Welfare and Growth in Open Economies

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Has Mexico gained from trade?

- Has liberalized trade policy starting in mid 1980s.
- Has had dramatic increase in trade.
- Has had no increase in GDP per capita.
Mexican trade and growth
Does this imply that Mexico has not gained from trade?
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No!
How has Mexico gained from trade?

• We find gains from trade
  In welfare
  Not in real GDP per capita

• We need theory for welfare

Bajona, Gibson, Kehoe, and Ruhl (2009)
We need theory for welfare

- Two workhorse theories:
  Heckscher-Ohlin models
  Heterogeneous firm trade models

- Both theories tell us trade
  Increases welfare,
  Does not increase GDP.

Heckscher-Ohlin models
Heckscher-Ohlin models

• In static model, opening to trade
  Increases welfare,
  Decreases GDP.

• In dynamic model, opening to trade
  Increases consumption in capital-poor countries,
  Decreases capital accumulation in capital poor countries.
Static Heckscher-Ohlin

• 2 factors of production — physical capital, labor

• 2 goods — capital intensive, labor intensive

• Stylized analysis of trade liberalization

  autarky $\rightarrow$ free trade

What happens to trade and GDP when we open to trade?
Welfare: Open to trade

\[ y^T = y^A = c^A \]

Welfare increases
Real GDP: Start in autarky

\[
GDP^A = p_1^A y_1^A + p_2^A y_2^A
\]
Real GDP: Open to trade

\[ GDP^A = p_1^A y_1^A + p_2^A y_2^A \]

Real GDP decreases
Real GDP: Open to trade

\[ GDP^A = p_1^A y_1^A + p_2^A y_2^A \]

What about capital accumulation and growth?
Dynamic Heckscher-Ohlin

- 2 goods, 2 factors, \( n \) countries, populations \( L_i \)
- Goods mobile across countries, factors not mobile
- Infinitely-lived consumers

\[
\max \sum_{t=0}^{\infty} \beta^t u(c_{1t}^i, c_{2t}^i) \\
\text{s.t.} \quad p_{1t} c_{1t}^i + p_{2t} c_{2t}^i + x_t^i = w_t^i + r_t^i k_t^i \\
k_{t+1}^i - (1 - \delta) k_t^i = x_t^i \\
c_{jt}^i \geq 0, \quad x_t^i \geq 0 \\
k_0^i = k_0^i.
\]

- Investment good

\[
k_{t+1}^i - (1 - \delta) k_t^i = x_t^i = f(x_{1t}^i, x_{2t}^i)
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k_{t+1}^i - (1-\delta)k_t^i = x_t^i = f(x_{1t}^i, x_{2t}^i)
\]

This is potentially very complicated!
Simplifying assumptions

• Factor intensities are extreme:
  \[ \phi_1(k_1, \ell_1) = k_1 \]
  \[ \phi_2(k_2, \ell_2) = \ell_2. \]

• Utility function is transformation of investment function:
  \[ u(c_1, c_2) = \log(f(c_1, c_2)). \]
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  Allows us to solve for equilibrium of world economy

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  Allows us to solve for equilibrium of one-sector model

Simpler Problem

We solve for the equilibrium of the world economy by solving

$$\max \sum_{t=0}^{\infty} \beta^t \log c_t$$

s.t.  \(c_t + x_t = f(k_t, 1)\)

\(k_{t+1} - (1-\delta)k_t = x_t\)

\(c_t \geq 0, \ k_t \geq 0\)

\(k_0 = \bar{k}_0,\)

where \(c_t = f(c_{1t}, c_{2t}).\)
Simpler Problem

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s.t. $c_t + x_t = f(k_t, 1)$

$$k_{t+1} - (1 - \delta)k_t = x_t$$

$c_t \geq 0, \ k_t \geq 0$

where $c_t = f(c_{1t}, c_{2t})$.

Growth model in first-year macro,

especially case where $\delta = 1$ and $f(k, 1) = dk^{a_1}$. 
Convergence of closed countries

\[ k_{t+1} \]

\[ k_t \]

\[ \hat{k} \]

\[ \bar{k}_0^i \]
Intuition

• In a world of closed countries,
  Rental rates higher in poorer countries than in richer,
  Poorer countries grow faster.

• In a world of open countries,
  Rental rates same in poorer countries as in richer,
  No convergence in cross section.
Proposition

Define GDP per capita in $i$:

$$y_t^i = p_{1t} y_{1t} + p_{2t} y_{2t} = r_t k_t^i + w_t = f(k_t^i, 1).$$

Suppose that $\delta = 1$, then

$$\frac{y_t^i - y_t}{y_t} = \frac{c_t / y_t}{c_0 / y_0} \left( \frac{y_t^i - y_0}{y_0} \right).$$
Proposition

Define GDP per capita in $i$:

$$y^i_t = p_{1t} y^i_{1t} + p_{2t} y^i_{2t} = r_t k^i_t + w_t = f(k^i_t, 1).$$

Suppose that $\delta = 1$, then

$$\frac{y^i_t - y_t}{y_t} = \frac{c_t / y_t}{c_0 / y_0} \left( \frac{y^i_0 - y_0}{y_0} \right).$$

Notice that

$c_t / y_t$ comes from solution to the one-sector model

If $c_t / y_t$ increases, income levels diverge.

