The International Rice Market:

Market Integration and Import Demand Analysis

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Motivation

- Global CGE models used for trade analysis
- No better than the theory and data underpinning it
- Econometric critique of parameters used in CGE models
- This paper contributes to on-going effort of providing an econometric foundation for the parameters used in GTAP
- Limited scope:
  - Elast. of subst. between imports from different sources
  - Rice

Analytical Approach

Step 1: Is the Armington structure appropriate ?

Cointegration analysis to determine integration of submarkets $\rightarrow$ homogenous or heterogenous goods

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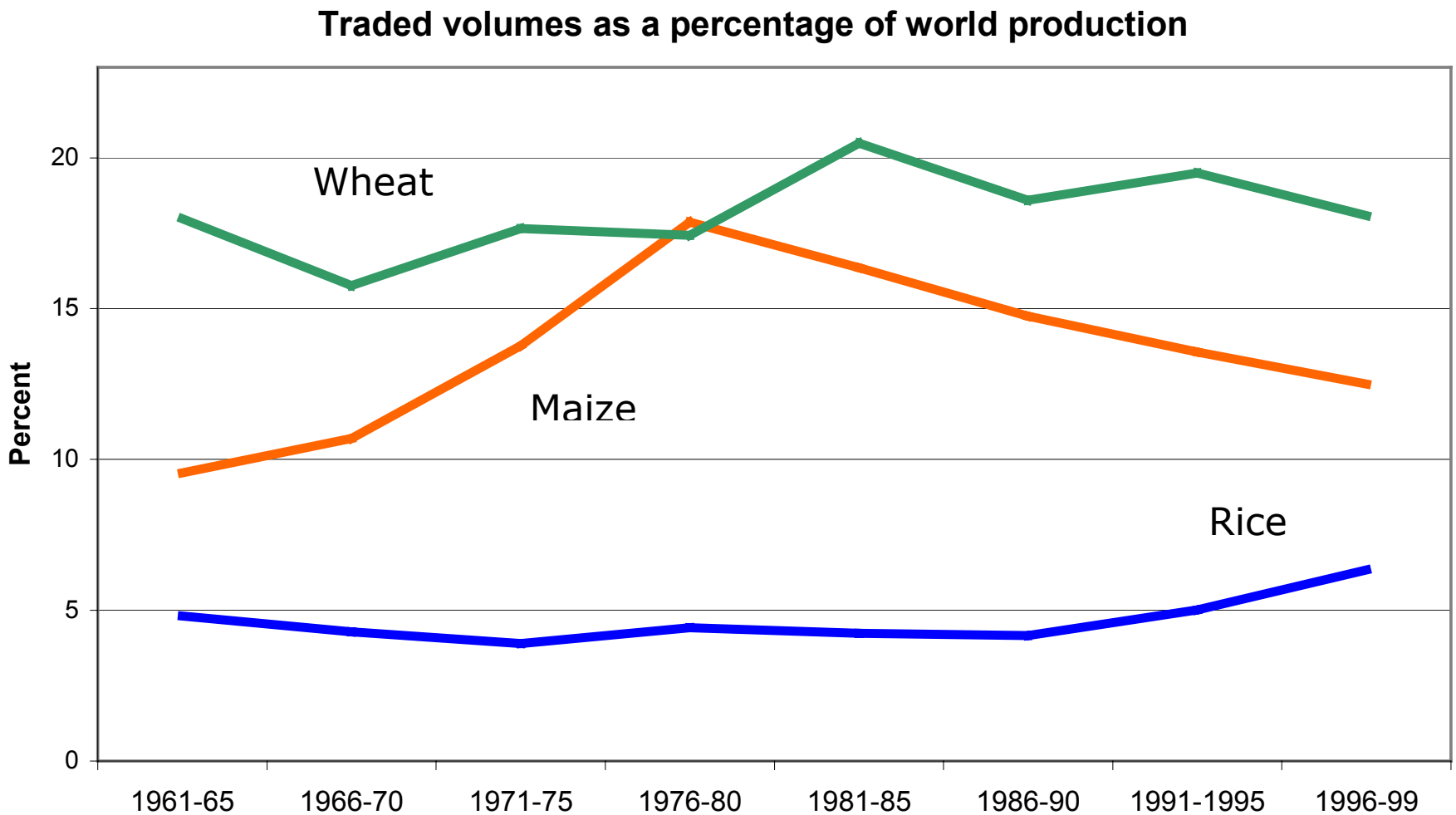

Source: FAOSTAT (2001)

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  - Vietnam 18%
  - China 10-11%
  - USA 10-11%
  - India 10-11%
  - Pakistan 7%

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- **A few large and many smaller importers:**

  - Indonesia, Bangladesh, Philippines, Malaysia
  - Middle East, Sub-Saharan Africa
  - Latin America and Caribbean
  - European Union

Background

Rice policies

- Rice: staple food in almost all rice-producing Asian cntrs
- Key policy obj: self-sufficiency and stable domestic prices

Restrictive trade policy instruments

Domestic support measures

} Isolated markets

- State trading enterprises
- *Ad valorem* tariffs, specific t's, combin. t's, variable levies
- Import and export quotas, seasonal bans, TRQs
- Export subsidies
- Preferential trade agreements, govt to govt contracts

Cointegration analysis

- **Determine validity of Armington assumption of product heterogeneity**

- **Law of One Price (LOP)**

  Test for $\beta_1 = 1$ in equation $\ln(p_1) = \beta_0 + \beta_1 \ln(p_2) + \varepsilon_t$

- **Prices are non-stationary. To avoid invalid inference and spurious regressions $\rightarrow$ use cointegration to identify stable long-run relations between prices**

- **Vector Autoregressive (VAR) model in VECM form:**

  $$\Delta X_t = \Pi X_{t-1} + \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k} + \Phi D_t + \varepsilon_t$$

  where X_t is a vector of p endogenous variables, ie. prices

Hypothesis testing

Law of One Price	Products
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Law of One Price	Long run exclusion	Products
Accepted		Perfect substitutes
Rejected	Accepted	Non-substitutable
Rejected	Rejected	Imperfect substitutes

