Does Improved Governance Contribute to Sustainable Forest Management?

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SUMMARY. This paper explores the hypothesis that improving governance is beneficial in reducing deforestation. The hypothesis is tested by including six objectively constructed measures of governance as explanatory variables in an econometric model of the causes of deforestation. Analysis of cross-section data for 90 countries shows an indirect but strong impact of governance on deforestation, working through per capita income. However, the evidence to support a *direct* beneficial impact of improved governance on deforestation is quite weak. The paper argues that if the main objective is to reduce deforestation especially in the short run then undertaking reforms directly related to the forest sector such as in the areas of forest policy, scientific forest management, and forest law enforcement and compliance are likely to be the most effective both in terms of cost and outcomes. However, improving overall governance should not be ignored as it is likely to yield long term bene-

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The views expressed in this paper are strictly the authors' and do not necessarily reflect those of the World Bank or any of its affiliated agencies. Helpful comments from the participants at the Yale conference and an anonymous referee are acknowledged.

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[Haworth co-indexing entry note]: "Does Improved Governance Contribute to Sustainable Forest Management?." Kishor, Nalin, and Arati Belle. Co-published simultaneously in *Journal of Sustainable Forestry* (Food Products Press, an imprint of The Haworth Press, Inc.) Vol. 19, No. 1/2/3, 2004, pp. 55-79; and: *Cutting Crime: Strategies for Addressing Illegal Logging in the Tropics* (ed: Ramsay M. Ravenel, Ilmi M. E. Granoff, and Carrie Magee) Food Products Press, an imprint of The Haworth Press, Inc., 2004, pp. 55-79. Single or multiple copies of this article are available for a fee from The Haworth Document Delivery Service [1-800-HAWORTH, 9:00 a.m. - 5:00 p.m. (EST). E-mail address: docdelivery@haworthpress.com].

http://www.haworthpress.com/web/JSF

Digital Object Identifier: 10.1300/J091v19n01_04

fits including enhanced effectiveness of reforms within the forestry sector.

KEYWORDS. Deforestation, illegal logging, forest policy, scientific forest management, tenure, governance, corruption, rule of law

THE PROBLEM: THE NATURE AND IMPACT OF FOREST CRIMES

The problem of illegal logging and corruption and other forest crimes such as wildlife poaching, trade in endangered species, arson and theft, is global and pervasive. Examples of illegal practices in the forestry sector include: unlawful occupation of forest land by rural families or corporations, international trade in protected species, logging outside concession boundaries, logging in protected areas, undergrading and misclassifying species, timber smuggling, transfer pricing in timber trade, timber processing without a license, etc. (Contreras, 2002). Furthermore, illegal acts and forest crimes of various kinds are common everywhere, in developing as well as developed nations, and in all major forest types–tropical, temperate and boreal (Callister, 1999, Contreras, 2002).

Recent estimates indicate that as much as 15% of global timber trade involves illegalities and corrupt practices. A case study of timber trade shows that illegally harvested ramin can be purchased in Indonesia for about US$20/m3 and (after being routed through Malaysia and Singapore) is sold to high-end users in the USA for US$1,000/$m^3$ (EIA, 2001). Illegal logging in public lands worldwide is estimated to cause losses in assets and revenue in excess of US$10 billion annually (Baird, 2001).

Some examples of forest crimes at the country level include (Contreras, 2002, Glastra, 1999):

- Canada, where violations were detected in 55% of areas designated for protection,
- Brazil, where a presidential commission concluded that fully 71% of the management plans in concessions did not comply with the law
- Russia, where 20% of timber logged is in violation of the law,
- PNG, where $20 million a year were being lost to illegal practices,
- Cambodia, where only 10% of logging was legal (estimate for 1997),
- Cameroon, where one-third of the timber cut was undeclared (estimate for 1992-93).

Forest crimes pose a threat to the sustainable management of forest resources everywhere. They also lead to a leakage of resources (tax revenues in particular) that legitimately belong in the government treasury. A low-end estimate of the royalties, reforestation fund and export taxes payments that are not being paid to the Government of Indonesia on stolen timber amount to US$ 600 million per annum. This amount is more than twice what the government spent on subsidized food programs for the poor in 2001 (Baird, 2001). In addition, illegal logging and other forest crimes put at risk the livelihoods of the poor and directly threaten ecosystems and biodiversity in protected areas and parks across the world (Contreras, 2002, Thomas et al., 2000). In overall terms, poor governance and weak law and order is likely to contribute to accelerated deforestation and forest degradation.

Efforts by international development agencies at assisting client countries to control illegal logging and improve governance in the sector have had limited success in slowing down deforestation. The constraints to effective action stem from several factors: a weak and resource constrained forest department; vested interest groups, particularly commercial ones; weak or nonexistent voice/participation of critical stakeholders; poor rule of law and ineffective judicial and police systems; paucity of useful information, and the lack of high-level political commitment, regional cooperation and collaboration among the producing and consuming nations.

Effectiveness of measures within the forestry sector is likely to be compromised if the quality of overall governance in the economy is poor, particularly if the forestry sector is large and has strong linkages with the rest of the economy. However, regardless of whether the forestry sector is large or small, one would expect that the probability of success of reforms aimed at improving governance in the sector is highest if they are accompanied by economy-wide reforms aimed at improving overall governance. Otherwise, following Gresham's Law-which states that if counterfeit money is not controlled, it will supplant legal tender and lead to monetary anarchy-bad practices will likely drive away the good policies (Johnston and Doig, 1999, World Bank, 1997).

The basic aim of this paper is to quantitatively explore some of these ideas by analyzing cross-section data on deforestation for 90 countries. The paper will estimate an econometric model of the causes of deforestation, but will depart from traditional models in an important way, by testing six different measures of governance as explanatory variables. Here governance is "unbundled" into six main measurable components: Rule of law, Control of corruption, Government effectiveness, Lack of Regulatory Burden, Voice and Accountability, and Political Stability and lack of Violence. Governance measures are defined in detail in section III of the paper.

