



# The effectiveness of avoided deforestation policies: the role of leakage.

AARES annual conference  
February 2011

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# How much of a problem is leakage in avoided deforestation projects?

*"unanticipated increase or decrease in GHG benefit outside of the project's accounting boundary . . . as a result of the project activities"*

IPCC 2000, §5.3.3, p. 246

- Avoided deforestation
  - excluded from CDM
- REDD proceeding
  - leakage threat unknown



Source: Greenpeace



Source: Greenpeace





# Leakage Literature

- Cross country leakage most commonly discussed.
- Avoided deforestation leakage literature focuses on output markets.
- Forestry focus
  - Gan and McCarl (2007, EcolEcon)
- Constrained credit markets
  - Alix-Garcia et al (2010, unpub)
- Factor markets important
  - Can moderate or reinforce output market effects
  - Karp (2010, unpub)
- The path of leakage is important

# Model

- Two sectors
  - Consumption good (single firm)
    - Two inputs: labour, land
  - Deforesting by households (investment)
    - Two regions: A, B
    - Single input: labour
- Single representative household
  - Maximise discounted consumption
  - Owns all factors
  - Allocate labour: current wages, future land rents.

# Euler conditions

- For both region A and B, equate
- Marginal benefits of current consumption paid by wages with

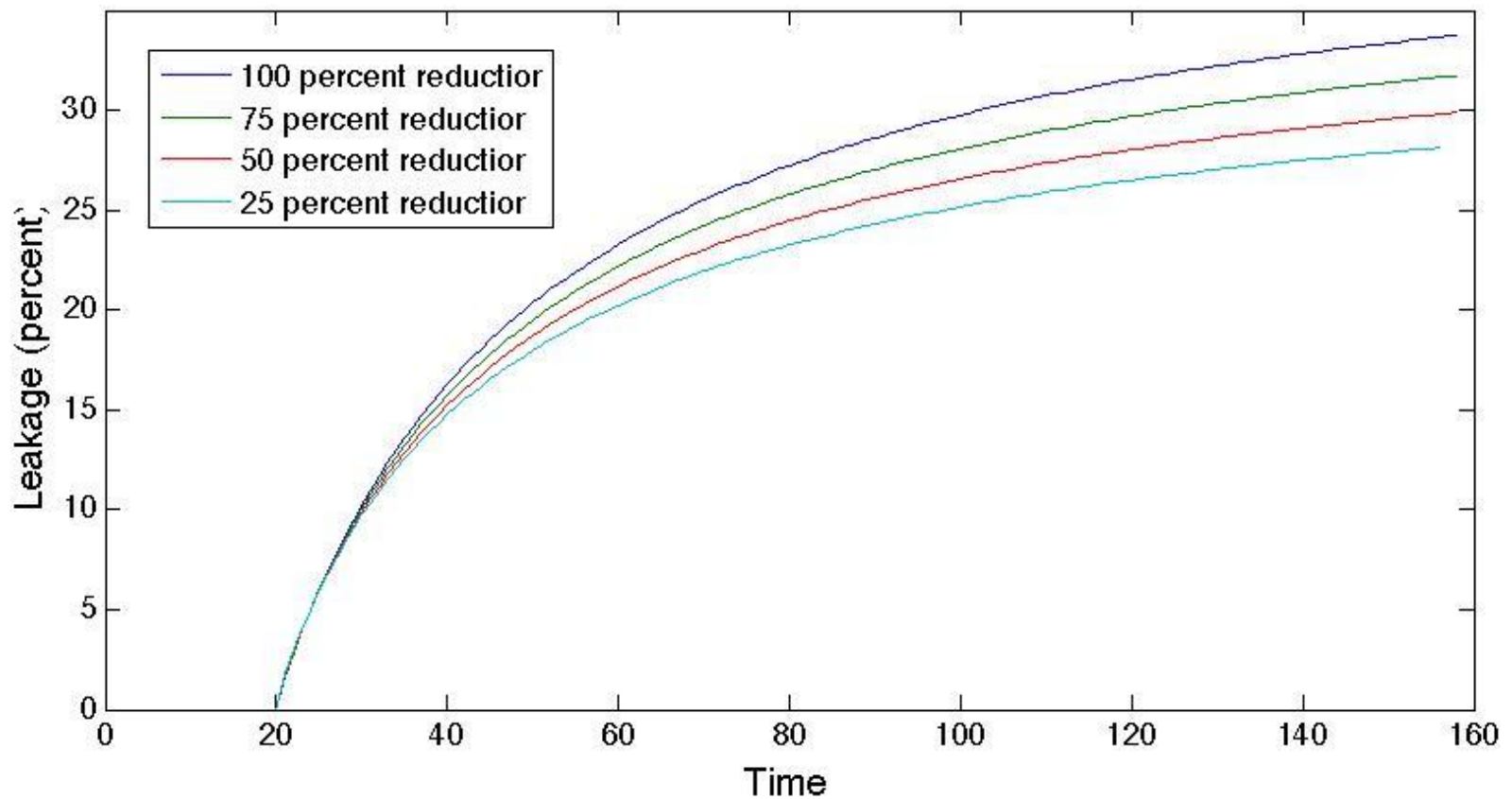
Discounted marginal benefits of increased consumption paid by extra rent

