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Factors Affecting Green Bond Issuance in Asia

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Abstract
Green corporate bonds are corporate bonds issued to invest in environmental protection projects according to the provisions of the Law on Environmental Protection. With the data range being the amount of green bonds issued by Asia-Pacific Countries in the period 2012-2020, we see that the economic value created per unit of CO2 and total national energy use is increasing while a decrease in inflation rate will increase the amount of bond issued. In addition, the legal corridor, strict environmental regulations, the Government's management mechanism and macroeconomic stability are factors that have an indirect but strong impact on the effectiveness of green bond issuance. Therefore, setting the goal of managing the financial market of the economy, the legal corridor for environmental regulations and bond issuance needs to be standardized and flexible, and policies issued need to be carefully researched. Impact the market. In addition, the government needs to avoid sudden policy changes that make investors feel insecure, and market fluctuations will have a strong and lasting impact on the macroeconomic stability of the economy.

Keywords: Green Bond, Economy, Investment

1. Introduction
According to the annual assessment of countries most affected by extreme weather events in the period 1997-2016, Vietnam ranked 5th in the 2018 Global Climate Risk Index and 8th in the 2018 Global Climate Risk Index. Long-term climate risk (CRI). New records are still set every year. The phrases "record heavy rain", "record heat", "record floods" have appeared increasingly popular in the mass media in Vietnam in recent years. 2017 is considered a record year for natural disasters in Vietnam, with more than 16 historic storms and floods that went against the law. The current average temperature in the North and North Central of Vietnam is 0.5-1.0°C higher than the average temperature of previous years according to calculations based on updated data of 30 years or more come here. The impact of climate change is happening even faster than expected, so it is necessary to have appropriate solutions to respond to climate change appropriately, avoid negative impacts and reduce negative impacts damage caused by climate change.
Therefore, Green Bonds (GB) are gradually gaining great attention in the policies of many countries around the world, including Vietnam, to promote green finance and move towards sustainability in the coming years. Green bond issuance is currently considered an effective means to attract capital from the private sector for projects with environmental and social benefits. This is an ongoing popular trend and plays an important role in meeting capital needs for a sustainable economy. In the context of rapid green economic development, especially after the Covid - 19 pandemic, people's awareness of the serious economic, social and health impacts has increased. The issuance of green bonds is part of this process, to ensure positive effects in both the short and long term. Therefore, the topic "Research on factors affecting green bond issuance - recommendations for Vietnam" has both theoretical and practical significance.

2. Research Overview
In 2022, Shanshan Wang and Derek Wang explored the relationship between ESG index and bond issuance performance in listed companies in China. By analyzing the individual impacts of the E, S and G indices, the authors found a positive correlation between the ESG index and the volume of green bond issuance of companies. In addition, implementing activities to improve ESG indicators not only promotes the growth of individual issuing companies, but also promotes the sustainable growth of companies listed on the market and the transformation process green of the National economy.
Fatica, Serena and Panzica (2020) use bond issuer data to examine the association between green bond issuances and waste output of non-financial firms. The results show that green bond issuers have a clear and more sustainable reduction in carbon emissions after issuance. The study also emphasizes the importance of the Paris Agreement on Climate Change (2015) from

promoting finance along with accelerating the low-carbon transition process to reduce climate risks.

Vincent Tawiah, Abdulrasheed Zakari & Festus Fatai Adedoyin (2021) [19] find the determinants of green growth in developed and developing countries when considering environmental and economic sustainability to 2030. With Using documents from 123 countries, empirical results show that economic development positively impacts green growth. However, trade openness is detrimental to green growth. Regarding factors related to energy, it is found that energy consumption negatively affects green growth, but renewable energy helps improve it significantly. During the analysis process, the author found that the level of influence of these factors differs between developed and developing countries. The results indicate that Countries at different levels will set different requirements to achieve the sustainable development goal by 2023.

Ki-Hoon Lee, Beom Cheol Cin and Eui Young Lee (2016) [20] found that effective environmental policy impacts a business's financial performance (measured by return on equity (ROE) and profitability). return on assets (ROA). The study uses data of Korean companies in the period 2011-2012 and uses two methods OLS and 2SLS, concluding that the relationship between implementing environmental responsibility and the company's ROA and ROE has a positive and statistically significant correlation.

