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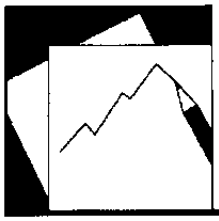

# IMF Working Paper

# Trade Integration and Political Turbulence: Environmental Policy Consequences

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# Trade Integration and Political Turbulence: Environmental Policy Consequences

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## Abstract



This paper seeks to contribute to the unresolved issue of the effect of economic integration on environmental policy. In particular, we discuss the joint impact of trade openness and political uncertainty. Our theory predicts that the effect of trade integreation on the environment is conditional on the degree of political uncertainty. Trade integration raises the stringency of environmental policies, but the effect is reduced when the degree of political uncertainty is great. Political uncertainty has a positive effect on environmental policy as it reduces lobbying efforts. Applying our model to a unique data set of primarily developing countries, the empirical findings support the theory and are robust under alterntive specifications.

JEL Classification Numbers: D72, D78, F13, Q28

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## I. INTRODUCTION

The current discussion on the effects of economic integration on environmental policymaking has risen to the forefront of the public debate in part due to the well-publicized protests at recent major trade negotiation meetings (for example, in Seattle (a WTO meeting, 1999), Quebec City (a FTAA meeting, 2001), Gothenburg (an EU meeting, 2001), and Genoa (a G-7 meeting, 2001)). Some observers appear to have concluded that economic liberalization necessarily results in a downward adjustment of environmental policy stringency.[2] Esty and Geradin (1998, p.7) state that: "considerable evidence suggests that government officials, facing the prospect of reduced sales, lost jobs and diminished investment in domestic industries caused by competition with foreign companies whose costs are lower due to more lax environmental requirements, often choose not to elevate environmental standards and sometimes even relax enforcement of current standards." Nonetheless, economic integration is progressing rapidly in several regions of the world, for example in the southern cone of Latin America (MERCOSUR), Asia (AFTA), North America (NAFTA), Europe (EU), and negotiations are under way for a Free Trade Area of the Americas (FTAA).

Simultaneously, it is often argued that political uncertainty has large adverse economic and social effects, especially in countries where the administration is driven by a short-term "revenue-seeking" motive, supporting narrow interest groups, and ignoring long-term costs (see Rodrik (1991) Aizenman (1997) and Bhattacharya (1999)). Interestingly, several rapidly liberalizing countries (for example, Argentina, Mexico, and Indonesia) are also the ones that have experienced significant degrees of political uncertainty.

While the effects of economic integration and political uncertainty have been studied in separate strands of the literature, no attempt has been made to study the interaction between them (on economic integration see, for example, Persson and Tabellini (1992) and Harrison and Hanson, (1999); on political uncertainty see, for example, Svensson (1998) and Bohn and Deacon (2000)).[3] In particular, their joint effects on policy determination have been ignored. We aim to close this gap in the literature.

In this paper, our focus is on the formation of environmental policy.[4] We develop a theoretical model of influence-seeking in environmental policymaking under political uncertainty which

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[2] In the context of increasing globalization of capital, environmentalists have argued that gaps in national environmental standards draw the most polluting industries to developing countries, creating "pollution havens" and propelling a global "race to the bottom" in environmental standards (see Wilson (1996) for a survey).

[3] The literature on economic integration includes Keen (1987) and Tanzi (1996). Political uncertainty, macro economic policy making, and growth is discussed by, for example, De Gregario (1992) Cukierman *et al.* (1992) Edwards (1996) and Svensson (1998). Deacon (1994) explores the relationships between deforestation, insecure property rights and government instability, Bohn and Deacon, 2000, study the effect of ownership security (a function of political violence and instability) on deforestation and oil extraction.

[4] López (1997) analyzes the effect of trade liberalization on environmental resources (biomass) and deforestation in Ghana, and Lee and Roland-Holst (1997) compare the effect of unilateral economic integration by Indonesia on

(continued...)

generates two predictions. First, trade integration causes an *increase* in the stringency of environmental policy. However, the effect is dampened by political uncertainty. Second, political uncertainty has a *positive* effect on the stringency of environmental policy. Finally, a cross-country index of the capacity of environmental policy was recently created by CIESIN *et al.* (2001). This index applies to environmental regulations in place in the late 1990s, and thus makes it possible to test our theory's predictions on recent data.

Our theory builds on Grossman and Helpman's (1994) model of trade policy determination, developed from Bernheim and Whinston's (1986) common agency model. This model has previously been extended to environmental policymaking by, for example, Aidt (1998) and Damania (2001). In our model, a lobby group representing the industry aims to influence the incumbent government's environmental policy choice by promising a contribution in return for a favorable policy decision. The incumbent government values both the bribe and aggregate social welfare. We focus the discussion on relatively corrupt regimes, which put a greater weight on bribes relative to social welfare.

In a three-stage model, we analyze the effects of economic integration on the behavior of the incumbent government and a producer lobby group in a small open economy. In the first stage, the government receives a bribe schedule by the lobby group, which relates the size of the bribe to the attractiveness of the government's environmental policy choice. The lobby takes the exogenous probability of eventual policy implementation into account. For policy implementation to occur, the incumbent government must remain in power throughout the (final) policy implementation stage, or alternatively, in the event that the incumbent government is ousted out of office, the new government must chose to keep the predecessor's policy (discussed below).

In the second stage, the government chooses its optimal environmental policy, taking into account the turnover probability. It receives in return the corresponding bribe promised by the lobby group. In the third stage, the environmental policy previously selected by the government is implemented, given that it remains in power, or in the event that the new government keeps the chosen policy. With a non-zero probability, the incumbent government will have to relinquish power before implementation has occurred. The political crisis causing the departure of the government could take the form of, for example, a coup d'etat or a vote of no confidence. If the incumbent government's policy is not implemented, the lobby group does not benefit from the bribe paid in the second stage.[5]

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industrial emissions, with and without pollution taxation. Bommer and Schulze (1999) and Fredriksson (1999) study (theoretically) the effect of trade liberalization on environmental policymaking but ignore political instability.