# Process

- Baseline:
  - Solve for optimal labour given initial agricultural land holdings.  $(A_U, B_U)$
- Policy:
  - Solve again where deforestation in region B restricted.  $(A_R, B_R)$

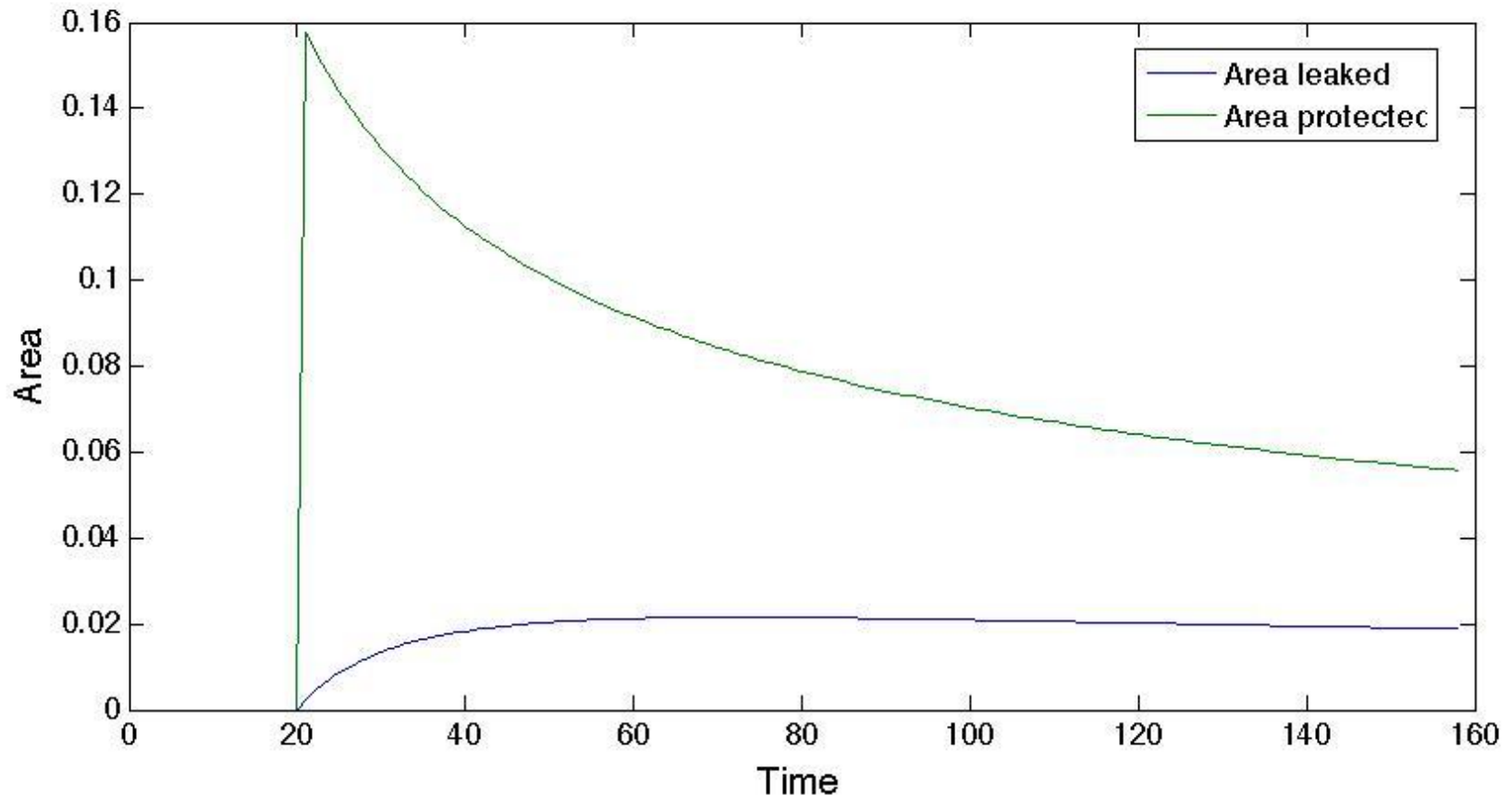
$$\text{Leakage} = (A_R - A_U) / (B_U - B_R)$$

