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Development, Environmental Policy, and Mass Media: Theory and Evidence

by

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Development, Environmental Policy, and Mass Media: Theory and Evidence[1]

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Abstract

This paper investigates the relationship between development, environmental policy determination, and mass media. It stresses the role of mass media as a channel through which the level of development influence environmental policy making. Special interests appear to wield considerable influence over environmental policies, and create policy distortion. We develop a model with two political parties competing in election and policy influence by special interests to study environmental policy determination. Mass media acts as information provider to voters in the election. It informs voters regarding environmental policy platforms announced by the political parties. The theory suggests that, as development progresses, environmental awareness rises and so does the demand for environmental news. This induces profit maximizing media firm to report more environmental news, and in turn keeps voters better informed regarding the policy platforms of the parties. We find that, in equilibrium, a more stringent environmental policy is implemented when the voters are better informed through mass media. The model also demonstrates the way in which process of development brings about the stringency of environmental policy at a level closer to the social optimum when special interests present. Empirical evidence across countries supports our findings.

Keywords: Environmental Policy; Mass Media; Special Interests; Electoral Competition

JEL Classification: D72; D8; H23

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1 Introduction

The dispute over whether the environment harmonises with development now stays at the centre of global interest. This concern has attracted so much political and academic attentions at least since the Earth Summit in Rio de Janeiro in 1992. Academically, Grossman and Krueger (1995) is a milestone of the understanding of the environment-development relationship. It has generated a fruitful debate and has motivated studies on the subject as a consequence. This paper is not an exception.

A main argument by Grossman and Krueger (1995) is that an improvement of the environment occurs as there is an increase in demand for and supply of environmental protection at high level of national income. They note that there is no reason to believe that the process is an automatic one, and point to an induced policy response as the strongest link between income and environment. That is, the richer countries tend to have relatively more stringent environmental standards and stricter enforcement of their environmental laws than the poorer countries. The induced policy response process is formed as a hypothesis in their study.

This paper offers a theoretical explanation to the environmental policy response to development. It opens the black box that has been traditionally placed in the middle of the relationship between environmental outcomes and development[1]. This paper also puts forward the idea that mass media is a channel through which this environmental policy response process occurs. Mass media is considered to have a significant impact on politics and policy determination (see, e.g. Besley and Burgess, 2002; Stromberg, 2001). The middle man in political market stands as a central role in this paper[2].

We develop a model with two political parties competing in election and policy influence by special interests to study environmental policy determination. Mass media acts as an information provider to voters in the election. It informs voters regarding environmental policy platforms announced by competing political parties. The theory suggests that, as development progresses, environmental awareness rises and so does the demand for environmental news. This induces profit maximizing media firm to report more environmental news, and in turn keeps voters better informed regarding the policy platforms of the parties.

We find a more stringent environmental policy in equilibrium when the voters are better informed through mass media. The model also demonstrates the

[1] A strand of the literature on development-environment relationship is Environmental Kuznets Curve (EKC) which examines the reduced-form relationship between environmental outcomes and income level. Even though a number of studies on EKC point to the importance of policy variables in explaining this relationship (see, e.g. Panayotou, 1997; Barbier and Burgess, 2001; Bhattarai and Hammig, 2001; Welsch, 2004; Torras and Boyce, 1998), there has never been an attempt to examine the induced policy response hypothesis.

[2] Barrett and Graddy (2000) argue that if the induced policy response reasoning is correct, then environmental quality will depend on citizens being able to acquire information about the quality of their environment, and on governments having an incentive to satisfy these preferences by changing policy.

way in which development brings about the stringency of environmental policy at a level closer to the social optimum when special interests present. Corruption appears to work against this process. Empirical evidence across countries supports our findings.

The organization of this paper is as follows. Section 2 discusses the related literature. Section 3 set outs the model. The findings are presented in section 4 and 5. We describe our empirical analysis and data in section 6. Empirical results are in section 7 and 8. Section 9 offers some final remarks.

2 Related Literature

This paper belongs in a broad literature of environmental policy determination. Special interests seem to have considerable influence on environmental policies. A number of studies have looked at environmental policy formation by an incumbent with the presence of lobby groups. Aidt (1998) adopted this framework to discuss how political process may result in an efficient environmental policy. Fredriksson and Svensson (2003) investigated the interaction of corruption and political instability as a determining factor of environmental policy. The effect of trade liberalisation on environmental policy was examined in Damania *et al* (2003). Most recently, Fredriksson *et al* (2005) looked at the impact of environmental lobby groups on the determination of environmental policy.

The departure point of this paper from the studies above is that it adds electoral competition to the framework of environmental policy determination. The model developed here is based on Grossman and Helpman (1996). In their work, Grossman and Helpman allow for political parties to compete in election with informed and uninformed voters. Special interests offer contributions to influence policy platforms to be announced by the political parties. Contributions can be used by the parties for campaign rhetoric. A merit of this model is that it permits us to investigate the role of information and relative power in politics. More precisely, it allows us to incorporate mass media as information provider to voters in election, and to understand how development affects policy determination through mass media.

This paper intertwines with the literature of mass media and politics. The idea that a key role of mass media is to inform the electorate is central to theoretical literature on mass media. Stromberg (2001) used probabilistic voting approach to see the effects of mass media on policies. He found that policies that are associated with higher rents and corruption are selected where there is less access to media. Mass media in his model has a policy bias in favor of the large and dispersed group as this group is of more value to mass media due to the economy of scale of production.

Besley and Burgess (2002), on the other hand, adopted the political agency model to understand how the government chooses policies in response to changes in mass media. They found that a larger extent of media circulation induces the government to act more responsively to a larger number of informed electorate. The same approach was taken by Besley and Prat (2002), while adding the

possibility that mass media may be captured by the government. They predicted that media plurality decreases the likelihood of media being captured. Moreover, it is suggested that corruption is negatively associated with effective media.

The literature of mass media and politics has placed mass media at one end to provide information to voters. However, in our model, mass media does not only supply news, but also interacts with development process. The empirical literature on media and policy outcomes are growing. Brunetti and Weder (2003) and Ahrend (2002) found negative effects of press freedom on corruption. Djankov *et al* (2001) turned the attention to media ownership issue. Their main finding was that state ownership of newspaper is negatively correlated with good government. Besley and Prat (2002) found that greater state ownership of press implies less press freedom. They also found a neagative relationship between corruption and degree of foreign ownership of media.

Besley and Burgess (2002) reported that state governments in India are more responsive to droughts and floods in terms of public spending where newspaper circulation is higher. Along the same line, Stromberg (2004) found that more funds are allocated to the US counties with more radio listeners. In contrast to the existing literature, our empirical contribution is on the effect of mass media on the stringency of environmental policy across countries. Moreover, this paper, to our best knowledge, provides the first empirical evidence of the impact of development on environmental policy.

3 The Model

We examine a jurisdiction with two political parties competing in election, a special interest group, and a continuum of voters in the political arena. The economy comprises consumers and polluting firms. Profit driven mass media plays a role in politics as an information provider to the election. We describe below the ingredients in our economy and political system.

3.1 The Consumers and Polluting Firms

Consider a small open economy with two competitive sectors. One is a clean sector which produces a numeraire good and does not pollute. Its output z is produced using CRS technology and labour as the only input, with world and domestic price equal to 1. The other is a polluting sector which produces good x. The polluting sector employs labour and sector-specific capital. The economy has consumers and polluting firms. The population is normalised to 1. A consumer can be employed in clean or polluting or mass media sector, and derives income from labour[3]. The wage rate is assumed to be constant across sectors, and equals to w.

The international price of good x is p^*, and is exogenously given. The domestic producer and consumer prices are p and q respectively. Assume that

[3] We assume that there are always employments in every sector.

$q = p^*$, so that there is no tax on consumption. There are N identical profit-maximising polluting firms whose technologies are described by a CRS Cobb-Douglas production function. The profit function of each firm is: $\pi(p) = \frac{1}{2}\alpha p^2$. Thus, the supply is $x(p) = \alpha p$. Pollution is $e(x) = \eta x(p), \eta > 0$. For simplicity, assume that a unit of good x produced creates a unit of emission e, that is $\eta = 1$[4]. The environmental policy is imposed on the polluting sector, and is denoted as $t = p^* - p$. Note that this can be pollution tax ($t > 0$) or subsidy ($t < 0$). Aggregate pollution tax revenues equal $T(p) = Nt\alpha p$.

Denote damage from emission function as $d(e) = \frac{1}{d}e^d; d > 1$[5]. Total pollution is thus: $E = \frac{N}{d}(\alpha p)^d$. We assume that tax revenues are distributed equally to all individuals. Consumers are not affected directly by the pollution emission. What concerns them is the knowledge of the extent to which their society will be polluted by the polluting firms[6]. Denote L as the disutility from pollution; $L(t) = \delta E(t), \delta \geq 0$.

The consumers attach some value to environmental news. Assume that the value of environmental news, θ, is different across the consumers and is uniformly distributed bewteen 0 and 1. A consumer buys environmental news if $p_n \leq \theta w^\gamma$, where p_n is the price of news and θw^γ is the willingness to pay for environmental news of a consumer, with $\gamma > 1$[7].Consumers are identical. The consumers derive utility from consumption of good z and x, disutility from pollution associated with good x, and utility from environmental news consumption. The utility function for a representative consumer is given by

$$U = c^z + u(c^x) - L(t) + \max[0, \theta w^\gamma - p_n] \tag{1}$$

where c^z and c^x are consumption of the numeraire good z and good x, and $u'(\cdot) > 0, u''(\cdot) < 0$. Maximising the utility function of representative consumer subject to budget constraint yields demand for good x, denoted by $D(p^*)$. The indirect utility function of a consumer can then be written as:

$$V(t) = w + CS(p^*) - \delta\frac{N}{d}\alpha^d(p^* - t)^d + \max[0, \theta w^\gamma - p_n] \tag{2}$$

where $w = c^z + p^*c^x$ and $CS(p^*) = u[D(p^*)] - p^*D(p^*)$ is the consumer's surplus derived from the consumption of good x[8]. Now we turn to describe the mass media sector.

