Skill Biased Heterogeneous Firms, Trade Liberalization and the Skill Premium

James Harrigan and Ariell Reshef
University of Virginia

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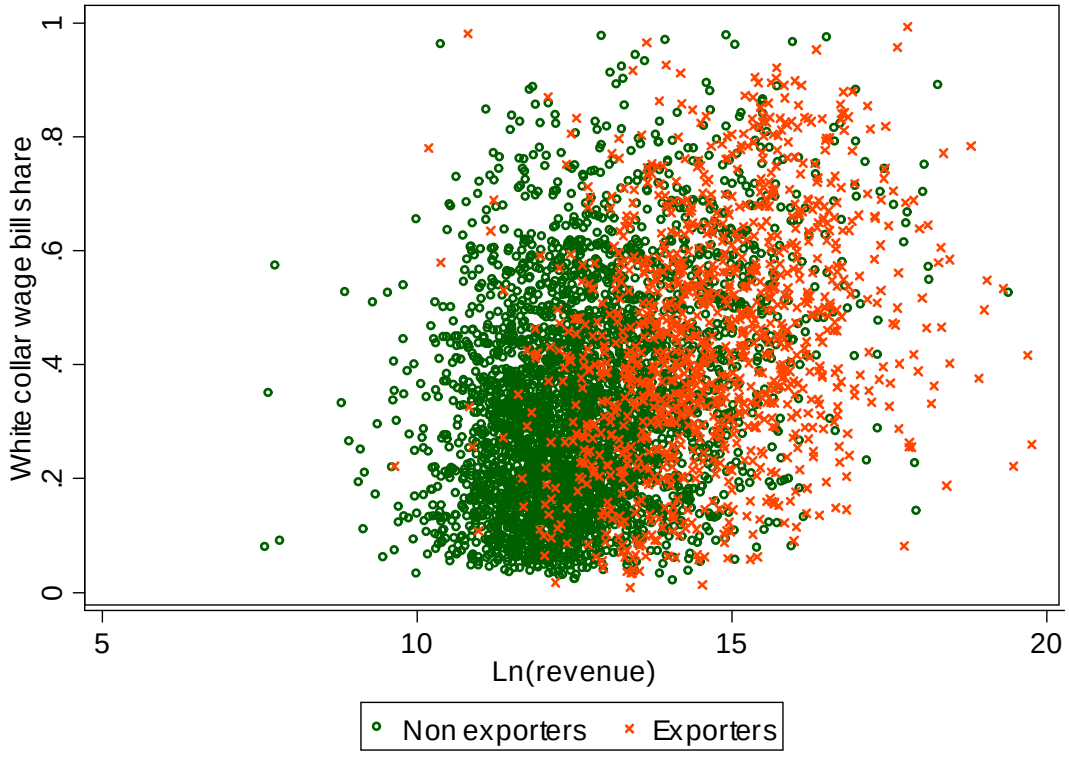
Trade liberalization and inequality

Since 1970s many economies have experienced trade liberalization, trade growth (globalization) and increased inequality (skill premia).

We propose a new model that combines **skill bias of technology** with **trade liberalization** in a GE model of **heterogenous firms**.

