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Democracy, political instability and tropical deforestation

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The alarming rate of depletion of tropical forests and the economic, social, and environmental implications are serious issues facing the world. Very prominent among the myriad factors at play is the political environment within these tropical countries. This study therefore investigates to what extent the rate of tropical deforestation is exacerbated by the democratic/non-democratic nature of the governments in power. We construct a democracy index variable for fifty-five countries across the four regions of the tropical world. The average annual deforestation from 1981–85, is compared to the democracy index variable. We find a strong negative correlation between the level of democracy and the rate of tropical forest exploitation. The global policy implications of this finding are outlined.

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Tropical[1] deforestation has been recognized today as arguably one of the serious environmental problems facing the world. In the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil (June 1992), tropical deforestation featured prominently as an issue that demands international attention. The achievements of this conference included treaties to protect the global climate and the earth's biodiversity, and *Agenda 21* (an 800-page action plan for sustainable development) (see Myers, 1976; WRI, 1992; FAO, 1993; French, 1994).

The Food and Agricultural Organization of the United Nations (FAO) states that 15.4 million ha (153,935.03 sq km or 59,434.38 sq miles) of tropical forests are converted to other uses every year. Annual deforestation by region showed Latin America and Caribbean to have the highest rate of 7.4 million ha, followed by Asia and Pacific 3.9 million ha, and Africa 4.1 million ha (FAO, 1993).

Tropical forests carry out such unique functions in our environment that their destruction will likely usher in a multitude of environmental problems involving real economic and social costs. Such issues as extinction of plant and animal species that have not yet been screened for their value to mankind, extensive wind and soil erosion, decline in soil fertility, and global warming have all been linked to tropical deforestation. Global warming is especially serious since climatologists estimate that global temperatures would rise by 2.0°C by the year 2100. A major concern is that this rise in global temperature would increase the transmission of diseases that are most sensitive to climate '... by shifting the vector's geographic range and increasing reproductive and biting rates and by shortening the pathogen incubation period'. These would include mosquito-borne diseases; malaria, dengue, and viral encephalitides (Mahar, 1989; WRI, 1992; Patz *et al*, 1996).

The proximate causes of tropical deforestation are numerous, but many studies indicate that the demand for agricultural land is a major factor driving deforestation. Other equally important factors that contribute to the unprecedented depletion of tropical forests include the absence of well defined property rights, commercial logging, rural population density, firewood and charcoal consumption by households and industries, lack of adequate forestry management facilities, government policies, and natural forces such as drought and fire (Barbier *et al*, 1991; Mahar, 1989; Repetto and Gillis, 1988; Postel and Heise, 1988; FAO, 1993; WRI, 1992; Deacon, 1995; Hassan and Hertzler, 1988;

[1]Tropical countries refer to countries located between the tropics of Cancer and Capricorn, therefore countries like Argentina and South Africa are not included in our sample. All the tropical countries in this study also fall under the general category of developing countries. Hence, the words developing and tropical are used interchangeably to refer to the same group of countries

Mendelsohn, 1994; Cropper and Griffiths, 1994). These causes of tropical deforestation are complex, and usually situation specific. A country-by-country examination may reveal that while 'lack of well defined property rights' is a major factor in country A, 'government policies' constitute the major factor in country B. Furthermore, different constituencies will emphasize different causes. For instance, forestry institutes may emphasize 'lack of adequate forestry management facilities' while deep ecological groups may emphasize the 'absence of well defined property rights'.

Deforestation in tropical countries is also exacerbated by external or international forces beyond the control of developing countries. For instance, the pressure to earn foreign exchange needed to service the huge external debts owed by these countries places immense pressure on the governments, which leads to 'myopic policies' that are detrimental to the interests of tropical forest conservation. The pressure to deforest is equally exacerbated by the declining terms of trade. During the past two decades, world prices of agricultural commodities relative to world prices of manufactured goods have tended to fall. As export revenues decline, while the pressure of development obligations mounts, these countries turn to their forests. Didia's study confirms that there is a strong negative relationship between export prices and tropical deforestation (von Moltke, 1990; Kahn and McDonald, 1995; Didia, 1993; Pearce and Warford, 1993; Vaughan, 1995).[2]

All the factors responsible for tropical deforestation discussed above can be broadly summarized as economic factors. In spite of the acknowledgement that non-economic factors such as the political environment within these tropical countries may be equally important, no formal analysis has yet attempted to include a political variable.