There are several advantages to this approach. First, the model will enable a valuable insight into the relative contribution of "traditional" variables (such

as per capita incomes, population density, and roads) vis-à-vis governance and corruption, to deforestation. This will be useful in prioritizing policy reform options. Second, the model will indicate which among the six governance measures have the most impact on deforestation. In turn this can identify areas of governance most requiring improvement and attention. Finally (apart from the information revealed from the empirical regularities), the statistical approach will help identify the "outliers". Analysis of the outliers will yield valuable insights in both types of countries–those characterized by–poor quality of governance and low levels of deforestation and those characterized by high quality of governance with high deforestation.

THE FRAMEWORK AND THE "DRAMATIS PERSONAE"

Forests provide multiple benefits to a multitude of users. If not carefully managed, this multiplicity of users can create situations of conflict leading to resource misuse. Thus, Sustainable Forest Management (SFM) (defined from the broad perspective of preserving all ecosystem services for the present and all future generations) requires attention to a range of issues (legislation, property rights capacity to implement, etc., for example) and the need to involve a number of actors (government, local stakeholders, NGOs, private sector, etc.). This has two important implications for the design of strategic approaches. First, the overall state of governance is one of several critical sets of factors determining outcomes in the sector (Kaimowitz, 2001, Kaimowitz and Angelsen, 1999). In other words, while improvement in governance is a necessary condition for SFM it cannot be sufficient by itself. But, by the same token, governance issues cannot be ignored otherwise the success of other reform efforts in forestry will likely be short-lived. And second, several stakeholders will need to be involved in any realistic strategy aimed at improving governance. In other words, any effective strategy to promote lasting SFM will likely require a multi-pronged approach (Kishor, 2002).

Figure 1 illustrates conceptually the 4 major sets of factors–forest policy, scientific forest management, overall governance, and specific forest law enforcement–which collectively influence SFM.

A comprehensive strategy to promote SFM will therefore require action on 4 fronts:

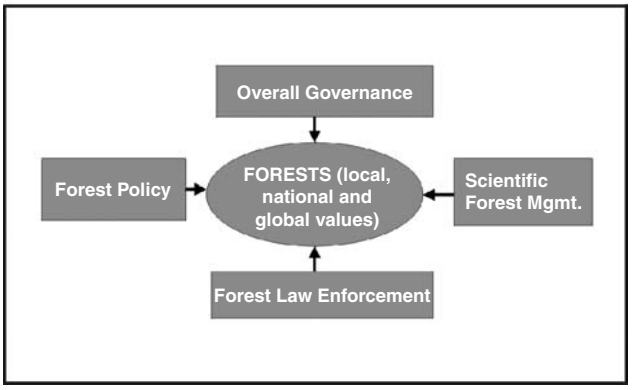
i. Actions to promote sustainable forest management via forest policy reforms;
ii. Actions to encourage adoption of scientific forest management techniques;
iii. Actions to promote a better overall quality of governance in the economy; and,

iv. Actions to improve law enforcement and promote specific anticorruption efforts in the forestry sector.

Key actions in the area of *forest policy* include: Clarification of property rights, setting the right level of taxes and royalties, use of market-based instruments, etc. Well-designed forest policies can simultaneously achieve economic and environmental and conservation objectives, at the same time as strengthening compliance and easing the problem of law enforcement (Magrath and Grandalski, 2001). Rational, reasonable and enforceable forest policies are necessary to ensure that other measures to improve governance and reduce corruption have positive and lasting impacts. For example, if there is excessive reliance on command and control type approaches in policy, enforcement is likely to be problematic. Reforming policy in the direction of greater use of market-based instruments will simultaneously make for a better climate of governance. As another illustration, ensuring that property rights to land are clear and non-controversial will enable the rule of law to be implemented effectively and prevent the abuse of forest lands. It is also important to note that the issue is not simply of designing better forest policy but also policy which can be translated into easily enforceable legislation with minimum scope for controversial and discretionary interpretation (Rosenbaum, 2002, Bekhechi, 2001).

Scientific forest management plans must be based on a careful consideration of management objectives, an assessment and inventory of the resource base and its projected trajectory, an estimation of a budget and resource requirements, and provision for evaluation and plan revisions. However, an ITTO study indicated that the extent of tropical forests being managed under

FIGURE 1. Factors Impacting Forests



sustainable yield systems was negligible (Poore, 1989). An assessment a decade later found that while significant progress had been made, the challenges of full and coordinated implementation of management plans remained inadequately addressed (ITTO, 2000). It is clear that poor quality of routine forest management will have serious repercussions on SFM. Improving the quality of forest management also reduces the scope for forest crimes such as logging in excess of allowable cuts, logging in vulnerable areas, etc. (bin Buang, 2001, Magrath and Grandalski, 2001). "Win-win" examples of the sort described above need to be identified, and the synergy they offer to counter forest crimes exploited to the full, while developing a strategy to fight corruption and improve governance in forestry to promote SFM.

Improving the *overall quality of governance* requires a system of checks and balances in society that restricts arbitrary actions and bureaucratic harassment, and promotes voice and participation by the population (Thomas et al., 2000). Equally importantly, it reduces the scope for the elite to "capture" the state to serve their own interests, and fosters the rule of law. In theory reforms may be necessary in several areas and a practical approach rests on a thorough examination of the actual situation with respect to: the structure of government, political accountability, a competitive private sector, quality of management of the public sector and the status of civil society with respect to voice and participation. In particular, there is widespread agreement that corruption is a fundamental symptom of public sector malfunction and public sector reforms are a key component in any anticorruption approach (World Bank, 2000).

Finally, SFM will include a specific *forest law enforcement and compliance system*. A recent and important body of work focuses at the impacts of specific monitoring and law enforcement initiatives as applying exclusively to the forest sector. The main message emerging from this literature is that specific steps within forestry to improve monitoring and enforcement aimed at controlling forest crimes do matter. But these are not sufficient in of themselves to ensure compliance and other prerequisite steps are necessary (Magrath and Grandalski, 2001, Melle and Beck, 2001). These (precursive) steps consist of making improvements in forest policy, forest management regimes, and governance. In this context, forest law enforcement is seen as a supplement to poor policies, poor management and weak governance and institutions. The three most important components of a forest law enforcement system are prevention, detection and suppression: (i) Prevention includes actions geared to reducing the opportunities for illegal acts such as the formulation of good management plans, reduction in discretionary powers of forest officials, encouraging whistleblowers, etc.; (ii) *Detection* includes monitoring and surveillance to determine if and where crime is occurring. This kind of information is crucial for setting priorities and for evaluating other elements of the enforcement program, and (iii) *Suppression* almost inevitably involves the use of

force after unlawful activities have occurred, or while they are underway. Suppression of illegal activity should be the last recourse in a forest law enforcement program, because suppression measures pose risks to agency personnel, the public, and the lawbreaker (Magrath and Grandalski, 2001).

