Regression Analysis on Forestry Transition in Asian Countries

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Econometric Analysis

- The relationship between socio-economic variables and deforestation along with forest cover is analysed using non linear regression models.
- The general empirical non linear model (Barbier and Burgess, 2002; Gomes and Braga, 2008; Santos et al., 2008) used in the study was as:

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$Y = \alpha + \beta_1 X + \beta_2 X^2 + \sum_{k}^{p} \beta_k Z_k + \varepsilon$$

- Y = deforestation rate or forest cover
- X = GDP per capita
- Z_k = Socio-economic parameters (GDP per capita, literacy rate, agricultural area, agricultural productivity, forest plantations, urbanization, etc.)
- ϵ = random error

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Model 1: Empirical model of forest cover (FC) with GDP per capita (GDPP)

$$FC = 129.204 - 15.779 * (\ln(GDPP)) + 0.952 * (\ln((GDPP))^2$$

$R^2 = 0.57$

Model 2: Empirical model of forest cover (FC) with GDP per capita (GDPP) and agricultural area (AA)

$$FC = 129.204 - 0.247 * AA - 8.05 * (\ln(GDPP)) + 0.514 * (\ln((GDPP))^2$$

$R^2 = 0.67$

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Model 3: Empirical model of Deforestation rate (Def) with GDP per capita (GDPP)

$$Def = -12.36 + 2.69 * (\ln(GDPP)) - 0.141 * (\ln((GDPP))^2$$

$R^2 = 0.79$

Model 4: Empirical model of deforestation (Def) with GDP per capita (GDPP) and agricultural area (AA)

$$Def = -9.97 + 0.077 * AA + 0.000071 * (GDPP) - 1.033E - 9 * (GDPP)^2$$

$R^2 = 0.69$

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Model 5: Empirical model of Deforestation (Def) with GDP per capita (GDPP) and agricultural productivity (AP)

$$Def = -17.22 - 0.0069 * AP + 4.23 * (\ln(GDPP)) - 0.131 * (\ln((GDPP))^2$$

$R^2 = 0.91$

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

- As the theory of EKC suggests that coefficient of GDP per capita is positive, which holds good in all the above established econometric models.

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Model explains

- The results are consistent with the basic concept of EKC hypothesis.
- Positive GDP per capita was observed in all the models which confirm the EKC relationship for deforestation of natural forests.
- Model 2 indicates that the expansion of agricultural area was at the expense of forests.
- Non significance of other socio-economic parameters provides evidence that forest cover and rate of deforestation are not governed by these parameters directly, but they may have some casual relationship with the deforestation rate or forest cover.

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Comparative Analysis

Data requirement

- Forest cover change or deforestation data for a period of . . .
- Data on various parameters of deforestation drivers (demography, economic, social, infrastructure, calamities) like GDP, GDP per capita, urbanization, population growth, agricultural production, forest plantation, import and export of timber, afforestation, area under TOF etc.

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Contd...

- Adequate data points to capture the variation
- Non-availability data points may be estimated through imputation or calibration or interpolation method based on statistical methods keeping in view of randomness criterion of the parameters

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Contd...

- Data availability at different countries
- Forest Transition will be treated as dummy variable based on certain criterion say (measured by transition rate, area under transition or qualitative trait)
- Some independent parameters may also be considered and used as dummy variable
- Model form may be linear or non-linear and based on analytics

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Contd...

- Relevant model statistics including coefficients will be estimated and tested through parametric and non-parametric test as per situation
- Model validation will also be considered and based on cross-validation.
- Qualitative and quantitative comparison between different countries will be made through statistical methods.

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

First Option –
Parameter Comparative Matrix

Country	Parameters					
	GDP	Agril. Area	Agril. Prod.	Forest Plantation	Population Growth	Urbanization
China						
India						
Indonesia						
Japan						
Korea						
Laos						
Malaysia						
Philippines						
Vietnam						

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Second Option – Relationship Comparative Matrix

Country	Relationship					
	Linear	Non Linear				
		Logarithmic	Quadratic	Cubic	Exponential	. . .
China						
India						
Indonesia						
Japan						
Korea						
Laos						
Malaysia						
Philippines						
Vietnam						

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Summary

- Country wise empirical relationship of forest cover/deforestation with regards to different drivers like GDP, Agricultural production / productivity, urbanization, forest plantation, population growth etc.
- Country wise empirical relationship of forest cover/deforestation with regards to different functions like linear and non linear (quadratic, cubic, exponential, logarithmic etc.)

$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

thanks…

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$$fx(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$