The purpose of this paper therefore is to explore an additional dimension which appears to have been largely omitted in empirical studies designed to explain the factors contributing to the unprecedented depletion of tropical forests. This additional factor or dimension has to do with how the internal political environment (ie the political environment within these developing countries) impacts the rate of exploitation of natural resources, in this case – tropical forests. More specifically, we would attempt to explore to what extent the rate of tropical deforestation has been aggravated by the democratic/non-democratic[3] nature of the governments in these tropical countries. In other words, which type of political environment (democracies or non-democracies) are more efficient in the use of tropical forests? This is the question that this paper will attempt to answer.

Gordon Tullock (1987) provides the first coherent work that examines the internal functioning and motivation of authoritarian regimes. However, this work as Tullock himself points out, does not provide any detailed empirical evidence with regard to the issues raised. Economists are now beginning to fill this void by providing further theoretical and much needed empirical research.

A good number of empirical studies have analysed the behaviour of authoritarian *vis-a-vis* democratic governments in several situations. These studies have yielded very interesting insights. For instance, an analysis of 'the politico-economic behaviour of authoritarian governments' reveals that autocratic governments may purposely hinder economic growth as a way of prolonging their tenure in power. A study examining 115 countries, from 1960–80, reveals that countries that

[2]'Myopic Policies' would include policies aimed at meeting the next scheduled interest and principal payments on debt and/or policies designed to secure one's tenure in office, where tropical forest resources are exploited to the extent needed without any regards to efficiency considerations or the needs of future generations. The debt–deforestation linkage is not very clear. While some studies as listed above stress that debt is a causal factor in deforestation; Hecht and Cockburn (1990) raise serious doubts about such linkage with regard to Brazil

[3]The definition of democracy given by Anderson (1988) states '... a democracy is a country in which multiparty competition is legal, national elections are held on a regular basis, and the present ruler was not installed as the result of a coup'. Any country that fails to conform to this definition is a non-democracy

subscribe to democracy, capitalism and the rule of law had economic growth rates that significantly exceed those of autocratic countries. While Bloch's analysis implies that autocratic governments may purposely hinder economic growth, another study confirms that these same governments may benefit by encouraging population growth. Anderson's study in which democracy is treated as a categorical variable reveals that authoritarian regimes are worse fiscal managers than their democratic counterparts (Bloch, 1986; Scully, 1988; Usher and Engineer, 1987; Anderson, 1988).

Utilizing a continuous measure of democracy, two authors examined the relationship between foreign public debt and political variables just as Anderson did. Their results in contrast to Anderson's was inconclusive. They find little support for Anderson's conclusion that *ceteris paribus*, autocratic regimes incur more public debt than democratic ones. Balkan examined how the level of democracy and political instability impact the probability that a country may reschedule its foreign loans. His study reveals that, while the probability of rescheduling increases as the level of political instability increases, it decreases as the level of democracy increases (Balkan and Green, 1990; Balkan, 1992).

The studies cited above indicate that autocratic and democratic governments may make different choices in similar situations. Clearly, there are different patterns of behaviour between these two types of government. It will be interesting to see if this difference in politico-economic decisions or motivation carries over to the exploitation of natural resources such as tropical forests.

This study therefore broadens the growing literature on the economic outcomes attributable to democratic versus autocratic governments. By examining whether efficiency in the exploitation of tropical forests increases as countries become more or less democratic, important insights into policy are delineated.

The paper is organized in the following manner: the second section discusses our conceptual framework, while data and construction of a continuous measure of democracy are described in the third section. Empirical results are given in the fourth section, where we show that a strong negative statistical relationship exists between the level of democracy and the rate of tropical deforestation. The final section takes up our summary and conclusions.

Conceptual framework

Do democracies manage their tropical forests more efficiently than non-democracies? To address this question, we must look into how democratic and non-democratic governments come into power, and their tenure in office. Dictators in most cases assume power by force. They are not elected by anybody, and remain in office until forced out by *coup d'etat* (another dictator) or death. The fact that a *coup d'etat* can happen at anytime means that the tenure of the dictator is constantly in jeopardy. When the tenure in office can end at any moment, as it is not guaranteed by any constitution or popular mandate, the dictator does not have much incentive for long-term planning.

