

Hardwood Lumber Becoming More Price Elastic and More Likely to Be Substituted

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Outline

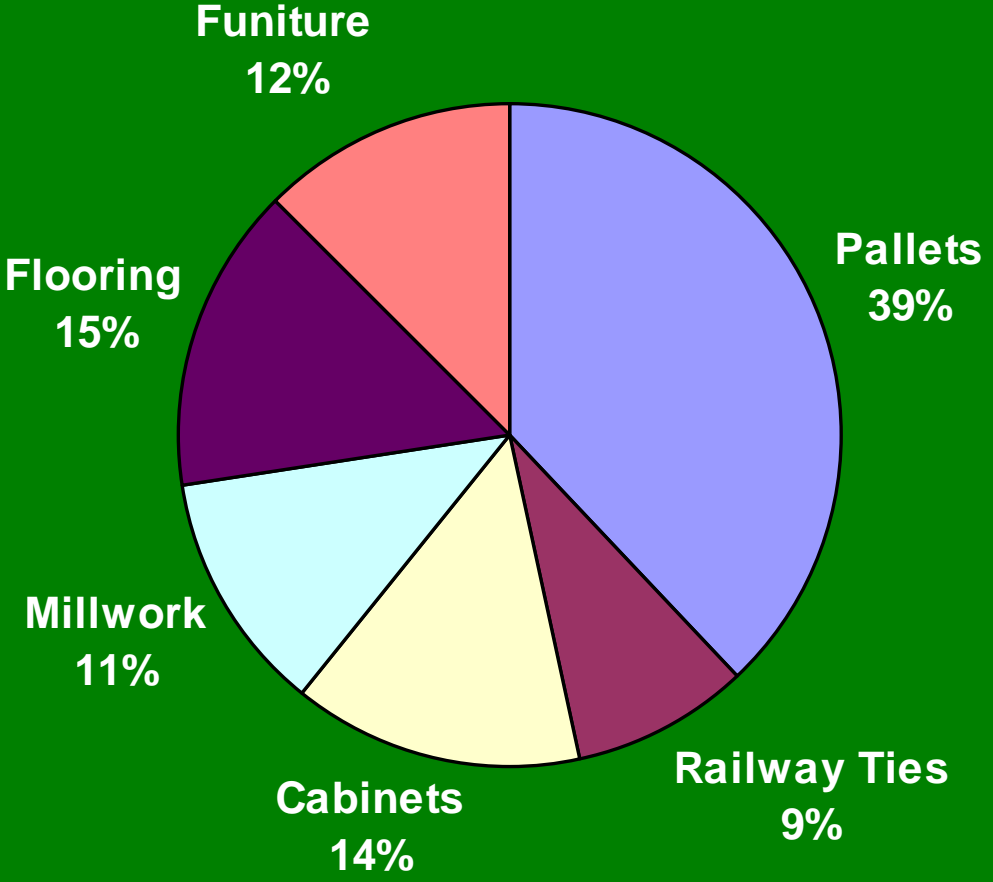
- A brief review of lumber consumption.
- Model and estimated results.
- Calculated elasticities over time.
- Analyses of contributions of variables
- Some opinions of the future demand and price.

Hardwood Lumber Demand 2004

- Industry 4.9 billion bf
 - Pallets 4 billion bf
 - Railway ties 0.9 billion bf
- Construction 4.3 billion bf
 - Millwork 1.2 billion bf
 - Cabinets 1.5 billion bf
 - Flooring 1.6 billion bf
- Furniture 1.3 billion bf

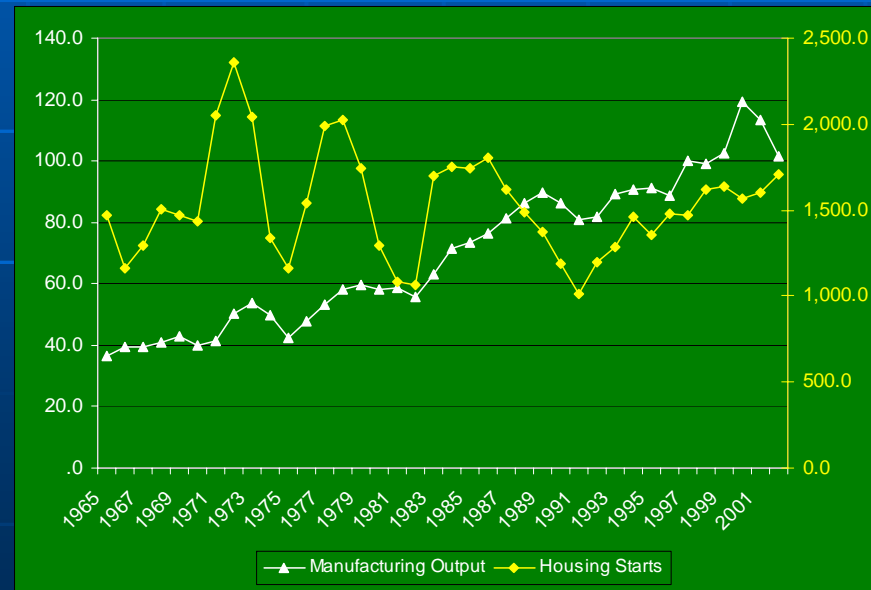
■ (Data from Hardwood Market Report)

