The Elusive Pro-Competitive Effects of Trade

Costas Arkolakis (Yale) Arnaud Costinot (MIT)
Dave Donaldson (MIT) Andrés Rodríguez-Clare (UC Berkeley)

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How Large Are the Gains from Trade Liberalization?

- Arkolakis, Costinot, and Rodriguez-Clare (2012), have shown that for fairly large class of trade models, welfare changes caused by trade shocks only depend on two statistics:

  1. Share of expenditure on domestic goods, $\lambda$
  2. Trade elasticity, $\varepsilon$, in gravity equation

- Assume small trade shock so that, $d \ln \lambda < 0$: associated welfare gain is given by

  $d \ln W = - \frac{d \ln \lambda}{\varepsilon}$
What About the Pro-Competitive Effects of Trade?

- Important qualification of ACR’s results:
  - All models considered in ACR feature CES utility functions
  - Thus firm-level markups are constant under monopolistic competition
  - This de facto rules out “pro-competitive” effects of trade
This Paper

- **Goal:** Study the pro-competitive effects of trade, or lack thereof
  - Depart from CES demand and constant markups.
  - Consider demands with variable elasticity and variable markups.

- **Focus:** Monopolistic competition models with firm-heterogeneity

- **Experiment:**
This Paper

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  - Depart from CES demand and constant markups.
  - Consider demands with variable elasticity and variable markups

• **Focus:** Monopolistic competition models with firm-heterogeneity

• **Experiment:**
  - Consider two classes of models with CES and without
    - Impose restrictions so that all these models have same macro predictions
    - What are the welfare gains under these two scenarios?
This Paper: Main Results

- Characterize welfare gains in this environment
  - Suppose small trade shock, $d \ln \tau$, raises trade openness, $d \ln \lambda < 0$
  - Welfare effect is given by
    $$d \ln W = -(1 - \eta) \frac{d \ln \lambda}{\varepsilon}$$

- $\eta \equiv$ structural parameter depends on
  - Degree of pass-through
  - Magnitude of GE effects
• Whether models with variable markups lead to larger or lower gains from trade liberalization depends on sign of $\eta$
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Demand parameter determines size of GE effects - non-parametric estimation
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    Incomplete pass-through (Direct effect of changes in trade costs)
    GE effects (Direct effect of changes in trade costs dominates)
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Related Literature

- Arkolakis Costinot Rodriguez-Clare ’12 (ACR)
  - Characterize gains from trade with variable markups

- Large theoretical literature on markups and trade (e.g. Krugman ’79, Feenstra ’03, Melitz Ottaviano ’07, Neary and Mrazova)
  - Consider a unified framework characterize gains from trade

- Large empirical literature on markups and trade (e.g. Levinsohn ’93, Krishna Mitra ’98, Loecker Warzynski ’12, Loecker et al ’12)
  - Consistent with Loecker at al ’12: liberalization leads to MC declines but markup increases

- Feenstra Weinstein ’10, Edmond Midrigan Xu ’12 using Atkeson Burstein
Roadmap

1. Basic Environment

2. Trade Equilibrium

3. Welfare Analysis

4. Empirical Estimates
1. Basic Environment
Basic Environment

- World economy comprising $i = 1, ..., n$ countries, denote $i$ the exporter, $j$ the importer

- **Representative Consumers**
  - Continuum of differentiated goods $\omega \in \Omega$, variable elasticity demand
  - One factor of production, labor, immobile across countries
    - $L_i \equiv$ labor endowment, $w_i \equiv$ wage in country $i$

- **Firms**
  - Each firm can produce a single product under monopolistic competition
  - $N_i$ is the measure of goods that can be produced in $i$
    - Free entry: potential entrants need to hire $F_i^e$ units of labor
Consumers

- All consumers have same preferences. Marshallian demand for good $\omega$ of consumer with income $w$ facing prices $p \equiv \{p_\omega\}_{\omega \in \Omega}$ is given by

$$q_\omega(p, w) = Q(p, w) \frac{D(p_\omega/P(p, w))}{P(p, w)}$$

- $Q(p, w)$ and $P(p, w)$ are aggregators of all prices and the wage s.t.

$$
\int_{\omega \in \Omega} [H(p_\omega/P)]^\beta [p_\omega QD(p_\omega/P)]^{1-\beta} d\omega = w^{1-\beta},
$$

$$Q^{1-\beta} \left[ \int_{\omega \in \Omega} p_\omega QD(p_\omega/P) d\omega \right]^\beta = w^\beta,$$

with $\beta \in \{0, 1\}$ and $H(\cdot)$ strictly increasing and strictly concave.
Examples

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$$q_\omega(p, w) = Q(p, w)D(p_\omega/P(p, w))$$