According to Tullock, one of the paramount concerns of a dictator is how to secure or prolong his tenure in office (Tullock, 1987). To survive and consolidate power may require ample resources to appease or eliminate potential coup plotters and other disgruntled elements in the mili-

tary or society at large. Since tropical forests are a source of funds for bribery and other self-serving expenditures, our dictator can be expected to exploit the quantity needed to secure his tenure, without regard to efficiency considerations. For most developing countries, tropical forests are the major source of foreign exchange. Forests can be cut down and the logs exported, or the land is cleared for the cultivation of cash crops which are equally exported. Since the general public has no meaningful voice in the affairs of the country, environmental/interest groups and other countervailing forces that would normally exist in democratic countries are non-existent. Even if these groups exist, the nature of the political environment renders them largely ineffective. The dictator is hereby given a blank cheque to fill in as he or she pleases. It is therefore quite logical, all things being equal, to expect non-democratic regimes to have higher rates of tropical deforestation than their democratic counterparts. This myopic behaviour induced significantly by the desire to secure one's tenure in office is clearly not in the interest of tropical forest conservation.

The recent crisis in Haiti provides a very good illustration of the behaviour of dictators. Many people would not be surprised to learn that General Raoul Cedras of Haiti and his immediate lieutenants were not engaged in any long-term planning for their country. Their primary concern before they were ousted, was how to survive and consolidate power.[4]

Democrats on the other hand, assume power by a majority mandate in most cases. Their tenure in office is stipulated in the constitution, and barring any unusual circumstances such as impeachment or death, elected officials are sure of their term in office. Since a constitution stipulates how long elected officials may serve before re-election, these officials behave as if they are going to be in office for the whole term. Hence, they are more likely to devote more time to tackling their campaign promises rather than constantly looking over their shoulders as dictators often do. Of course, in some emerging and fragile democracies, elected officials do worry about their tenure in office as military incursions into politics is always a possibility. Again, Haiti provides a recent example of where a democratically elected president, Jean-Bertrand Aristide was overthrown by the military in less than a year after taking office. A look at the countries of West Africa for instance, reveals that, with the exception of two or three countries, others have had the military overthrow of a democratically elected government at one time or another. On the contrary, in established democracies such as India, UK, USA or Israel, the chief executive has no reason to be preoccupied with his or her tenure in office. In non-democracies however, the dictators are constantly worried about their survival or tenure in office.

This perceived difference with regard to stability of tenure in office is the critical factor that leads to different behaviours observed in democratic and non-democratic governments. Our reasoning is in line with Brough's and Kimenyi's argument that 'dictators have extremely high time preferences because of institutional instability' (Brough and Kimenyi, 1986). High time preferences or discount rates which favour the allocation of resources to the present at the expense of the future, result because dictators are concerned with the immediate need of securing their tenure in office. Hence, resources at their disposal, including tropical forests are exploited for this purpose without any regards to future needs or efficiency considerations.

[4]General Raoul Cedras and his soldiers ousted Father Jean-Bertrand Aristide, a democratically elected president. When all negotiations failed to persuade General Cedras to relinquish power, President Clinton threatened to send in US troops. Eventually, Cedras stepped aside in 1994, and went on exile

Anderson argues to the contrary, that dictatorships are inherently stable. He cites the Duvaliers in Haiti (1957–86), Qadhafi in Libya (1969–present), and Marcos in the Philippines (1972–86) as examples of the tenacity of dictators (Anderson, 1988). We do not dispute the fact that dictators do remain in office for long periods of time. The thrust of our argument is that, since dictators are uncertain of their tenure in office (continuously living under the sword of Damocles according to Tullock), as opposed to elected officials in democracies, the pressure from this uncertainty leads to myopic behaviours which are detrimental to tropical forest conservation.

It must be stressed here that we are in no way implying that elected officials in democracies are incapable of myopic behaviours for short-term goals just like the dictators. The difference between both parties lies in the structures and institutions that exist in democratic and non-democratic countries. In democratic countries, there are structures and institutions (checks and balances) such as the executive, legislature, judiciary, and the free press, which curtail the extent of these myopic behaviours. These checks and balances may not exist in autocratic countries, or where they exist, they are largely ineffective due to the nature of the political environment.

