Deforestation, economic prosperity, and political institutions in East Asia and the Pacific

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Abstract: By examining annual data (1994–2003) for 15 countries from East Asia and the Pacific, this study provides an analysis of the effects of political institutions and other socioeconomic factors on deforestation. Results show that economic prosperity does not automatically cause higher environmental quality. Furthermore, it was found that population growth and agricultural sector growth worsen deforestation. In contrast, openness to international trade was observed to reduce deforestation. More importantly, greater political freedom was associated with poorer environmental quality. As in Olson's theory, in the presence of powerful special interest groups, policies might fall short of improving environmental regulation. Added to this is the presence of myopic voters which may impede the progress of environmental programmes.

Keywords: deforestation; political institutions; East Asia; Pacific.

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1 Overview

Forests embody an enormous number of environmental attributes such as carbon sequestration and greenhouse gas emissions (Bhattarai and Hammig, 2004). However, despite the growing concern about deforestation, the annual conversion of forest to other land use has been increasing (FAO, 1997). With such, efforts on identifying factors which could affect deforestation have intensified.

Therefore, economics literature has largely concentrated on the effects of economic variables, e.g., income and trade openness, on environmental quality, e.g., deforestation. However, there is little empirical evidence of a direct link between political institutions and environmental quality (Matthews and Mock, 2003).

In this study, the effect of political institutions, as measured by political rights and civil liberties, on deforestation is assessed. Because the relationship between deforestation, income, and associated factors is not straightforward, the validity of the environmental Kuznets curve (EKC) hypothesis is also evaluated. The EKC suggests that economic growth and environmental quality has an inverted U-shaped relationship. The EKC predicts that once a given economic level is attained, countries wealthy enough might invest in environmental protection (Stern, 2004). More importantly, as forests are publicly owned goods in most countries, it is also noted that the EKC relationship is probably linked with various socio-political institutions.

It is assumed that forest conversion has a close link with the development process and the political and institutional constraints affecting the process. Thus, the effect of the strength of political institutions and economic growth on deforestation is investigated in this paper. More specifically, using data from 1994 to 2003, the case for 15 countries from an emerging region – East Asia and the Pacific – is analysed.

2 Background

2.1 Deforestation EKC

The EKC is usually used as a guide in assessing the effects of economic variables on environmental quality. For deforestation, the EKC assumes that as income grows, investments in forests (through replanting and plantation development of the areas cut for logging) will provide compensation for the losses. It is also assumed that economic structure and energy demand may change amid economic growth. It is thought that fuel wood energy predominates during early stages of development. However, petroleum-based fuels become more important during later stages, thereby reducing deforestation (Bhattarai and Hammig, 2004). Furthermore, it is assumed that socio-political changes might accompany economic development and may affect forest conservation efforts.

2.2 Environmental quality as a public good

Little attention has been given to the effect of political variables on environmental quality (Matthews and Mock, 2003). Thus, there is obviously limited empirical evidence of a direct link between political institutions and deforestation. Theories of public goods provision offer a starting point for such research.

In particular, it has been argued that non-democratic countries are more likely to underprovide public goods (Olson, 1993). Non-democratic regimes are usually ruled by elites which use resources to create personal wealth. Stricter environmental regulation disrupts economic growth and has a negative effect on the elites (Bernauer and Koubi, 2004). Consequently, for rent-seeking elites in non-democratic countries, the marginal cost of public goods, e.g., environmental quality, is relatively higher than the marginal benefit. Therefore, stricter environmental policies are not supported. In contrast, income distribution is assumed to be more equal in democratic countries. This could imply lower

marginal costs and stricter regulation. Hence, it is argued that environmental policies are more likely to be successful in democratic regimes.

However, some scholars have claimed that in democratic countries, special interest groups have a huge influence on policymaking. This implies that public goods might also be under provided in the presence of powerful special interest groups opposing certain environmental programmes (Olson, 1965, 1982).

