



Krugman's Influence on Quantitative Analysis of Trade Policies

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**Contribution to the AAEA 2009 Organized Symposium
in Honor of Paul Krugman's Nobel Prize-winning
Contributions to Economics**

Krugman's work allowed introduction of several important new effects into computational trade policy analysis

- **#1: Scale economies - particularly important for small economies opening to the world market (e.g. CUSFTA; Harris)**
- **#2: New varieties - access to greater variety important to both consumers and producers (Ethier on intermediate variety)**
- **Paved way for two additional features (using extensions of the Krugman model)**
 - **#3: Pro-competitive effects - disciplining oligopolistic markups (Vousden, Hertel)**
 - **#4: Firm selection: increasing sectoral productivity via selection of more productive firms in the industry (Melitz)**
- **Offer here selected review of literature on #1 - #4:**
 - **CGE model implementation, results and analysis**
 - **Econometric Evidence (see also review by Feenstra)**

Topic #1: Scale Economies

- **Unexploited scale economies were a key part of the Harris (1984) analysis of Canada-US FTA:**
 - Argued that some firms would exit leaving room for remaining firms to move down cost curve; produce fewer varieties at greater scale
 - Gave rise to significant gains due to scale economies; Harris predicted scale expansion of more than 50%, labor productivity gains in excess of 20% from CUSFTA
- **Potential scale effects were also important in the debates over EU enlargement and the DDA :**
 - Regions expanding agriculture or low markup sectors (e.g. apparel) can lose from trade liberalization as they draw resources from sectors exhibiting scale economies
 - E.g., Francois Meijl and Tongeren predict a loss to China from global liberalization due to limited scale economies in expanding apparel sector; Michigan model analyses predicted losses to SSAfrica due to expansion of agriculture at expense of manufacturing
- **Ex post empirical evidence is mixed: Canadian impacts following CUSFTA is limited (Head and Ries; Trefler); did not see the magnitude of expansion in scale of operations predicted by Harris**

Topic #2: Access to new varieties

- **Do we really love variety? Perhaps better explained in terms of a discrete choice model with heterogeneous consumers; increased variety allows better matching of individual preferences with available varieties. Under certain assumptions this can be shown produce aggregate demands of the CES form (Anderson, de Palma and Thisse)**
- **Limitations:**
 - **One parameter does a lot of work in this model:**
 - **Determines price elasticity of demand**
 - **Also determines the value placed on variety**
 - **Consider below a generalization: introduce additional LoV parameter**
 - **To calibrate to real world trade data need an additional calibration step**

Matching theory with data: The problem of calibration

- **To match observed trade flows in the model, need additional degrees of freedom**
- **Approach #1: attribute to unobserved trade costs**
 - Typically gives very high trade costs, Anderson and van Wincoop's gravity-based estimates – when implemented in a monopolistic competition CGE model by Balistreri and Hillberry, implies that as much as 50% of output “melts” in transit
- **Approach #2: include preference biases – typically puts more weight on domestic varieties (Venables):**
 - Preference biases have strong implications for impacts of trade reforms, since loss of domestic varieties maybe more costly than loss of foreign varieties
 - In CGE context, find that these preference biases tend to dominate scale and variety effects in determining the pattern of gains from trade liberalization (Hertel and McCorrison) – tends to “gut” the theoretical model of Krugman of its predictive power

Does Krugman Love Variety Too Much?

Paper by Adina Ardelean

- **Krugman predicts that rate of variety expansion is proportional to country size:**
 - In standard model, output per variety constant (determined by fixed markup/elasticity of substitution in consumption); all trade growth is fueled by variety
 - Yet Hummels and Klenow find that varieties represent only 59% of growth in exports for large countries
 - Evidence that national product differentiation is still important:
 - What was your second choice in automobile? Tends to follow nationality of first choice; similarly with wine, etc.
- **CGE models based on Ethier style cost functions also tend to predict too much specialization:**
 - Tib increases variety available to firms, increased variety lowers costs, lower costs encourage expansion; models are highly unstable
 - Led Alan Deardorff to postulate a different form of utility function in which there is a decreasing love of variety
 - Adina Ardelean has explored the GE implications of this specification
 - Ardelean has also estimated the underlying LoV parameter

