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

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Abstract

We explain the determinants of corporate green investments (GI) by using a series of both firm- and country-level factors. We employ environmental expenditures as a proxy for green investments at the firm level. We find that larger firms tend to invest more in green projects, whereas firms that are more profitable 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 a proxy for GI. The results of the latter analysis are mostly in line with the results of our firm-level analysis. However, several of our findings are in contrast to previous research on the determinants of GI, suggesting that research in this area may be strongly influenced by researchers' sample and variable choices.

Keywords: Green investments, Sustainability, Environmental expenditures, Ecological footprint
JEL codes: G11, M14, O13

1. Introduction

Green Investments (GI) have accelerated in recent years due to rapid technology changes and policy support. Eyraud et al. (2013) define GI as the investment necessary to reduce greenhouse gas and air pollutant emissions without significantly reducing the production and consumption of non-energy goods. Examples of GI include renewable energy technologies, transportation (Tesla being the biggest name), projects that are committed to preserving natural resources, implementing clean air, water and waste projects, and the implementation of environmentally conscious business practices, to name a few. According to the 2018 Global Trends in Renewable Energy Investment report[1], one category of GI, global new investments in renewable energy, strongly increased to $287.8 billion in 2011 from $211 billion in 2010 ($162 billion in 2009 and $173 billion in 2008) and have fluctuated around that level since then. This fluctuation can be explained by a myriad of factors, but mainly by political and social pressures. While Asian countries kept heavily investing money in GI, traditional green investors such as the UK and the US have slowed down their GI efforts. In 2015, a record amount of global new investments in renewable energy, transportation and waste of $323.4bn was documented, which was topped in 2018 by Global clean energy investments totalling $332.1bn.

Although GI has been growing rapidly (see Figure 1), the driving forces behind GI have been scarcely researched. One of the first papers in this area, Eyraud et al. (2013), shows a positive association between countries' GDP and GI. 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

[1] Frankfurt School-UNEP Centre/BNEF, 2018.

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. Our study addresses this gap in the literature by exploring key determinants of GI, using a series of firm- and country-level indicators collected for a broad cross-section of developed and developing economies. We expand Eyraud et al.'s (2013) definition of GI by including all investment activities that focus on projects that are committed to environmentally conscious business practices. In particular, we study GI from the perspective of both countries and firms and examine whether certain firm characteristics and country-level factors, such as macroeconomic, institutional, and cultural variables, influence a firm's environmental expenditures.[2]

Insert Figure 1 around here

In summary, we examine whether a firm's financial factors, macroeconomic indicators and various governance, institutional, legal, political, environmental and cultural measures encourage GI at both the firm and aggregate country level. Our project contributes 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. The findings of our research not only contribute to the academic literature in these areas, but also have important implications for both regulators and

[2] We employ environmental expenditures as a proxy for GI due to its availability across firms in a cross-country setting. We recognize that better proxies may be available when focusing on single countries or when exploring country- rather than firm-specific determinants of GI in a cross-country setting. We close an existing gap in the literature by providing the first cross-sectional international study of GI, but recognize that there is no universal measurement of GI and that our results may at least be partially influenced by our variable choice.

policymakers in countries that exhibit sub-par GI investments or who otherwise aim to increase green investments by firms operating in their country.

Our paper is structured as follows: In Section 2, we review the related literature and develop the hypotheses for the empirical analysis. We describe the dataset and explain the explanatory variables in Section 3. In Section 4, we describe the empirical methodology and present the results. Section 5 presents our robustness tests. We conclude in Section 6.

2. Literature review and hypothesis development

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 renewable energy. Similarly, Nesta (2014) reports that the combination of environmental policies and market deregulation is the most effective method of facilitating renewable energy innovation.

Renewable energy policies are in place in 146 countries according to the Renewables 2018 Global Status Report (REN21, 2018). 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 (research and development) 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 empirically investigated the impact of a broader range of country-level drivers on GI, such as macroeconomic and cultural factors. Stern (2004) finds that there are larger environmental expenditures and more environmental innovation in higher-income countries. Eyraud et al. (2013) examine the effect of a series of macroeconomic factors on GI, including GDP, GDP per capita, inflation, income, and interest rates. Their results suggest that higher GDP growth and higher income levels 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 may affect 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, Jaraitė et al. (2012), analyses the effects of various determinants on firms' environmental expenditures and investments. They report that firms that are more profitable and more energy-intensive 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 Hypothesis development

Although previous studies have focused, to a limited extent, on economic growth, regulations, and population as determinants of environmental expenditures and green investments, very few studies have paid attention to institutional or cultural factors to the

best of our knowledge. However, institutional factors, such as legal origin and investor rights, and cultural factors, e.g. religion, are generally assumed to have a great influence on investment. This study attempts to close this 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) suggest 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) note that firms that are more profitable tend to spend more on the environment. Accordingly, we propose a similar hypotheses, i.e. that larger firms will spend more on GI. We do, however, differ in our expectations with respect to the relation between profitability and GI. We hypothesize that more profitable firms are more profitable because they choose to forego investments without immediate or short-term payoffs, including GI. Therefore, we expect more profitable firms to invest less in GI.