Hypothesis testing

Also test for weak exogeneity: response to disequilibrium

Classification of markets:	Long run exclusion	Weak exogeneity
Long run segmented markets	√	√
Long run leader markets	x	√
Long run follower markets	x	x
Long run regulator markets	√	x

Data

Monthly price series: **Rice type/quality**

Very high quality:	**US 2/4** **Thai 100**
High quality:	**Thai 5%** **Vietnamese 5%** **Indian 5%**
Low quality:	**Thai 25%** **Vietnamese 25%** **Indian 25%**
Very low quality:	**Thai A1 Super**

Available for 1990:01 – 2001:12, i.e. 144 observations
Except India 1996:01 – 2001:12, i.e. 72 observations

Deflated by relevant CPI

Data

Monthly price series:	Rice type/quality	Avg. (real) price USD/ton
Very high quality:	US 2/4	291
	Thai 100	213
High quality:	Thai 5%	205
	Vietnamese 5%	112
	Indian 5%	220
Low quality:	Thai 25%	167
	Vietnamese 25%	90
	Indian 25%	198
Very low quality:	Thai A1 Super	86

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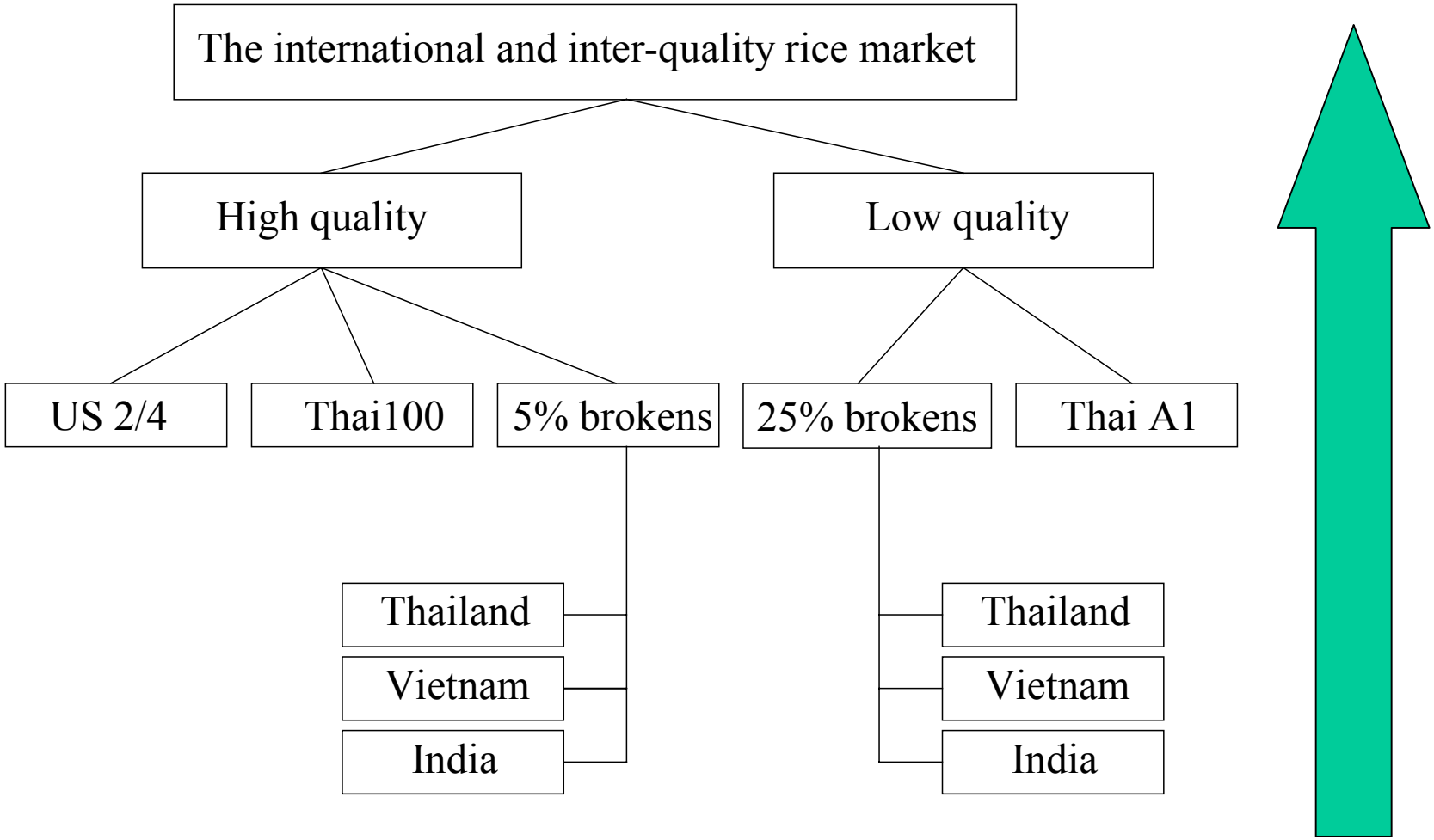
Nesting structure for the test of the Law of One Price on the int'l rice market