Besides, there are many research articles on factors affecting the effectiveness of green bond issuance such as:

Qinghua Wang and Yaning Zhou (2019) [15] argue that the risk premium of green bonds has a great impact on the success of the issuance as it directly affects the costs of market issuers and the capital returns of investors. By using multivariate statistical regression; with the explanatory variables being micro and macro factors, Green certification factors, etc. The model has shown most of the negative correlations between the explanatory variables and risk insurance premiums, specifically: (i) Green certification factor (based on third-party green assessment can significantly reduce the risk premium of green bond issuance), (ii) micro factor (debt credit rating, duration The larger the bond and issuance scale, the stronger the liquidity of the green bond, the lower the risk fee), (iii) macro factors (market interest rates), (iv) factors from internal sources. issuance (principal debt, assets, return on net assets have a negative correlation). Limitations: the study considers risk premiums as the decisive key to the success of green bond issuance and trading but forgets other macro factors such as the environment, economic growth, HDI.

In the research of A. Russo, M. Mariani and A. Caragnano (2020), three factors that determine the performance of green bonds are focused: project characteristics, orientation of the issuer and policy of the Nation. The authors reviewed 1788 Green projects of 306 issuers in 85 countries and used the GLS method to find the results: (i) The performance of green bonds depends largely on the characteristics of the project, the projects Projects related to eco-tech products, pollution prevention and control and sustainable water management positively impact bond performance. (ii) With the issuer's orientation, becoming a company operating entirely in the green field also leads to higher bond performance. (iii) For the Country level perspective, the number of environmentally related technologies developed provides a significant impact on Green Bond performance, while a higher credit risk rating for the Country will reduces the effectiveness of GB.

Vuong and colleagues (2019) studied the factors affecting the issuance risk premium in China's green bond market. The main results show that debt credit rating, issuance time and issuance scale are three different factors that directly impact the risk premium in green bond issuance..

3. Research Methodology and Research Data

The method of general analysis and comparison aims to synthesize previous research results on green bonds to draw conclusions about factors affecting the issuance of green bonds.

Quantitative method: Regression estimation with panel data to analyze factors affecting green bond issuance in the World and Vietnam

From analyzing factors affecting green bond issuance: Environmental factors; Social factors impact; Legal factors; interest rate; inflation, credit ratings of bond issuers, the authors built a research model as follows:

$$GBI_{i,t}=\alpha_1+\beta_1 ESG_{i,t}+\beta_2 FB_{i,t}+\beta_3 Rating_{i,t}+\beta_4 GDP_{i,t}$$
$$\beta_5 Population_{i,t}+\beta_6 PBP_{i,t}+\beta_7 TES_{i,t}+\beta_8 PEC_{i,t}$$
$$+\beta_9 Trade_{i,t}+\beta_{10} Inflation_{i,t}+\varepsilon_{i,t}$$

Trong đó:

a_1: model constants
$\beta_2,\ldots,\beta_{10}$: Regression coefficient
e: Residual of the regression equation
i: National research
t: Year of research

Dependent Variable

$GBI_{i,t}$: Number of GB issued by Country i in year t.

Independent Variables

$ESG_{i,t}$: Country i's Environmental, Social and Governance score in year t.

$Fiscal\ balance_{i,t}$: Fiscal balance of Country i in year t

$Rating_{i,t}$: Credit rating score of Country i in year t

$GDP_{i,t}$: GDP per capita of Country i in year t

$Population_{i,t}$: Population of Country i in year t

PBP - $Production-based\ CO2\ productivity_{i,t}$:

Economic value created per unit of CO2 in Country i in year t

TES-Total energy supply_(i,t): Total energy supply of Country i in year t

PEC-Primary energy consumption_(i,t): Primary energy consumption of Country i in year t

Trade_(i,t): Trade openness of Country in year

$Inflation_{i,t}$: Inflation coefficient of Country i in year t

The above research model is used to test the following research hypotheses:

Hypothesis H1: ESG index scores have a positive relationship with the green bond issuance volume of Countries.