To illustrate the point made above, Allen and Barnes expressed the average annual deforestation from 1976–80 by country, as a function of forest area for tropical countries. Their figures, after adjusting for the endowment of forest and, reveal that Ghana had the highest rate of deforestation, followed by Ivory Coast (Cote D'Ivoire) and Nigeria to name just a few. About the same period (1972–88) covered by Allen and Barnes and this paper, Ghana was under military dictatorship, experimenting briefly with democracy for only two years (1979–80); while Nigeria was under military rule from 1970–88, experimenting briefly with democracy for only four years (1979–82). For the same period (1970–88), Cote D'Ivoire was under one-party rule of the late President Houphouet Boigny with no opposition parties (Allen and Barnes, 1985).

It is remarkable to note that about the same time period (1970–88), Venezuela, India and Sri Lanka each with about the same area of closed forest as Ghana, Nigeria or Cote D'Ivoire, had significantly lower rates of deforestation. As a matter of fact, Venezuela, India, and Sri Lanka had some of the lowest rates of deforestation of all tropical countries examined by Allen and Barnes. The interesting fact here is that, during this time period examined, these three countries (Venezuela, India and Sri Lanka) were much more stable democracies. They had chief executives that were elected, effective legislatures, and multiple political parties competing with each other.[5] While this example is not by itself a conclusive evidence that autocracies exploit their tropical forests more inefficiently than democracies, it does show some pattern and cause for further inquiry.

Consequently, if we express tropical deforestation (D) as a function of the level of democracy (W), we would expect a negative relationship between the two variables.

$$D = f(W) \tag{1}$$

$$\sigma D/\sigma W < 0 \tag{2}$$

Holding everything constant, Equation (2) states that as the level of democracy in a country goes up, we can expect a decrease in the rate of

[5]Arthur Banks' Cross-National Time Series Data Archive is a very rich source of information on political variables across the countries of the world. The archive provides the variables that make it possible for us to construct a continuous measure of democracy (democracy index). The data archive is maintained at the Center for Social Analysis, SUNY-Binghamton, New York

deforestation. Our empirical analysis in section four tests the validity of this theory or proposition.

Data and democracy index construction

The data on tropical deforestation comes from Food and Agricultural Organization (FAO) sources. It was made available by Kahn and McDonald. The FAO defines deforestation as a situation where a formerly forested piece of land is cleared to less than 10% of tree crown cover (FAO, 1993; Kahn and McDonald, 1995). The data on tropical deforestation is available as an average between 1981–85, measured in thousands of hectares. This limits the time dimension of this paper. The democracy indices are therefore constructed to correspond to this same period, 1981–85. We now proceed to construct a measure of the democracy variable (democracy index).

Construction of the democracy index

This study utilizes a measure of democracy that shows substantial improvement over other measures.[6] For instance, the measure of democracy employed by Anderson classifies a country as democratic where '... multiparty competition is legal, national elections are held on a regular basis, and the present ruler was not installed as a result of a coup (Anderson, 1988). Any country that does not conform to this definition is classified as non-democratic. According to this scheme, South Korea and the Philippines are not democratic whereas Brazil, Israel and South Africa are democratic, and Mexico could go either way. Clearly, this dichotomous perception of democracy raises serious classification problems as even Anderson acknowledged.[7]

Bloch also recognized this dichotomous problem when he pointed out that most countries in the world fit neither democratic cum capitalist nor authoritarian cum centrally planned models. A better model or classification scheme according to Bloch would be 'more or less authoritarian cum more or less capitalist – which reasonably describes a large number of developing countries (Bloch, 1986). The political environment in developing countries is such that we cannot easily classify them as purely autocratic or purely democratic. Rather, countries fall on a continuum, somewhere between the two extremes of autocracy and democracy. We will therefore examine how the rate of deforestation is influenced as we go from one end of the spectrum to the other (ie from less democratic to more democratic and vice versa).

In constructing our measure of democracy, we will follow the same procedure as Arat with a very minor modification. We utilize Arthur Banks' Cross-National Time Series Data Archive which allows us to construct a continuous measure of democracy. The democracy indices constructed this way, show high correlation with democracy indices constructed by other scholars as Arat's work indicates (Arat, 1984) see also Note 5.