Covers demands suggested by
- Krugman (1979): Symmetric Additively Separable Utility Functions
- Feenstra (2014): QMOR Expenditure Functions (Homoth.)
- Klenow and Willis (2016): Kimball Preferences (Homoth.)
Example I

- All consumers have same preferences. Marshallian demand for good $\omega$ of consumer with income $w$ facing prices $p \equiv \{p_{\omega}\}_{\omega \in \Omega}$ is given by

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Example I:

- Symmetric Additively Separable Utility, $U = \int u(q_{\omega}) \, d\omega$, as in Krugman ’79
  - $\beta = 0$, $D = u'^{-1}$, $P = 1/\lambda$ ($\lambda \equiv$ Lagrange mult.)
  - see also Behrens et al ’09, ’11, Zhelobodko et al. ’11
Example II

- All consumers have same preferences. Marshallian demand for good $\omega$ of consumer with income $w$ facing prices $\mathbf{p} \equiv \{p_\omega\}_{\omega \in \Omega}$ is given by

$$q_\omega(\mathbf{p}, w) = Q(\mathbf{p}, w) D\left(p_\omega / P(\mathbf{p}, w)\right)$$

Example II:

- Kimball preferences. Utility $Q$ is implicitly given by $\int Y\left(\frac{q_\omega}{Q}\right) d\omega = 1$
- Manipulating the first-order conditions of this problem we get

$$q_\omega = QY'^{-1} \left(\frac{\lambda \int q_\omega Y' \left(\frac{q_\omega}{Q}\right) d\omega}{Q} p_\omega\right)$$

for all $\omega$.

- $\beta = 1$, $D \equiv Y'^{-1}$, $P \equiv Q / \left(\lambda \int q_\omega Y' \left(\frac{q_\omega}{Q}\right) d\omega\right)$, and $H \equiv Y(D)$,
Additional Restrictions on the Demand System

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$$ q_\omega(p, w) = Q(p, w) D(p_\omega / P(p, w)) $$

- **[Choke Price]:** There exists $a \in \mathbb{R}$ such that for all $x \geq a$, $D(x) = 0$.

- **Comments:**
  - CES can have welfare gains from new varieties but constant markup
  - Here variable markups but choke price guarantees that “cut-off” varieties have no welfare effect
  - Wlog we normalize $a = 1$ so that $P =$ choke price
Firms

- Monopolistic competition with free entry. $N_i$ is measure of entrants in $i$

- Firms need to pay $w_i F_i^e$ to enter, production is subject to CRS
  - As in Melitz ’03, firm-level productivity $z$ is realization of r.v. $Z_i$
  - $Z_i$ is drawn independently across firms from a distribution $G_i$

- $G_i$ is Pareto with same shape parameter around the world:

- **Pareto** For all $z \geq b_i$, $G_i(z) = 1 - (b_i / z)^\theta$, with $\theta > \beta - 1$
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- Pareto assumption is central to our experiment:

  - In spite of differences in demand system, model considered in this paper will have same macro implications as model with CES in ACR
Trade Costs

• Trade is subject to iceberg trade costs $\tau_{ij} \geq 1$
  • Good markets are perfectly segmented across countries (Parallel trade is prohibited)

• There are no exporting fixed costs of selling to a market
  • Selection into markets driven entirely by choke price
2. Trade Equilibrium
Firm-Level Markups

- Firm optimization problem is given by

\[ \pi (c, Q, P) = \max_p \{(p - c) q(p, Q, P)\} , \]

taking \( Q, P \) as given.

- \( c \equiv \frac{w_i}{z} \tau_{ij} \) denotes marginal cost of this firm (production + shipping)

- Monopoly pricing implies:

\[ \frac{(p - c)}{p} = -1/\left(\frac{\partial \ln q(p, Q, P)}{\partial \ln p}\right) \]
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- Define \( m \equiv p/c, \ v \equiv P/c \) & use demand system:
  \[ m = \varepsilon_D(m/v) / (\varepsilon_D(m/v) - 1) \]
  where \( \varepsilon_D(x) \equiv -\frac{\partial \ln D(x)}{\partial \ln x} \) measures the elasticity of demand
Firm-Level Markups

- Given our demand system, firm-level markups satisfy

\[ m = \varepsilon_D(m/v)/(\varepsilon_D(m/v) - 1) \]

- This implies that in any market:
  - Firm relative efficiency in a market, \( v \equiv P/c = P_jz/w_i\tau_{ij} \), is a sufficient statistic for firm-level markup, \( m \equiv \mu(v) \)
  - With a choke price the marginal firm (\( v = 1 \)) has no markup (\( m = 1 \))
  - More efficient firms charge higher markups, \( \mu'(v) > 0 \), if and only if demand functions are log-concave in log-prices, \( \varepsilon'_D > 0 \)
  - Mrazova and Neary (2013) provide further discussion
Firm-Level Decisions