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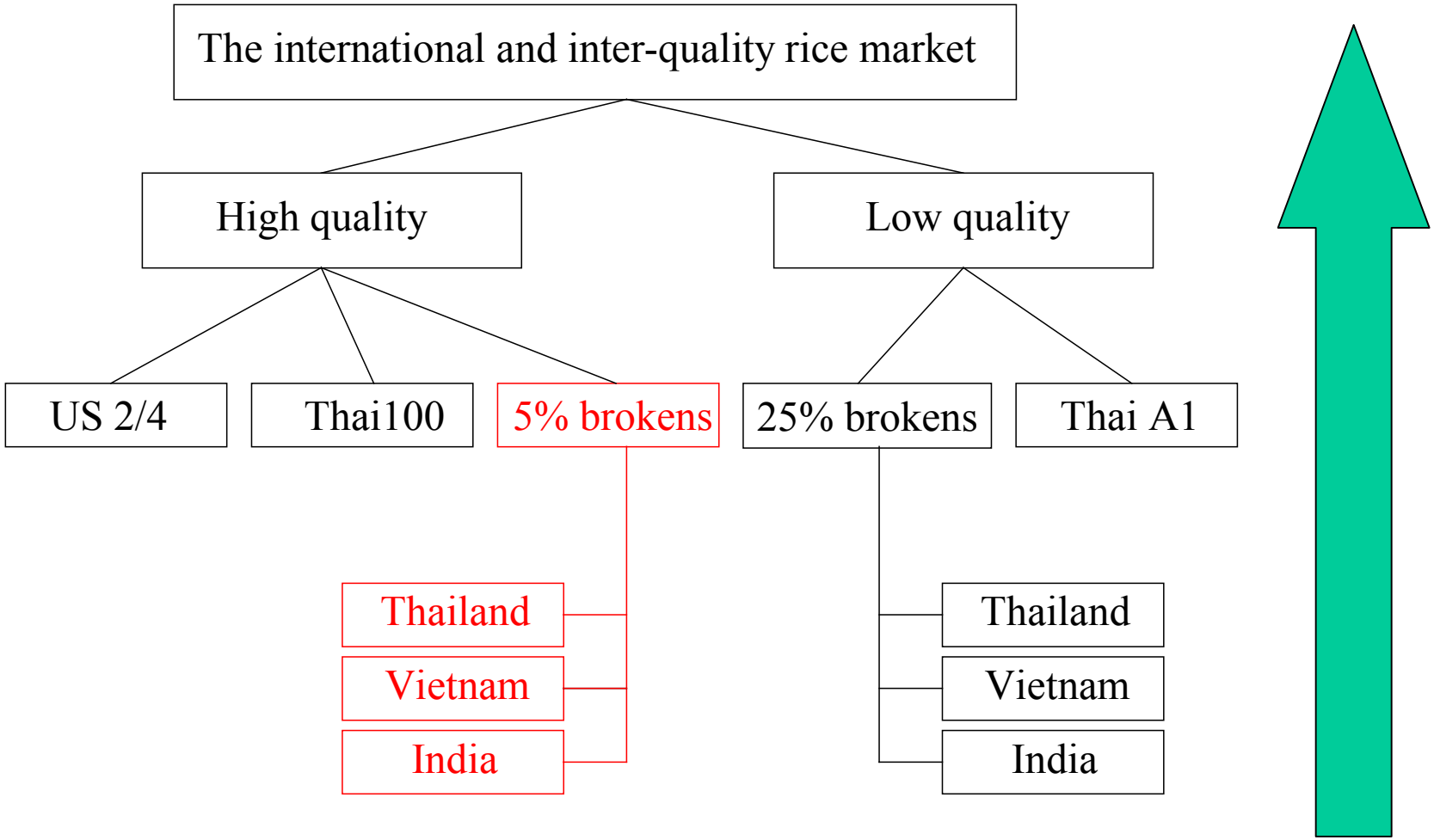

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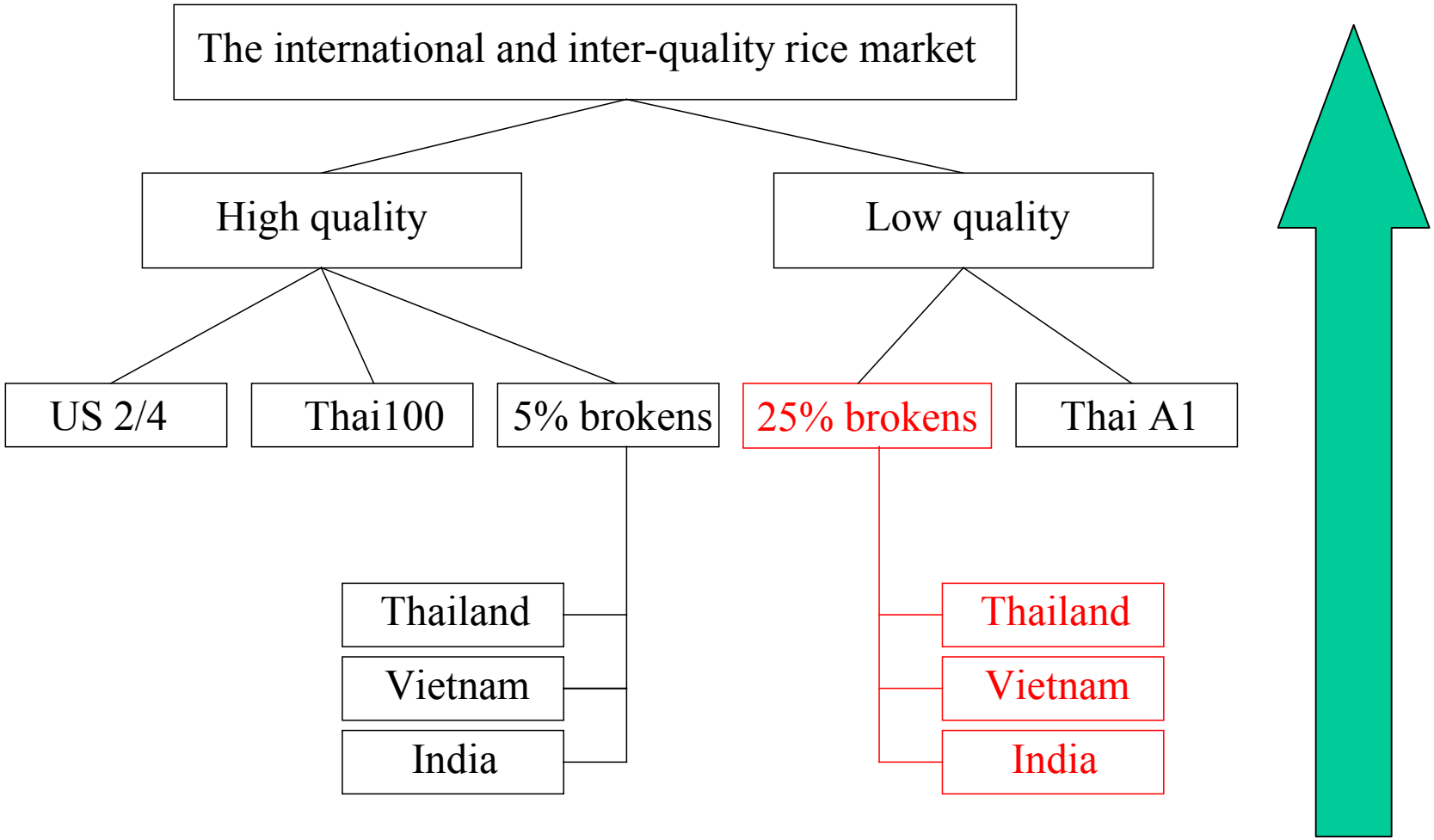