GOVERNANCE DEMYSTIFIED

What is Governance? And Corruption?

Governance is defined as the manner in which power is exercised in the management of a country's economic and social resources. Good governance is epitomized by predictable, open, and enlightened policymaking (that is, transparent processes); a bureaucracy imbued with a professional ethos; an executive arm of government accountable for its actions; and a strong civil society participating in public affairs; and all behaving under the rule of law (World Bank, 2000). Governance encompasses the capacity to formulate and implement sound policies, and the respect of the citizens and the state for the institutions that govern economic and social interactions among them. It also includes the process of selecting, monitoring and replacing governments (Kaufmann et al., 1999a, 1999b).

It is important to emphasize that governance is not just about the organization, the employees and the policies of the apparatus of government of a country–it extends far beyond that to include the key role and contributions of other stakeholders as well-e.g., the role of civil society in electing a government, the role of the private sector in complying with rules and regulations governing concession management, etc. This point assumes critical importance in any strategy for improving governance. Thus, improvements in governance can and indeed should be the responsibility of all stakeholders-government policymakers, private sector executives, parliamentarians, academics, and civil society at large. Any strategy to improve governance needs to be multi-pronged (Thomas et al., 2000).

Corruption by contrast is commonly defined to be the abuse of public office for private gain or for the benefit of a group to which one owes allegiance (Bardhan, 1997). Corruption is most often associated with misuse of power by civil servants and politicians but it can exist in any situation where there is misuse of power (Stapenhurst and Kpundeh, 1997). However, corruption is usually not a cause but a symptom of the weakness of the state and indicates the need for institutional reforms for its control.

Unbundling Governance and Measuring its Quality

Starting with the broad notion of governance as defined above, governance can be logically subdivided into six main measurable components: Rule of

law, Control of corruption, Government effectiveness, Lack of regulatory burden, Voice and accountability, and Political stability and lack of violence (Kaufmann et al., 1999a).

Rule of law–The rule of law is best defined as the opposite of the rule by powerful men or women. Rule of law includes issues such as the protection of property rights, enforceability of contracts, and maintaining the effectiveness and independence of the judiciary, and the perceptions of the incidence of both violent and nonviolent crimes. In overall terms this component refers to that aspect of governance that measures the success of a society in developing an environment in which fair and predictable rules form the basis for economic and social interactions.

Control of corruption (or graft)–The presence of corruption is often a manifestation of a lack of respect, on part of both the one who corrupts and the one who is corrupted, for the societal rules governing the interaction between the two. The existence of corruption itself is often seen as a symptom of weak or poor governance and this component measures the perception of corruption by society.

Government effectiveness–This component focuses on the quality of policymaking and refers to the "inputs" required for the government to be able to formulate and implement good policies and to deliver public services. This combines perceptions of the quality of provision of public services, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of government commitment to its policies.

Lack of regulatory burden–This component focuses on the content of the policies themselves. It includes measures of the incidence of market unfriendly policies such as price controls and inadequate bank supervision, as well as the perceptions of burdens imposed by excessive regulation in areas such as environmental management, foreign trade and business development.

Voice and accountability–This includes indicators of governance dealing with various aspects of the political process, civil liberties, political rights, and the freedom of the press. This component measures the extent to which the citizens of a country are able to participate in the selection and the running of governments. This also includes the independence of the media that plays an important role in monitoring and holding accountable those in authority.

Political stability and lack of violence–This includes indicators that measure perceptions of the likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means. This component captures the idea that the quality of governance in a country may be compromised by the likelihood of "catastrophic" changes in government that have a direct impact on the continuity of policies.

Empirical Measurement of the Quality of Governance

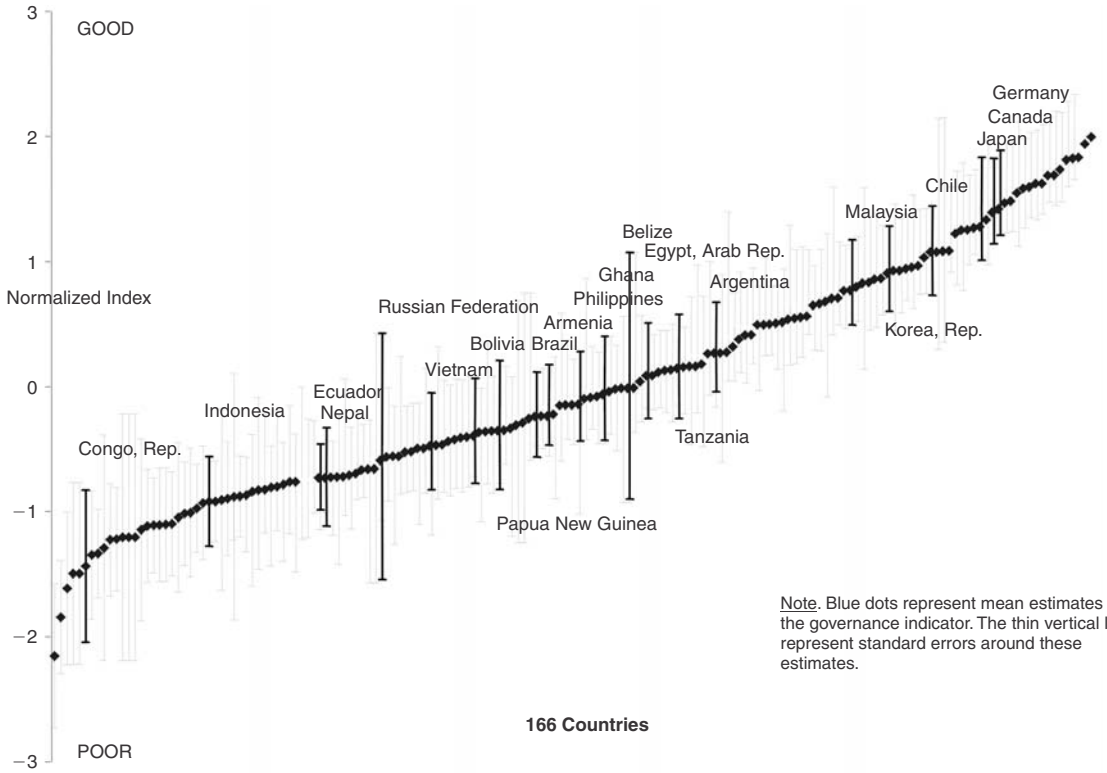
Unbundling "governance" into its key components is useful for several reasons:

i. It enables more precision in policy discussions of which aspects of governance require most improvement and attention, and to identify specific steps through which that might be achieved;
ii. By allowing for a relatively precise measure of its components it enables a benchmarking of the quality of governance in a country, and to track the changes in its quality over time;
iii. It enables a statistical analysis of how the quality of governance impacts upon desired developmental outcomes such as increase in per capita incomes, reduction in infant mortality, increases in literacy, reduction in deforestation and expansion of area under sustainable forest management, control of pollution, etc.;
iv. It allows for a comparison of the development experience across countries. In particular, the linkages between governance and development outcomes will likely yield a useful learning experience from cross-country analysis.

Kaufmann et al. (1999a, 1999b) have analyzed hundreds of cross-country indicators as proxies for various aspects of governance. These are based on more than 150 measures produced by more than 12 different organizations. They are drawn from various published and unpublished sources spanning private forecasting and business risk organizations, think-tanks and other NGOs. They include the results of surveys carried out by multilateral and other organizations such as the Business Environment Risk Intelligence, Standard and Poors, European Bank for Reconstruction and Development, Economist Intelligence Unit, Freedom House, etc. They are based on surveys of experts, firms and citizens and cover a wide range of topics: perceptions of political stability and the business climate, views on the efficiency of public service provision, opinions on respect for the rule of law, and perceptions of corruption.

As an illustration of this approach we present the results for the measurement of the rule-of-law (See Figure 2). Included in this measure are aspects

FIGURE 2. Country Performance on the Rule of Law Index



Note. Blue dots represent mean estimates for the governance indicator. The thin vertical lines represent standard errors around these estimates.

Source: "Governance Matters" by Daniel Kaufmann, Aart Kraay and Pablo Zoido-Lobaton, May 1999 (Kaufmann et al., 1999b). http://www.imf.org/external/pubs/ft/fandd/2000/06/kauf.htm.

such as the enforceability of contracts, variability in the application of the rule of law applied across groups within the country, police effectiveness in safeguarding personal property, size of a black market, etc. In the figure, countries are ordered along the horizontal axis according to their rankings, while the vertical axis indicates the estimates of the rule of law for each country. The vertical bars represent the country specific confidence intervals (margins of error) for the point estimate for rule of law. Note that this measure (and the other five also) have been scaled to lie between −2.5 and +2.5, and oriented so that higher values correspond to better outcomes.

The margins of error can be considerable and rather than a strict ranking (based on imprecise point estimates) it is deemed more useful to classify countries into three color-coded groups. The red light group consists of those countries that should be considered to be in a crisis of governance characterized in this example by a significant lack of operation of the rule of law (for example, Bangladesh, Ecuador, Guatemala, Indonesia, Myanmar, Russian Federation). The yellow light group characterizes those countries which are vulnerable or at risk of falling into a governance crisis (Argentina, Brazil, Ghana, PNG, Tanzania). And finally, the green light group of countries may be said to have a robust rule of law component of governance and not likely to be at risk of reverting into a crisis situation (Chile, Malaysia, Japan, S. Korea, Canada, Germany, US. The traffic lights approach is useful in identifying the most vulnerable countries that should be high priority for reforms aimed at improving governance (Thomas et al., 2000).

The Development Dividend of Improving the Quality of Governance

Development outcomes such as increases in per capita income, reductions in child mortality, and increases in literacy have been statistically examined with the data on governance measures and development outcomes. The empirical analysis suggests that the direct impact of better governance resulting in better development outcomes is large (Kaufmann et al., 1999a, 1999b,Thomas et al., 2000). As an illustration consider an improvement (of one standard deviation) in the rule of law from the low level in the Russian Federation today to the middling level in the Czech Republic or a similar reduction in corruption from that in Indonesia to that in South Korea. This is associated with an increase in per capita incomes by two to four times, a reduction in infant mortality by a similar magnitude, and an improvement in literacy by 15 to 25 percent points in the long run. Consider also that much larger improvements in governance from the levels in Tajikistan (in the red light group) to those in Chile (green light group) are associated with a near doubling of the development impacts mentioned above.

The relationship between various development outcomes and four measures of governance are illustrated in Figure 3. The heights of the vertical bars show the differences in development outcomes with weak, average and strong governance and illustrate the strong correlation between good outcomes and good governance. The solid lines represent the estimated impact of improving governance on development outcomes-the "development dividend" from governance. This evidence provides strong support for the argument that improving governance is of crucial importance for developing countries.