Several studies on environmental quality support these conflicting views. For example, Barrett and Graddy (2002) noted that an increase in political freedoms decreases sulphur dioxide pollution. However, it was found out that democracy has no effect on other pollutants, e.g., pollutants affecting water quality. In addition, Bernauer and Koubi (2004) found out that civil liberty has an ambiguous effect on sulphur emissions. They stated that while more freedom in less liberal countries translate into cleaner environments, more civil liberties in relatively free countries do not cause better environmental quality.

2.3 The deforestation-democracy relationship

Most empirical studies on deforestation have focused only on the impact of population growth (Allen and Barnes, 1985). As noted earlier, the impact of other variables such as political freedom and institutional structure has not been emphasised. Fortunately, studies such as those of Bhattarai and Hammig (2004) have taken note of the effect of the quality of governance on forest conservation in 60 countries from three tropical regions (Latin America, Asia, and Africa). More specifically, they found out that governance is an important determinant of forest resource preservation. On the other hand, Norton (1998) found that deforestation is greater in countries with relatively weak property rights. Moreover, Deacon (1994) noted that political insecurity was positively related to the deforestation process.

3 Methodology

3.1 Data

3.1.1 Sources and descriptions of data

The relationship of deforestation with economic growth and political institutions is examined for 15 countries from East Asia and the Pacific during the period of 1994 to 2003. Detailed descriptions of the variables are given in Table 1.

3.1.1.1 Forest area

The dependent variable employed in this study is FOR. FOR is a measure of environmental quality with higher FOR values indicating less deforestation. Cross-country statistics on natural forest cover was obtained from the World Bank's World Development Indicators (WDI) database. The data on forest area, measured in square kilometres, were compiled using estimates by the Global Environmental Monitoring Systems and the Food and Agriculture Organization.

Table 1 Definitions of variables used in this study

Variable	*Unit*	*Description*	*Source(s)*
Forest area, FOR	Square kilometres	Logarithm of forest area in country *i* for time *t*	World Bank's WDI online
Real gross domestic product per capita, GDP	US$	Logarithm of GDP per capita in constant 2,000 prices	Penn World Table
Real gross domestic product per capita-squared, GDPSQ	US$		
Agriculture value-added, AGRI	%	Value added of agriculture to GDP	WDI
Population growth, POP	%	Annual percentage population growth rate	WDI
Openness to trade, OPEN	%	Sum of exports and imports over the GDP (total trade's share of the GDP)	Penn World Table
Political institutions index, POL	Index	Sum of political rights and civil liberties	Freedom House (http://www.freedomhouse.org)

3.1.1.2 Income

Real gross domestic product (GDP) per capita, in 2,000 US dollars, is used as a measure of economic prosperity or national income. These data were obtained from the Center for International Comparisons, University of Pennsylvania's Penn World Table. As the theory of the EKC suggests, it is expected that the coefficient of the quadratic GDP per capita term is negative, and the unit GDP per capita term is positive. However, because greater deforestation (less environmental quality) is signalled by lower forest area values, the expected coefficient signs for GDP variables are the opposite. In short, in the context of this research, a parabolic (not an inverse U-shaped) EKC is hypothesised.

3.1.1.3 Political institutions

The political institutions variable, POL, is an index which measures democratic access (political rights and civil liberties), as reported by Freedom House. The indices were drawn from the Universal Declaration of Human Rights. Accordingly, the fundamental components of freedom are where citizens of the country:

> "1. Participate freely in the political process; 2. Vote freely in legitimate elections; 3. Have representatives that are accountable to them; 4. Exercise freedoms of expression and belief; 5. [Are] able to freely assemble and associate; 6. Have access to an established and equitable system of rule of law; 7. Have social and economic freedoms, including equal access to economic opportunities and the right to hold private property." (Freedom House, 2008)

Using the above mentioned criteria, POL is created by adding each country's political rights and civil liberties indices. Political rights and civil liberties indices are computed

on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest. With the addition of the two indices, the POL index value ranges from two to 14. A higher value implies less political and economic freedom.