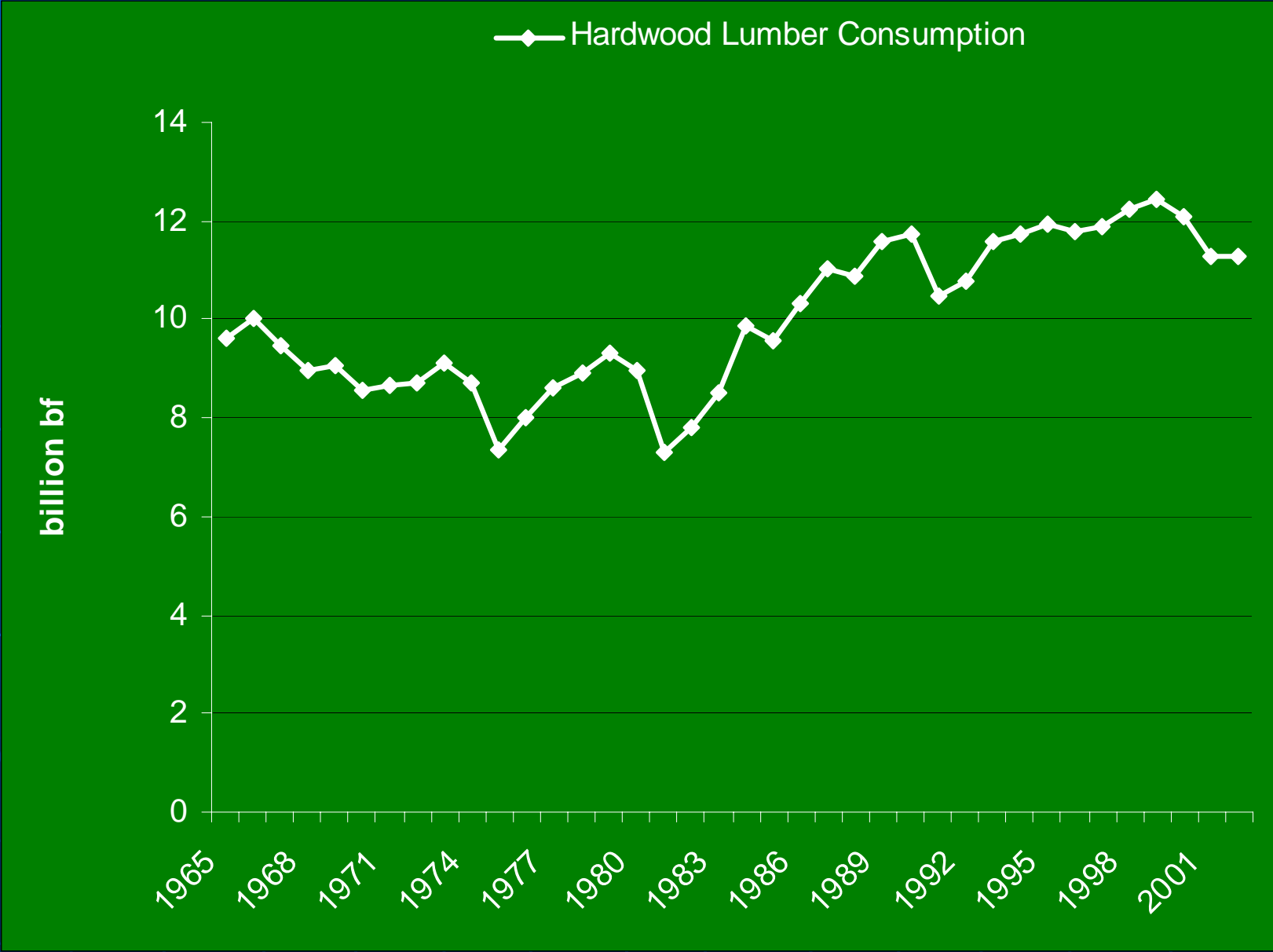
Hardwood Lumber Consumption



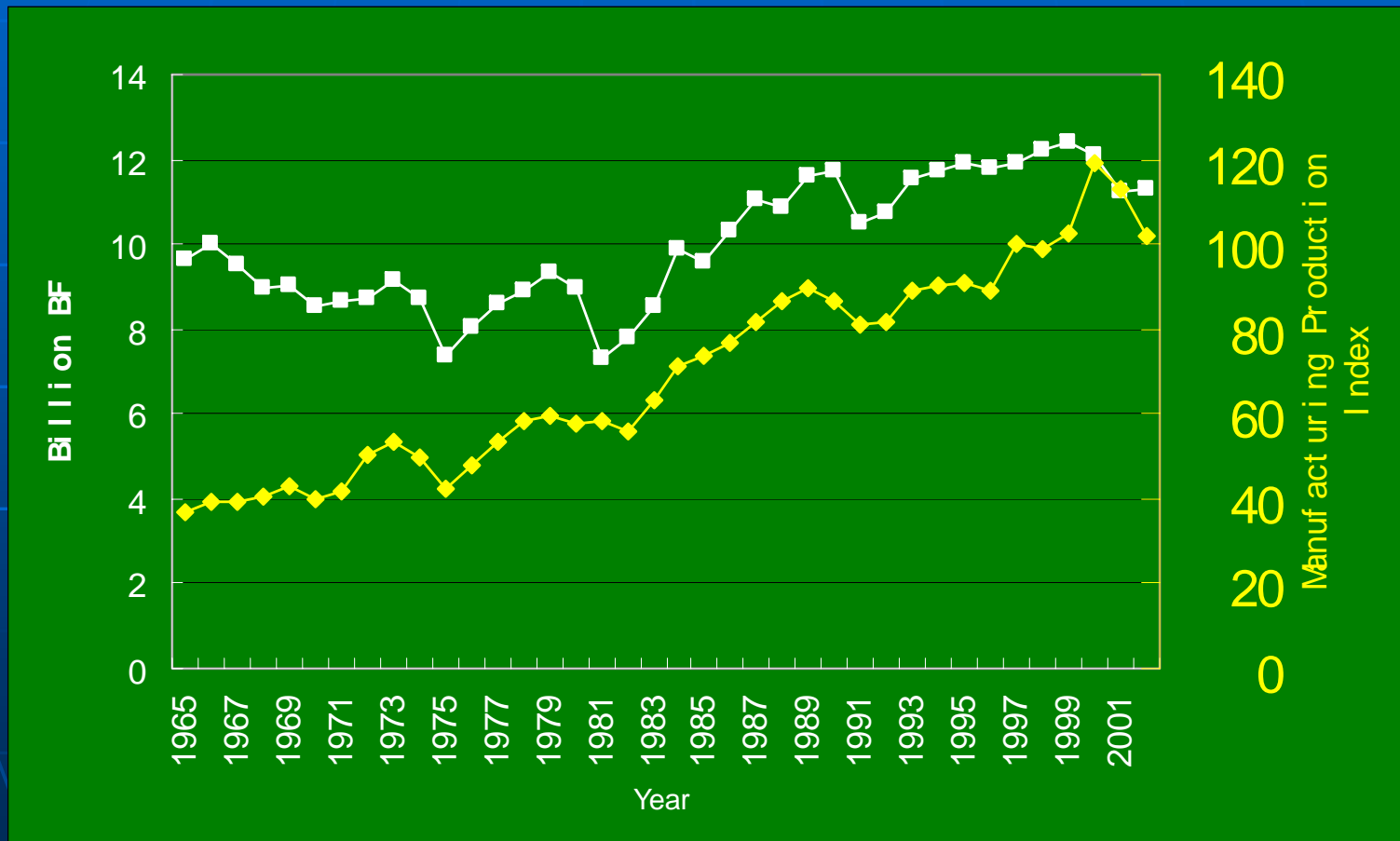
Manufacturing Industry is the Driving Force of Hardwood Lumber Demand