[5] In other words contributions are not conditional on the policy being implemented and there is no legal recourse to making bribes returnable. Another implicit assumption here is that a government dislodged from power will not seek reelection.

We show that in this game increased political uncertainty has two opposing partial effects on environmental policy. On the one hand, the producer lobby has a lower incentive to offer a bribe since the probability of a positive payoff declines when the incumbent government is less likely to deliver. On the other hand, the government has an increased incentive to take the bribe when the likelihood of gaining utility from its policy choice declines.[6] We thus find from our model that the first effect dominates in relatively corrupt societies, and thus an increase in political uncertainty causes an *increase* in the pollution tax.

Trade integration also affects both the producer lobby's and the government's incentives in the policy formation process, and these incentives are conditional on the degree of political uncertainty. Trade liberalization in an import-competing polluting sector has two opposing effects on the pollution tax. First, as output falls as a result of a lower tariff, the lobby has less at stake and its lobbying effort falls accordingly. This causes the pollution tax to rise.[7] Second, the government's (second-best) incentive to tax excessive output and pollution created by protection declines, which causes the pollution tax to fall. The net effect of trade integration on the pollution tax is thus positive (the pollution tax rises) when the government is sufficiently corrupt.[8]

The model also predicts that the net effect of trade integration is conditional on the degree of political uncertainty. Since political uncertainty reduces both the lobby's incentive to seek influence, and the government's incentive to deliver welfare, the declines in the intensities of these motives as a result of trade integration are moderated by political uncertainty. In the limit when political uncertainty is extremely high, trade integration has close to no effect on environmental policy.

The two predictions generated by the model are tested using unique cross-country data from 74 developing and developed countries. In our empirical modelling both corruption and political uncertainty are endogenous, and the findings are fully consistent with the model's predictions, both for the 50 developing countries by themselves and for the larger data set including the 24 industrialized countries. First, political uncertainty *raises* the stringency of environmental policies. Second, countries that are more open to trade set *stricter* environmental policies on average, and the marginal effect of openness is conditional on the degree of political

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[6] This is based on the assumption that a government once ousted from power will not be eligible to seek reelection immediately and hence has no incentive to either placate the lobby or address welfare questions.

[7] Our small country assumption implies that we can disregard terms-of-trade effects. In the large country case, the pollution tax (or tariff) may be used to influence the terms-of-trade.

[8] Note that the effect of trade liberalization on environmental policy (and thus on environmental quality) differs from the traditional scale, composition, and technique effects often discussed in the literature (see, for example, Copeland and Taylor (1994), Hettige *et al.* (2000), and Antweiler *et al.* (2001)). The effects discussed in this paper build on shifts in the bribe- giver's and bribe-taker's incentives as a result of changes in trade policy.

uncertainty.[9] In particular, the positive marginal effect of trade integration on environmental policymaking is *reduced* in more unstable countries, as predicted by the model. These findings are robust to two alternative measures of the degree of economic integration.

The political game surrounding environmental policy determination is likely to be similar to policymaking in other areas, and thus our study may have more general applicability (to taxation, and health and safety regulations, for example). Moreover, because environmental policy receives relatively minor attention in the political debate in many developing countries (and in some industrialized nations), the feedback effect from environmental policy outcomes to political instability and economic integration is likely close to zero. This simplifies our empirical work.

The paper is organized as follows. Section II sets up the theoretical model and discusses the effects of trade integration and political uncertainty on policy. Section III presents our empirical model, and Section IV the empirical results. Section V offers a brief conclusion.

## II. THE MODEL

A small open economy has two sectors. The "clean" sector produces a numeraire good $z$, and the polluting import competing sector produces a good $x$. The economy is populated by two types of individuals $k$, consumers (denoted by $S$) and factor owners ($F$). The two population groups are of size $s$ and $f$, respectively, and the population is normalized to 1. We assume that the factor owners are a highly concentrated group such that their share of the population is approximately zero, i.e. $f$=0 and $s$ =1 (this assumption does not alter the results). All individuals have labor income, factor owners in addition have factor income from ownership of a sector-specific factor. The consumers derive disutility from the pollution associated with the local production. An individual $k$, $k$=$S,F$, has a utility given by[10]

$$U^k = c^{zk} + u^k(c^{xk}) - \delta^S \theta X, \tag{1}$$

where $c^{zk}$ and $c^{xk}$ are consumption of the numeraire good $z$ and good $x$ by a type $k$, with world and domestic prices equal to 1 and $p^*$, respectively. The world market price is exogenously given as the country is a price taker. $u(c^{xk})$ is a strictly concave and differentiable sub-utility function. $\delta^S$ is an indicator variable which takes a value of one if the individual is a consumer, and zero otherwise. Production of $x$ is given by $X$, and $\theta$ is the per-unit damage coefficient,

[9] The intuition for our result is straightforward. Trade openness creates an economic surplus that can be used for environmental protection measures. Governments are likely to impose increasingly strict abatement policies, reflecting positive income elasticities for environmental quality along with increasing levels of environmental awareness.

[10] Corner solutions may result with quasi-linear preferences. We assume interior solutions, however.

which is assumed constant for simplicity.[11] The government regulates pollution by levying a pollution tax $t \in T$, $T \in \Re$, on each unit of damage from polluting production activities. Imports in the polluting sector face an ad-valorem import tariff, $\tau$. Whereas the pollution tax is set by the government (relatively few pollutants are covered by international agreements), the tariff is assumed determined entirely by multilateral trade negotiations which this small country government is unable to influence. All individuals thus take the tariff rate as given. The aggregate consumer surplus from consumption of good $x$ equals $C(p^*(1+\tau))$.