If $c_t / y_t$ decreases, income levels converge.
Proposition

\[ \frac{y_t^i - y_t}{y_t} = \frac{c_t / y_t}{c_0 / y_0} \left( \frac{y_0^i - y_0}{y_0} \right) \]

\[ f(x_1, x_2) = dx_1^{a_1} x_2^{a_2} \]

⇒ \( c_t / y_t \) constant

⇒ no convergence in cross section

\[ f(x_1, x_2) = d \left( a_1 x_1^b + a_2 x_2^b \right)^{1/b}, \ b < 0 \]

⇒ \( c_t / y_t \) increases as the world economy grows

⇒ divergence in cross section
What happens to poor country’s welfare?

• Answer: it increases
  
  \[ t = 1: \text{static gains due to change in prices} \]
  
  \[ t > 1: \text{dynamic gains due to saving less} \]

• Gain depends on elasticity of substitution, factor intensities, discount factor.
What happens to poor country’s welfare?

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Trade equilibrium allocation is in the core: a closed economy always gains from opening to trade.
What happens to poor country’s real GDP?

• Answer: it decreases
  
  \( t = 1 \): static decrease due to change in prices
  \( t > 1 \): slower capital accumulation due to lower rental rate
  
• Loss depends on elasticity of substitution, factor intensities, discount factor.
Heterogeneous firm trade models
Heterogeneous firm models

Opening to trade

• Increases welfare

• Does not change real GDP (with popular functional forms)

Gibson (2007)
Heterogeneous firm models

- Consumers
  Preference for variety: $u(c) = (1/\rho)\log \int_z c(z)^\rho \, dz$

- Firms
  Monopolistic competition
  Heterogeneous productivities: $x \sim 1 - \gamma (\theta / x)^\gamma$
  Fixed cost of production

Melitz (2003), Chaney (2008)
Start in autarky

• Cutoff productivity

Firms with $x < \bar{x}_d^A$ do not produce

Firms with $x > \bar{x}_d^A$ produce for domestic market
Start in autarky

$\bar{x}_d^A$

density

exit

produce

productivity $x$
Open to trade

• 2 symmetric countries
• Additional fixed cost to export
• New cutoff productivity

Firms with $x < \bar{x}_e^T$ do not export
Firms with $x \geq \bar{x}_e^T$ export
Open to trade

density

$\bar{X}_d^A$ $\bar{X}_d^T$ $\bar{X}_e^T$ productivity $x$

exit | domestic | export
Open to trade

Labor moves to more productive firms

\( \bar{X}_d^A \quad \bar{X}_d^T \quad \) productivity \( x \)

exit | domestic | export
What happens to welfare?

- More physical units of goods
- Gain depends on
  - Elasticity of substitution
  - Distribution of productivities

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- More physical units of goods
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  - Distribution of productivities


In Melitz model, number of varieties consumed goes down.
What happens to real GDP?

\[ GDP^A = \mu \int_{X_d}^{\infty} p^A(x) y^A(x) dF(x) \]

\[ GDP^T = \mu \int_{X_d}^{\infty} p^A(x) y^T(x) dF(x) \]

With C.E.S. utility,

\[ p^T(x) = p^A(x) = \frac{w}{\rho x} \]

More efficient firms have larger markets only because they charge lower prices.
What happens to real GDP?

- Labor moves from low productivity to high productivity firms
  Increases GDP
What happens to real GDP?

- Labor moves from low productivity to high productivity firms
  Increases GDP

- Labor moves from high price to low price firms
  Decreases GDP
What happens to real GDP?

• Labor moves from low productivity to high productivity firms
  Increases GDP

• Labor moves from high price to low price firms
  Decreases GDP

With C.E.S. and Pareto,
these two forces exactly cancel out.

GDP is unchanged.
Lessons from theory

• Match concepts in theory with those in data.

• Measure gains in welfare, not in GDP per capita.

• Tell Mexican friends not to worry.
Lessons from theory

- Match concepts in theory with those in data.
- Measure gains in welfare, not in GDP per capita.
- Tell Mexican friends not to worry.

...or should they?
What about China?
Chinese GDP per capita has grown.
Growth accounting for China

\[ Y_t = A_t K_t^\alpha L_t^{1-\alpha} \]

\[ \frac{Y_t}{N_t} = A_t^{1/(1-\alpha)} \left( \frac{K_t}{Y_t} \right)^{\alpha/(1-\alpha)} \frac{L_t}{N_t} \]
Growth accounting for China

\[
\frac{Y_t}{N_t} \\
\frac{L_t}{N_t} \\
\left(\frac{K_t}{Y_t}\right)^{\frac{\alpha}{1-\alpha}} \\
A_t^{\frac{1}{1-\alpha}}
\]
Chinese growth has been driven by productivity
Standard trade theory does not explain productivity growth.

What theories of openness can do so?


Incentives for internal reforms: Bajona-Chu (2008)