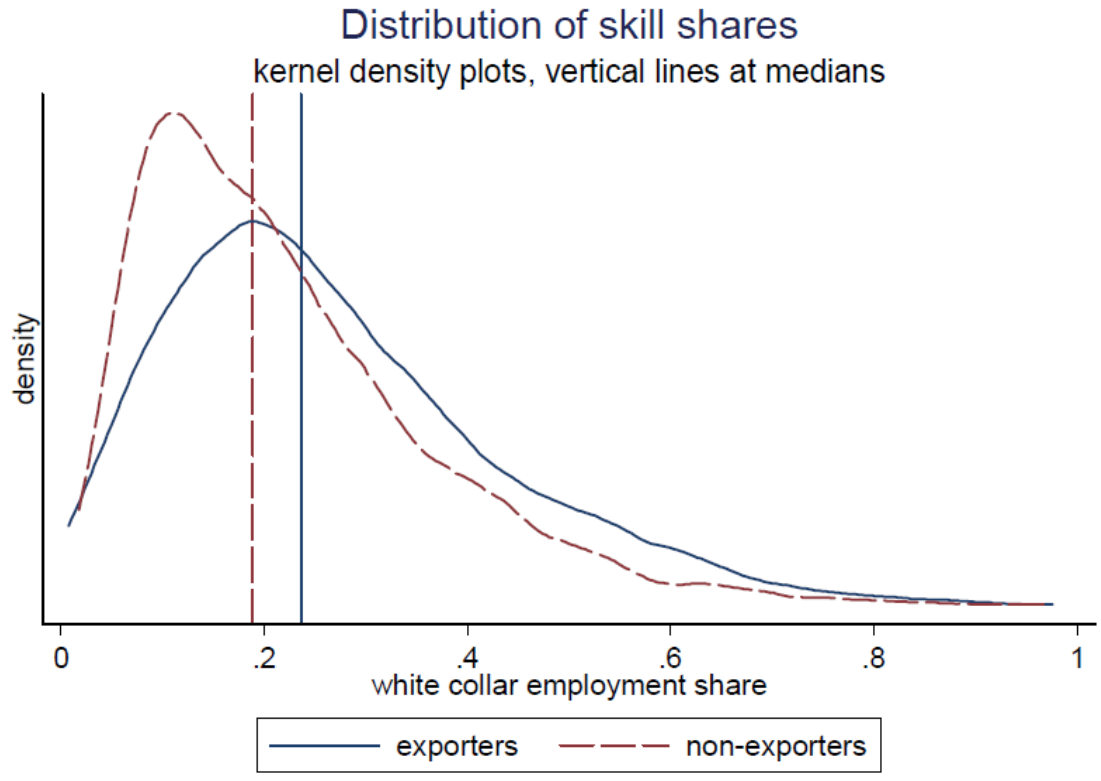
- Designed to generate stylized facts on firm heterogeneity.
- Increase in skill premium after trade liberalization **unrelated to factor endowments or relative prices**:
- **not a Stolper-Samuelson** mechanism, not HO, yet **GE**
- w/**trade patterns** and **factor content** predictions as HO.

We highlight **changes in composition**, not with-firm changes.



- Exporters larger and more skill intensive, on average.
- Positive (imperfect) relationship between size and skill.
- Lots of heterogeneity, overlap.

Our model is designed to generate similar scatter plots.



- Higher median for exporters, similar variance, overlap.
- Variance within 4-digit industries is 50% higher than between.
- Same for U.S.: Dunne, Foster, Haltiwanger and Troske ('04).

Our model is designed to generate similar distributions.

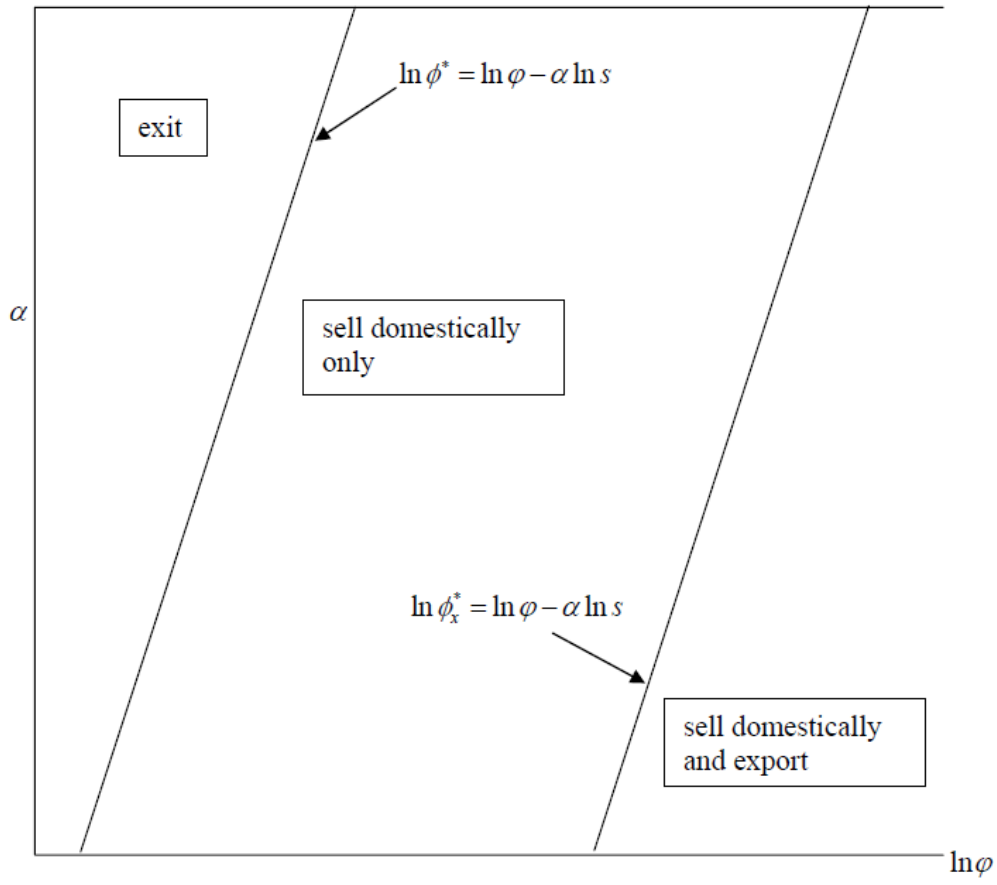
What we do: add skill heterogeneity to Melitz (2003)