Each individual has a unit of labor and the total labor endowment equals $l$. Good $z$ is produced by labor alone with a constant returns to scale technology, and an input-output coefficient equal to one. The labor supply is sufficiently large for the supply of this good to be positive which implies a wage rate equal to one. The inputs into production of good $x$ are labor and a sector-specific factor. The technology is constant returns to scale. Ignoring labor costs, producers of good $x$ face a net price given by $p = p^*(1+\tau) - t\theta$, and the factor reward depends entirely on the producer's net price $p$, i.e. $\pi(p)$. The supply curve for good $x$ is given by Hotelling's Lemma, i.e. $X(p) = \pi_p(p)$, where $X_p > 0$, and $X_{pp} = 0$. Imports of the polluting good are given by $M(p) = p^*[d(p^*(1+\tau)) - X(p)]$. Net aggregate tax and tariff revenues are given by

$$R(t,\tau) = t\theta X(p) + \tau M(p), \tag{2}$$

and are assumed distributed equally to all individuals as lump-sum.

The income obtained by the owners of the sector-specific factor depends on the environmental policy (as well as trade policy). Factor owners are assumed able to organize into a lobby group that coordinates a prospective bribe offer to the incumbent government. The consumers are assumed to face sufficiently severe free-riding problems to be unable to organize political action (see Olson (1965)). The model defines a three-stage game between the government and the lobby. Both players are risk neutral. The timing assumptions are as follows.

*Stage 1*. In stage one the lobby group offers the incumbent government a bribe schedule $\Lambda^F(t)$, i.e. it offers a specific bribe for selecting a policy $t$. The lobby faces uncertainty on whether the incumbent government will remain in power long enough for the lobby to reap a reward to its bribe (policy implementation occurs only in stage three). In stage one, the lobby assigns a probability $0 < \gamma < 1$ that the government will be thrown out of office, and a probability $(1-\gamma)$

[11] Adding an abatement technology would not significantly alter our results. Note also that an individual $k$ spending $Y^k$ consumes $c^x = d(p^*) = u_c^{-1}$ and $c^z = Y^k - p^* d(p^*)$. Thus, the indirect utility function of a consumer is expressed as $V^k(p^*, t, Y^k) = Y^k + C(p^*) - \theta X$, where $C(p^*) = u[d(p^*)] - p^* d(p^*)$ is the consumer surplus derived from consumption of good $x$. There is no consumer surplus from consumption of good $z$.

that it will remain. However, it also assigns a probability $0 < \lambda < 1$ that the chosen policy is implemented by the *new* government, in the event the incumbent leaves office early.[12]

*Stage 2*. In the second stage the incumbent government proceeds to set its optimal environmental policy, given the lobby group's strategy. The government also collects the associated bribe from the producer lobby.[13] Bribes are used for the incumbent politicians' personal consumption during this stage.

*Stage 3*. In the third stage, the selected policy is implemented, given that the incumbent government remains in power, or in the event that the successor keeps the policy selected by its predecessor. Turnover could occur, for example, because of a vote of no confidence, or a coup attempt. From the lobby's perspective in stage one policy implementation occurs with a probability $1-\gamma(1-\lambda)$. This is the probability that all policy-favors "purchased" by the lobby will be delivered. With a probability $\gamma(1-\lambda)$ the incumbent is removed from office and the policy is not implemented.[14] The new government then plays the policy game again in the next period. For simplicity, the game between the lobby and the incumbent simply ends here in this event. Since the challenger did not receive a bribe within the period, it is not committed to its predecessor's policy promises, although it may chose to implement its predecessor's policy choice. In the event the challenger decides to change the predecessor's environmental policy in stage three, the new government is assumed to set an exogenous tax $t^c$, until a new lobbying game starts between itself and the lobby.

The lobby takes the political uncertainty into account in its formulation of its bribe schedule. The gross (indirect) utility of the lobby group is therefore given by the expected value of factor income,

$$E[\Omega^F(t,\tau)] \equiv \pi(p)[(1-\gamma(1-\lambda)] + \pi(p^c)[\gamma(1-\lambda)], \tag{3}$$

where $E[.]$ is the expectations operator and $\pi(p)$ is aggregate factor income. This factor income is received in the event that the policy determined by the incumbent materializes. Since $f = 0$, the lobby ignores tax and tariff revenues, as well as consumer surplus (it receives a negligible share).

If the incumbent government is removed and the successor chooses a different policy, the lobby's exogenous factor income equals $\pi(p^c)$, where $p^c = p^*(1+\tau) - t^c\theta$.

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[12] For example, the new government may have other policy priorities before the next election, or may want to avoid that environmental policy becomes an election issue.

[13] Neither the lobby group, nor the government, is assumed to renege on their promises in the second or third stages.

[14] We abstract from possible strategic choices by the lobby. For example, we do not model the bribery game between the lobby and the new government.

The incumbent government values bribes and aggregate social welfare. Bribes are used for personal consumption, and social welfare is of relevance because the incumbent is more likely to win future re-election, the greater is average welfare. However, aggregate welfare is assumed of value to the incumbent government only if it stays in office. The incumbent government's policy choice influences its own welfare only if it stays in power, in which case aggregate social welfare is given by

$$\Omega^A(t,\tau) \equiv \pi(p) + l + C(p^*(1+\tau)) + R(t,\tau) - s\theta X(p), \tag{4}$$

which expresses the sum of all individuals' aggregate factor rewards, labor income, consumer surplus, tax and tariff revenues, take the consumers' aggregate disutility from pollution (see also Fredriksson (1999)). Note that the FOC of (4) yields the Pigouvian tax, $t = s + \tau p^*/\theta > s$. Since the presence of a tariff stimulates output, the optimal tax exceeds the marginal disutility of pollution. If the incumbent government loses power, it has no interest in aggregate social welfare, and from the incumbent government's point of view it is equal to zero.

