The firm-and country-level determinants of green investments:
An empirical analysis

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Abstract

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This paper examines the determinants of corporate green investments (GI) by using a series of both firm- and country-level factors. We use environmental expenditures as a proxy for green investments on a firm level. We find that bigger firms tend to invest more in green projects, whereas more profitable firms are less likely to go green. In terms of country-level determinants, we find that GDP per capita and surface area are negatively related with GI， while population is positively associated with GI. Firms in English common-law countries and English-speaking countries invest less in GI than firms in other countries. To verify the results of our country-level determinants, we also perform a country-level test that employs a country's ecological footprint as the proxy for GI. Our results are mostly in line with our firm-level analysis.

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1. Introduction

There is no doubt that climate change and environmental pollution are two of the most severe problems we are facing today. In order to mitigate their negative effects, every country should have low-carbon, climate-resilient (LCR) development and environmental sustainability as a policy goal. To achieve this goal, both firms and governments should invest in green energy and environmental protection on a much larger scale than previously.

Admittedly, Green Investments (GI) has accelerated in recent years due to rapid technology innovations and policy support. According to the Global Trends in Renewable Energy Investment report (2016), released by the United Nations Environment Programme (UNEP) and Bloomberg New Energy Finance (BNEF), 2015 saw a new record in global investments in renewable energy. The amount of money spent on renewables (excluding large hydro-electric projects) rose by 5% to $285.9 billion, exceeding the previous record of $278.5 billion obtained in 2011.

Although GI has been growing rapidly, the drivers of GI have been scarcely researched. One of the first papers in this area, Eyraud et al. (2013) show a positive association between countries' GDP and green investments. The study also reports that an increase in oil prices tends to motivate firms to go green. However, it is still unknown whether other firm- and country-level indicators determine GI. For instance, these factors could include a country's legal environment, political system, natural environment (e.g. pollution, land usage, and population density), as well as the predominant religion and cultural orientation of the country's citizens.

The goal of this study is to explore the key determinants of GI using a series of firm- and country-level indicators collected for a broad cross-section of developed and developing economies. To accomplish this, we will first define the concept of green investments. Eyraud et al. (2013) define GI as the investment necessary to reduce greenhouse gas and air pollutant emissions, for example, investing in renewable energy technologies, without significantly reducing the production and consumption of non-energy goods. In this paper, we will expand this definition of green investment by including all investment activities that focus on projects that are committed to environmentally conscious business practices.

In particular, we will study green investments from the perspective of both countries and firms. We will examine whether certain firm characteristics and country-level factors e.g. macroeconomic factors, institutional factors, cultural factors etc., influence the firm's

environmental expenditures. It is worth noting that although we use the term "firm-level study" to refer to the set of analyses where the firm's environmental expenditures are the dependent variable, the independent variables in this study include both firm and countrywide factors. In a separate country-level study, we will confirm our firm-level results by focusing exclusively on aggregate country-level green investments and their determinants.

A number of findings of this survey are in stark contrast to previous research on determinants of green investments. Specifically, we find that firms in countries with higher GDP per capita and higher CPI are less likely to go green. Furthermore, firms in civil-law countries invest more in the environment than those in common-law countries, while firms in English-speaking countries and Protestant-practicing countries are less likely to undertake green investments than firms in other language-speaking countries. Among the country factors, CO_2 emissions, population, and creditor rights are positively associated with the level of GI, which are in line with our hypotheses. Regarding the firm-level determinants, we find that bigger firms and higher valued firms tend to invest more in the environment, whereas the more profitable the firm, the less it invests in green projects.

Because many of these findings are not as expected, we perform a robustness test which includes only country-level determinants. In this study, however, we will use a country's ecological footprint instead of environmental expenditures as a proxy for green investments. Based on the Living Planet Report (2000), the ecological footprint measures a population's consumption of food, materials, and energy in terms of the area of biologically productive land or sea required to produce those resources and to absorb the corresponding waste. According to Issoufou and Ouattara (2011), the rationale for using a country's ecological footprint as a proxy for green investment is that a decrease in this variable implies a reduction in the aforementioned demand on the biosphere and this decrease is analogous to relieving the pressures on the environment. In other words, the size of a country's ecological footprint is, presumably, closely associated with the amount of green investments it undertakes. Accordingly, higher green investments translate into a lower ecological footprint and vice versa[1].

Nevertheless, our observations are still similar to the firm-level study. First, GDP per capita is negatively related to GI. Second, civil law countries are more likely to undertake green

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[1] To the best of our knowledge, no one has actually proven this link.

investments than common law countries, while English-speaking countries are less likely to invest in green projects than countries with other languages. Moreover, just like firm-level test, population is positively related with GI, while surface area is negatively related with GI.

In summary, we will examine whether a firm's financial factors, macroeconomic indicators and various governance, institutional, legal, political, environmental and cultural measures encourage green investments on both the firm and aggregate country level. Our project will contribute to the finance literature on sustainable investments as well as to the newly emerging literature that examines the association between sustainable investments, ethical finance, and economic growth. Our advantage compared with other research is that we examine the influences of some determinants that has never been studied earlier on GI, i.e. shareholder rights, creditor rights, legal origin, language, and religion. The findings of our research will not only contribute to the academic literature in these areas but will also have important implications for both regulators and policymakers.

2. Literature review

2.1 Literature review

The literature on environmental economics has largely overlooked the firm-level and country-level determinants of GI. However, a few specific determinants have been studied in some detail, in particular those that bear an obvious relationship to GI such as environmental policies. Johnstone et al. (2010) find that public policies have a very significant influence on the development of new technologies in the area of renewable energy. Nesta (2014) reports that the combination of environmental policies and market deregulation is the most effective method of facilitating renewable energy innovation.

Nearly all countries now have renewable energy support policies in place. As of year-end 2015, renewable energy policies were in place in 146 countries based on the Renewables 2016 Global Status Report (GSR, 2016). Countries around the world continue to develop new policy measures to support renewable energy investments. According to Eyraud et al. (2013), specific public interventions to support GI can be useful. In particular, feed-in-tariffs (FIT) stand out as one of the most important instruments for supporting the expansion of GI; countries undertake two to three times more GI when adopting such a scheme.

Other studies have examined the regulatory determinants of environmental innovation. Porter and van der Linde (1995) illustrate that environmental regulations can create pressure and a motive for environmental innovation. Similarly, Jaffe and Palmer (1997) find a significant positive relationship between regulatory compliance expenditures and environmental R&D expenditures. Brunnermeier and Cohen (2003) reveal that increased monitoring and enforcement are likely to lead to more environmental innovation because firms tend to comply with regulations when faced with the threat of penalties.

Few studies, however, have undertaken an empirical investigation of a wide range of country-level drivers of GI, such as macroeconomic factors, size and culture. Stern (2004) states that there are larger environmental expenditures and more environmental innovation in higher-income countries. In a recent study, Eyraud et al. (2013) examine the effect of a series of macroeconomic factors on green investments, including GDP, GDP per capita, inflation, income, and interest rates. Their results suggest that higher GDP growth and higher income level result in an increase in GI, while interest rates are negatively associated with GI.

In addition to macroeconomic factors, Eyraud et al. (2013) report that population variables could have an impact on GI. Countries with rapidly increasing populations face important energy needs, but traditional energy resources are sometimes not able to meet these needs because of scarce fossil fuels. To make up for this shortfall, investments in alternative energy sources and green technologies are required. In addition, an accelerating population may boost the capital market. We thus expect a positive relationship between population and GI, as is found in other, more general, models of investment.

Moreover, technological progress can be a significant driver of GI. R&D spending on the environment in particular is of vital importance for the expansion of GI. There is no denying that a firm's technological capabilities can induce environmental innovation (Horbach, 2007). Furthermore, Eyraud et al. (2013) hypothesize that GI is positively associated with R&D spending and human capital variables.

Another related study, by Jaraitė et al. (2012), researches the effects of various determinants on firms' environmental expenditures and investments. They report that more profitable and more energy-intensive firms are more likely to undertake environmental expenditures. Additionally, firms belonging to the EU Emission Trading System (EU ETS) are observed to spend more on environmental R&D. In terms of environmental investments, they find that larger firms and ETS

firms are more likely to make such investments. Furthermore, ETS firms are more likely than non ETS firms to make investments targeted at reducing air pollution. Finally, Haller and Murphy (2012) demonstrate that bigger and older firms are more likely to spend on environmental protection.

2.2 Hypotheses development

Although previous studies have focused, to a limited extent, on economic growth, regulation, population and policy as determinants of environmental expenditures and green investments, to the best of our knowledge, very few studies have paid attention to institutional or cultural factors. There is now common consensus that institutional factors, such as legal origin and investor rights, and cultural factors, e.g. religion, have a great influence on investment. This study attempts to bridge the gap by examining the effect of these factors on environmental investment.

