

# Does Monopolistic Competition Explain the Intra-industry Trade of Forest Products?

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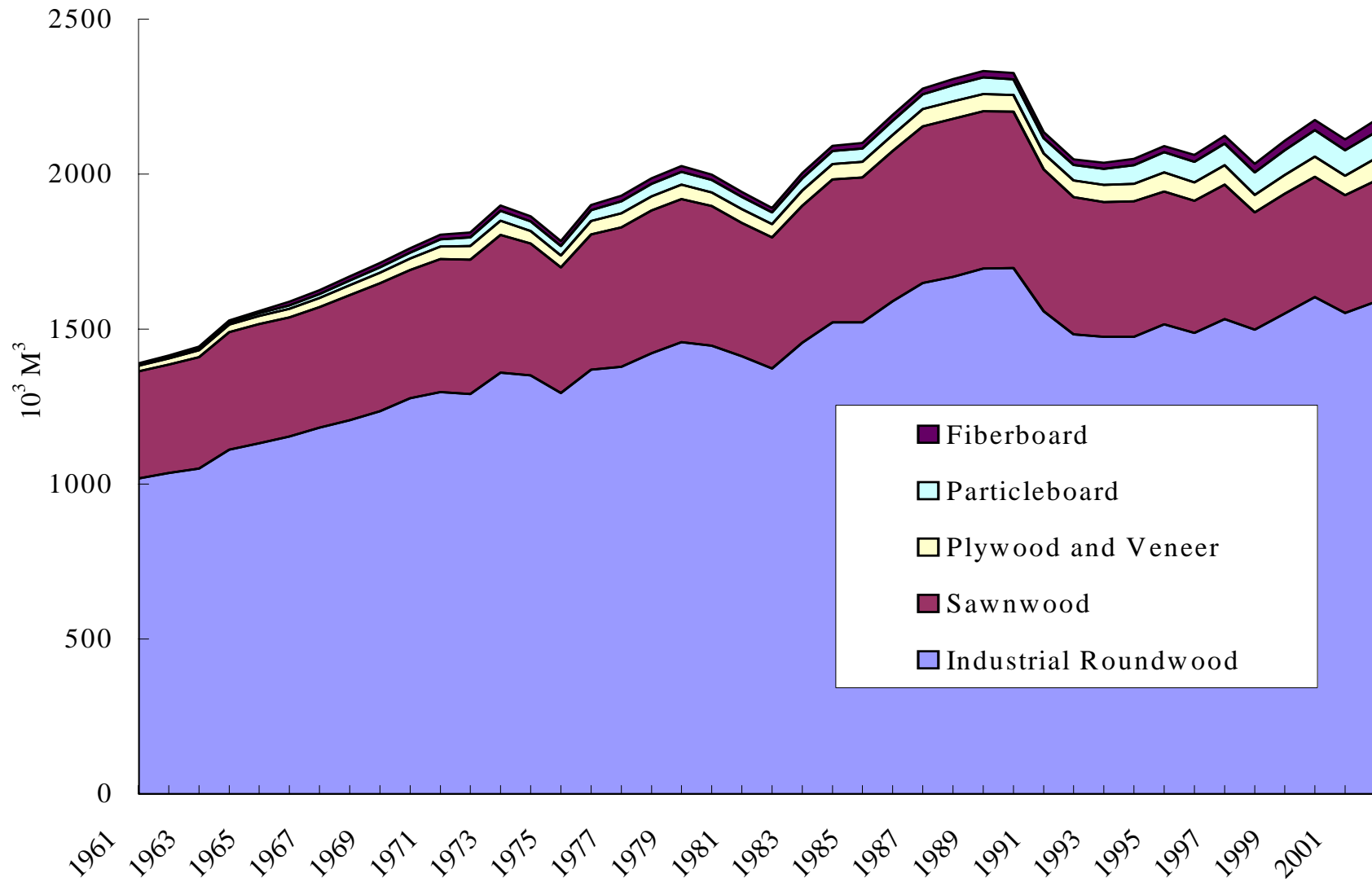
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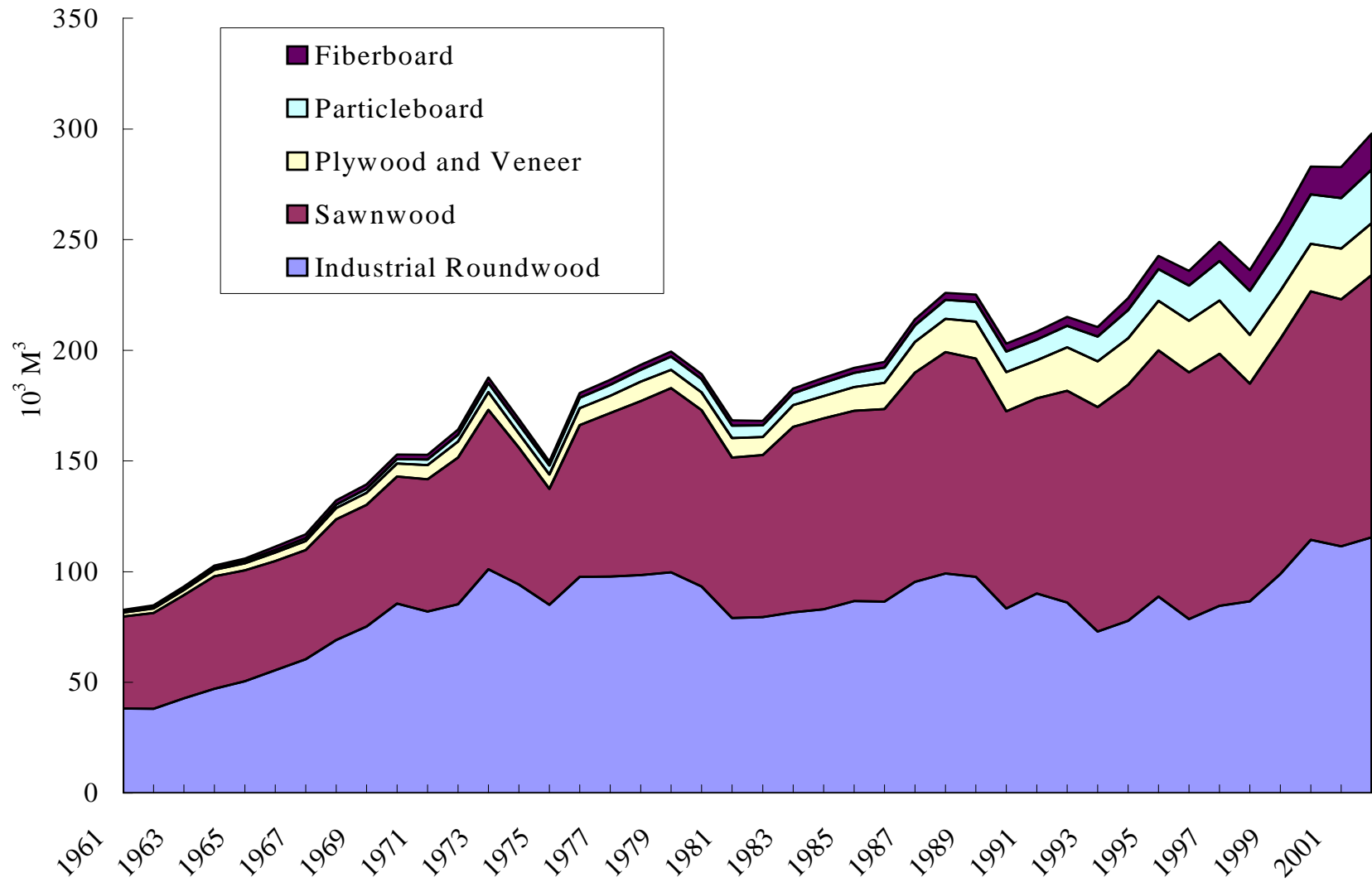
## Background