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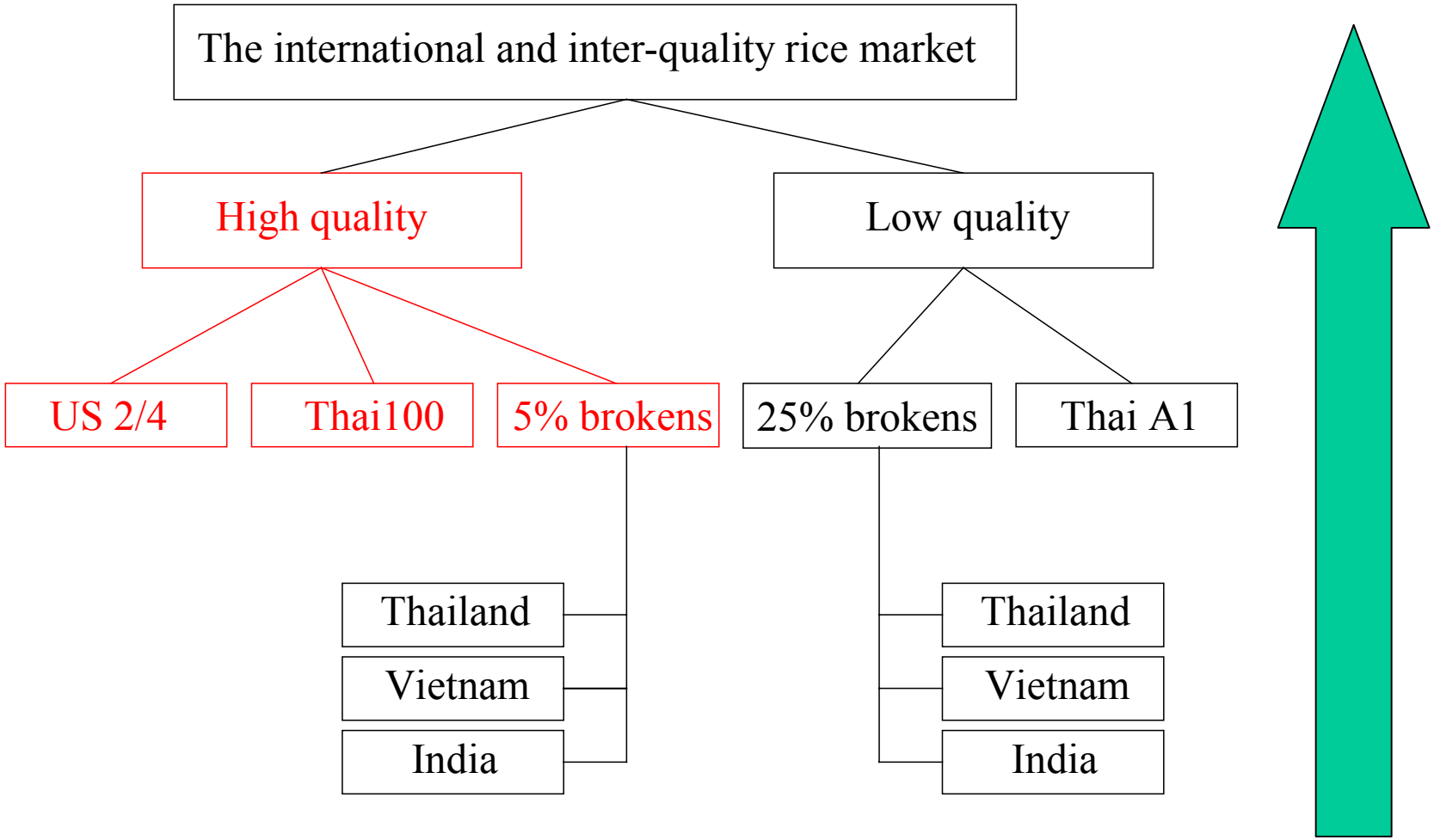

