Timber Market Recovery After A Hurricane

Changyou Sun

Associate Professor
Mississippi State University

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When a hurricane hits a forested region, ...

The immediate consequence is tree damage.

Timber quantity = undamaged timber harvest + salvage sales

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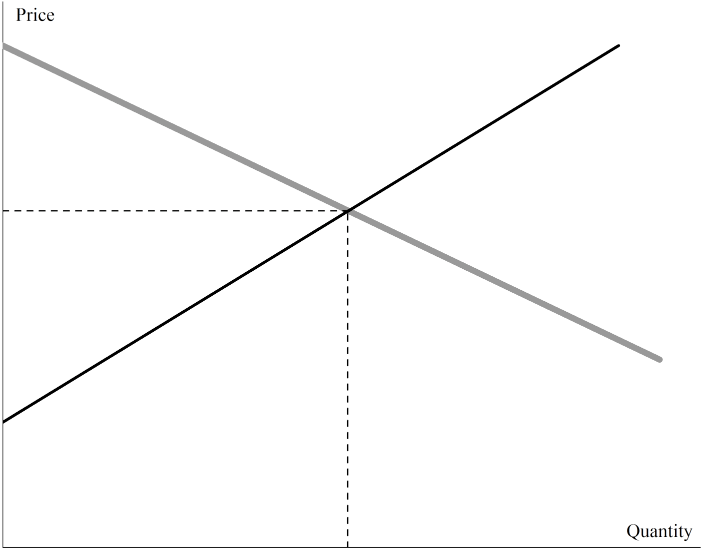
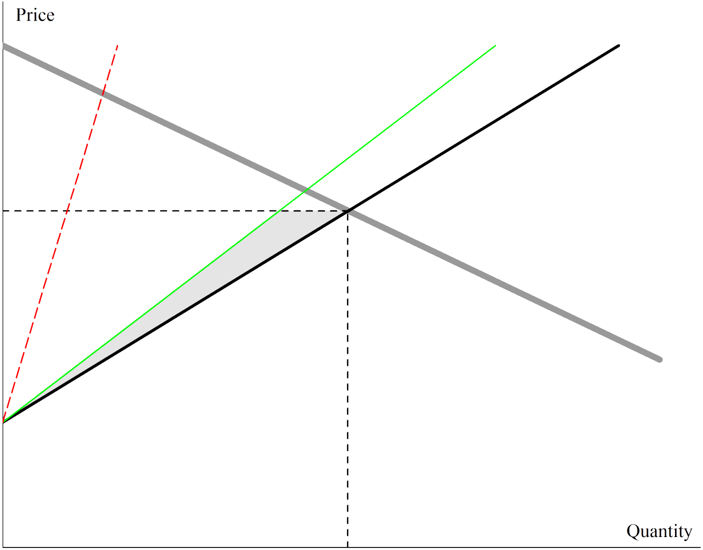
Timber price: opposite impacts

