Trade, Technology, and the Skill Premium:
The Case of Mexico

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March 2018
Motivation

- In the 1980's the manufacturing skill premium began to rise in the US and Mexico
US Manufacturing Skill Premium

The graph shows the ratio of wages over time from 1960 to 2010. The ratio of wages has increased significantly from the 1960s to the 2000s, with a notable peak around the year 2000. The trend line indicates a consistent rise in the ratio of wages, suggesting a growing premium for skilled labor in the manufacturing sector.
MEXICO MANUFACTURING SKILL PREMIUM
INCREASE IN SKILL PREMIA
In the 1980’s the manufacturing skill premium began to rise in the US and Mexico.

Rise coincided with a large-scale unilateral Mexican trade liberalization whereby US-Mexican trade increased dramatically.
Mexican Manufacturing Trade

![Graph showing the trend of imports and exports as a percentage of value added over years from 1970 to 2015. The graph indicates a steady increase in both imports and exports.]}
MEXICAN MERCHANDISE TRADE

Merchandise Trade/GDP  US Imports from Mexico
In the 1980’s the manufacturing skill premium began to rise in the US and Mexico.

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Literature has had difficulty in establishing a large role of increase in trade flows on skill premium.
**Motivation**

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- Rise coincided with a large-scale unilateral Mexican trade liberalization whereby US-Mexican trade increased dramatically.
- Literature has had difficulty in establishing a large role of increase in trade flows on skill premium.
  - Skill premium moves counter to theoretical predictions in Mexico (increases).
QUESTION

Why did the skill premium go up by so much in Mexico?
THIS PROJECT

Why did the skill premium go up by so much in Mexico?

- Trade in technology or “ideas” through integration of supply chains between US and Mexico responsible for rising skill premia in both countries.
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    - Mexico through an “adoption channel”
    - U.S. through an “investment channel”
For Today

Evidence from Mexico
For Today

Evidence from Mexico

- Industries that trade more in intermediates with U.S. have greater increases in their skill premia
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A calibrated exercise that captures
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▶ Rising skill premia in both countries, larger in Mexico
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A calibrated exercise that captures

- Rising skill premia in both countries, larger in Mexico
- 12% of the rise in the skill premium in Mexico and 10% of the rise in the U.S.
For Today

Evidence from Mexico

- Industries that trade more in intermediates with U.S. have greater increases in their skill premia

A calibrated exercise that captures

- Rising skill premia in both countries, larger in Mexico
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Adding trade in technology reverses standard H-O predictions
Evidence of the Mechanism
Case Study: The Auto Industry

In the 1980’s US auto makers partnered with Mexican parts manufacturers to produce

- Crankshafts
- Intake Manifold
- Cylinder Head
- Cylinder Block

using the “latest state-of-the art.” Interviewed managers said there was “no difference in the technology used in Detroit and Mexico.”
PRODUCTION LINE: STANDARD SET UP
PRODUCTION LINE: STANDARD SET UP
PRODUCTION LINE: AN EXAMPLE OF SKILL-AUGMENTING TECHNOLOGY
PRODUCTION LINE: AN EXAMPLE OF SKILL-AUGMENTING TECHNOLOGY
ON THE JOB TRAINING

Skilled Workers

► Extensive pre-job training
► Apprenticeship program for both technicians and supervisors
► Supervisors brought to US to observe plant management

Unskilled Workers

► Taught basic characteristics of the machine that they would operate
► Taught how to assess which technician to contact if machine breaks down
Transfer of Technology

Supply chains served as ways to transfer

- Technology for making parts for final production
  - Blueprints for production of parts
  - Technology embedded in intermediate goods and parts
- Best practices for efficient production
- Organizational capital such as worker training programs
Mexico’s Trade Liberalization

- Begins in 1986
- Liberalization during NAFTA is relatively modest in comparison
- Between 1986 and 1990:
  - Average tariff rates fall from 30% to 5%
  - Average license coverage falls from 80% to 3%
- Following NAFTA
  - Average tariff rates fall from 5% to 3%
  - Average license coverage falls from 3% to 1%
Tariffs

![Graph showing the decline in average tariff rate paid over years from 1985 to 2005. The graph illustrates a significant decrease in tariff rates, with some fluctuations from 1995 onwards.]
**Mexico: Manufacturing Data**

- Manufacturing only - about 80% of manufacturing sector
- Plant-level available from 1984 - 1990
  - Information on production/non-production workers and wages, royalties paid, ownership, and investment
  - Also includes trade and tariffs paid from 1986-1990
- Industry-level available from 1984 - 1994
  - Information on production/non-production workers and wages, royalties paid, ownership, and investment
  - Matched to U.S.-Mexico Trade data from Schott (2008)

Use these data to relate trade liberalization to skill premium
Tariff Reduction and Royalties

Question: Do plants (industries) that face lower tariffs rent more technology?