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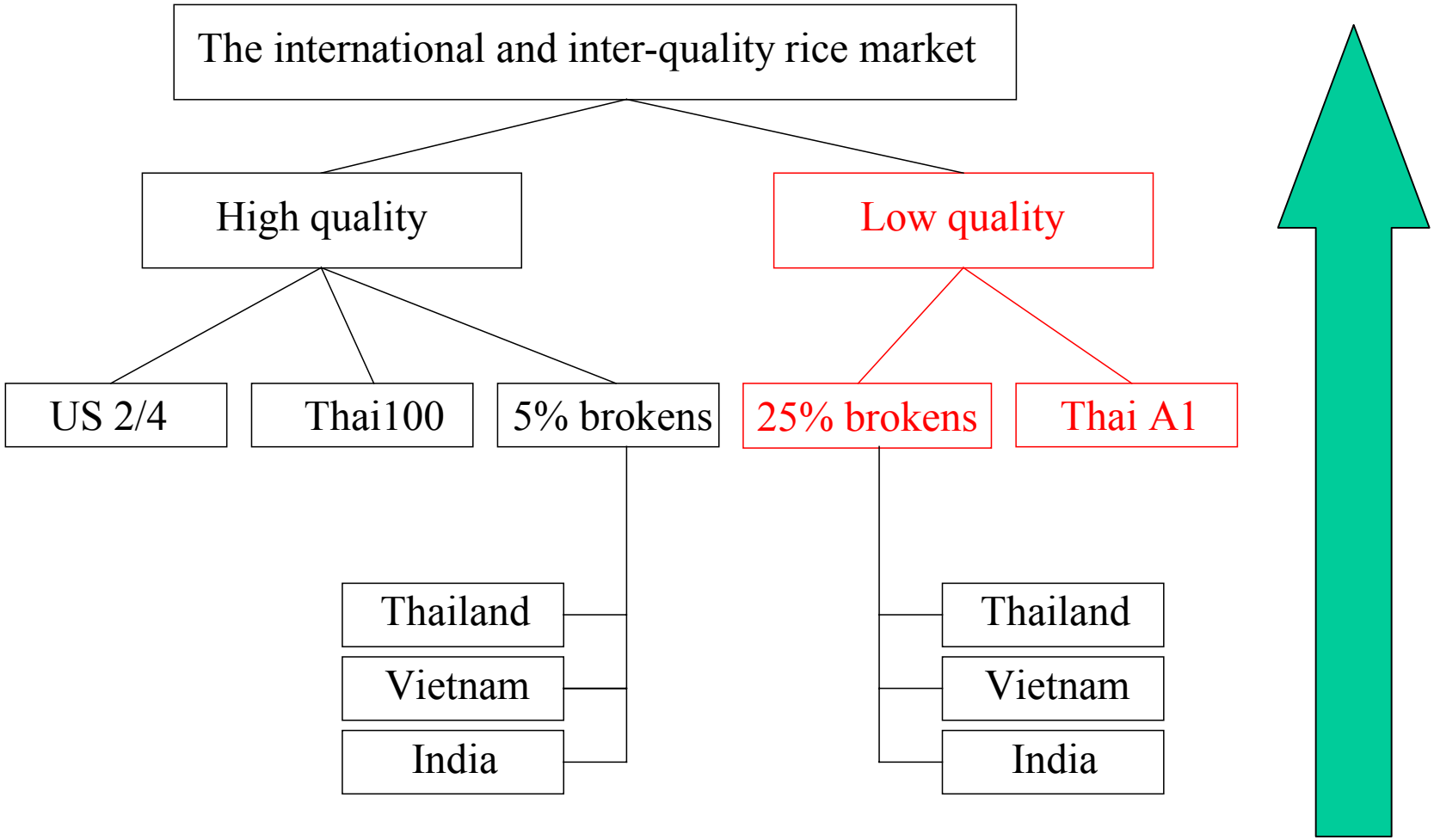

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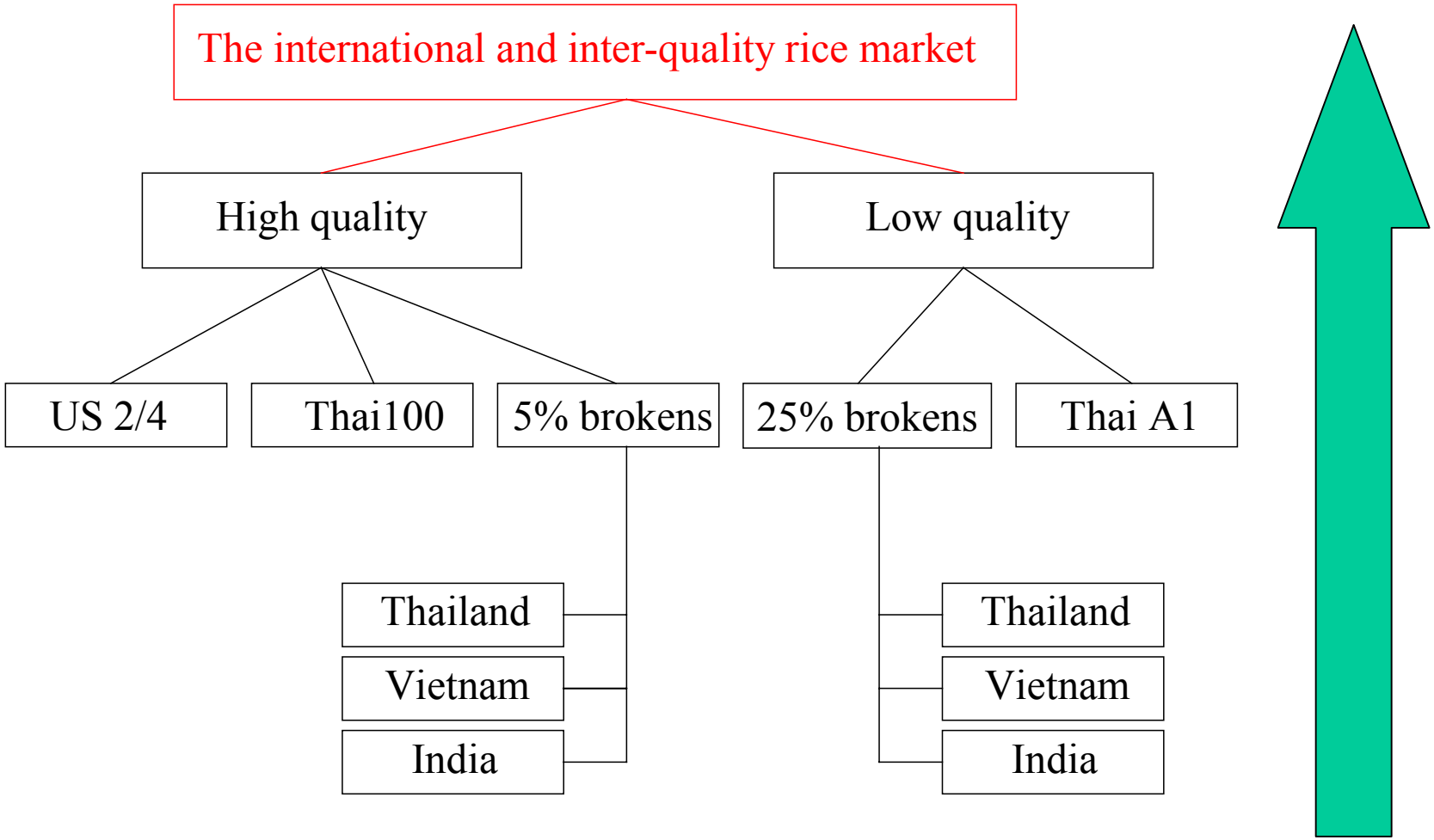

Results

- **LOP is rejected in most cases**

Summary of results: Validity of the Law of One Price and classification of markets

Market type / Market	5% brokens	25% brokens	Low quality	High quality	International and inter-quality*
Long run segmented market					
Long run leader market			Thai A1		
Long run follower market	Thai 5% Viet 5%		Viet 25%		
Long run regulator market					

Note: The circles indicate the markets for which there is evidence that the Law of One Price holds.