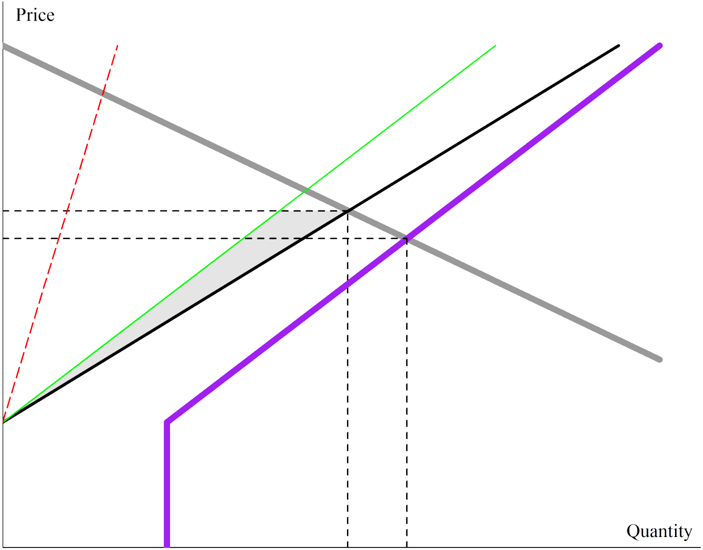
Initial timber market



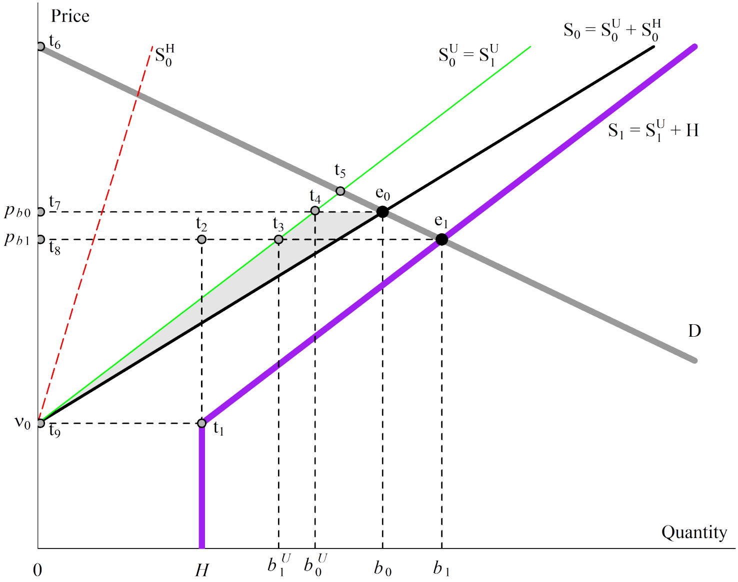
Effect of inventory loss



Effect of salvage sales



Timber market equilibrium after a hurricane



Partial equilibrium model

Structural model for timber b

Timber demand $b = k\,(p_b)$

Timber supply $b = m\,(p_b, I) + \lambda\,\delta\,(I_0 - I)$

Partial equilibrium model

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Total differentiation

Timber demand $\tilde{b} = \eta_b \tilde{p}_b$

Timber supply $\tilde{b} = \varepsilon_b \tilde{p}_b + \varepsilon_I \tilde{I} - \lambda\delta \frac{I_0}{b_0} \tilde{I}$

Partial equilibrium model

Solve the system symbolically

$$\tilde{p}_b = \frac{\varepsilon_I}{\eta_b - \varepsilon_b}\tilde{I} - \frac{\lambda \delta I_0}{(\eta_b - \varepsilon_b)\, b_0}\tilde{I}$$

Partial equilibrium model

Solve the system symbolically

$$\tilde{p}_b = \frac{\varepsilon_I}{\eta_b - \varepsilon_b}\tilde{I} - \frac{\lambda \delta I_0}{(\eta_b - \varepsilon_b)\, b_0}\tilde{I}$$

Solve the system numerically

$$\tilde{p}_b = \frac{1.0}{-0.6 - 0.4} \times (-0.15) - \frac{0.14 \times 0.25 \times 100}{-0.6 - 0.4} \times (-0.15)$$

$$\tilde{p}_b = 0.15 - 0.525 = -0.375$$

Knowledge gap

- Stumpage market only; logging, manufacturing, and lumber markets ignored
- Buyer and seller power of industrial firms ignored
- Limited comparison of various policy options

Objective

The objective is to assess the impact of hurricanes on market equilibrium and compare the effectiveness of different policy options for recovery.

The sawtimber and lumber market in the Southeast District in Mississippi after Hurricane Katrina of 2005 will be used as an illustration.

Method

The method employed is a partial microeconomic equilibrium model with both static and dynamic components.

Method

Major steps:

- Developing a structural model with 10 equations
- Deriving the differential form
- Solving the model numerically for 5 quarters separately
- Conducting a sensitivity analysis with different parameter values
- Evaluating different policy interventions