Beyond size and profitability, we argue that a firm's valuation and leverage may also influence GI. Myers (1977) show that if a firm's debt overhang is large enough, it can mitigate the firm's fund raising for positive net present value (NPV) projects. As a result, in this paper, we assume that 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) document the influence of several macroeconomic factors, such as GDP per capita, GDP growth, and CPI and gasoline prices on GI. Naturally, companies in wealthier countries, i.e. countries with a higher GDP per capita, will be able to afford larger investments in the environment. Our expectations for the GDP growth variable, on the contrary, are not straightforward. On one hand, GDP growth suggests a healthy economy which should be able to afford environmental investments. On the other hand, less developed countries may have higher growth rates due to their low current GDP levels and, therefore, may not have the resources to invest in GI and/or make GI a priority. We employ the same factors as Eyraud et al. (2013) in our study. With the exception of GDP growth for which our expectations are mixed, we hypothesize that each of these economic determinants is positively associated with GI and environmental expenditures.

Furthermore, economic freedom is an important indicator of a country's 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 economic freedom are more likely to invest in green projects.

2.2.3 Institutional factors

According to La Porta et al. (LLSV, 1998) and Beck, 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 affords both shareholders and creditors the strongest protections, while the latter protects investors the least.

The effects of legal origin and investor protection on firms' investment and access to external finance have been widely analyzed. La Porta et al. (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 green projects.

However, there is also a discussion ongoing 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 GI in situations 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. 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 appears to play a significant role in explaining a country's 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 performing government than either predominantly Catholic or predominantly Muslim countries. Stulz and Williamson (2003) examine the relationship between country-level culture, 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. Such countries also have more competitive stock markets with greater pressure for short-term

performance. Considering the shareholder vs. stakeholder model, (e.g. Jensen, 2005) we expect that higher shareholder protection will lead to greater pressures for profitability and fewer GI in English-speaking countries. Therefore, we expect that English-speaking countries and Protestant countries are less likely to make green investments.

2.2.5 Environmental factors

We expect countries with higher levels of greenhouse gas emissions and air pollution to be more inclined to undertake GI. We assume a positive relationship between these variables due to international agreements to reduce emissions. This should drive countries with higher emissions to invest in GI to achieve future emission reductions.

2.2.6 Demographic factors

According to Eyraud et al. (2013), countries with larger populations are more likely to invest in green projects. However, we attempt to differentiate between population size and density. We hypothesize that more densely populated countries will invest more in green initiatives. Therefore, even though population size is correlated with physical size, we expect a positive relationship between a country's population and GI, but a negative relationship between country's surface area and GI.

3. Data

3.1 Samples construction and dependent variable definition

In our firm-level estimations, we employ the natural log of environmental expenditures (the expenditures that firms make in the environment) as a proxy for green investments. The data are obtained from the Environmental, Social and Governance (ESG) section of Datastream. 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 disclose that data. 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. Following the extant literature, we hypothesize that firm size and profitability are positively related with green investments. Moreover, we expect that firms with lower leverage and higher valuations are more likely to invest in green projects.

The country-level independent variables span a wide range of categories. Firstly, as mentioned above, we expect that economic growth will lead to an increase in GI. Specifically, we consider GDP per capita, GDP growth, and CPI as indicators of the economic condition of a country. Our hypotheses are that all of 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. The index ranges from 0 to 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 the 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 employ a dummy variable, Legal_Origin, which equals 1 if the country adopts English common law and 0 otherwise. We assume that Legal_Origin is positively related with GI.

To measure shareholder rights protection, we employ the anti-director rights index from La Porta et al. (1997, 1998). This index measures the voting power of stockholders and the strength of legal support for shareholders. Similarly, we proxy for creditor rights with a creditor rights index based on La Porta et al. (1998) and Djankov et al. (2007), in which the index measures the powers of 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. (1998). We hypothesize that both the anti-director rights index and the creditor rights index have a positive influence on GI.

To characterize the political regime, we employ the commonly used Polity IV data, which measures a country's level of Democracy and Autocracy. We expect these variables to be positively related to GI.

Feed-in-tariff policies for renewable energy continue to be a primary means for governments around the globe to express their commitment to renewable energy deployment. We thus construct a dummy variable, which indicates whether a country imposes feed-in-tariff policies, as a proxy for the country's policy regarding green investments. We expect 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 in a given country. We employ two dummy variables which equal 1 if a country's main religion or language is Protestant or English, and 0 otherwise. We use the CIA Fact book to collect data on language and religion and we hold the hypotheses that firms in English-speaking countries and Protestantism-practicing 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 more air pollution and higher 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 merge several datasets, we encounter some missing data during the merge. We find that all variables are available for a 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). To deal with this problem, we winsorize the lowest and highest 5% of all Tobin's Q observations.

Table 1 provides definitions for all firm- and country-level variables described in this section. Table 2 shows the correlation coefficients for all independent variables. We observe that Democracy is correlated with several variables. Moreover, Legal_Origin, English and Protestant are highly correlated. We thus employ these variables in separate regression models in our multivariate analysis.