- $w \equiv$ unskilled wage, $s \equiv$ skilled wage.
- Cobb-Douglas production $\Rightarrow$ unit costs in variable costs:

$$c_v(\alpha, \varphi, s, w) = \frac{1}{\varphi} s^{\alpha} w^{1-\alpha} \equiv \frac{1}{\boldsymbol{\phi}}$$

- Entrants pay to draw **technology** $(\alpha, \varphi) \sim G(\alpha, \varphi)$.
  - Consider $G(\alpha, \varphi)$ set of production possibilities.
  - Once drawn, technology (α, φ) is fixed.
- Given factor prices s and w, some firms $\phi \geq \phi^*$ survive, of which only the most competitive $\phi \geq \phi_x^* > \phi^*$ export.
- Only ϕ matters for **competitiveness**, and comes with heterogenous φ and α.
- **Technique** $= \frac{H}{L} = \frac{\alpha}{1-\alpha} \left(\frac{s}{w}\right)^{-1}$ responds to factor prices.

Size, skill intensity and exporting in equilibrium



Positive skill premium $\Rightarrow$ upward sloping cutoffs (iso-cost curves).

What we do: consider correlation

$$c_v(\alpha, \varphi, s, w) = \frac{1}{\varphi} s^{\alpha} w^{1-\alpha} \equiv \frac{1}{\boldsymbol{\phi}}$$

Consider correl$(\alpha, \varphi) > 0$ (as implied by data):

- Positive association between skill, productivity and competitiveness.
- Interpretation: to produce more efficiently, must hire more engineers, on average.
- Result: Exporters are more skill intensive.

(When $s > w$, conditional on φ, higher α is *less* competitive)

Fixed technology assumption

We highlight **changes in composition**, not within-firm changes.

- Consistent with findings in Bernard and Jensen (1997).

$$c_v(\alpha, \varphi, s, w) = \frac{1}{\varphi} s^{\alpha} w^{1-\alpha} \equiv \frac{1}{\boldsymbol{\phi}}$$

We assume no effect of liberalization on firm α or φ:

- Simplification that allows general equilibrium analysis.
- *Trade-induced* upgrades in α are small (Bustos 2011).
- Haltiwanger, Lane and Spletzer (2007): firm level heterogeneity very persistent.
- Chilean data consistent with fixed α.

Heckscher-Ohlin tradition

Factor intensity in production related to preferences.

- Competition stronger among producers with same factor intensity than across producers with different intensities.
- Elasticity across varieties produced with same intensity $\eta >$ ϵ elasticity across varieties produced with different intensities.
  - Standard HO competitive model: $\eta = \infty$
  - Dornbusch, Fischer, and Samuelson (1980): $\eta = \infty$, $\epsilon = 1$
  - Helpman and Krugman (1985): $\eta > 1$, $\eta > \epsilon$
  - Bernard, Redding and Schott (2007): $\eta > \epsilon = 1$

$\Rightarrow$ Trade liberalization has different effects on different industries depending on factor intensity $\Rightarrow$ **Stolper-Samuelson effects**.

What we do: separate preferences from production

Break with HO tradition: **preferences over goods not related to goods' factor intensity**

- All firms compete head-to-head, **regardless of skill intensity**.
- Only ϕ matters for **competitiveness**, regardless of α.
- Symmetry in demand: one elasticity of substitution σ for all.

A more natural way to model preferences.

- Is competition stronger across or within skill categories?
- Data: $Var(\alpha)$ within $> 1.5 \times Var(\alpha)$ between industries.

$\Rightarrow$ Trade liberalization has same effect on all firms, regardless of firms' skill intensity $\Rightarrow$ **No Stolper-Samuelson effects**, *yet*

- **Trade patterns** and **factor content** predictions **as HO**.

Symmetric effect on all firms

Sales

$$\begin{aligned} \text{Domestic} &: r_d(\phi) = R_d (\rho P_d)^{\sigma-1} \phi^{\sigma-1} \\ \text{Export} &: r_x(\phi) = \tau^{1-\sigma} R_x (\rho P_x)^{\sigma-1} \phi^{\sigma-1} \end{aligned}$$

depend only on ϕ.

- Increase import competition: $P_d \downarrow$ on impact.
- More export opportunities: $\tau \downarrow$ on impact.
- Both affect all firms equally, regardless of skill intensity (α).