[4] The implication of this assumption is that tax on emission is equivalent to tax on production.

[5] $d'(e) > 0; d''(e) > 0$

[6] This is because environmetal policy is announced by political parties prior to the election. Voters therefore foresee only expected disutility from the policy. In essence, We stress the voters' interest in environmental policy that will be enacted.

[7] It will be seen in the subsequent section that $\gamma > 1$ is assumed to capture the normal good characteristic of environmental news.

[8] Consumption of good z yields no consumer's surplus.

3.2 The Mass Media

The mass media is a newspaper industry with identical media firms. The newspaper firms seek for environmental news to be printed, and make profits by selling the news. Each firm devotes a fraction of its news space, n, per print to the environmental issue. The whole space per print of a newspaper is normalized to 1. As $\theta \in [0,1]$ and is uniformly distributed, the media firms face the demand for environmental news

$$n^d = 1 - \frac{p_n}{w^\gamma} \tag{3}$$

Note that w also captures the level of income in the economy. Assume that a fraction σ of the consumers receive environmental news and are informed. σ increases with n, and is assumed to take the form $\sigma(n) = n$. Environmental news is produced by means of a Cobb-Douglas technology

$$n^s = f \cdot r^{\frac{1}{2}} \qquad , \ f \in [0,1] \tag{4}$$

where r is the number of population employed by the media firm (the reporters) and f is an index of media productivity. The degree to which the mass media permits free flow of information to and from public identifies press freedom. We assume that media productivity reflects press freedom.

3.2.1 Competitive Media

Consider a representative media firm which takes the price of environmental news as given. The profit function of the media firm is $\varpi = p_n n - wr$. The media firm chooses r to maximise its profit. Differentiate the profit with respect to r, we obtain

$$\frac{\partial \varpi}{\partial r} = \frac{1}{2} p_n f \cdot r^{-\frac{1}{2}} - w = 0 \tag{5}$$

Solve (5) for r and the demand function for reporters is

$$r = \left[\frac{p_n f}{2w}\right]^2 \tag{6}$$

Substitute (6) into (4), we obtain the supply of environmental news

$$n^s = \frac{1}{2w} p_n f^2 \tag{7}$$

The news market clears in equilibrium. Use (3) and (7) to solve for equilibrium price and production of environmental news. The equilibrium environmental news is

$$n = 1 - \frac{1}{\frac{1}{2}f^2 w^{\gamma-1}+1} \tag{8}$$

The fraction of the informed consumers in the total population is thus determined by

$$\sigma = 1 - \frac{1}{\frac{1}{2}f^2 w^{\gamma-1}+1} \tag{9}$$

The fraction of informed voters is increasing with the level of income, $\frac{\partial \sigma}{\partial w} > 0$. This is because environmental news is a normal good with positive income elastic demand ($\gamma > 1$)[9]. A higher level of income associates with a higher demand for environmental news. This induces the media firm to devote more environmental news proportion in news production. Besides, a larger fraction of informed voters comes with a higher degree of press freedom.

3.2.2 Monopolistic Media

Now we turn to consider the monopoly case. In this situation, The profit of the monopolistic media firm is $\varpi_m = p_n(n^d)n^s - wr$. The firm chooses r to maximise its profit. Differentiate ϖ_m with respect to r, we obtain

$$\frac{\partial \varpi_m}{\partial r} = \frac{1}{2} f w^{\gamma} r^{-\frac{1}{2}} - f^2 w^{\gamma} - w = 0 \tag{10}$$

Solve (10) for r and the demand function for reporters is

$$r_m = \left[\frac{1}{2}\frac{w^{\gamma} f}{w + w^{\gamma} f^2}\right]^2 \tag{11}$$

Substitute (11) to (4). The supply of environmental news in monopoly case is

$$n_m = \frac{f}{2} \cdot \frac{w^{\gamma} f}{w + w^{\gamma} f^2} \tag{12}$$

When the news market is monopoly, the fraction of the informed consumers in the total population is given by

$$\sigma_m = \frac{f}{2} \cdot \frac{w^{\gamma} f}{w + w^{\gamma} f^2} \tag{13}$$

Numerical examples give a comparison between (9) and (13). For any values of f, w, and γ, it can be observed that $\sigma > \sigma_m$. A fraction of informed consumers is always larger in competitive than in monopolistic news market. This implies that a change of structure in news market toward a more competitive one results in more voters being informed. Notice that the positive relationships between σ and w, and between σ and f also hold in monopoly case. Note that the competitive news market case will be used as reference in our analysis hereafter. Having explained our economy, the political side of the model is next considered.

[9] $(\gamma - 1)$ is an indicator of income elasticity of demand for environmental news. if $\gamma < 1$ then $(\gamma - 1)$ is negative and environmental news in that case is an inferior good.

3.3 The Political Parties and voters

The consumers possess rights to vote. The political arena contains two political parties A and B. The political parties choose their platforms of environmental policy to maximise their seats in the legislature. We assume that seats in the parliament are allocated by proportional representation. Then the fraction of the legislature controlled by a party matches the fraction of the total votes received by the party.

The voters are of two types: informed and uninformed. The informed voters are those who know and understand the parties's positions on both environmental policy and other exogenous issues. The uninformed voters are, by contrast, those who are unable to evaluate the parties positions on environmental policy, but are able to understand the parties' exogenous aspects. The informed voters prefer the platform of party A, t^A, to that of party B, t^B, if

$$V(t^A) - V(t^B) = \Delta V \geq \beta \tag{14}$$

where, β represent voters' preference in favour of party B on its fixed issues and exogenous characteristics. This value can be negative in case voters' preference lean toward party A. The parties cannot observe β of any particular voter; however they know that this is to be drawn from a known distribution $F(\beta)$. Then both parties have a probability $F(\Delta V)$ that an informed voter will vote for party A.

The uninformed voters are not aware of platform announcements. Following Grossman and Helpman (1996), we assume that uninformed voters are affected by campaign rhetoric. These voters may have initial tendency toward one party or the other, but they can be swayed in the course of the campaign. If party A spends C^A and party B spends C^B on campaigning, then an uninformed voter casts his ballot for party A if

$$h(C^A - C^B) = \Delta V_h \geq \phi \tag{15}$$

where, h is a positive constant determining the effect of campaign spending on the uninformed voters. ϕ measures the voters' bias toward campaigning by party B when it takes positive value, and measures the bias toward party A when it takes negative value. ϕ of each voter is unknown to both parties, and is assumed to be drawn from a distribution $H(\phi)$.Then $H(\Delta V_h)$ is the probability that an uninformed voter will vote for party A. The fraction of the total votes gained by party A is

$$s = \sigma F[\Delta V] + (1 - \sigma) H(\Delta V_h) \tag{16}$$

which is the sum of the share of votes from informed and uninformed voters that vote for party A. Assume that β and ϕ are both uniformly distributed on

$\left[-\frac{1}{2}, \frac{1}{2}\right]$. The fraction of the total votes party A receives can then be expressed as

$$s^A = \frac{1}{2} + \sigma\Delta V + (1-\sigma)\Delta V_h \tag{17}$$

where $s^A = 1 - s^B$. Notice that if party A and B announce the same environmental policy platform and make no campaign spending, then each party equally receives half of the total votes[10]. The political parties choose t^K to maximise $s^K; K = A, B$. They do so bearing in mind that their environmental policy endorsement will affect the welfare of informed voters. At the same time, the platforms are chosen with an eye toward the organised interest group (discussed below), who makes political support depending on the positions taken by the parites. The parties know that the contributions they collect from the orgainsed group can be used to finance campaign activities that will attract votes from uninformed voters. The subsequent section turns to the interest group.

3.4 The Special Interest

The profits obtained by the polluting firms depend on environmental policy. The N polluting firms are assumed to manage to organise into a lobby group that coordinates a prospective political contribution offers to the two parties in order to influence their policy platforms. On the other hand, the consumers are assumed to be unorganised due to sufficiently severe free-riding problem (Olson, 1965). Denote $W_j(t)$ as the aggregate utility that members of the interest group derive from environmental policy. As all the N firms are identical,

$$W_j(t) = N\pi(t) = N\tfrac{1}{2}\alpha(p^* - t)^2 \tag{18}$$

We assume that the polluting firms cooperate fully in their collective action, and seek to maximise their expected joint welfare from environmental policy net of campaign contributions. The objective function of the interest group is

$$S = \omega(s)W_j(t^A) + [1-\omega(s)]W_j(t^B) - C^A - C^B \tag{19}$$

where, $\omega(s)$ is the probability that the legislature adopts the environmental policy t^A. For simplicity, we assume that $\omega(s) = s$, and thus $1 - \omega(s) = 1 - s$. The lobby is allowed to design their contribution schedule, $C^K(t^K)$, which is offered to a particular party contigent on its proposed environmental policy[11]. Assume that $C(t)$ is continuous, differentiable when positive, and everywhere

[10] From the assumption on uniform distributions, $F(\Delta V) = \frac{1}{2} + \Delta V$, and $H(\Delta V_h) = \frac{1}{2} + \Delta V_h$. Substitute in (16), we obtain (17).