Please insert Tables 1 and 2 about here

4. Methodology and results

4.1 Univariate analysis

To provide some insight into the variables we use in our 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 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, with respect to legal origin, the sample is separated into common-law countries and civil-law countries. Our univariate analyses are presented in Table 3.

Please insert Table 3 about here

We observe that the mean and median tests show similar levels of significance for each variable. Thus, all numerical results discussed 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 we group our observations 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 make more green investments (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. Based on a preliminary analysis, Democracy, Legal_Origin, English, and Protestant are highly correlated. We thus include these variables in separate models.

Our first regression includes our firm-level variables, such as size, performance, leverage, and Tobin's Q. The second regression model only includes our country-level variables GDP per capita, GDP growth, CPI, the Economic Freedom Index, gasoline prices, creditor rights, anti-director rights, feed-in tariff policies, population, and surface area. We call this group the "basic country" variables. We exclude CO2 emissions and PM2.5 because they have a considerable number of 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 our environmental variables, i.e. CO2 emissions and PM 2.5. Furthermore, because Democracy, Autocracy, Legal Origin, Language, and Religion are highly correlated, we add each of these variables into the subsequent firm-level regressions one at a time. For example, the fifth regression employs firm-level variables as well as Democracy and Autocracy. Because Democracy and Autocracy stand for the polity regime, we call them polity variables. The sixth regression includes our firm-level variables as well as English and Protestant.

Please insert Table 4 about here

The results for our firm-level regressions are shown in Table 4. In the first regression with only firm-level financial variables, we find that all variables, with the exception of leverage, have a significant effect on environmental expenditures. It is note-worthy that their significance persists throughout each regression. In particular, firm size and Tobin's Q are positively related to environmental expenditures, while ROA shows a negative association. In the second regression in which we only employ our basic country variables, we find that almost all variables are significantly related with environmental expenditures. In particular, GDP per capita, inflation, economic freedom, and surface area are negatively associated with environmental expenditures, 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 exhibit strong significance including leverage. The findings for the country-level variables are similar to those obtained for the second regression although economic freedom and gasoline prices become significantly positively associated with environmental expenditures. In the fourth regression which consists of firm characteristics plus LN_CO2_Emissions and PM2.5, we observe a positive

and significant relationship between CO2 emissions and environmental expenditures, but no significance for the PM 2.5 factor. Moreover, when we add Democracy and Autocracy to the firm-level variables, Democracy is significantly negatively associated with environmental expenditures. In the sixth regression, we notice that English legal origin has a significant negative impact on environmental expenditures. For the regression that includes the firm-level, religion as well as language variables, we find that English is significantly negatively related with environmental expenditures, while Protestant shows no significance.

In summary, we demonstrate that larger firms and higher valued firms are more inclined to invest in the environment, which is in line with our hypotheses. As expected, firms with greater profitability are less likely to invest in the environment. This finding may be explained by the fact that less profitable firms use environmental investments as a differentiating factor and try to increase customer demand by portraying themselves as green firms, even though GI generally take longer to pay off. Leverage has no effect on a firm's environmental expenditures.

With respect to our country-level variables, we find that firms in countries with a stronger economy, e.g. a higher GDP per capita and higher inflation countries, are less likely to invest in the environment. In other words, firms in developed countries (as measured by GDP per capita) are less likely to spend on the environment. These findings are in contrast with our hypotheses. This might be explained to some degree by a potential conflict between economic growth and the environment. Mishan (1967) argues that economic growth may have a negative effect on environmental quality. He argues that they are two goals that cannot be achieved simultaneously. Later research has proposed a U-

shaped relationship between economic development and environmental quality. Grossman and Krueger (1995) report an inverted U-shaped relationship between GDP per capita and the level of pollutants which, in turn, indicates a U-shaped relationship between GDP per capita and environmental quality. In other words, in the earlier stages of economic growth, as the economy develops, environmental expenditures decrease. However, when the living standard of a country has reached a sufficiently high level, people will pay greater attention to environmental protection[3].

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 CO2 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 have no significant influence on environmental expenditures. Regarding legal origin, firms in common-law countries appear to invest less in the environment than those in civil-law countries. This result may be based on an alleged conflict between environmental expenditures and shareholder value. Because English common law countries have stronger shareholder rights protection, firms in these countries often treat shareholder value maximization as their first goal while assuming that environmental investments are not good for firm value. Hence, these firms are less likely to have environmental expenditures. In the last regression, which includes the language

[3] We address this issue by performing a robustness test in which we include (GDP per capita)^2 as an additional variable. Please refer to our robustness test section for details.

and religion variables, we find a negative relationship between English language and environmental expenditures as well as a negative relationship between Protestantism and environmental expenditures. These latter findings are likely due to the strong positive correlation between the English common law dummy and these two factors.

5. Robustness tests

5.1 Country-level tests

Although most of our results appear to have a logical explanation, several of them are 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 construction of our main variables, we perform several robustness tests.