- Manufacturing industry
 - Includes most of the end-use industries using hardwood lumber.

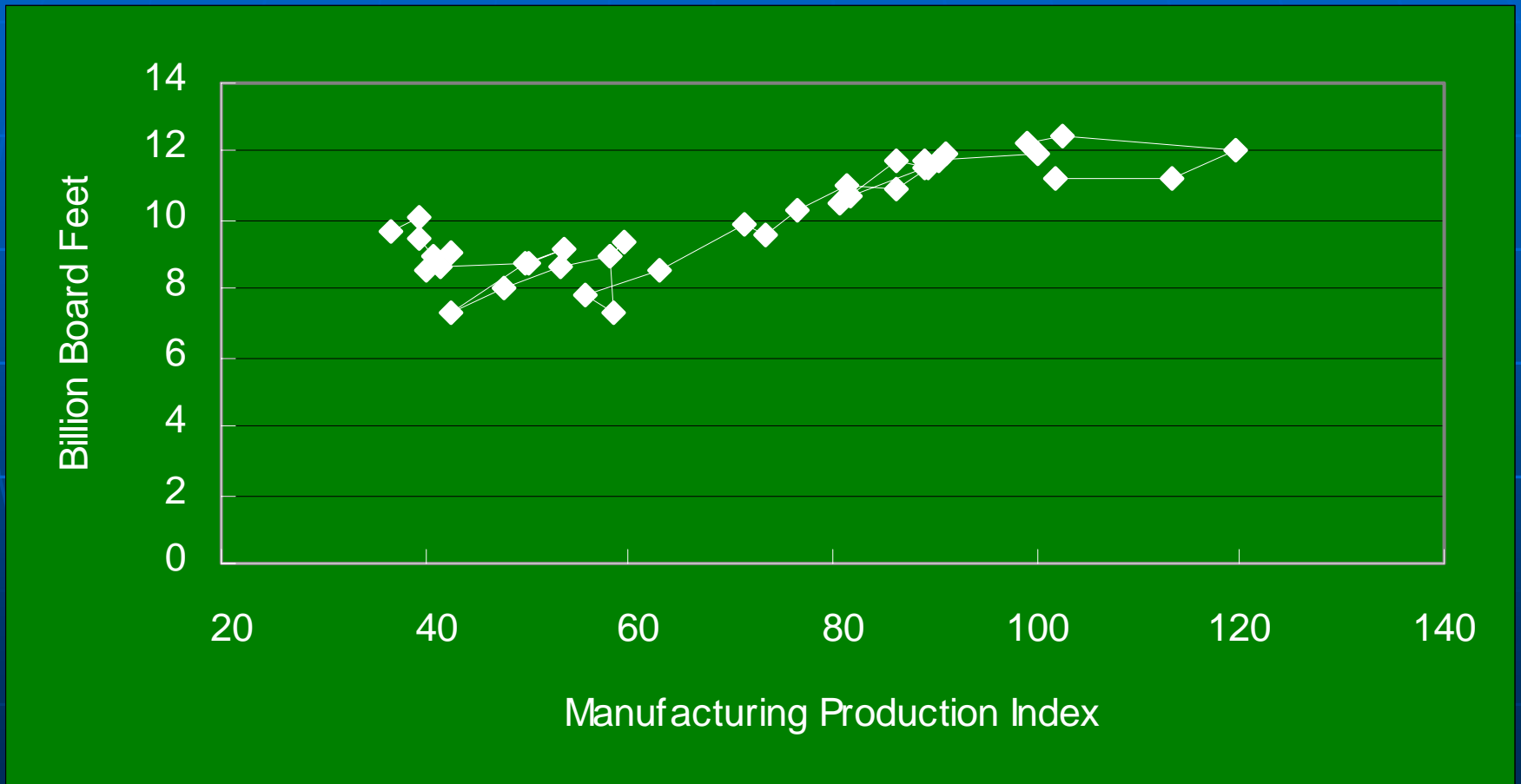


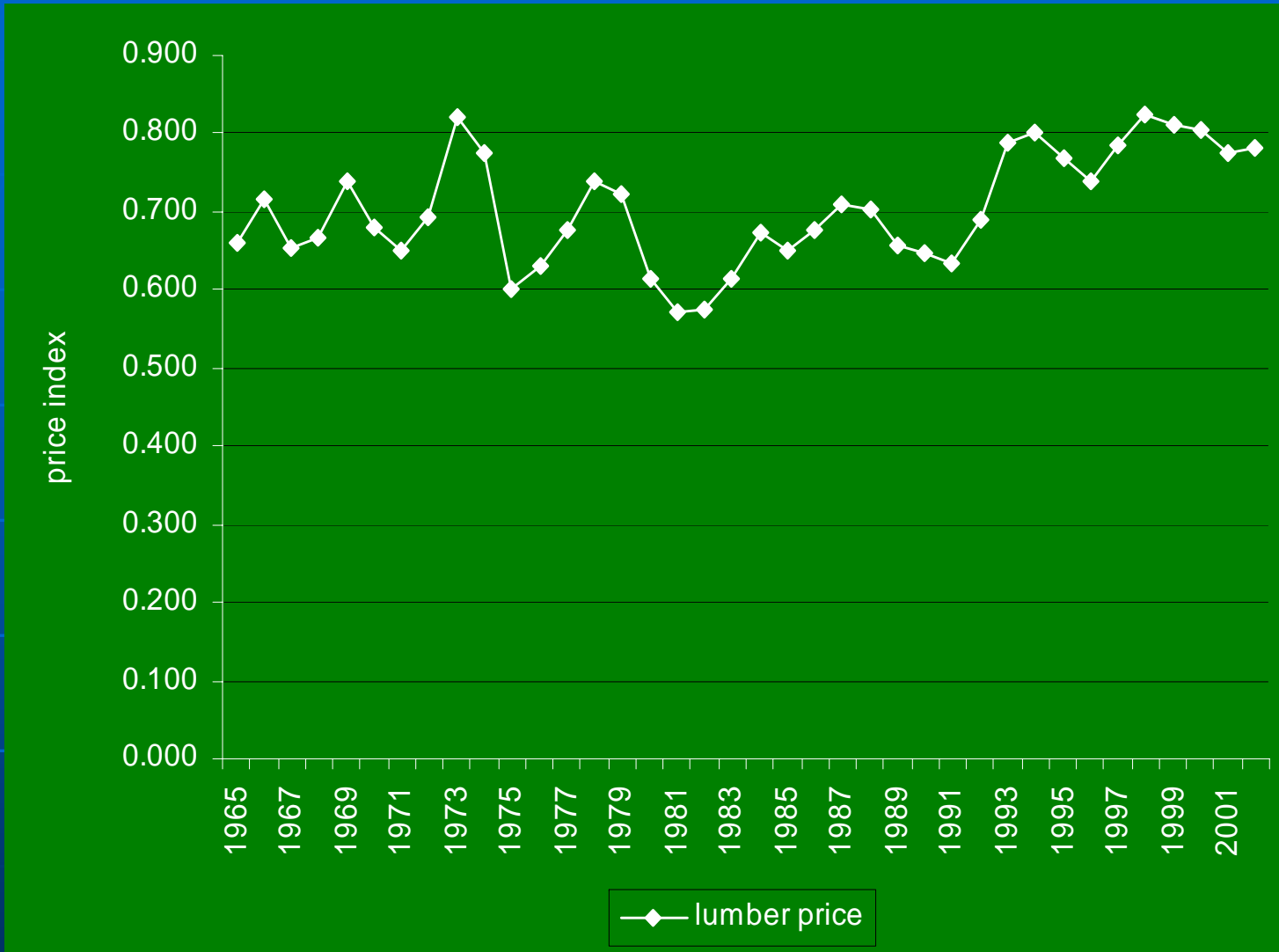