The two components that make up our democracy index are political participation and political competitiveness. The participation component captures the extent that the will of the majority is reflected in the executive and legislative branches of government. Since the legislature and the chief executive make decisions on behalf of the masses, the participation component of our democracy index looks into how these two insti-

[6]Our democracy index is a measure of democracy widely employed by political scientists. Economists have also adopted this measure of democracy. This measure incorporates some structures, political processes, and checks and balances that are available in democracies. For more details on the construction of this measure of democracy, and the rationale behind the several components, see Arat (1984); Balkan (1988, 1992); Balkan and Green (1990). The variables used in constructing our democracy indices come from Arthur Banks' Cross-National Time Series Data Archive (see Note 5)

[7]The ambiguity with respect to Mexico results from this dichotomous perception of democracy. This perception is subjective and open to various biases depending on the individual making the classification. The measure of democracy used in this study is very objective, and avoids this problem

tutions are established. If the chief executive (ie president, monarch, premier etc) is elected, the country is assigned one point, and zero otherwise. On the selection of the legislative branch, three areas (legislative selection, legislative effectiveness, competitiveness of the nomination procedure) are examined. Two points are assigned if the selection of the legislature is by popular elections, and one point otherwise. If a legislature does not exist, zero point is assigned. Three points are assigned if the legislature is effective, two points if partially effective and one point if largely ineffective. On the competitiveness of the nomination procedure, two points are assigned if the procedure is competitive, one point if essentially non-competitive, and zero if no legislature exists. To get the score for the 'democraticness' of the legislature, we add one to the product of the scores of the three areas of the legislature discussed above {ie 1 + (legislative selection * legislative effectiveness * competitiveness of the nomination procedure)}. The final score for the participation component of our index is obtained by adding scores from the executive and legislative subcomponents (ie executive score + 1 + legislative score). This score ranges from 1 to 14.

The political competitiveness component of our democracy index is measured via two subcomponents: party legitimacy and party competitiveness. On party legitimacy, a country is assigned four points if no parties are excluded from the political process, three points if only 'extremist' parties are excluded, two points if a significant exclusion of parties occurs, and one point if there is only one dominant party or there are no political parties at all. For the party competitiveness subcomponent, two points are assigned if the largest party held less than 70% of the total votes in the latest national elections, and one point if there are no elections, or the party received more than 70% of the votes. The scores from these two subcomponents are summed to get the score for the political competitiveness component of our index (political competitiveness score = party legitimacy score + party competitiveness score). We finally arrive at our democracy index by adding the scores from political participation and political competitiveness. This procedure can be summarized in a simple mathematical illustration:

democracy index = [(executive selection + (legislative selection * legislative effectiveness * competitiveness of the nomination procedure) + 1 + party legitimacy + party competitiveness)]

The democracy indices for our sample of 55 tropical countries calculated as averages from 1981–85 ranges from 3 to 20, where 3 represents the least democratic and 20 the most democratic. These indices are similar to those of other scholars who employ the same procedure in their studies (Balkan, 1988; Balkan and Green, 1990; Balkan, 1992). Table 1 shows the countries in our sample, average annual deforestation and average democracy index for the period 1981–85.

Empirical results

The data on deforestation as provided by the FAO is available as an annual average between 1981–85. This in turn dictates the time dimension of this study. We therefore construct our democracy index to correspond to this 1981–85 time period. Wide disparities in our sample countries with regard to size makes adjusting our dependent variable

Table 1. Sample countries, average annual deforestation and average democracy index, 1981–85