# Leakage

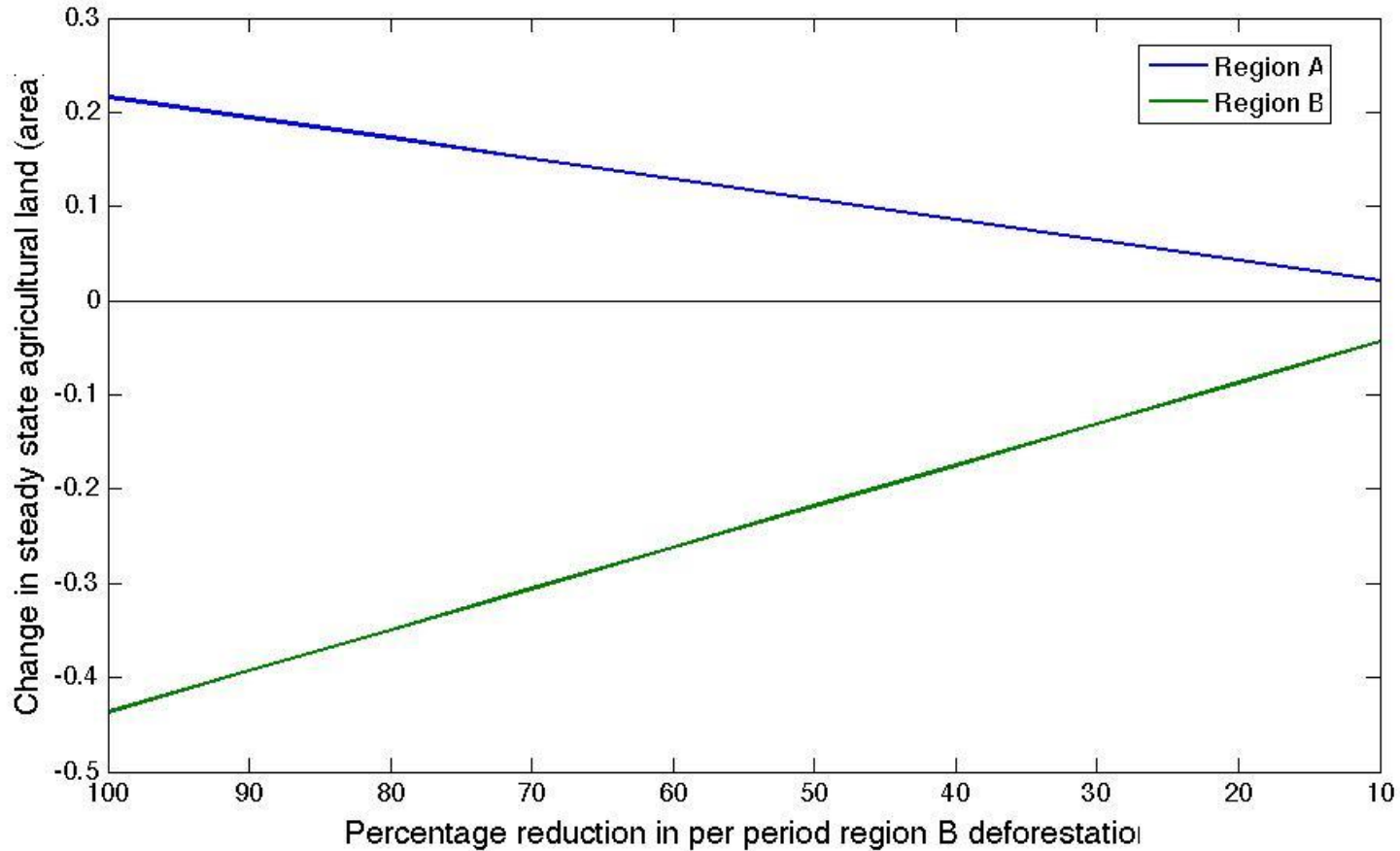


# Deforestation – area

(100 percent reduction in region B deforestation)



# Steady State Land Allocation



# Conclusion

- Leakage is a threat, but not overwhelming
  - In line with recent estimates of REDD projects
- Transition allows leakage mitigating policies to be developed ex post
  - Must also be cautious about interpreting early leakage estimates
- Deforestation *flow* restrictions influence steady state *stock* allocations
- Future work
  - Solve for general sequences
  - Balanced growth path
  - Calibration

Thank you

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# Equations

$$T_{A,t+1} = (1 - \delta)T_{A,t} + AL_{A,t}^{\phi}$$

$$c_t = y_t = (T_{At} + T_{Bt})^{\alpha} L_{1t}^{1-\alpha}$$

$$u(c_t) = \frac{C_t^{1-\sigma} - 1}{1-\sigma}$$

# Equations

$$\mathcal{L} = \max_{\{c_t, L_{At}, L_{Bt}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(c_t) + \lambda p_t (w_t (Nt - L_{At} - L_{Bt}) + s_t ((1 - \delta)(T_{At-1} + T_{Bt-1}) + G_A(L_{At-1}) + G_B(L_{Bt-1}) + \eta_t (X_t - G_B(L_{Bt})))$$