* The Indian prices could not be included due to the short length of these time series relative to the number of parameters to be estimated in this model.

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Long run leader market		Thai 25%	Thai A1	Thai 100 Thai 5%	US 2/4 Thai A1
Long run follower market	Thai 5% Viet 5%	Inde 25%	Viet 25%	US 2/4 Viet 5% Inde 5%	Thai 5% Viet 5% Thai 25%
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Conclusions:

1. **Int'l markets are highly segmented since LOP rejected in most cases**

2. **The Thai markets take on a long run leader role**

3. **Vietnamese rice is considered to be of a lower quality compared with rice of similar grading from other cntrs**

Conclusion and next steps in the analysis

Step 1: Is the Armington structure appropriate ? √

Step 2: Elast. of subst. estimated for key importers

Step 3: Simple illustration of implications for trade lib.

Armington assumption of heterogenous goods is valid

→ Proceed to estimate elasticities of substitution among different sources

Estimating Armington elasticities

- Method
  - Literature
  - Basic model: $\sigma_{ij} = \frac{\partial \ln(q_i / q_j)}{\partial \ln(p_j / p_i)}$
  - ECM specification

$$\Delta Q_{ij}(t) = a_{ij} + \gamma_{ij}^{1} \Delta P_{ij}(t) + \gamma_{ij}^{2} Q_{ij}(t-1) + \gamma_{ij}^{3} P_{ij}(t-1) + u_{ij}(t)$$

- Data
  - monthly series on import values/quantities for semi- and wholly-milled rice (HS-6 level)
  - available for USA, JPN, EU, BRA and IDN
  - series length differs;
  - many small partners and many zero observations

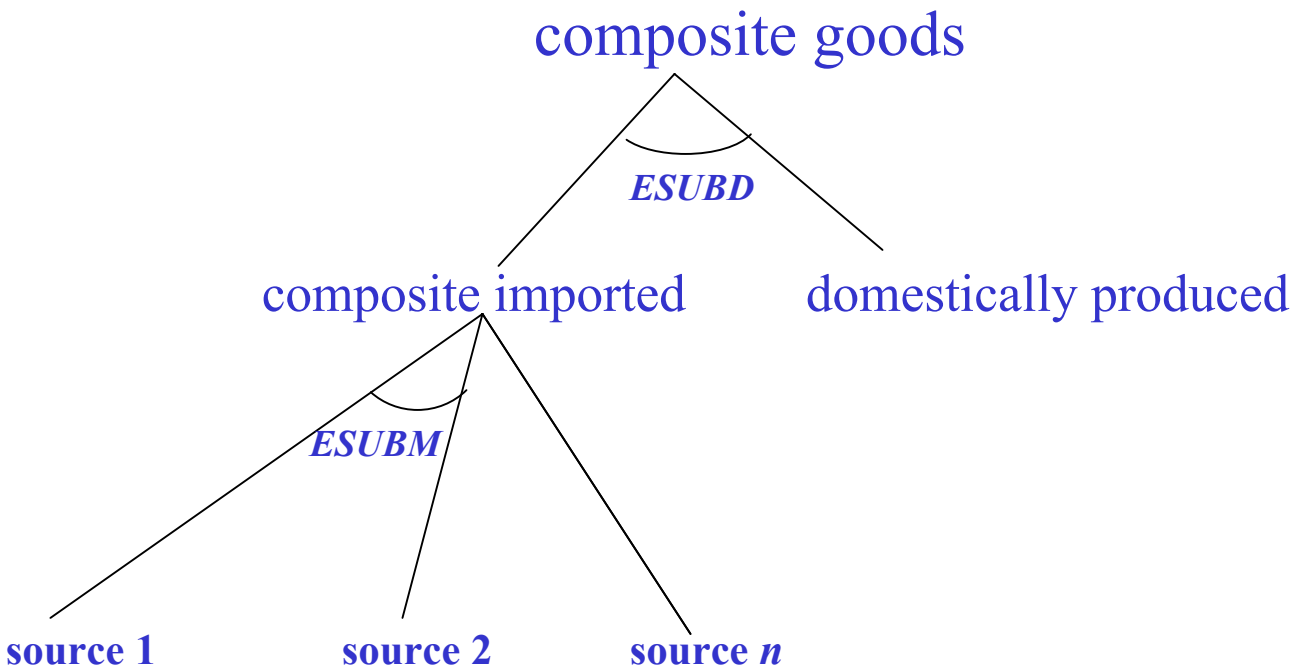
Estimation results

- Generally robust estimates for short-run elas., but not for long-run ones
- Lower values, compared to those used in standard GTAP
- but consistent with co-integration analysis

Table. Estimated subsitution elasticities for USA

	estimated elas.		
partner pairs	short-run	long-run	GTAP
India-EU	0.835***	0.675***	4.4
India-Pakistan	0.962***	0.921**	4.4
India-Thailand	0.962***	0.868**	4.4
India-China	1.65***	1.526***	4.4
EU-Pakistan	0.886***	0.726*	4.4
EU-Thailand	0.692***	0.472	4.4
EU-China	1.997***	**2.055*** **	4.4
Pakistan-Thailand	0.905***	0.67	4.4
Pakistan-China	2.11***	**2.33*** **	4.4
Thailand-China	1.925***	1.922***	4.4

