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Trust and Compliance: Evidence from the EU Emissions Trading Scheme

Ara Jo*

Abstract

I study the role of trust in firms' compliance decisions in the context of the EU Emissions Trading Scheme, an international regulation implemented in multiple countries with different levels of trust. I find that trust in the country where the installation operates has a strong positive influence on its compliance decision. Including country fixed effects by exploiting the differences in the location of headquarters of multinational firms provides further evidence on the positive impact of trust on compliance.

Keywords: Trust, compliance, EU ETS.
JEL Classification: Q54, Z1, K32.

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1 Introduction

The importance of generalized trust – the expectation that a random member of society is trustworthy – in economic outcomes has gained recognition in the literature. In particular, a number of papers have studied the influence of trust in the design and stringency of regulations (Algan and Cahuc, 2009; Aghion et al., 2010; Aghion, Algan and Cahuc, 2011). A related question is then whether and to what extent trust affects compliance of regulated entities under a given regulation. Although the effect of formal institutional measures on compliance is well-documented, there is a dearth of empirical evidence on the effect of *informal* institution, such as the culture of generalized trust, on compliance.[1]

To address the gap in the literature, I study how trust affects compliance decisions in the context of the European Union Emissions Trading Scheme (EU ETS): the world's largest carbon trading market. This setting offers a number of advantages. First, it provides an ideal environment in which the same legislation is implemented in multiple countries, thus allowing me to investigate the systematic differences in compliance behavior caused by cultural traits such as trust, which largely varies at the country level.[2] Relatedly, the penalty for noncompliance is set at the EU level. This feature substantially reduces the problem of having differential levels of severity in punishment for violation. Finally, the European Union Transaction Log (EUTL), a system harmonized at the EU level, provides detailed installation level compliance data comparable across countries. Existing papers that studied compliance of firms under environmental regulations have used data on a single industry or several industries in a single country (e.g. Gray and Deily, 1996; Shimshack and Ward, 2005, 2008; Dasgupta, Hettige and Wheeler, 2000; Nyborg and Telle, 2006; Duflo et al., 2014; Evans, 2016). I address this lacuna by taking advantage of this unique international dataset that contains over 16,000 installations operating in 31 different countries.

Identifying the role of trust in compliance is confounded by the task of having

[1] Luttmer and Singhal (2014) note that there is a lack of attention to social and intrinsic motivations behind tax compliance and only recently papers have started to empirically investigate the importance of these nonpecuniary motivations (e.g. Dwenger et al., 2016; Hallsworth et al., 2017; Besley, Jensen and Persson, 2019). A similar gap exists in the literature on compliance in environmental regulation, to which the current paper is more closely related (Gray and Shimshack, 2011).

[2] Some papers have also exploited within-country variation in trust. For instance, Guiso, Sapienza and Zingales (2004) study the effect of trust on financial development in Italy, a country known for its substantial cultural variation across regions. Tabellini (2010) also exploit regional variation in trust across 8 large European countries.

to disentangle the effect of legal enforcement from the role of trust. Although the stringency of formal enforcement is harmonized at the EU level, it is likely that country-specific regulatory environment or institutional capacity is correlated with how the rules are actually enforced in each country. Given that previous studies have documented a strong influence of trust on the design of institutions and regulations (Algan and Cahuc, 2009; Aghion et al., 2010; Aghion, Algan and Cahuc, 2011), it is then likely that trust picks up the effect of formal enforcement on compliance, rather than trust per se.

I attempt to circumvent this difficulty with two approaches. First, I instrument the average level of trust in each country with trust inherited by second-generation immigrants whose parents came from these countries. Given the persistence of trust across generations (Rice and Feldman, 1997; Guiso, Sapienza and Zingales, 2006), inherited trust observed in second-generation immigrants is expected to be correlated with the level of trust in their countries of origin where their parents came from, and yet unlikely to directly affect compliance behavior of firms operating in their source countries since they are born and reside in their adopted countries. Second, based on the documented influence of the source-country characteristics in multinational enterprises (MNEs)' operation abroad (Bloom and Van Reenen, 2007; Burstein, Monge-Naranjo et al., 2009; Bloom, Sadun and Van Reenen, 2012*b*), I investigate if trust in the country where the multinational is headquartered has influence on compliance decision in the affiliate's foreign location. This specification allows me to include country of operation fixed effects, which removes any bias associated with unobservable national characteristics that may be spuriously correlated with trust and compliance.

Consistent with the main prediction of the conceptual framework, I find that trust prevalent in the country where the installation is located has a strong positive influence on its compliance decision. Further, exploiting the differences in the location of global headquarters of MNEs reveals that installations owned by firms headquartered in high-trust countries are more likely to comply with the regulation than installations owned by firms based in low-trust countries, even when they operate in the same geographic area (country as well as region): for example, in Germany, an installation operated by a multinational firm headquartered in Norway (a high-trust country) would be more likely to be in compliance with the EU ETS than an installation owned by another firm whose global headquarters are located in Greece (a low-trust country). The magnitude of the estimated effect is economically meaningful: a change in ownership from a

multinational firm based in the lowest-trust country in my sample (Philippines) to another MNE headquartered in the highest-trust country (Norway) would be associated with a 1.5 percentage point decrease in the probability of noncompliance when the average noncompliance rate is 3.2 percent. This effect is comparable to the previous estimates for the effectiveness of traditional formal enforcement measures.

This paper contributes to the established literature on the effect of trust on various economic outcomes. Trust has been shown to affect economic development (e.g. Tabellini, 2010; Algan and Cahuc, 2010), financial development (Guiso, Sapienza and Zingales, 2004), trade patterns (Guiso, Sapienza and Zingales, 2009), and global cooperation (Jo and Carattini, 2018). This paper presents the first empirical evidence on the effect of trust on compliance and by doing so, provides a micro-empirical foundation for a number of papers that study how trust affects the design of formal institutions through the degree of law-abidingness of citizens in society (Algan and Cahuc, 2009; Aghion et al., 2010; Aghion, Algan and Cahuc, 2011).

Also relevant is the literature that investigates firms' compliance in environmental regulations. A number of papers have documented strong deterrent effects of formal enforcement actions (Gray and Deily, 1996; Deily and Gray, 2007; Shimshack and Ward, 2005, 2008; Dasgupta, Hettige and Wheeler, 2000; Nyborg and Telle, 2006; Telle, 2013; Duflo et al., 2014; Evans, 2016). My paper differs from the existing literature as I investigate the effect of informal institution – the culture of generalized trust – on the enforcement of regulation, which has received relatively little attention in the literature despite its documented importance and effectiveness (Ostrom, 1990, 2000).

The article is organized as follows. Section 2 presents a simple conceptual framework along with supporting evidence. Section 3 provides background information on the institutional setting and Section 4 describes data used for the analysis in detail. Section 5 presents the empirical analysis and Section 6 concludes.

2 Conceptual framework

In this section I discuss two main mechanisms behind the association between the culture of trust and compliance based on the existing literature. I then focus on the common prediction of both theories that higher levels of generalized trust positively affect compliance.

2.1 Internalized norms

Sociologists have documented that individuals in high-trust societies tend to have strong internalized norms: they donate to charity, obey traffic rules, and pay taxes because they feel obligated to do so (Portes, 1998). In a similar spirit, trust shared in an area may positively affect compliance in environmental regulation.

The growing literature on corporate culture suggests such internalized norms are present at the firm level. Most firms have clearly defined corporate culture – principles and values that should inform the behavior of all the firm's employees (Guiso, Sapienza and Zingales, 2015*b*).[3] It is then likely that these self-declared values are influenced by internalized norms of the individuals who form the organizations and those of the region where they operate.

In parallel to the literature on the transmission of culture by immigrants that emphasizes the strength and persistence of internalized norms (Fernández and Fogli, 2006, 2009; Giuliano, 2007), there is a growing interest in the influence of source-country characteristics in multinational firms' operation abroad. For instance, Bloom, Sadun and Van Reenen (2012*b*) provide empirical evidence that firms in high-trust areas tend to be more decentralized since trust facilitates delegation of decision making power from the CEO to managers. More interestingly, they find that trust in the country where multinational firms are headquartered has a strong positive correlation with decentralization in the affiliate's foreign plants, even when the managers in the plants are hired locally. This finding suggests that firms also take some of their home country culture abroad and emphasizes the strong presence of internalized corporate culture within firms. Thus, I expect trust in the country where firms operate to be positively correlated with their compliance behavior and to potentially affect their foreign subsidiaries' compliance decisions through shared corporate culture.

2.2 Social punishment for noncompliance

Alternatively, assuming that social sanctions for noncompliance are stronger when compliance rate is higher, trust may affect compliance decisions of firms through a high expected compliance rate in society. In reality, the 'name-and-shame' sanction in the EU ETS whereby member states "ensure publication of the names of operators and

[3]Guiso, Sapienza and Zingales (2015*b*) report that when they looked at companies' web pages, they found that 85% of the Standard and Poor's 500 (S&P 500) companies had a section dedicated to corporate culture.

aircraft operators who are in breach of requirements to surrender sufficient allowances" (Article 16(2) of the Directive 2003/87/EC, henceforth the Directive), clearly embodies the threat of social punishment for noncompliance.[4]

I provide a simple analytical model of firms' pollution behavior in the presence of regulation to formalize this reasoning.[5] Let firm i with emission intensity (or simply type) $\theta_i \in [0,1]$ choose an action $b_i \in [0,1]$ when there is a regulation $L \in [0,1]$ that imposes an upper bound on firms' actions.[6] The payoff is represented by:

$$u_i(b_i, \theta_i) = -a(b_i - \theta_i)^2 - (1-a)(b_i - B_j)^2 - \gamma \sum_{i \in N} b_i - \mu I_{\{b_i > L\}} \phi \tag{1}$$

where the element of trust shared in society j is introduced by B_j as the expected action of other firms. I assume that higher trust leads to a lower expected polluting action of other firms. The parameter $a \in (0,1)$ is an (inverse) measure of social sensitivity that governs the relative importance of matching one's own type versus matching the expected average action of other firms as shown in the first two terms.[7] γ captures negative externalities from the total emissions in society. It justifies interpreting lower B_j as higher trust because given this society-wide externality, trust or perceived trustworthiness of other firms leads to the expectation that other firms will choose lower actions for the common good. The last term subtracts the fine ϕ imposed on noncompliant firms, those choosing $b_i > L$, conditional on there being a formal inspection by the authority with probability μ.

Given the set-up, there is a threshold type $\theta^* = f(B_j, L, \mu, \phi)$, beyond which all types violate the regulation and below which all types comply with the regulation.[8] It is then straightforward to show that fewer firms violate the regulation (i.e., θ^* increases) when trust is higher (B_j is lower), the regulation is less stringent (the upper bound L

[4]Banerjee and Shogren (2010) and Qin and Shogren (2015) provide theoretical frameworks for social motivations behind firms' compliance in environmental regulation.

[5]The set-up is adopted from Acemoglu and Jackson (2017) where they study the role of social norms in the enforcement of laws.

[6]Firm i' type $\theta_i \in [0,1]$ is distributed according to a cumulative distribution function F. For simplicity, F is assumed to be strictly increasing and continuous on [0,1] with $F(0) = 0$ and $F(1) = 1$.

[7]Note that deviation in both directions is equally costly. For deviation from the prevailing action in the opposite direction (complying when others violate), Fehr and Gächter (2000) provide experimental evidence that there is a strong aversion against being the "sucker" who cooperates when others do not.