- Forest products in different forms are traded actively between countries.
- The global trade of forest products grew faster than production after WWII.
- Intra-industry trade can not be explained by competitive advantage models of international trade

# World Production



# World Exports



## Definitions

- Intra-industry trade: exports and imports of products of the same industry.
- Example: United States

In 2002, Industrial Roundwood

imports= 6.6 million M<sup>3</sup>

exports= 11 million M<sup>3</sup>

In 2004, Other Paper and Paperboard

imports= 3.5 million ton

exports= 6.8 million ton

(FAOSTAT)

# Measurement

- Grubel-Lloyd index (Grubel and Lloyd 1975)

$$\bar{G}_i = \frac{\sum_j [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{\sum_j (X_{ij} + M_{ij})}$$

Ranges between 0 and 1

$X_i$  exports

$M_i$  imports

$i = 1, 2, \dots$  products

$j = 1, 2, \dots$  countries

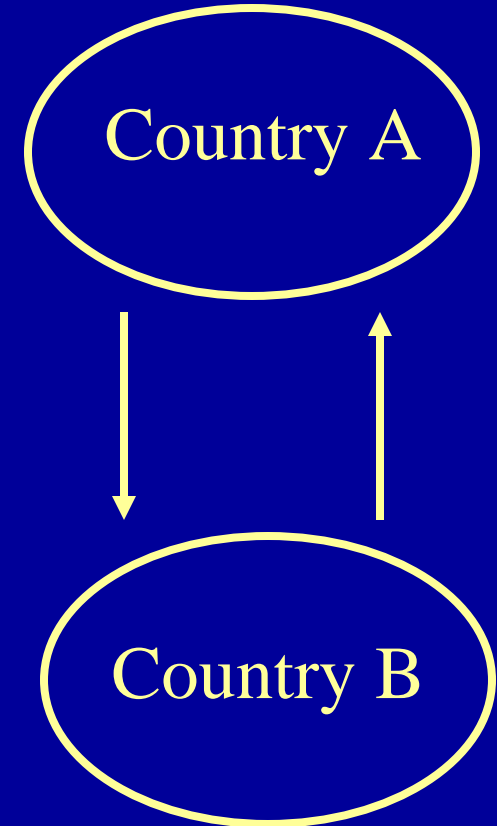
# Monopolistic competition trade theory

Helpman and Krugman (1985)

Scale economy  
+  
Differentiated products

↓  
Monopolistic  
Competition

↓  
Intra-industrial trade  
(Observed and Data)



## Model

- Monopolistic Competition Model:

$$X_{ijk} = s_k Y_{ij}$$

$X_{ijk}$ : exports of product  $i$  by country  $j$  to country  $k$

$s_k$ : importing country  $k$ 's share of world GDP

$Y_{ij}$ : exporting country  $j$ 's output of product  $i$

- Test monopolistic competition hypothesis on intra-industry trade for forest products



Implication for total exports:

$$X_{ij} = s_i Y_{ij}$$

Logarithmic form:

$$\ln(X_{ij}) = \ln(s_i) + \beta_i \ln(Y_{ij}) + \varepsilon_{ij}$$

Test the hypothesis:

$$H_0 : \beta_i = 1$$

$$H_1 : \beta_i \neq 1$$

## Production and export panel data (1961-2002, FAOSTAT)

Industry	Obs.	Production		Exports		Corr	Ratio
		Mean	S.D.	Mean	S.D.		
		$10^5 \text{ m}^3$					
Industrial roundwood	1260	33314	67315	1505	3488	0.64	4.50%
Sawnwood	1554	8226	16874	1720	5407	0.49	20.90%
Plywood/veneer	1344	1253	3181	310	955	0.45	24.70%
Particleboard	462	1330	1912	262	373	0.74	19.70%
Fiberboard	672	735	1437	156	250	0.38	21.20%
		$10^5 \text{ tonne}$					
Mechanical woodpulp	588	1623	2358	86	141	0.41	5.30%
Chemical and semichemical woodpulp	1083	3298	8226	731	1591	0.57	22.20%
Recovered paper <sup>1</sup>	495	3916	6791	591	1375	0.85	15.10%
Newsprint	1382	761	1648	380	1347	0.87	49.90%
Printing and writing paper	588	2850	4330	730	1165	0.26	25.60%
Other paper and paperboard	1092	3740	8405	631	1050	0.71	16.90%

<sup>1</sup>Data from 1970 to 2002



Picture courtesy of Ontario Ministry of Natural Resources

## Grubel-Lloyd Indexes (1961-2002)

Industry	N	Grubel-Lloyd Index		
		Mean	Max	Min
Particleboard	21	0.6	0.82 (Germany)	0.10 (Finland)
Other paper and paperboard	32	0.53	0.95 (Netherlands)	0.07 (Finland)
Fiberboard	37	0.52	0.82 (Italy)	0.14 (Japan)
Printing and writing paper	16	0.48	0.91 (Germany)	0.01 (Finland)
Recovered paper	32	0.41	0.91 (Netherlands)	0.08 (U.S.A.)
Plywood/Veneer	14	0.3	0.80 (Japan)	0.00 (Indonesia)
Chemical/Semichemical wood pulp	14	0.28	0.86 (Morocco)	0.01 (Chile)
Industrial roundwood	17	0.23	0.75 (France)	0.00 (Japan)
Sawnwood	37	0.19	0.85 (Singapore)	0.01 (U.K.)
Newsprint	26	0.11	0.81 (Switzerland)	0.00 (Canada)
Mechanical wood pulp	17	0.07	0.55 (Spain)	0.00 (New Zealand)