[11] Note that the contribution offer to a party is dependent only on the policy announced by that party, and not the other.

non-negative. The lobby's proposal is credible. That is, the lobby delivers its contributions according to the offers made, although there is no binding contract.

The parties have the option to opt out of the agreement and decline the interest group's offer. In this senario, the parties will choose the platform that attracts the largest number of votes from the informed voters[12]. The lobby's contribution schedule must satisfy a *participation constraint* to ensure that political parties are willing to accept their offers and enact the agreed policy accordingly. The lobby must therefore guarantee each party at least a fraction of seats in the legislature as it would capture by endorsing the policy that maximises informed voters' vote. Let t^* be the environmental policy which maximises the share of votes from informed voters, i.e., t^* satisfies $\frac{\partial \sigma F(\Delta V)}{\partial t^*} = 0$. Evidently, the lobby must offer to the parties contributions of at least

$$C^K \geq \frac{\sigma}{(1-\sigma)h}[V(t^*) - V(t^K)] \qquad ; K = A, B \tag{20}$$

This is *participation constraint* of party K[13]. Notice that the constraints stipulate the minimum sizes of the campaign contributions as functions of the environmental policy platforms that the lobby chooses to influence. Assume that the lobby gives the two parties the minimum contributions just enough to induce them to support t^A and t^B. This assumption leads to the situation where each party can capture half of the seats in the legislature ($s^A = s^B = \frac{1}{2}$), regardless of the policy t^A and t^B. The description of our model is now completed. Next, we turn to the outcomes of the model.

4 Political Equilibrium

The timing of events is as follows. In the first stage, the mass media maximises its profits by employing a fraction of population to produce environmental news. A fraction of voters is then informed by environmental news. In the second stage, the interest group independently and simultaneously offers its contribution schedules to the two political parties. In the third stage, the parties maximise their legislative representation by choosing their environmental policy platforms. After the platfoms are announced, the contributions are paid, and the campaign rhetoric follows. Then, the election takes place. Finally, the legislature implements one of the party's environmental policy. We seek a subgame-perfect Nash equilibrium of the sequence described above.

From the model set out in the preceding section, it follows that the problem becomes one that the lobby chooses the two platforms to maximise its expected

[12] There is no campaign rhetoric in this situation. Equation (15) thus becomes redundant. Equivalently, $H(\Delta V_h) = 0$ in equation (16). The political party consequently chooses t^K to maximise $s = \sigma F[\Delta V]$.

[13] To find this, set $s(t^*) = s(t^K)$ such that $\Delta V_h = hC^K$.Then solve for C^K.

utility, equation (19), subject to the *participation constraint*, equation (20), with equality. Differentiate (19) with respect to t^K

$$s^K \frac{\partial W_j}{\partial t^K} - \frac{\partial C^K}{\partial t^K} = 0 \tag{21}$$

Equation (21) reflects the local truthfulness of the contribution schedule. Differentiate equation (20) with respect to t^K, obtain

$$\frac{\partial C^K}{\partial t^K} + \frac{\sigma}{(1-\sigma)h} \frac{\partial V(t^K)}{\partial t^K} = 0 \tag{22}$$

Substitute (21) into (22), we can express

$$s^K \frac{\partial W_j}{\partial t^K} + \frac{\sigma}{(1-\sigma)h} \frac{\partial V(t^K)}{\partial t^K} = 0 \tag{23}$$

The characterisation of equlibrium environmental policy is given by (23). To find the equilibrium environmental policy[14],

$$t^K = \arg\max_t \left[s^K W_j(t) + \frac{\sigma}{(1-\sigma)h} V(t) \right] \tag{24}$$

where $s^K = \frac{1}{2}$ and $K = A, B$. From (24), the equilibrium environmental policy is equivalent to one in which the policy is chosen to maximise a weighted sum of the welfare of the lobby group and the consumers. Clearly, the welfare of the consumers is more heavily weighted when more of them are informed. Nonetheless, their welfare is less important as campaign rhetoric becomes more effective.

Proposition 1 *If the campaign contributions from the lobby satisfy the participation contraints of the two political parties, given by equation (20), and the lobby maximises their expected welfare, given by equation (19), then the equilibrium environmental policy platforms is*

$$t^K = p^* - \left[\frac{\alpha^{1-d}}{2\delta} \frac{(1-\sigma)h}{\sigma} \right]^{\frac{1}{d-2}} \tag{25}$$

It is obvious, from (25), that the equilibrium environmental policy with the presence of the lobby group and its contribution is less stringent than the one when neither lobbying nor campagin contributions present. In other words, the pollution tax is lower or the pollution subsidy is higher with the lobby. Note that in the situation where there is no campaign contributions the political parties act

[14] The second order condition satisfies the maximum.

to maximise votes from the informed voters, and they would choose $t^K = p^*$.This is due to the fact that when both parties maximise the informed votes, they try to offer policy such that it gives relatively higher utility to informed voters. The best strategy is then to reduce the disutility from pollution to zero by choosing $t^K = p^*$ [see, equation (2)]. The second term on the RHS of (25) is always positive, environmental policy is therefore stricter in the case where there is none of lobbying and campaign activities.

5 Comparative Statics

We analyse the effects of parameters on equilibrium environmental policy in this section. The primary aim is to derive hypotheses to be tested empirically in the following sections.

5.1 Development and Environmental Policy

First, we consider the effect of the level of income on the determination of environmental policy. Differentiate (25) with respect to σ, yields:

$$\frac{\partial t^K}{\partial \sigma} = -\frac{1}{d-2}\underbrace{\left[\frac{\alpha^{1-d}}{2\delta}\frac{(1-\sigma)h}{\sigma}\right]^{\frac{1}{d-2}-1}}_{(+)} \cdot \Big(\underbrace{\frac{\alpha^{1-d}}{2\delta}\frac{(\sigma-1)h}{\sigma^2}}_{(-)} - \underbrace{\frac{\alpha^{1-d}}{2\delta}\frac{h}{\sigma}}_{(+)}\Big) \tag{26}$$

Whether the effect of the fraction of informed voters on environmental policy is positive or negative depends on the value of d. We can see that $\frac{\partial t^K}{\partial \sigma} > 0$ if $d > 2$, and $\frac{\partial t^K}{\partial \sigma} < 0$ otherwise. d measures the rate at which the damage to environment rises as emission increases. We can infer that, when the emission is sufficiently harmful to the environment, more informed voters in the economy leads to a more stringent environmental policy. According to (9), we know that $\frac{\partial \sigma}{\partial w} > 0$. This means that the number of informed voters increases with the level of income of the economy. In other words, a more developed economy is associated with a higher ratio of infomed to uninformed voters. Combine the positive effect of w on σ and (26), we reach the next proposition.

Proposition 2 *When the damage from pollution is sufficiently large, $d > 2$, a more developed economy in terms of income level is associated with a higher fraction of informed voters in its politics, and this determines a more stringent environmental policy.*

The basic assumption behind this result is the assumption that the environmental news is a normal good. The intuition is that when the level of income is higher in an economy, its population demands more environmental news. This induces the mass media firm to boost the environmental news production so

as to capture the profits. The more enviromental news printed, the larger proportion of voters are informed. Becoming informed allows them to understand and evaluate the environmental policy platforms announced by political parties. This process empowers the informed voters as political parties place more weight on their welfare when they constitute a larger fraction of the electorate. This means that the contribution to be spent on campaign rhetoric paid from the lobby is less important. This creates the balance-of-power shift toward the consumers and away from the pollution generator. The environmental policy announced, and to be implemented, is therefore stricter when the level of income rises. This is to give favour for the bigger group of informed voters with the hope that it will attract more votes and thus more seats in the legislation for the political parties.

5.2 Corruption and Environmental Policy

Corruption is multi-facet in its nature. The process of campaign rhetoric are in many contexts considered vote-buying. On the other hand, the campaign contributions by the special interest to the politcal parties are at times in line with policy/political corruption. Corruption in this kind occurs when the politicians or political parties intentionally make policy favouring some particular groups and receive bribe in return. These activities are inevitably considered corruption. We are interested to see how corruption (possibly happen in our model) affect the making of environmental policy.

As discussed in the preceding section, the presence of lobby group and its contribution weakens the stringency of environmental policy. It can thus be expected that more policy corruption brings about a less strict environmental policy. Another potential class of corruption is vote-buying. As h measures the effect of campaign spending on the uninformed voters, we believe that h captures the tendency that a vote can be bought. To put differently, h can be interpreted as an indicator of the effectiveness of the money spent on vote-buying. In this light, it is reasonable to see the effect of corruption on environmental policy by considering the effect of h on t^K.

$$\frac{\partial t^K}{\partial h} = -\frac{1}{d-2}\frac{\alpha^{1-d}}{2\delta}\frac{(1-\sigma)}{\sigma}\cdot \underbrace{\left[\frac{\alpha^{1-d}}{2\delta}\frac{(1-\sigma)h}{\sigma}\right]^{\frac{1}{d-2}-1}}_{(+)} \tag{27}$$

We can see that, since the last term is always positive, $\frac{\partial t^K}{\partial h} < 0$ if $d > 2$, and $\frac{\partial t^K}{\partial h} > 0$ otherwise. The signs also depend on the value of d in this case.

