1.501)	15.578 (1.065)	0.395 (1.536)
Observations	57	57	57	57
R <sup>2</sup>	0.258	0.237	0.323	0.224
Adjusted R <sup>2</sup>	0.169	0.146	0.241	0.131

Note: Table 5 reports coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variables are number and dollar value of social and pandemic bonds. The independent variables are country-level macroeconomic variables and cultural features. Variable definitions are provided in Appendix 1. Reported in the parentheses are t-statistics. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance level.

Source: Author's compilation.



**Table 6: Determinants of Green Penetration**

	<b>Fraction Number</b> (1)	<b>Fraction Size</b> (2)
GDP growth	-0.003* (-1.951)	-0.017** (-2.066)
Unemployment	0.001 (1.376)	0.006* (1.755)
English origin	-0.007 (-1.147)	0.009 (0.257)
Travel	0.002 (1.339)	0.015* (1.926)
BBB rating or above	0.009 (1.483)	0.004 (0.131)
CO <sub>2</sub> emission	-0.0004 (-0.500)	0.004 (0.963)
Export	-0.008 (-1.219)	-0.049 (-1.338)
Uncertainty avoidance	-0.0002* (-1.926)	-0.002** (-2.389)
Long-term orientation	0.0001 (1.222)	0.0002 (0.384)
Observations	45	45
R <sup>2</sup>	0.331	0.369
Adjusted R <sup>2</sup>	0.158	0.207

CO<sub>2</sub> = carbon dioxide, GDP = gross domestic product.

Table 6 reports coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variables are number or total market capitalization of green bond issuers scaled by the total number of total capitalization of publicly listed companies in the country. The independent variables are country-level macroeconomic variables and cultural features. Variable definitions are provided in Appendix 1. Reported in the parentheses are t-statistics. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance level.

Source: Author's estimates.

**Table 7: The Political Economy of Green Finance**

	<b>Green Bond Issue</b>	<b>Green Bond Issue Volume (US\$ billion)</b>
	(1)	(2)
Left-wing government	0.020* (1.703)	0.185 * (1.879)
Observations	436	436
R <sup>2</sup>	0.007	0.008
Adjusted R <sup>2</sup>	0.004	0.006

Note: Table 7 reports coefficient estimates from ordinary least-squares (OLS) regressions. The dependent variables are green bond number of issues and green bond issue volume in billion United States dollars. The independent variable is whether the government is from the left wing party. Variable definitions are provided in Appendix 1. Reported in the parentheses are t-statistics. \*\*\*, \*\*, and \* represent 1%, 5%, and 10% statistical significance level.

Source: Author's estimates.

## Appendix 1: Variable Definitions

### Panel A: Country Level Variables

Variable	Definition	Source
<i>Total green/GDP</i>	Total green bond dollar volume from 2007 to 2019 divided by GDP over the same period	Bloomberg, Factiva, World Bank
<i>Government green/GDP</i>	Total green bond dollar volume issued by government entity from 2007 to 2019 divided by GDP over the same period	Bloomberg, Factiva, World Bank
<i>Private sector green/GDP</i>	Total green bond dollar volume issued by nongovernment entity from 2007 to 2019 divided by GDP over the same period	Bloomberg, Factiva, World Bank
<i>Number of green bond</i>	Number of green bond issuances for each country from 2007 to 2020	Bloomberg, Factiva
<i>Volume of green bond</i>	US dollar volume of green bond issuances for each country from 2007 to 2020	Bloomberg, Factiva
<i>Number of social bond</i>	Number of green bond issuances for each country from 2009 to 2020	Bloomberg, Factiva
<i>Volume of social bond</i>	US dollar volume of green bond issuances for each country from 2009 to 2020	Bloomberg, Factiva
<i>Number of pandemic bond</i>	Number of green bond issuances for each country from January 2020 to September 2020	Bloomberg, Factiva
<i>Volume of pandemic bond</i>	US dollar volume of green bond issuances for each country from January 2020 to September 2020	Bloomberg, Factiva
<i>GDP growth</i>	GDP growth in US dollar	World Bank
<i>GDP per capita</i>	GDP per capita in US dollar	World Bank
<i>Unemployment rate</i>	Unemployment divided by total labor force	World Bank
<i>CO<sub>2</sub> emission/GDP</i>	CO <sub>2</sub> emission (in kiloton) divided by country GDP	World Bank
<i>Export/GDP</i>	Exports of goods and services divided by GDP	World Bank
<i>BBB rating or above</i>	Arithmetic mean of sovereign credit rating by Moody's, S&P, and Fitch.	Moody's, S&P, and Fitch
<i>Long-term orientation</i>	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)
<i>Indulgence</i>	In an indulgent culture it is good to be free.	Hofstede (2010)
<i>Masculinity</i>	Masculinity is the extent to which the use of force is endorsed socially.	Hofstede (2010)