DATA ANALYSIS

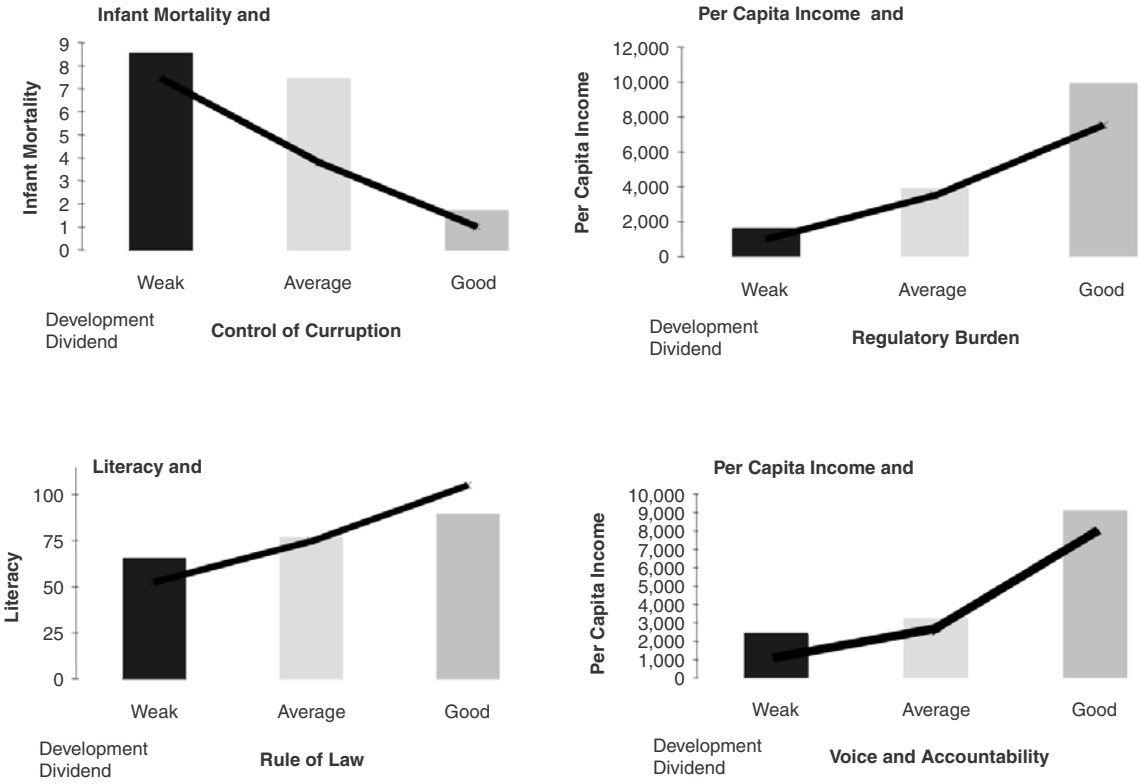
Models of Deforestation

Studies on the causes of deforestation abound in the literature. Given our interest in exploring policy options to control deforestation, however, it is neither our intention nor our task to do an extensive literature review. For this, the interested reader can go to a recent and comprehensive review by Kaimowitz and Angelsen (1999). Instead, we will focus on the literature that deals specifically with the relationship between governance and deforestation.

While extensive concern has been raised regarding the impact of governance on deforestation, few attempts have been made at a careful analysis and measurement of this relationship. Part of the reason may stem from the difficulty in getting objective measures of governance (which we try to address in this paper). However, the study by Deacon is a good attempt (Deacon, 1994). Using cross-country data he tests the hypothesis that insecure ownership exacerbates deforestation. He finds consistent associations between deforestation and political variables (such as constitutional changes, guerilla warfare and revolutions) reflecting insecure ownership. However, the estimates are not very robust and the author suggests the need for better data and better model building (particularly to test for the exogeneity of the political attributes). Shafik (1997), however, concludes that vesting clear property rights increases deforestation. Mainardi (1996) concludes that deforestation is likely to be more in countries that are politically unstable. Similarly, Didia (1997) concludes that democracies are characterized by lower deforestation. Palo (2001) uses Transparency International's Corruption Perception Index as an explanatory variable in a cross-country regression equation for deforestation (using the ratio of forest to non-forest area as the dependent variable). For a sample of 36 tropical countries, the coefficient was found to be significant at the 10% level. The coefficient indicates that a 10% improvement in the Corruption Perception Index will increase the ratio of forest to non-forest area by 5%.

The results from these studies generally support the hypothesis that improvements in governance reduce deforestation. However, we build on the

FIGURE 3. The Development Dividend of Good Governance



Note: The bars depict the simple correlation between good governance and development outcomes. The line predicted value when taking into account the causality effects ("Development Dividend") from improved governance to development outcomes (Drawn from Thomas et al., 2000).

previous work by refining the model, particularly through the use of more comprehensive and objectively constructed measures of governance in order to test our hypotheses rigorously.

The Variables and Sample Size

The dependent variable used in the analysis is the annual average rate of deforestation between 1990 and 2000. This variable is taken from the FAO estimates, as reported in the World Development Indicators. We examine 15 basic explanatory variables. The econometric estimates also test the significance of quadratic terms (for income and rural population density), several interaction terms, and dummy variables as explanatory variables. In addition to the six governance measures described in section III above, we also include per capita income, percentage rural population, rural population density, geographical region (1-6), forest type (tropical/others), total roads, globalization, trade openness, and a proxy for government commitment to forest protection. The list of variables, their definition and sources are given in the table in Annex 1.

The total sample size of 90 countries breaks down as follows: Africa (26), East Asia and the Pacific (12), Europe and Central Asia (30), Latin America (18), South Asia (2) North America (2). Only four countries in the sample (Togo, Albania, Macedonia and Fiji) have forested areas of less than 10,000 hectares. 19 countries have a 1995 per capita income of more than US$10,000 per annum. Table 1 below reports the descriptive statistics for the data.

The rate of deforestation ranges from a maximum of 3.11% p.a. in the case of Cote d'Ivoire, to a minimum of −1.7% in the case of Portugal. In general the range of dispersion for most variables indicates that this is likely to be a representative sample of countries.

A First Cut at the Role of Governance

A correlation matrix for the data shows that the simple correlation coefficient between deforestation per annum and governance ranges from −0.22 in the case of regulatory burden to-−0.43 in the case of political stability (and rule of law). Thus, at first blush it appears that an improvement in any of the six dimensions of governance is likely to reduce deforestation.

This finding is corroborated when we estimate a simple linear regression for each of the six variables, on deforestation rates. In each case the coefficient for the independent variable is negative and significant at the 5% level (see table in Annex 2).

The Full Econometric Analysis

To recap, we are interested in testing the hypothesis that our various measures of overall governance impact the forestry sector. Our a *priori* expecta-

TABLE 1. Descriptive Statistics for Model Variables.