A modified LoV model (Ardelean)

$$D_i = \left[\sum_{j=1}^m n_{ij}^{\frac{\beta-1}{\sigma}} \left(\sum_{l=1}^{n_{ij}} x_{ijl}^{\frac{\sigma-1}{\sigma}} \right) \right]^{\frac{\sigma}{\sigma-1}}$$

The parameter $\sigma > 1$ represents the elasticity of substitution across exporters j ; x_{ijl} , p_{ijl} and n_{ij} denote the quantity, prices per variety, and number of varieties bought from country j (including domestic varieties brought from country i). The parameter $\beta \in [0,1]$ represents the consumer's *love of variety* – the marginal valuation of an exporter's variety. If this equals 1.0 then have Krugman model; if equals 0.0 have Armington model.

A modified LoV model (Ardelean)

With $\omega = 1$ (and symmetric imported quantities and equal number varieties across sources) we get full LoV:

$$U_i = \left[\sum_{j=1}^M n_{ij} x_{ij}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} x_{ij}^{\frac{\sigma}{\sigma-1}} = (Mn)^{\frac{\sigma}{\sigma-1}} x$$

With $\omega = 0$ (and same assumptions) we get no LoV:

$$U_i = \left[\sum_{j=1}^M (n_{ij} x_{ij})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} x_{ij}^{\frac{\sigma}{\sigma-1}} = (M)^{\frac{\sigma}{\sigma-1}} (nx)$$

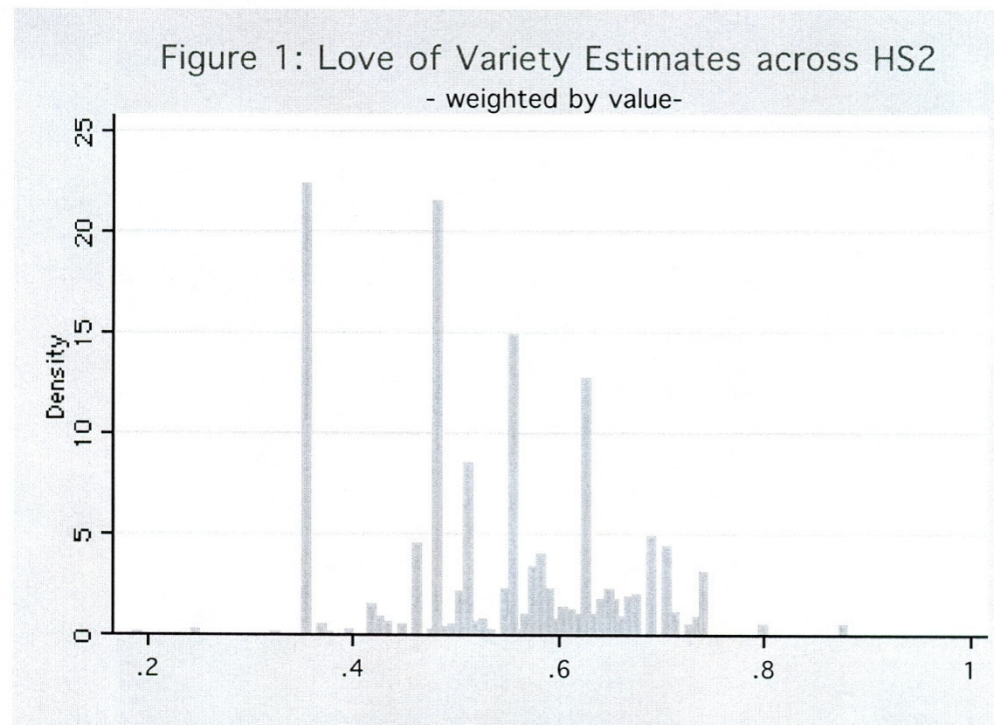
A modified LoV model (Ardelean)

If all varieties from originating country are symmetric in prices, we get the following relative total import demand from countries j and k :

$$\frac{M_j}{M_k} = \left(\frac{P_j}{P_k} \right)^{1-\sigma} \left(\frac{n_j}{n_k} \right)^\beta$$

An increase in the # of varieties exported by j , yield less than proportional increase in relative imports if $\beta < 1$.