[8]The existence of a threshold type follows from the monotonicity of the first order conditions. I provide a formal proof of this statement in the Online Appendix.

is higher), and formal enforcement rules are stricter (μ and ϕ higher).[9]

2.3 Supporting evidence

The two potential channels discussed so far share the prediction that higher levels of trust lead to more compliance. Here I provide descriptive evidence that is consistent with the prediction. Figure 1 illustrates that there is indeed a negative correlation between trust and noncompliance rates in the EU ETS across countries. While some countries are close to full compliance, other countries such as Bulgaria, Italy and Slovakia (relatively low-trust countries according to several international social surveys) display very high noncompliance, over or close to 10 percent.

[Figure 1]

Micro-level regressions in Table 1 confirm the negative correlation between trust and noncompliance. I begin by regressing the binary noncompliance variable that takes 1 if the installation is noncompliant and 0 otherwise against the trust measure of the country where the installation is located, without any controls (column (1) of Table 1).[10] In the next columns, I include an increasingly extensive set of controls that may affect compliance at the country level and at the firm level. The correlation between trust and noncompliance, however, seems to exist independently over and above these factors.

[Table 1]

Although the common prediction is supported, it is challenging to distinguish the two potential channels empirically. Later I attempt to provide suggestive evidence for the presence of internalized corporate culture by looking at multinational firms' compliance behavior when they operate abroad.

[9] Similarly, I formally show $\frac{\partial \theta^*}{\partial B_j} < 0$ in the Online Appendix.

[10] The variables used here will be described in detail in Section 4. The set of controls in the next columns includes year and industry fixed effects, country-level countrols (rule of law, perceived regulatory quality, log GDP per capita, percentage of population with tertiary education, log population) and firm-level controls (the number of employees, revenue, total assets and the number of installations).

3 Institutional background

Launched in 2005, the European Union Emissions Trading Scheme (EU ETS) is the world's first and the largest carbon trading market operating in 31 countries (all 28 EU countries plus Iceland, Liechtenstein and Norway). It limits emissions from heavy energy-using installations (including power stations and industrial plants) and airlines operating between these countries covering around 45% of the EU's greenhouse gas emissions. Its geographic coverage, as large as all of Europe, offers a unique setting to investigate the extent to which compliance behavior with respect to the same regulation may differ across countries due to the differences in trust and civicness of the population.

According to the annual compliance cycle, operators of industrial installations and aircraft operators (henceforth called installations) report their emissions of the previous year verified by third-party accredited verifiers by 31 March of each year. Installations are then required to surrender a quantity of allowances equal to the volume of their verified greenhouse gas emissions of the previous year by 30 April of that year. An installation is considered out of compliance if the number of allowances surrendered by 30 April is lower than its verified emissions.[11] Noncompliant installations are subject to the EU level penalty for the amount of emissions for which the installation failed to surrender allowances (40 euro per tCO_2 in phase 1 and 100 euro per tCO_2 in phase 2 and 3) and the shortfall in compliance is then added to the compliance target of the following year (i.e. paying a fine does not exempt noncompliant installations from their obligations to surrender sufficient allowances).

To ensure compliance, each national government is required to lay down penalties that are "effective, proportionate, and dissuasive" (Article 16(1) of the Directive) and to submit a report on the implementation of the EU ETS to the European Commission that contains information on monitoring and enforcement activities of the regulatory body running the regulation. I analyzed these reports and found that enforcement was generally weak across countries. Table A1 shows whether there were any penalties imposed on violators in each country in phase 1 when noncompliance was considerably higher than in the following phases. For instance, of the countries that submitted a report for 2005 (four countries did not) only three (Portugal, Spain and the UK)

[11] There are other forms of noncompliance such as failing to report changes in the installation's capacity or monitoring plans. However, data on these forms of noncompliance comparable across countries are unavailable.

issued penalties on violators although most countries had violators in that year. A policy report prepared by the European Commission (European Court of Auditors, 2015) confirms that most countries are not successful in implementing EU ETS-related penalties. European Court of Auditors (2015) explains that countries are often limited in their own legal and administrative capacity for the successful implementation of EU ETS penalties. Institutions running the regulation are either not empowered to impose sanctions themselves (e.g. Italy) or need to await the outcome of lengthy court procedures and appeals (e.g. Germany).[12] The report adds that on-the-spot inspections to assess the implementation of the self-monitoring plan submitted by installations were also very limited.[13] This lack of strong institutional enforcement may explain the existence of noncompliance despite the fact that the cost of purchasing allowances was well below the penalty for not surrendering sufficient allowances throughout the sample period (Figure A1). It also makes the EU ETS a suitable context to study the influence of culture on compliance, which would be minimal in the presence of perfect monitoring and enforcement.

Although enforcement was weak generally across countries, the presence of these country-specific enforcement rules introduces difficulties in identifying the role of trust in compliance (i.e. it would be problematic if high-trust countries also have more stringent enforcement rules and more frequent inspections).[14] In later sections, I propose identification strategies that overcome this obstacle.

4 Data description

4.1 Compliance in the EU ETS

Data on compliance is provided by the European Union Transaction Log (EUTL), a system harmonized at the EU level that publishes information on compliance status,

[12]Indeed, the German authority mentions in their 2007 report that penalties for violators in 2005 were issued only in 2007 and a majority of the cases (11 out of 16) are on appeal.

[13]European Court of Auditors (2015) explains that other types of visits to installations were often performed in the context of the Integrated Pollution Prevention and Control (IPPC, Directive 2008/1/EC) or other environmental legislation that were considered to be of higher priority (e.g. in France, Germany and Poland) without specifically addressing EU ETS-related issues.

[14]A related concern raised by Ellerman and Buchner (2007) is the possibility that some member states systematically overallocated permits to their installations in phase 1 and 2 when allocation was carried out at the national level (from phase 3 allocation is done at the EU level). To the extent that the degree of overallocation might be correlated with trust this could also bias the estimate for the effect of trust on compliance.

permit allocation, verified emissions, and surrendered allowances at the installation level. Existing papers that have studied compliance behavior of firms have focused on a single industry or several industries in a single country.[15] While providing valuable insights into various motivations behind compliance decisions, these studies are unable to shed light on the systematic differences in compliance behavior caused by cultural traits such as trust, which largely varies at the country level. I address this lacuna by taking advantage of this unique international dataset that contains installations operating in multiple industries and multiple countries.[16]

I use information on compliance status from 2005 to 2015 that includes all three phases so far. There are five possible compliance codes installations can be given: (1) A, when the number of allowances and permits surrendered by the deadline (30 April) is greater than or equal to verified emissions, (2) B, when the number of allowances and permits surrendered by the deadline is lower than verified emissions, (3) C, when verified emissions were not entered until the deadline, (4) D, when competent authority corrected verified emissions after the deadline and decided that the installation is not in compliance, and (5) E, when competent authority corrected verified emissions after the deadline and decided that the installation is in compliance. The distribution is reported in Table A2 in the Appendix in detail. Based on this categorization, I construct a binary noncompliance variable that takes 1 if an installation is given either B or D and 0 if an installation is given either A or E. In my preferred specification, I treat compliance status of code C as missing in order to be conservative.[17] Alternative specifications such as considering A and B only or treating C differently yield similar results.

[Figure 2]

[15]For single industry studies, see, for example, Gray and Deily (1996) for the US steel industry, Shimshack and Ward (2005, 2008) for the US pulp industry. Multi-industry studies include Dasgupta, Hettige and Wheeler (2000) for Mexico, Decker and Pope (2005) and Evans (2016) for the US, Nyborg and Telle (2006) for Norway, and more recently Duflo et al. (2014) for India.

[16]I drop Cyprus, Iceland, Liechtenstein, Malta, and Luxembourg since there are too few installations (less then 50) operating in these countries, thus may not represent the culture of the environment in which they operate. Due to the small number of regulated installations, in some cases, technical aspects of monitoring, reporting and verification procedures were delayed (for instance, Malta), which could affect the compatibility of the data. I also drop Croatia that joined the EU ETS in 2013.

[17]Although failing to report verified emissions is strictly speaking noncompliance, two observations call for a more cautious approach. First, among observations with compliance status C, around 80 percent have incomplete information on permit allocation, either missing or zero even in the first two phases when most permits are given for free based on their historical emissions. Second, these installations tend to have missing verified emissions for multiple periods followed by missing compliance status in the following periods. Taken together, it is plausible that these installations were no longer regulated (or active) and therefore did not have reporting obligations.

The cross-country compliance rates depicted in Figure 2 reveals startling variation across countries. It is noteworthy that the distribution is highly right-skewed with a majority of countries close to full compliance and several countries with very high noncompliance. Some countries such as Bulgaria, Italy, and Slovakia, have close to or over 10 percent noncompliant installation-year observations. However, the mean noncompliance rate is very low – 3.2 percent – and half the countries show less then 1 percent noncompliant observations during the sample period.[18]

4.2 Measuring trust

I build trust measures using the European Social Survey (ESS). I pool data from the seven waves (from 2002 to 2014), which includes all European countries that participate in the EU ETS. The ESS measures generalized trust – the expectation that a random member of the society is trustworthy – by asking the classical question, "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?".[19] Respondents' answers are given on a scale of 0 to 10, where 0 implies "You can't be too careful" and 10 means "Most people can be trusted". The variable that I use in the econometric regression is the average of this answer within the country where the installation is located. For identification purposes, I later also explore the importance of trust prevalent in the location of the firm's headquarters (that owns the installation) when the firm's headquarters are located in a different country and therefore likely to be exposed to a different set of values and corporate culture.

This trust question appears in several other surveys including the World Value

[18]The occurrence of noncompliance was very high in 2005 (59% of all noncompliance occurring in the first year) and the rate was substantially lower in 2006 onwards (Figure A2 in the Appendix). In case the cross-country pattern observed in 2005 is an outlier I exclude 2005 and calculate noncompliance rates across countries. A similar cross-country pattern continues to exist, albeit with lower magnitudes, as shown in Figure OA1 in the Online Appendix with Bulgaria, Italy and France appearing high in the ranking. Even without 2005, noncompliance tends to be less frequent in phase 2 and phase 3. One possible reason is that the EU level fine for the amount of emissions for which the installation failed to surrender allowances increased by 2.5 times starting from phase 2 (40 euro per tCO_2 in phase 1 to 100 euro per tCO_2 in phase 2 and 3).

[19]The ESS also measures trust that respondents have in parliament, legal system, the police, politicians and political parties. These measures can also explain compliance patterns and are highly correlated with the measure of generalized trust (the smallest pairwise correlation coefficient being 0.84 between trust in parliament and generalized trust). However, they are likely to reflect the quality of the corresponding institutions, whose effect on compliance I try to remove in order to focus on the effect of trust as culture. Thus I believe it is appropriate to focus on this measure of generalized trust in my analysis.

Survey (WVS) with the same wording and has been the most widely used tool to measure trust across countries in the literature. A number of papers have confirmed that it is indeed correlated with trusting behavior. Fehr et al. (2003) show that survey questions of this type do capture trust by running a series of experiments, and Fehr (2009) further demonstrates that the survey measure of trust is strongly correlated with the behavioral measure of trust derived from trust games. On the contrary, Glaeser et al. (2000) provide experimental evidence that the survey question captures the trustworthiness of respondents rather than trust; but, this conflicting finding has been reconciled by Sapienza, Toldra-Simats and Zingales (2013) who show that subjects in a homogeneous sample (such as Harvard undergraduates as in Glaeser et al. (2000)) tend to extrapolate the trustworthiness of others based on their own trustworthiness. However, in a large anonymous sample (such as random individuals in Germany as in Fehr et al. (2003)) in which respondents are not extrapolating expected trustworthiness of others based own their own trustworthiness, the survey question does seem to capture trust. Thus, I believe the trust measure from the ESS is appropriate for the purpose of my analysis that investigates the role of trust in compliance decisions by firms.