Variable	Abbreviated Name	Mean	Standard Deviation	Minimum Value	Maximum Value
Percentage rate of deforestation per annum	Dfpa	0.45	0.94	-1.70	3.11
Area deforested per annum	Dfarpa	846.82	3642.83	−18063.00	22264.00
Per Capita Income in 1995	Pppcy95	7404.62	7638.15	474.00	28274.00
Rural Population Density	Popdenrur95	324.7345	653.23	5.74	6021.4
Government Commitment for Forest Protection	Forprot	9.44	8.15	0.00	43.09
Total Roads Network	Roads	256662.90	741804.10	3370.00	6296107.00
Rural Populationa as a % of total population	Rurpop	46.01	21.12	3.00	87.50
Globalization	Globalness	31.01	24.90	2.01	137.12
Trade Openness	Openess	2.84	1.15	1.00	5.00
Voice and Accountability	Voice	0.27	0.87	−1.62	1.69
Political Stability and Lack of Violence	Polstability	−0.02	0.90	−2.59	1.69
Government Effectiveness	Goveffect	0.07	0.84	−1.77	1.99
Lack of Regulatory Burden	Regburden	0.21	0.66	−2.34	1.21
Control of Corruption and Graft	Corrupgraft	0.03	0.90	−1.56	2.09
Rule of Law	Rulelaw	0.02	0.92	−2.15	2.00

tion is that an improvement in governance will have a positive impact in reducing deforestation. The preliminary analysis suggests that indeed governance does matter for forest management. But this is clearly only a partial picture. Section II of the paper points out that deforestation is likely to be affected by a large number of factors. Moreover, at a conceptual level, these relationships are likely to be complex and two-way, direct and indirect, and strong and diffuse (Kaimowitz and Angelsen, 1999). Thus, we need to incorporate several other explanatory variables in our regression estimates in order to test in a robust manner whether governance matters. To the extent that reliable measures are available, these will be included in the econometric equations being estimated.

As a starting point, deforestation is regressed on all the variables of interest in our sample-including the square of the per capita income-for the entire sample of 90 countries. The results are reported in panel 3.1 of Annex 3. The overall explanatory power of the model is reasonable ($R^2 = 0.48$). However, *none of the 6 governance coefficients are statistically significant*. Only three coefficients are significant at 10% or less: per capital income, the square of per capita income, and the total road network.

In a regression using the area deforested as the dependent variable, the coefficient of per capita income (PPPCY95) is negative and that for the square of per capita income (PPCY95SQ) is positive. This casts doubt on the "Kuznets curve" hypothesis for this sector and turns out to be an important (and robust) finding of the present analysis (results available upon request). The Kuznets hypothesis states that as incomes rise, deforestation will fall after an initial increase, at a certain threshold level of income. For this to happen, the coefficient of the income variable should be positive and the coefficient of the square of the income term should be negative-just the reverse of our estimates.

The coefficient for the road network is significant, but unexpectedly has a negative sign. A *priori*, one would expect that more roads would lead to greater clearing of forestlands. One explanation for the unexpected sign on the road variable is that because of data unavailability, we measure the total road network in a country rather than the road network in forest areas. The latter variable may still be relevant to deforestation rates.

The apparent contradiction between a reasonable overall R^2 and individual coefficients that are mostly insignificant suggests multicollinearity among the explanatory variables. Multicollinearity occurs when explanatory variables predict each other and do not have individual explanatory power. The simple correlation matrix for this data indicates a very high degree of collinearity among our 6 governance variables with the simple correlation coefficient ranging from 0.71 to 0.94. This suggests that multicollinearity is a likely problem: dropping some of these variables may correct the problem. Changing the sample size is yet another option: this has been explored by regressing on a subset of the sample but the results were not favorable. Because of this problem of multicollinearity, subsequent regressions use only one out of the six governance measures. Various combinations of the governance variables were tried but none were statistically significant when income and the square of income were included as explanatory variables (results available upon request from authors). With the qualification that the results come out much the same no matter which governance measure is tried, the rest of the analysis in this paper will focus on exploring the function of voice and accountability (VOICE) on the rate of deforestation.

The simple correlation coefficients between per capita income (PPPCY95) and the governance measures are also high, ranging from 0.62 to 0.85. They are also almost as highly correlated with the square of the per capita income. This was to be expected and it is consistent with the finding that improvement in governance leads to large increases in incomes, the so-called "development dividend" story discussed in section III above. In this data sample, regressing per capita income on the governance measures individually yields high R^2 (these range from 0.39 to 0.73) and coefficients that are significant at 1%

level, thus corroborating the Kaufman et al. (1999b) results. (results available upon request from authors).

These findings suggest that governance variables are likely to have an *indirect* impact on deforestation, through the per capita income variable. But does governance have a *direct* impact on deforestation? In order to test this hypothesis, we first "purged" the influence of income by regressing deforestation on income and the square of income and calculating the residuals. In the second step, these estimated residuals (DFPARES) from the first regression equation were regressed on the other explanatory variables plus one governance measure in turn.

The regression equation for VOICE is reported in Annex 3.2. The coefficient for VOICE is not statistically significant. The only significant variable is DUM3 (which takes the value 1 if a country is in the Europe or Central Asia region, and 0 otherwise), with a negative sign, indicating that, all else equal, if a country belongs to the ECA region it is likely to experience less deforestation. Qualitatively similar results are obtained when VOICE is replaced by other measures of governance. Thus, in overall terms the message emerging from this data analysis is that governance measures do not have a direct impact on deforestation but a favorable indirect impact cannot be ruled out.

An additional test of whether governance has a direct impact on deforestation was conducted as follows: the most favorable conditions under which this could happen are provided by: (i) not purging the influence of per capita income from DFPA (the dependent variable), and (ii) not including per capita income as an explanatory variable. Annex 3.3 reports the regression equation using VOICE as one of the explanatory variables. The coefficient of VOICE has a negative sign but is not statistically significant. Only two variables are statistically significant. First, RURPOP (which is the proportion of total population residing in rural areas) has a positive sign-indicating that a higher proportion of population living in the rural areas, other things being equal, is likely to lead to greater deforestation. And second, DUM3, has a negative sign-indicating that if a country belongs to the ECA region, all else equal, it is likely to experience less deforestation.

CONCLUDING REMARKS

To test the basic hypothesis that improving governance has a favorable impact in reducing deforestation, we have performed a variety of statistical analyses on a cross-country dataset for 90 countries. This dataset is unique from others in the literature in that it includes six objectively constructed variables which measure various aspects of governance such as the strength of the rule of law and the extent of civil liberties including the freedom of the press-as-

pects which are expected to impact deforestation. Our main conclusion is that, with these measures of governance and with the econometric approach adopted, we find little evidence of a *direct* impact of governance on deforestation.

However, two findings from our data analysis are significant. First, income has a statistically significant and negative impact on deforestation, i.e., rising incomes are likely to reduce the rate of deforestation. Second, the governance measures used in this study have a statistically significant and quantitatively large impact in increasing incomes-i.e., improving governance may act as a catalyst to increasing incomes. These two findings taken together imply that *improving governance may have an indirect but strong impact on curbing deforestation*.