Estimates of the Love of Variety (Ardelean)



Love of Variety: Implications

- **Estimates of the gains to the economy due to increased variety based on Krugman model (Broda and Weinstein) are overstated (1.5% instead of 2.6%)**
- **Appropriate specification of utility and cost functions in CGE models require an additional parameter: the LoV parameter:**
 - **Places empirical model somewhere between Armington and Krugman**
 - **Permits calibration to estimates of expansion at extensive margin**
 - **Slows rate of variety growth**
 - **Reduces gains from trade reform**
 - **Limits degree of specialization in the wake of trade liberalization**

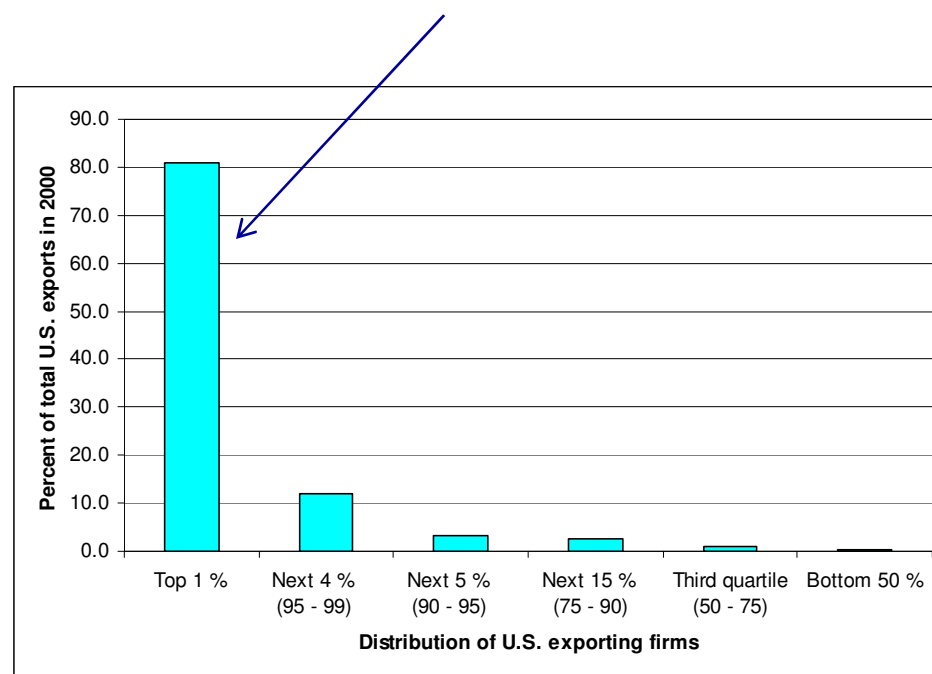
Topic #3: Procompetitive Effects

- **Definition:**
 - Reductions in optimal markups (Vousden)
 - Does not arise in basic Krugman model, with large numbers of firms; however, does enter into play in context of oligopolies
- **Elasticity of markup wrt tariff in Krugman model under oligopoly (Hertel):**
 - Increasing in elasticity of substitution among varieties
 - Larger for more imperfectly competitive (higher markup) industries
 - Decreasing in number of varieties
- **Empirical evidence:**
 - Estimates from Australia (Ianchovichina, Binkley and Hertel):
 - Vary widely by industry
 - Highest for industries with high elasticity of substitution, high concentrations; high est for autos (0.44 = el of power of markup wrt power of tariff)
 - Evidence from EU single market program: Badinger finds evidence of reductions in manufacturing markups (see also Feenstra for extended discussion)

Topic #4: Firm Selection in the Presence of Producer Heterogeneity

- Growing evidence of the diversity of firms and of the concentration of large firms in trade
- If exporters are more productive, then expansion of trade will bid up factor prices and lead to exit of less productive firms, thereby boosting industry productivity

US mnfcng exports are very concentrated:
1% of exporters account for 80% volume



Source: Bernard, Jensen, and Schott (2005), Importers, Exporters, and Multinationals: A Portrait of Firms in the U.S. that Trade