[Figure 3]

Figure 3 plots the average level of trust by country. Two points are noteworthy. First, as shown in previous studies, there exists substantial variation in trust across countries. The average level of trust ranges from a minimum of 3.8 observed in Portugal to a maximum of 6.9 in Denmark. Second, it is readily observable that there are differences across regions of Europe; for instance, Nordic countries (Denmark, Norway, Finland, and Sweden) display highest levels of trust in the sample. On the other hand, Mediterranean countries such as Greece, Italy, and Portugal appear to have lower levels of trust. Continental European countries tend to be in the middle of the trust ranking.

4.3 Firm-level controls

Data on firm characteristics comes from Bureau Van Dijk's Orbis Database. The account holders' information in the EU ETS (i.e., regulated installations) was matched to the corporations in the Orbis Database in Calel and Dechezleprêtre (2016). I obtain key financial variables that may affect compliance decisions (i.e., firms may be too financially constrained to buy enough permits) including the number of employees, operating revenue and total assets for the sample period as well as firms' ownership

structure in 2015 and the number of installations run by each firm. These controls will also account for firm-level heterogeneity more generally. Table OA1 in the Online Appendix reports the descriptive statistics of these variables for firms in each country.

5 Trust and compliance

The discussions in the conceptual framework in Section 2 predict that greater trust leads to higher compliance, or fewer firms violating the regulation. In this section, I subject this prediction to rigorous econometric investigation.

5.1 Using inherited trust as instruments

The negative correlation between trust and noncompliance documented in Section 2 is consistent with the theoretical prediction. However, it is possible that trust picks up the effect of country-specific regulatory environment or institutional capacity that might be correlated with trust, given the documented influence of trust in shaping institutions and regulations (Algan and Cahuc, 2009; Aghion et al., 2010; Aghion, Algan and Cahuc, 2011). Relatedly, Cohen (1998) and Brehm and Hamilton (1996) have argued that the presence and characteristics of other environmental regulations may affect compliance behavior of firms through higher degrees of familiarity and knowledge with compliance procedures. I included a measure that controls for rule of law and the perceived quality of regulation in section 2.3, but it may not be perfect.

It is also plausible that the correlation could also be explained by some unobservable factors that affect regulatory compliance of firms and the level of trust within the country simultaneously.[20] For instance, Jo and Carattini (2018) document that high-trust countries have reduced their per capita CO_2 emissions more substantially than low-trust countries between 1950 and 2010. Then, one might argue that it might be easier for installations in high-trust countries to comply with the EU ETS since they already operate in an environment more conducive to reducing emissions. Thus, what I need is a measure that can predict the average level of trust in a country, but uncorrelated with country-specific formal institutions and other unobservable features that may affect compliance behavior of firms.

[20] I believe the threat of reverse causality is minimal given the extensive evidence on the importance of historical determinants of trust (Guiso, Sapienza and Zingales, 2009; Tabellini, 2010).

One such measure is the *inherited* component of trust observed in second-generation immigrants. This epidemiological approach has gained recognition in the literature (Fernandez, 2007) and been adopted by several papers that attempt to isolate the causal effects of trust on economic outcomes (Algan and Cahuc, 2010; Butler, Giuliano and Guiso, 2016; Jo and Carattini, 2018). The insight is based on the evidence that trust is highly persistent across generations through the transmission of values within families (Rice and Feldman, 1997; Guiso, Sapienza and Zingales, 2009). Then, inherited trust observed in second-generation immigrants is expected to be correlated with the level of trust in their countries of origin where their parents came from, and yet unlikely to directly affect compliance behavior of firms operating in their source country since they are born and reside in their adopted countries.

I apply this idea to my analysis by using, for example, the average level of trust among second-generation British immigrants born and raised in any of the other ESS countries to predict the level of trust in Britain. The exclusion restriction is then trust of second-generation British immigrants born and living in Spain, for instance, should not directly affect compliance decisions of regulated firms operating in Britain between 2005 and 2015. The number of second-generation immigrants from each country from which I estimate this measure of inherited trust is reported in Table OA2 in the Online Appendix. Figure 4 clearly depicts a strong positive correlation between the inherited trust of immigrants and the level of trust observed in their source county, which ensures a strong first stage.

[Figure 4]

I estimate regression equations of the following form:

$$Noncompliance_{ijct} = \alpha + \beta Trust_c + \phi C_{ct} + \rho F_{ijct} + \delta Year_t + \xi Industry_j + \epsilon_{ijct} \quad (2)$$

where $Noncompliance_{ijct}$ is a binary variable that takes 1 if firm i in industry j in country c is out of compliance in year t. $Trust_c$ is the average trust of country c where installations are located. It is reasonable to suppose that the variable does not vary over time during the 11-year period I study, given the persistent nature of trust across generations.[21] Most empirical analyses in the trust literature follow this approach by

[21] To formally test if there is time variation over the study period I check whether there is overlap in the 90% confidence intervals of the trust variable for the start and end year using 2000 and 2014 wave, respectively. Only two out of 25 countries in my sample have non-overlapping confidence intervals over this period.

taking the average of trust in surveys conducted since the 80s (e.g. Tabellini, 2010; Bloom, Sadun and Van Reenen, 2012*b*).[22] Therefore, I run a pooled regression despite the panel nature of the dependent variable. To avoid understating the standard errors due to repeated observations, the errors are clustered at the country level over all years. C_{ct} and F_{ijct} represent country-level controls and firm-level controls. I further include year dummies and industry dummies.

Table 2 reports IV probit estimates. Column (1) first shows the IV estimates from the regression that does not include any controls to begin with. The coefficient on trust is negative and statistically significant (with P-value 0.018). The instrument is strong with F-statistics over 40. Column (2) includes year dummies and industry dummies, which will capture industry-specific characteristics that may affect compliance such as available abatement technology or market situations. In column (3), I include country-level controls such as log GDP per capita, log population, educational attainment and two governance indicators that measure country-wide rule of law and perceived regulatory quality (summary statistics of these variables are reported in the Online Appendix). In column (4), I further include firm-level variables such as the number of installations each firm owns (to control for economies of scale in compliance) and operating revenue, total assets and number of employees to control for the possibility that firms were too financially constrained to buy permits. Due to the large number of missing values in these firm-level financial variables, the sample size falls substantially, and yet the negative relationship between trust and noncompliance remains robust.[23] Column (5) shows the reduced form relationship between inherited trust and noncompliance. The 2SLS estimate from a linear probability model is qualitatively similar with a coefficient (standard error) of -0.049 (0.028).

[Table 2]

[22]Few studies exploit time variation in trust with a notable exception being Algan and Cahuc (2010). They suggest a methodology to recover long intertemporal variation in trust by comparing immigrants who moved to America from different countries at different points in time and generate a trust measure for 25 countries with time variation over 60 years, which arguably covers multiple generations. Their trust variable measures trust in two points far apart in time, 1935 and 2000, to allow sufficient time for the evolution of trust. Algan and Cahuc (2009) also exploit time variation in trust over 20 years in one of the specifications, using only the end points of their data (1980 and 2000) to get enough variation.

[23]To make sure the presence of missing values does not alter the distribution of compliance, I check if the compliance rate differs with and without observations with missing firm-level controls and find that the distribution of the dependent variable (noncompliance) is not statistically different across the two groups (with P-value of the test statistics 0.64).

The magnitude of the association between trust and compliance is substantial. The estimate from column (4) that includes the full set of controls implies a 1 standard deviation increase in trust (roughly from trust in Italy to trust in Netherlands) is associated with a 2.4 percentage point decrease in the probability of noncompliance.

Some papers have exploited within-country regional variation in trust for identification purposes (Guiso, Sapienza and Zingales, 2004; Tabellini, 2010; Bloom, Sadun and Van Reenen, 2012*b*). I also try a trust measure at the region level in column (6) and find consistent results. The most prominent benefit of exploiting regional variation in trust is that it allows including country fixed effects and the studies mentioned above successfully combine country fixed effects with region-level instruments to estimate the causal effects of trust. However, the difficulty of adopting this approach in my context is that country fixed effects will make it impossible to use my instrument, which is at the country level (the *region* of origin of immigrants is not asked in the ESS).[24] In the next section, I suggest an alternative design that allows both using the instrument and country fixed effects.

5.2 Exploiting differences in the location of headquarters

About 80 percent of installations (10,692 in total) for which I have ownership data are owned by multinational firms (MNEs) and 4,310 of them are owned by foreign MNEs whose central headquarters are located in a different country from the country where the installations operate. This subsample offers a chance to further probe the causality of the relationship that I attempted to estimate so far by allowing country of operation fixed effects. Country fixed effects remove any bias associated with unobservable national characteristics that may be spuriously correlated with trust and compliance. I then compare compliance behavior of installations that are exposed to the exact same external environment (e.g. formal enforcement, stringency of other related regulations, etc.) but have different levels of trust coming from the country of origin.

The importance of country of origin characteristics in MNEs' management and organizational structure has long been recognized in the relevant literature. A study most relevant to my analysis is Bloom, Sadun and Van Reenen (2012*b*) where they provide

[24] Another concern is that there might not be enough regional variation in trust once country dummies are included, given that my sample includes 25 European countries, many of which are culturally homogeneous. Previous studies that exploited regional variation in trust focused on large countries known for substantial within-country variation in trust including Italy (Guiso, Sapienza and Zingales, 2004; Tabellini, 2010) or on the entire world Bloom, Sadun and Van Reenen (2012*b*).

evidence that the level of trust prevalent in the country where the multinational is headquartered has a strong positive effect on the degree of decentralization in the affiliate's foreign location (for instance, a Swedish affiliate operating in the US is typically more decentralized than a French affiliate in the US). Furthermore, Bloom, Sadun and Van Reenen (2012*a*) show that US multinationals operating in Europe displayed higher productivity in the use of information technologies (IT) than non-US multinationals in Europe during the period when the US experienced a rapid productivity growth in sectors that intensively use IT. Burstein, Monge-Naranjo et al. (2009) and Bloom and Van Reenen (2007) also document the transmission of knowledge and management practices across countries in MNEs. Given this ample evidence on the influence of source-country characteristics over MNEs' operation abroad, it seems legitimate to investigate whether there might be different patterns in compliance behavior across multinationals based in different countries.[25]

The results of this analysis are reported in Table 3. For this exercise, I construct another trust measure from the World Value Survey (WVS) since there are a number of non-European countries in which MNEs in my sample are headquartered and thus not included in the ESS.[26] As before, I pool together individual responses from all six waves conducted so far (1984, 1993, 1999, 2004, 2009, and 2014), and compute the average level of trust in the country where the global headquarters of the installation is located.[27] I later also check for the independent role of trust in the installation's location.

[Table 3]

Column (1) shows the relationship between compliance and the level of trust in the country where the central headquarters are located without any controls. Standard errors are clustered at the country level. The coefficient is negative and significant at 1

[25]It is possible that some firms might have experienced changes in ownership through mergers and acquisitions (M&As) just before or while being subject to the EU ETS. To reduce the potential measurement error arising from this scenario, I identify firms that were bought out by foreign companies (i.e., target firms in foreign M&A deals) since 2000 using rich M&A data from Bureau Van Dijk's Zephyr Database. There are only a small number of such firms in my sample (264 out of 8,156 firms). I drop 573 installations owned by these firms from the regression.