Shanshan Wang and Derek Wang (2022) [12] explored the relationship between ESG index and GB issuance performance in Chinese listed companies. Specifically, the

authors argue that good ESG scores help listed companies achieve larger GB issuance. Or as in the research of Capelle-Blancard *et al*. 2016, 2019; Berg *et al*. 2016; Crifo *et al*. 2017; Margaretic and Pouget, 2018; Badía *et al*. 2019 pointed out the positive impact of ESG indicators on the bond market, contributing to reducing borrowing costs. Li *et al*.'s (2020) study analyzed the impact of ESG metrics on interest costs in the China GB market, showing that high ESG scores lead to reduced bond yields. Additionally, Prajapati *et al*. (2021) in their study of GB in India found that positive ESG is an important factor in investment decisions.

Hypothesis H2: The Fiscal Balance of a Country has a positive relationship with the volume of green bond issuance of Countries.

Anamaria Dan and Adriana Tiron-Tudor (2021) [9] argue that the fiscal balance is another important variable leading to an increase in GB issuance. Specifically, stability in the economic environment will increase investor confidence, leading to higher demand for GB investment. The group's hypothesis is also similar to the conclusions of previous studies by Yamahaki and colleagues (2020) or Balima and Combes (2019) when studying the impact of fiscal balance in developing the GB market.

Hypothesis H3: Country credit rating (Rating) has a positive relationship with the volume of green bond issuance of countries.

According to the research results of Anamaria Dan and Adriana Tiron-Tudor (2021) [9], credit rating scores have a positive and significant impact on GB issuance. Investors rely on the credit rating of the issuer's default risk level. High rating-increased credit reputation. The group's hypothesis is also similar to the conclusions of Barua and Chiesa (2019), Benito and colleagues (2016) or Bastida and colleagues (2017). All three hypotheses above assume that the financial health of the issuer plays an important role in influencing the volume of GB issued.

Hypothesis H4: GDP has a positive relationship with business profitability.

The size of the economy positively affects the likelihood of issuing GB according to Tolliver *et al*. (2020). Or as in the conclusion of Presbitero *et al*. (2016), the authors believe that economic scale and high GDP per capita are characteristics of countries that regularly issue GB. To strengthen the above hypothesis, the group cited the conclusion of Glomsrød and Wei (2018) that the growth of green finance is similar to the GDP growth of countries around the world.

Hypothesis H5: Population of a Country has a positive relationship with the volume of green bond issuance of Countries.

The hypothesis is explained by the conclusion of Presbitero *et al*. (2016) that population positively affects the issuance of Government bonds.

Hypothesis H6: The economic value created per unit of CO2 (PBP) has a negative relationship with the green bond issuance volume of Countries.

The team based this hypothesis on the conclusion that green issuers show a decrease in the carbon emission level of their assets after borrowing on the green segment Serena Fatica, Roberto Panzica (2021). Or in the study of Mohammed Benlemlih, Jamil Jaballah, Lamya Kermiche (2022), the authors investigated how the issuance of GB affected the carbon emissions and environmental performance of companies. The authors argue that the issuance of GB significantly improves the overall environmental performance of companies and their capacity to create new environmental technologies and processes.

Hypothesis H7: A Country's trade openness (Trade) has a positive relationship with the volume of green bond issuance of Countries.

This hypothesis is first inherited from the conclusion of Toliver and colleagues (2020), when the authors believe that trade openness is an important factor when considering the influence of the Government bond market. Phu. Next, this hypothesis is also reinforced by the conclusion of Capelle-Blancard *et al*. (2019), when the authors argue that a high level of trade openness leads to a narrowing of the interest rate gap between bonds.

Hypothesis H8: The inflation coefficient of the Country (Inflation) has a positive relationship with the volume of green bond issuance of Countries.

First of all, this hypothesis is supported by the conclusion of Nickel *et al*. (2011). The authors believe that higher inflation rates lead to macroeconomic instability, reducing the Government's credit capacity. In addition, inflation rates play an essential role in the access to long-term finance of the new EU States (Alexopoulou *et al*. 2010). In particular, Presbitero and colleagues (2016) found that high inflation rates lead to a decrease in the ability to issue government bonds, and increase borrowing costs in subsequent issuances. In addition, the inflation rate is a financial factor that affects the expansion of the green market, high inflation levels negatively affect investors' decisions according to Anh Tu *et al*. (2020) [8].