Hardwood Lumber Consumption Following Manufacturing production



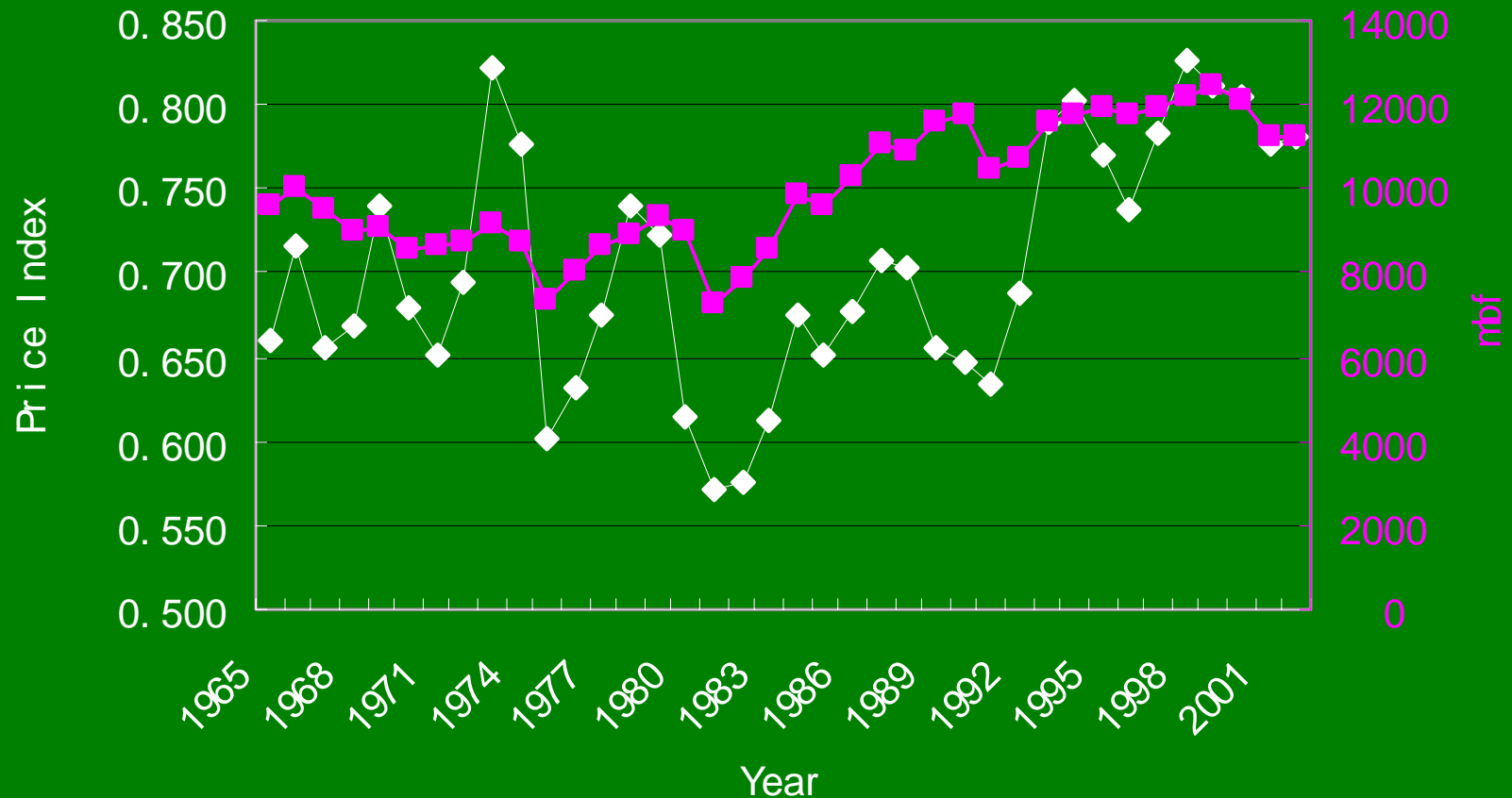
Manufacturing Drives the Hardwood Lumber Demand