Using plant-level data, we can relate royalties paid to tariffs faced by plants, as well as connection to U.S.:

\[
\left( \frac{R}{Y} \right)_{jt} = \alpha + \beta_1 \tau_{jt} + \beta_2 US_j + \beta_3 (\tau \times US)_{jt} + SI_{j0} + \gamma_j + T_t + \epsilon_{jt}
\]
Tariff Reduction and Royalties

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Using plant-level data, we can relate royalties paid to tariffs faced by plants, as well as connection to U.S.:

\[
\left( \frac{R}{Y} \right)_{jt} = \alpha - \beta_1 \tau_{jt} + \beta_2 \left( \frac{USExp}{Y} \right)_{jt} + \beta_3 \left( -\tau \ast \frac{USExp}{Y} \right)_{jt}
+ SI_{j0} + \gamma_j + T_t + \epsilon_{jt}
\]
## Tariff Reduction and Royalties

<table>
<thead>
<tr>
<th></th>
<th>U.S. Co</th>
<th>U.S. Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.094</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>(0.133)</td>
<td>(0.133)</td>
</tr>
<tr>
<td>$\tau_{jt}$</td>
<td>$-0.002^{*}$</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>$US_j$</td>
<td>0.709***</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.097)</td>
<td></td>
</tr>
<tr>
<td>$(US \ast \tau)_{jt}$</td>
<td>$-0.011^{***}$</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td></td>
</tr>
<tr>
<td>$USExp_{jt} / Y_{jt}$</td>
<td></td>
<td>0.608*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.342)</td>
</tr>
<tr>
<td>$(-\tau \ast USExp_{jt} / Y)_{jt}$</td>
<td></td>
<td>0.023*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.011)</td>
</tr>
<tr>
<td>$SI_{j0}$</td>
<td>0.789***</td>
<td>0.806***</td>
</tr>
<tr>
<td></td>
<td>(0.083)</td>
<td>(0.104)</td>
</tr>
<tr>
<td>Industry Fixed Effects?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Fixed Effects?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.108</td>
<td>0.111</td>
</tr>
</tbody>
</table>

*Significance levels: * p < 0.1, ** p < 0.05, *** p < 0.01
**Changes in Trade and the Skill Premium**

**Question:** Do plants that trade more (with the U.S.) and rent more technology have higher skill premia?

\[
SP_{jt} = \alpha + \beta_1 \left( \frac{Exp}{Y} \right)_{jt} + \beta_2 \left( \frac{Imp}{Y} \right)_{jt} + \beta_3 \left( \frac{R}{Y} \right)_{jt} + \beta_4 US_j + \beta_5 \left( \frac{Exp}{Y} * US \right)_{jt} + \beta_6 \left( \frac{Imp}{Y} * US \right)_{jt} + \beta_7 \left( \frac{R}{Y} * US \right)_{jt} + S_{Ij0} + \gamma_j + T_t + \epsilon_{jt}
\]
# Changes in Trade and the Skill Premium