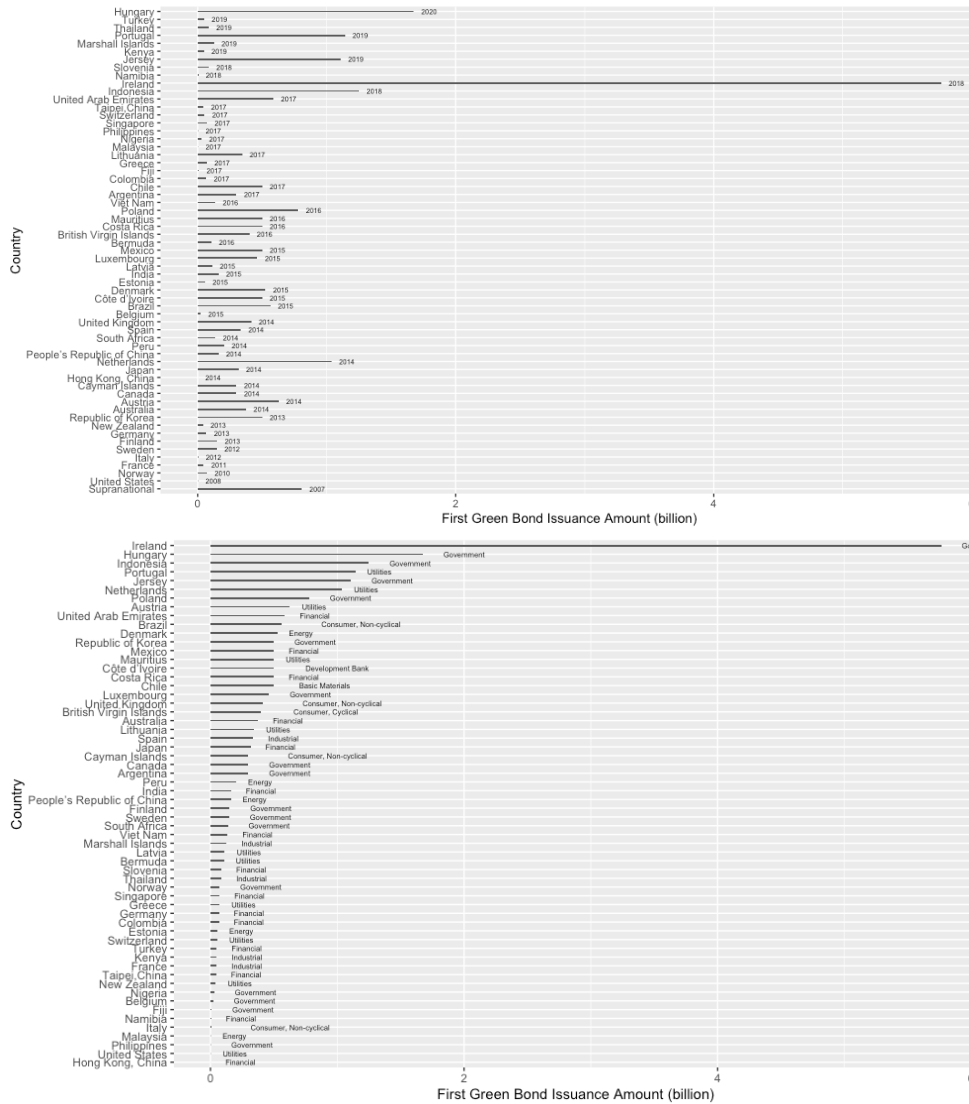
<b>Variable</b>	<b>Definition</b>	<b>Source</b>
<i>Uncertainty avoidance</i>	Uncertainty avoidance deals with a society's tolerance for uncertainty and ambiguity.	Hofstede (2010)
<i>Individualism</i>	Individualism is the extent to which people feel independent as opposed to being interdependent as members of larger wholes.	Hofstede (2010)
<i>Left right party</i>	0--10 scale mean value in left/right dimension with data from Benoit and Laver (2006).	Holger and Manow (2019)
<i>English origin</i>	Equals to 1 if the country legal origin is from English common law	La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998)
<i>Credit right</i>	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)
<i>Google search volume</i>	Google search index for each word within country. For example, searching for "Green bond" in the United States.	Google Trend