Armington Structure in GTAP



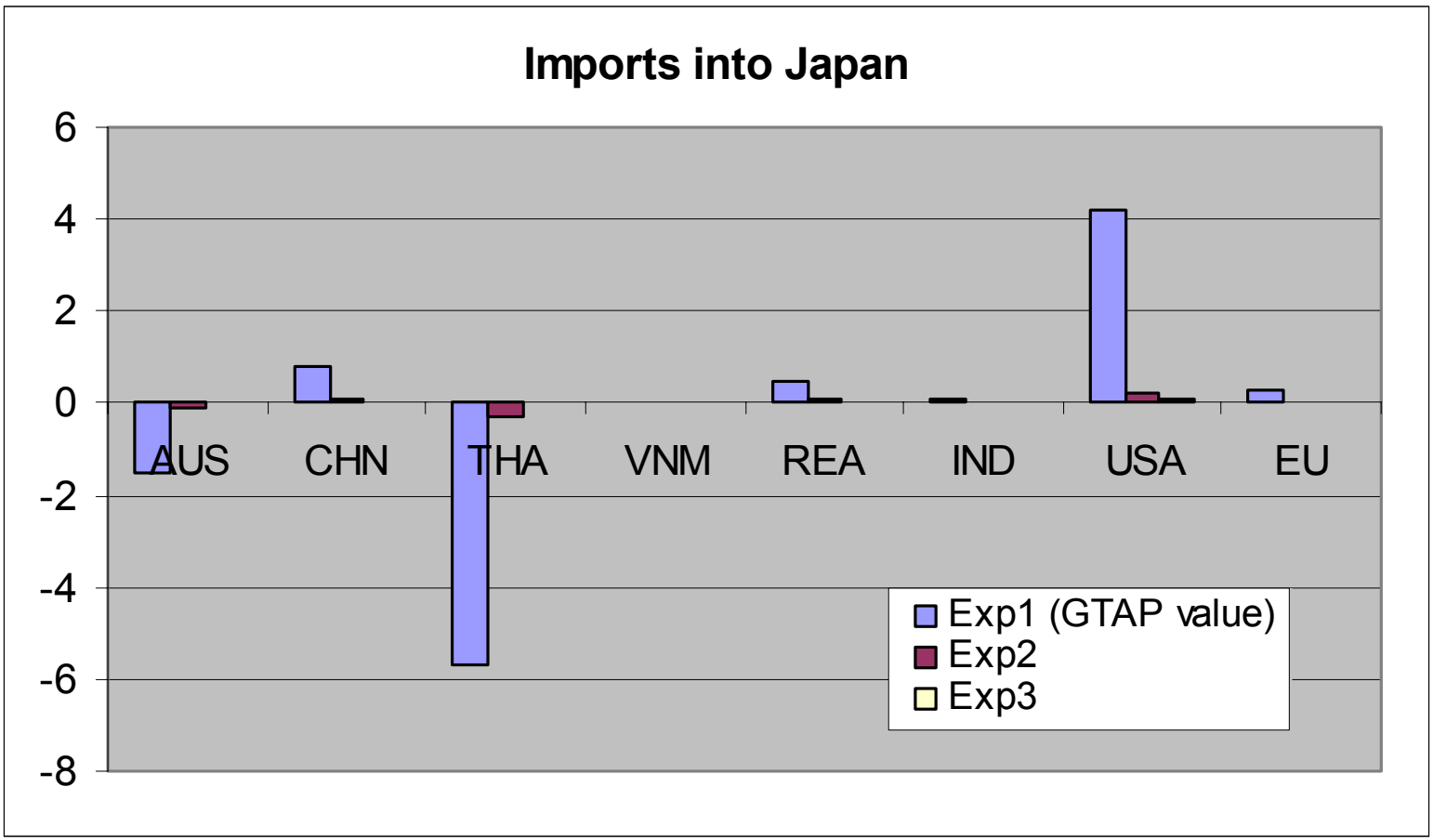
Illustrative trade liberalizarion scenarios:
100% tariff cut for rice under alternative parameters

- **Exp1**— default GTAP parameter values for *ESUBD* and *ESUBM*
- **Exp2** — average of estimated *ESUBM*; default GTAP *ESUBD*
- **Exp3** — average of estimated *ESUBM*; *ESUBD* set to half of *ESUBM*

Table. Parameters used in the experiments

	Regions	Exp1 (GTAP value)	Exp2	Exp3
ESUBD	all	2.2	2.2	0.615
ESUBM	Indonesia	4.4	1.632	1.632
	USA	4.4	1.343	1.343
	EU	4.4	1.413	1.413
	Brazil	4.4	0.94	0.94
	other	4.4	1.23	1.23

Experiment results: changes in trade shares by sources



Note: Changes are based on the shares from GTAP database; the differences are multiplied by 100

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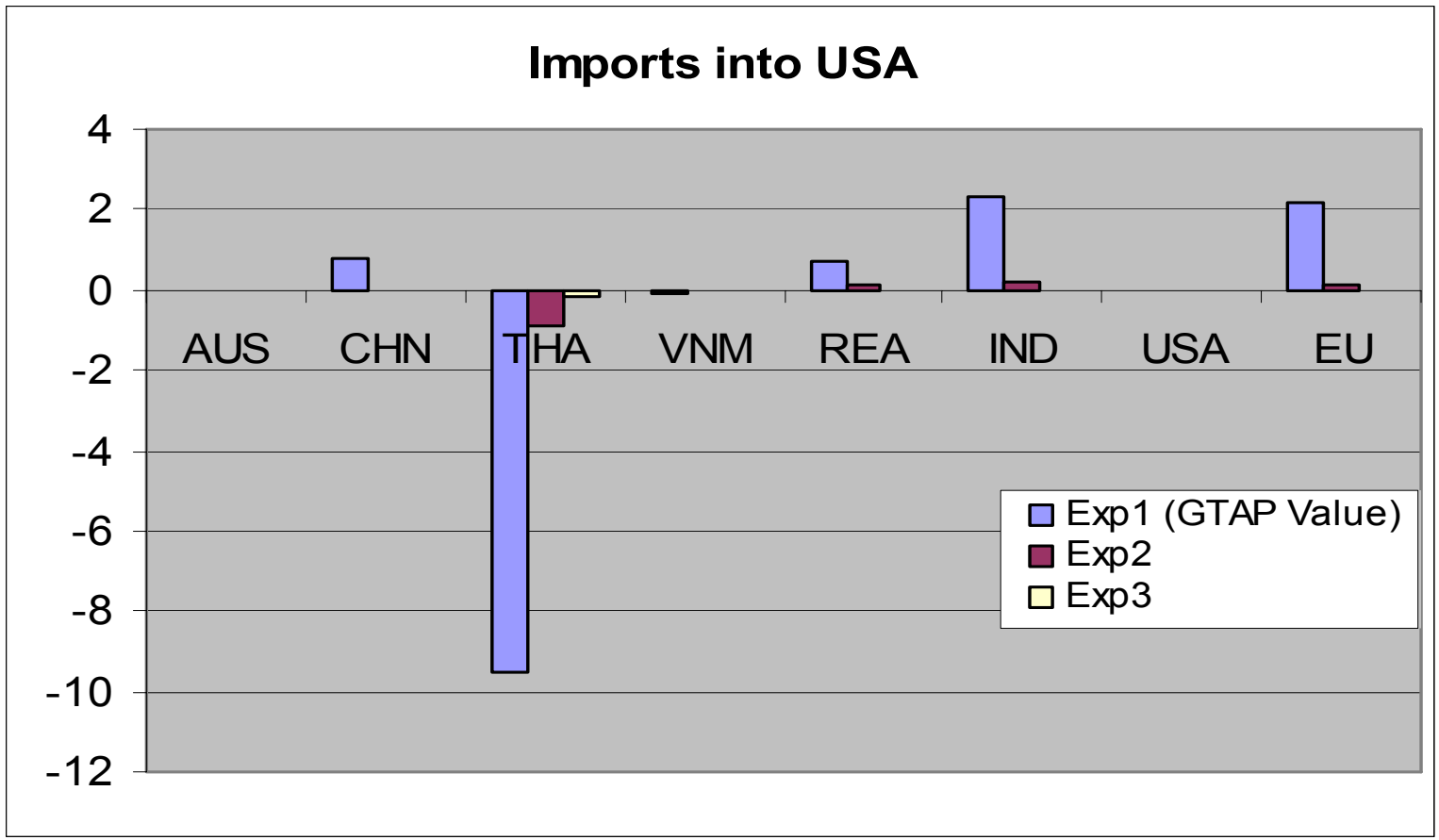