3.1.1.4 Agricultural sector growth

The relationship between deforestation (lower forest area values) and agricultural sector growth is captured by a variable tracking the GDP value-added of agriculture. Increases in agricultural value-added are hypothesised to provide alternative income for rural populations (Bhattarai and Hammig, 2004). Thus, agriculture is regarded as a substitute for forest resource extraction.

3.1.1.5 Population

To control for population characteristics, a variable on annual population growth rate is used. It is hypothesised the higher population growth rate causes greater demand for residential space. Moreover, urbanisation might be induced. Hence, it is expected that higher population growth is associated with less forest cover.

3.1.1.6 Trade

Possible explanations on the effects of trade liberalisation on environmental quality are offered by the displacement hypothesis and pollution haven hypothesis. The displacement hypothesis states that trade openness will lead to more rapid growth of pollution-intensive businesses in developing countries as the developed nations enforce stricter environmental policies. In contrast, the pollution haven hypothesis implies that lower trade barriers could damage the environment if heavy polluting industries transfer to countries with poor regulatory institutions (Dinda, 2004). In this study, the relationship between openness to trade and forest area is captured by OPEN, an explanatory variable which measures a country's trade intensity.

3.1.1.7 Income dummies

To provide more homogeneity in the results, dummies reflecting the income groups of selected countries from East Asia and the Pacific are included. The groupings used in this paper were based on the World Bank's WDI online database. The country categories are summarised in Table 2. Middle income countries serve as the base group. The dummy, HIGHINC, is equal to one for countries with high incomes and is zero for others. The dummy, LOWINC, is unity for low income countries. Otherwise, it takes a value of zero.

Table 2 World Bank's income classification of East Asia and the Pacific countries

Income classification	*Countries*
High income	Australia, Japan, South Korea, Brunei Darussalam, New Zealand
Middle income	China, Indonesia, Malaysia, Mongolia, Philippines, Thailand
Low income	Laos, Papua New Guinea, Vietnam, Solomon Islands

3.1.2 Summary statistics

Lastly, due to data constraints, only 15 countries from East Asia and the Pacific were included in the sample. Overall, with a span of ten sample years and 15 countries, a total of 150 observations are utilised in this paper. Summary statistics of the variables are provided by Table 3.

Table 3 Summary statistics of variables in this study

Variable	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
Forest area, FOR	398,295	563,888.6	2,820	1,891,744
Agriculture value-added, AGRI	18.19897	15.40027	.801097	57.57632
Population growth, POP	1.575875	.7722927	.1552043	2.866351
Real gross domestic product per capita, GDP	10,534.22	9,261.243	1,220.385	27,993.56
Openness to trade, OPEN	91.27538	47.20121	16.03709	228.8739
Political institutions index, POL	7.193333	4.200826	2	14

3.2 Empirical models

The relationship between economic growth and deforestation is analysed using cross-section time series regressions, i.e., panel data analysis. Furthermore, the impact of political and other socioeconomic variables are revealed by cross-country analysis which provides for wide variation of institutions. Lastly, to avoid outlier effects, the natural logarithm of large level variables (e.g., GDP) are taken.

Using the variable definitions discussed above, the econometric models adopted in this study are as follows:

$$\ln \mathrm{FOR}_{it} = \beta_0 + \beta_1 \ln \mathrm{GDP}_{it} + \beta_2 \left(\ln \mathrm{GDP}_{it}\right)^2 + \beta_3 \mathrm{POL}_{it} + \alpha_i + \upsilon_{it} \tag{1}$$

$$\ln \mathrm{FOR}_{it} = \beta_0 + \beta_1 \ln \mathrm{GDP}_{it} + \beta_2 \left(\ln \mathrm{GDP}_{it}\right)^2 + \beta_3 \mathrm{POL}_{it} + \beta_4 \mathrm{AGRI}_{it} + \beta_5 \mathrm{POP}_{it} + \beta_6 \mathrm{OPEN}_{it} + + \delta_1 \mathrm{HIGHINC} + \delta_2 \mathrm{LOWINC} + \alpha_i + \upsilon_{it} \tag{2}$$

where

β_0 constant

α_i unobserved heterogeneity

υ_{it} error term.