The incumbent government thus has an objective function equal to

$$E[I(t,\tau)] \equiv \Lambda^F(t) + a(1-\gamma)\Omega^A(t,\tau), \tag{5}$$

a weighed sum of the bribe and the expected aggregate social welfare. The exogenous parameter $a$ is the weight on welfare relative to bribes, which in our view reflects the degree of corruption. In our model, the bribe aims to influence government policy and not elections (see also Schulze and Ursprung (2001)).[15] López and Mitra (2000) employ a similar formulation in their investigation of the effect of corruption on the relationship between income and environmental quality. The government trades off the size of the bribe (which it enjoys with probability 1) with the expected value of aggregate social welfare.

In order to ensure that the analysis is particularly applicable to corrupt regimes (rather than, for example, policymakers with a trade-off weighted heavily towards welfare) we make the following assumption on one of the parameters of the model.

**Assumption 1:** $a < \dfrac{X(1-\lambda)}{[(s-t)\theta + \tau p^*]X_p} \leq 1.$

[15] The value of high-level political connections in Indonesia has recently been estimated by Fisman (2001). He finds that for the largest Indonesian corporations, 16 percent of their total value may be attributable to their political connections. He also notes that in the "Perceived Corruption Ranking" by Transboundary International, countries like India, Russia, Pakistan, China, Nigeria, and Bangladesh are ranked as more corrupt than Indonesia. Note, however, that Indonesia had been a highly stable country politically at the time, with Suharto in power for decades.

This assumption ensures that politicians weigh the bribe relatively more than social welfare, and that changes in bribe offers can have substantial impacts on policy outcomes. This may be particularly true in developing countries (see also Treisman (2000) and Persson *et al.* (2000)).[16] The Nash equilibrium in the well-known model by Grossman and Helpman (1994) can be found using two necessary conditions:

$$t^* = \arg\max_t \Lambda^{F^*}(t) + a(1-\gamma)\Omega^A(t,\tau) \text{ on T}; \tag{C1}$$

$$t^* = \arg\max_t [\Omega^F(t,\tau) - \Lambda^{F^*}(t)] + [\Lambda^{F^*}(t) + a(1-\gamma)\Omega^A(t,\tau)] \text{ on T}. \tag{C2}$$

The equilibrium policy $t^*$ simultaneously maximizes the government's utility function (condition (C1)) and the joint utility of the lobby and the incumbent (condition (C2)), given the turnover probability. The equilibrium characterization is found by taking the first-order conditions of (C1) and (C2), which yields

$$\Lambda_t^{F^*}(t^*) + a(1-\gamma)\Omega_t^A(t^*,\tau) = 0, \tag{6}$$

and

$$[\Omega_t^F(t^*,\tau) - \Lambda_t^{F^*}(t^*)] + [\Lambda_t^{F^*}(t^*) + a(1-\gamma)\Omega_t^A(t^*,\tau)] = 0. \tag{7}$$

Substituting (6) into (7) yields $\Omega_t^F(t^*,\tau) = \Lambda_t^F(t^*)$, which reflects the fact that the bribe schedule is locally truthful, as discussed by Grossman and Helpman (1994). The characterization of the equilibrium pollution tax is found by substituting this condition into (6), which yields

$$\Omega_t^F(t^*,\tau) + a(1-\gamma)\Omega_t^A(t^*,\tau) = 0. \tag{8}$$

Differentiation of equations (3) and (4) with respect to the pollution tax yields

$$\Omega_t^F(t,\tau) = -\theta X[(1-\gamma(1-\lambda)], \tag{9}$$

and

$$\Omega_t^A(t,\tau) = \theta X_p[(s-t)\theta + \tau p^*]. \tag{10}$$

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[16] Developing countries make up 67.6 percent (50 countries out of 74) of the data used in the empirical work below. Porter (1999), for example, argues that in many industrializing countries, political institutions are unresponsive to public demand for tighter regulation of industrial pollution, and regulatory decisions are highly skewed in favor of industry interests. He argues that corruption in the area of environmental policy is high in countries such as Malaysia, Taiwan, Indonesia, and Brazil. In these countries, "industrialists use close ties with key bureaucrats, elected officials, or ruling parties to ensure that regulatory policies serve their interests in return for a share of profits, either in the form of political contributions or making the bureaucrat a business partner" (Porter (1999, p. 141)).

Substituting expressions (9) and (10) into equation (8), and rearranging, we find an explicit expression for the equilibrium characterization given by

$$-X[(1-\gamma(1-\lambda)]+a(1-\gamma)X_p[(s-t)\theta+\tau p^*]=0. \qquad (11)$$

Note that the second term in (11) is adjusted by $(1-\gamma)$ rather than $[1-\gamma(1-\lambda)]$, since the incumbent government does not benefit from its policy choice in the event it leaves office. Note also that the equilibrium tax rate $t^*$ is smaller than the Pigouvian tax, $s+\tau p^*/\theta$. Without uncertainty and lobbying, the government would choose this tax rate. Since the first term in (11) is negative, the second term must be positive, which can be accomplished only if $t^* < s+\tau p^*/\theta$.

*Trade Integration and Political Uncertainty*

In this section we analyze the effects of trade integration on environmental policymaking, accounting for political uncertainty. The aim is to derive testable hypotheses for our empirical work carried out in the subsequent sections. In order to focus on the relevant effects, we make a simplifying assumption on the size of a second parameter of the model.