Trade liberalization mechanism

As in Melitz (2003), with falling barriers:

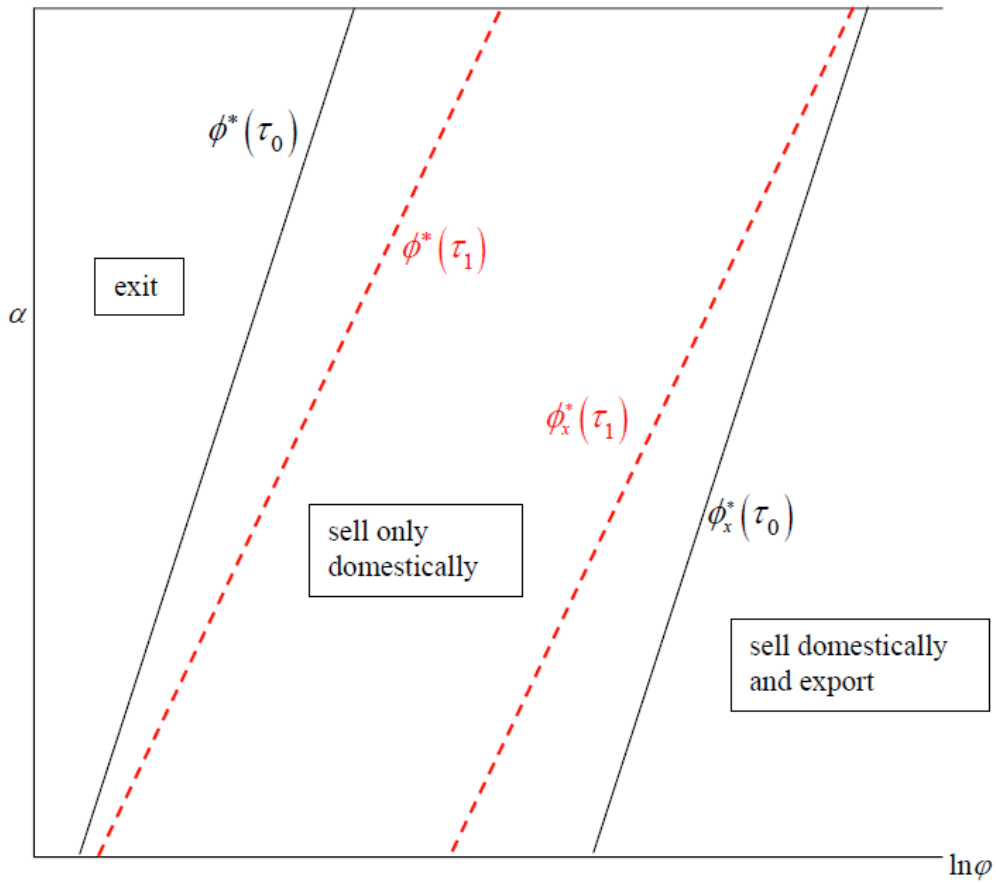
- $\phi^* \uparrow$: least competitive firms exit (import competition).
- $\phi_x^* \downarrow$: some marginal non-exporters decide to export.
- Incumbent and new exporters expand, non-exporters retrench/exit.

If correl$(\alpha, \varphi) > 0$ (as in the data), then:

- Incumbent exporters: relatively skill intensive and expand.
- Non exporters: relatively skill un-intensive and contract.
- Aggregate demand for skill rises $\Rightarrow$ skill premium rises.

Caveat: Newest exporters less skill intensive than incumbents. When very open, further liberalization may lower skill demand.

Tariff reduction



$\tau_0 > \tau_1$. Skill premium increases $\Rightarrow$ cutoff slopes become flatter.

Two Asymmetric Countries

Asymmetric equilibrium

Two countries (A and B) identical except for endowments,

$$(H/L)^A > (H/L)^B \quad \Leftrightarrow \quad (s/w)^A_{aut} < (s/w)^B_{aut}$$

Choose $(H+L)^B$ so that $Q^B = Q^A$ in autarky to avoid *ex ante* market size effects.

- A and B have same $G(\alpha, \varphi)$.

No analytical results. Numerical solution challenging, equilibrium involves all endogenous variables simultaneously from both countries, including aggregates, e.g.,

$$\phi_x^{*a} = \phi^{*a}\tau \left(\frac{P^a}{P^b}\right)\left(\frac{R^a}{R^b}\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} .$$

$$P^a = \left[M^a\left(1/\rho\widetilde{\phi}^a\right)^{1-\sigma} + \chi^b M^b\left(\tau/\rho\widetilde{\phi}^b_x\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} .$$

Numerical Experiments

Parametrization of joint distribution

Marginal distributions

- $\varphi \sim$Pareto(m, k). Standard.
- $\alpha \sim$Beta(a, b). Restricts $\alpha \in [0, 1]$.