The lack of support for a direct impact of governance variables on deforestation is consistent with the notion that governance is a macro-level variable-or an "underlying variable" (Kaimowitz and Angelsen 1999)-and as such, its impact on the forestry sector a *priori* is expected to be diffuse and uncertain. Our findings are also consistent with a "targets and instruments" approach, which states that the best policy levers are those that have (or are thought to have) the most direct impacts on the chosen targets. In our case this approach would suggest that if the main objective is to reduce deforestation in the short run then undertaking steps most specific to the forestry sector are likely to be the most effective both in terms of cost and outcomes. Our review of the literature suggests that specific strategies include reforms in forest policy, scientific forest management, and forest law enforcement and compliance. In the present analysis, variables such as government commitment to forest protection, extent of globalization, trade openness, rural population as a percentage of total population, rural population density were included as proxies for these direct policy options. Only the rural population density variable proved to be statistically significant (equation 3.3 in Annex 3) and with the expected sign, thus providing support for the targets and instruments approach.

The measures used here are indeed incomplete and imprecise and much more analytical rigor is required. As such, the results in this paper should be treated as preliminary. A key research effort in the future is to collect more and better data on variables measuring sector-specific actions of the type mentioned in section II of the paper (indicators of forest policy, scientific forest management and forest law enforcement). Such data would enable more rigorous testing of the hypotheses proposed in this paper. It is also important to note that, in addition to refining the formal econometric model, it is crucial to cross-check our findings against site specific surveys and country case-studies (Kaimowitz and Angelsen 1999). This also includes an analysis of "outliers" referred to but not pursued in this paper.

Despite the lack of evidence of direct impacts of governance on deforestation, efforts must be made to continually improve the quality of overall gover-

nance in any economy, for at least two reasons. First, good governance acts as a catalyst for many desirable social and economic outcomes such as improvements in literacy and child mortality rates, and a sharper rise in growth and incomes. In turn, at least some of these, particularly growth in incomes, have been shown as having beneficial impacts in controlling deforestation. And second we should not forget Gresham's law, which in the context of governance is to be interpreted as stating that an overall environment of poor governance will likely drive out good policies. Thus, in the long run, policy reforms in the forestry sector will likely have a better chance of being implemented and have lasting impacts in a situation of better overall governance in the economy.

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APPENDIX 1. Variable Definition and Data Sources

Variable & Acronym	Description and Source
Annual % rate of Deforestation (**DFPA**)	Average annual deforestation refers to the permanent conversion of natural forest area to other uses, including shifting cultivation, permanent agriculture, ranching, settlements, and infrastructure development. Deforested areas do not include areas logged but intended for regeneration or areas degraded by fuelwood gathering, acid precipitation, or forest fires. This covers the period 1990 to 2000. Negative numbers indicate an increase in forest area. Drawn from the World Development Indicators (WDI).
Per Capita Income (**PPPCY95**)	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current international dollars for 1995.
Rural Population Density (**POPDENRUR95**)	Rural population density is the rural population divided by the arable land area. Rural population is calculated as the difference between the total population and the urban population. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. The information is taken from the WDI for 1995.
Total roads network (**ROADS**)	Total road network includes motorways, highways, and main or national roads, secondary or regional roads, and all other roads in a country, for 1995. For more information, see WDI.

APPENDIX 1 (continued)

Variable & Acronym	Description and Source
Rural Population as a % of total (**RURPOP**)	Rural population is calculated as the difference between the total population and the urban population, for 1995. For more information, see WDI.
Globalization (**GLOBALNESS**)	Trade in goods as a share of PPP GDP is the sum of merchandise exports and imports measured in current U.S. dollars divided by the value of GDP converted to international dollars using purchasing power parity rates (see WDI table 1.1 for a discussion of PPP). For more information, see WDI.
Government commitment to protect forests (**FORPROT**)	Nationally protected areas are totally or partially protected areas of at least 1,000 hectares that are designated as national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes and seascapes, or scientific reserves with limited public access. The data do not include sites protected under local or provincial law. Total land area is used to calculate the percentage of total area protected. For more information, see WDI.
Trade Openness (**OPENESS**)	Index of trade openness developed by the Heritage Foundation and the Wall Street Journal. It takes a value between 1 and 5 with higher values representing greater openness. An economy earns "5" if it has an average tariff rate of less than or equal to four percentage points and/or has very few non-tariff barriers; and "1" if the average tariff rate is greater than 19% and there are very high non-tariff barriers that virtually prohibit exports.
Regional Dummy Variables (**DUM1, DUM2, DUM3, DUM4, DUM5**)	Dum1=1 if country is from the Africa region, 0 otherwise; Dum2=1 if country is from the East Asia and Pacific region, 0 otherwise, Dum3=1 if country is from the Europe and Central Asia region, 0 otherwise; Dum4=1 if country is from the Latin America and the Caribbean region, 0 otherwise; Dum5=1 if country is from the South Asia region, 0 otherwise.
Voice and Accountability (**VOICE**)	Definition given in main text. Scaled to lie between -2.5 and +2,5 with higher values corresponding to better outcomes (Kaufmann et al. 1999a)
Political Stability and Lack of Violence (**POLSTABILITY**)	Definition given in main text. Scaled to lie between -2.5 and +2,5 with higher values corresponding to better outcomes (Kaufmann et al. 1999a)
Government Effectiveness (**GOVEFFEC**T)	Definition given in main text. Scaled to lie between -2.5 and +2,5 with higher values corresponding to better outcomes (Kaufmann et al. 1999a)
Lack of Regulatory Burden (**REGBURDEN**)	Definition given in main text. Scaled to lie between -2.5 and +2,5 with higher values corresponding to better outcomes (Kaufmann et al. 1999a)
Control of Corruption and Graft (**CORRUPGRAFT**)	Definition given in main text. Scaled to lie between -2.5 and +2,5 with higher values corresponding to better outcomes (Kaufmann et al. 1999a)
Rule of Law (**RULELAW**)	Definition given in main text. Scaled to lie between -2.5 and +2,5 with higher values corresponding to better outcomes (Kaufmann et al. 1999a)