**Assumption 2:** The probability $\lambda$ is small.

Total differentiation of Eqn. (11) with respect to the tariff equals

$$\frac{dt}{d\tau}=\frac{\theta X_p p^*[(a-1)(1-\gamma)-\gamma\lambda]}{-|D|}, \qquad (12)$$

where $|D|<0$ is the second-order condition of the government's maximization (8), which is required to be negative for a maximum. We assume this to be the case. Under our assumptions, the following prediction emerges from the model.

**Prediction 1:** *Under Assumptions* 1 *and* 2, *trade integration causes the pollution tax rate to rise, but the effect disappears as the degree of political uncertainty rises.*

The intuition is the following. In this model, trade integration has two opposing effects on environmental policy, and their impacts both depend on the degree of political uncertainty. The first term in the numerator of Eqn. (12), $\theta X_p p^* a(1-\gamma)$, reflects the change in the government's incentive to tax pollution for second-best (welfare) reasons. The tariff introduces distortions in consumption and production, and thus increases the aggregate level of pollution damage. However, since we are dealing with a small open economy only one policy instrument is available to address these distortions, which is the pollution tax. Trade integration reduces the marginal incentive to tax pollution, which in turn causes the pollution tax to fall.

The second term in the numerator, $-\theta X_p p^*(1-\gamma)$, represents the reduction in the producers' incentive to seek a lower pollution tax, as a result of trade integration. When output shrinks, less is at stake for the lobby in the political process, the bribe offer is reduced and the pollution tax rises.

Both effects are adjusted for the probability of successful eventual policy implementation, $(1-\gamma)$. Bribery and social welfare are important (to the lobby and the government, respectively) only as long as the government stays in power long enough to deliver and reap the benefit of its policy choice. In addition, the lobby also benefits from bribery to the extent that a new government would implement the policy paid for (without extra cost), $\gamma\lambda$. The model predicts that trade integration (under our assumptions) has a positive effect on the stringency of environmental policy, but the effect is weaker the greater is the level of uncertainty.

Next, we turn our attention to the direct effect of political uncertainty. Total differentiation of Eqn. (11) with respect to $\gamma$ yields

$$\frac{dt}{d\gamma} = \frac{X(1-\lambda) - aX_p[(s-t)\theta + \overline{p}^*]}{-|D|}. \tag{13}$$

The sign of expression (13) is ambiguous, and depends on two opposing forces. The positive first term in the numerator, $X(1-\lambda)$, reflects the reduction in the bribe effort for a lower tax due to an increase in the probability that the incumbent government will leave office before policy implementation. This causes the pollution tax to rise as a result of an increase in political uncertainty. From Eqn. (11), the second term in the numerator, $-aX_p[(s-t)\theta + \overline{p}^*]$, is negative. It represents the government's reduced attention to social welfare when the turnover probability rises, and the consequent fall in the expected value to the government of providing welfare. This causes the pollution tax to decline as uncertainty increases. Although Eqn. (13) is ambiguous, we can provide a further insight. If the government is sufficiently corrupt (Assumption 1), i.e. if $a$ is small, Eqn. (13) is positive because the effect of a fall in the bribe offer (the first effect discussed above) dominates. We obtain the following prediction.

**Prediction 2:** *Under Assumption* 1, *an increase in political uncertainty raises the pollution tax.*

## III. Empirical Work

### A. Model Specification

The theoretical model developed in the previous section yields testable implications of the relationships between trade openness, political instability, and environmental policy formation, expressed in Predictions 1 and 2. Our objective is to test these implications using cross-country data on environmental policy.

The empirical estimation can be formulated as follows,

$$STR_i = \boldsymbol{x}'_i\beta^x + \beta^{POL}POL_i + \beta^{OPEN}\text{OPEN}_i + \beta^{POL*OPEN}POL_i*OPEN_i + \beta^{CORC}COR_i + \varepsilon_i, \qquad (14)$$

where $STR_i$ is the stringency of environmental policy in country $i$, $\boldsymbol{x}_i$ is a vector of controls, $POL_i$ is the degree of political uncertainty, $OPEN_i$ is the degree of trade openness, $COR_i$ is corruption, and $\varepsilon_i$ is a zero mean error term. Whereas $\beta^{POL}$, $\beta^{OPEN}$, $\beta^{POL*OPEN}$ and $\beta^{COR}$ are coefficient scalars, $\beta^x$ is a coefficient vector.

### B. Test for Endogeneity

Given the possible endogeneity of the corruption, political uncertainty, and trade policy variables, OLS is expected to lead to biased results. We therefore test for the necessity of an instrumental variable approach (whether the set of estimates obtained by least squares are consistent or not) by using an augmented regression test (DWH test) suggested by Davidson and MacKinnon (1993). This is carried out by including the residuals of each endogenous right-hand side variable as a function of all exogenous variables in a regression of the original model.[17] A smaller p-value for corruption (0.0048) and political instability (0.0083) in our model indicates that OLS is inconsistent. However, trade openness was found to be exogenous (p-value 0.0223). We correct for the endogeneity of corruption and political uncertainty by using Two-Stage Least Squares (2SLS). We also test for possible heteroskedasticity and correct using the standard White's correction.[18]

### C. Data

We now describe the variables (proxies) used to test the predictions generated by our theory. Table 1 summarizes the descriptive statistics. The Data Appendix contains a further description of the data and sources. Our measure of the stringency of environmental regulations is a recent index developed as a part of the *2001 Environmental Sustainability Index* (ESI). The ESI scores are based upon a set of 22 core indicators each of which combines two to six variables, identified on the basis of a careful review of the environmental literature and substantiated by statistical analysis. In this study, we employ one of the core indicators as our measure of the stringency of environmental policies, which we denote as **Environmental Stringency**. This indicator captures the extent to which the country has in place institutions and policies that

[17] This is an augmented form of the Hausman test for contemporaneous correlation between the error term and the regressors, used to test exogeneity of variables (Hausman (1983)). The low p values indicate that OLS is not consistent.