First, we use a country's ecological footprint instead of firm-level environmental expenditures as the dependent variable. 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 GI is that a decrease in this variable implies a reduction in the aforementioned demand on the biosphere and this decrease is analogous to relieving pressures on the environment. In other words, the size of a country's ecological footprint is, presumably, closely associated with the amount of GI it undertakes. Accordingly, we assume that higher GI translate into a lower ecological footprint and that the lower a country's ecological footprint, the higher its

GI. Because ecological footprint is a country-level variable, we perform country-level tests that only include country-level variables. The robustness tests confirm the results of our main analysis.

The country sample is 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. After merging our datasets, we find that PM2.5 and anti-director rights are only available for 848 and 616 country-year observations, respectively.

Table 5 shows the correlation coefficients between our independent variables. Similar to our firm-level correlation analysis, Legal_Origin, English, and Protestant are highly correlated with each other; thus, we examine these variables separately from each other.

Please insert Table 5 about here

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. Our subsamples are constructed in the same fashion as for our firm-level tests.

Please insert Table 6 about here

Our results are shown in Table 6. First, we observe that all macroeconomic factors exhibit large differences in the ecological footprint between the two sub-samples. Countries with higher GDP growth and inflation have smaller footprints (2.279 and 1.979, respectively) than countries with lower GDP growth and inflation (3.174 and 3.466, respectively), while countries with higher GDP per capita and economic freedom have larger footprints (3.998 and 3.833, respectively, compared to 1.405 and 1.791, respectively for their counterparts). In addition, countries and years with higher gasoline prices have significantly larger ecological footprints. 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 larger footprint, while surface area does not seem to influence a country's ecological footprint. Dividing the sample according to anti-director rights and creditor rights, we find that countries with better shareholder rights and creditor rights have a significantly larger footprint (4.035 and 3.592, respectively, compared to 3.561 and 2.497 for those with poorer rights). Democracy and autocracy are not significant in explaining ecological footprint. Countries with a feed-in-tariff policy have a larger footprint (2.896) than those without such a policy (2.479). Finally, our results illustrate that Protestant countries and English-speaking countries have significantly larger footprints than countries with other religious denominations and languages.

5.1.2 Regression analysis

We perform a series of regression analyses to test the influence of various determinants on a country's ecological footprint. Because PM2.5 and anti-director rights do not have as

many observations as other variables, we examine them individually. The first regression includes only the basic country variables, i.e. GDP per capita, GDP growth, inflation, the Economic Freedom Index, gasoline prices, CO2 emissions, creditor rights, feed-in-tariff policies, population and surface area. The second regression further includes PM2.5 and anti-director rights in the model. The third regression includes the basic country variables and polity variables, while the fourth regression includes the basic country variables and culture variables.

Please insert Table 7 about here

Our findings are provided in Table 7. We begin by analyzing the results for the country-level regressions. In the first regression, which only considers the effect of our basic country variables on ecological footprint, we find that GDP per capita is significantly positively associated with a country's ecological footprint, while GDP growth, CPI, and economic freedom show no significance. Moreover, we observe a significant negative effect of population and a positive effect of surface area on a country's ecological footprint. Similarly, creditor rights are significantly positively associated with a country's ecological footprint. In the second regression, in which we employ PM2.5 and anti-director rights, we observe no significance for either variable. In the same vein, in the third regression, Democracy and Autocracy exhibit no significant influence on green investments. In the fourth regression with Legal_Origin included, we find a significant positive relationship between Legal_Origin and ecological footprint. Moreover, in a regression that includes the religion and language variables, we find that English language is significantly positively related with a country's ecological footprint, whereas Protestant has no effect. Lastly, it is

worth noting that GDP per capita, population, surface area, and creditor rights remain significant in all regressions.

In summary, we conclude that a country's GDP per capita is consistently positively associated with its 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. Also, the positive association between creditor rights and footprint indicates that countries whose creditor rights are stronger are less likely to invest in green technology. Finally, we find that English common law countries and English-speaking countries invest less in green projects than their counterparts do.

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 consistent country variable finding is that English common law countries are less likely to invest in GI. Similarly, English-speaking countries invest less in green technologies. However, while our firm-level tests show a significant relationship for GDP growth, inflation, economic freedom, gasoline prices, CO_2 emissions, anti-director rights, and Protestantism, our country-level tests indicate no significance for these variables. There is also a conflicting finding between two tests. Particularly, our firm-level tests show that firms in countries with stronger creditor rights are more likely to go green, while our country-level tests show the opposite.

5.2 Determinants of GI in non-US firms

We believe that an important reason for some of the aforementioned unexpected results is that US firms have a strong effect on our full sample results, since we have 1,296 US observations. To address this issue, we exclude all US firms, which leaves us with 4,298 observations. As we did in our firm-level tests, we estimate several regression models. The results are shown in Table 8.

Please insert Table 8 about here

Overall, our results are almost identical to our initial firm-level results. However, the main difference from our firm-level tests is that GDP per capita is now positively associated with environmental expenditures, which is in line with our hypothesis. This suggests that the comparatively low level of GI in the US (which has a high GDP per capita) has negatively affected our full sample results.