2.2.1 Firm-level factors

Recent studies (Haller and Murphy, 2012, and Jaraitė et al., 2012) have suggested that larger firms are more likely to be more polluting and hence are more likely to undertake environmental expenditures and investments. Moreover, Jaraitė et al. (2012) maintain that more profitable firms tend to spend more on environment. Accordingly, we will hold the same hypotheses that larger firms and more profitable firms are more likely to invest in environment.

Except for size and profitability, we suppose that firm value and firm's leverage could also influence GI. Myers (1977) show that if a firm's debt overhang is large enough, it can mitigate firm's fund raising for positive net present value (NPV) projects. As a result, in this paper, we assume that firm's leverage is negatively related with GI. Furthermore, we hypothesize that higher valued firms are more likely to invest in green projects.

2.2.2 Macroeconomic factors

Eyraud et al. (2013) have shown the influences of several macroeconomic factors, such as GDP per capita, GDP growth, CPI and gasoline prices on GI. We will employ these same factors in our study. Our hypotheses are that all these economic determinants are positively associated with green investments and environmental expenditures.

Furthermore, economic freedom is an important indicator of the macro-economy. Economic

freedom measures the extent to which rightly acquired property is protected and individuals are free to engage in voluntary transactions (Haan and Sturm, 2000). Doucouliagos and Ulubasoglu (2006) perform a meta-analysis showing a positive and statistically significant association between economic freedom and economic growth. In our study, we assume that countries with higher freedom are more likely to invest in green projects.

2.2.3 Institutional factors

According to La Porta et al. (LLSV, 1996) and Demirgüç-Kunt and Levine (2005), the commercial law of almost all countries can be classified into four legal origin categories, namely English, French, German, and Scandinavian law. The biggest difference lies between English common-law countries and French civil-law countries. The former afford both shareholders and creditors the strongest protections, while the latter protect investors the least.

The effects of legal origin and investor protection on firms' investment and access to external finance have been widely analyzed. LLSV (1997) find that French civil-law countries have both the weakest investor protections and the least developed capital markets, compared with common-law countries. Zhang and Zhao (2012) assume that in countries with stronger investor protection laws, managers and shareholders are less likely to abuse the firm's resources and more likely to invest in projects that benefit shareholders. In addition, they find that it is much easier for firms to secure external finance in countries with stronger investor protection laws. Benmelech and Bergman (2011) demonstrate that good legal protection of creditors makes it easier for firms to make large capital investments. Based on these studies, we hypothesize that common-law countries with stronger investor protection are more likely to invest in renewable energies.

However, there is doubt as to whether investing in green projects benefits shareholders. In a study of corporate social responsibility (CSR), Chih, Chih, and Chen (2009) observe that stronger shareholder rights have a negative impact on the incentives of firms to engage in CSR activities, since engaging in such activities may incur a substantial cost. Similarly, firms with stronger investor protection may not be willing to undertake green investments when such investments are in conflict with shareholders' goal of value maximization.

A country's political system and regime type also have a considerable indirect influence on economic performance and investment behaviour. However, the precise nature of this

relationship, e.g., whether democracy has economic benefits, is not entirely clear. Drury et al. (2006) argue that democracy allows for the eviction of incompetent politicians who may harm the economy. Furthermore, democracy may motivate citizens to work, save, and invest. Zouhaier and Karim (2012) find a positive relationship between democracy and investment. In contrast, Przeworski and Limongi (1993) argue that democracy unleashes pressures for immediate consumption, which occurs at the cost of investment, and hence of economic growth. Our hypothesis is that democratic countries are more likely to go green.

2.2.4 Cultural factors

On a country level, culture plays a significant role in explaining countries' financial development. In much of the previous literature, religion has been used as a proxy for culture. La Porta et al. (1999) study the quality of government and demonstrate that predominantly Protestant countries have better government than either predominantly Catholic or predominantly Muslim countries. Stulz and Williamson (2003) examine the relationship between the country-level factors culture and legal origin and financial development. Specifically, they show that religion is correlated with the development of debt markets and that legal origins are correlated with stock market development.

Language has also been commonly used as a proxy for culture. Stulz and Williamson (2003) examine the nature of the relationship between cultural factors (including language) and investor rights. They find that English-speaking countries and Protestant countries afford shareholders more rights than countries with other predominant languages and religions. Furthermore, countries whose primary language is English have a significantly higher anti-director rights index than countries with other predominant languages. Therefore, we expect that English-speaking countries and Protestant countries are more likely to make green investments.

2.2.5 Environmental factors

Our environment is under threat due to inappropriate human activities. Billions of tons of carbon emissions are steadily driving up the planet's temperature and are creating significant and harmful impacts on our health, environment, and climate. To better mitigate the negative effect carbon emissions brings about, each country should adopt green technology to reduce greenhouse emissions and air pollution. Thus, we expect countries with higher levels of greenhouse gas

emissions and air pollution to be more inclined to undertake GI.

2.2.6 Demographic factors

According to Eyraud et al. (2013), countries with larger populations are more likely to invest in green projects. In this paper, we expect the same relationship between population and GI. Given that population size is correlated with physical size, we further hypothesize that the surface area of a country is positively associated with GI.

3. Data

3.1 Samples and dependent variable

In our firm-level estimations, we employ environmental expenditures (the expenditures that firms make in the environment) as a proxy for green investments. More specifically, we employ the natural log of environmental expenditures as the dependent variable. The data are obtained from Datastream in the category of Environmental, Social and Governance (ESG). Datastream provides information on environmental expenditures from 2002 onwards, thus we calculate the variable for the 2002-2015 period. Forty countries have firms that disclose their environmental expenditures. Specifically, 123 firms in North America and 640 firms in the rest of the world announce their environmental expenditure. Our final sample consists of 5,582 firm-year observations.

3.2 Independent variables

To examine the determinants of firms' environmental expenditures, we employ the following financial characteristics of a firm: size, profitability, leverage, and Tobin's Q. Like the earlier literature, we hypothesize that firm size and profitability are positively related with green investments. Besides, we add leverage and Tobin's Q in our study. We think that firms with lower leverage and higher value are more likely to invest in green projects.

The country-level independent variables span a wide range of categories. Firstly, as mentioned above (see section 2.2.2), we expect that economic growth will lead to an increase in GI. Therefore, we consider GDP per capita, GDP growth, and CPI as indicators of the economic condition of a country. Our hypotheses are that all these macroeconomic factors have positive

influences on GI.

To measure economic freedom, we follow Haan and Sturm (2000) and use the Economic Freedom Index from the Heritage Foundation. It is a score ranging from 0-100, with a higher score implying greater economic freedom. It measures economic freedom based on 10 quantitative and qualitative factors: property rights, freedom from corruption, fiscal freedom, government spending, business freedom, labour freedom, monetary freedom, trade freedom, investment freedom, and financial freedom. We expect economic freedom index to be positively associated with GI.

We adopt the legal origin classification by Djankov et al (2007) which groups countries into five legal origins, i.e. English common law, French civil law, German civil law, Scandinavian civil law, and Socialist civil law. Because the biggest difference in legal origin lies between English common law and civil law, we use a dummy variable "Legalorigin" that equals 1 if the country adopts English common law and 0 otherwise. We assume that Legalorigin is positively related with GI.

To measure shareholder rights protection, we employ the anti-director rights index from La Porta et al. (1996, 1997). This index measures the voting power of stockholders and the strength of legal support for shareholders. We proxy creditor rights with a creditor rights index based on La Porta et al. (1996) and Djankov et al. (2007), in which the index measures the powers of the secured creditors in a corporate bankruptcy case. The values of the anti-director rights index and the creditor index for each country are taken from La Porta et al. (1996). We hypothesize that anti-director rights index and creditor rights index both have positive influence on GI.

To characterize the political regime, we employ the commonly used Polity IV data, which measure a country's level of democracy and autocracy, i.e. Democracy and Autocracy. We expect them to be positively related with GI.

Worldwide, feed-in-tariff policies for renewable energy continue to be a primary means for governments to express their commitment to renewable energy deployment. As a result, we construct a dummy variable, indicating whether a country imposes feed-in-tariff policies, as a proxy for the country's policy regarding green investments. Our expectation is a positive relationship between feed-in-tariff policies and GI.

Similar to Stulz and Williamson（2003）, we restrict our choice of proxies for culture to just two: language and religion. We define the primary religion (language) as the one practiced

(spoken) by the majority of the population of a country. Because Protestant and English are very different from other religions and languages, we employ two dummy variables which equal 1 if a country's main religion or language is Protestant or English, 0 otherwise. We use the CIA Factbook to collect data on language and religion. And we hold the hypotheses that firms in English-speaking countries and Protestant-practiced countries are more likely to make GI than firms in other countries.