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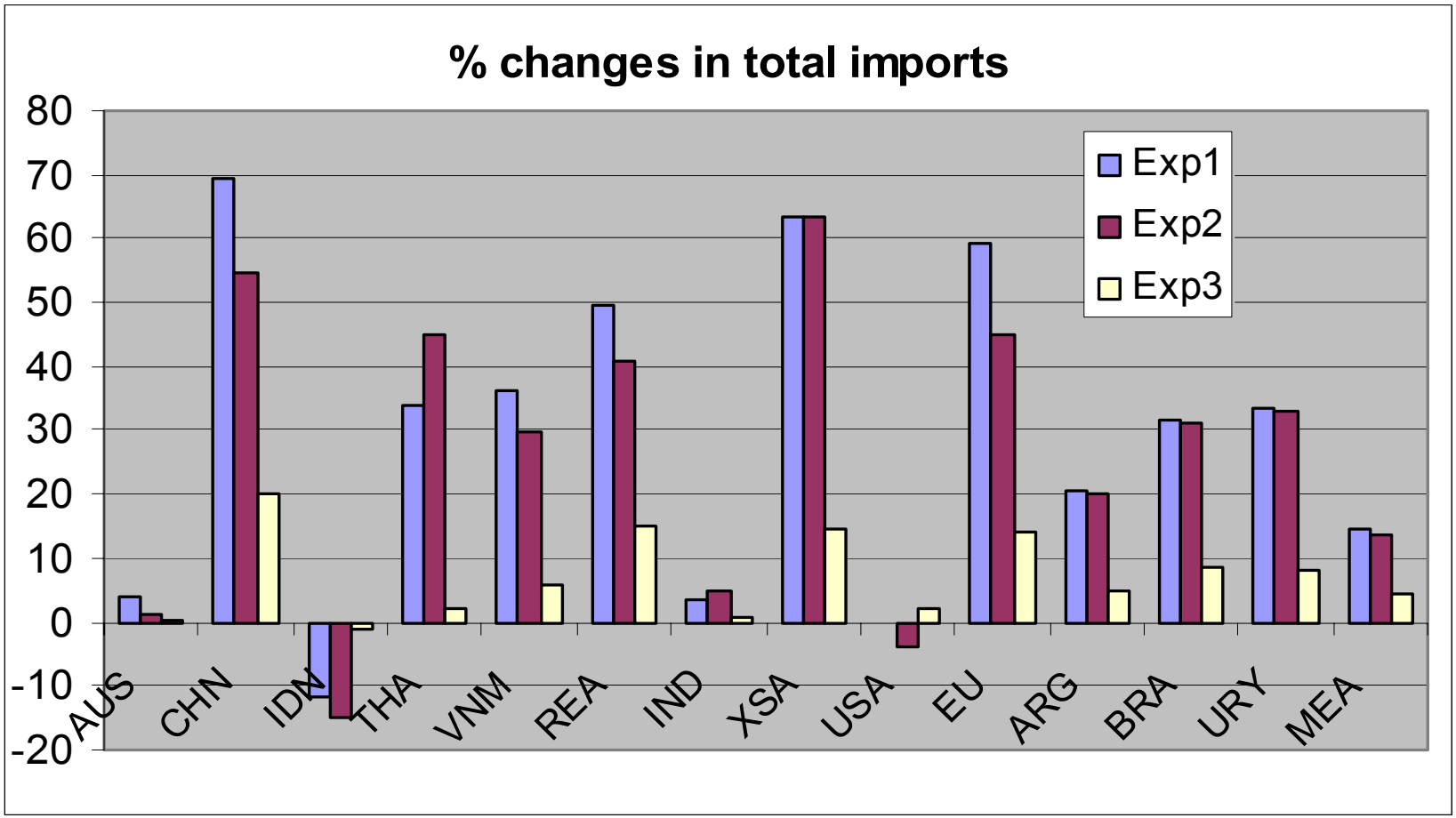
Experiment results: total rice imports



Concluding remarks

- Conclusions
  - Co-integration analysis accepts the Armington assumption of heterogeneous rice products
  - Estimation confirms co-integration results and finds lower values of *ESUBM*
  - Trade liberalization experiment using estimated *ESUBM* leads to persistent trade shares by sources, although total trade flows not affected much

- Further efforts
  - Further econometric investigation to get better estimates for long run elas.
  - Longer time series
  - Trade modeling structure that can accormodate pair-wise ESUBM (?)