4 Results and discussion

Table 4 reports the results from the regression based on model 1. Both the random effects (RE) and fixed effects (FE) estimations are presented. However, the FE estimates corrected for heteroskedasticity and serial correlation [fixed effects general least squares (FEGLS)] are used for analysis. This is because the FE technique's estimated parameters are conditional on the time and country-specific effects in the selected sample of data.

Furthermore, though the process of deforestation varies across countries, the fixed effect panel regression method allows for the estimation of common coefficients for variables, while allowing structural constraints to vary across countries (Bhattarai and Hammig, 2004).

Again, the results on the effects of GDP per capita and political institutions are reported in Table 4. The dependent variable is the annual forest area for East Asia and the Pacific sample countries for the period 1994 to 2003. The coefficient of GDP is positive. This implies that as GDP per capita increases, the area covered by forests increases. On the other hand, the quadratic GDP term is negative. This means that after a threshold income, forest area decreases. As in Mills and Waite's (2009) study on economic prosperity and biodiversity conservation, this observation is inconsistent with the EKC hypothesis. A possible explanation is countries being more concerned with economic development than environmental conservation. In other words, as a country experiences growth, it may protect forest areas at first. However, resource constraints to support urbanisation efforts may force it to convert forest areas.

Table 4 GDP per capita and political factors affecting forest area in East Asia and the Pacific, 1994–2003

Explanatory variable	*RE*	*FEGLS*
GDP	.0087881	.0022063*
	(.0086755)	(.0001308)
GDPSQ	–.065263	–.0169298*
	(.0662187)	(.0009892)
POL	.0024372*	.0003879*
	(.0014155)	(.0000169)
CONSTANT	5.278263*	5.205355*
	(.2273418)	(.0018336)
R^2	0.0001	0.0373

Note: *Significant at the 10% level

The coefficient for the political institutions variable, POL was positive. Note that, as stated earlier, a higher POL value corresponds to less political and civil freedom. Thus, the positive coefficient indicates that less democracy implies greater forest cover (less deforestation). This provides evidence for the argument on the existence of special interest groups. In more democratic countries, giving too much political power to special interest groups that oppose stricter environmental regulation could lead to lower environmental quality (Olson, 1965, 1982). In summary, when special interest groups enjoy a disproportionate influence on policymaking, stricter environmental regulations may not be implemented.

Meanwhile, the results for Model 2, as shown in Table 5, strengthen that of Model 1. As in Table 4, the signs of the income variables did not support the EKC. It is possible that the rich countries in the dataset were, unfortunately, not characterised by improved conservation (Mills and Waite, 2009). However, with the addition of other explanatory variables, the significance of GDP and GDPSQ disappears. This could signal slightly that GDP per capita might not be a strong determinant of deforestation.

Table 5 Socioeconomic and institutional factors affecting forest area in East Asia and the Pacific, 1994–2003

Explanatory variable	*RE*	*FEGLS*
GDP	.005757	.0035481
	(.0090592)	(.0042401)
GDPSQ	–.0436149	–.0283315
	(.0689406)	(.0323587)
POL	.0026884*	.0060675*
	(.0014416)	(.001473)
AGRI	.0012467*	–.001945*
	(.0004695)	(.0005636)
POP	–.00476	–.0704492*
	(.0059503)	(.0098543)
OPEN	–.000014	.0000328*
	(.0000308)	(.0000156)
HIGHINC	–.4699519	–.1682084*
	(.3610537)	(.0325737)
LOWINC	–.4411101	–.3239402*
	(.3849042)	(.0274915)
CONSTANT	5.498969*	5.518569*
	(.276252)	(.0675664)
R^2	0.0056	0.0907

Note: *Significant at the 10% level

But, the significance of income classification dummies in this study further supports Mills and Waite's notion that wealthy countries are not generally characterised by improved conservation. HIGHINC's and LOWINC's negative coefficients signify that high and low income countries are characterised by relatively lower forest coverage as compared to the middle income group. This provides further evidence for the inverted U-shape relationship of income and forest area.