Implications for study of trade in manufactured food products

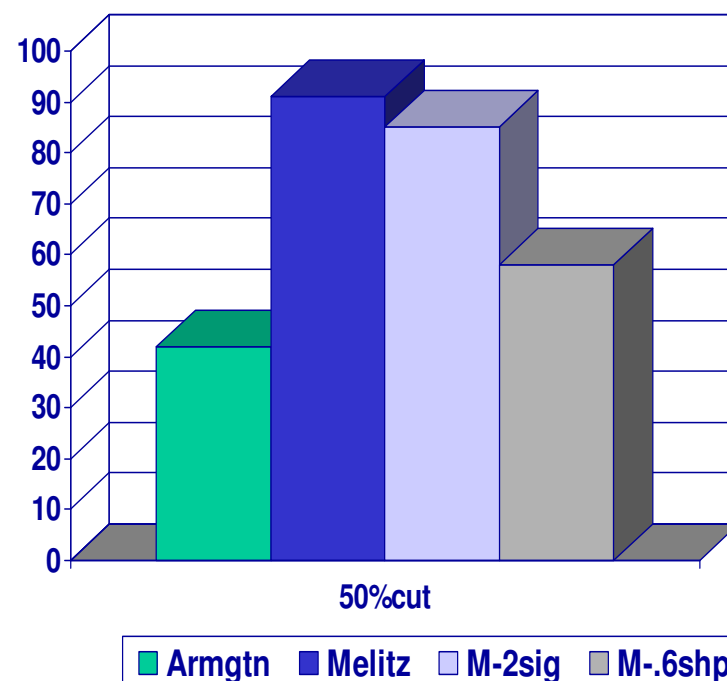
- **Fits well within the theory, food mnfc plants:**
 - Account for 8% of all mnfc plants
 - Very close to all mnfc mean for:
 - Exports/total shipments
 - % plants exporting
 - Capital and skill intensity
- % Firms exporting, importing slightly below overall average
- Role of multiple products likely to be especially important – nicely accommodated in Bernard et al
- FDI is also key mode of delivery for mnfc food products

Firm heterogeneity and the gains from trade liberalization (Fan Zhai)

- **Begins with Melitz model:**
 - Continuum of goods; product differentiation by firm
 - Fixed and variable costs of production; fixed cost of exporting
 - Sunk cost of entry with random productivity draw upon entry; do not produce if negative profits; similarly for exporting
 - Average productivity rises with trade opening; most productive firms expand while least productive firms contract/exit the industry
- **Simplifications necessary for CGE implementation (see also Chaney):**
 - Abstract from dynamics: no entry/exit, no sunk costs and no uncertainty about productivity (eliminates multiple equilibria)
- **Data and calibration:**
 - GTAP data base and parameters
 - Calibration is key:
 - Fixed costs and scale economies; Markups
 - Shape of productivity distribution
 - Relative importance of extensive margin in differing export values (Hummels and Klenow = 60%)

Firm heterogeneity and the gains from trade liberalization: Fan Zhai

- Consider \$bill global welfare from 50% global tariff cut
- In base model, gains from Melitz roughly double those due to Armington model
- Sensitivity to doubling of trade elasticities:
 - Armington doubles
 - But Melitz relatively insensitive (M-2sigma) – fall slightly
- Sensitivity to 1/3 reduction in firm heterogeneity: Melitz model welfare gains fall by 1/3 (M-0.66 shape)
- Shifts our attention to different parameters; different measurement issues



Empirical Evidence: Productivity Gains from Trade Liberalization

- **Trefler(2004) (see also Feenstra, 2006) focused on CUSFTA impacts:**
 - **Canadian industries protected by tariffs had 12% drop in employment**
 - **Overall mnfcng employment dropped by 5% in near term**
 - **After 10 years, employment effects negligible; while low productivity plants shut down, high productivity plants expanded into US market and increased employment**
 - **In the formerly sheltered industries, labor productivity jumped by 15%; much of this due to the closing of inefficient plants**
 - **Overall mnfcng productivity rose by 6%**

Future Research

- **Assessing the extent of unexploited scale economies/calibration of fixed costs**
- **Estimating the LoV and adopting more general specification in CGE models**
- **Adding a more complete treatment of trade costs and thereby better explaining geographic biases in trade patterns**
- **Moving to Melitz-type models: requires us to estimate the extent of firm heterogeneity**

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