

Climate Change and Land Use

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Markets and Land Use

- This paper builds two economic models to explain how markets have shaped land use
- One model explains the competition for land among agriculture, forests, and other users
- A timber model explains the harvest of old growth (primary) forest and the birth of renewable forestry

Deforestation and Emissions

- Deforestation has led to greenhouse gas emissions (136Gt since 1850)
- Energy and cement caused another 270Gt
- Historically, deforestation has been responsible for one third of carbon emissions
- In recent decades, deforestation has been responsible for 20% of emissions

Concentrations and Climate Change

- Cumulative emissions have led to higher concentrations in the atmosphere (from 285 to 370 ppm)
- Higher concentrations have led to temperature change: +0.5°C so far

Net Impact of Land Use is Lower

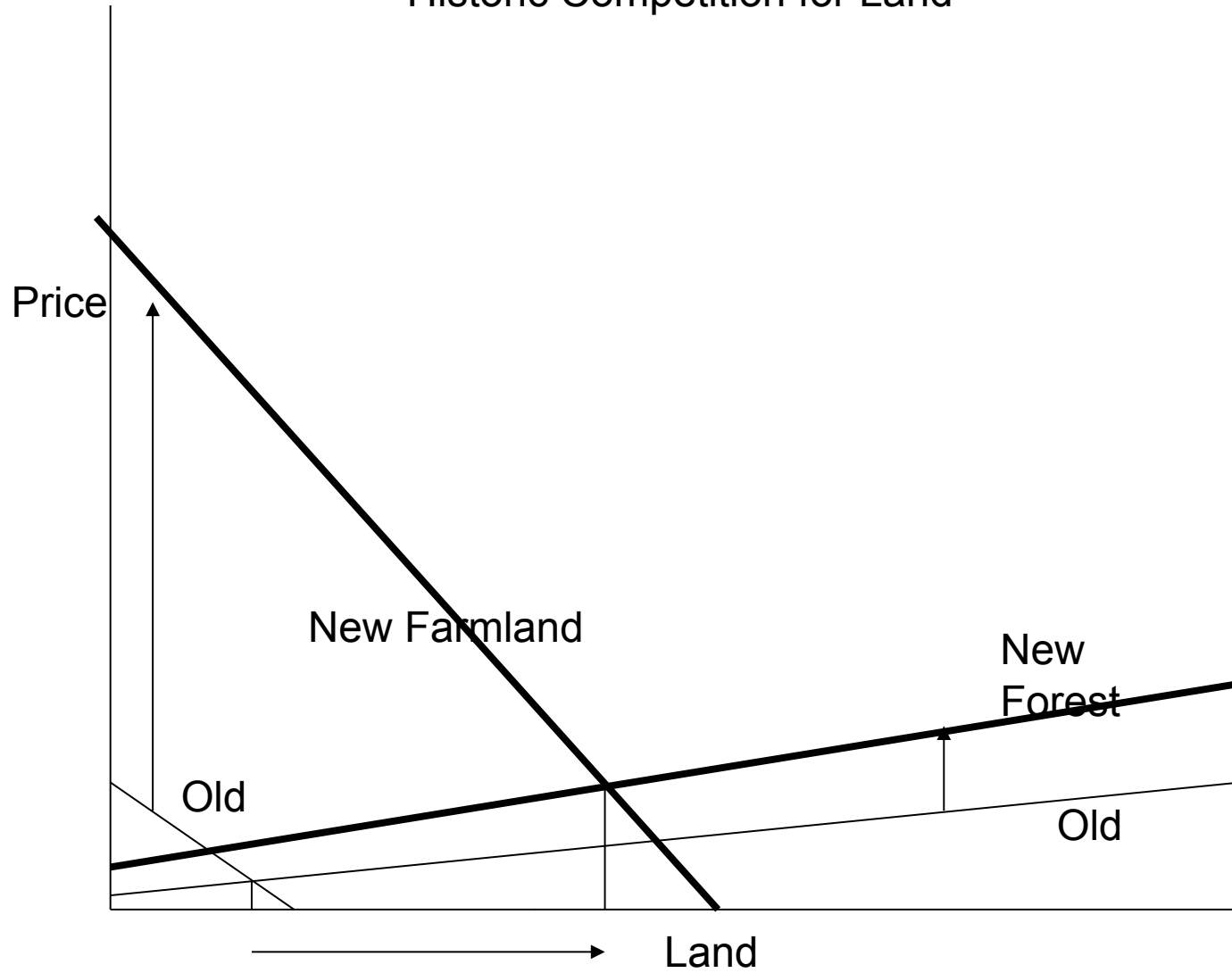
- Land has also absorbed 115Gt since 1850
- Historic cumulative net impact of land use is just 21Gt compared to 270Gt from energy and cement
- The economic models explain why land use in recent decades has been and will continue to be a sink