Proposition 3 *When the damage from pollution is sufficiently large, $d > 2$, a more effective campaign rhetoric (vote-buying) is associated with a less stringent environmental policy.*

The explanation to this proposition is that when the campaign activities or vote-buying becomes more effective, it is relatively easier to garner votes from

the uninformed voters. This make the group of informed voters less important to the political parties. The parties are better off making environmental policy such that it pleases the lobby, so that they gain more contribution which can be spent on campaign rhetoric. To this end, it can be expected to observed empirically that more corruption results in a weaker environmental policy.

5.3 Mass Media and Environmental Policy

Now, we look at the effect of media parameters on environmental policy. Essentially, we are asking how changes in media industry structure affect the determination of environmental policy. Differentiation of t^K with respect to press freedom, f, involves complication for presentation and is left out. We therefore summarise the effects of f on t^K as follows.

$$\frac{\partial t^K}{\partial f} = \underbrace{\frac{\partial t^K}{\partial \sigma}}_{(+,-)} \cdot \underbrace{\frac{\partial \sigma}{\partial f}}_{(+)} \tag{28}$$

As (26) suggests that $\frac{\partial t^K}{\partial \sigma} > 0$ if $d > 2$, and $\frac{\partial t^K}{\partial \sigma} < 0$ otherwise, we cannot provide a conclusive remarks on the relationship. We can only affirm that the degree of press freedom increases the share of informed voters in total population, according to (9). The more free media industry, the better voters are informed regarding the environmental policy platforms. Also, section 2 suggests that a more intense competition in media market leads to a larger fraction of informed voters.

Proposition 4 *When the damage from pollution is sufficiently large, $d > 2$, a more intense competition in media industry and a higher degree of press freedom strengthen the environmental policy.*

When the competition in mass media sector is intense and the freedom of press is not restricted, both situation induce the media firm to produce a greater proportion of environmental news to achieve maximum profit. This enhances the fraction of voters who are well informed about the environment. Provided that the damage of pollution to the environment is not trivial, we should expect to observe a competitive media sector and free press with a more stringent environmental policy. The analysis here yields a few testable hypotheses which will be carried out in the subsequent section. The following section describes the empirical strategy and data to be used.

6 Empirical Analysis and Data

This section describes basic specification of our econometric analysis and the set of data to be used therein. The econometric models are tied closely to the theory developed above. Testable implications from the theoretical predictions will be

tested with cross-national econometric methods using both reduced-form and structural-form approaches. Our empirical work is primarily to find whether there exists systematic relationship between development and environmental policy as suggested by the theoretical model. First, we run the following basic specification:

$$ENVIRPOL_i = \alpha_{0i} + \alpha_{1i} DEV_i + \alpha_{3i} COR_i + \alpha_{4i} controls_i + \varepsilon_i \qquad (29)$$

where environmental policy is the dependent variable, as denoted by t^K in the theoretical model. The level of development and corruption are main explanatory variables. These are to capture w and h in our model respectively. Other control variables are also included in the analysis. ε_i is the error term. Table A1 and A2 in the Appendix provide the summary of statistics.

6.1 Data Description

6.1.1 Dependent Variable: Environmental Policy

The main indicator of environmental policy used in this paper is the stringency of environmental policy (*SEP*) used in Eliste and Fredriksson (2002) and Fredriksson and Svensson (2003). *SEP* is an index initially constructed by Dasgupta *et al* (1995). This index is compiled from individual country report for use at the 1992 United Nations Conference on Environment and Development. The survey-based report provides specific information about the state of the environmental regulatory framework, focusing on existing environmental policies, legislation, control mechanisms, and enforcement. Using the information gathered, a quantitative index was developed by Dasgupta *et al* (1995) for a set of 31 countries. The data set was extended by Eliste and Fredriksson (2002) to 63 countries using identical methodology. As noted in Fredriksson and Svensson (2003), this index measures the stringency of environmental regulations facing the producers in the agricultural sector.

Lead content in gasoline (*LEAD*) is used as an alternative measure of environmental policy. This index has been used to measure stringency of environmental regulations by others, e.g. Damania *et al* (2003); Fredriksson *et al* (2005). The data is originally from Octel's Worldwide Gasoline Survey, and it measures the maximum allowed lead content in gasoline in grams per litre. This data provides a different aspect of environmental regulation from *SEP*, as it is a non-subjective indicator. We take the index for the year 1990 for our analysis.

6.1.2 Independent Variables

Development and Corruption As our primary measure for development, we use per capita GDP (in a thousand) converted to current international dollars using Purchasing Power Parity rates (*GDPPC*). The data in taken from the World Development Indicators for 1990. As an alternative measure of development, we adopt the Human Development Index (*HDI*) obtained from Human

Development Reports for the year 1990. This is a composite index of three different measures: life expectancy, education, and GDP index. We experiment with *HDI* as we believe it offers a broader definition to development.

We use corruption index (*NCOR*) from Political Risk Services which is regularly published in the International Country Risk Guide. *NCOR* is an average measure of corruption across countries between 1982 and 1995. The index ranges from 0 to 10 indicating highest to lowest level of corruption, and is based on expert opinion. This index has the advantage of being consistently available for a relatively long period. We obtain this data from the data set used by Friedman *et al* (2000).

Female education variables are utilised as instrumental variable for the level of development. The percentage of female secondary school enrolment (*FEMEN*) and the female average length of schooling (*FEMYR*) are together used as proxies for female education. *FEMEN* is from the World Development Indicator 2004 provided online by the World Bank. *FEMYR* is calculated from female of age over 25, and is taken from the Barro-Lee International Data on Educational Attainment (Barro and Lee, 2000).

Instituitional and Geographical Controls We use three main control variables. The first is a country's geographical latitude (*LAT*). It is aimed to capture differences in geographical characteristics across countries. We suspect that geographical factors may contribute to geographical environments, their problems, and different ways in which environmental policy is devised. The data is available online from the Center for International Development, Harvard University[15].

Second, we use a dummy variable on legal origin (*LEGAL*). It takes the value of 1 if a country's legal origin is from a common law system, and takes the value of 0 if it is developed from a civil law system. *LEGAL* index is aimed at capturing differences in policy and law making in each country. The source of the data is Triesman (2000) and initially compiled by La Porta *et al* (1998). Third, we use a dummy for high income OECD countries (*OECD*) to capture structural differences of economy between the countries in the group and the others.

Other data are made used in robustness analysis. Democracy index (*DEMOC*) is a measure of the degree of democracy in a given country based on the competitiveness of political participation, the openness and competitiveness of executive recruitment, and the constraints on the chief executive. The variable ranges from 0 to 10, where higher values equal a higher degree of institutionalized democracy. This variable is calculated as the average from 1960 through 2000. The source of this index is Jaggers and Marshall (2000). The percentage of population in the geopraphical tropics (*TRPOP*) is used to capture the interface of demographic and geographical factor. The percentage of land area in tropical zone (*TRLND*) is another geographical variable. *TRPOP* and *TRLND* are from online data set by the Center for International Development, Harvard

[15] http://www.cid.harvard.edu/ciddata/ciddata.html

University.

Mass Media In our structural regressions, we focus on the role of mass media as a channel through which demand for environment translate to policy making process. Attention is paid to σ_i, which is the fraction of informed voters. To capture this, the number of TV sets (TV) and radio (RD) per thousand population are used. We believe that these variables measure the proportion of the population that is exposed to mass media. TV refers to the estimated number of television sets in use by both businesses and households per 1,000 members of the population. RD is the number of radio receivers used for broadcast to the general public, divided by a country's population in thousands. Private sets installed in public places are also included as well as communal receivers. Both TV and RD are for 1990, and are taken from the World Resources Institute's Earth Trend database. The data are originally from the World Telecommunications Indicators 2004 compiled by the International Telecommunications Union[16].

Lack of political right and civil liberty index ($LCKPC$) is also used to reflect a different interpretation of σ_i, i.e. the degree of public participaiton in policy making process. This is a simple average of an index of political right and an index of civil liberty constructed by Freedom House for 1990. This index captures factors such as the right to vote, the right to organize political parties, fair elections, meaningful representation by elected representatives, freedom of assembly and demonstration, an independent judiaciary, and the absence of political terror and torture. Note that higher value of $LCKPC$ means less of political right and civil liberty in a country. This index is aimed to captures the power of voters in policy making processes.

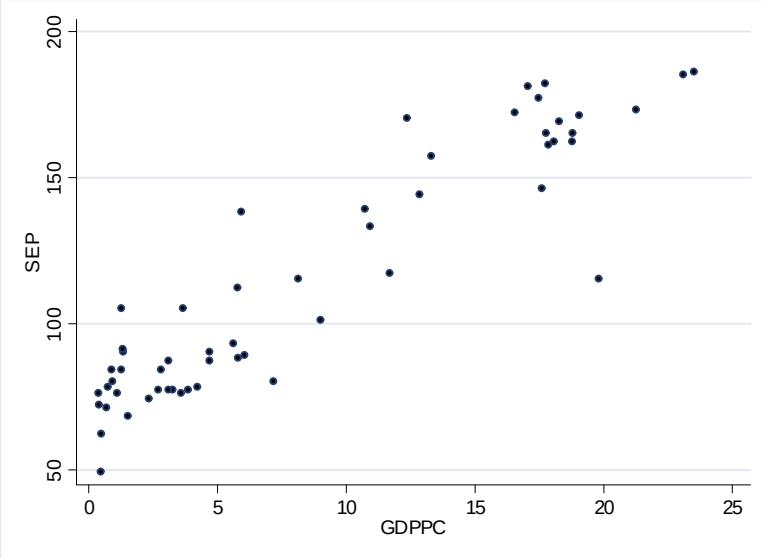
A proxy for media competition ($MEDCOM$) is constructed by using an index of media competition and an index of ownership of press. The former is obtained from Kruckeberg and Tsetsura (2003) data on media competition. This data is originally from the Walden's World of Information Business Intelligence Reports. This report gives us the number of daily newspapers published in each country. The authors calculate the media competition index by dividing population number by the number of daily newspaper published in each country in 2000. This index will be combined and adjusted with data on media ownership constructed by Djankov *et al* (2001) for the year 1999 to make our $MEDCOM$.