[26]There are 44 source countries in my sample and the median (mean) number of firms headquartered in each source country is 28 (103).

[27]The only difference in the trust question in these two surveys is the scale used for the answer. While the ESS uses the scale of 10, the WVS provides a binary choice between 0 and 1 where 0 implies "You can't be too careful" and 10 means "Most people can be trusted".

percent level, which suggests that trust prevalent in source countries is positively correlated with the affiliates' compliance decisions. The influence of trust in the country of headquarters remains strong even when I control for individual firm-level characteristics in column (2). Next, I include country of operation fixed effects as well as year and industry fixed effects. The magnitude of the coefficient falls sharply with an extensive set of fixed effects, but the coefficient in column (3) is still negative and significant. This implies that installations owned by firms based in high-trust countries are less likely to violate the regulation than those owned by firms in low-trust countries, even when they operate in the same institutional environment. In column (4), I add the level of trust in the location where the installation operates (at the region level, since the country-level measure will be omitted due to country fixed effects). The coefficient on trust in the region of installation is insignificant, while the role of trust in the country of headquarters remains negative and statistically significant with a similar magnitude as in column (3). One might worry that time-varying omitted variable bias may still confound the estimate. For instance, after the 2011 nuclear accident in Japan, Germany decided to dramatically reduce their dependence on nuclear power plants while increasing the share of renewable sources in producing electricity. This led to changes in regulatory environment and energy prices that might have affected firms' compliance behavior under the EU ETS. To deal with this concern of time-varying country specific confounders, I include country *by* year fixed effects in column (5). The sample size falls as there are country-year pairs with perfect compliance, thus no variation; however, the coefficient remains qualitatively similar.

A remaining concern is potential omitted variable bias related to trust in the country of headquarters. For instance, Bloom, Sadun and Van Reenen (2012*b*) show that MNEs with headquarters in high-trust countries are larger in firm size and more productive than those with headquarters in low-trust countries. If compliance behavior is correlated with these firm characteristics related to trust that I cannot directly control for (although I control for the number of employees), the estimate might be biased. Thus, I apply the same instrument developed in the section above to further probe the role of trust in compliance behavior. The measure of inherited trust observed in second-generation immigrants is still valid in this context, since it predicts the level of trust in their source countries but unlikely to be correlated with the organization and performance (such as size and productivity) of MNEs headquartered in those countries. Column (6) reports the IV estimates. The coefficient is negative and of larger

magnitude when instrumented and still statistically significant. Column (7) shows the presence of a negative and significant relationship between noncompliance and the measure of inherited trust in the reduced form. In column (8), I further include country (of operation) by year fixed effects (as in column (5)). Even in this demanding specification, the influence of trust in the MNE's source country continues to exist. Repeating this specification in a linear probability model yields similar results (unreported).[28]

Not only is the estimated effect of trust on compliance statistically significant, it is also economically meaningful. The estimate in column (5) implies that a change in ownership from a multinational firm based in Philippines (the lowest-trust country in my sample) to another MNE headquartered in Norway (the highest-trust country) would be associated with a 1.2 percentage point decrease in the probability of noncompliance. How large is this effect relative to that of formal enforcement on compliance? To provide a sense of magnitude, I compare this effect with other existing estimates for the effectiveness of formal enforcement actions reported in previous papers. Estimates for the effect of traditional regulatory measures (e.g. inspections and fines) range between 42 and 52 percent treatment effects (Gray and Shimshack, 2011).[29] Also, Evans (2016) documents that an information-based enforcement tool such as the "watch list" in the Clean Air Act is associated with a 21 percentage point decrease in the probability of noncompliance, indicating a 29 percent treatment effect given the average noncompliance rate 72 percent. Compared with these previous estimates, the effect of trust still seems large: given the average compliance rate of 3.2 percent in my sample, the predicted fall in the probability of noncompliance by 1.2 percentage point caused by the change in ownership from a Filipino firm to a Norwegian firm implies a 37 percent treatment effect.

[28]It yields a coefficient (standard error) on the trust measure of -0.021 (0.008).

[29]Deily and Gray (2007) studied the deterrent effects of regulatory measures on compliance in the Clean Air Act using compliance data on large steel mills in the Unites States. They found that being subject to an enforcement activity in the prior two years decreased the probability of noncompliance by 32 percentage point. Given the overall noncompliance rate 62 percent, the estimate suggets a 52 percent treatment effect. In a similar context, using compliance data on pulp and paper mills Gray and Shadbegian (2005) found that a typical regulatory action decreased the probability of violation by 10 percentage point, implying a 42 percent treatment effect (with the average violation rate 24 percent in the sample).

5.3 Discussions

The strong effect of trust in the country of headquarters on MNEs' compliance provides support for the channel of internalized corporate culture discussed in Section 2.1 In the Appendix, I further explore this line of argument by investigating the influence of bilateral trust between two countries on MNEs' compliance. For instance, is a French affiliate more likely to comply with the regulation in Belgium (that the French tend to trust) than in the United Kingdom (that the French tend to distrust)? I find that the effect of bilateral trust is negligible and firms operate in accordance with their source-country culture regardless of where they operate (Table A3), which provides further support for the presence of internalized corporate culture.

Yet, this evidence does not necessarily rule out the channel of social sanctions for noncompliance. To the extent that MNEs care about their reputation back home (in which case the expected action of neighboring firms will be that of firms operating in their home countries), the channel of social punishment for violation may still be at play (Wijen and van Tulder, 2011).[30] This possibility makes it challenging to empirically disentangle the two channels. The findings should therefore be taken as a reduced-form average effect of these mechanisms.

Finally, the evidence presented in this paper is also consistent with the literature that emphasizes the role of knowledge in compliance by distinguishing two sources of noncompliance, namely, ignorance and evasion (Brehm and Hamilton, 1996; Cohen, 1998; Jørgensen and Pedersen, 2005). The strong effect of trust in the country of MNEs' headquarters on compliance might indicate that firms in high-trust countries obtain information required for compliance more actively due to internalized corporate culture or strong social sanctions for violation. However, once equipped with the set of knowledge necessary to comply with the regulation firms may comply wherever they operate, regardless of the strength of formal enforcement activities in the country of operation since the cost of doing so is low.

[30] A recent example would be the Volkswagen diesel emissions scandal. When it broke on Friday 18 September 2015 in the US, on the following Monday morning (before it became an international scandal) the company's share price dropped almost 20 percent in the Frankfurt stock exchange and the German government issued a statement that condemns the company's alleged violation of the US law. For a timeline of the scandal, see https://www.theguardian.com/business/2015/dec/10/volkswagen-emissions-scandal-timeline-events.

5.4 Robustness checks

In this section I report the results from a number of robustness checks. Table OA3 in the Online Appendix reports robustness checks for the cross-country analysis using all firms (as in Section 5.1) where I try to (1) drop late joiners in the EU ETS, (2) use alternative specifications for noncompliance, (3) use alternative measures of trust, (4) use an alternative specification for the measure of inherited trust, and (5) check if installations' compliance behavior is different also at the intensive margin, i.e., if the amount by which installations are noncompliant can also be explained by the level of trust. Here I focus on the main results from the specification using MNEs that includes country of operation fixed effects. First, I add region-level economic controls (log GDP per capita, log population and the percentage of population with tertiary education) in addition to country of operation fixed effects (column (1) in Table 4). Also, I exclude Bulgaria and Romania that joined the EU ETS later, in case there might have been technical difficulties arising from immature infrastructure. Bulgaria and Romania started to participate in the ETS in 2007 when they joined the European Union in the same year.[31] Excluding these late joiners does not affect the relationship between trust and compliance (column (2)).

[Table 4]

Next, I try alternative specifications for the binary noncompliance variable. In my preferred specification, I dropped installations with compliance status C that did not report their verified emissions (the step before they surrender corresponding amount of permits) in order to be conservative because there is suggestive evidence that these installations are no longer regulated or active (see footnote 17). Alternatively, I treat these installations as noncompliant when they can be reasonably presumed to be active by two standards: first, when they have non-missing information on permit allocation in the current period and second, when they have non-missing compliance status other than C in the following period. The regression in column (3) uses this alternative measure of noncompliance. The magnitude of the coefficient on the trust measure falls but it remains significant at 10 percent level. I also try to drop installations whose verified emissions were corrected later by the competent authority (i.e. those with code D and E) and find similar results (column (4)).

[31] Croatia also joined the ETS in 2013 and is already dropped from my sample along with five small countries with less then 50 installations.

In column (5) and (6) I try alternative measures of trust to get a sense of potential measurement error in the trust variable. First, I construct a measure that takes into account year-specific shocks since I pool multiple waves conducted in different years to calculate the average level of trust in each country. Following Bertrand, Duflo and Mullainathan (2004) and Guiso, Sapienza and Zingales (2009), I regress trust on year dummies, form residuals, and then compute the means of these residuals by country. Column (5) shows that the coefficient on this alternative measure of trust is still negative and significant at 1 percent level. Next, I try a potentially more demanding approach that further takes into account individual respondents' characteristics such as gender, age, education and income as well as year dummies. To proceed, I follow Algan and Cahuc (2010) by regressing trust on a set of individual characteristics, year fixed effects and country fixed effects. The coefficients on the country fixed effects then measure the average level of trust relative to the omitted reference country (Germany, in this case). The results from the individual-level regression are reported in Table OA5 in the Online Appendix. The fact that coefficients on the country dummies are significant (with standard errors clustered at the country level) even after controlling for a set of individual characteristics and year dummies confirm the substantial cross-country variation in trust documented in the literature. Column (6) reports the IV probit estimate from the specification using this alternative trust measure and shows the results consistent with previous findings. The effect of trust on compliance remains robust across different measures of trust.

Finally, I try an alternative specification of the instrument that imposes a minimum of 25-year lag between the launch of the EU ETS and the year of immigration of the second-generation immigrants' parents as in Algan and Cahuc (2010). This is to further ensure that the exogeneity assumption is satisfied, since I only use second-generation immigrants born before 1980 and therefore whose parents must have left their source countries before 1980, at least 25 years (one generation) prior to the start of the EU ETS in 2005. Then it is even less likely that the level of trust transmitted by those who left the country at least 25 years ago still affects compliance behavior of firms in that country. Column (7) shows that the result with this instrument is very similar and the modified instrument still has a strong predictive power (F-stat is 18.6). Column (8) shows the presence of a negative and significant relationship between noncompliance and the alternative instrument in the reduced-form regression.

6 Conclusion

In this article, I attempt to provide rigorous empirical evidence on the effect of informal institution, the culture of trust, on compliance. I find strong evidence that trust positively affects compliance and more importantly, there exist systematic differences in firms' compliance patterns depending on the country in which they are headquartered, even when they operate in the same geographic area with the same external environment.