Given marginals, use Plackett copula to characterize

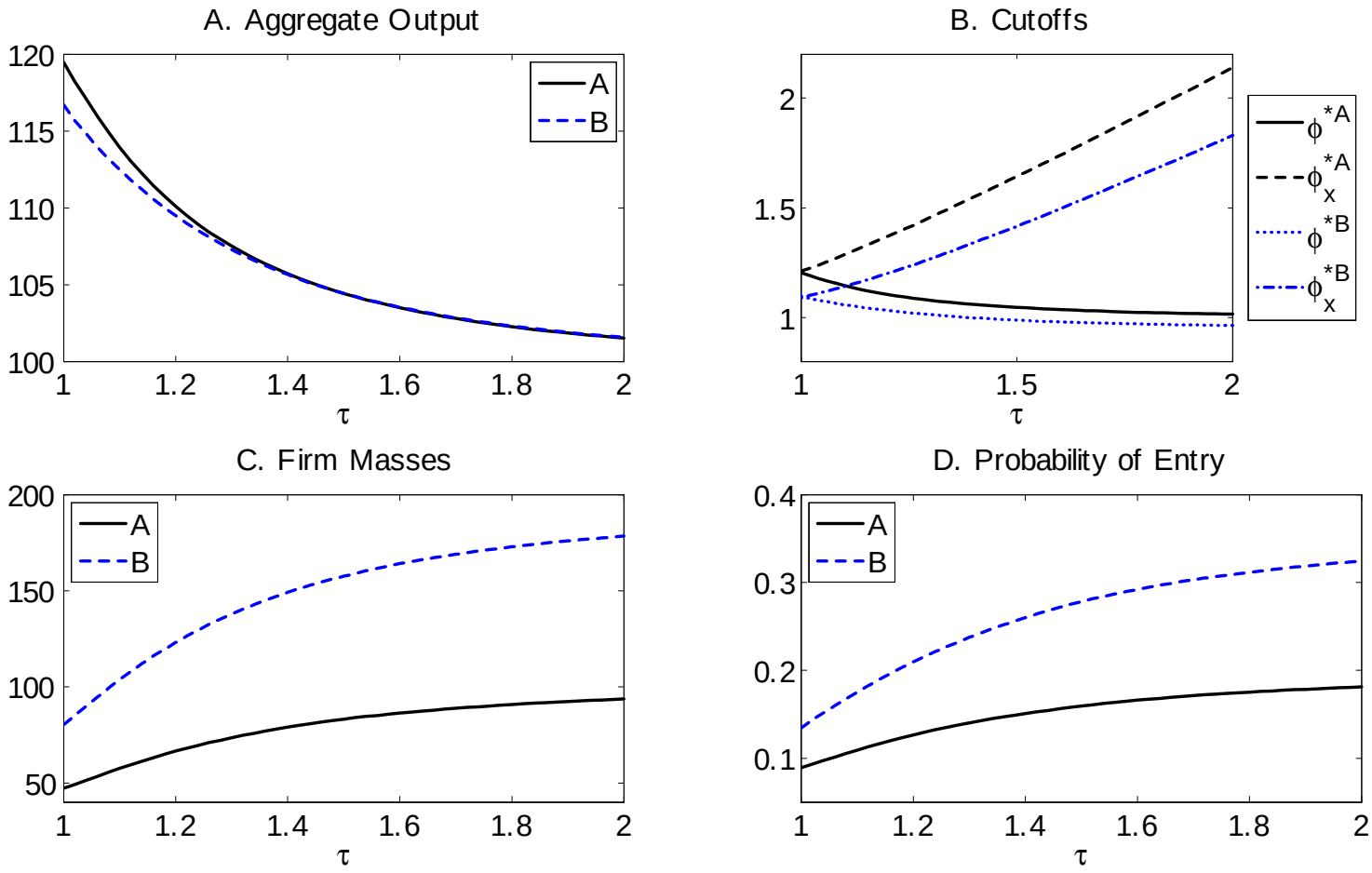
$$G(\alpha, \varphi) = C_{\theta}\left[B(\alpha), P(\varphi)\right] ,$$

where $P(\varphi)$ and $B(\alpha)$ are the marginal distributions.

- θ governs degree of association between α and φ.
- $G(\alpha, \varphi)$ has 5 parameters: m, k, a, b, θ; Normalize $m = 1$.