We use the natural logarithm of CO2 emissions (measured in kilotons) and PM2.5 air pollution as proxies for the state of the environment. PM2.5 measures the microscopic solid or liquid matter suspended in the Earth's atmosphere. We expect that firms in countries with higher air pollution and more CO2 emissions invest more in the environment.

In addition to these macroeconomic, institutional, cultural, and environmental factors, we hypothesize that a country's population and surface area may determine the level of GI. We collect these two types of data from the World Bank Database.

Because we need to merge several datasets, there are some missing data during the merge. It is found that all variables have similar number of observations (over 5,000 observations) except for CO2 emissions (3,275), PM 2.5 (1,987) and Feedintariff (4,145). Moreover, we find that the range of Tobin's Q is very large (0.003-8,000), which is very confusing. To deal with this problem, we winsorize the lowest 5% and highest 5% of all Tobin's Q observations.

Table 1 provides precise definitions of all firm- and country-level variables described in this section. Table 2 shows the correlation results for all independent variable. We observe that Democracy is correlated with quite a few variables. Moreover, Legalorigin, English and Protestant are very correlated.

4. Methodology and results

4.1 Univariate analysis

To provide some insight into the variables we use in the subsequent regression analysis, and to allow for a comparison of our results with earlier studies, we perform a series of univariate tests to examine whether the mean and median of environmental expenditures differ across various subsamples of our dataset. Similar to Walker et al. (2014), we use two-sample t-tests to test for the significance of differences in means and Kruskal-Wallis median tests to test for the

significance of differences in medians between each set of subsamples. Median tests have the advantage of being more robust to outliers.

For all firm-level variables, we construct two sub-samples, one with values above the median and the other with values below the median. For the country-level variables, we construct sub-samples using the median of a range of independent variables, including GDP growth, GDP per capita, economic freedom, gasoline prices, CO2 emissions, PM2.5, population size and surface area. For anti-director rights, we divide the sample into countries with scores from 0-2 and those that score from 3-5, while for creditor rights, the samples are separated into two groups scoring 0-2 and 3-4, respectively. For the political regime variables, democracy and autocracy, we construct the sub-samples along a score of 5, i.e., one sample with scores 0-5 and the other with scores 6-10. The feed-in-tariff variable is used to divide the sample into countries with a feed-in-tariff policy and those without such a policy. Finally, for legal origin, the sample is separated into common-law countries and civil-law countries. The findings of all the univariate analyses are presented in Table 3.

First, we find that the mean and median tests show similar levels of significance for each variable. Thus, all numerical results presented hereafter refer to the mean value. Moreover, we find that there are significant differences for all firm-level variables. In particular, firms of bigger size, with higher leverage, and with higher Tobin's q invest significantly more in the environment (5.550, 5.227, and 7.195 versus 4.598, 4.929 and 2.928 for their respective counterparts), whereas firms with higher profitability invest less in the environment (4.556 vs 5.604). In terms of country-level variables, we surprisingly find that when firms are grouped based on macroeconomic factors, firms in countries with lower GDP growth, lower GDP per capita, lower CPI and less economic freedom invest more in the environment. Moreover, firms in countries with greater CO2 emissions, higher PM2.5, and larger populations tend to invest more in green projects. Similarly, firms that operate in countries or periods of higher gasoline prices invest more in green technologies. Firms that are located in countries with a larger surface area, on the other hand, invest less in the environment. When observing the effects of creditor rights and anti-director rights, we find that firms in countries with better shareholder rights invest more in the environment (5.724) than firms in countries with poorer shareholder rights (3.634). On the contrary, firms in countries with stronger creditor rights invest less in the environment. We further observe that firms in civil-law countries tend to invest more in the environment than those

in common-law countries. Democracy and autocracy are not significant in explaining differences in environmental expenditures. Lastly, firms in English-speaking and Protestant countries appear to invest less in green projects than firms in countries with other languages and religions.

4.2 Regression analysis

Because univariate analyses only allow us to examine the impact of one factor at a time without controlling for changes in other variables, we perform a series of ordinary least squares (OLS) regressions to determine which factors affect the environmental expenditures of firms. And according to the correlation results, Democracy, Legalorigin, English, and Protestant are very correlated. We thus run several models for them.

Specifically, we run only regressions using several groups of independent variables. The first regression includes the firm-level variables such as size, performance, leverage, and Tobin's Q. The second regression model only includes the country-level variables: GDP per capita, GDP growth, CPI, the Economic Freedom Index, gasoline prices, creditor rights, anti-director rights, feed in tariff policy, population, and surface area. We call this group of variables the "basic-country" variables. We exclude CO2emissions and PM2.5 because they have quite a few missing observations, which may affect our results. The third regression includes both the firm-level variables and "basic-country" variables. The fourth regression includes only firm-level variables, and environment variables, i.e. CO2 emissions, and PM 2.5. Furthermore, because democracy, autocracy legal origin, language, and religion are highly correlated, we add each kind of these variables into the subsequent firm-level regressions one at a time. For example, the fifth regression consists of firm-level variables, Democracy, and Autocracy. Because democracy and autocracy stand for the polity regime, we call them polity variables. The sixth regression includes firm-level variables, English, and Protestant.

The results of the firm-level regressions are shown in Table 4. In terms of the first regression with only firm-level financial variables, we find that all variables, with the exception of leverage, are significantly associated with environmental expenditures. And it is note-worthy that these significances exist throughout each regression. In particular, firm size and Tobin's Q are positively related to environmental expenditures, while ROA show negative associations. In the second regression in which we only employ the basic country-level variables, we find that almost all variables are significantly related with environmental expenditures. In particular, GDP per

capita, CPI, economic freedom, and surface area are negatively associated with environmental expenditure, while GDP growth, population, and creditor rights show a positive association. Moreover, when we combine the firm- and country-level variables, we find that firm-level variables still show great significance, even leverage does. The observations for the country-level variables are similar to those obtained for the second regression in spite of the fact economic freedom and gasoline price become significantly positively associated with environmental expenditures. As for the fourth regression that consists of firm characteristics, LN_CO2emissions and PM2.5, we observe a positive significance within CO2 emissions and environmental expenditures, but no significance between PM 2.5 and environmental expenditures. Moreover, when we add democracy and autocracy to firm-level variables, it is only found that democracy is negatively associated with environmental expenditures. In the sixth regression, we notice that legal origin demonstrates a significant negative association. For the regression that includes firm-level, religion as well as language variable, we find that English is significantly, negatively related with environmental expenditures, while Protestant shows no significance.

In summary, we demonstrate that bigger firms and higher valued firms are more inclined to invest in the environment, which are in line with our hypotheses. On the other hand, firms with greater profitability are less likely to invest in the environment. This finding may be driven by the fact that those less profitable firms use environmental investments as a differentiating factor and try to increase customer demand by portraying themselves as green firms. Leverage has no effect on firm's environmental expenditures.

With respect to our country-level variables, we find that firms in the countries with a stronger economy, e.g. higher GDP per capita, and higher CPI, are less likely to invest in the environment. In other words, firms in developed countries are less likely to spend on the environment. These findings are in contrast with our hypotheses. The reason for that may be explained by the conflict between economic growth and environment. Mishan (1967) argues that economic growth could has a negative effect on environment quality. They are two goals that could not be achieved simultaneously. Later research has proposed an inverted-U or "Kuznets" relationship between environment and economic development. (Kuznets, 1955, Grossman and Krueger. 1994). Particularly, as GDP per capita goes up environmental quality decreases down to a point, after which environment gets better. In other words, in the earlier stages of economic growth, as economy develops, environmental expenditures decrease. However, when the living standard of a

country has reached at a sufficiently high level, people will give greater attention to environmental protection.

Additionally, firms in countries with a greater surface area tend to invest less in the environment, while population is positively related with environmental investments. Not surprisingly, firms in countries with greater levels of CO_2 emissions tend to invest more in the environment. Moreover, firms in countries with better creditor rights are more likely to invest in the environment, which is in line with our hypotheses. Besides, we find no effect of democracy and autocracy on environmental expenditures. Also, feed-in-tariff policy and anti-director rights indicate no significant influence on environmental expenditures. Regarding legal origin, firms in common-law countries invest less in the environment than those in civil-law countries. We can explain this result based on the conflict between environmental expenditures and shareholder' value. Because English common law countries have stronger shareholder rights protection, firms in these countries treat shareholder value maximization as their first goal. Assuming environment investment is not good for firm's value, firms are less likely to make environment expenditures. In the last regression with language and religion variables, we find a negative relationship between English and environmental expenditures as well as a negative one between Protestant and environmental expenditures.