In addition, Table 5 shows the results on the effects of other macroeconomic policy and population variables on forest cover. The negative coefficient of AGRI implies that as the agricultural sector's GDP value-added increases, the forest area in a given country decreases. This means that forest land is probably converted for agricultural use (e.g., kaingin system) in some countries. Unfortunately, this also suggests that agricultural modernisation does not automatically provide incentives to preserve forests.

The second additional variable, POP, exhibited a negative coefficient. This implies that population growth imposes pressure on natural forest conversion. It is possible that deforestation is taking place where rural population pressure is highest. But, most probably, excessive deforestation is mainly driven by urban bias in developmental policy to provide fuelwood for growing urban populations (Bhattarai and Hammig, 2004).

Thirdly, the effect of openness to trade on forest cover was also tested. The significant positive coefficient of OPEN signals that trade liberalisation has a positive

effect on environmental quality. This result is consistent with the displacement hypothesis. That is, as an economy develops, its export of polluting commodities will increase. On the other hand, its imports of polluting goods will fall. This will displace the environmentally degrading activities to other countries (Dinda, 2004). The pollution haven hypothesis provides an extension of the aforementioned explanation. Its central argument is that due to trade liberalisation, pollution-intensive industries tend to transfer to countries with relatively less stringent environmental regulations (Akbostanci et al., 2007). Moreover, with intensive trade, it is possible that countries acquire cleaner technologies from abroad.

Lastly and more importantly, the coefficient of the political institutions variable, POL, remained positive. A higher POL value (less democracy) implies higher forest area coverage (less deforestation). As stated earlier, this supports Olson's theory of special interest groups. As Olson (1982) puts it, "the larger the number of individuals or firms that would benefit from a collective good, the smaller the share of gains from action in the group interest that will accrue to the individual or firm that undertakes the action. Thus, in the absence of selective incentives, the incentive for group action diminishes as group size increases, so that large groups are less able to act in their common interest than small ones".

In other words, the provision of public goods, e.g., environmental quality, might suffer in more democratic countries. This is because of the existence of a large number of special interest groups (for example, business associations and labour unions in the manufacturing sector) that have no incentive to make sacrifices in the interest of the society as a whole. These groups compete for political power in order to gain larger shares of society's production. Consequently, in the presence of powerful special interest groups, policies might fall short of improving environmental quality (Bernauer and Koubi, 2004).

In addition, it has been argued that elected governments have shorter planning periods than non-elected ones because of political myopia (Congleton, 1992). Unfortunately, many forms of environmental degradation occur longer. The social costs of current policy choices usually impose problems to future politicians. Therefore, democracies may undersupply environmental public goods relative to non-democratic governments. This is because in non-democratic regimes, political leaders do not face frequent elections. Without the fear of being punished by myopic voters, they can also impose costlier, stricter environmental regulation with longer term benefits (Bernauer and Koubi, 2004).

5 Conclusions and recommendations

Empirical research on the determinants of environmental quality has focused largely on economic factors, e.g., income and trade. Economic literature on the political determinants of environmental quality is rather limited.

This paper provides a preliminary investigation into the effects of political institutions and other socioeconomic factors on deforestation. The results suggest that economic prosperity and forest cover has an inverted U-shape relationship. This implies that rich countries in East Asia and the Pacific are not generally characterised by improved conservation. Also, more political rights and civil liberties do not automatically translate into less deforestation. In more democratic regimes, it is possible that giving political

power to special interest groups that oppose environmental regulation might lead to lower environmental quality. Furthermore, political myopia puts a burden on environmental regulation. In addition, agricultural sector growth and population growth seem to put pressure on forest conversion. Fortunately, trade liberalisation tends to improve environmental quality.

Further research should focus on testing for other forms of pollution, e.g., biological oxygen demand, nitrogen oxide emissions, and the like. To provide more sufficient analysis, it is also recommended that the scope of countries and the time frame covered be extended. Finally, the use of other political indicators, e.g., governance index, regulatory quality score, and form of government dummy, is suggested.

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