We use the press freedom index ($PRFDM$) from Freedom House. It measures the degree to which each system permits the free flow of information to and from the public determines the classification of each countries index. In compiling the survey, Freedom House measures the degree to which law and administrative decisions of the government influence the content of the news media, the degree of political influence or control over the content of the news system, the economic influences on the media exerted either by government or private entrepreneurs, and the degree of oppression of the news media exhibited in many forms. Press freedom index is available online from the Freedom House website[17], and is

[16] http://www.itu.int/ITU-D/ict/publications/world/world.html

[17] www.freedomhouse.org

Figure 1: Correlation - stringency of environmental policy and per capita income



taken for the year 1994. We rescale the index so that the higher value means more free press.

7 Empirical Results

This section presents the results obtained from performing econometric analysis on our basic specification. There is a close relation between the environmental policy and the level of development across countries in our data set. Figure 1 shows the scatter plot of the stringency of environmental policy (*SEP)* against per capita GDP; while Figure 2 shows that of the *SEP* against Human Development Index (*HDI*). We observe a more stringent environmental policy with a higher level of development in both figures. Figure 3 and Figure 4 show that a lower lead content in gasoline comes with a higher level of development. Note that we intend to allow flexibility of ways in which the term 'development' may be defined.

The results of OLS regressions are presented in Table 1. Standard errors are White-corrected to allow for the possibility of heteroskedasticity in our data. Regression 1 reports the result with the stringency of environmental policy (*SEP*) as dependent variable and GDP per capita (*GDPPC*) and other controls as explanatory variables. The sign of estimated coefficient for *GDPPC* shows that *SEP* is increasing in the level of *GDPPC*. A country's environmental policy is also more stringent when it experiences less degree of corruption.

The positive coefficient for *LEGAL* shows that the countries that are devel-

Figure 2: Correlation - stringency of environmental policy and human development index

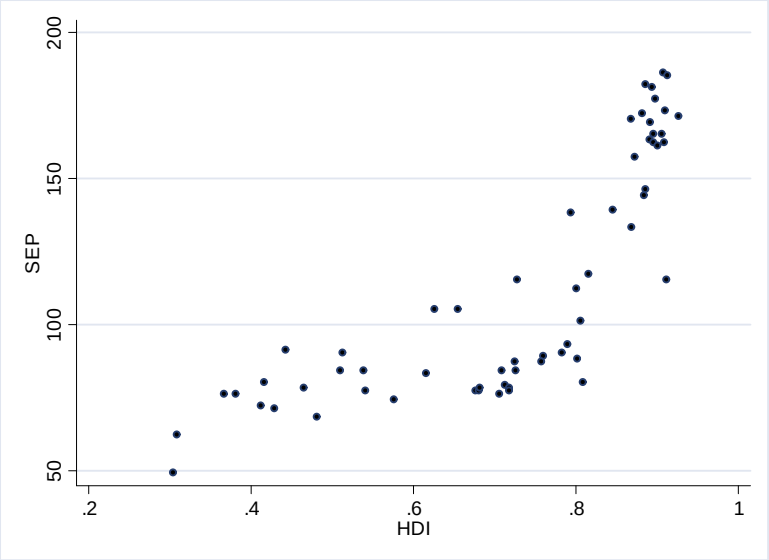


Figure 3: Correlation - lead content and income per capita

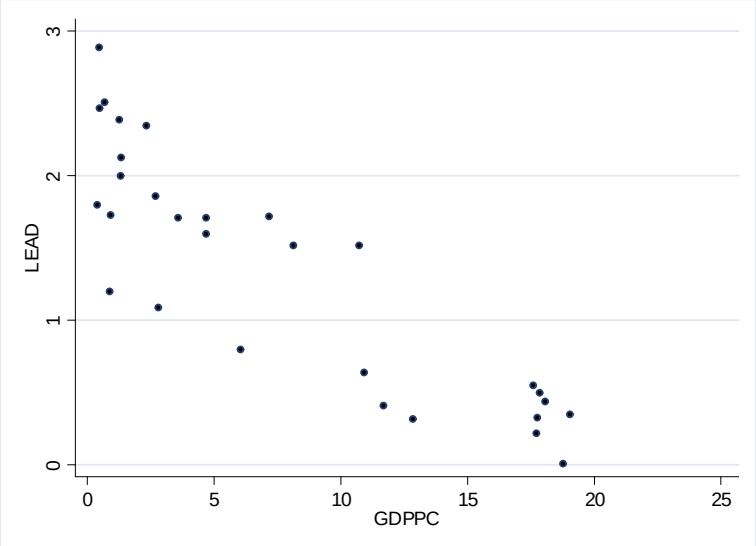
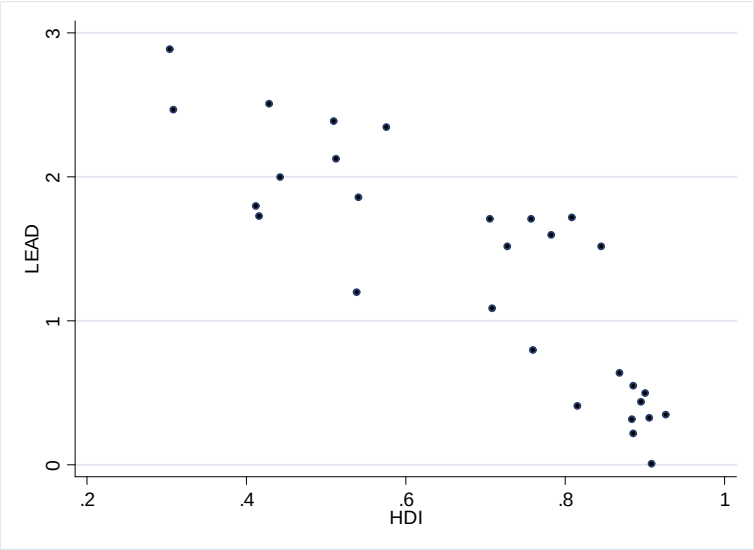


Figure 4: Correlation - lead content and human development index



oped originally from a common law system tend to possess a stricter environmental policy. The dummy variable of high income OECD countries confirms that this group has more stringent environmental policy than others. These variables enter regression 1 with high significace at 1 percent level. Besides, The latitude of a country matters. *LAT* is statistically significant at 5 percent level and the coefficient implies that a country with higher latitude tends to regulate its environment more heavily than one with lower latitude.

Regression 2 makes use of an alternative measure of development. *HDI* is highly significant and the sign of estimated coefficient suggests that the stringency of environemtal policy is positively associated with human development. The results on other explanatory variables stay close to that inferred from regression 1. As for economic significance, the coefficient of *GDPPC* equals 2.18, implying that a one-thousand US dollar per capita improvement of income leads to a 2.18-point increase in *SEP*. A 1-point increase in *HDI* results in a 46.7-point increase in *SEP*. To put this in perspective, if Nigeria would be improved in terms of *HDI* to that level of Norway, then the stringency of its environmental policy would be improved to Czech Republic's level.

To see the applicability of the relationship between environmental policy and development put forward by the theory, a different measure of environmental policy, *LEAD*, is used as a supplement to *SEP*. Regression 3 and 4 are re-estimations of regression 1 and 2 respectively with *LEAD* as dependent variable. However, we drop *LEGAL*, as including it reduces size of our sample below 20. Australia is an outlier, and its observation is also dropped[18]. Both measures of

[18] Australia is the only high income country which has a lax regulation on lead content in

development enter regression 3 and 4 negatively and are statistically significant. A more advanced country is associated with a stricter regulation on lead content in gasoline. Nonetheless, corruption index and other control variables become insignificant in these regressions.

Table 1: Environmental Policy Regression - Basic findings

	OLS	OLS	OLS	OLS
	SEP	*SEP*	*LEAD*	*LEAD*
	(1)	(2)	(3)	(4)
GDPPC	2.179***		-0.108**	
	(0.582)		(0.045)	
HDI		46.693***		-2.379***
		(15.118)		(0.668)
NCOR	4.126***	5.065***	0.051	-0.011
	(1.243)	(1.344)	(0.064)	(0.046)
LAT	0.131**	0.179***	0.001	-0.003
	(0.069)	(0.067)	(0.004)	(0.004)
LEGAL	7.583***	9.874***		
	(2.818)	(3.681)		
OECD	24.61***	37.672***	-0.206	-0.449
	(8.672)	(8.175)	(0.603)	(0.445)
Observations	56	57	29	29
R^2	0.91	0.90	0.77	0.81

Note: OLS regression. Constants are not reported. Standard errors in parentheses, and are corrected for heteroskedasticity. ***,** , and * denotes significance at the 1, 5, and 10 percent level repectively.