5. Robustness test

5.1 Country-level test

Although most of our results appear to have a logical explanation, several of them are in contrary to our initial hypotheses. To ensure that our results are not driven by our choice of variables, our choice of sample period, or the destruction of our main variables, we perform several robustness tests. First, we will use ecological footprint instead of environmental expenditures as dependent variable. As mentioned in the introduction, the ecological footprint measures a population's consumption of food, materials, and energy in terms of the area of biologically productive land or sea required to produce those resources and to absorb the corresponding waste. We assume that the lower ecological footprint, the higher the GI. It has to be noted that ecological footprint is a country-level variable, thus we perform a country-level test that includes country-level variables only.

The country sample is constructed based on ecological footprint data from the Living Planet Report released by the Global Footprint Network. Because Living Planet Reports are only available from 2000 to 2012, the ecological footprint data pertains to this period. Furthermore, some countries do not disclose their ecological footprint for the whole period. Therefore, our sample consists of footprint data for 1,925 country-years. And after merge of datasets, we find PM2.5 and Antidirector are only left 848 and 616 data, respectively.

The correlation results of independent variables are shown in Table 5. Similar to firm-level correlation analysis, Legalorigin, English, Protestant are very correlated with each other, thus we examine these variables separately from the other independent variables.

5.1.1 Univariate analysis

Similar to our firm-level tests, we use two-sample t-tests to test for the significance of differences in means and Kruskal-Wallis median tests to test for the significance of differences in medians between each set of subsamples. Median tests have the advantage of being more robust to outliers. Our subsamples are constructed in the same way as in our firm-level tests.

Our results are shown in Table 6. First, we observe that all macroeconomic factors indicate a large difference in the ecological footprint between the two sub-samples. However, countries with higher GDP growth and CPI have lower footprint scores (2.279 and 1.979, respectively) than countries with lower GDP growth and CPI (3.174 and 3.466, respectively), while countries with higher GDP per capita and economic freedom have higher footprint scores (3.998 and 3.833, respectively, compared to 1.405 and 1.791, respectively). In addition, the countries with higher gasoline price have significantly higher ecological footprint. we also observe a significantly higher footprint in countries with greater CO2 emissions (3.617 vs. 1.690), whereas PM2.5 shows no significance. A further finding is that countries with a smaller population have a higher footprint, while surface area does not seem to influence a country's ecological footprint. Subdividing the sample according to anti-director rights and creditor rights, we find that countries with better shareholder rights and creditor rights have a significantly higher footprint (4.035 and 3.592, respectively, compared to 3.561 and 2.497 for those with poorer rights). However, democracy and autocracy are not significant in explaining ecological footprint. Countries with a feed-in-tariff policy show a higher footprint score (2.896) than those without such a policy (2.479). Finally, our results illustrate that Protestant countries and English-speaking countries

have significantly higher footprints than countries with other religious denominations and languages.

5.1.2 Regression analysis

In this part we perform a series of regression analyses to test the influences of various determinants on ecological footprint. Because PM2.5 and Antidirector do not have as many observations as other variables, we will examine them individually. The first regression includes only the "basic-country" variables, i.e. GDP per capita, GDP growth, CPI, the Economic Freedom Index, gasoline prices, CO_2 emissions, creditor rights, feed-in-tariff policy, population and surface area. The second regression consists of "basic country" variables, PM2.5, and Antidirector. The third regression includes "basic-country" variables and polity variables, while the forth regression includes "basic country" variables and culture variables.

The findings can be seen in Table 7. We begin by analyzing the results for the country-level regressions. In the first regression, which considers only the effect of basic-country variables on ecological footprint, it can be seen that GDP per capita is significantly positively associated with ecological footprint, while GDP growth, CPI, and economic freedom show no significance. Moreover, we see a negative significant effect of population and a positive effect of surface on ecological footprint. And creditor rights is positively and significantly associated with the ecological footprint. In the second regression in which we employ PM2.5 and anti-director rights, we find no significance existed in PM2.5 and Antidirector. Regarding the third regression, it shows that Democracy and autocracy are not significant in accounting for green investment. In the fourth regression with legal origin included, we find a significantly positive relationship between legal origin and ecological footprint. Moreover, when we consider the regression that includes religion and language variables, it can be seen that English is significantly and positively related with ecological footprint, whereas Protestant has no effect on ecological footprint. Lastly, it is worthy noting that GDP per capita, population, surface, and creditor rights remain significant along all regressions.

In summary, we conclude that a country's GDP per capita is consistently positively associated with ecological footprint, indicating that more developed countries are less likely to invest in green projects. Moreover, countries with a larger population are more likely to invest in green projects, while countries with a larger surface area are less likely to go green. Besides, the

positive association between creditor and footprint indicates that countries whose creditor rights are stronger are less likely to spend on green technology. This is in line with the observation that English common law countries are less prone to green investment. Finally, we see that English countries invest less on green project than other language-spoken countries.

When one considers the findings for ecological footprint and environmental expenditures together, the following conclusions emerge. First, as the firm-level tests show, firms in countries with higher GDP per capita invest significantly less in the environment, which is also true for the country-level tests. Furthermore, both tests suggest that population is positively related with GI, while surface area is negatively related with GI. Another same observation lies in legal origin, i.e. English common law countries are less likely to invest in GI. This result can be strengthened by the finding that English-speaking countries invest less in green investments. However, while firm-level test shows significance in GDP growth, CPI, economic freedom, gasoline price, CO_2 emissions, anti-director rights, and Protestant, country-level test indicates no significance for all these variables. There is also a conflicting finding between two tests. Particularly, firm-level test shows that firms in countries with stronger creditor rights are more likely to go green, while country-level test shows an exact opposite result.

5.2 Determinants for GI in non-US firms

We assume that an important reason for the unexpected results is that US firms have a tremendous effect on the whole results, sine we have 1,296 USA observations. As a consequence, we exclude USA firms, and get 4,298 observation left. Like we did in the firm-level test, we perform several regression models. The results are shown in Table

In terms of firm-level variables, we find that firm size and Tobin's Q are positively related with environmental expenditures, while ROA and leverage are negatively related with GI. These findings are same with the findings of firm-level test. On country-level, we find that GDP per capita and GDP growth have positive influences on GI, while CPI has a negative influence on GI. The difference from firm-level test is that GDP per capita is positively associated with environmental expenditures, which is in line with our hypothesis. Besides, whereas population is positively related with environmental expenditures, surface area is negatively related with GI. Creditor rights is positively related with environmental expenditures, while anti-director rights has no influence on environmental investments. Moreover, we find a positive relationship

between CO2 emission and GI, which is not unexpected. Regarding the legal origin and cultural variables, we find that firms in English common law countries, English-speaking countries, and Protestant-practicing countries are less likely to make GI.

To summarize, when we exclude the US firms from our whole sample and study the effect of these factors on GI, we find almost the same results with firm-level test. The only improvement is that there is a positive association between GDP per capita and environmental expenditures, which is just in line with our hypothesis.

5.3 Determinants of GI in different time periods

As far as we are concerned, another important reason for the unexpected results is the time period. We know that there is a financial crisis in 2008, so we assume that there will be different findings before and after the year 2008. Consequently, we divide the whole sample into two sub-samples, i.e. observations from 2002 to 2007, and observations 2008-2015.

The findings are shown in table 9 and table 10, which indicate the relationship between various determinants and environmental expenditures for 2002-2007 period and 2008-2015 period separately. Start with table 9, we find that firm-level determinants have same influences on GI with firm-level test. On country-level, GDP per capita, economic freedom, and CPI all have negative influences on GI, which is also in line with our findings for firm-level test. As for cultural factors, we find that firms in English-speaking countries are less likely to invest in green projects, while Protestant has no effect on GI.

When it comes to table 10 which shows the results for 2008-2015 period. The only difference from 2002-2007 period is that GDP growth has a positive influence on GI. Other factors have same effect on GI compared with 2002-2007 period.

In summary, we find few differences between two time periods. So we think that time sequence has no influence on GI.

5.4 Test for inverted-U relationship

Beckerman (1992) finds that although economic growth usually leads to environmental degradation in the early stages of the process, in the end the environmental quality will get better as country gets rich.   Other studies argue that there is an inverted-U or "Kuznets" relationship between environment and economic development (Grossman and Krueger, 1994, Stern, 2004). In

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particular, for those relatively poor countries, as GDP grows, environmental quality worsens accordingly. However, when a country gets sufficiently rich, people in this country will be more willingly to spend on environment. To prove our explanation, we will divide countries into two groups: countries belong to Organization for Economic Co-operation and Development (OECD) and those countries do not. OECD has 35 members, most of which are regarded as developed countries. We do firm-level test for both groups and see whether GDP per capita has different effect on GI in two sub-samples. Still, we exclude USA firms. After division, we have 3,584 observations for OECD group and 644 for non-OECD group. Because we aim to test the inverted-U relationship between GDP per capita and environmental expenditures, we will focus on variable LN_GDPpercapita.