- **Note:**
  - Pareto implies distribution of markups is unaffected by trade costs
  - In addition, extensive margin response here is irrelevant for welfare
  - Variable markups **do matter** for welfare, as we will see
Closing the Model

• Free entry condition \((\Pi_{ij} : \text{aggregate profits of firms from } i \text{ in } j)\):

\[
\sum_j \Pi_{ij} = N_i w_i F_i^e.
\]

• Labor market clearing condition \((X_{ij} : \text{bilateral trade})\):

\[
\sum_j X_{ij} = w_i L_i
\]

• Given firm choices, conditions pin down measure of entrants, \(N_i\), wages, \(w_i\).
Closing the Model

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• Labor market clearing condition ($X_{ij}$: bilateral trade):
  \[ \sum_j X_{ij} = w_i L_i \]

• Given firm choices, conditions pin down measure of entrants, $N_i$, wages, $w_i$.

• Pareto guarantees $\Pi_{ij} / X_{ij}$ is constant (key restriction in ACR).
  • In turn, $N_i$ does not change with different trade costs
  • This also implies that same results hold if entry is fixed
Bilateral Trade Flows and Pareto

- Under Pareto one can check that trade flows satisfy gravity equation:

\[ \lambda_{ij} \equiv \frac{X_{ij}}{\sum_l X_{lj}} = \frac{N_i b_i^{-\theta} (w_i \tau_{ij})^{-\theta}}{\sum_l N_i b_l^{-\theta} (w_l \tau_{lj})^{-\theta}} \]

- The exact same structural relationship holds in ACR
  - see also Krugman '80, EK '02, Anderson van Wincoop '03, EKK '11

- Gravity equation has strong implications for welfare analysis
  - Changes in trade, relative wages caused by a trade shock same as in ACR (once calibrated to match initial trade flows, \( X_{ij} \), and elasticity, \( \theta \))
3. Welfare Analysis
Welfare Analysis

- Consider a small trade shock from \( \tau \equiv \{ \tau_{ij} \} \) to \( \tau' \equiv \{ \tau_{ij} + d\tau_{ij} \} \)

- Let \( e_j \equiv e(p_j, u_j) \) denote expenditure function in country \( j \)
Welfare Analysis

- One can show that changes in (log-) expenditure are given by:

\[
d \ln e_j = \sum_i \lambda_{ij} d \ln (w_i \tau_{ij}) + (-\rho) \sum_i \lambda_{ij} d \ln (w_i \tau_{ij}) + \rho d \ln P_j
\]

where

\[
\rho \equiv \int_1^\infty \frac{d \ln \mu(v)}{d \ln v} \frac{\left(\frac{\mu(v)}{v}\right) D(\frac{\mu(v)}{v}) v^{-\theta-1}}{\int_1^\infty \frac{\left(\frac{\mu(v')}{v'}\right) D(\frac{\mu(v')}{v'}) (v')^{-\theta-1}}{d v'}}
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- Consider a “good” trade shock s.t. \( \sum_i \lambda_{ij} d \ln (w_i \tau_{ij}) < 0 \):
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\[ \rho \equiv \int_1^\infty \frac{d \ln \mu(v)}{d \ln v} \frac{(\mu(v)/v) D(\mu(v)/v) v^{-\theta-1}}{\int_1^\infty (\mu(v)/v') D(\mu(v)/v') (v')^{-\theta-1}} dv'. \]

- Consider a “good” trade shock s.t. \( \sum_i \lambda_{ij} d \ln (w_i \tau_{ij}) < 0 \):
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• Consider a “good” trade shock s.t. \( \sum_i \lambda_{ij} d \ln (w_i \tau_{ij}) < 0 \):

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  • **Direct markup effect:** If \( \rho > 0 \) lower gains from trade liberalization (incomplete pass-through)
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Change in marginal costs
Direct markup effect
GE markup effect

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• Consider a “good” trade shock s.t. \( \sum_i \lambda_{ij} d \ln (w_i \tau_{ij}) < 0 \):
  • First term is what one would get if markups were constant
  • **Direct markup effect:** If \( \rho > 0 \) lower gains from trade liberalization (incomplete pass-through)
  • **GE markup effect:** If \( \rho > 0 \) tends to increase gains if good trade shocks lead to a lower \( P_j \); see Melitz and Ottaviano ’07
Welfare Analysis

- The rest of the analysis proceeds in two steps

- **Use labor market clearing condition**
  Relate change in choke price to overall magnitude of trade shock:

  \[ d\ln P_j = \frac{\theta}{1 - \beta + \theta} \sum_i \lambda_{ij} d\ln (w_i \tau_{ij}) \]