5.3 Determinants of GI in different time periods

We further explore whether our results are robust across different time periods. Given that our sample includes the financial crisis in 2008, our findings may differ before and after the year 2008 as firms had to recover from the crisis in recent years and thus may have been less willing to invest in green projects. To address this issue, we divide our sample into two sub-samples, i.e. observations from 2002 to 2007 and observations from 2008 to 2015.

The findings are shown in Table 9, Panel A and Panel B for the 2002 to 2007 and 2008 to 2015 period, respectively. Overall, we find that both our firm and country level variables exhibit similar results to those in Table 4.

Please insert Tables 9 here

The only difference between the two time periods is that GDP growth has a positive influence on GI in the latter period whereas it was largely insignificant in the earlier period.

5.4 Test for a U-shaped relationship

Beckerman (1992) finds that although economic growth usually leads to environmental degradation in the early stages of a country's economic development, in the end environmental quality will improve as countries gets richer. Mirroring these results, Grossman and Krueger (1995) find an inverted-U relationship between economic development and the level of pollutants (see also the more detailed discussion provided by Stern, 2004). In particular, as GDP grows for relatively poor countries, environmental quality worsens. However, when a country is sufficiently rich, people in this country will be more willing to spend on the environment. To address this issue, we divide our sample countries into two groups: countries that belong to the Organization for Economic Co-operation and Development (OECD) and countries that do not. The OECD has 35 members, most of which are regarded as developed countries. We perform our firm-level tests for both groups and explore whether a country's GDP per capita has a different effect on GI in the two sub-samples. Still, we exclude US firms to avoid any bias from this sample concentration in that country. We have 3,584 observations for OECD countries and 644

for non-OECD countries. Because we aim to test the U-shaped relationship between GDP per capita and environmental expenditures, we focus our attention on the variable LN_GDPpercapita.

We estimate three regressions for each group. The first regression includes only firm-level variables, the second regression includes only our basic country variables, i.e. LN_GDPpercapita, Squared LN_GDPpercapita, GDP growth, CPI_Inflation, Economic_Freedom, Gasoline_Prices, Creditorrights, Antidirector, Feedintariff, Population, and Surface. In the last model we use our firm-level and basic country variables. The results are shown in Table 10.

Please insert Table 10 here

First, we compare the significance of our firm-level indicators. We find similar results for OECD and non-OECD firms, except for ROA. While ROA is significantly negatively related to environmental expenditures for the OECD group, it is insignificant for the non-OECD group. As noted before, our main attention focuses on GDP per capita. As we assumed, LN_GDPpercapita and Squared LN_GDPpercapita are both positively related with environmental expenditures in the OECD group, and are negatively related with environmental expenditures in the 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 tests.

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 our 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 relationship between CO2 emissions and GI. 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 firms' environmental expenditures. This means that economic prosperity does not have a positive influence on GI. We also find that surface area and gasoline prices are negatively related with GI. Moreover, we notice that common-law countries, compared with civil-law countries, are less inclined to invest in green projects. Also, English-speaking countries are less likely to go green. These findings are in sharp contrast with our hypotheses.

We perform a series of robustness tests. First, we run country-level tests that use a country's 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. The results suggest that population density is positively

related to GI, which is consistent with the hypothesis that stakeholders in more densely populated countries seek better environmental standards and greater investment in GI.

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. Our findings for GDP per capita, surface area, legal origin, English, and Protestant are consistent with our hypotheses, but are in contrast with some of the previous studies in this area.

During our tests, we were concerned that US firms may have a biasing effect on our results. As US firm observations account for approximately 20% of the whole sample, we perform firm-level tests that exclude US firms. For this non-US subsample, we find a positive relationship between GDP per capita and environmental expenditures, which is in line with our hypothesis. Moreover, we explore whether our results are consistent across different time periods. To address this issue, we divide the whole sample into two sub-samples, i.e. the 2002-2007 and 2008-2015 period. However, we find no significant difference between these subsample tests and our original firm-level test.

We try to explain the negative relationship between GDP per capita and GI by exploring the possibility of a U-shaped relationship between economic development and environmental expenditures. Specifically, we divide our results into developed and developing countries, and compare the relationship between GDP per capita and GI between these groups. The results support our hypotheses. We find a negative relationship between GDP per capita and environmental expenditures in developing countries, and a positive relationship in developed countries. This indicates that developing countries

assume a trade-off between economic development and environmental expenditures and, therefore, sacrifice environmental expenditures for economic development. When countries are more developed in terms of GDP per capita, however, they appear to be more willing to spend on the environment which might result from a better awareness of positive effects of environmental expenditures on economic prosperity.