Country (code)	Deforestation (1000s of hectares)	Democracy index
Bangladesh (13)	8.0	4.2
Benin (16)	67.2	6.0
Bolivia (20)	117.2	13.4
Botswana (21)	20.0	15.0
Brazil (22)	2530.0	13.2
Burundi (27)	1.1	5.4
Cameroon (29)	110.0	6.0
Central African Rep. (32)	55.0	4.0
Colombia (38)	890.0	15.0
Congo (40)	22.0	5.0
Costa Rica (41)	65.0	20.0
Dominican Rep. (47)	4.0	15.0
Ecuador (48)	340.0	16.0
El Salvador (50)	4.5	11.8
Ethiopia (52)	88.0	3.0
Gabon (58)	15.0	6.4
Ghana (62)	72.0	3.0
Guatemala (69)	90.0	9.2
Haiti (73)	1.8	5.0
Honduras (74)	90.0	12.6
India (78)	147.0	19.6
Indonesia (79)	620.0	8.0
Cote D'Ivoire (85)	510.0	6.0
Jamaica (86)	2.0	19.0
Kenya (89)	39.0	9.6
Liberia (96)	46.0	3.6
Madagascar (100)	156.0	9.0
Malawi (101)	150.0	5.0
Malaysia (102)	255.0	10.8
Mali (104)	36.0	7.2
Mauritania (107)	13.3	3.0
Mauritius (108)	−0.1	16.0
Mexico (109)	615.0	14.6
Nicaragua (120)	121.0	4.4
Niger (121)	67.1	4.2
Nigeria (122)	400.0	9.4
Pakistan (125)	9.0	4.0
Panama (126)	36.0	6.4
Paraguay (128)	212.0	8.0
Peru (129)	270.0	15.0
Philippines (130)	92.0	6.4
Rwanda (138)	5.2	6.0
Senegal (141)	50.0	8.0
Sierra Leone (143)	6.0	6.0
Sri Lanka (149)	58.2	15.0
Sudan (153)	504.0	5.4
Tanzania (159)	130.0	12.0
Thailand (160)	379.0	11.0
Togo (162)	12.1	6.0
Trinidad–Tobago (164)	0.8	19.0
Burkina Faso (172)	80.0	3.0
Venezuela (175)	245.0	19.0
Zaire (182)	370.0	6.0
Zambia (183)	70.0	6.0
Zimbabwe (136)	80.0	15.0

Note: Table shows actual deforestation levels in hectares, that occurred in each of these countries as reported by the FAO. Deforestation figures here are therefore not scaled. It is clear that countries with the same democracy index may not necessarily show the same level of deforestation. This is because countries vary in size and endowment of forest land. Besides, there are socio-economic factors which equally impact the rate of deforestation, and these factors vary across countries. However, to control for the effect of size, so that we do not observe a situation where deforestation is driven by size rather than economic, social and political variables, we scale deforestation figures by GNP and population. These scaled figures are used in our regression analysis in the fourth section.

(average annual deforestation) necessary to avoid observing a relationship based on size, as large countries with large areas of forest land might also have large areas of deforestation. If we do not adjust for size, we may observe a relationship between tropical deforestation and the level of democracy that is completely induced by country size and has nothing to do with the level of democracy or political environment.

We can measure the size of a country by the amount of the gross national product (GNP) or by the population among other measures. Hence, we can adjust for size via two avenues – dividing all relevant variables by GNP or by population. Both methods of adjustment are utilized in this study. We therefore carry out two separate estimations. Estima-

tion one is scaled by GNP, and estimation two is scaled by population. In both regressions, a single equation ordinary least squares (OLS) model is employed:

$$\text{deforestation} = \text{constant} + \text{democracy index} + \text{error term}$$

For our estimations, we use the personal computer version 5.1 of the Limdep econometric software. Regressions are corrected for heteroskedasticity (Green, 1989). As explained in the second section, we expect the coefficient of the democracy index to be negative, establishing a negative relationship between deforestation and the level of democracy.

Results of estimation one, scaled by GNP is listed below. (T-ratios are in parentheses.)

$$\text{deforestation} = 0.0454 - 0.00215 \text{ democracy index}$$
$$(4.743) \qquad (3.217)$$
$$R^2 = 0.13, \qquad \text{adjusted } R^2 = 0.11, \qquad N = 55$$

Results of estimation two, scaled by population is listed below. (T-ratios are in parentheses.)

$$\text{deforestation} - 13.097 - 0.041 \text{ democracy index}$$
$$(3.667) \qquad (0.129)$$
$$R^2 = 0.0003, \qquad \text{adjusted } R^2 = 0.019, \qquad N = 55$$

From estimation one, we see that the democracy index coefficient had the expected negative sign, and was statistically significant. This implies that as the level of democracy increases, the rate of tropical deforestation decreases. In estimation two, the democracy index had the expected sign, but showed no statistical significance. This may be due to measurement errors in population which we used to adjust for size here. A few studies have highlighted the problems inherent in using population figures from developing countries. Since population is taken into account in determining foreign loans and aids, developing countries have an incentive to inflate their population figures (Bauer, 1972). Therefore, when we divided the average annual deforestation by population, we may have inadvertently biased downwards the per capita average annual deforestation.