We do three regressions for each group. The first regression includes only firm-level variables, the second one consists of only "basic country" variables, i.e. LN_GDPpercapita, squared LN_GDPpercapita, GDP growth, CPI, Economicfreedom, Gasolineprices, Creditorrights, Antidirector, Feedintariff, Population, and Surface. In the last model we employ firm-level variables and "basic-country" variables. The results are shown in table 11.

First, we begin by comparing the significance of firm-level indicators. We find similar significance between OECD firms and non-OECD firms, except for ROA. While ROA is negatively and significantly related with environmental expenditures for OECD group, it is not significantly related with environmental expenditures for non-OECD group. Our main attention lies in GDP per capita. Jus as we assumed, LN_GDPpercapita and squared LN_GDPpercapita are both positively related with environmental expenditures in OECD group, and are negatively related with expenditures in non-OECD group. These findings are consistent with our hypotheses that for poor countries, environmental spending decreases as GDP grows; for rich countries, the higher the GDP, the higher the environmental expenditures. Other variables show similar significance as the earlier firm-level test.

6. Conclusions

When examining the firm-level determinants of green investments, we find that bigger firms and higher valued firms are more likely to spend on the environment, while firms that are more profitable invest less in the environment. The reason for this finding may be that less profitable firms try to gain back revenues by marketing themselves as green, i.e. by increasing

environmental expenditures. In addition, it may be that the overly high environmental expenditures may cause the firms to be less profitable in the first place.

Regarding the country-level factors, we find that GDP growth is positively related with environmental expenditures. Moreover, we observe a positive relationship between population and GI as well as a positive one for CO2 emissions. As for institutional determinants, we find that both creditor rights and anti-director rights are significantly and positively associated with GI.

The results for other determinants are in contrast with our hypotheses. For instance, GDP per capita, economic freedom, and CPI are negatively associated with firm's environmental expenditures. This means that economic prosperity does not have a positive influence on GI. We also find that surface area and gasoline price are negatively related with GI. Moreover, we notice that common-law countries, compared with civil-law countries, are less inclined to have environmental expenditures. Also, English-speaking countries are less likely to go green. These findings are in sharp contrast with our hypotheses.

In order to verify the findings of the firm-level test, we undertake a series of robustness tests. First, we perform a country-level test which employs ecological footprint as the dependent variable. Still, we find that GDP per capita is negatively associated with GI. Population is positively related with GI, whereas surface area shows negative significance. Moreover, English common-law countries and English-speaking countries are less likely to invest in green projects. All of these findings are in line with our firm-level tests. Creditor rights become negatively related with GI, while other variables show no significance. Still, we find that the findings of GDP per capita, surface area, legal origin, English, and Protestant are in contrast with our hypotheses.

We think that US firms may have a significant effect on the whole results, since US firm observations take 20% of the whole sample. Consequently, we do a firm-level test which excludes the US firms. And we find a positive relationship between GDP per capita and environmental expenditures, which confirms to our hypothesis.

Moreover, we assume that time sequence may have an effect on our results. So we divide the whole sample into two sub-samples, i.e. 2002-2007 period and 2008-2015 period. However, we find no different results with original firm-level test.

We try to explain the negative relationship between GDP per capita and GI by stating an inverted-U relationship between environmental expenditures and economic development. In

particular, for relatively poor countries, as GDP grows, environmental quality worsens accordingly. However, when a country gets sufficiently rich, people in this country will be more willing to spend on the environment. To validate our hypotheses, we divide the whole firm-year group into developed countries group and developing countries group, and we compare the relationship between GDP per capita and GI between these groups. The results of our robustness test verify our hypotheses. We find a negative relationship between GDP per capita and environmental expenditures in developing countries group, and a positive relationship in developed countries group.

Although we find negative association between creditor rights, legal origin, English and GI, we can explain this by announcing the conflict between environmental expenditures and shareholder value maximization. English-speaking countries and English common-law countries tend to have stronger shareholder protection than other countries. The goal of firms in these countries is to maximize the value of shareholders. Environmental spending, however, may be in conflict with this goal. In other words, undertaking environmental investment may not benefit shareholders. As a result, these countries are less inclined to invest in the environment. These relationships appear to persist despite our best efforts to address any potential multicollinearity concerns in our regression analysis.

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Appendices

Table 1
Definition of variables

Variable	Data source	Description
Panel A: Firm variables		
LN_Size	Compustat	Natural log of the market capitalization
Leverage	Compustat	Assets divided by shareholders' equity
Tobin's q	Compustat, Datastream	Market value divided by book value of assets
ROA	Compustat	Proxy for profitability, which equals net income divided by assets
Panel B: Country variables		
LN_GDPpercapita	World Bank Database	Natural log of the GDP divided by the average population
GDPgrowth	World Bank Database	The change in GDP compared with the previous year
CPI	World Bank Database	Changes in the price level of a market basket of consumer goods and services purchased by households
Economicfreedom	Heritage Foundation	A score that ranges from 0-100, with a higher score meaning greater economic freedom
LN_Population	World Bank Database	Natural log of the population for each country
LN_Surface	World Bank Database	Natural log of the surface area (sq. km) for each country
Gasolineprice	World Bank Database	Pump price of gasoline (US$ per liter)
LN_CO2emissions	World Bank Database	Natural log of CO_2 emissions (sq. km)
PM2.5	World Bank Database	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)
Creditor	Djankov et al. (2007)	A score that ranges from 0 to 4, with 0 being the lowest and 4 the highest level of creditor rights
Antidirector	LLSV (1996, 1997)	A score that ranges from 0 to 6, with 0 representing the lowest level of shareholder rights, while 6 the highest
Autocracy	Center for Systemic Peace (CSP)	A score that ranges from -10 to 10, with a higher score meaning higher autocracy
Democracy	Center for Systemic Peace (CSP)	A score that ranges from -10 to 10, with a higher score meaning higher democracy
Legalorigin	Djankov et al. (2007)	A dummy variable that equals 1 if the country adopts English common law, 0 otherwise
Protestant	CIA Factbook	A dummy variable that takes the value 1 if a country's primary religion is Protestant
English	CIA Factbook	A dummy variable that takes the value 1 if a country's primary language is English

Table 2
Correlations. We report Pearson/Spearman correlation coefficients for each variable pair of firm-level test. P-Values are reported in brackets below each correlation coefficient.

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Size													
2	Tobins' Q	-0.022												
		0.108												
3	ROA	-0.054	0.114											
		0.000	0.000											
4	Leverage	0.132	-0.012	-0.003										
		0.000	0.358	0.802										
5	GDPpercapita	0.009	-0.194	-0.094	0.004									
		0.538	0.000	0.000	0.748									
6	GDPgrowth	-0.046	0.128	0.141	0.034	-0.158								
		0.001	0.000	0.000	0.013	0.000								
7	CPI	0.003	0.118	0.157	-0.021	-0.454	0.347							
		0.808	0.000	0.000	0.126	0.000	0.000							
8	Economicfreedom	-0.017	-0.137	-0.041	0.004	0.500	-0.121	-0.180						
		0.216	0.000	0.002	0.750	0.000	0.000	0.000						
9	Population	-0.025	0.027	0.104	0.010	-0.170	0.289	0.332	0.018					
		0.068	0.049	0.000	0.443	0.000	0.000	0.000	0.189					
10	Surface	-0.048	-0.037	0.044	0.008	0.229	0.196	0.285	0.301	0.431				
		0.000	0.006	0.001	0.560	0.000	0.000	0.000	0.000	0.000				
11	Gasolineprice	0.074	-0.091	-0.106	-0.006	-0.038	-0.197	-0.206	-0.249	-0.448	-0.751			
		0.000	0.000	0.000	0.667	0.006	0.000	0.000	0.000	0.000	0.000			
12	CO2emissions	-0.034	-0.051	0.076	0.012	0.261	0.079	0.155	0.346	0.671	0.761	-0.755		
		0.055	0.004	0.000	0.485	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
13	PM2.5	0.039	0.196	0.001	0.001	-0.106	0.087	-0.061	-0.441	-0.113	-0.268	0.289	-0.206	
		0.086	0.000	0.966	0.979	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	
14	Creditor	0.036	0.031	-0.069	-0.008	-0.122	0.027	0.039	-0.107	-0.179	-0.371	0.317	-0.318	-0.102
		0.007	0.020	0.000	0.535	0.000	0.046	0.004	0.000	0.000	0.000	0.000	0.000	0.000
15	Antidirector	-0.054	-0.070	0.006	0.006	0.264	0.134	0.074	0.419	0.366	0.757	-0.668	0.774	-0.327
		0.000	0.000	0.658	0.665	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	Democracy	0.185	-0.561	-0.148	-0.029	0.918	-0.634	-0.677	0.948	-0.639	-0.953	0.613	0.350	-0.291
		0.003	0.000	0.016	0.642	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2 continued