Adjusted with PPI

Hardwood Price Following Hardwood Consumption

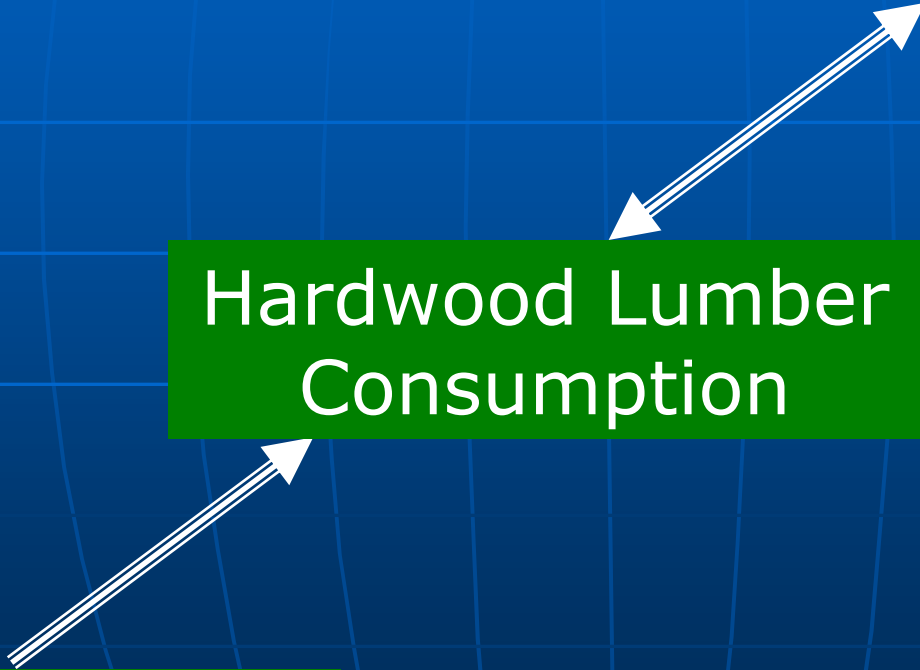


Observed

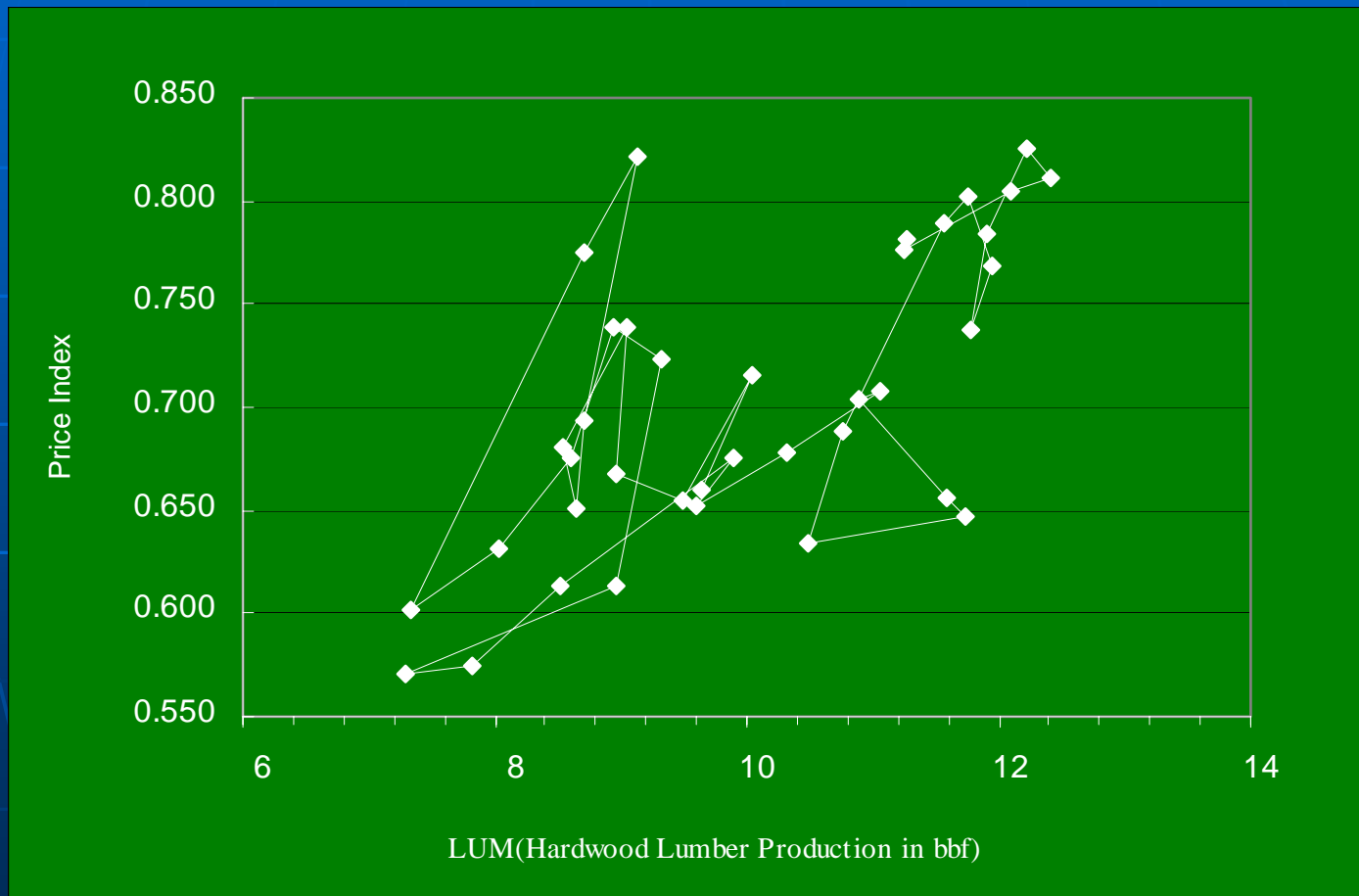
Hardwood Lumber
Price

Hardwood Lumber
Consumption

Manufacturing



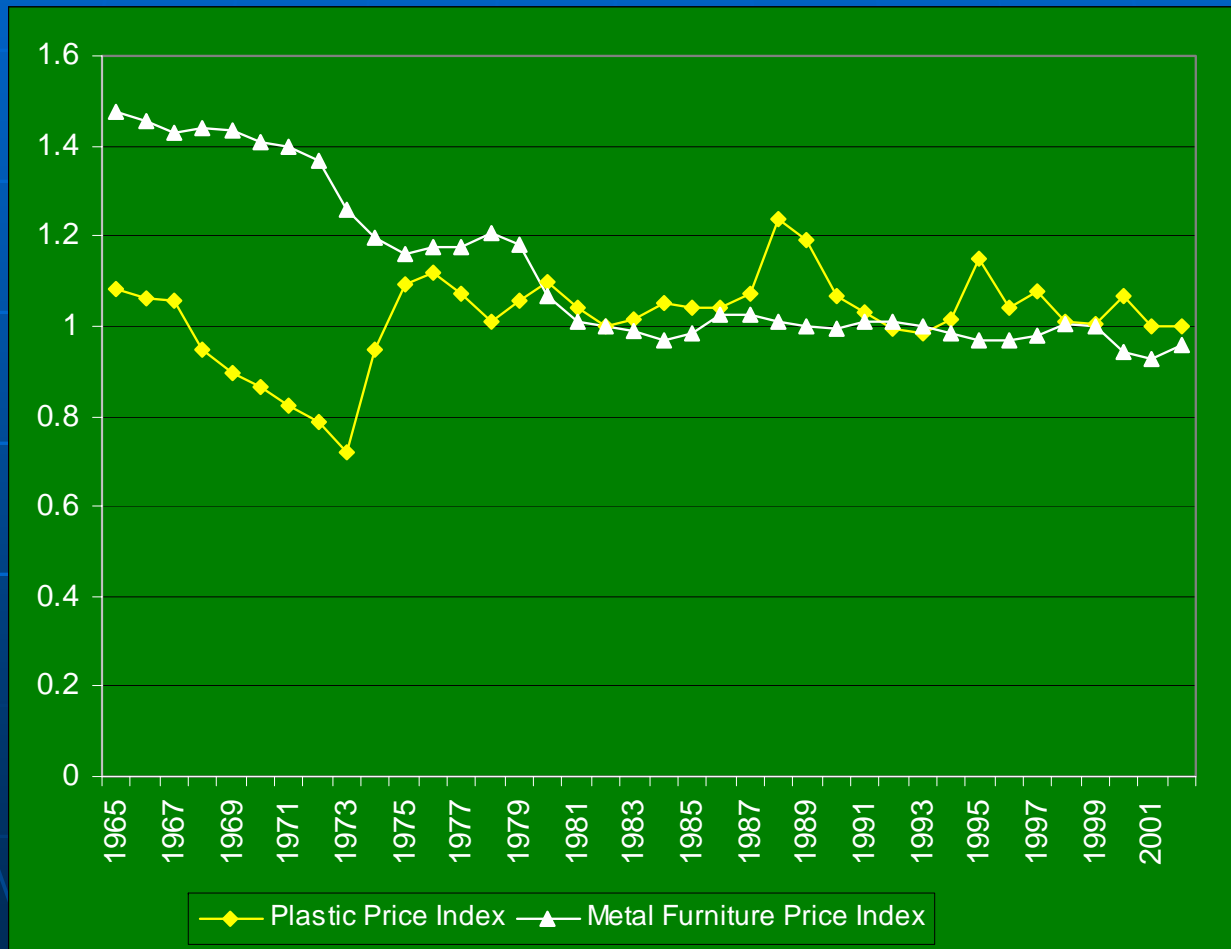
Demand Shift Along Supply Curve



Substitutes and Complements

- Wood substitutes:
 - Hardboard, Particle board, fiber board.
- None-wood substitutes:
 - Steel for furniture, windows, doors
 - Plastic for furniture, windows, doors
- Capital
- Electricity