$$u'(c_t) w_t = \beta u'(c_{t+1}) s_{t+1} G'_A(L_{A,t})$$

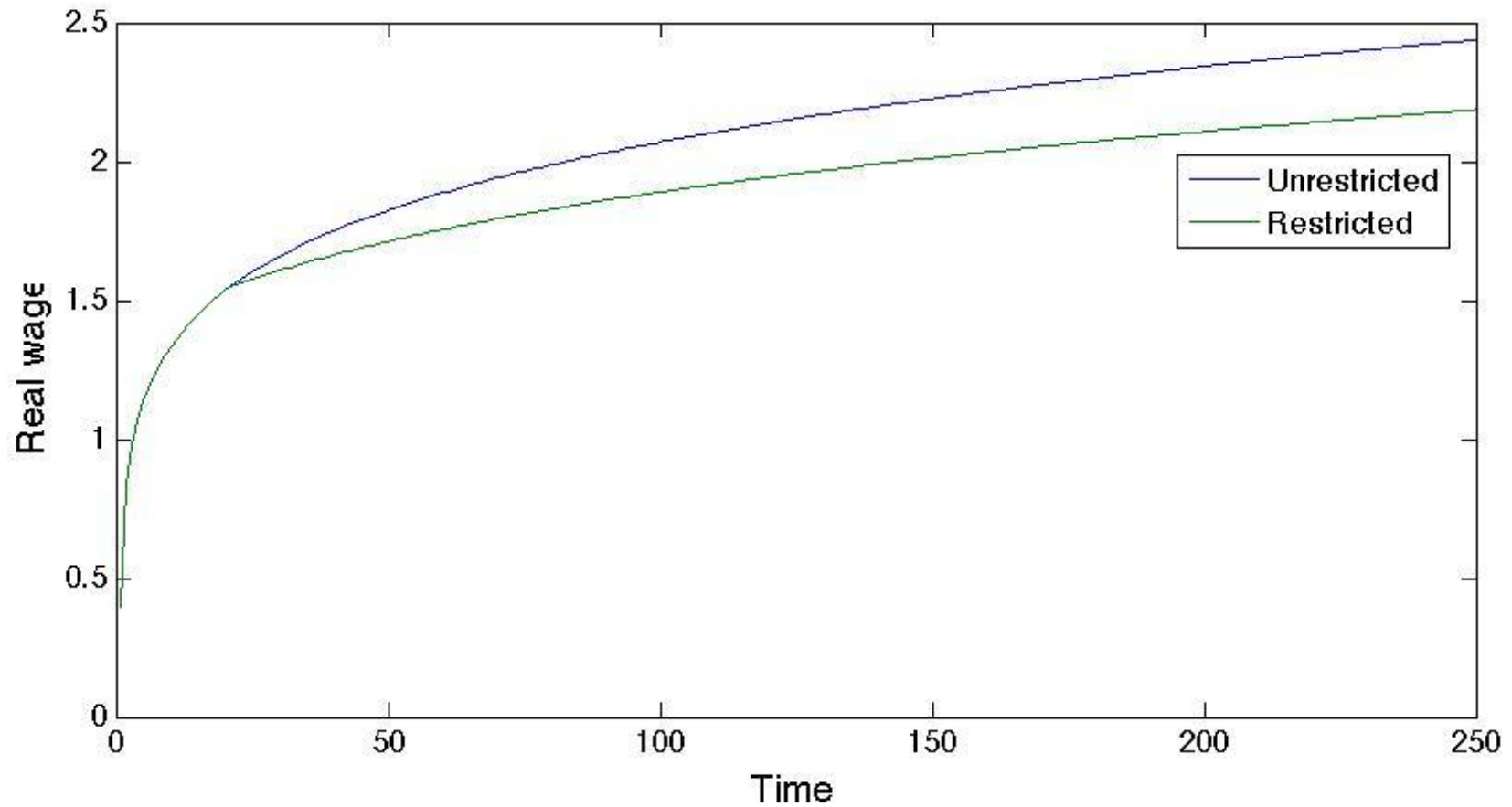
$$1 = \beta \left( \frac{c_t}{c_{t+1}} \right)^\sigma \frac{s_{t+1}}{w_t} \frac{A\phi}{L_{A,t}^{1-\phi}}$$

# Equations

$$(N_t - L_{At} - L_{Bt})\alpha\beta A\phi = (1 - \alpha) \left[ (1 - \delta)(T_{At} + T_{Bt}) + AL_{At}^\phi + BL_{Bt}^\theta \right] L_{At}^{1-\phi}$$

$$(N_t - L_{At} - L_{Bt})\alpha\beta B\theta = (1 - \alpha) \left[ (1 - \delta)(T_{At} + T_{Bt}) + AL_{At}^\phi + BL_{Bt}^\theta \right] L_{Bt}^{1-\theta}$$

# Importance of factor markets



# Parameters

Parameter	Value	Parameter	Value
$\alpha$	0.35	$\beta$	0.95
A	2.75	B	1.25
$\phi$	0.5	$\theta$	0.6
		$\delta$	0.025
Land in region A	1	Land in region B	1