		1	2	3	4	5	6	7	8	9	10	11	12	13
17	Autocracy	-0.029	-0.033	-0.048	0.007	-0.113	0.236	0.298	-0.108	-0.013	0.016	0.176	-0.551	-0.106
		0.641	0.596	0.440	0.913	0.069	0.000	0.000	0.081	0.838	0.799	0.004	0.000	0.202
18	Feedintariff	0.019	-0.009	-0.054	-0.017	0.438	-0.170	-0.313	0.453	0.152	0.064	-0.046	0.208	-0.087
		0.211	0.555	0.001	0.276	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000
19	Legalorigin	-0.009	-0.065	0.031	0.000	0.248	0.209	0.305	0.383	0.385	0.760	-0.603	0.657	-0.288
		0.526	0.000	0.021	0.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	Protestant	-0.006	-0.086	0.017	-0.008	0.322	0.085	-0.044	0.030	0.496	0.480	-0.521	0.713	-0.229
		0.732	0.000	0.340	0.673	0.000	0.000	0.016	0.097	0.000	0.000	0.000	0.000	0.000
21	English	-0.057	-0.066	-0.044	-0.076	0.626	0.266	0.159	0.914	0.517	0.788	-0.593	0.616	-0.462
		0.005	0.001	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

		14	15	16	17	18	19	20
15	Antidirector	-0.101						
		0.000						
16	Democracy	0.948	0.715					
		0.000	0.000					
17	Autocracy	-0.226	-0.273	-0.265				
		0.000	0.000	0.000				
18	Feedintariff	-0.116	0.177	0.267	0.064			
		0.000	0.000	0.000	0.337			
19	Legalorigin	-0.034	0.781	0.715	-0.273	0.154		
		0.011	0.000	0.000	0.000	0.000		
20	Protestant	0.038	0.587	0.710	-0.239	0.207	0.616	
		0.034	0.000	0.000	0.009	0.000	0.000	
21	English	0.336	0.927	.	.	0.329	1.000	0.651
		0.000	0.000	.	.	0.000	0.000	0.000

Table 3
Preliminary examination of environmental expenditure in a series of univariate analyses. We form subsets of country samples and firm samples along various dimensions, as described in the text. For each determinant, the upper results show the number of observations, the middle results show the mean values for the two sub-samples while the lower results show the median values. We employ t-tests and Kruskal-Wallis tests to test for the equality of the means and medians, respectively, of the two subsamples. The last column reports p-values for both tests.

Environmental Expenditure(N=5582)

Subsample 1	N, mean, median	Subsample 2	N, mean, median	Tests of differences means (p-value) medians (p-value)
Low LN_Size	2725	High LN_Size	2725	
	4.598		5.550	0.000
	4.476		4.954	0.000
Low ROA	2729	High ROA	2729	
	5.604		4.556	0.000
	5.371		4.317	0.000
Low Leverage	2759	High Leverage	2759	
	4.929		5.227	0.002
	4.450		5.165	0.004
Low Tobin's q	2723	High Tobin's q	2723	
	2.928		7.194	0.000
	3.135		7.774	0.000
Low GDPgrowth	2695	High GDPgrowth	2695	
	5.412		4.728	0.000
	5.357		4.337	0.000
Low LN_GDPpercapita	2560	High LN_GDPpercapita	2560	
	6.035		4.239	0.000
	6.681		3.850	0.000
Low CPI	2680	High CPI	2680	
	6.110		4.031	0.000
	6.889		3.845	0.000
Low Economicfreedom	2722	High Economicfreedom	2722	
	5.411		4.739	0.000
	5.316		4.264	0.000
Low Gasolineprice	2563	High Gasolineprice	2563	
	4.938		5.364	0.000
	4.654		5.148	0.000
Low LN_CO2emissions	1630	High LN_ CO2emissions	1630	
	3.941		6.687	0.000
	3.728		7.314	0.000
Low PM2.5	972	High PM2.5	972	
	3.963		6.160	0.000

Table 3 continued

	3.689		6.900	0.000
Low LN_ Population	2660	High LN_Population	2660	
	3.792		6.325	0.000
	3.500		6.828	0.000
Low LN_Surface	2705	High LN_Surface	2705	
	6.500		3.621	0.000
	7.443		3.664	0.000
Antidirector (0-2)	1705	Antidirector (3-5)	3699	
	3.634		5.724	0.000
	3.367		6.174	0.000
Creditor(0-2)	4566	Creditor(3-4)	919	
	5.289		4.029	0.000
	5.123		3.592	0.000
Autocracy (0-5)	4037	Autocracy (6-10)	700	
	5.110		5.063	0.740
	4.853		4.538	0.679
Democracy (0-5)	1845	Democracy (6-10)	2892	
	5.151		5.072	0.446
	4.797		4.853	0.414
No Feedintariff	564	Feedintariff	3471	
	4.711		4.932	0.166
	4.315		4.575	0.095
Civil law	3592	Common law	1867	
	5.897		3.467	0.000
	6.397		3.664	0.000
Protestant	1677	Non-Protestant	3904	
	3.988		5.551	0.000
	3.807		5.795	0.000
English	1649	Non-English	3871	
	3.350		5.819	0.000
	3.784		6.823	0.000

Table 4
OLS regression analysis of environmental expenditure: We examine whether firm-level and country-level determinants have an influence on a firm's environmental expenditure. The first two columns show results for the first regression model, which includes only basic firm variables. The second regression includes basic country variables only, while the third regression includes both firm variables and basic country variables. The subsequent three regressions are calculated by adding the legal origin dummy, religion dummy and language dummy, respectively. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value. The last three rows provide the number of observations, F-test static, and adjusted R^2

	Firm	Country	Firm+Country	Firm+Environment	Firm+Polity	Firm+Legalorigin	Firm+Culture
Constant	-3.717	2.557	-11.677	-9.034	-3.625	-3.006	-3.195
	0.000	0.151	0.000	0.000	0.000	0.000	0.000
LN_Size	0.915		0.774	0.847	0.904	0.871	0.885
	0.000		0.000	0.000	0.000	0.000	0.000
Tobin's Q	0.057		0.043	0.057	0.056	0.054	0.054
	0.000		0.000	0.000	0.000	0.000	0.000
ROA	-7.437		-7.943	-13.226	-7.272	-7.151	-7.159
	0.000		0.000	0.000	0.000	0.000	0.000
Leverage	-0.014		-0.044	-0.044	-0.014	-0.013	-0.013
	0.065		0.000	0.186	0.071	0.083	0.084
LN_GDPpercapita		-0.827	-0.523				
		0.000	0.000				
GDPgrowth		0.130	0.056				
		0.000	0.001				
CPI		-0.720	-0.427				
		0.000	0.000				
Economicfreedom		-0.039	0.025				
		0.000	0.002				
LN_Population		1.416	0.877				
		0.000	0.000				
LN_Surface		-0.858	-0.259				
		0.000	0.000				
Gasolineprice		-0.425	0.595				

Table 4 continued

		0.015	0.000				
Creditorright		0.473	0.291				
		0.000	0.000				
Antidirector		0.298	0.196				
		0.100	0.258				
Feedintariff		-0.374	-0.408				
		0.324	0.139				
LN_CO2emissions				0.494			
				0.000			
PM2.5				0.012			
				0.354			
Democracy					-0.013		
					0.087		
Autocracy					0.010		
					0.119		
Legalorigin						-0.718	
						0.000	
Protestant							-0.257
							0.020
English							-0.469
							0.000
Number of observations	4908	3779	3334	1185	4391	4908	1569
Adjusted R^2	0.434	0.363	0.535	0.493	0.431	0.443	0.251
F-statistic	752.870	216.140	256.090	165.720	475.890	650.670	75.960