<table>
<thead>
<tr>
<th>Sample</th>
<th>U.S. Only</th>
<th>No U.S.</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>3.113***</td>
<td>3.197***</td>
<td>3.124***</td>
</tr>
<tr>
<td></td>
<td>(0.116)</td>
<td>(0.114)</td>
<td>(0.116)</td>
</tr>
<tr>
<td>$\frac{\text{Exp}}{Y_{jt}}$</td>
<td>0.562***</td>
<td>0.391**</td>
<td>0.452***</td>
</tr>
<tr>
<td></td>
<td>(0.130)</td>
<td>(0.183)</td>
<td>(0.100)</td>
</tr>
<tr>
<td>$\frac{\text{Imp}}{Y_{jt}}$</td>
<td>0.027</td>
<td>0.041</td>
<td>0.027</td>
</tr>
<tr>
<td></td>
<td>(0.079)</td>
<td>(0.123)</td>
<td>(0.065)</td>
</tr>
<tr>
<td>$\frac{\text{Royalties}}{Y_{jt}}$</td>
<td>0.039***</td>
<td>0.040***</td>
<td>0.039***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>$\text{US}_{jt}$</td>
<td>0.356***</td>
<td>0.420***</td>
<td>0.343***</td>
</tr>
<tr>
<td></td>
<td>(0.067)</td>
<td>(0.065)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>$(\frac{\text{Royalties}}{Y_{jt}} \cdot \text{US}_{jt})$</td>
<td>$-0.031$</td>
<td>$-0.049$</td>
<td>$-0.037$</td>
</tr>
<tr>
<td></td>
<td>(0.032)</td>
<td>(0.032)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>$(\frac{\text{Exp}}{Y_{jt}} \cdot \text{US}_{jt})$</td>
<td>0.804***</td>
<td>$-0.042$</td>
<td>0.757***</td>
</tr>
<tr>
<td></td>
<td>(0.360)</td>
<td>(0.751)</td>
<td>(0.323)</td>
</tr>
<tr>
<td>$(\frac{\text{Imp}}{Y_{jt}} \cdot \text{US}_{jt})$</td>
<td>$-1.204$</td>
<td>0.341</td>
<td>$-0.423$</td>
</tr>
<tr>
<td></td>
<td>(0.765)</td>
<td>(1.027)</td>
<td>(0.503)</td>
</tr>
<tr>
<td>$SI_{jt0}$</td>
<td>$-1.172***$</td>
<td>$-1.187***$</td>
<td>$-1.175***$</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
<td>(0.078)</td>
<td>(0.078)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.155</td>
<td>0.153</td>
<td>0.155</td>
</tr>
</tbody>
</table>
INDUSTRY-LEVEL EVIDENCE

Use industry-level evidence to test:

- Impact of tariffs on
  - Royalties
    \[
    \left( \frac{R}{Y} \right)_{it} = \alpha + \beta_1 \tau_{it} + \gamma_i + T_t + \epsilon_{it}
    \]
  - Skill Premium
    \[
    SP_{it} = \alpha + \beta_1 \tau_{it} + \gamma_i + T_t + \epsilon_{it},
    \]

- Trade with U.S. on the skill premium:
  \[
  SP_{it} = \beta_1 \left( \frac{\text{Royalties}}{Y} \right)_{it} + \beta_2 \left( \frac{\text{Exports}}{Y} \right)_{it} + \beta_3 \left( \frac{\text{Imports}}{Y} \right)_{it} + \beta_4 S_{i0} + \gamma_i + T_t + \epsilon_{it}
  \]
**Impact of Tariffs**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\frac{R}{Y_{it}}$</th>
<th>$SP_{it}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.289</td>
<td>2.560***</td>
</tr>
<tr>
<td></td>
<td>(0.0349)</td>
<td>(2.333)</td>
</tr>
<tr>
<td>$\tau_{it}$</td>
<td>$-0.011^{***}$</td>
<td>$-0.003^{**}$</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Industry Fixed Effects?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Fixed Effects?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.388</td>
<td>0.784</td>
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</tbody>
</table>
# Impact of Trade with U.S.

<table>
<thead>
<tr>
<th></th>
<th>Level</th>
<th>Change (1984-1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royalties</td>
<td>0.024**</td>
<td>0.082***</td>
</tr>
<tr>
<td>( \frac{Y_{i,t}}{Y_{i,t}} )</td>
<td>(0.010)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Exports</td>
<td>0.128*</td>
<td>0.358***</td>
</tr>
<tr>
<td>( \frac{Y_{i,t}}{Y_{i,t}} )</td>
<td>(0.077)</td>
<td>(0.054)</td>
</tr>
<tr>
<td>Imports</td>
<td>-0.053</td>
<td>-0.079</td>
</tr>
<tr>
<td>( \frac{Y_{i,t}}{Y_{i,t}} )</td>
<td>(0.040)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>SI(_{i0})</td>
<td>8.432***</td>
<td>2.742***</td>
</tr>
<tr>
<td></td>
<td>(0.392)</td>
<td>(0.065)</td>
</tr>
<tr>
<td>Fixed Effects?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.981</td>
<td>0.650</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
SUMMARY OF DATA

- Case study points to technology capital transference via supply chains
- Plants/industries facing higher tariffs rent less technology and have lower skill premia
- Plants/industries with increased trade with U.S. and more technology rental have higher skill premia
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- Case study points to technology capital transference via supply chains
- Plants/industries facing higher tariffs rent less technology and have lower skill premia
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Suggests technology transfer may occur through supply chains
Model
ENVIRONMENT