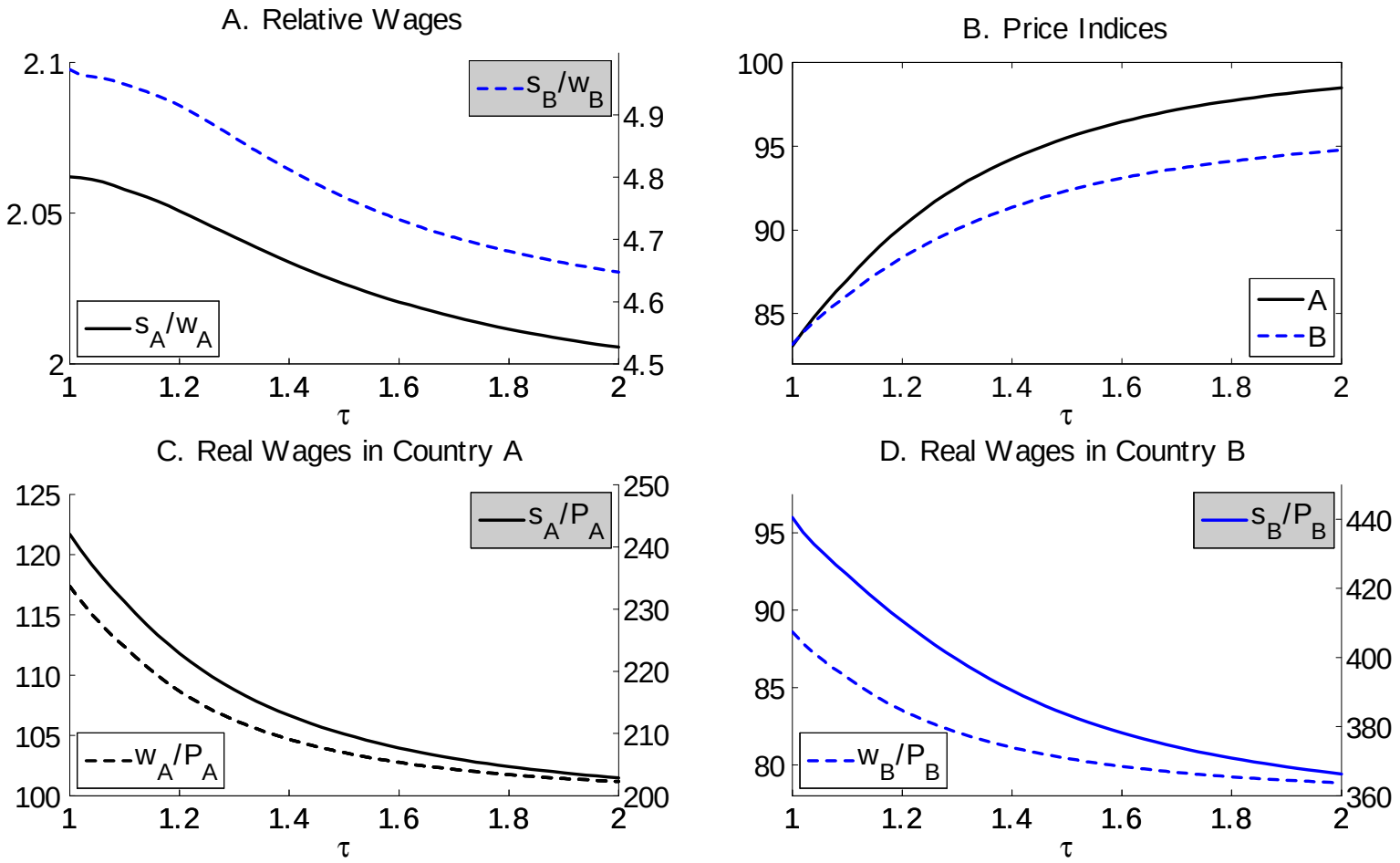
Use minimum distance estimator (values of other parameters from the literature); estimates imply *ex ante* correl$(\alpha, \ln \varphi) \approx 0.6$.