- **Use gravity equation, as in ACR**
  Relate trade shock to change in share of expenditure on domestic goods, level of trade elasticity:

  \[ \sum_i \lambda_{ij} d\ln (w_i \tau_{ij}) = \frac{d\ln \lambda_{jj} \theta}{\theta} \]

- Putting things together, we obtain our new welfare formula
A New Welfare Formula

- **Proposition:** Compensating variation associated with small trade cost:

\[ d \ln W_j = - (1 - \eta) \frac{d \ln \lambda_{jj}}{\theta}, \text{ with } \eta \equiv \rho \left( \frac{1 - \beta}{1 - \beta + \theta} \right) \]
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  - \( \beta \) and \( \theta \) determine the GE effect.
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What is the sign of \( \eta \) under common alternatives to CES?

- Kimball preferences or QMOR expenditure functions correspond to \( \beta = 1 \) (same gains as in ACR). In this case, \( \eta = 0 \).
- Additively separable utility corresponds to \( \beta = 0, \rho \in (0, 1) \). In this case, \( \eta > 0 \). Thus, lower gains from trade liberalization
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  • Additively separable utility corresponds to \( \beta = 0, \rho \in (0, 1) \). In this case, \( \eta > 0 \). Thus, lower gains from trade liberalization
Intuition

- If all countries are symmetric, compensating variation can be written as

\[
d \ln W_j = - \sum_i \lambda_{ij} d \ln \tau_{ij} + \rho \sum_i \lambda_{ij} d \ln \tau_{ij} + \rho d \ln P_j
\]

Direct markup effect

GE markup effect

\[
= - \sum_i \lambda_{ij} d \ln \tau_{ij} + \text{cov} \left( \mu_{\omega,i}, \frac{dL_{\omega,i}}{L_j} \right)
\]

where \( \text{cov} \left( \mu_{\omega,i}, \frac{dL_{\omega,i}}{L_j} \right) = \sum_i \int_{\omega \in \Omega_{ji}} [\mu_{\omega,i} d \left( \frac{L_{\omega,i}}{L_j} \right)] d\omega \)
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• Covariance term only appears if markups are variable
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• Covariance term only appears if markups are variable

• A new source of gains or losses depending on reallocation of labor and correlation with markups
4. Empirical Estimates
What is the value of $\eta$ in the data?

- In the homothetic case ($\beta = 1$) we then have $\eta = 0$, and hence no pro-competitive effects, irrespective of other parameters.
- In the non-homothetic case ($\beta = 0$) the value of $\eta$ depends on $1/(1 + \theta)$ and $\rho$.
  - $\theta$ is equal to the elasticity of aggregate trade flows with respect to trade costs. We use $\theta = 5$, in line with recent estimates of “trade elasticity.”
  - This implies that $\eta$ lies between zero (for homothetic demand) and $\rho/6$ (for non-homothetic demand).
- If we want tighter bounds, we need to estimate $\rho$
Estimation of $\rho$: Approach I

• **Approach I** = Estimate $D(\cdot)$ directly and use estimate to evaluate $\rho$ (under monopolistic competition)

• We focus on the case of additively separable preferences in the “Pollak family”. This corresponds to

\[
D(p_\omega / P) = (p_\omega / P)^{1/\gamma} - \alpha.
\]

• This nests the CES case (if $\alpha = 0$) but also allows for the possibility of either $\rho > 0$ (if $\alpha > 0$) or $\rho < 0$ (if $\alpha < 0$)

• We estimate the inverse demand relation given by

\[
\Delta_t \Delta_{gi} \ln p_{git}^k = \gamma \Delta_t \Delta_{gi} \ln (q_{git}^k + \alpha) + \Delta_t \Delta_{gi} \ln \epsilon_{git}^k,
\]

• Non-linear IV estimate is $\hat{\gamma} = -0.347 \ [\hat{\gamma} = -0.373, -0.312]$ and $\hat{\alpha} = 3.053 \ [0.633, 9.940]$. This leads to $\hat{\rho} = 0.36$ and $\hat{\eta} = \hat{\rho} / 6 = 0.06$ (using $\theta = 5$)
Estimate of $\rho$: Approach II

- **Approach II** = Use estimates of pass-through of costs into prices
- GKLP '12: cross-sectional regression of (log) prices on (log) mc yields 0.35
  - With $\rho = 0.65$ and $\theta = 5$, we now get $\eta = 0.11$
- Burstein and Gopinath (2014): time series evidence on long-run exchange rate pass-through between 0.14 and 0.51
  - This gives $\rho$ between 0.49 and 0.86 and, in turn, $\eta$ between 0.08 and 0.14
- **Conclusion**: small downward adjustment in gains from trade liberalization (though with homotheticity, gains could be the same)
  - Hence the title “The Elusive Pro-Competitive Effects of Trade”