One interesting implication is related to the idea of using corporations as a lab in which to study the role of culture. Although the role of culture in economic activities has long been recognized, economists' attempts to develop a deeper insight into specific workings of culture have not been straightforward because (1) it is difficult to know where culture comes from, (2) it is sticky with rare drastic changes, and (3) even when these cultural changes occur they take place over a long period with many other things happening at the same time. Guiso, Sapienza and Zingales (2015*a*) note this problem and suggest corporations as an alternative environment to study the role of culture. This is indeed promising since with corporate culture, we know (1) when, how, and based on what values corporations are founded, (2) corporate culture is subject to more frequent changes (e.g., through hiring, firing and M&As), and (3) performance is more easily measured (Guiso, Sapienza and Zingales, 2015*a*). There is an increasing interest in this line of reasoning that sheds light on specific mechanisms behind the documented effect of culture at the macro-level. For instance, Bloom, Sadun and Van Reenen (2012*b*) provides evidence on the influence of trust in firms' decision to decentralize, which allows more efficient resource allocation within and across firms that leads to higher firm productivity and economic growth. This serves as microevidence for the long-held belief that trust facilitates economic growth through lower transactions costs (Arrow, 1972). Similarly, this article provides microevidence on the role of trust in compliance and by doing so, validates the documented effect of trust on the design of formal regulation through how law-abiding people are (Tabellini, 2008). I concur with Guiso, Sapienza and Zingales (2015*a*) that these approaches substantially enhance our understanding of how cultural norms affect economic behavior and relate to formal institutions.

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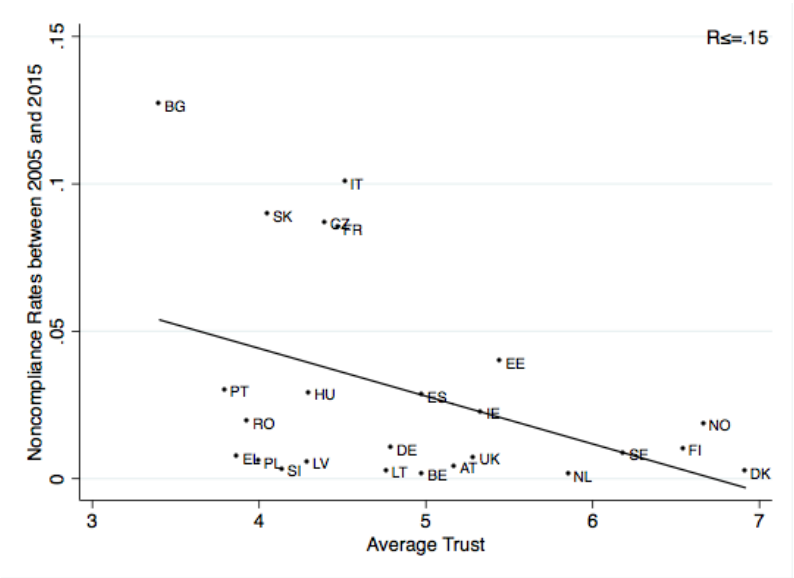
Figures and tables for the main text

Figure 1: Correlation between Trust and Noncompliance Rate in the EU ETS



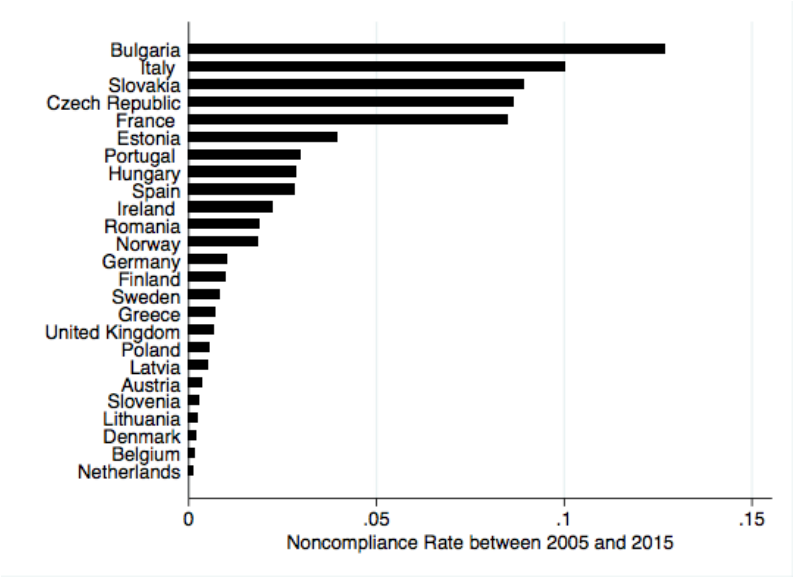
Note: the plot shows a correlation between the level of average trust and compliance rates in the EU ETS across countries. The level of average trust measure is constructed based on the European Social Survey (2002-2014).

Table 1: Probit Estimation: Trust and Noncompliance in the EU ETS between 2005 and 2015

	Dependent variable: Indicator for noncompliance				
	(1)	(2)	(3)	(4)	(5)
Trust measured in the country of operation	-0.358*** (0.111)	-0.444*** (0.150)	-0.379* (0.222)	-0.468* (0.261)	-1.320** (0.657)
Observations	119,701	119,163	119,163	73,498	73,498
Firm-level controls (4)	No	No	No	Yes	Yes
Country-level controls (5)	No	No	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Clustering	Country	Country	Country	Country	Country
Number of clusters	25	25	25	25	25

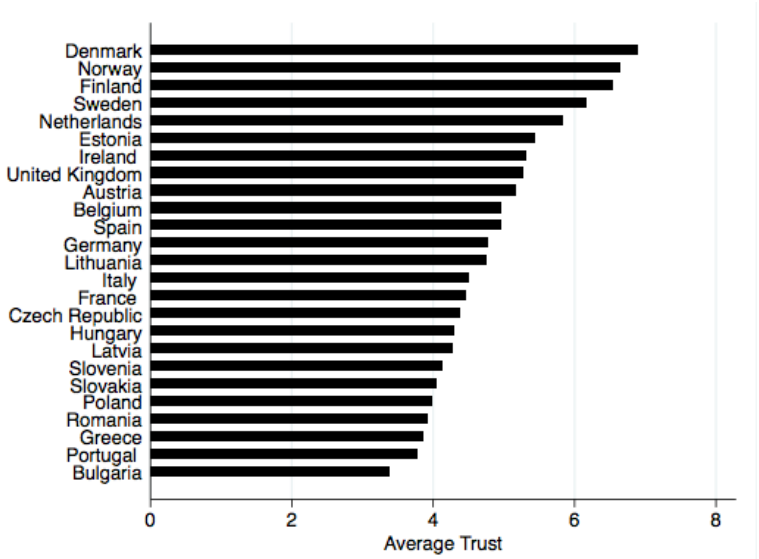
Notes: The dependent variable in all columns is the binary noncompliance measure that takes 1 if the installation is out of compliance and 0 otherwise. All estimation is by Probit except for column (5) where I try a logit model. Standard errors are clustered at the country of installations' location. "Industry dummies" are based on the main activity type information provided in the European Transaction Log.

Figure 2: Average Noncompliance Rate between 2005 and 2015



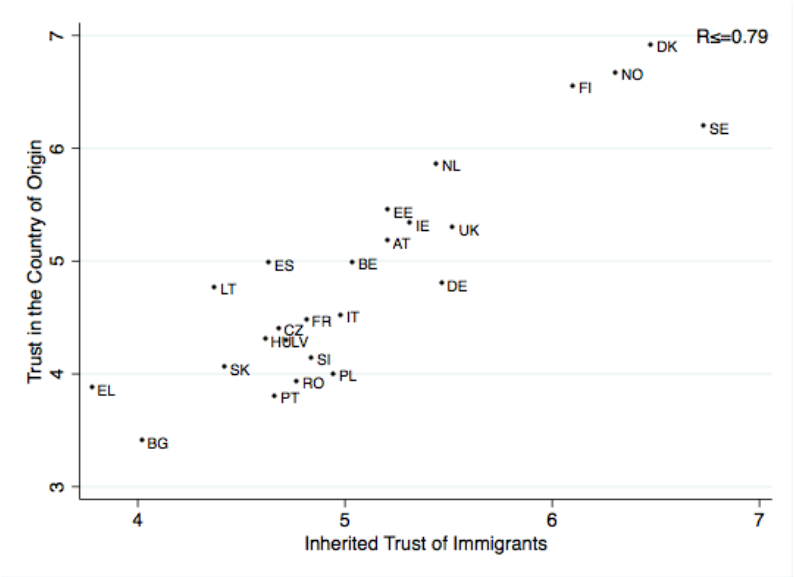
Note: the plot shows variation in noncompliance rates across countries. The data on compliance in the EU ETS is provided by the European Union Transaction Log (EUTL).

Figure 3: Average Trust



Note: the plot shows variation in the level of average trust across countries. The level of average trust measure is based on the European Social Survey (2002-2014).

Figure 4: Correlation between Trust in Source Country and Inherited Trust



Note: the plot shows a correlation between inhered trust of second-generation immigrants and the level of trust in their countries of origin. These measures are constructed based on the European Social Survey (2002-2014).

Table 2: IV Probit Estimation: Trust and Noncompliance in the EU ETS between 2005 and 2015

	Dependent variable: Indicator for noncompliance					
	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	IV Probit	IV Probit	IV Probit	IV Probit	Probit	IV Probit
Trust measured	-0.459***	-0.575***	-0.750*	-0.865*		-0.892***
in country of operation	(0.118)	(0.153)	(0.427)	(0.461)		(0.258)
Inherited Trust					-0.494*	
					(0.292)	
Observations	119,701	119,163	119,163	73,498	73,498	71,356
Firm-level controls (4)	No	No	No	Yes	Yes	Yes
Country-level controls (5)	No	No	Yes	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes	Yes
Clustering	Country	Country	Country	Country	Country	Region
Number of clusters	25	25	25	25	25	165
First stage F stat	40.4	45.0	32.1	60.2		57.7

Notes: The dependent variable in all columns is the binary noncompliance measure that takes 1 if the installation is out of compliance and 0 otherwise. Standard errors are clustered at the level shown in each column. "Industry dummies" are based on the main activity type information provided in the European Transaction Log. Column (1) shows an IV probit estimate without any controls. Column (2) includes year and industry dummies. Column (3) includes a set of country level controls (GDP per capita, education, population and two governance indicators). Column (4) further includes several firm-level controls (number of installations each firm owns, total assets, operating revenue, and number of employees). Column (5) shows the reduced form relationship between noncompliance and the instrument. Column (6) uses a measure of trust that varies at the region level.

Table 3: Trust and Noncompliance in the EU ETS between 2005 and 2015:
Exploiting the Differences in the Location of Headquarters

	Dependent variable: Indicator for noncompliance							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	Probit	Probit	Probit	Probit	Probit	IV Probit	Probit	IV Probit
Trust measured	-1.596***	-1.616***	-0.390*	-0.417**	-0.460*	-0.591***		-0.818**
in country of central headquarter	(0.380)	(0.343)	(0.204)	(0.207)	(0.277)	(0.222)		(0.326)
Trust measured				0.217				
in region of operation				(0.167)				
Inherited Trust							-0.111***	
							(0.042)	
Observations	69,912	51,070	49,174	47,692	33,173	49,160	49,160	33,173
Firm-level controls (4)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Country × year FE	No	No	No	No	Yes	No	No	Yes
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
Number of clusters	25	20	20	20	20	20	20	20

Notes: The dependent variable in all columns is the binary noncompliance measure that takes 1 if the installation is out of compliance and 0 otherwise. The sample in this table includes multinational firms only. Standard errors are clustered at the level shown in each column. "Industry dummies" are based on the main activity type information provided in the European Transaction Log. Column (1) does not include any controls and column (2) adds firm-level controls (number of installations each firm owns, total assets, operating revenue, and number of employees). Column (3) includes year, industry and country of operation fixed effects. Column (4) separately checks the influence of trust in the region where the installation is located. Column (5) includes country *by* year fixed effects. Column (6) shows the IV estimate and column (7) presents the reduced form relationship between noncompliance and the instrument. Column (8) further includes country *by* year fixed effects.