Tariff reduction in **Asymmetric** world: reals



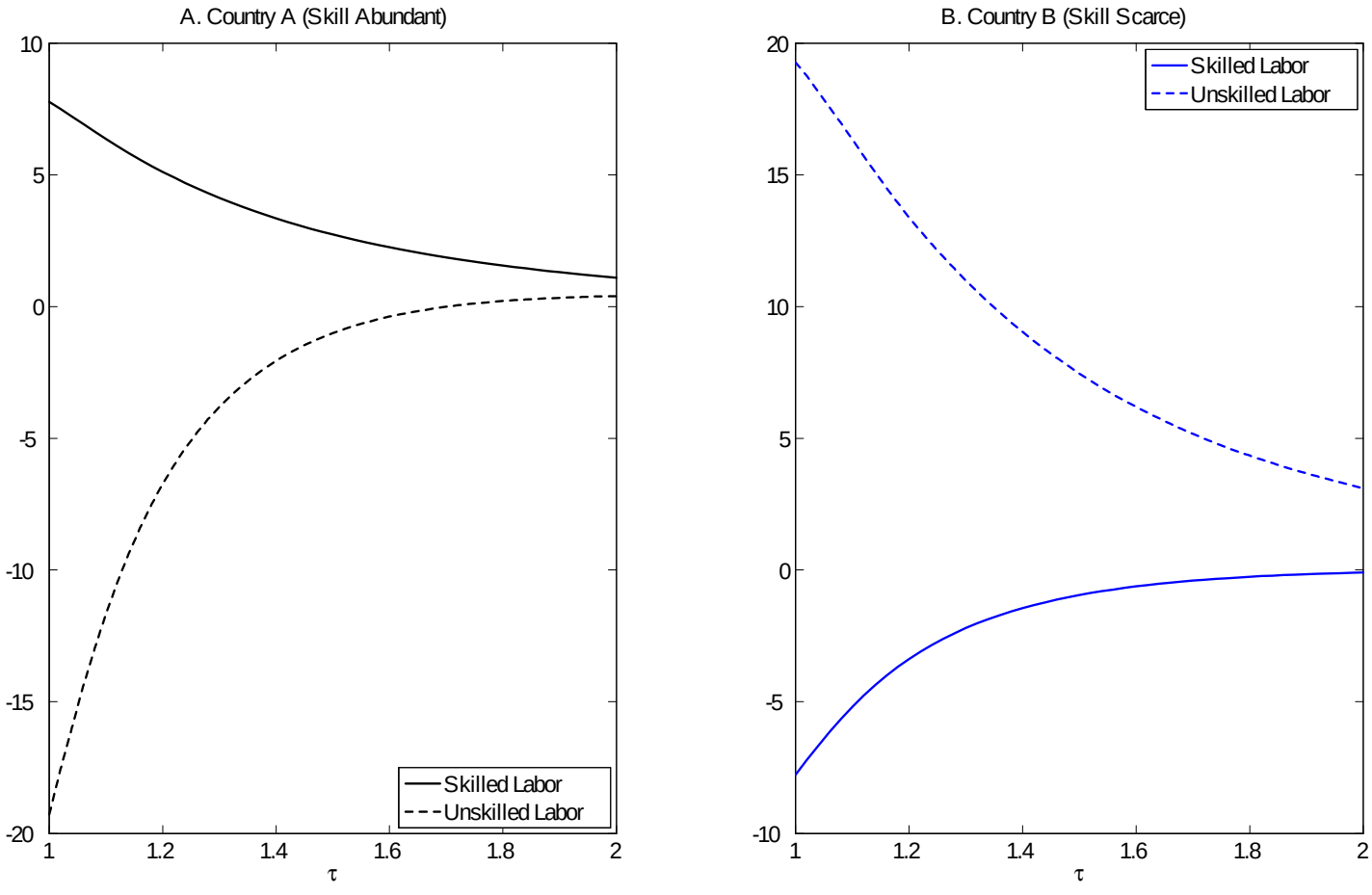
Same as in Melitz (2003), but larger gains from trade in A.