[18] White's general test for heteroskedasticity in the error distribution is done by regressing the squared residuals on all distinct regressors, cross-products, and squares of regressors. The Lagrange multiplier test statistic is distributed Chi-square (p) under the null hypothesis of homoskedasticity. White's general test statistic for our model was statistically significant at 40.973 with a p-value of 0.4718 suggesting presence of heteroskedasticity. It was corrected using White-corrected standard errors.

Table 1: Descriptive Statistics

| Variable | Number of Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Environmental Stringency | 118 | 46.94 | 18.38 | 18.10 | 92.30 |
| GDP | 159 | 6999.89 | 7426.91 | 458.00 | 33505.00 |
| GDP2 | 159 | 10.4E7 | 19.3E7 | 209764.00 | 11.2E8 |
| Openness | 152 | 2.69 | 1.22 | 1.00 | 5.00 |
| Corruption | 87 | 5.48 | 1.98 | 1.12 | 8.33 |
| Control of Corruption | 77 | 0.23 | 0.84 | -1.11 | 1.78 |
| Political Stability | 77 | 0.15 | 0.65 | -0.79 | 1.35 |
| Percent Non-Ag. Labor | 170 | 61.88 | 28.11 | 5.88 | 99.63 |
| Racial Tension | 106 | 3.63 | 1.65 | 0.00 | 6.00 |
| Democracy | 95 | 0.22 | 0.42 | 0.00 | 1.00 |
| Common Law | 95 | 0.31 | 0.46 | 0.00 | 1.00 |
| OECD dummy | 206 | 0.14 | 0.35 | 0.00 | 1.00 |

result in effective responses to environmental problems (i.e., laws on the book, implementation, monitoring, and enforcement). It takes values between 0 and 100, where a higher value implies greater environmental policy stringency.

Political uncertainty, or more precisely the perceived probability of a government turnover, is not (directly) observable. However, a measure of political stability has recently been developed by Kaufmann *et al.* (1999b) for the years 1997-98. The **Political Stability** index combines several indicators which seek to measure perceptions of the likelihood that the government in power will be destabilized or overthrown. It takes values from –2.5 to 2.5, where a higher value represents greater political stability.

Our trade openness measure is an index developed by the Heritage Foundation and the *Wall Street Journal* (O'Driscoll *et al.* (2000)) (**Openness**). An economy earns a "5" if it has an average tariff rate of ≤4 percent and/or has very few non-tariff barriers, and "1" if the average tariff rate is >19 percent and/or there are very high non-tariff barriers that virtually prohibit imports. Greater the index greater is the perceived degree of openness. We expect a positive sign.

Our theoretical model, as well as the previous empirical literature (see, for example, Eliste and Fredriksson (2001)) is informative concerning control variables to include in regression (15). Our two sets of controls capture demand factors and structural features of an economy that may influence environmental policy in alternative ways not the focus of the present paper. First, many studies have found a non-linear relationship between income and environmental quality

(see, for example, Selden *et al.* (1999), Hettige *et al.* (2000)). We thus include purchasing power adjusted per capita **GDP** and **GDP²**.[19] Industrial environmental policies are also influenced by the workers employed in polluting sectors, and the greater their stake in the policy outcome, the greater their political pressure and success. However, Olson's (1965) theory of free-riding implies that political influence may decline as the size of the interest groups increases. We use the proportion of the total labor force working in non-agricultural sectors (**Percent Non-Ag. Labor**) as our measure of worker political pressure on industry environmental policies. Labor force here comprises all individuals who meet the International Labor Organization's definition of the economically active population. The expected sign is indeterminate.

The remaining control variables seek to adjust for structural differences between countries.[20] We include a dummy variable for industrial countries (**OECD**) to control for the overall level difference in environmental policies across developed and developing countries. As a proxy for corruption, we use the Corruption Perceptions Index (**Corruption**) developed by Transparency International, which measures the "perceptions of the degree of corruption as seen by business people, risk analysts, and the general public." The index is computed as the sample average of a number of different surveys assessing each country's performance. **Corruption** ranges between 0 (perfectly clean) and 10 (highly corrupt).[21] We expect a negative sign. As an alternative measure of corruption, we used an index developed by Kaufmann *et al.* (1999a, 1999b), **Control of Corruption**.[22] It measures perceptions of corruption in a country, or more precisely, the use of public power for private gain. The index takes values from –2.5 to 2.5, where a higher value implies less corruption, and thus we expect a positive sign.

Given the endogeneity of **Corruption** (and **Control of Corruption**) and **Political Stability**, we use a number of instrumental variables to test and correct for the bias. Different theories have been expounded on factors determining corruption (see, for example, Persson *et al.* (2000) and Fisman and Gatti (2000)). We model the determinants of corruption into two main categories, namely standard economic controls, and political and legal history. Although there is to our knowledge no well-developed theory of the determination of political stability, it is reasonable

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[19] We also experimented with alternative functional forms including logarithm of per capita GDP, which yielded qualitatively similar results. We also estimated equations with logarithms for both dependent and independent variables. However, the number of observations in this case dropped to only 30 and the result is not reported.

[20] We do not include a measure of the marginal damage from pollution since this will be determined by environmental policy.

[21] The index is inverted in the scale from the original data by subtracting values from 10 to make results more intuitive. A number of recent empirical studies of corruption have employed this index, including Persson *et al.* (2000), Fisman and Gatti (2000), and Treisman (2000).