Table 5
Correlations. We report Pearson/Spearman correlation coefficients for each variable pair of country-level test. P-Values are reported in brackets below each correlation coefficient.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	GDPpercapita															
2	GDPgrowth	-0.159														
		0.000														
3	CPI	-0.033	-0.040													
		0.165	0.090													
4	Economicfreedom	0.468	-0.149	-0.071												
		0.000	0.000	0.004												
5	Population	0.054	0.072	0.002	-0.059											
		0.018	0.002	0.923	0.013											
6	Surface	-0.040	0.098	0.011	-0.100	0.497										
		0.077	0.000	0.659	0.000	0.000										
7	Gasolineprice	0.035	-0.064	-0.003	0.047	-0.037	-0.041									
		0.142	0.007	0.914	0.052	0.120	0.079									
8	CO2emissions	0.258	-0.012	0.001	0.098	0.386	0.326	-0.049								
		0.000	0.598	0.968	0.000	0.000	0.000	0.038								
9	PM2.5	-0.041	0.082	-0.025	-0.255	0.043	-0.071	-0.202	0.090							
		0.229	0.017	0.485	0.000	0.210	0.039	0.000	0.009							
10	Creditor	0.222	-0.012	0.055	0.104	0.042	-0.227	0.007	0.112	-0.019						
		0.000	0.640	0.030	0.000	0.092	0.000	0.766	0.000	0.603						
11	Antidirector	0.020	0.024	0.024	0.193	0.121	0.367	-0.109	0.097	-0.296	0.220					
		0.623	0.554	0.559	0.000	0.003	0.000	0.007	0.016	0.000	0.000					
12	Democracy	0.068	-0.024	-0.011	-0.011	0.017	0.039	0.008	0.066	-0.032	-0.018	-0.010				
		0.005	0.333	0.658	0.656	0.493	0.107	0.750	0.006	0.379	0.505	0.821				

Table 5 continued

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	Autocracy	0.065	-0.032	0.015	-0.020	-0.007	-0.014	0.005	0.039	-0.014	-0.044	0.001	0.864			
		0.007	0.191	0.559	0.419	0.777	0.571	0.840	0.108	0.695	0.097	0.985	0.000			
14	Feedintariff	0.057	0.007	-0.032	0.005	0.052	0.094	-0.002	0.128	0.043	0.086	-0.015	0.025	0.016		
		0.014	0.759	0.186	0.836	0.023	0.000	0.923	0.000	0.219	0.001	0.704	0.314	0.507		
15	Legalorigin	-0.001	-0.005	0.043	0.148	0.053	0.010	-0.032	-0.032	-0.084	0.241	0.495	0.005	0.049	0.078	
		0.971	0.833	0.069	0.000	0.022	0.661	0.175	0.165	0.015	0.000	0.000	0.831	0.045	0.001	
16	Protestant	0.087	-0.079	0.092	-0.040	0.031	0.028	-0.003	0.044	-0.109	0.216	0.254	-0.012	0.085	-0.007	0.349
		0.000	0.000	0.000	0.087	0.170	0.215	0.889	0.051	0.001	0.000	0.000	0.606	0.000	0.743	0.000
17	English	0.068	-0.057	-0.010	0.246	-0.068	-0.081	-0.006	-0.055	-0.113	0.159	0.494	0.053	0.036	0.085	0.592
		0.003	0.014	0.671	0.000	0.003	0.000	0.815	0.015	0.001	0.000	0.000	0.028	0.135	0.000	0.000

		16
17	English	0.348
		0.000

Table 6
Preliminary examination of ecological footprint in a series of univariate analyses. I form subsets of country samples and firm samples along various dimensions, as described in the text. For each determinant, the upper results show the number of observations, the middle results show the mean values for the two sub-samples while the lower results show the median values. I employ t-tests and Kruskal-Wallis tests to test for the equality of the means and medians, respectively, of the two subsamples. The last column reports p-values for both tests.

Ecological Footprint (N=1926)

Subsample 1	N, mean, median	Subsample 2	N, mean, median	Tests of differences means (p-value) medians (p-value)
Low GDPgrowth	937	High GDPgrowth	938	
	3.174		2.279	0.000
	2.570		1.695	0.000
Low LN_GDPpercapita	962	High LN_GDPpercapita	963	
	1.405		3.998	0.000
	1.200		3.740	0.000
Low CPI	888	High CPI	887	
	3.466		1.979	0.000
	3.160		1.530	0.000
Low Economicfreedom	882	High Economicfreedom	883	
	1.791		3.833	0.000
	1.400		3.600	0.000
Low Gasolineprice	909	High Gasolineprice	908	
	2.403		3.092	0.000
	1.700		2.700	0.000
Low LN_CO2emissions	862	High LN_ CO2emissions	860	
	1.690		3.617	0.000
	1.300		3.295	0.000
Low PM2.5	260	High PM2.5	260	
	2.829		2.753	0.667
	1.94		2.145	0.569
Low LN_ Population	954	High LN_Population	954	
	2.992		2.417	0.000
	2.300		1.700	0.000
Low LN_Surface	962	High LN_Surface	961	
	2.784		2.618	0.071
	2.000		2.000	0.257
Antidirector (0-2)	340	Antidirector (3-5)	274	
	3.561		4.035	0.007
	3.900		3.875	0.000
Creditor(0-2)	1184	Creditor(3-4)	443	0.047
	2.497		3.592	0.000
	1.760		3.300	0.000
Autocracy (0-5)	1468	Autocracy (6-10)	220	
	2.657		2.697	0.778
	1.950		5.800	0.135
Democracy (0-5)	607	Democracy (6-10)	608	
	2.661		2.663	0.980
	1.890		1.990	0.944
No Feedintariff	773	Feedintariff	1118	
	2.479		2.896	0.000
	1.700		2.240	0.000

Table 6 continued

Civil law	1405	Common law	460		
	2.701		2.810	0.315	
	2.100		1.500	0.003	
Protestant	135	Non-Protestant	1280		
	3.676		2.521	0.000	
	2.900		1.840	0.000	
English	199	Non-English	615		
	3.584		2.292	0.000	
	2.010		1.700	0.007	

Table 7

OLS regression analysis of ecological footprint: we examine whether country-level determinants have an influence on GI. The first two columns show results for the first regression, which includes only basic country variables. The second regression includes basic country variables and one dummy variable: legal origin. The subsequent two regressions consist of a religion dummy and language dummy, respectively. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value. The last three rows provide the number of observations, F-test static, and adjusted R^2.

	Country	Country+Antidirector+PM2.5	Country+Polity	Country+Legalorigin	Country+Culture
Constant	-4.211	-9.014	-4.168	-4.036	-3.612
	0.000	0.000	0.000	0.000	0.000
LN_GDPpercapita	1.003	1.376	1.002	1.012	1.023
	0.000	0.000	0.000	0.000	0.000
GDPgrowth	0.005	-0.009	0.000	0.005	0.007
	0.415	0.713	0.997	0.415	0.243
CPI	-0.003	-0.009	-0.005	-0.003	-0.004
	0.406	0.284	0.175	0.370	0.250
Economicfreedom	0.005	0.013	0.004	0.003	-0.003
	0.084	0.057	0.179	0.273	0.257
LN_Population	-0.273	-0.091	-0.258	-0.281	-0.275
	0.000	0.291	0.000	0.000	0.000
LN_Surface	0.225	0.106	0.210	0.223	0.207
	0.000	0.103	0.000	0.000	0.000
Gasolineprice	-0.011	-0.768	-0.008	-0.010	-0.010
	0.276	0.000	0.412	0.313	0.346
LN_CO2emissions	0.010	-0.023	0.006	0.010	0.012
	0.233	0.409	0.501	0.206	0.136
Creditor	0.091	0.290	0.055	0.076	0.055
	0.000	0.000	0.030	0.003	0.027
Feedintariff	0.032	-0.144	0.053	0.022	-0.029
	0.541	0.288	0.341	0.670	0.579
PM2.5		-0.003			
		0.723			
Antidirector		0.056			
		0.385			
Democracy			-0.002		
			0.696		
Autocracy			-0.001		
			0.820		
Legalorigin				0.140	
				0.030	
Protestant					-0.097
					0.369
English					0.864
					0.000
Number of observations	1449	264	1265	1449	1449
Adjusted R^2	0.763	0.815	0.759	0.764	0.776
F-statistic	467.910	97.250	332.040	426.890	419.590

Table 8

OLS regression analysis of environmental expenditure for non-US firms: We examine whether firm-level and country-level determinants have an influence on a firm's environmental expenditure for non-US firms. The first two columns show results for the first regression model, which includes only basic firm variables. The second regression includes basic country variables only, while the third regression includes both firm variables and basic country variables. The subsequent three regressions are calculated by adding the legal origin dummy, religion dummy and language dummy, respectively. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value. The last three rows provide the number of observations, F-test static, and adjusted R^2