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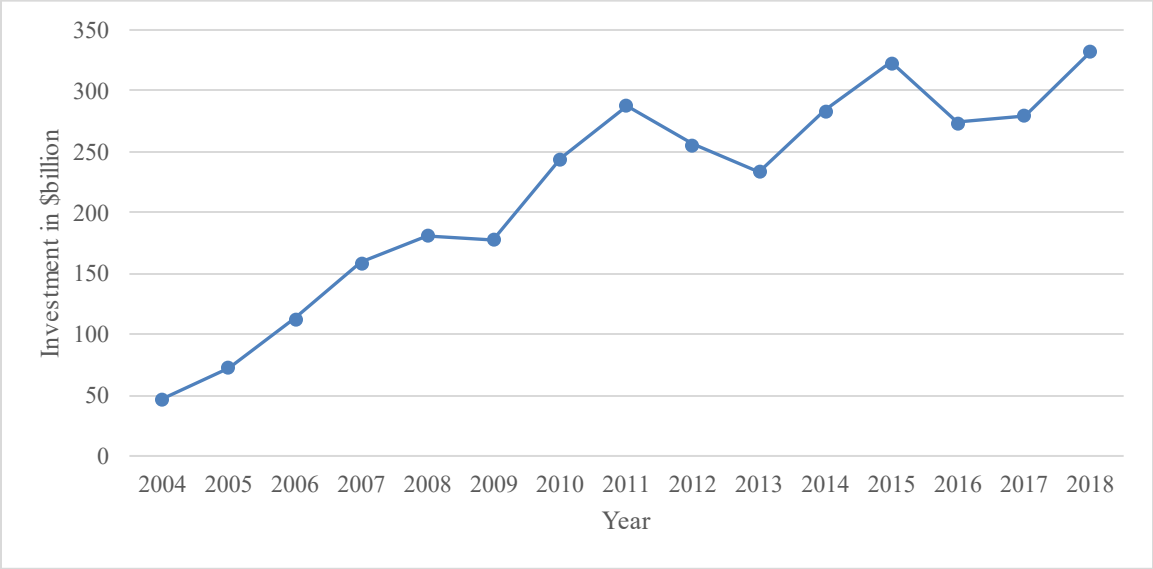
Figure 1: Global Green Investments in Renewable Energies from 2004 to 2018



Source: Bloomberg NEF Research

Table 1: Definition of variables

Variable	Data source	Description
Panel A: Firm variables		
LN_Size	Compustat	Natural log of a firm's market capitalization
Leverage	Compustat	Total assets divided by shareholders' equity
Tobin's Q	Compustat, Datastream	Market value divided by book value of assets
ROA	Compustat	Net income divided by assets
Panel B: Country variables		
LN_GDPpercapita	World Bank Database	Natural log of a country's GDP divided by its total population
GDPgrowth	World Bank Database	Change in GDP compared to the previous year
CPI_Inflation	World Bank Database	Change in the price level of a market basket of consumer goods and services purchased by households
Economic_Freedom	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
Gasoline_Price	World Bank Database	Pump price of gasoline (US$ per liter)
LN_CO2_Emissions	World Bank Database	Natural log of CO2 emissions (tonnes)
PM2.5	World Bank Database	PM2.5 air pollution, mean annual exposure (micrograms per cubic meter of air)
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 (1997, 1998)	A score that ranges from 0 to 6, with 0 representing the lowest level of shareholder rights, and 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
Legal_Origin	Djankov et al. (2007)	A dummy variable that equals 1 if the country adopts English common law, 0 otherwise
Protestant	CIA Fact book	A dummy variable that takes on a value of 1 if a country's primary religion is Protestant
English	CIA Fact book	A dummy variable that takes on a value of 1 if a country's primary language is English

Table 2: Firm-level correlations

We report Pearson/Spearman correlation coefficients for each variable pair at the firm level. 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	16	17	18	19	20
1	LN_Size																				
2	Tobin's 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	LN_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_Inflation	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	Economic_Freedom	-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	LN_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	LN_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	Gasoline_Price	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	LN_CO2_Emissions	-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	-0.101						
		(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)	(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	0.948	0.715					
		(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)	(0.000)	(0.000)					
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	-0.226	-0.273	-0.265				
		(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)	(0.000)	(0.000)	(0.000)				
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	-0.116	0.177	0.267	0.064			
		(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)	(0.000)	(0.000)	(0.000)	(0.337)			
19	Legal_Origin	-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	-0.034	0.781	0.715	-0.273	0.154		
		(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)	(0.011)	(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	0.038	0.587	0.710	-0.239	0.207	0.616	
		(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)	(0.034)	(0.000)	(0.000)	(0.009)	(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	0.336	0.927	.	.	0.329	1.000	0.651
		(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)	(0.000)	(0.000)	.	.	(0.000)	(0.000)	(0.000)

Table 3: Preliminary examination of firm level environmental expenditures – univariate tests

We form subsets of country samples and firm samples along various dimensions, as described in the text. For each univariate test, the upper results show the number of observations, the middle results show the mean values and the lower results show the median values for the two subsamples. 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 the p-values for both tests.