Plastic and Metal Price Indices



Model

- **Generalized Leontief demand equation** (Diewert and Wales, 1987).

$$\frac{Lum_t}{Mf_t} = b_0 + \sum_{i \neq Lum} b_i \left(\frac{P_{i,t}}{P_{lum,t}} \right)^{1/2} + b_{Mf} Mf_t + b_t t + b_{t2} t^2 + \varepsilon_{gt}$$

Elasticities

$$e_{i,t} = \frac{1}{2} b_i \left(\frac{P_{i,t}}{P_{lum,t}} \right)^{1/2} \frac{Mf_t}{Lum_t}$$

$$\begin{aligned} e_{lum,t} &= -\frac{1}{2} \sum_i b_i \left(\frac{P_{i,t}}{P_{lum,t}} \right)^{1/2} \frac{Mf_t}{Lum_t} \\ &= -\sum_i e_{i,t}. \end{aligned}$$

$$e_{Mf,t} = 1 + b_{mf} \frac{\mathcal{E}''(Mf_t)^2}{Lum_t}$$

Estimation

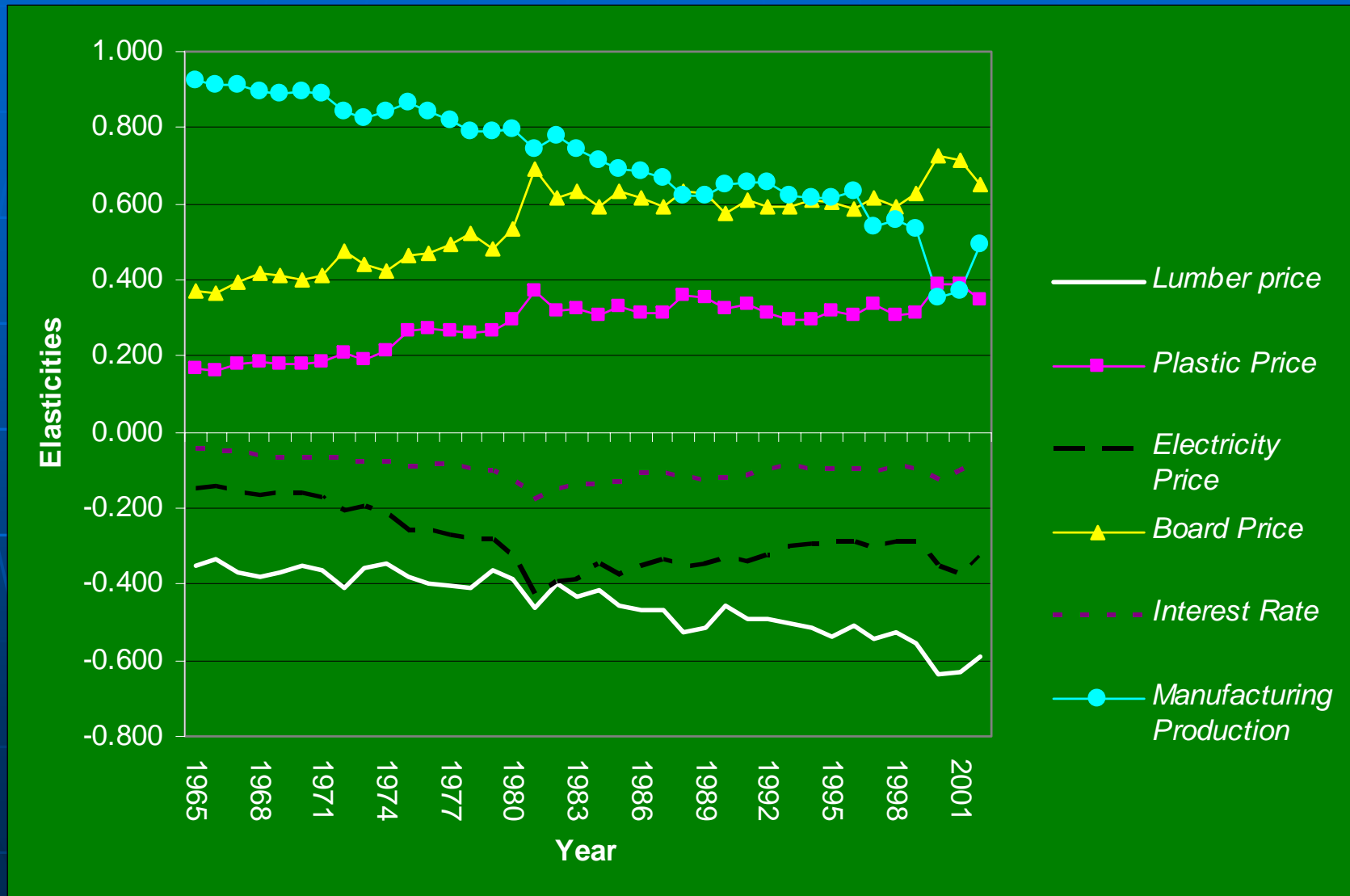
- Fully Modified Least Square (FMOLS) by Philips and Hansen (1990)
- All the coefficients are significant at 2% level except that of t^2 .
- $R^2 = 0.97$
- $DW = 2.02$

Variables	Coefficients	Significance level
b_0	93.909	0.000
$P_{pla,t}/P_{lum,t}$	68.363	0.000
$P_{ele,t}/P_{lum,t}$	-29.644	0.000
$P_{boa,t}/P_{lum,t}$	131.438	0.000
$P_{cap,t}/P_{lum,t}$	-8.843	0.015
$Mf_{,t}$	-0.551	0.010
t	-2.493	0.013
t^2	0.028	0.157
R^2	0.97	
DW	2.02	

Changing Elasticities

Models	Generalized Leontief			Cobb-Douglas
Variables	1965	2002	Average Elasticities	
$P_{lum,t}$	-0.351	-0.589	-0.450	-0.295
$P_{pla,t}$	0.166	0.349	0.283	0.231
$P_{ele,t}$	-0.145	-0.329	-0.284	-0.318
$P_{boat,t}$	0.372	0.648	0.548	0.457
$P_{cap,t}$	-0.042	-0.080	-0.097	-0.074
Mf_t	0.923	0.495	0.719	0.731

More Price Elastic



Proportionally Decreasing Demand for Hardwood Lumber

- In 1965 the hardwood lumber production would increase **0.923%** for each percent of additional production in manufacturing.
- This effect was only **0.495%** for 2002
- Possible reason is the existence of substitutes.