Table 1 demonstrates the significance of the level of development as a determining factor of environmental policy, as expected by Proposition 2. More importantly, Table 1 confirms this relationship despite using a broader definition of development, *HDI*, instead of *GDPPC*.

7.1 Robustness Test

This section is aimed to carry out an additional test of robustness for the results obtained in the preceding section. It employs the two-stage least square technique (2SLS) to cope with the potential simultaneity problem. In sum, we continue to find a significant impact of the level of development on the stringency of environmental policy. *GDPPC* consistently appears to be statistically significant throughout various specifications.

Arguably, per capita GDP in a country may be simultaneously determined by the stringency of environmental policy. In most developing countries, natural resources and the environment immensely contribute to the development. The set of rules that constrain the population from making profits out of natural

gasoline.

resources and the environment is clearly a bar placed against the expansion of an economy. Even though, natural resources do not contribute as much in terms of production in developed economies, stringent environmental policies do not give permission to producers to freely carry out activities that may harm the environment. In this situation, we may encounter endogeneity bias in our OLS estimation where simultaneity is not taken into account. Table A3 in Appendix demonstrates the possibility that simultaneity problem may occur with *GDPPC*[19].

To correct endogeneity bias, regression 5 to 12 adopt 2SLS estimates instrumenting for *GDPPC* with a proxy for female education. This includes the female secondary school enrolment rate (*FEMEN*) and the average years of female schooling (*FEMYR*)[20]. Table A4 in Appendix assures that both indicators of female education do not suffer from the reverse causation. Apart from the exogenous characteristic of female education variables, there are reasons to believe that they capture the extent to which a country is developed. It is widely acknowledged and is a consensus that education is vital to development. In addition, female education reflects the degree to which people in a society are permitted to strive for their rights and freedom. This allows a broader caption of development.

A highly significant F-statistics from the first stage regressions indicate that the instruments perform well. For the instruments to be valid, it is necessary to assume that *GDPPC* is the only channel through which *FEMEN* and *FEMYR* affect environmental policy variables. We test this assumption using Hausman test for over-identifying restrictions. The test indicates that we are far from being able to reject the null hypothesis of the validity of the exclusion restrictions. In other words, we find no evidence that the *FEMEN* and *FEMYR* belong in the environmental policy regression. The statistics of the Hausman test are reported in Table 2, and the p-values are in parentheses.

7.1.1 Stringency of Environmental Policy as Dependent Variable

The first part of Table 2 uses *SEP* as dependent variable, while the second uses *LEAD*. The measure of *GDPPC* continues to be highly significant in 2SLS regressions 5 to 8. The extent to which *GDPPC* affects *SEP* is somewhat greater than the earlier OLS findings in Table 1. The democracy index (*DEMOC*) is added in regression (6) to see whether political regimes have a role to play as a determinant of environmental policy. The estimated coefficient suggests that a country with higher degree of democracy has a more stringent environmental policy; however, the evidence is of no statistical significance. Note that *NCOR* and *OECD* become statistically significant after adding *DEMOC*.

Regression 7 and 8 add *TRLND* and *TRPOP*, and then *ELEVA* respectively.

[19] *HDI* is no longer utilised as an alternative measure of development in this section to allow the focus on our primary indicator of development, *GDPPC*. Furthermore, unlike *GDPPC*, *HDI* does not seem to suffer the problem of simultaneity (see, Table A3).

[20] The two variables together as a proxy for female education outperforms using either of them. We believe that these two capture different dimensions of female education.

They do not statistically contribute to the stringency of environmental policy. More importantly, *NCOR* and *OECD* remain significant with expected sign throughout. It can be inferred quite strongly that less corruption brings about a more stringent environmental policy. Also, an economy of high-income OECD structure has stricter environmental policy than others. As well as in OLS estimates, *LEGAL* positively and significantly affect *SEP*. On the other hand, the role geographical latitude becomes less important in our 2SLS estimates. More importantly, regression 5 to 8 provide an affirmation that the level of development contribute to the stringency of environmental policy.

Table 2: Environmental policy regression - Robustness test

	2SLS	2SLS	2SLS	2SLS
	SEP	*SEP*	*SEP*	*SEP*
	(5)	(6)	(7)	(8)
GDPPC	3.949**	2.583***	2.529***	2.528***
	(1.778)	(0.704)	(0.745)	(0.753)
NCOR	2.41	3.163***	3.189***	3.167***
	(2.089)	(1.022)	(1.199)	(1.226)
LAT	0.107*	0.083*	0.086*	0.091*
	(0.078)	(0.051)	(0.056)	(0.059)
LEGAL	8.49***	7.69**	7.679**	7.773***
	(2.951)	(3.332)	(3.258)	(3.173)
OECD	6.13	26.73***	26.6***	27.93***
	(19.48)	(7.398)	(8.218)	(8.94)
DEMOC		0.582	0.607	0.637
		(0.681)	(0.739)	(0.765)
TRLND			0.691	3.07
			(9.018)	(8.173)
TRPOP			-1.69	-3.205
			(7.381)	(6.683)
ELEVA				0.003
				(0.003)
Over-id test	0.585	0.647	0.68	0.798
(p-value)	(0.75)	(0.72)	(0.71)	(0.67)
Obs	50	35	35	35
R^2	0.88	0.96	0.97	0.97

7.1.2 Lead Content as Dependent Variable

The second part of Table 2 presents 2SLS results with *LEAD* as dependent variable. The *GDPPC* measure, despite being statistically significant, appears to be a less important determinant of lead content in gasoline than of the *SEP*. Other explanatory variables including *NCOR*, *LAT*, *LEGAL*, and *OECD*, are of no statistical significance. This is consistent with the result obtained in Table 1 with OLS. Interestingly, unlike in *SEP* regressions, *TRPOP* and *ELEVA*

become significant determinants of *LEAD*. We can see that a country with higher elevation from sea level and more proportion of its population in tropical zone tends to has devised a stricter regulation on lead content in gasoline.

Table 2 (continued)

	2SLS *LEAD* (9)	2SLS *LEAD* (10)	2SLS *LEAD* (11)	2SLS *LEAD* (12)
GDPPC	-0.143*	-0.142*	-0.158**	-0.117*
	(0.087)	(0.086)	(0.077)	(0.074)
NCOR	0.111	0.129	0.153*	-0.033
	(0.109)	(0.117)	(0.102)	(0.089)
LAT	0.001	-0.004	0.001	0.0003
	(0.006)	(0.005)	(0.004)	(0.004)
LEGAL	0.008	-0.098	-0.095	0.037
	0.257	(0.247)	(0.188)	(0.207)
OECD	0.159	0.105	-0.352	-0.545
	(0.86)	(0.771)	(0.772)	(0.713)
DEMOC				0.056*
				(0.034)
TRLND			0.623	0.256
			(0.816)	(0.873)
TRPOP			-1.214**	-1.155**
			(0.653)	(0.679)
ELEVA		-0.0006**	-0.0005**	-0.0005***
		(0.0003)	(0.0002)	(0.0001)
Over-id test	0.69	0.27	0.22	0.626
(p-value)	(0.71)	(0.87)	(0.89)	(0.73)
Obs	23	23	23	20
R^2	0.71	0.76	0.82	0.90

Note: Constants are not reported. Standard errors in parenthesis and are conrrected for heteroskedasticity. ***,** , and * denotes significance at the 1, 5, and 10 percent level respectively. The female secondary school enrolment rate, and the female of over 25 average years of school are used as instruments for per capita GDP in 2SLS. Over-identifying restriction test is distributed as a χ^2 under the null hypothesis of instruments validity[21].

It is worth noting the difference in the determining pattern of different environmental policy measures. It can be seen that the variables that reflect the characteristics and structure of an economy, including *GDPPC*, *NCOR*, *LEGAL*, and *OECD*, seems to play a more important role to determine *SEP* than

[21] We ran the residuals from 2SLS regression on all of the predetermined variables in the model. The statistics is obtained by multiplying R^2 by the number of observations and is distributed as a χ^2 with j degree of freedom; j equals the number of exogenous variables excluded from the model minus the number of endgenous variables included in the model.

LEAD. On the other hand, the variables that capture geographical characteristics, such as *TRPOP* and *ELEVA*, tend to play a more important role when it comes to determining *LEAD*. This is possibly due to the fact that the nature of environmental problems and their processes of policy determination might be different[22]. As for the objective of this section, Table 2 confirms that our results are robust to conclude that the level of development has a significant role to play in determining environmental policy.

8 Structural Regression Analysis

We examined the effect of development on stringency of environmental policy in previous sections by using reduced-form approach. Now we turn to investigate the role of mass media as a means through which the demand for environmental news translate to the environmental policy making process. As in our model, the demand for environment rises as development progresses. Development was instrumented by female education variables in the preceding analysis, and they are used again here. We use 2SLS technique to estimate the following structural specification:

$$\begin{aligned} SEP_i &= \beta_{0i} + \beta_{1i}\sigma_i + \beta_{2i}controls_i + \eta_i \\ \sigma_i &= \omega_{0i} + \omega_{1i}FEMEDU_i + \omega_{2i}MEDIA_i + \omega_{4i}controls_i + \nu_i \end{aligned} \tag{30}$$

where σ_i is the fraction of informed voters as denoted in theoretical model. $FEMEDU_i$ is the vector of female education variables, $MEDIA_i$ is the vector of mass media parameters. We proxy σ_i with *TV*, *RD*, and *LCKPC*. *TV* and *RD* are aimed to capture the extensiveness of people in a society who are informed by mass media. *LCKPC* is, in contrast, aimed to capture the power and freedom of voters, and their involvement in politics. the determinants of σ_i is suggested by section 2, while that of SEP_i is suggested by equation (25). Control variables are the same set used in basic specification above. Note that *LEAD* is not adopted as dependent variable here as including it makes the sample size drop below 20 countries.