Land allocation:

Conversion of Forests to Cropland

- World population has grown from 1 to 6.3 billion and the economy has grown from \$1 trillion to \$62 trillion from 1900 till now
- Demand for cropland has grown to 1.5 billion ha and for pasture land to 3.5 ha while forest land has shrunk from 6 billion ha to 3.6 billion ha

Historic Competition for Land

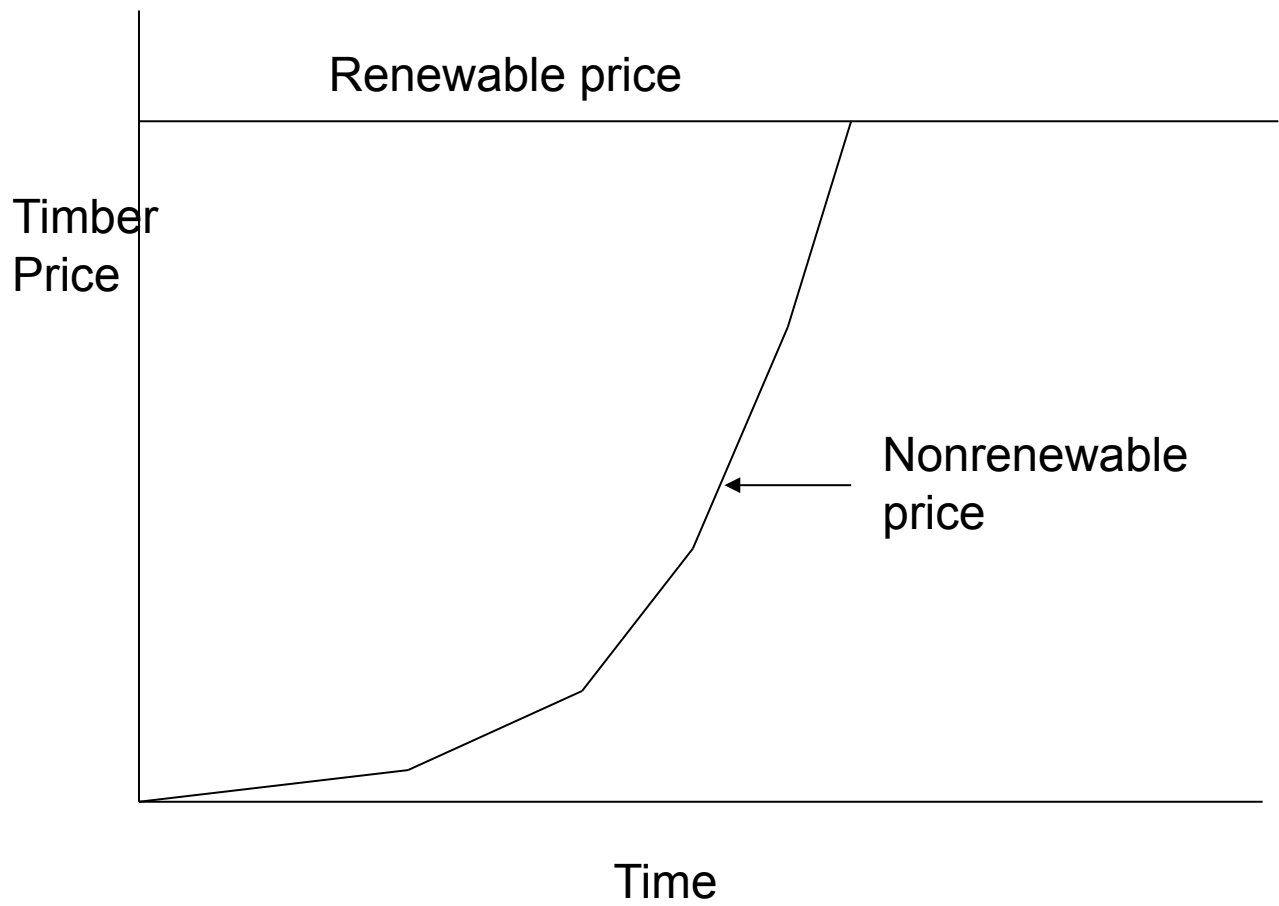


Future Conversion to Farms

- As population growth slows, reaching a final population of 9 billion and farm productivity continues to increase at 2% per year, the demand for more land for agriculture will diminish
- We may be quite near the maximum amount of global farmland now
- Agriculture is not likely to be a driving force for deforestation in the future