Table 1: Summary of variables in the research model

Symbol	Variable name	Where to get data	Define
GBI	Number of GB issued by Country	According to data from the Climate Bonds Initiative	Total GB issued by each Country.
ESG	Country Environmental, Social and Governance Score	According to World Bank data	According to World Bank data Based on information that the rating organization collected through surveys, combined with other data.
Fiscal Balance	National fiscal balance	According to World Bank data	Số tiền mà Chính Phủ nhận được từ doanh thu thuế và tiền bán tài sản, trừ đi mọi khoản chi tiêu của Chính Phủ
Rating	According to World Bank data	Gross domestic product of the Country for the year divided by the average population for the corresponding year.	Scores are converted based on national credit rating from Fitch Ratings.
GDP	GDP per capita of the Country		
Population	Population of the Country	According to World Bank data	Calculated according to the total population of each Country.
PBP	Economic value is created per	According to OECD data	Economic value is created per unit of CO2 emitted.

	unit of CO2		
TES	Total energy supplied	According to OECD data	Total energy supply is calculated as energy production plus energy imports, minus energy exports.
PEC	Primary energy consumption	According to OECD data	Primary energy consumption measures the total primary energy consumption of a Country.
Trade	Country's trade openness	According to World Bank data	Take the total value of imports and exports divided by GDP.
Inflation	National inflation coefficient	According to World Bank data	Inflation rate = (log Po - log P-1) x 100%.

Data taken from: 15 GB Issuing Countries in Asia, over 9 years, with a total of 135 observations

4. Analyze Research Results

After analyzing correlation and checking for multicollinearity, the authors conducted regression analysis as follows:

After conducting regression analysis with the Pool OLS method, the team continued to test for heteroscedasticity with the imtest, white command and test for autocorrelation with the xtserial command.

The command imtest, white gives the result Prob > chi2 < 0.005

```
White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

   chi2(65) = 123.81
Prob > chi2 = 0.0000

Cameron & Trivedi's decomposition of IM-test
```

The xtserial command gives the result Prob > F < 0.005

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      14) =     64.694
           Prob > F =      0.0000
```

The team found that the model had both heteroscedasticity and autocorrelation. Therefore, the team continued to estimate the results using the FEM and REM models.

Table 2: Summary of estimation results with OLS, FEM and REM methods

Variable	Pool OLS		FEM		REM	
	Co.efficient	P value	Co.efficient	P value	Co.efficient	P value
ESG	-2.73e+07	0.711	-2.38e+07	0.872	-2.73e+07	0.71
FB	23735.61	0.921	17994.25	0.926	23735.61	0.921
Rating	3.00e+08	0.188	-1.76e+08	0.651	3.00e+08	0.186
GDP	53075.7	0.237	3.565.587	0.969	53075.7	0.235
Population	-1.953.743	0.248	-3.589.315	0.019	-1.953.743	0.246
PBP	4.09e+08	0.046	3.25e+09	0.000	4.09e+08	0.044
TES	6535023	0.000	4.30e+07	0.000	6535023	0.000
PEC	-12676.36	0.489	-16012.88	0.268	-12676.36	0.488
Trade	-4.88e+08	0.351	4.30e+09	0.185	-4.88e+08	0.349
Inflation	-2.16e+10	0.107	-1.35e+10	0.379	-2.16e+10	0.105
_cons	-3.51e+09	3.24e+09	-3.51e+09	3.24e+09	-3.51e+09	3.24e+09
R-squared	0.5508		0.5508		0.5078	
Prob> F	0.0000		0.0000		0.0000	

Source: Descriptive statistical results from STATA software

The study conducts model regression with different methods to select the most accurate results based on the models: Using Pool OLS Pooled Least Squares method, FEM fixed effects model, and the REM random effects model, the team compiled the estimation results and presented them in Table 2.

Results from the FEM fixed effects model show that the dependent variable GBI is influenced by three independent variables Population, PBP and TES. In which the two variables PBP and TES have a positive impact on the dependent variable GBI. On the contrary, the GBI variable is negatively affected by the independent variable Population. The remaining variables have p-value > 0.1 so they are not statistically significant.

Next, the results from the random effects model REM show that the dependent variable GBI is only influenced by two independent variables, PBP and TES. Through the results of the REM model, we see that both independent variables PBP and TES have a positive influence on the dependent variable GBI. The remaining variables have p-value > 0.1 so they are not statistically significant.

The team used the Hausman test to check the fit between the FEM fixed effects model and the REM random effects model in testing the fit of the two models.