[22] The indicator reflects the statistical compilation of perceptions of the quality of governance of a large number of survey respondents in industrial and developing countries, as well as non-governmental organizations, commercial risk rating agencies, and think-tanks during 1997 and 1998.

to assume that it is to a large extent a function of economic, political and social factors prevailing in a country. **Democracy, Common Law and Racial Tension** serve as instruments. The test of over-identifying restrictions was applied to the various sets of instruments and it indicates these are valid instruments.[23]

## IV. EMPIRICAL RESULTS

The estimation results of the **Environmental Stringency** equation are presented in Table 2. The models contain estimates from 2SLS regressions using different controls. We empirically tested our model for a sample of 74 countries and for a sub-set of 50 developing countries separately. The results support the theory and the estimates appear robust under alternate specifications.

We start by discussing Models 1 and 2 in Table 2. The **Openness** variable is significant across the two models, indicating that countries with more liberal trade policies, thus more economically integrated with the rest of the world, tend to set more stringent environmental policies. This result lends support to our theoretical prediction that economic integration tends to reduce lobbying success by the polluting industry lobby (Prediction 1). The **Political Stability** estimates are negative, and significant at conventional levels in Model 2. This initial result lends some support to our theoretical prediction that increased political instability reduces the bribe offer by the polluter lobby, causing the stringency of environmental policies to increase (Prediction 2).

The positive and significant coefficients for **Openness*Political Stability** are consistent with the predictions of the model. The effects of openness and political stability are interdependent. The results indicate that as the degree of openness rises, so does the stringency of environmental policy, and this is *particularly* true in politically stable countries. The reduction of industry bribery as a result of trade integration is particularly strong when influence-seeking and bribery takes place under predictable (stable) political conditions.

Turning to our control variables, **Corruption** and **Control of Corruption** are significant across Models 1 and 2 with the expected signs, suggesting that a lower level of corruption tends to strengthen environmental policy. The **OECD** country dummy, intended to capture structural differences between countries (not accounted for by **GDP**) is consistently significant through the models. Industrial countries appear to have a greater capacity to implement environmental policy than their developing counterparts. Next, we find that **GDP** and **GDP$^2$** are insignificant. The **OECD** dummy may account for income differences, and the link between income and environmental policy may be indirect, for example via corruption. **Percent Non-Ag. Labor** is significant with a negative sign, indicating that the industry lobby's influence increases in its relative size.

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[23] The order condition necessary for identification is satisfied since both the corruption and the political stability equations are over-identified.

Table 2: Environmental Stringency Equation Regressions
(Two-Stage Least Squares)

| Variable | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| GDP | 0.001<br>(1.3) | 0.001<br>(1.5) | 0.001<br>(1.8)*** | 0.001<br>(1.6)*** |
| $GDP^2$ | -6.85e-09<br>(0.3) | -9.39e-09<br>(0.4) | -2.69e-08<br>(1.1) | -2.58e-08<br>(1.1) |
| Corruption$^+$ | -3.59<br>(3.0)* | | -2.99<br>(2.3)** | |
| Control of Corruption$^+$ | | 8.96<br>(2.1)** | | 10.83<br>(2.3)** |
| OECD | 8.92<br>(2.7)** | 9.86<br>(3.1)* | 5.38<br>(1.6)*** | 5.73<br>(1.7)*** |
| Percent Non-Ag. Labor | -0.10<br>(1.8)*** | -0.08<br>(1.5) | -0.12<br>(2.0)** | -0.09<br>(1.4) |
| Openness | 4.20<br>(4.2)* | 4.13<br>(4.1)* | | |
| Economic Freedom | | | 3.48<br>(3.9)* | 3.39<br>(3.5)* |
| Political Stability$^+$ | -12.77<br>(1.5) | -19.73<br>(2.2)** | -28.53<br>(2.6)** | -42.30<br>(3.4)* |
| Openness* Political Stability$^+$ | 5.80<br>(2.2)** | 7.32<br>(2.9)* | | |
| Economic Freedom* Political Stability$^+$ | | | 4.70<br>(3.3)* | 6.07<br>(4.2)* |
| Constant | 48.17<br>(4.8)* | 23.48<br>(4.5)* | 35.3<br>(3.0)* | 16.34<br>(2.4)** |
| $R^2$ | 0.889 | 0.884 | 0.896 | 0.898 |
| Number of Observations | 74 | 74 | 72 | 72 |

t-statistics in parenthesis
*Statistically significant at 1 percent level
**Statistically significant at 5 percent level
***Statistically significant at 10 percent level
+ predicted (fitted) values

In Models 3 and 4 (Table 2), we use a more comprehensive (general) measure of economic liberalization and openness, the **Economic Freedom** Index, compiled by the Fraser Institute (Gwartney *et al.* (2000)). The **Economic Freedom** index is a composite index of ten individual indices for 1997. It takes values between zero and ten, where a higher value for the index indicates a greater degree of economic liberalization and freedom. The results for **Economic Freedom** and **Economic Freedom*Political Stability** are consistent with the corresponding earlier **Openness** estimates. Moreover, **Political Stability** is significant in both models. The magnitudes are relatively stable across model types.

The developing country results in Table 3 (Models 5-8) support the model's predictions in terms of the impact of **Openness**, **Economic Freedom**, **Political Stability** and their interaction variables on **Environmental Stringency** hold true. The only variable that becomes less significant is **Percent Non-Ag. Labor**, although the sign is consistent with previously reported results. In sum, it appears that our theoretical predictions consistently receive empirical validation using data from the late 1990s, and they appear to apply across different country categories.

## V. Conclusion

This paper develops a theory of how environmental policy formation is affected by the degree of openness to trade and political turbulence. The predictions that emerge are that political uncertainty and trade openness are associated with stricter environmental policies, given that the level of corruption is sufficiently great. Moreover, the effect of trade integration is conditional on the level of political uncertainty. In particular, trade integration raises the stringency of environmental policy, but the effect disappears as the level of political uncertainty increases. The predictions are supported by our empirical findings. The stringency increasing effect on environmental policy of trade integration is greater in politically stable countries.