Forest Harvest Model

- Since the industrial revolution, primary forests have been harvested as a nonrenewable timber resource
- The stock of primary forest has fallen dramatically
- Price of timber has risen at the interest rate



Renewable forest

- Price is now high enough now to support a renewable forest
- Trees harvested today were planted
- The conversion of primary to secondary forest is largely over
- Timber prices are stabilizing
- As secondary forests, the world's managed forests now are young and growing

Carbon Emissions From Land Use

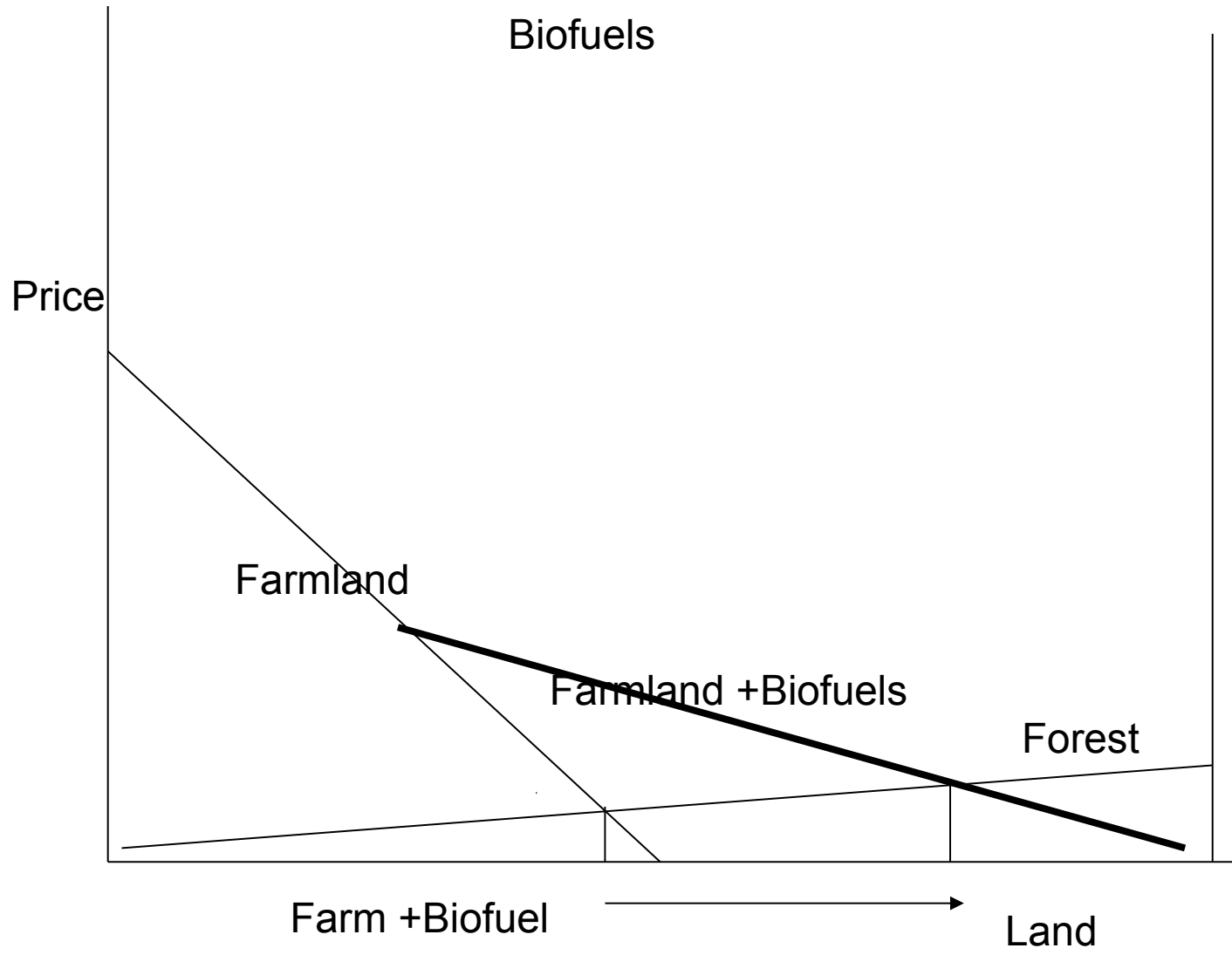
- The economic models consequently suggest that historically land use was a source of carbon
- However, in recent decades this has changed so that land use is now a sink for carbon
- This is confirmed by new carbon cycle measurements that suggest land has become a carbon sink +0.6Gt/yr

Future Projections of Carbon Emissions from Land Use

- Timber harvesting and agriculture will lead to ever smaller deforestation rates
- Secondary forest will continue to grow as harvested carbon is stored in economic assets
- Land use will continue to be a small carbon sink