Table 3 presents the results of the structural regression. Regression 13 and 14 use *TV* to capture σ_i. *FEMYR* has significant positive impact on *TV*, while *FEMEN* does not. As average years of female schooling increases in a country, a larger proportion of its population is exposed to mass media. Media parameters including *MEDCOM* and *PRFDM* are added in regression 14; however, they do not appear to be significant determinants of *TV*. This means that increase in competition in media industry and freedom of press do not ensure that a larger fraction of population will be exposed to the information provided by media. *TV* in turn has a positive and significant impact on *SEP* in both regression 13 and 14.

[22] Giving an insightful answer to this is beyond the scope of this paper.

Table 3: 2SLS - Structural environmental policy regression

	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	TV	*TV*	*RD*	*RD*	*LCKPC*	*LCKPC*
	(13)	(14)	(15)	(16)	(17)	(18)
FEMEN	0.317	-0.443	-0.163	0.153	-0.008*	-0.004
	(0.697)	(0.848)	(1.564)	(2.11)	(0.006)	(0.006)
FEMYR	33.11***	37.953***	99.36***	132.57***	-0.212***	-0.085
	(8.673)	(11.613)	(19.514)	(27.654)	(0.078)	(0.081)
MEDCOM		-31.78		-19.75		-0.439***
		(27.748)		(72.44)		(0.162)
PRFDM		-2.163		-2.148		
		(2.841)		(6.978)		
OECD	127.43**	131.68**	344.49***	371.42**	-1.059**	-1.112**
	(56.189)	(76.11)	(123.96)	(186.17)	(0.507)	(0.46)
R^2	0.75	0.72	0.74	0.71	0.62	0.68
	SEP	*SEP*	*SEP*	*SEP*	*SEP*	*SEP*
TV	0.089***	0.07**				
	(0.032)	(0.035)				
RD			0.031***	0.02**		
			(0.012)	(0.01)		
LCKPC					-11.162**	-5.895**
					(5.734)	(3.437)
NCOR	3.921**	7.572***	5.265***	9.41***	5.346***	9.472***
	(1.792)	(1.377)	(1.923)	(1.616)	(2.057)	(1.25)
LAT	0.144**	0.15**	0.17**	0.182**	0.198**	0.2**
	(0.077)	(0.077)	(0.076)	(0.078)	(0.103)	(0.086)
LEGAL	4.974	1.673	0.283	-2.739	12.075**	5.489
	(3.874)	(5.15)	(4.18)	(5.726)	(6.674)	(6.165)
OECD	24.061***	21.166**	25.5***	22.646**	22.577*	22.93**
	(9.918)	(10.812)	(10.338)	(10.597)	(14.698)	(12.124)
Over-id test	0.005	0.93	0.117	1.5	0.317	2.56
(p-value)	(0.99)	(0.63)	(0.94)	(0.47)	(0.85)	(0.28)
Obs	46	31	45	30	46	32
R^2	0.90	0.93	0.88	0.93	0.81	0.91

Note: 2SLS regression. Constants are not reported. Standard errors in parenthesis and are conrrected for heteroskedasticity. ***,** , and * denotes significance at the 1, 5, and 10 percent level respectively. Over-identifying restriction test is distributed as a χ^2 under the null hypothesis of instruments validity.

Regression 15 and 16 follow the specifications of regression 13 and 14 respectively with *RD* as a measure for the fraction of informed voters, σ_i.The results are very similar to those obtained from regression 13 and 14. *FEMYR* continues to enter positively and has significant impact on *RD*. Media parameters are again of no statistical significance. *RD* appears to be statistically significant.

A more stringent environmental policy is resulted from a larger exposure of population to mass media, particularly television and radio in this analysis. A larger fraction of informed citizens is in turn determined by a higher level of development as measured by female education in this study.

LCKPC is used as an alternative proxy for σ_i in regression 17 and 18. Although *LCKPC* is not suitable for capturing mass media as a information provider to voters, it generally captures the fraction of informed voters in politcal sense. We believe *LCKPC* reflects the power of voters as a whole. *FEMYR* is significant in regression 17. However, it becomes insignificant when *MEDCOM* is included. *MEDCOM* is significant in regression 18. An intense competition in media sector is associated with high level of political rights and civil liberty in a society.

All in all, Table 3 provides a suggestive evidence that mass media act as a significant channel through which development process affects the determination of environmental policy. Note that we perform the over-identifing restriction test, and cannot reject the null hypothesis of instrument validity at conventional levels for most regressions except for 16 and 18.

9 Final Remarks

This paper stresses the role of mass media in the politics. We study its role in policy making process, and in the determination of environmental policy in particular. Our view is that mass media acts as a means through which concerns for environment or environmental awareness is translated to policy determination. The model suggests that mass media, as information-provider, empowers the voters in the sense that their welfare and desire become significant from the political parties' viewpoint. An old adage: "information is power" is at work here.

The political parties embrace the citizens' preferences into their policy making consideration to a larger extent when the voters are armed with information that make them capable of making judgment on the parties' policy platforms. As the level of development increases, there is a shift of the balance of power in the economy toward the consumers/voters, i.e. σ_i becomes larger. This points to a different way of interpretation to σ_i - the fraction of informed voters as a measure of public participation in policy making process.

An interesting implication from the model is worth noting here. Even though consumers/voters are dispersed and are unable to overcome free-riding problem to organise and to pursue their interest, mass media helps to facilitate this process. This is because mass media integrate the dispersed group's preferences together through the news market.

9.1 A Note on Environmental Kuznets Curve

The literature of environment-development relationship is extensive. This is the literature of which the environmental Kuznets curve (EKC) is a subset. An

important assumption implicitly made in EKC studies is that the downward part of the inverted U-shape occurs as a result of induced policy response to rising demand for environment. The process that the demand for environment is trasformed to the resulted environmental policy was treated as a black-box. This paper contributes to a way in which an explanation can be offered to this reduced-form process.

Grossman and Krueger (1995) gives an explanation to EKC. The upward part of the inverted U-shape is caused by the scale effect - expansion of production without environmental regulations in place. The downward part is resulted from the technique and composition effects - substitution for cleaner technology and structural changes toward a cleaner economy occurs as development progresses beyond some point. This explanation is consistent with our theoretical model. In our view, technique and composition effects are due to a more stringent environmental policy that comes with higher level of development. A stricter environmental policy provides incentive for producers which in aggregate makes technique and composition effects.

The theoretical prediction of our model has $d > 2$ as central condition to our conclusion (see Proposition 2). This condition measure the relative importance between the damage accrues to consumers and the profitability of polluting sector to producers. When $d < 2$, the damage is less important to the policy makers than the profits from polluting sector. This scenario suits to reflect the development at initial stage of a country. In this case, our model predicts that as development progresses, the policy makers devise a less strict environmental policy. This situation happens possibly because environment may not be a primary concern of the consumers and policy maker, unlike perhaps economic growth. When $d > 2$, the damage from pollution becomes relatively more important than the profits from pollution. Things turn around in this case, where the model predicts that environmental policy is more stringent as development progresses. This latter scenario suits the development at later stage of a country - a more advanced economy. Theoretically, we can see that the relationship between environmental policy and development is of a U-shape.

To this point, it seems that the structure of a less developed economy possesses the characteristics of $d < 2$ and low σ_i,and vice versa to a more developed economy. Also, there exist, in our theory, a U-shape relationship between environmental policy and development. Provided that environmental outcomes are linear to environmental policies, we should be able to observe empirically the environmental Kuznets curve. Importantly, it should be noted here that we cannot find systematic U-shape relationship between environmental policy and development in most of our specifications, except the situation where we relate *SEP* to *HDI*. However, this issue deserve scrutiny in future research. Bimonte (2001) study the relationship of protected areas and income, and finds that there is a U-shape pattern as suggested by our theoretical model.

All things considered, whether or not EKC exhibits in any particular case depends very much on context-specific environmental issues at hand and the nature of the problem. This is to say that it is likely that the relationship between environmental outcomes and environmental policies is not necessarily linear. In

practical terms, this is the issue of policy implementation which is beyond the scope of this paper. In any case, relate the data on environmental indicators to the level of development seems to be a trivial exercise. In order to be capable of answering whether development can bring about environmental improvement, we are required to understand not only the policy determination which resulted from development process, but also the effectiveness of enforcement and implementation of the environmental policy that has been made. This paper is hoped at least to contribute to a better understanding of the former aspect.

10 References

Ahrend, R. (2002), "Press Freedom, Human Capital, and Corruption", DELTA Working Papers 2002-11, DELTA.

Aidt, T. (1998), "Political Internalization of Economic Externalities and Environmental Policy", *Journal of Public Economics*, **69**(1), 1-16.

Barbier, E.B. and Burgess, J.C. (2001), "The Economics of Tropical Deforestation", *Journal of Economic Survey*, **15**(3), 413-33.

Barrett, S. and Graddy, K. (2000), "Freedom, growth, and the environment", *Environment and Development Economics*, **5**, 433-456.

Barro, R.J. and Lee, J.W. (2000), "International Data on Educational Attainment: Updates and Implications", CID Working Paper No. 42, Center for International Development, Harvard University.