Table 4: Trust and Noncompliance in the EU ETS between 2005 and 2015: Robustness Checks

	Dependent variable: Indicator for noncompliance							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	Probit
Trust measured	-0.598***	-0.609**	-0.398*	-0.602***	-0.615***	-0.599**	-1.064*	
in country of central headquarter	(0.223)	(0.249)	(0.219)	(0.222)	(0.230)	(0.241)	(0.562)	
Inherited Trust								-0.113***
								(0.044)
Observations	46,257	47,570	49,204	48,921	49,160	49,160	49,160	49,160
Firm-level controls (4)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-level controls (3)	Yes	No	No	No	No	No	No	No
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
Number of clusters	20	18	20	20	20	20	20	20
First stage F stat	172.7	191.9	179.8	187.1	194.0	218.7	21.2	

Notes: The dependent variable in each column is a binary noncompliance measure that takes 1 if the installation is out of compliance and 0 otherwise. Standard errors are clustered at the level shown in each column. "Industry dummies" are based on the main activity type information provided in the European Transaction Log. Column (1) includes region-level controls and column (2) drops ETS late joiners in my sample (Bulgaria and Romania). In column (3) and (4) I use alternative specifications for the binary compliance variable. In column (5) and (6) I try alternative measures of trust to check for potential measurement error. In column (7) I try an alternative instrument and column (8) shows the reduced-form relationship between noncompliance and the alternative instrument.

Appendix

Bilateral trust

Several papers have looked at the influence of *bilateral* trust between two countries in economic activities (Guiso, Sapienza and Zingales, 2009; Bloom, Sadun and Van Reenen, 2012*b*). The measure of bilateral trust used in the literature comes from the following question in a series of surveys conducted for the European Commission: "I would like to ask you a question about how much trust you have in people from various countries. For each, please tell me whether you have a lot of trust, some trust, not very much trust, or no trust at all." This question allows me explore the role of trust in compliance controlling for country of operation and country of origin fixed effects at the same time and thus solely exploit the pairwise variation in trust. In other words, it will reveal, for instance, if a French affiliate is more likely to comply with the regulation in Belgium (that the French tend to trust) than in the United Kingdom (that the French tend to distrust).

[Table A3]

Column (1) in Table A1 shows that bilateral trust does not play a significant role in multinationals' compliance behavior when I include a full set of country of location and origin dummies (therefore this specification only includes foreign MNEs). The result is similar when I add firm-level financial variables in column (2). In case the bilateral trust variable is affected by endogeneity (for instance, better compliance behavior in the country of operation might engender trust towards the source country or there might be omitted bilateral factors affecting trust and compliance behavior at the same time), I use a measure of religious similarity between two countries developed in Guiso, Sapienza and Zingales (2009) to instrument for bilateral trust. This measure is positively correlated with bilateral trust due to long-standing cultural affinities, but unlikely to affect regulatory compliance exhibited by firms. It yields a strong first stage (with F statistics of 30) as in previous studies, but the bilateral variable is still insignificant as shown in column (3). I add an additional instrument in column (4) that measures somatic distances, based on the average frequency of specific traits (hair color, height, etc.) present in the indigenous population as in Guiso, Sapienza and Zingales (2009) since people tend to trust other people who look like them more. The

first stage F statistics continues to be strong (around 38). However, the result remains qualitatively similar.[32]

This finding can be interpreted in light of the literature on the "transportation" of culture by individuals across countries. For example, Fisman and Miguel (2007) show that diplomats from different countries stationed in the same city (the New York City) display significantly different patterns of corruptive behavior (measured by unpaid parking fines) that can be explained by the level of corruption in their home countries. The weak role of bilateral trust together with the strong influence of trust in the source country is consistent with their findings since it implies that firms operate with their source-country culture regardless of where they operate.[33] Also, another possible interpretation is related to the importance of knowledge in compliance. Brehm and Hamilton (1996) and Cohen (1998) distinguish between two sources of noncompliance, namely, ignorance and evasion. The fact that trust has a strong influence over firms' compliance but bilateral trust does not, might imply that firms in high-trust countries may obtain information required for compliance more actively encouraged by the high anticipated compliance rates by neighboring firms. However, once equipped with the set of knowledge necessary to comply with the regulation firms may comply wherever they operate, which makes the role of bilateral trust minimal.

[32]When I only include the measure of somatic distances as an instrument, the first stage is slightly weaker with F-statistics 9.7. The result is still qualitatively similar with a coefficient (standard error) of -0.159 (1.073) on the bilateral trust measure.

[33]Relatedly, it is likely that firms take into account social sanctions coming from their countries of origin, not from the countries of operation. This interpretation also explains the non-differential compliance behavior of firms headquartered in the same country but operate in different countries (thus no effect of bilateral trust).

Figure A1: Permit price (spot) between 2005 and 2015

Note: the graph plots the evolution of the EU ETS permit (EUA) price in the spot market. The data comes from the European Energy Exchange.

Table A1: Incidence of Penalties Imposed in the EU ETS Phase 1 by Country

Country	2005	2006	2007
Austria	No	No	No
Belgium	No	No	No
Bulgaria			No
Czech Republic	.	No	No
Denmark	No	No	.
Estonia	No	No	No
Finland	No	No	No
France	No	No	No
Germany	locked	locked	Yes
Greece	.	.	No
Hungary	No	No	Yes
Ireland	No	.	.
Italy	No	No	No
Latvia	No	No	No
Lithuania	.	.	No
Netherlands	No	No	No
Norway			
Poland	.	locked	No
Portugal	Yes	No	locked
Romania			.
Slovakia	No	No	No
Slovenia	No	No	No
Spain	Yes	Yes	Yes
Sweden	No	No	Yes
UK	Yes	Yes	No

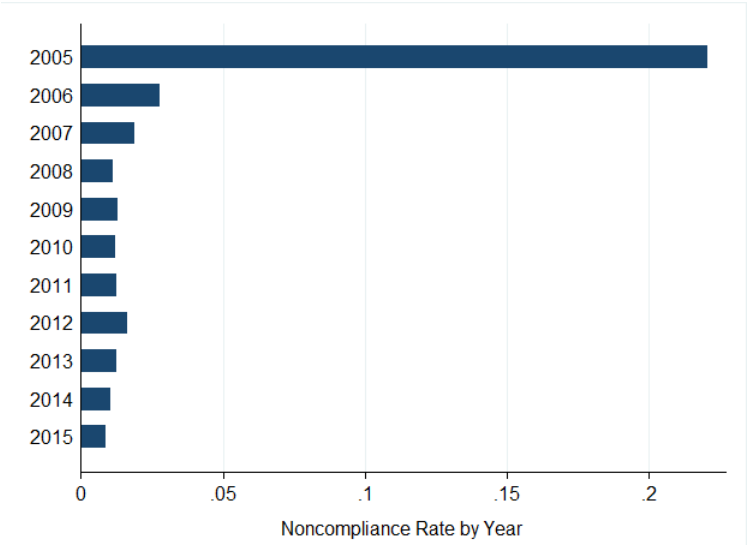
Note: '.' indicates that the country did not submit the report. 'locked' indicates that the country submitted the report but access was restricted. Bulgaria and Romania joined the EU ETS in 2007 and Norway in 2008, thus did not have reporting obligations in earlier years. The table presents the incidence of penalties administered to punish any infringements of the EU ETS regulation such as operating without permits and not reporting changes in the capacity, as well as excessive emissions.
Source: European Environmental Agency Reporting Obligation Database.

Table A2: Distribution of Compliance Code, installation by year observations

Code	Frequency	Percent
A	122,647	93.93
B	4,010	3.07
C	3,273	2.51
D	86	0.07
E	563	0.43
Total	130,579	100.0

Source: European Union Transaction Log (EUTL).

Figure A2: Noncompliance Rate by Year



Note: the plot shows variation in noncompliance rates across years. The data on compliance in the ETS is provided by the European Union Transaction Log (EUTL) at the installations level and I collapse the data over countries to calculate average yearly compliance rates.

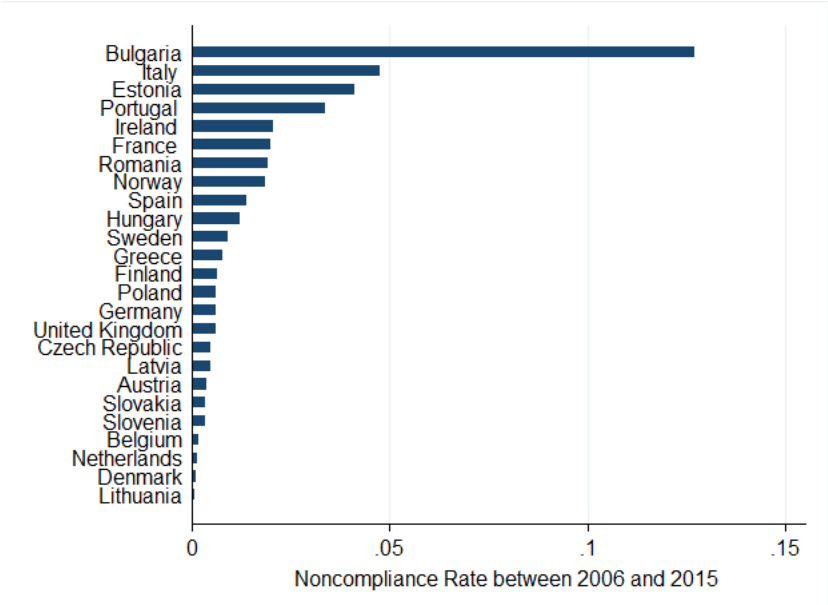
Table A3: Bilateral Trust and Noncompliance in the EU ETS between 2005 and 2015

	Dependent variable: Indicator for noncompliance			
	(1)	(2)	(3)	(4)
Estimation method	Probit	Probit	IV Probit	IV Probit
Bilateral trust	-0.007	-0.059	1.717	0.623
	(0.254)	(0.260)	(1.536)	(0.804)
Observations	12,292	9,199	7,696	7,696
Firm-level controls (4)	No	Yes	Yes	Yes
Country of operation FE	Yes	Yes	Yes	Yes
Country of HQ FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Clustering	Country pair	Country pair	Country pair	Country pair
Number of clusters	125	111	77	77
First stage F stat			31.5	38.3

Notes: The dependent variable in all columns is the binary noncompliance measure that takes 1 if the installation is out of compliance and 0 otherwise. Standard errors are clustered at the country of headquarter by country of operation (country pair) level. "Industry dummies" are based on the main activity type information provided in the European Transaction Log. I use religious similarity as an instrument in column (3) and somatic distances as well as religious similarity in columnn (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

Supplementary material for online publication only (Online Appendix)

Figure OA1: Noncompliance Rate between 2006 and 2015 (Excluding 2005)



Note: the plot shows variation in noncompliance rates across countries, excluding 2005. The data on compliance in the ETS is provided by the European Union Transaction Log (EUTL) at the installations level and I collapse the data over all years (excluding 2005) to calculate average compliance rates.