```
Test of H0: Difference in coefficients not systematic

    chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            = 106.91
Prob > chi2 = 0.0000
(V b-V B is not positive definite)
```

Prob = 0.0000 < 0.05 so the FEM fixed effects model is more suitable to explain the results.

To continue checking the accuracy of the estimates, the team continued to check for model defects, including heteroskedasticity and autocorrelation.

To check the phenomenon of heteroskedasticity of the FEM model, the team used the xttest3 command and performed the Modified Wald test. The results show that Prob = 0.0000 < 0.05, showing that the FEM model has heteroscedasticity.

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (15)  =    8734.11
Prob>chi2 =      0.0000
```

Next, the team used the xtserial command to perform the Wooldridge test on the autocorrelation phenomenon of the model. With the result Prob = 0.0000 < 0.05, the team concluded that the FEM model has autocorrelation phenomenon.

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      14) =     64.694
           Prob > F =      0.0000
```

Thanks to the above two results, the team concluded that the FEM estimation method has the phenomenon of heteroskedasticity and autocorrelation, so to overcome the above defects, the research team used the estimation method. Least squares GLS to overcome the above phenomena.

Table 3: Using the GLS Method to overcome autocorrelation and heteroscedasticity in regression results

Variable	Co.efficient	P value
ESG	-7096329	0.771
FB	-13975.48	0.671
Rating	2.37e+07	0.694
GDP	16260.23	0.259
Population	0.2192656	0.838
PBP	1.73e+08	0.037
TES	3435080	0.008
PEC	-3.031.051	0.368
Trade	-6.25e+07	0.782
Inflation	-5.54e+09	0.026
_cons	-9.25e+08	**0.353**
Prob> chi2		0,0000
Mức ý nghĩa		*** 10%; ** 5%; *** 1%**

Source: Descriptive statistical results from STATA software

Looking at the regression results using the GLS method to overcome the phenomenon of heteroskedasticity and autocorrelation, we can see:

The independent variables ESG, FB, PEC, and Trade are negatively correlated with the dependent variable GBI, however these results are not meaningful because the p value is greater than 5%. On the contrary, the independent variables Rating, GDP and Population have a positive correlation with the dependent variable GBI, but these results are not meaningful because the p value is greater than 5%.

The two independent variables PBP and TES have a positive correlation with the dependent variable GBI, while the variable Inflation has a negative relationship with the dependent variable GBI with statistical significance at the 5% level.

Discuss the Results as Follows:

Economic Value is Created Per Unit of Carbon

PBP is positively correlated with the dependent variable GBI, which means Production-based CO2 productivity: The increase in economic value created per unit of CO2 or (GDP/CO2) will affect the amount of GB issued. the larger, specifically: economic growth and reduced CO2 emissions cause GB issuance to increase. The results of the model provide similar conclusions compared to previous research by the author group José García, Herrero, José Luis, Mari (April 2023) when it was assumed that companies after issuing GB record the index Better environment, lower CO2 emission volume.

Total Energy Supply of the Nation

Meanwhile, TES also has a positive correlation with GBI. This can be explained by the fact that as the total energy supply increases, the volume of GB released increases. According to the OECD definition, total energy supply means the total volume of energy production plus energy imports, minus energy exports. Therefore, it can be simply understood that the total energy supply of a Country is the total energy source that can provide for that Country's activities.

Inflationary

And finally, Inflation-inflation has a negative correlation with GBI. This result is similar to the group's expectations. This shows that the more GB issued by Countries in the Asia and Pacific region, the more they contribute to reducing their own inflation. This is an extremely important conclusion because in recent years, the inflation rate of many countries has continuously increased, causing social imbalance.

5. Conclusion

The research focuses on using quantitative research methods with panel data from 15 countries in the Asia and Pacific region between 2012 and 2020. Methods such as Pooled OLS regression, the random effects model REM, the fixed effects model FEM and the least squares estimation method GLS are used to analyze the factors affecting the GB issuance volume. The results from running these models will be presented and analyzed in detail in Chapter 4, in order to propose solutions to improve the ability to issue GB in countries of the Asia and Pacific region.

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