Wood Substitution Effect

- Board price elasticity of hardwood lumber demand increased from 0.372 in 1965 to 0.648 in 2002.
- When lumber price increases more hard wood lumber will be replaced by hard board, particle board and fiber board.
- With cheaper wood substitutes, more hardwood lumber will be replaced

Non-Wood Substitution Effect

- The plastic price elasticity of hardwood lumber demand increased from 0.166 in 1965 to 0.349 in 2002
- When lumber price increases more hard wood lumber will be replaced by hard board, particle board and fiber board.
- With cheaper plastic and metals, more hardwood lumber has been replaced.

Electricity and Interest Rate

- Electricity price has a negative effect on hardwood lumber demand, and the effect increased before 1981 and slightly decreased after 1981.
- Interest rate has a smaller negative effect on hardwood lumber demand, and this effect increased before 1981 and slightly decreased after 1981.

Contribution of Lumber Price and Manufacturing

- From 1965 to 2002 real lumber price increased 18.4%.

$$\Delta \text{Lum} / \text{Lum} = \varepsilon_{\text{lum}} * \Delta P / P$$

- With average elasticity -0.45, the change in lumber consumption is approximately -8% (the total lumber hardwood lumber consumption changed 17%) in the 38 years.
- Manufacturing elasticity of hardwood lumber demand is averagely 0.719.
- The lumber demand could have changed 128% because of manufacturing that has increased 177%.

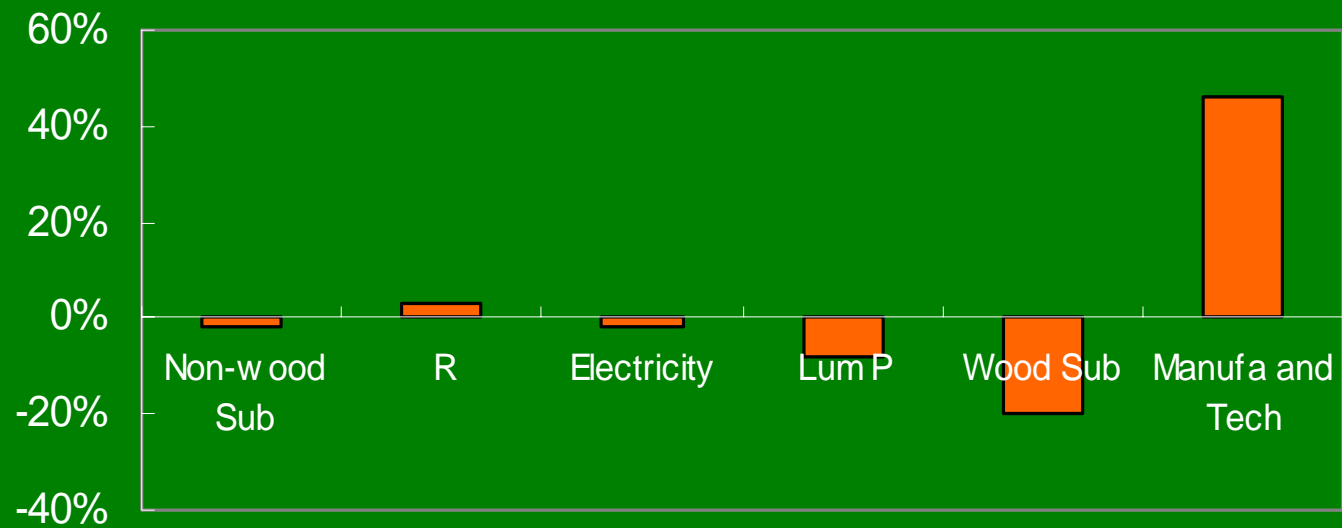
Contribution from Other Prices

- Price of non-wood products contributes -2%
- Electricity price contributes -2%
- Price of wood products contributes -20%
- Interest rate contributes 3%
- Technological progress in manufacturing industries (the trend effect) contributes -82%
- The net effect of manufacturing production and technological progress of manufacturing production in the 38 years is 46%.

Contributions(I)



Contributions(II)



Real Price of hardwood lumber Is Expected to Go up Slightly in the Long-Run with Less Vibration

- Historical price shows that the real price of hardwood lumber did not grow very much in the long-run because of substitutions.
- Manufacturing will continue to drive demand for hardwood lumber in the long-run. And price will increase slowly in the long-run as demand grows.
- Because of substitutes are more sensitive to changes of lumber price, they are likely moderate increases in hardwood lumber price in the future.
- Long-run waves are possible considering the nonstationary property of the hardwood lumber price.
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Conclusion (I)

- Elasticities of hardwood demand are increasing, and hardwood lumber is **more likely to** be substituted although the consumption may not decrease in the long-run because of the manufacturing effect.
- Hardwood lumber price and production are expected to **go up slowly with less vibration.**

Conclusion (II)

- Lumber is mainly **substituted by wood products** such as hard board, particle board and fiber board.
- Technological progress eliminates a part of the manufacturing's demand effect for hardwood lumber, and the net effect of the two in the 38 years is **46%**

Conclusion (III)

- In the same period, growth in lumber price reduced the lumber demand for **8%**.
- Interest rate, electricity and non-wood products have changed lumber demand **less than 3% in 38 years**.

Questions/comments

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