On the other hand, GNP figures reported by developing countries tend to be more accurate because international lending institutions have an incentive to audit the figures, since the ability to repay a loan can be approximated by the national output. Also, in many developing countries, government expenditures account for a very significant portion of the GNP, and these expenditures which occur on the open market can be monitored. In fact, for many developing countries, government is the only business. In such cases, government expenditure can serve as good proxies for GNP. It would therefore be extremely difficult for developing countries to report false GNP figures. Anderson alluded to these GNP/population measuring problems in his study on autocratic versus democratic governments (Anderson, 1988).

Our regression results (estimation one) suggest that a strong negative correlation exists between the rate of tropical deforestation and the level of democracy. In other words, as a country becomes more democratic, we can expect a reduction in the rate of tropical deforestation. This is quite logical since we would expect an increase in the 'democraticness' of a country to give birth to certain structures, institutions and political processes which directly or indirectly work for

the interests of tropical forest conservation. These structures, institutions and political processes may not exist in autocratic/non-democratic countries, and if they exist, the nature of the political environment renders them largely ineffective. Some of these structures, institutions and political processes include:

Environmental/interest groups

As a country becomes more democratic, we can expect a rise in the number of environmental and other interest groups who will work for the interests of tropical forest conservation. Given the nature of democracies, these groups are not afraid to confront the government or anyone else in situations where they are seen as 'enemies' of tropical forests. Techniques such as protests and court actions can be employed to stop, or at least slow down the depletion of tropical forests. Chico Mendes, the leader of a movement of rubber tappers in the Brazilian Amazon was killed on 22 December 1988, by ranchers who saw him as an obstacle to their conversion of the Amazon forest to pasture land. Before Chico Mendes was finally eliminated, he had emerged as a major player in the international struggle to save the Amazon. The Yananamo and Kayapo Indian inhabitants of the Amazon Rainforests in Brazil have on a few occasions chased away gold-miners and other intruders destroying their forests. These Indians have even on other occasions taken their protests to the capital, confronting government officials. For instance, in 1989 when the government of Brazil proposed to build two dams (Kararao and Babaquara) on the Xingu River in the Amazon, about 600 local Indians converged in the city of Altamira in protest. The government eventually dropped Babaquara from this project. In these confrontations, the government had to negotiate with the Indians. The nomadic Penan group of Borneo have tried to stop the depletion of their forests by protests and building road blockades. In 1990, 'Greenpeace' launched an elaborate campaign to save the remaining rainforests (Shoumatoff, 1990; *World Rivers Review*, 1989; Carothers, 1990). These activities did succeed to some extent by focusing the attention of the world on the plight of tropical forests.

The point here is that environmental groups such as 'Greenpeace' may not exist in autocratic/non-democratic countries, and if they exist, the nature of the political environmental render them largely ineffective. Moreover, the actions and protests of the Penan or the Yananamo are very unlikely if not unthinkable in purely autocratic regimes. Hence, democracies have mechanisms that work in the interests tropical forest conservation.

Market mechanism

Democracies generally subscribe to market mechanism and private ownership of resources. Market forces and secure property rights ultimately lead to more efficiency in the exploitation of natural resources such as tropical forests. When a forest is cut down prematurely or put to a less than optimum use, the owner loses money. Therefore, to maximize profits, tropical forests need to be managed properly. Part of proper management includes harvesting at the optimum time, avoiding destructive harvesting techniques such as clear cutting, and replanting. In non-democratic countries where the allocative mechanism of market forces is inoperative because the government controls everything, the role of profits in better management of resources is lost.

There are those who might argue that the plight of tropical forests at the moment is too precarious to be left to market forces. The argument is that market forces fail to internalize externalities such as environmental and social costs. Hence, the understatement of costs make profits bigger, thereby encouraging greater deforestation (Pearce and Warford, 1993). While there may be some merit to this argument, we should also recognize that the predicament of tropical forests would be better under market forces than where market forces are completely absent. Market forces therefore, could act as mitigating factors with regard to the expected decline in inefficiency in tropical forest exploitation, as the level of democracy increases.