Several policy implications emerge. First, trade openness not only raises economic growth as discussed in a large recent literature (see, however, Harrison and Hanson (1999), Rodrik (1999)), but also the stringency of environmental policies. It appears that fears of adverse effects of trade liberalization efforts on environmental policies may not be well founded. Second, in order to realize the full effects of trade liberalization, the political system should preferably be relatively stable. This also implies that the success of reform process in countries is contingent to a large extent on the degree of political uncertainty.

Table 3. Environmental Stringency Equation Regressions
(Two-Stage Least Squares) Developing Countries Only

| Variable | Model 5 | Model 6 | Model 7 | Model 8 |
|---|---|---|---|---|
| GDP | 0.0001<br>(0.1) | 0.0001<br>(0.1) | -0.0004<br>(0.3) | -0.0007<br>(0.6) |
| $GDP^2$ | 2.53e-08<br>(0.5) | 3.32e-08<br>(0.6) | 7.64e-08<br>(1.4) | 8.84e-08<br>(1.7)*** |
| Corruption$^+$ | -3.88<br>(3.0)* | | -3.75<br>(2.3)** | |
| Control of Corruption$^+$ | | 10.61<br>(2.9)* | | 13.8<br>(2.7)** |
| Percent Non-Ag. Labor | -0.08<br>(1.4) | -0.06<br>(1.1) | -0.08<br>(1.3) | -0.039<br>(-0.6) |
| Openness | 4.67<br>(4.7)* | 4.51<br>(4.7)* | | |
| Economic Freedom | | | 4.30<br>(4.1)* | 4.25<br>(4.0)* |
| Political Stability$^+$ | -10.09<br>(1.1) | -17.97<br>(1.9)*** | -33.1<br>(1.6)*** | -51.8<br>(2.3)** |
| Openness*<br>Political Stability$^+$ | 4.87<br>(1.7)*** | 6.45<br>(2.3)** | | |
| Economic Freedom*<br>Political Stability$^+$ | | | 5.57<br>(2.0)** | 7.44<br>(2.7)* |
| Constant | 60.13<br>(6.5)* | 35.18<br>(8.2)* | 43.9<br>(3.4)* | 20.1<br>(2.4)* |
| $R^2$ | 0.663 | 0.651 | 0.671 | 0.682 |
| Number of Observations | 50 | 50 | 48 | 48 |

t-statistics in parenthesis
*Statistically significant at 1 percent level
**Statistically significant at 5 percent level
***Statistically significant at 10 percent level
+ predicted (fitted) values

## Variable Definition and Data Sources

| Variable | Definition and Source |
|---|---|
| Environmental Stringency | Captures the extent to which the country has in place institutions and policies that result in effective responses to environmental problems. It takes values between 0 and 100, where a higher value implies greater environmental policy stringency. Source: Center for International Earth Science Information Network (CIESIN), Global Leaders for Tomorrow, and Yale Center for Environmental Law and Policy (2001), "Environmental Sustainability Index," Columbia University, World Economic Forum, and Yale University. The data is available at http://www.ciesin.org/indicators/ESI/pilot_esi.html. |
| GDP | GDP Per Capita (PPP) or Purchasing power adjusted GDP is obtained when GDP is converted to international dollars using purchasing power parity rates. An international dollar thus has the same purchasing power over GDP as the U.S. dollar in the United States. Source: World Development Indicators (2000. |
| Corruption | Corruption Perceptions Index published by Transparency International, describes the level of perceived corruption in the public sector using a poll of political risk indexes. Original scores range from 0 (completely corrupt) to 10 (clean). Average of CPI indexes for years 1997, 1998, and 1999. The index is inverted in scale by subtracting values from 10 to make the results more intuitive. Available at: www.transparency.de/documents/. |
| Control of Corruption | Measures perceptions of corruption in a country, or more precisely, the use of public power for private gain. The index takes values from –2.5 to 2.5, where a higher value implies greater control over corruption. Source: Kaufmann et al. (1999a, 1999b). |
| Political Stability | Measure perceptions of the likelihood that the government in power will be destabilized or overthrown. It takes values from –2.5 to 2.5, where a higher value represents greater political stability. Source: Kaufmann et al. (1999a, 1999b). |
| Openness | Index of trade openness developed by the Heritage Foundation and the Wall Street Journal. It takes a value from 1 to 5. An economy earns a "5" if it has average tariff rate of less than or equal to 4 percentage points and/or has very few non-tariff barriers, and "1" if the average tariff rate is greater than 19 percent and/or there are very high non-tariff barriers that virtually prohibits imports. A greater index number indicates a greater degree of openness. Source: O'Driscoll et al. (2000). |
| Percent Non-Ag. Labor | Proportion of the total labor force recorded as working in non-agricultural sectors. Source: World Development Indicators (2000). |
| Economic Freedom | Measure of economic liberalization and openness compiled by the Fraser Institute. It is a composite index of ten individual indices for 1997 and takes values between zero and ten, where a higher value for the index indicates a greater degree of economic liberalization and freedom. Source: Gwartney et al. (2000). |
| OECD | Dummy OECD countries taking a value 1 if a country is OECD member, 0 otherwise. |
| Democracy | Dummy for countries that have been Democratic in all 46 years between 1950 and 1995, and 0 otherwise. Criteria being 1) the chief executive is elected; 2) at least one legislature is elected; 3) more than one party contests elections; 4) at least one turnover of power between parties in last three elections. Source: Alvarez et al. (1996) |
| Common Law | Dummy for countries with company law or commercial code based on English common law. Source: La Porta et al. (1997). |
| Racial Tension | Dummy for countries experiencing racial tension. It takes values from 1 (low tension) to 6 (high tension). Source: Knack and Keefer (1995). |

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