Subsample 1	N mean median	Subsample 2	N Mean median	Tests of differences means (p-value) medians (p-value)
Low LN_Size	2,725	High LN_Size	2,725	
	4.598		5.550	0.000
	4.476		4.954	0.000
Low ROA	2,729	High ROA	2,729	
	5.604		4.556	0.000
	5.371		4.317	0.000
Low Leverage	2,759	High Leverage	2,759	
	4.929		5.227	0.002
	4.450		5.165	0.004
Low Tobin's Q	2,723	High Tobin's Q	2,723	
	2.928		7.194	0.000
	3.135		7.774	0.000
Low GDPgrowth	2,695	High GDPgrowth	2,695	
	5.412		4.728	0.000
	5.357		4.337	0.000
Low LN_GDPpercapita	2,560	High LN_GDPpercapita	2,560	
	6.035		4.239	0.000
	6.681		3.850	0.000
Low CPI_Inflation	2,680	High CPI_Inflation	2,680	
	6.110		4.031	0.000
	6.889		3.845	0.000
Low Economic_Freedom	2,722	High Economic_Freedom	2,722	
	5.411		4.739	0.000
	5.316		4.264	0.000
Low Gasoline_Price	2,563	High Gasoline_Price	2,563	
	4.938		5.364	0.000
	4.654		5.148	0.000
Low LN_CO2_Emissions	1,630	High LN_ CO2_Emissions	1,630	
	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
	3.689		6.900	0.000
Low LN_Population	2,660	High LN_Population	2,660	
	3.792		6.325	0.000
	3.500		6.828	0.000
Low LN_Surface	2,705	High LN_Surface	2,705	
	6.500		3.621	0.000
	7.443		3.664	0.000
Antidirector (0-2)	1,705	Antidirector (3-5)	3,699	
	3.634		5.724	0.000
	3.367		6.174	0.000
Creditor (0-2)	4,566	Creditor (3-4)	919	
	5.289		4.029	0.000

	5.123		3.592	0.000
Autocracy (0-5)	4,037	Autocracy (6-10)	700	
	5.110		5.063	0.740
	4.853		4.538	0.679
Democracy (0-5)	1,845	Democracy (6-10)	2,892	
	5.151		5.072	0.446
	4.797		4.853	0.414
No Feedintariff	564	Feedintariff	3,471	
	4.711		4.932	0.166
	4.315		4.575	0.095
Civil law	3,592	Common law	1,867	
	5.897		3.467	0.000
	6.397		3.664	0.000
Protestant	1,677	Non-Protestant	3,904	
	3.988		5.551	0.000
	3.807		5.795	0.000
English	1,649	Non-English	3,871	
	3.350		5.819	0.000
	3.784		6.823	0.000

Table 4: OLS regression analysis of firm-level environmental expenditures

We examine whether firm-level and country-level determinants influence a firm's environmental expenditure. The first two columns show results for the first regression model which only includes the basic firm variables. The second model only includes the basic country variables, while the third regression includes both the firm and country variables. The subsequent three regressions add the legal origin dummy, religion dummy and language dummy, respectively. For each variable, we report the coefficient and the corresponding heteroskedasticity-adjusted p-value below the coefficient. The last three rows provide the number of observations, F-statistic, and adjusted R^2.

	Firm	Country	Firm + Country	Firm + Environment	Firm + Polity	Firm + Legal_Origin	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_Inflation		-0.720	-0.427				
		(0.000)	(0.000)				
Economic_Freedom		-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)				
Gasoline_Price		-0.425	0.595				
		(0.015)	(0.000)				
Creditor		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_CO2_Emissions				0.494			
				(0.000)			
PM2.5				0.012			
				(0.354)			
Democracy					-0.013		
					(0.087)		
Autocracy					0.010		
					(0.119)		
Legal_Origin						-0.718	
						(0.000)	
Protestant							-0.257
							(0.020)
English							-0.469
							(0.000)
No. of observations	4,908	3,779	3,334	1,185	4,391	4,908	1,569
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: Country-level correlations

We report Pearson/Spearman correlation coefficients for each variable pair at the country level. 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	16
1	GDPpercapita																
2	GDPgrowth	-0.159															
		(0.000)															
3	CPI_Inflation	-0.033	-0.040														
		(0.165)	(0.090)														
4	Economic_Freedom	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	Gasolin_Price	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	LN_CO2_Emissions	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)					
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	Legal_Origin	-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	0.348
		(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)	(0.000)

Table 6: Preliminary examination of country-level ecological footprint – univariate tests

We form subsets of country samples and firm samples along various dimensions, as described in the text. For each univariate test, the upper results show the number of observations, the middle results show the mean values and the lower results show the median values for the two subsamples. 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 the p-values for both tests.

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_Inflation	888	High CPI_Inflation	887	
	3.466		1.979	0.000
	3.160		1.530	0.000
Low Economic_Freedom	882	High Economic_Freedom	883	
	1.791		3.833	0.000
	1.400		3.600	0.000
Low Gasoline_Price	909	High Gasoline_Price	908	
	2.403		3.092	0.000
	1.700		2.700	0.000
Low LN_CO2_Emissions	862	High LN_CO2_Emissions	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
	1.940		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)	1,184	Creditor (3-4)	443	0.047
	2.497		3.592	0.000
	1.760		3.300	0.000
Autocracy (0-5)	1,468	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	1,118	
	2.479		2.896	0.000
	1.700		2.240	0.000
Civil law	1,405	Common law	460	
	2.701		2.810	0.315
	2.100		1.500	0.003
Protestant	135	Non-Protestant	1,280	
	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 country-level ecological footprint

We examine whether country-level determinants have an influence on green investments using country-level ecological footprint as a proxy. The first two columns show results for the first regression, which only includes our basic country variables. The second regression includes basic country variables and one dummy variable: Legal_Origin. The subsequent two regressions include 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 statistic, and adjusted R^2.