Tariff reduction in **Asymmetric** world: prices

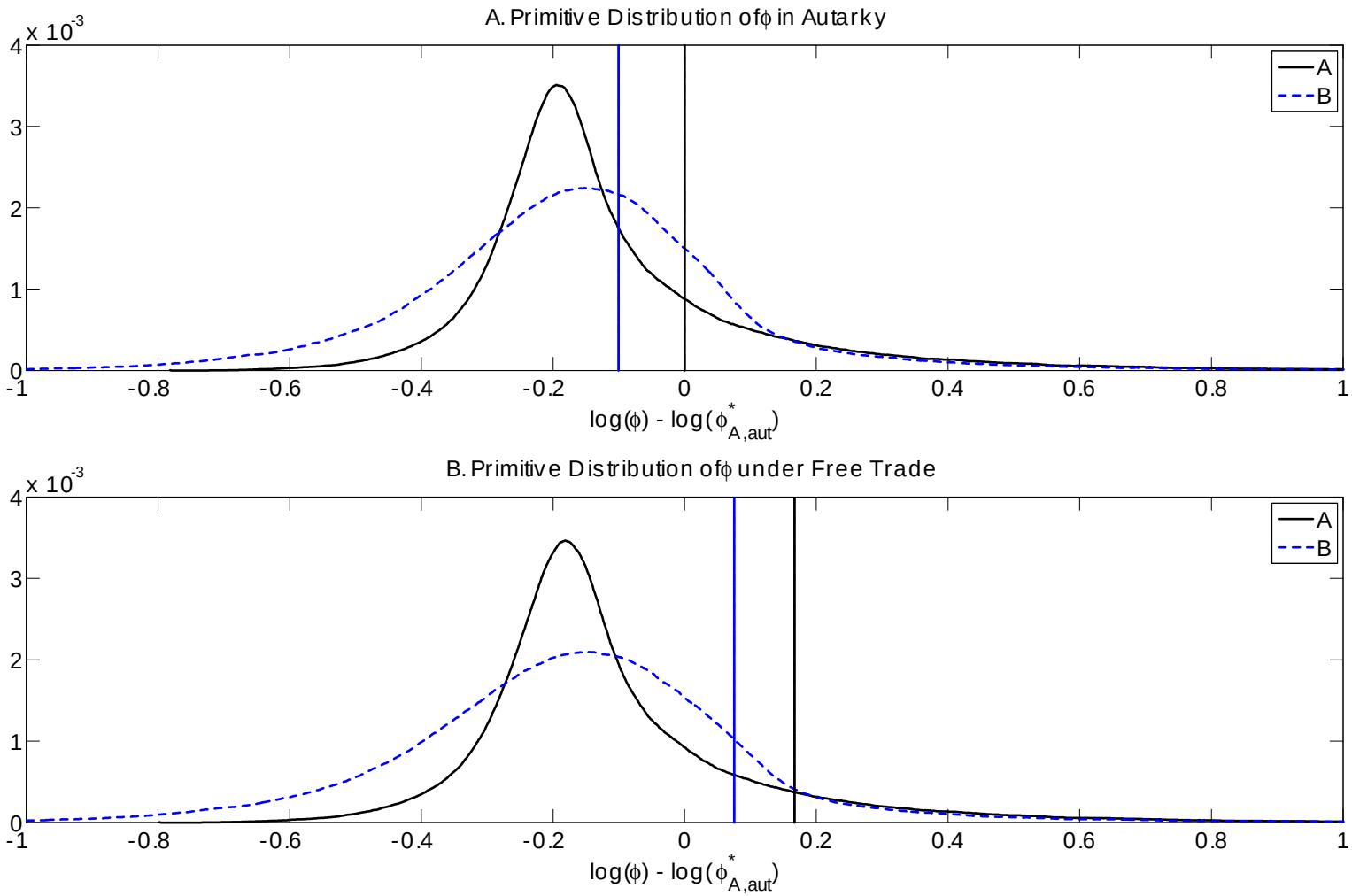


Skill premium rises, real wages rise, both in A and B.

Net Factor content of trade



We have a HO thm-like result (when $\tau > 1$ not mirror image).



B is less competitive, more mediocre firms: Higher skill premium – endowment (supply) farther away from ideal (technology, demand) – taxes the most φ-productive firms.

Skill abundance (endowment) convergence of B to A

	$(H/L)^B$	country A	country B	B/A
Real	0.5	100	100	1
GDP	0.3	99.6	90.7	0.91
	0.1	98.4	70.9	0.72
Skill	0.5	2.04	2.04	1
premium	0.3	2.04	2.76	1.36
	0.1	2.03	4.84	2.39
Real	0.5	204	204	1
skilled	0.3	203	240	1.18
wage	0.1	200	343	1.71
Real	0.5	100	100	1
unskilled	0.3	99.6	86.8	0.87
wage	0.1	98.6	70.8	0.72

Big effects in B—little effects on A. Counteracting forces:

- B becomes more competitive $\Rightarrow$ kills less productive A firms.
- B mkt size $\uparrow \Rightarrow$ easier for less productive A firms to survive.

Conclusions

1. Model: Two dimensional heterogenous firms in φ and α.
   - GE, but non Heckscher-Ohlin mechanism.
     - Breaks link between technology and preferences.
     - Does not rely on relative prices (no Stolper-Samuelson thm).
     - Predicts patterns/net factor content of trade (yes HO thm).

2. Model matches salient features of the data:
   - Estimate technology is skill biased: $\text{correl}(\alpha, \varphi) > 0$.
   - Exporters larger and more skill intensive, on average.
   - Lots of skill heterogeneity along size/exporting dimensions.

3. Trade liberalization generates increase in skill premium:
   - Both in identical and asymmetric countries.
   - Larger gains in more competitive (skill abundant) country.