Table OA1: Descriptive Statistics: Firm-level Variables

Country	Number of firms	Number of employees	Number of installations per firm	Total assets Thousand USD	Operating revenue Thousand USD
Austria	146	712	1.72	626,484	487,542
Belgium	248	945	1.54	3,320,201	814,570
Bulgaria	112	413	1.35	96,637	107,210
Czech Republic	278	850	1.58	279,192	223,508
Denmark	269	815	1.60	383,084	424,302
Estonia	37	184	1.54	144,959	60,214
Finland	183	802	3.68	514,466	412,311
France	669	5,281	1.85	3,173,589	1,624,696
Germany	1,194	2,730	1.92	1,719,551	1,614,392
Greece	104	584	1.46	508,478	409,479
Hungary	136	881	2.07	407,152	370,139
Ireland	113	4,386	1.39	5,439,998	4,342,960
Italy	747	1,037	1.68	971,609	707,199
Latvia	75	304	1.49	109,923	59,061
Lithuania	78	265	1.49	105,722	127,252
Netherlands	327	527	1.43	382,333	588,377
Norway	87	599	1.56	1,916,191	1,552,504
Poland	584	776	1.70	216,743	216,529
Portugal	242	188	1.19	163,830	137,704
Romania	209	845	1.34	171,379	153,741
Slovakia	152	726	1.35	216,850	203,772
Slovenia	91	666	1.10	189,347	142,437
Spain	957	529	1.34	448,584	364,320
Sweden	279	980	3.09	855,421	493,645
United Kingdom	839	6,750	1.65	8,159,246	3,469,543
Average	335	1,348	1.68	1,267,680	791,675

Notes: The table reports summary statistics of the financial variables of 8,156 firms used in the regressions by country. The data comes from Bureau Van Dijk's Orbis Database.

Table OA2: Descriptive Statistics: Number of Second-generation Immigrants from Each Source Country

Country of origin	Number of second-generation immigrants
Austria	333
Belgium	153
Czech Republic	382
Denmark	143
Estonia	38
Finland	315
France	520
Germany	1299
Greece	169
Hungary	347
Ireland	233
Italy	971
Latvia	78
Lithuania	80
Netherlands	187
Norway	128
Poland	835
Portugal	186
Romania	388
Slovakia	373
Slovenia	44
Spain	251
Sweden	149
United Kingdom	510

Notes: The table reports the number of second-generation immigrants from each country that I use to estimate inherited trust. The data comes from the European Social Survey.

Table OA3: Trust and Noncompliance in the EU ETS between 2005 and 2015:
Robustness Checks for Country-level Analysis

	Dependent variable: Indicator for noncompliance							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation method	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	Poisson
Trust measured	-0.814**	-0.923**	-0.835*	-0.869*	-0.871*	-0.837*	-0.699	-1.505*
in the country of operation	(0.351)	(0.454)	(0.451)	(0.483)	(0.465)	(0.453)	(0.430)	(0.878)
Observations	69,312	71,158	73,563	73,146	73,498	73,498	73,498	77,558
Firm-level controls (4)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-level controls (3)	Yes	No	No	No	No	No	No	No
Country-level controls (5)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	Country	Country	Country	Country	Country	Country	Country	Country
Number of clusters	25	23	25	25	25	25	25	25
First stage F stat	35.3	55.7	60.2	61.0	61.8	70.4	37.5	

Notes: The dependent variable in each column is a binary noncompliance measure that takes 1 if the installation is out of compliance and 0 otherwise. Standard errors are clustered at the level shown in each column. "Industry dummies" are based on the main activity type information provided in the European Transaction Log. Column (1) adds region-level controls and column (2) drops ETS late jointers (Bulgaria and Romania) in my sample. Column (3) and (4) use alternative specifications for the binary compliance variable. In column (5) and (6), I try alternative measures of trust to check for potential measurement error (detailed explained in the main text). In column (7), I use an alternative instrument and column (8) tries an alternative measure for noncompliance that measures the amount by which installations are noncompliant.

Table OA4: Alternative Measure of Trust: Coefficients on the Country Dummies from the European Social Survey

Dependent variable: Trust		
Country Indicator	Coefficient	SD
Austria	0.856***	(0.016)
Belgium	0.216***	(0.01)
Czech Republic	0.134***	(0.014)
Germany	Reference category	
Denmark	2.288***	(0.003)
Estonia	1.191***	(0.012)
Spain	0.453***	(0.018)
Finland	1.781***	(0.006)
France	-0.293***	(0.011)
United Kingdom	0.598***	(0.005)
Greece	-0.772***	(0.03)
Hungary	-0.185***	(0.014)
Ireland	0.744***	(0.006)
Italy	-0.087***	(0.032)
Lithuania	0.558***	(0.026)
Latvia	-0.095***	(0.045)
Netherlands	1.049***	(0.005)
Norway	1.823***	(0.006)
Poland	-0.507	(0.019)
Portugal	-0.314***	(0.058)
Romania	-0.129	(0.053)
Sweden	1.545***	(0.009)
Slovenia	-0.318***	(0.02)
Slovak Republic	-0.175	(0.018)
Observations: 283,181		
R-squared: 0.16		

Notes: I report the point estimates on country dummies used as an alternative measure of trust across countries in column (5) and (6) in Table OA3. The coefficients measure the level of trust in each country relative to Germany, which is the omitted reference category. Apart from the country dummies, the regression also included gender, age, education and income as well as year dummies (not reported). Standard errors are clustered at the country level.
Source: European Social Survey 2002 - 2014.

Table OA5: Alternative Measure of Trust: Coefficients on the Country Dummies from the World Value Survey

Dependent variable: Trust					
Country Indicator	Coefficient	SD	Country Indicator	Coefficient	SD
Australia	0.093***	(0.003)	Japan	0.014*	(0.008)
Brazil	-0.299***	(0.009)	South Korea	-0.100***	(0.006)
Bulgaria	-0.112***	(0.005)	Latvia	-0.138***	(0.010)
Canada	0.000	(0.01)	Mexico	-0.160***	(0.006)
Switzerland	0.055***	(0.005)	Malaysia	-0.283***	(0.005)
Chile	-0.201***	(0.007)	Netherlands	0.240***	(0.006)
China	0.204***	(0.005)	Norway	0.332***	(0.005)
Cyprus	-0.265***	(0.006)	Philippines	-0.335***	(0.013)
Czech Republic	-0.084***	(0.01)	Poland	-0.164***	(0.002)
Germany	Reference category		Romania	-0.220***	(0.002)
Estonia	-0.054***	(0.006)	Russian Federation	-0.112***	(0.002)
Spain	-0.123***	(0.006)	Saudi Arabia	0.114***	(0.023)
Finland	0.176***	(0.006)	Sweden	0.255***	(0.006)
France	-0.164***	(0.01)	Singapore	-0.107***	(0.012)
Hong Kong	0.081***	(0.005)	Slovenia	-0.179***	(0.004)
Hungary	-0.071***	(0.01)	Slovakia	-0.100***	(0.011)
Indonesia	0.069***	(0.008)	Turkey	-0.260***	(0.01)
Israel	-0.182***	(0.024)	Ukraine	-0.085***	(0.003)
India	-0.08***	(0.007)	United Kingdom	-0.067***	(0.006)
Italy	-0.037***	(0.01)	United States	-0.020***	(0.006)
Jordan	-0.136***	(0.007)	South Africa	-0.187***	(0.009)
Observations: 263,695					
R-squared: 0.109					

Notes: I report the point estimates on country dummies used as an alternative measure of trust across countries in column (6) in Table 4. The coefficients measure the level of trust in each country relative to Germany, which is the omitted reference category. Apart from the country dummies, the regression also included gender, age, education and income as well as year dummies (not reported). Standard errors are clustered at the country level.
Source: World Value Survey 1981 - 2013.

Proofs

The presence of the threshold type The existence of a cutoff type θ^*, above which all types violate and below which all types comply with the regulation, directly follows from the monotonicity of firms' actions. Firm i chooses an action b_i to maximize its expected payoff written as:

$$\mathbb{E}u_i(b_i, \theta_i) = -a(b_i - \theta_i)^2 - (1-a)(b_i - B_j)^2 - \gamma \sum_{i \in N} b_i \qquad \text{if } b_i \leq L \tag{3}$$

$$\begin{aligned}\mathbb{E}u_i(b_i, \theta_i) = &-\mu[a(L - \theta_i)^2 + (1-a)(L - B_j)^2 + \phi] \\ &- (1-\mu)[a(b_i - \theta_i)^2 + (1-a)(b_i - B_j)^2] - \gamma \sum_{i \in N} b_i \qquad \text{if } b_i > L\end{aligned} \tag{4}$$

where (3) represents the expected payoff of abiding by the law and (4) represents the expected payoff of violating the law.

The first order conditions are:

$$b_i = \min[a\theta_i + (1-a)B_j - \frac{\gamma}{2}, L] \qquad \text{if } b_i \leq L \tag{5}$$

$$b_i = a\theta_i + (1-a)B_j - \frac{\gamma}{2} \qquad \text{if } b_i > L \tag{6}$$

Note that both (5) and (6) are nondecreasing in θ_i and (6) is always greater than (5). Thus, the only possible violation of the monotonicity property is where the payoff-maximizing action at θ_i is smaller than (or equal to) L, while at $\theta_i' < \theta_i$ the payoff-maximizing action is greater than L. To rule out this scenario, it suffices to show that for any b_{low} and b_{high} such that $b_{\text{low}} \leq L$ and $b_{\text{high}} > L$, $\mathbb{E}u_i(b_{\text{high}}, \theta_i) - \mathbb{E}u_i(b_{\text{low}}, \theta_i)$ is increasing in θ_i.

From (2) and (3), it follows that

$$\begin{aligned}\mathbb{E}u_i(b_{\text{high}}, \theta_i) - \mathbb{E}u_i(b_{\text{low}}, \theta_i) = &-\mu[a(L - \theta_i)^2 + (1-a)(L - B_j)^2 + \phi] \\ &- (1-\mu)[a(b_{\text{high}} - \theta_i)^2 + (1-a)(b_{\text{high}} - B_j)^2] + a(b_{\text{low}} - \theta_i)^2 + (1-a)(b_{\text{low}} - B_j)^2\end{aligned} \tag{7}$$

Differentiating with respect to θ_i yields:

$$2a\mu(L - b_{\text{high}}) + 2a(b_{\text{high}} - b_{\text{low}}) \tag{8}$$

It is straightforward to see that the above expression is positive given the definition

of b_{low} and b_{high} that are smaller (or equal to) and greater than L, respectively for any $a \in [0,1]$ and $\mu \in [0,1]$. From this monotonicity property, the existence of the threshold θ^* follows. QED

θ^* as a decreasing function of B_j I characterize the expression for a threshold θ^* by balancing the costs and benefits of violating the regulation for the threshold firm at θ^*.

Suppose that firm θ^* decides to violate the regulation. Then the expected payoff will be:

$$\begin{aligned} &-\mu[a(L-\theta^*)^2 + (1-a)(L-B_j)^2 + \phi] \\ &\quad -(1-\mu)[a(a\theta^* + (1-a)B_j - \frac{\gamma}{2} - \theta^*)^2 + (1-a)(a\theta^* + (1-a)B_j - \frac{\gamma}{2} - B_j)^2] \end{aligned} \tag{9}$$

Suppose instead that firm θ^* decides to abide by the regulation.

$$-a(L-\theta^*)^2 - (1-a)(L-B_j)^2 \tag{10}$$

The threshold θ^* is given by setting (11) equal to (12). Differentiating both sides of the resulting equation with respect to B yields:

$$a(L-\theta)\frac{\partial \theta^*}{\partial B_j} + (1-a)(L-B_j) = -a(1-a)(\theta^* - B_j)(\frac{\partial \theta^*}{\partial B_j} - 1) \tag{11}$$

Solving for $\frac{\partial \theta^*}{\partial B_j}$ and simplifying the expression yields $1 - \frac{1}{a}$, which is negative for any $a \in [0,1)$.