Biofuels Likely to Threaten Carbon Storage on Land

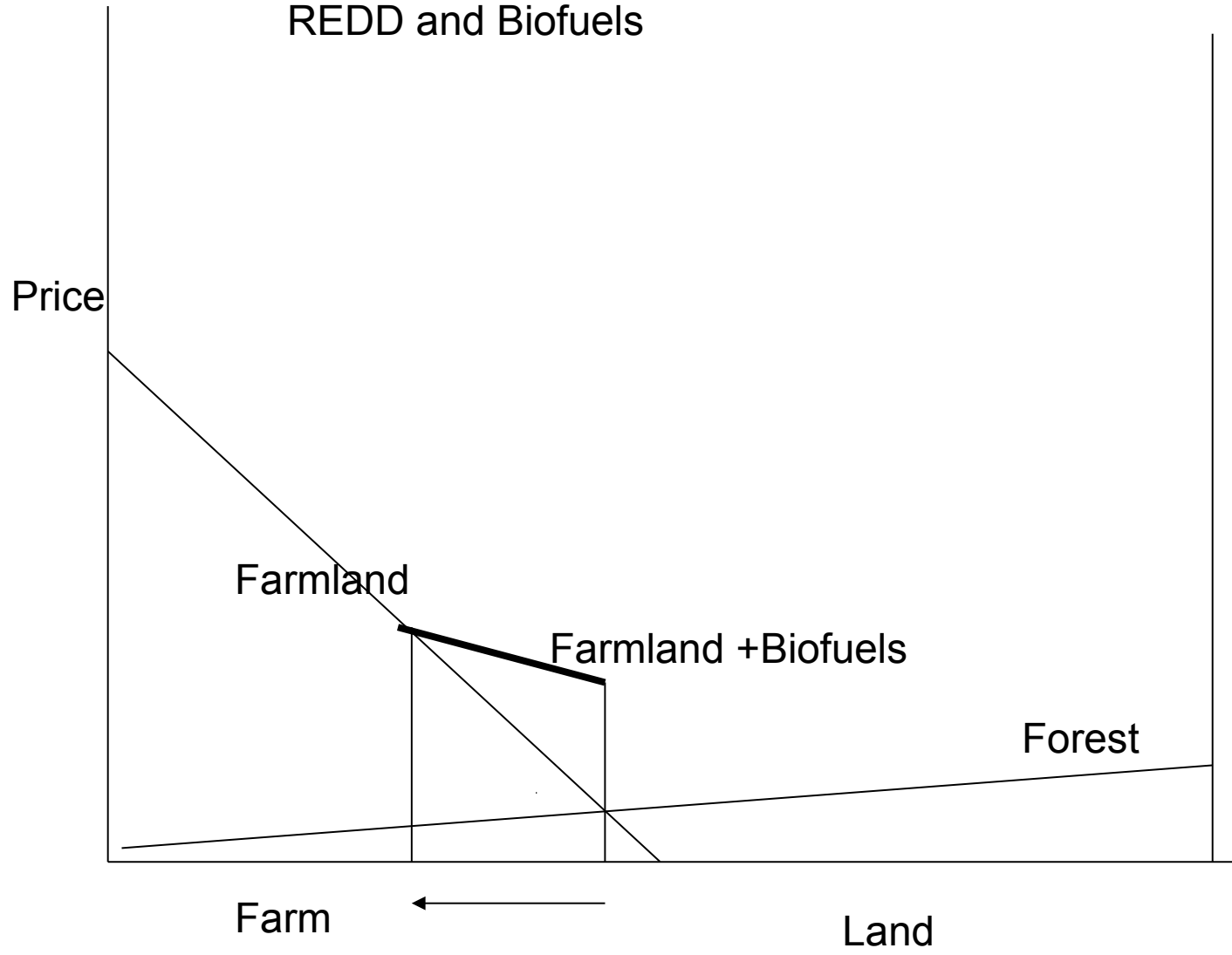
- If the world moves to biofuels, the demand for land for crops and biofuels will increase.
- This will place ever increasing pressure on forest land to be converted to either crops or biofuels
- The net result will likely be a reduction in carbon stored on land



Biofuels +REDD

- REDD can stop deforestation
- But then land for biofuels will have to come from cropland
- Biofuels will be expensive
- Food prices will become very expensive-worse than any impact of climate change

REDD and Biofuels



Sequestration Policies

- Government policies can encourage additional storage of carbon on lands through either regulations or incentives
- For example, farmers can be encouraged to use no-till farming, foresters can extend rotations, conservationists can set aside more forest tracts
- As the value of carbon increases, the incentives should increase