- Time is infinite and discrete, $t = 0, 1, 2, ...$
- Two countries: US ($U$) and Mexico ($M$)
- Two types of workers: High-skill ($H$) and Low-skill ($L$)
- Households supply labor inelastically
- $I$ final goods
- Producers of non-traded final goods own and invest in technology and rent it to intermediate goods producers
- Technology is skill-augmenting
**Technological Investment and Transfer**

\[ I_{ki} = Z'_{ki} - (1 - \delta)Z_{ki} \]

- Looks like standard saving decision
Technological Investment and Transfer

\[ I_{ki} = Z'_{ki} - (1 - \delta)Z_{ki} + r_{kk'i}Z_{ki} \]

- Looks like standard saving decision
- Except returns come from renting technology out to
  - Domestic intermediate goods producers
Technology Investment and Transfer

\[ I_{ki} = Z'_{ki} - (1 - \delta)Z_{ki} + r_{kki}Z_{ki} + r_{kji}Z_{ki} \]

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  - Domestic intermediate goods producers
  - Foreign intermediate goods producers when open to trade
Technological Investment and Transfer

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- Transfer occurs through technology rental
**Intermediate Goods Producers: \( y_{jki}(\omega) \)**

Intermediate goods producers in country \( k \) produce for domestic (\( k \)) and foreign (\( j \)) final goods producers using the technology of the producer they are supplying. They solve:

\[
\max \sum_j \left( y_{jki}(\omega) \frac{p_{jki}(\omega)}{\tau_{jki}} - w^H_k h_{jki}(\omega) - w^L_k l_{jki}(\omega) - \tau_{zj}r_{ji} Z_{ji} \right)
\]

s.t.

\[
y_{jki}(\omega) = A_k \left[ \theta_i \left( Z_{ji}^\alpha h_{jki}(\omega)^{1-\alpha} \right)^{\frac{\sigma-1}{\sigma}} + (1 - \theta_i) l_{jki}(\omega)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}
\]

\[
y_{jki}(\omega) = Y_{ji} \left[ \frac{p_{jki}(\omega)}{P_{ji}} \right]^{1/(\rho-1)}
\]
Intermediate Goods Producers: \( y_{jki}(\omega) \)

The firm’s choice is distorted along two dimensions: a tariff \((\tau_{jki})\) and a distortion to the technology rental rate \((\tau_{ki})\)

\[
\max \sum_{j} \left( y_{jki}(\omega) \frac{p_{jki}(\omega)}{\tau_{jki}} - w_{k}^{H} h_{jki}(\omega) - w_{k}^{L} l_{jki}(\omega) - \tau_{zj} r_{ji} Z_{ji} \right)
\]

s.t.

\[
y_{jki}(\omega) = A_{k} \left[ \theta_{i} \left( Z_{ji}^{\alpha} h_{jki}(\omega)^{1 - \alpha} \right)^{\frac{\sigma - 1}{\sigma}} + (1 - \theta_{i}) l_{jki}(\omega)^{\frac{\sigma - 1}{\sigma}} \right]^{\frac{\sigma}{\sigma - 1}}
\]

\[
y_{jki}(\omega) = \gamma_{ji} \left[ \frac{p_{jki}(\omega)}{P_{ji}} \right]^{1/(\rho - 1)}
\]
Trade Liberalization

There are two different forms of liberalization in the model:

1. Reduction in tariffs leads to more trade in intermediates
2. Reduction of $\tau_z$ allows for greater inflow of technology
**What Is $\tau_z$?**

$\tau_z$ represents the ease of using foreign technology capital

- Ease of transferring/using U.S. blue-prints in Mexico
- Can be thought of as standing in for intellectual property rights protection
- As part of liberalization with the U.S., Mexico began to adopt the intellectual property protection laws that were in place in the U.S.
- Began as part of negotiations in the late 1980’s
WHAT HAPPENS WHEN MEXICO LIBERALIZES?