QED

Further data descriptions

Trust

European Social Survey I build trust measures using the European Social Survey (ESS), a collection of cross-country surveys on the individual beliefs, values and social norms as well as basic demographic information of respondents such as age, education, religion and occupation, etc. I pool data from the seven waves collected so far (from 2002 to 2014), which includes all European countries in my sample.

The survey elicits trust of respondents by asking the standard question, "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" Answers are given on a scale of 0 to 10, where 0 implies "You can't be too careful" and 10 means "Most people can be trusted". The frequency of individual responses used to build the trust measure by country and wave is reported in Table OA6.

World Value Survey In Section 5.2, I exploit the difference in the country where the regulated installations' global headquarters are located, which include a number of non-European countries. For this specification, I rely on the World Value Survey for the data on trust since its geographic coverage is world-wide, while the ESS covers Europe only. The WVS allows me to exploit the geographical variation in trust across 44 countries shown in Table OA7.

The WVS measures trust by asking the exact same question that appears in the ESS, which makes the two measures based on the two surveys reasonably comparable. The only difference is that the answer to the trust question in the WVS is binary, while the ESS uses a scale of 0 to 10.

Similarly as with the ESS, I pool together seven successive waves administered so far (1984-2014) and compute the country level trust by taking the simple average over all observations available for each country available across all waves. The frequency of individual responses used to build the trust measure by country and wave is reported in Table A9.

Compliance in the EU ETS

The data on compliance behavior in the EU ETS is provided by the European Union Transaction Log (EUTL), a system harmonized at the EU level that publishes information on permit allocation, verified emissions and surrendered allowances at the installation level. I drop countries with less than 50 installations (Cyprus, Iceland, Liechtenstein, Malta, and Luxembourg). The number of installations in each country is reported in Table OA8.

In addition to this detailed information, the EUTL also automatically calculates the compliance status of each installation. There are five possible codes installations can be given: (1) A, which implies "the number of allowances and ERUs/CERs surrendered by 30 April is greater than or equal to verified emissions.", (2) B, which implies "the number of allowances and ERUs/CERs surrendered by 30 April is lower than verified emissions.", (3) C, which implies "verified emissions were not entered until 30 April.", (4) D, which implies "verified emissions were corrected by competent authority after 30 April of year X. The competent authority of the Member State decided that the installation is not in compliance for year X-1.", and (5) E, which implies "verified emissions were corrected by competent authority after 30 April of year X. The competent authority of the Member State decided that the installation is in compliance for year X-1." CERs refer to Certified Emission Reductions and ERUs refer to Emission Reduction Units (ERUs) from the Clean Development Mechanism (CDM) and Joint Implementation (JI) that can be used as permits in the EU ETS.

Country-level controls

Governance indicators I use two governance indicators developed by the World Bank to control for law enforcement or institutional capacity between 2005 and 2015. One is a measure of country-wide 'rule of law' defined as "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence". The values range between -0.171 and 2.12 in my sample. The second measure is the perceived regulatory quality defined as "perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development". The values range between 0.213 and 1.921 in my sample. The data can be accessed at:

http://data.worldbank.org/data-catalog/worldwide-governance-indicators.

Economic controls For country-level economic controls, I use GDP per capita in Euro, the percentage of population with tertiary education and total population between 2005 and 2015. The data comes from the Eurostat. Descriptive statistics for all country-level controls is reported in Table OA9.

Table OA6: European Social Survey: Number of Respondents

Country	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Total
Austria	2,257	2,256	2,405	2,255	2,259	0	1,795	13,227
Belgium	1,899	1,778	1,798	1,760	1,704	1,869	1,769	12,577
Bulgaria	0	0	1,400	2,230	2,434	2,260		8,324
Czech Republic	1,360	3,026	0	2,018	2,386	2,009	2,148	12,947
Denmark	1,506	1,487	1,505	1,610	1,576	1,650	1,502	10,836
Estonia	0	1,989	1,517	1,661	1,793	2,380	2,051	11,391
Finland	2,000	2,022	1,896	2,195	1,878	2,197	2,087	14,275
France	1,503	1,806	1,986	2,073	1,728	1,968	1,917	12,981
Germany	2,919	2,870	2,916	2,751	3,031	2,958	3,045	20,490
Greece	2,566	2,406	0	2,072	2,715	0	0	9,759
Hungary	1,685	1,498	1,518	1,544	1,561	2,014	1,698	11,518
Ireland	2,046	2,286	1,800	1,764	2,576	2,628	2,390	15,490
Italy	1,207	1,529	0	0	0	960	0	3,696
Latvia	0	0	1,960	1,980	0	0	0	3,940
Lithuania	0	0	0	2,002	1,677	2,109	2,250	8,038
Netherlands	2,364	1,881	1,889	1,778	1,829	1,845	1,919	13,505
Norway	2,036	1,760	1,750	1,549	1,548	1,624	1,436	11,703
Poland	2,110	1,716	1,721	1,619	1,751	1,898	1,615	12,430
Portugal	1,511	2,052	2,222	2,367	2,150	2,151	1,265	13,718
Romania	0	0	2,139	2,146	0	0	0	4,285
Slovakia	0	1,512	1,766	1,810	1,856	1,847	0	8,791
Slovenia	1,519	1,442	1,476	1,286	1,403	1,257	1,224	9,607
Spain	1,729	1,663	1,876	2,576	1,885	1,889	1,925	13,543
Sweden	1,999	1,948	1,927	1,830	1,497	1,847	1,791	12,839
United Kingdom	2,052	1,897	2,394	2,352	2,422	2,286	2,264	15,667

Source: European Social Survey (ESS, 2002-2014).

Table OA7: World Value Survey: Number of Respondents

Country	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Total
Australia	1,228	0	2,048	0	1,421	1,477	6,174
Brazil	0	1,782	0	0	1,500	1,486	4,768
Bulgaria	0	0	1,072	0	1,001	0	2,073
Canada	0	0	0	1,931	2,164	0	4,095
Chile	0	1,500	1,000	1,200	1,000	1,000	5,700
China	0	1,000	1,500	1,000	1,991	2,300	7,791
Cyprus	0	0	0	0	1,050	1,000	2,050
Czech Republic	0	924	1,147	0	0	0	2,071
Estonia	0	0	1,021	0	0	1,533	2,554
Finland	1,003	0	987	0	1,014	0	3,004
France	0	0	0	0	1,001	0	1,001
Germany	0	0	2,026	0	2,064	2,046	6,136
Hong Kong	0	0	0	0	1,252	1,000	2,252
Hungary	1,464	0	650	0	1,007	0	3,121
India	0	2,500	2,040	2,002	2,001	5,659	14,202
Indonesia	0	0	0	1,000	2,015	0	3,015
Israel	0	0	0	1,199	0	0	1,199
Italy	0	0	0	0	1,012	0	1,012
Japan	1,204	1,011	1,054	1,362	1,096	2,443	8,170
Jordan	0	0	0	1,223	1,200	1,200	3,623
Korea, Republic of	970	1,251	1,249	1,200	1,200	1,200	7,070
Latvia	0	0	1,200	0	0	0	1,200
Malaysia	0	0	0	0	1,201	1,300	2,501
Mexico	1,837	1,531	2,364	1,535	1,560	2,000	10,827
Netherlands	0	0	0	0	1,050	1,902	2,952
New Zealand	0	0	1,201	0	954	841	2,996
Norway	0	0	1,127	0	1,025	0	2,152
Pakistan	0	0	733	0	0	0	733
Philippines	0	0	1,200	1,200	0	1,200	3,600
Poland	0	938	1,153	0	1,000	966	4,057
Romania	0	0	1,239	0	1,776	1,503	4,518
Russian Federation	0	1,961	2,040	0	2,033	2,500	8,534
Saudi Arabia	0	0	0	1,502	0	0	1,502
Singapore	0	0	0	1,512	0	1,972	3,484
Slovakia	0	466	1,095	0	0	0	1,561
Slovenia	0	0	1,007	0	1,037	1,069	3,113
South Africa	1,596	2,736	2,935	3,000	2,988	3,531	16,786
Spain	0	1,510	1,211	1,209	1,200	1,189	6,319
Sweden	954	0	1,009	1,015	1,003	1,206	5,187
Switzerland	0	1,400	1,212	0	1,241	0	3,853
Turkey	0	1,030	1,907	3,401	1,346	1,605	9,289
Ukraine	0	0	2,811	0	1,000	1,500	5,311
United Kingdom	0	0	1,093	0	1,041		2,134
United States	2,325	0	1,542	1,200	1,249	2,232	8,548

Source: World Value Survey (WVS, 1984-2014).

Table OA8: Number of Installations in the EU ETS by Country

Country	Number of installations
Austria	275
Belgium	481
Bulgaria	172
Czech Republic	464
Denmark	455
Estonia	65
Finland	679
France	1,520
Germany	2,532
Greece	207
Hungary	287
Ireland	215
Italy	1,482
Latvia	118
Lithuania	124
Netherlands	622
Norway	173
Poland	1,020
Portugal	358
Romania	284
Slovakia	221
Slovenia	104
Spain	1,362
Sweden	875
United Kingdom	1,373
Total	15,468

Source: European Union Transaction Log (EUTL).

Table OA9: Descriptive Statistics: Country-level Variables

Country	Rule of law	Regulatory quality	GDP per capita (Euro)	Tertiary education (level 3-8, %)	Population
Austria	1.870	1.528	35,645	76.9	8,368,325
Belgium	1.360	1.291	33,591	67.5	10,861,533
Bulgaria	- 0.120	0.600	5,045	73.9	7,429,690
Czech Republic	0.962	1.134	14,300	85.5	10,406,087
Denmark	1.956	1.821	44,009	70.4	5,530,786
Estonia	1.153	1.440	12,273	81.9	1,333,244
Finland	1.974	1.769	35,573	76.7	5,352,147
France	1.442	1.202	30,909	68.7	64,631,834
Germany	1.696	1.571	32,673	79.0	81,483,174
Greece	0.593	0.667	18,855	62.5	11,025,804
Hungary	0.721	1.023	10,018	75.3	9,990,034
Ireland	1.729	1.707	41,555	69.4	4,469,781
Italy	0.377	0.840	26,773	53.9	59,184,429
Latvia	0.748	1.020	9,882	79.8	2,117,490
Lithuania	0.756	1.074	9,918	82.9	3,120,577
Netherlands	1.822	1.751	37,791	69.1	16,578,149
Norway	1.950	1.495	66,745	74.8	4,868,568
Poland	0.620	0.914	9,218	81.8	38,085,752
Portugal	1.055	0.926	16,445	34.6	10,512,146
Romania	0.014	0.545	6,336	69.5	20,479,399
Slovakia	0.503	1.015	11,927	83.4	5,392,052
Slovenia	0.962	0.738	17,418	79.5	2,035,400
Spain	1.077	1.068	22,845	52.1	45,787,350
Sweden	1.930	1.713	40,409	75.8	9,345,354
United Kingdom	1.715	1.744	32,909	75.6	62,513,575
Average	1.116	1.195	24,355	72.142	19,430,388

Source: Eurostat and the World Bank.