APPENDIX 2. Deforestation and Governance: Preliminary Regressions

1. regress dfpa voice, robust

dfpa	Coef. (Std. Err.)	t value	P > t	[95% Conf.	Interval]
voice	−.4289583 (.1164568)	−3.68	0	−0.6603917	−0.19752
_cons	.5605176 (.1095465)	5.12	0	0.3428169	0.778218
				R-squared	0.1581

2. regress dfpa Polstability, robust

dfpa	Coef. (Std. Err.)	t value	P > t	[95% Conf.	Interval]
polstability	−.4487853 (.0944765)	−4.75	0	−0.6365375	−0.26103
_cons	.4380415 (.089025)	4.92	0	0.2611231	0.61496
				R-squared	0.1872

3. regress dfpa goveffect, robust

dfpa	Coef. (Std. Err.)	t value	P > t	[95% Conf.	Interval]
goveffect	−.434321 (.0900261)	−4.82	0	−0.6132289	−0.25541
_cons	.4780577 (.0950131)	5.03	0	0.2892392	0.666876
				R-squared	0.1512

4. regress dfpa regburden, robust

dfpa	Coef.(Std. Err.)	t value	P > t	[95% Conf.	Interval]
regburden	−.3061839 (.1576361)	−1.94	0.055	−0.6194524	0.007085
_cons	.5091147 (.109868)	4.63	0	0.2907752	0.727454
				R-squared	0.0466

5. regress dfpa corrupgraft, robust

dfpa	Coef. (Std. Err.)	t value	P > t	[95% Conf.	Interval]
corrupgraft	−.4182503 (.0796322)	−5.25	0	−0.5765026	−0.26
_cons	.4590076 (.0922028)	4.98	0	0.2757739	0.642241
				R-squared	0.1608

6. regress dfpa rulelaw, robust

dfpa	Coef. (Std. Err.)	t value	P > t	[95% Conf.	Interval]
rulelaw	−.4403785 (.0792503)	−5.56	0	−0.5978719	−0.28289
_cons	.4562608 (.0905906)	5.04	0	0.2762311	0.636291
				R-squared	0.1859

APPENDIX 3. Estimated Regression Equations.

R-squared = 0.4760
Root MSE = .76529

3.1

dfpa	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
pppcy95	**−.0001192**	**.0000691**	**−1.72**	**0.089**	**−.000257**	**.0000187**
ppcy95sq	**4.47e-09**	**2.34e-09**	**1.91**	**0.060**	**−1.99e-10**	**9.14e-09**
popdenrur95	−.0000717	.0001057	−0.68	0.500	−.0002825	.0001392
Rurpop	.0034669	.00706	0.49	0.625	−.0106139	.0175477
Roads	**−2.70e-07**	**1.43e-07**	**−1.89**	**0.063**	**−5.54e-07**	**1.47e-08**
Forprot	−.0041247	.0084392	−0.49	0.627	−.0209562	.0127068
Globalness	−.0009419	.0049217	−0.19	0.849	−.010758	.0088741
Openess	−.0088526	.1103738	−0.08	0.936	−.2289863	.211281
voice	.0095661	.2970145	0.03	0.974	−.5828106	.6019429
polstability	−.1300711	.2806978	−0.46	0.645	−.6899051	.429763
goveffect	−.1140439	.3581059	−0.32	0.751	−.8282635	.6001758
regburden	.4008919	.3142829	1.28	0.206	−.2259256	1.027709
corrupgraft	.1092471	.309303	0.35	0.725	−.5076382	.7261324
rulelaw	−.1136987	.2987075	−0.38	0.705	−.7094521	.4820546
dum1	.279334	.5497427	0.51	0.613	−.8170932	1.375761
dum2	−.0020431	.4917389	−0.00	0.997	−.9827853	.9786992
dum3	−.6086299	.4543127	−1.34	0.185	−1.514728	.2974681
dum4	.2056796	.4971742	0.41	0.680	−.7859031	1.197262
dum5	.1123848	.6016586	0.19	0.852	−1.087585	1.312355
_cons	.8505096	.9084316	0.94	0.352	−.9613002	2.662319

R-squared = 0.2093
Root MSE = .75325

3.2

dfpa	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
popdenrur95	−.0000118	.0000933	−0.13	0.899	−.0001976	.0001739
Rurpop	−.0010213	.0052154	−0.20	0.845	−.0114043	.0093617
Forprot	−.0009322	.0070216	−0.13	0.895	−.0149111	.0130468
Globalness	−.0022947	.00633	−0.36	0.718	−.0148966	.0103073
Openess	.0848079	.1072875	0.79	0.432	−.128785	.2984009
voice	.0922575	.1438151	0.64	0.523	−.1940564	.3785714
globaleca	.0110322	.0071316	1.55	0.126	−.0031657	.0252302
dum1	.4594703	.4679036	0.98	0.329	−.4720542	1.390995
dum2	.1481475	.4446566	0.33	0.740	−.7370958	1.033391
dum3	**−.8379219**	**.4543598**	**−1.84**	**0.069**	**−1.742483**	**.0666389**
dum4	.4211026	.4297406	0.98	0.330	−.4344452	1.27665
_cons	−.246896	.6044129	−0.41	0.684	−1.45019	.9563976

R-squared = 0.4338
Root MSE = .74885

3.3

dfpa	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
popdenrur95	−8.03e-06	.0000828	−0.10	0.923	−.0001729	.0001568
Rurpop	**.0091163**	**.0050173**	**1.82**	**0.073**	**−.0008703**	**.0191029**
Forprot	.0011052	.0075559	0.15	0.884	−.0139343	.0161448
Globalness	.0018468	.0035676	0.52	0.606	−.0052544	.008948
Openess	.0824247	.097113	0.85	0.399	−.1108739	.2757232
voice	−.1053883	.1426285	−0.74	0.462	−.3892832	.1785066
dum1	.6128054	.3934408	1.56	0.123	−.1703188	1.39593
dum2	−.0479116	.3849347	−0.12	0.901	−.8141049	.7182816
dum3	**−.6064678**	**.3285722**	**−1.85**	**0.069**	**−1.260474**	**.0475388**
dum4	.4937404	.3690511	1.34	0.185	−.2408375	1.228318
_cons	−.3120502	.465309	−0.67	0.504	−1.238225	.6141243