Elections/re-elections

In democracies, politicians make campaign promises in order to get elected. Once in office, they are expected to deliver on their promises. In order to gain the support of environmental organizations, a politician may promise to work for a cleaner environmental and/or the protection of some endangered species.

Vice President Al Gore is the environmental point man for the Clinton administration, and we may be aware of the recent trouble in Washington state about preserving the 'spotted owl'. The trouble was simply that preserving the forests (habitat) for the owls would mean stopping all logging activities. However, the economy of the surrounding communities is so dependent on logging that many timber workers would lose their jobs. A major conflict thereby erupted between timber workers and those who wish to preserve the owl. The conflict was so intense that President Clinton personally visited the area and a compromise was worked out. Elected officials often face the threat of not bing re-elected if they renege on their campaign promises. Hence, in democracies, environmental constituencies (groups) have an easy way to register their dissatisfaction with the government. This avenue does not exist in non-democracies.

Free press

Democracies encourage freedom of the press. The press in turn serves as a watchdog for the citizenry, and places the government under constant scrutiny. Consequently, the government cannot engage in destruction of tropical forests or nuclear waste dumping without alerting environmental groups. Cover-ups are a little more difficult in democracies than autocracies. The protests and activities of the Yananamo and Kayapo Indians, and the Penan in Borneo would have little or no impact if the press was not around to disseminate the information. When the Kayapo protested against the Xingu dam projects (Kararao and Babaquara) in the Amazon, 200 journalists were in attendance. Their reports helped focus international attention on the plight of tropical forests in the region. Hence, activities that are detrimental to tropical forest conservation are less likely to go unchallenged in democracies.

Conclusions

Many studies, as cited earlier, have investigated the impact of economic variables on the rate of tropical deforestation, and we have gained a lot of insight from these studies. However, economic variables alone, may

not fully explain the unprecedented levels of tropical deforestation observed today. The main objective of this paper is to explore an additional dimension which appears to have been neglected by quite a few empirical studies on this issue. This additional dimension has to do with how the political environments within developing countries influence the rate of tropical deforestation. We posed the question – which type of political environments (democracies or non-democracies) are more efficient with regard to the use of tropical forests?

Our empirical analysis suggests that a strong negative correlation exists between the rate of tropical deforestation and the level of democracy. In other words, as a country becomes more democratic, we can expect a reduction in the rate of tropical deforestation. This is quite logical since we would expect an increase in the 'democraticness' of a country to give birth to certain structures, institutions and political processes which directly or indirectly work for the interests of tropical forest conservation.

A major policy implication of our findings is that lending support to democratic movements and democratic institutions in tropical countries would go a long way in conserving the remaining tropical forests. This paper represents only a preliminary investigation on the behaviour of democracies versus non-democracies with regard to tropical forest exploitation. Clearly, more research is warranted to provide support to the findings of this study.

The role of the international community in preserving the remaining tropical forests must be explored. Future studies therefore need to examine the extent to which the international community influences the political environment within tropical countries by such instruments as loans, aid and foreign investment, and how these actions impact the exploitation of natural resources such as tropical forests. More sophisticated models that can incorporate the impact of these variables on the rate of tropical forest exploitation will definitely enhance our understanding of the forces responsible for tropical deforestation.

In June, 1992, a United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro, Brazil. Several world leaders were in attendance, and treaties covering such issues as global climate, preservation of plant and animal species, and sustainable development emerged. While this is a step in the right direction, it remains to be seen whether the international community has the wherewithal to implement these treaties.

It is clear that we do not claim to have addressed all the variables responsible for tropical deforestation as the low R^2 values in our estimations indicate. Another limitation of this study, hence the results, is that existing techniques of assessing deforestation levels are not very accurate. More sophisticated and accurate techniques of measuring deforestation levels are becoming available, and the FAO is completing a new survey on deforestation levels in the tropics. While more research is needed to adequately understand the forces responsible for the unprecedented depletion of tropical forests, we hope that this paper has made the impact of the political environment on tropical deforestation a little more apparent.

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