Besley, T. and Burgess, R., (2002), "The Political Economy of Government Responsiveness: Theory and Evidence from India", *The Quaterly Journal of Economics*, **117**(4), 1415-51.

Besley, T. and Prat, A. (2002), "Handcuffs for the Grabbing Hand? Media Capture and Government Accountability", CEPR Discussion Papers 3132.

Bhattarai, M. and Hammig, M. (2001), "Institutions and the Environmental Kuznets Curve for Deforestation: A Crosscountry Analysis for Latin America, Africa, and Asia, *World Development*, **29**(6), 995-1010.

Bimonte, S. (2001), "Model of Growth and Environmental Quality. A New Evidence of the Environmental Kuznets Curve", University of Siena Economics Working Paper No. 321.

Brunetti , A. and Weder, B. (2003), "A Free Press is Bad News for Corruption", *Journal of Public Economics*, **87**(7), 1801-1824.

Damania, R., Fredriksson, P.G. and List, J.A. (2003), "Trade liberalization, corruption, and environmental policy formation: theory and evidence", J*ournal of Environmental Economics and Management*, **46**(3), 490-512.

Dasgupta, S., Mody, A., Roy, S. and Wheeler, D. (1995), "Environmental Regulation and Development: A cross-country empirical analysis", Policy Research Working Paper 1448, World Bank, Washington DC.

Djankov, S., McLiesh, C., Nenova, T. and Shleifer, A. (2001), "Who Owns the Media?", NBER Working Paper 8288, National Bureau of Economic Research.

Eliste, P. and Fredriksson, P. (2002), "Environmental Regulations, Transfers and Trade", *Journal of Environmental Economics and Management*, **41**, 33-57.

Fredriksson, P.G. and Svensson, J. (2003), "Political Instability, corruption, and policy formation: the case of environmental policy", J*ournal of Public Economics*, **87**, 1383-1405.

Fredriksson, P.G., Neumayer, E., Damania, R. and Gates, S. (2005), "Environmentalism, democracy, and pollution control", *Journal of Environmental Economics and Management*, **49**, 343-65.

Friedman, E., Johnson, S., Kaufman, D. and Zoido-Lobatan, P. (2000), "Dodging the grabbing hand: the determinants of unofficial activity in 69 countries", *Journal of Public Economics*, **75**, 459-93.

Grossman, G.M. and Helpmand, E. (1996), " Electoral Competition and Special Interest Politics", *Review of Economic Studies*, **63**, 265-86.

Grossman, G.M. and Krueger, A.B. (1995), "Economic Growth and the Environment", *The Quarterly Journal of Economics*, **110**(2), 353-77.

Jaggers, K and Marshall, M.G. (2000), "Polity IV Project", Center for International Development and Conflict Management, University of Maryland.

Kruckeberg, D. and Tsetsura, K. (2003), "A Composite Index by Country Of Variables Related to the Likelihood Of the Existence Of 'Cash for News Coverage", The Institute for Public Relations.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A and Vishny, R.W. (1998), "The Quality of Government", *Journal of Law, Economics, and Organization*, **15**, 222-79.

Olson, M., (1965), *The logic of collective action: Public Goods and the Theory of Groups*, Harvard University Press, Cambridge.

Panayotou, T. (1997), "Demystifying the environmental Kuznets curve: turning a black box into a policy tool", *Environment and Development Economics*, **2**, 465-84.

Stromberg, D. (2001), "Mass media and public policy", *European Economic Review*, **45**, 652-63.

Stromberg, D. (2004), "Radio's Impact on Public Spending", *The Quarterly Journal of Economics*, **119**(1), 189-221.

Torras, M. and Boyce, J.K. (1998), "Income, inequality, and pollution: a reassessment of the environmental Kuznets curve", *Ecological Economics*, **25**, 147-60.

Triesman, D. (2001), "The Causes of Corruption: A Cross-National Study", *Journal of Public Economics*, **76**(3), 399-457.

Welsch, H. (2004), "Corruption, growth, and the environment: a cross-country analysis", *Environment and Development Economics*, **9**, 663-93.

Appendix

Table A1: Descriptive Statistics

Variable	Obs	Mean	S.D.	Min	Max
SEP	62	112.97	40.68	49	186
LEAD	33	1.41	0.92	0	3.03
GDPPC	60	8.59	7.31	0.42	23.54
TV	61	246.43	198.24	2	776
RD	61	505.33	406.04	37	2129
PRFDM	61	35.23	20.17	7	89
MEDCOM	41	3.43	1.25	0	5
LCKPC	61	2.80	1.82	1	7
NCOR	61	6.39	2.36	1.01	10
FEMEN	53	85.04	39.41	5.22	170.29
FEMYR	58	5.98	2.99	0.56	11.59
HDI	61	0.72	0.18	0.31	0.93
OECD	62	0.38	0.49	0	1
LEGAL	59	0.34	0.48	0	1
LAT	61	22.54	29.73	-41.81	67.47
ELEVA	61	555.79	428.31	18.12	1871.13
TRLND	61	0.36	0.45	0	1
TRPOP	61	0.34	0.46	0	1
DEMOC	40	7.07	3.20	0.21	10

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Table A2: Correlation Matrix

SEP	1																		
LEAD	-0.69	1																	
GDPPC	0.92	-0.71	1																
TV	0.86	-0.69	0.90	1															
RD	0.79	-0.58	0.85	0.89	1														
PRFDM	-0.72	0.69	-0.78	-0.74	-0.68	1													
MEDCOM	0.58	-0.35	0.62	0.54	0.46	-0.80	1												
LCKPC	-0.70	0.63	-0.77	-0.76	-0.64	0.88	-0.79	1											
NCOR	0.84	-0.62	0.85	0.79	0.71	-0.68	0.53	-0.59	1										
FEMEN	0.75	-0.52	0.74	0.75	0.68	-0.72	0.54	-0.76	0.66	1									
FEMYR	0.77	-0.50	0.81	0.83	0.82	-0.72	0.60	-0.75	0.71	0.74	1								
HDI	0.79	-0.67	0.84	0.83	0.71	-0.77	0.64	-0.85	0.69	0.86	0.88	1							
OECD	0.90	-0.66	0.92	0.77	0.74	-0.72	0.57	-0.69	0.79	0.68	0.66	0.73	1						
LEGAL	-0.10	0.37	-0.21	-0.18	-0.03	0.12	-0.05	0.28	-0.16	-0.19	-0.17	-0.39	-0.13	1					
LAT	0.58	-0.58	0.56	0.49	0.40	-0.27	0.13	-0.40	0.46	0.41	0.37	0.45	0.54	-0.34	1				
ELEVA	-0.22	0.15	-0.19	-0.24	-0.25	0.35	-0.22	0.38	-0.11	-0.29	-0.19	-0.23	-0.24	-0.03	-0.23	1			
TRLND	-0.66	0.64	-0.65	-0.66	-0.55	0.42	-0.24	0.49	-0.59	-0.67	-0.56	-0.65	-0.58	0.40	-0.53	0.04	1		
TRPOP	-0.64	0.56	-0.63	-0.64	-0.56	0.43	-0.25	0.49	-0.56	-0.66	-0.55	-0.63	-0.57	0.38	-0.46	0.08	0.97	1	
DEMOC	0.83	-0.38	0.80	0.75	0.68	-0.81	0.64	-0.83	0.77	0.56	0.71	0.73	0.77	-0.03	0.42	-0.34	-0.48	-0.49	

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Table A3: Development Endogeneity

	OLS *GDPPC*	OLS *HDI*	OLS *GDPPC*	OLS *HDI*
SEP	0.154***	0.0002		
	(0.057)	(0.015)		
LEAD			-0.812	-0.041
			(1.017)	(0.038)
NCOR	0.229	0.023*	0.845*	0.015
	(0.489)	(0.015)	(0.528)	(0.018)
LAT	-0.007	-0.001**	-0.011	-0.0016*
	(0.016)	(0.0005)	(0.023)	(0.001)
LEGAL	-2.103**	-0.101***		
	(0.969)	(0.033)		
OECD	-0.285	0.117*	7.26***	0.158*
	(3.117)	(0.074)	(2.463)	(0.096)
DEMOC	0.092	0.006	0.386	0.007
	(0.165)	(0.006)	(0.311)	(0.011)
Obs	38	39	25	25
R^2	0.93	0.86	0.93	0.75

Note: Constants are not reported. Standard errors in parenthesis and are corrected for heteroskedasticity. ***, **, and * denotes significance at the 1, 5, and 10 percent level respectively.

Table A4: Female Education Exogeneity

	OLS *FEMYR*	OLS *FEMEN*	OLS *FEMYR*	OLS *FEMEN*
SEP	0.044	-0.317		
	(0.041)	(0.455)		
LEAD			0.475	13.435
			(0.893)	(12.42)
NCOR	0.430	8.554**	0.754*	11.35***
	(0.503)	(4.301)	(0.480)	(3.568)
LEGAL	-0.429	-9.81	-1.207	-20.06
	(0.732)	(13.60)	(1.163)	(17.45)
OECD	-1.762	36.65*	0.196	24.185
	(2.485)	(26.11)	(2.001)	(22.038)
DEMOC	0.113	0.577	0.151	-1.691
	(0.156)	(2.511)	(0.212)	(2.101)
Obs	39	35	25	24
R^2	0.68	0.53	0.58	0.63

Note: Constants are not reported. Standard errors in parenthesis and are corrected for heteroskedasticity. ***, **, and * denotes significance at the 1, 5, and 10 percent level respectively.