## Panel B: Firm Level Variables

Variable	Definition	Source
<i>Size</i>	Logarithm of net sales or revenues	Worldscope Item 1001
<i>ROA</i>	Net income divided by total assets	Worldscope Item 8326
<i>Leverage</i>	Total debt dived by total asset	Worldscope Item 8236
<i>Cash holding</i>	Cash and cash equivalents divided by total current asset	Worldscope Item 8111
<i>Current ratio</i>	Current asset divided by current liabilities	Worldscope Item 8106
<i>Maximum drawdown</i>	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
<i>Buy and hold return January 2020–June 2020</i>	Buy the stock from January 2020 and hold until the end of June 2020, the monthly cumulative return of the stock	Compustat Global
<i>Green bond issue before 2020</i>	Dummy variable for whether the firm has issued green bond before 2020	Bloomberg, Factiva
<i>Green bond issue at 2020</i>	Dummy variable for whether the firm issued green bond during 2020	Bloomberg, Factiva
<i>CAR for green bond</i>	Cumulative abnormal return using the CAPM model and country index as market	Compustat global, Bloomberg, Factiva

CAPM = capital asset pricing model, CAR = cumulative abnormal returns, CO<sub>2</sub> = carbon dioxide, GDP = gross domestic product, ROA = return on assets, US = United States.  
Source: Author's compilation.

## Appendix 2: First Green Bond Issuance for Each Country



Source: Author's compilation.

### Appendix 3: Top Investment Banks for Green Bond Underwriting

<b>2019 Rank</b>	<b>Lead Manager</b>	<b>Volume (\$ million)</b>	<b>2018 Rank</b>	<b>Lead manager</b>	<b>Volume (\$ million)</b>
1	HSBC	14,823	1	Crédit Agricole CIB	10,532
2	Bank of America Merrill Lynch	13,974	2	Bank of America Merrill Lynch	9,836
3	Credit Agricole CIB	13,699	3	HSBC	8,880
4	JP Morgan	11,790	4	BNP Paribas	8,032
5	Citigroup	11,750	5	Citigroup	6,867
6	BNP Paribas	11,326	6	JP Morgan	5,878
7	Barclays	7,344	7	Barclays	4,891
8	Société Générale	6,919	8	SEB	4,708
9	Nordea	5,955	9	Société Générale	4,014
10	Goldman Sachs	5,912	10	ING	3,747

CIB = corporate and investment bank, HSBC = The Hongkong and Shanghai Banking Corporation.

Source: Environmental Finance.

#### Appendix 4: Converting Letter Ratings to Numerical Values

<b>Moody's</b>	<b>Moody's #</b>	<b>S&amp;P</b>	<b>S&amp;P #</b>	<b>Fitch</b>	<b>Fitch #</b>
Aaa	26	AAA	26	AAA	26
Aa1	25	AA+	25	AA+	25
Aa2	24	AA	24	AA	24
Aa3	23	AA-	23	AA-	23
A1	22	A+	22	A+	22
A2	21	A	21	A	21
A3	20	A-	20	A-	20
Baa1	19	BBB+	19	BBB+	19
Baa2	18	BBB	18	BBB	18
Baa3	17	BBB-	17	BBB-	17
Ba1	16	BB+	16	BB+	16
Ba2	15	BB	15	BB	15
Ba3	14	BB-	14	BB-	14
B1	13	B+	13	B+	13
B2	12	B	12	B	12
B3	11	B-	11	B-	11
Caa1	10	CCC+	10	CCC	10
Caa2	9	CCC	9	CCC	10
Caa3	8	CCC-	8	CCC	10
Ca	7	CC	7	CCC	10
Ca	7	C	6	CCC	10
C	6	D	5	DDD	5
C	6	D	5	DD	4
C	6	D	5	D	3

Source: Author's definitions.