	Country	Country + Antidirector + PM2.5	Country + Policy	Country + Legal_Origin	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_Inflation	-0.003	-0.009	-0.005	-0.003	-0.004
	(0.406)	(0.284)	(0.175)	(0.370)	(0.250)
Economic_Freedom	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)
Gasoline_Price	-0.011	-0.768	-0.008	-0.010	-0.010
	(0.276)	(0.000)	(0.412)	(0.313)	(0.346)
LN_CO2_Emissions	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)		
Legal_Origin				0.140	
				(0.030)	
Protestant					-0.097
					(0.369)
English					0.864
					(0.000)
Number of observations	1,449	264	1,265	1,449	1,449
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: Robustness Test- OLS regression analysis of environmental expenditure for non-US firms

We examine whether firm-level and country-level determinants influence firms' environmental expenditures for non-US firms. The first two columns provide results for the first regression model, which only includes our basic firm variables. The second regression only includes our basic country variables, while the third regression includes both firm variables and basic country variables. The subsequent three regressions add 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 statistic, and adjusted R^2.

	Firm	Country	Firm + Country	Firm + Environment	Firm + Polity	Firm + Legal_Origin	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_Inflation		-0.438	-0.301				
		(0.000)	(0.000)				
Economic_Freedom		-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)				
Gasoline_Price		-2.634	-1.259				
		(0.376)	(0.126)				
Creditor		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_CO2_Emissions				1.211			
				(0.000)			
PM2.5				0.002			
				(0.839)			
Democracy					-0.023		
					(0.001)		
Autocracy					0.020		
					(0.010)		
Legal_Origin						-0.801	
						(0.000)	
Protestant							-0.555
							(0.000)
English							-0.694
							(0.000)
Number of observations	3,969	3,059	2,711	981	3,550	3,969	3,969
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: Robustness test: OLS regression analysis of environmental expenditures for different time periods

We separate our sample into observations from 2002 to 2007 (Panel A) and observations from 2008 to 2015 (Panel B). 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 statistic, and adjusted R^2.

Panel A: 2002-2007 Period

	Firm	Country	Firm + Country	Firm + Environment	Firm + Polity	Firm + Legal_Origin	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 Q	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_Inflation		-0.758	-0.425				
		(0.000)	(0.000)				
Economic_Freedom		-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)				
Gasoline_Price		-0.711	0.966				
		(0.012)	(0.000)				
Creditor		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)		
Legal_Origin						-0.519	
						(0.000)	
Protestant							0.318
							(0.072)
English							-0.800
							(0.000)
No. of observations	1,636	1,319	1,148	382	1,476	1,636	1,636
Adjusted R^2	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

Panel B: 2008-2015 Period

	Firm	Country	Firm + Country	Firm + Environment	Firm + Polity	Firm + Legal_Origin	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_Inflation		-0.641	-0.318				
		(0.000)	(0.000)				
Economic_Freedom		-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)				
Gasoline_Price		-0.155	0.966				
		(0.484)	(0.000)				
Creditor		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_CO2_Emissions				0.393			
				(0.000)			
PM2.5				-0.002			
				(0.880)			
Democracy					-0.008		
					(0.247)		
Autocracy					0.009		
					(0.224)		
Legal_Origin						-0.659	
						(0.000)	
Protestant							-0.520
							(0.000)
English							-0.158
							(0.252)
No. of observations	3,272	2,460	2,186	803	2,915	3,272	3,272
Adjusted R^2	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 10: OLS regression analysis of environmental expenditures: OECD vs. non-OECD countries

We separate our sample into OECD and non-OECD countries, and focus on the influence of GDP per capita on environmental expenditures. The left three regressions show the results for firms headquartered in OECD countries. The first regression includes only firm-level variables, the second regression includes our basic-country variables, while the third regression consists of both firm-level and our 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 statistic, and adjusted R^2.

	OECD Countries			Non-OECD Countries		
	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)
Squared LN_GDPpercapita		0.145	0.097		-0.482	-0.372
		(0.005)	(0.063)		(0.017)	(0.050)
GDPgrowth		0.056	0.060		0.119	0.098
		(0.005)	(0.001)		(0.074)	(0.087)
CPI_Inflation		-0.414	-0.364		0.091	0.091
		(0.000)	(0.000)		(0.362)	(0.296)
Economic_Freedom		-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)
Gasoline_Price		-2.172	-1.034		-1.731	-0.346
		(0.000)	(0.000)		(0.057)	(0.745)
Creditor		-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)
No. of observations	3,218	2,538	2,259	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