Complete structural model

2 stages: harvesting and processing

5 commodities: y, x, a, b, c

Market participants: loggers, landowners, sawmills, consumers

(1) $y = u\,(p_y, W)$	Demand for lumber product y
(2) $y = f\,(x, a)$	Production function for y (stage 1)
(3) $p_x(1+\Omega) = p_y(1+\Psi)\,f_x$	Demand for log x
(4) $p_a = p_y(1+\Psi)\,f_a$	Demand for processing service a
(5) $a = g\,(p_a, R)$	Supply for a
(6) $x = h\,(b, c)$	Production function for x (stage 2)
(7) $p_b = p_x\,h_b$	Demand for stumpage b
(8) $p_c = p_x\,h_c$	Demand for logging service c
(9) $b = m\,(p_b, I) + \lambda\,\delta\,(I_0 - I)$	Supply for b
(10) $c = n\,(p_c, Z)$	Supply for c

Data sources

Data features:

- Katrina of 2005
- Sawtimber and lumber products
- Southeast District of Mississippi: 15 counties
- Parameters of initial equilibrium: five markets (y, x, a, b, c)
- 10 elasticities with uncertainty: triangular distribution
- Exogenous variables: five shifters

Mississippi Southeast District

Results: base scenario over 5 quarters

Stumpage price: recovered with less timber salvaged over time

Landowners with undamaged timber: lost first; positive welfare changes when the stumpage price is improved

Landowners with damaged timber: gain first; negative welfare changes when salvage sales stop

Loggers and mills: only small gain from the process

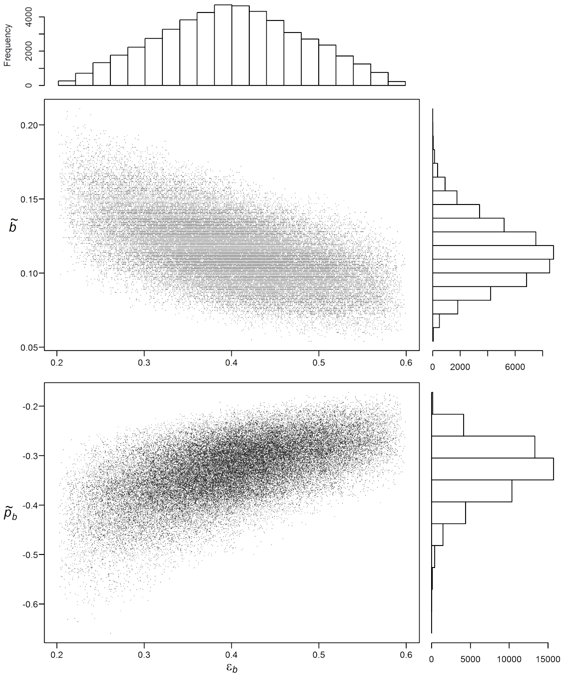
Results: parameter uncertainty

Simulation: triangular distribution; 50,000 random draws

Large impacts from 3 out of 10 parameters

- price elasticity of demand for lumber products ($|\eta_y|$)
- price elasticity of supply for stumpage (ε_b)
- inventory elasticity of supply for stumpage (ε_I)

Output conjectural elasticities of market power: some moderate impact on lumber P and Q, but a small impact on the delivered timber and stumpage markets



Frequency
0
2000
4000
$\tilde{b}$
0.05
0.10
0.15
0.20
0.2
0.3
0.4
0.5
0.6
0
2000
6000
$\tilde{p}_b$
-0.6
-0.5
-0.4
-0.3
-0.2
0
5000
10000
15000
ε_b

Results: policy intervention

Simulation and comparison among five shock types

- Salvage sales
- Inventory loss
- Increase in lumber product demand
- Expansion of harvesting service
- Expansion of processing service

Salvage sales >> inventory loss effect >> product demand increase

Expansion in the processing and harvesting services has a small impact.

Summary

The immediate bearing of a hurricane on forests is tree damage and an increase of timber supply during salvage operations.

A hurricane also can increase lumber demand in impacted regions during reconstruction phase.

Governments often have various policies in helping forest communities recover from the disturbance.

Summary

The market evolution after a hurricane is inherently dynamic and the recovery of timber market takes time.

This disturbance to timber supply will be passed to other markets through the vertical linkage of harvesting and processing.

Market participants will gain or loss from the change, depending on their position in the market and the speed of recovery in the timber market.

Summary

Policy intervention related to lumber product demand has the best promise in facilitating recovery of timber market.

Governments:

- help homeowners start rebuilding activities soon;
- encourage home builders to use lumber from damaged region

Thank you.