## Beta coefficient from static model ( $\beta$ , $H_0: \beta = 1$ )

Industry	Fixed effect	Random effect	Differencing
Industrial Roundwood	1.39**	1.32**	0.60**
Sawnwood	0.85**	0.85**	0.58**
<b>Plywood/Veneer</b>	<b>1.06</b>	<b>1.05</b>	0.40**
Particleboard	1.40**	1.38**	0.72*
Fibreboard	1.47**	1.46**	0.51**
Mechanical Woodpulp	0.53**	0.62**	0.04**
<b>Chemical and Semicheical Woodpulp</b>	1.26**	1.23**	<b>0.86</b>
<b>Recovered Paper</b>	<b>1.05</b>	<b>1.02</b>	0.51**
<b>Newsprint</b>	1.26**	1.24**	<b>0.9</b>
<b>Printing and Writing Paper</b>	1.33**	1.32**	<b>1.01</b>
<b>Other Paper and Paperboard</b>	2.00**	1.98**	<b>0.83</b>

\*\* , \* : significant at 1% and 5% significance level, respectively

## Beta coefficient from dynamic model ( $\beta$ , $H_0: \beta = 1$ )

Industry	Fixed effect	Random effect	Differencing	Arellano-Bond
Industrial Roundwood	0.25**	0.15**	0.57**	-0.01**
Sawnwood	0.13**	0.11**	0.49**	0.42**
Plywood/Veneer	0.09**	0.09**	0.35**	0.35**
Particleboard	0.22**	0.20**	0.70**	0.66**
Fibreboard	0.20**	0.14**	0.50**	0.66**
Mechanical Woodpulp	0.19**	0.25**	0.26	<b>0.91</b>
<b>Chemical and Semicemical Woodpulp</b>	0.23**	0.18**	<b>0.92</b>	0.76**
Recovered Paper	0.23**	0.16**	0.48**	0.10**
<b>Newsprint</b>	0.40**	0.34**	<b>0.98</b>	<b>1.07</b>
<b>Printing and Writing Paper</b>	0.25**	0.20**	<b>1.01</b>	<b>0.97</b>
<b>Other Paper and Paperboard</b>	0.30**	0.22**	<b>0.86</b>	<b>0.62</b>

\*\* , \* : significant at 1% and 5% significance level, respectively

## RMSE (1963 - 2002)

Industry	Static models			Dynamic models			
	FE	RE	FD	FE	RE	FD	AB
Industrial Roundwood	0.59	0.588	0.582	0.773	0.784	0.579*	0.584
Sawnwood	0.554	0.554	0.551	0.766	0.779	0.536*	0.537
Plywood/Veneer	0.517	0.516	0.493	0.656	0.663	0.481*	0.482
Particleboard	0.535	0.535	0.522	0.658	0.665	0.521*	0.522
Fibreboard	0.408	0.407	0.357*	0.479	0.486	0.357*	0.358
Mechanical Woodpulp	0.932	0.932	0.929	1.122	1.14	0.814*	0.829
Chemical and Semicheical Woodpulp	0.507	0.507	0.505*	0.633	0.642	0.508	0.489*
Recovered Paper	0.421	0.42	0.410*	0.583	0.597	0.426	0.431
Newsprint	0.79	0.789	0.785	1.007	1.029	0.736*	0.736*
Printing and Writing Paper	0.319	0.319	0.316	0.419	0.425	0.315*	0.315*
Other Paper and Paperboard	0.39	0.39	0.372*	0.518	0.526	0.375	0.377

\* smallest root mean square error

## Long-run elasticity by first differencing ( $H_0: LRE = 1$ )

Industry	Elasticity $\beta / (1 - \gamma)$
Industrial Roundwood	0.55**
Sawnwood	0.43**
Plywood/Veneer	0.33**
<b>Particle board</b>	<b>0.74</b>
Fibreboard	0.49**
Mechanical Woodpulp	0.20**
<b>Chemical and Semicemical Woodpulp</b>	<b>0.83</b>
Recovered Paper	0.43**
<b>Newsprint</b>	<b>0.85</b>
<b>Printing and Writing Paper</b>	<b>1.02</b>
Other Paper and Paperboard	0.79*

\*\* , \* : significant at 1% and 5% significance level, respectively



## Conclusion

- International trade data support the theory of monopolistic competition as an explanation of intra-industry trade for pulp and paper industries, but not other forest products.
- More likely due to economies of scale
- Use the model on secondary manufacturing products/consumer products.



**Thank you!**

**Questions?**