	Firm	Country	Firm+Country	Firm+Environment	Firm+Polity	Firm+Legalorigin	Firm+Culture
Constant	-4.521	-18.516	-25.308	-18.132	-4.418	-3.702	-3.669
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LN_Size	0.972		0.809	0.847	0.966	0.906	0.906
	0.000		0.000	0.000	0.000	0.000	0.000
Tobin's Q	0.056		0.029	0.040	0.055	0.054	0.053
	0.000		0.000	0.000	0.000	0.000	0.000
ROA	-8.454		-8.903	-13.118	-8.262	-8.512	-8.632
	0.000		0.000	0.000	0.000	0.002	0.001
Leverage	-0.036		-0.071	-0.129	-0.034	-0.037	-0.038
	0.003		0.000	0.000	0.006	0.000	0.000
LN_GDPpercapita		0.743	0.431				
		0.000	0.001				
GDPgrowth		0.098	0.058				
		0.000	0.001				
CPI		-0.438	-0.301				
		0.000	0.000				
Economicfreedom		-0.051	0.010				
		0.000	0.205				
LN_Population		1.987	1.407				
		0.000	0.000				
LN_Surface		-0.973	-0.483				
		0.000	0.000				
Gasolineprice		-2.634	-1.259				
		0.376	0.126				

Table 8 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Creditorright		0.800	0.633				
		0.000	0.000				
Antidirector		-0.023	0.029				
		0.705	0.592				
Feedintariff		-0.527	-0.304				
		0.001	0.053				
LN_CO2emissions				1.211			
				0.000			
PM2.5				0.002			
				0.839			
Democracy					-0.023		
					0.001		
Autocracy					0.020		
					0.010		
Legalorigin						-0.801	
						0.000	
Protestant							-0.555
							0.000
English							-0.694
							0.000
Number of observations	3969	3059	2711	981	3550	3969	3969
Adjusted R^2	0.445	0.469	0.606	0.563	0.446	0.452	0.452
F-statistic	795.720	271.550	298.880	211.580	476.450	654.470	545.890

Table 9

OLS regression analysis of environmental expenditures for different time periods: we separate the whole firm-year groups into observations from 2002 to 2007, and observations between 2008 and 2015. This table shows the results for regressions of 2002-2007 period. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value. The last three rows provide the number of observations, F-test static, and adjusted R^2.

	Firm	Country	Firm+Country	Firm+Environment	Firm+Polity	Firm+Legalorigin	Firm+Culture
Constant	-4.153	3.826	-13.603	-10.182	-4.164	-3.445	-3.512
	0.000	0.258	0.000	0.000	0.000	0.000	0.000
LN_Size	0.851		0.704	0.733	0.843	0.816	0.807
	0.000		0.000	0.000	0.000	0.000	0.000
Tobin's O	0.045		0.035	0.042	0.045	0.042	0.043
	0.000		0.000	0.000	0.000	0.000	0.000
ROA	-5.172		-6.284	-10.598	-5.019	-5.150	-5.258
	0.000		0.000	0.000	0.000	0.000	0.000
Leverage	0.244		0.410	0.232	0.321	0.175	0.244
	0.331		0.154	0.674	0.220	0.484	0.326
LN_GDPpercapita		-0.933	-1.159				
		0.000	0.000				
GDPgrowth		0.061	-0.005				
		0.076	0.853				
CPI		-0.758	-0.425				
		0.000	0.000				
Economicfreedom		-0.045	0.098				
		0.000	0.000				
LN_Population		1.269	0.881				
		0.000	0.000				
LN_Surface		-0.499	-0.030				
		0.000	0.725				
Gasolineprice		-0.711	0.966				

		0.012	0.000				
Creditorright		0.435	0.096				
		0.000	0.376				
Antidirector		0.034	0.083				
		0.793	0.443				
Feedintariff		-0.621	-0.899				
		0.230	0.092				
LN CO2emissions				0.562			
				0.000			
PM2.5				0.008			
				0.689			
Democracy					-0.016		
					0.121		
Autocracy					0.008		
					0.447		
Legalorigin						-0.519	
						0.000	
Protestant							0.318
							0.072
English							-0.800
							0.000
Number of observations	1636	1319	1148	382	1476	1636	1636
Adjusted R	0.464	0.376	0.561	0.483	0.467	0.469	0.472
F-statistic	355.860	80.580	105.770	60.490	216.800	289.820	244.340

Table 10

OLS regression analysis of environmental expenditures for different time periods: we separate the whole firm-year groups into observations from 2002 to 2007, and observations between 2008 and 2015. This table shows the results for regressions of 2008-2015 period. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value. The last three rows provide the number of observations, F-test static, and adjusted R^2.

	Firm	Country	Firm+Country	Firm+Environment	Firm+Polity	Firm+Legalorigin	Firm+Culture
Constant	-3.717	-3.010	-16.451	-8.557	-3.596	-3.130	-3.382
	0.000	0.170	0.000	0.000	0.000	0.000	0.000
LN_Size	0.840		0.756	0.852	0.838	0.813	0.838
	0.000		0.000	0.000	0.000	0.000	0.000
Tobin's Q	0.080		0.066	0.089	0.080	0.077	0.077
	0.000		0.000	0.000	0.000	0.000	0.000
ROA	-8.641		-7.691	-11.543	-8.573	-8.189	-8.222
	0.000		0.000	0.000	0.000	0.000	0.000
Leverage	-0.019		-0.051	-0.090	-0.019	-0.017	-0.018
	0.008		0.000	0.007	0.012	0.017	0.013
LN_GDPpercapita		-0.468	-0.308				
		0.001	0.023				
GDPgrowth		0.131	0.052				
		0.000	0.012				
CPI		-0.641	-0.318				
		0.000	0.000				
Economicfreedom		-0.039	0.043				
		0.000	0.000				
LN_Population		1.696	0.964				
		0.000	0.000				
LN_Surface		-1.176	-0.383				
		0.000	0.000				

Gasolineprice	-0.155	0.966					
	0.484	0.000					
Creditorright	0.377	0.227					
	0.000	0.001					
Antidirector	0.456	0.199					
	0.245	0.304					
Feedintariff	-0.354	-0.315					
	0.124	0.127					
LN CO2emissions				0.393			
				0.000			
PM2.5				-0.002			
				0.880			
Democracy					-0.008		
					0.247		
Autocracy					0.009		
					0.224		
Legalorigin						-0.659	
						0.000	
Protestant							-0.520
							0.000
English							-0.158
							0.252
Number of observations	3272	2460	2186	803	2915	3272	3272
Adjusted R2	0.466	0.375	0.560	0.548	0.463	0.473	0.473
F-statistic	713.500	148.430	199.770	163.490	420.500	587.970	488.300

Table 11
OLS regression analysis of environmental expenditures: we separate the whole firm-year groups into OECD group and non-OECD group, and focus on the influence of GDP per capita on environmental expenditures. The left three regressions show the results for OECD firms. The first regression includes only firm-level variables, and the second regression includes "basic-country" variables, while the third regression consists of both firm-level and "basic-country" variables. The right three columns are for non-OECD firms. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value. The last three rows provide the number of observations, F-test static, and adjusted R^2.

| | OECD | | | non-OECD | | |
	Firm	Country	Firm+Country	Firm	Country	Firm+Country
Constant	-4.075	-26.495	-28.655	-5.104	47.378	21.077
	0.000	0.000	0.000	0.000	0.000	0.094
LN_Size	0.978		0.799	1.098		0.917
	0.000		0.000	0.000		0.000
Tobin's Q	0.056		0.027	0.028		-0.004
	0.000		0.000	0.000		0.592
ROA	-8.683		-9.408	-0.290		-0.114
	0.000		0.000	0.841		0.948
Leverage	-0.004		-0.052	-0.154		-0.100
	0.777		0.000	0.000		0.000
LN_GDPpercapita		0.668	0.172		-2.683	-1.680
		0.001	0.401		0.000	0.002
GDPgrowth		0.056	0.060		0.119	0.098
		0.005	0.001		0.074	0.087
CPI		-0.414	-0.364		0.091	0.091
		0.000	0.000		0.362	0.296
Economicfreedom		-0.037	0.023		0.158	0.089
		0.000	0.005		0.314	0.330
LN_Population		2.408	1.752		-2.583	-1.110
		0.000	0.000		0.000	0.043
LN_Surface		-0.855	-0.408		1.744	0.502
		0.000	0.000		0.000	0.180
Gasolineprice		-2.172	-1.034		-1.731	-0.346
		0.000	0.000		0.057	0.745
Creditorright		-0.083	-0.044		-0.374	-0.587
		0.165	0.000		0.238	0.060
Antidirector		0.857	0.630		-1.499	-0.300
		0.000	0.000		0.000	0.414
Feedintariff		-2.744	-2.128		1.265	1.020
		0.030	0.000		0.000	0.001
Number of observations	3218	2538	2259	566	484	415
Adjusted R^2	0.451	0.548	0.644	0.373	0.314	0.419
F-statistic	529.350	309.030	273.090	68.220	23.100	20.890