- Cost of using $Z_U$ in Mexico falls
  - Mexican firms adopt more U.S. skill-augmenting technology capital, $Z_U \rightarrow$ Adoption channel
  - All else equal, this drives demand for skilled labor up
  - Offsets standard H-O effect
- Return to investing in $Z_U$ increases for the final goods producer in US
  - U.S. firms increase investment in $Z_U \rightarrow$ Investment channel
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  - U.S. firms increase investment in $Z_U \rightarrow$ Investment channel

How does this affect the skill premium?
**Skill Premium: H-O vs. Supply Chain Model**

Basic H-O model:

\[ SP_k = \frac{\theta_i}{1 - \theta_i} \left( \frac{h_{jki}}{l_{jki}} \right)^{-\frac{1}{\sigma}} \]

Supply Chain model:

\[ SP_k = (1 - \alpha) \frac{\theta_i}{1 - \theta_i} \left( \frac{Z_{ji}}{h_{jki}} \right)^{\alpha \frac{(\sigma - 1)}{\sigma}} \left( \frac{h_{jki}}{l_{jki}} \right)^{-\frac{1}{\sigma}} \]

Technology endogenously changes skill-intensity of a sector
**Skill Premium: H-O vs. Supply Chain Model**

Basic H-O model:

\[
SP_M = \frac{\theta_i}{1 - \theta_i} \left( \frac{h_{UMi}}{l_{UMi}} \right)^{-\frac{1}{\sigma}}
\]

Supply Chain model:

\[
SP_M = (1 - \alpha) \frac{\theta_i}{1 - \theta_i} \left( \frac{Z_{Ui}}{h_{UMi}} \right)^{\alpha \frac{\sigma - 1}{\sigma}} \left( \frac{h_{UMi}}{l_{UMi}} \right)^{-\frac{1}{\sigma}}
\]

Big rise comes from *adopting* the technology from the U.S.
Results
**Experiment**

- Calibrate a the model to match key pre-liberalization features of data
- Two Counter-Factual Experiments:
  - Baseline: Set trade costs using tariff data and set $\tau_z$ to match industry-level trade flows between U.S. and Mexico both pre- and post-liberalization
  - Extreme: Completely erode barriers to use of foreign technology to see how important they are
WHAT THEORY PREDICTS

Reduction in tariffs and barriers to use of foreign technology will cause

▶ In Mexico
  ▶ Less specialization
  ▶ Workers flow to producing intermediates for export
  ▶ Adoption of U.S. technology
  ▶ Skill premium ↑↑

▶ In U.S.
  ▶ Returns to investing in Sector Y ↑
  ▶ Skill premium ↑
RESULTS: SKILL PREMIUM
INTUITION: BASELINE EXPERIMENT

- Trade increased from 5% to 16% of Mexican manufactured output from 1986 to 1994
- In the absence of frictions, Mexican firms would like to almost evenly split their production between producing for U.S. supply chain and the Mexican one (50% of output for export)
- To see only 16% of output exported, frictions need to remain relatively high even after liberalization
- We see Mexican firms moving from producing for Mexico to producing for U.S. supply chain but not enough to import much technology
**Intuition: Extreme Experiment**

Reduce all frictions to use of foreign technology, reduce tariffs as observed in data

- Mexican manufacturers within a given industry shift towards producing more for export, less for domestic production
- This shift varies across industries
- Industries that increase trade with U.S. by more end up renting more technology capital from the U.S.
- This technology is more skill-intensive
CONCLUSION

- Argue that trade is a channel by which technology is diffused across countries

- Show that integration with the U.S. supply chain is an important determinant of increasing skill premium in Mexican industries

- Build a model in which integration of supply chains leads to increasing skill premiums

- Show that mechanism can account for about 12% of increase in SP in Mexico
CONCLUSION

- Argue that trade is a channel by which technology is diffused across countries
- This means that it’s not trade or technology that is driving increasing inequality, but rather, both in tandem
- Show that integration with the U.S. supply chain is an important determinant of increasing skill premium in Mexican industries
- Build a model in which integration of supply chains leads to increasing skill premia
- Show that mechanism can account for about 12% of increase in SP in Mexico
Appendix
US Education & Manufacturing Premium

Skill Premia (Ratios)

Skill Premia (1970 = 1)

Skill Premia (1980 = 1)

Skill Premia (1987 = 1)
Mexican Manufacturing Trade / GDP

[Graph showing the percentage of GDP for imports and exports over time, from 1960 to 2020.]
MEXICAN MANUFACTURING TRADE
MEXICAN MERCHANDISE TRADE/GDP
Mexican Merchandise Trade

The graph shows the trend of imports and exports in Real US $ from 1960 to 2020. The data indicates a significant increase in both imports and exports over the years.
US IMPORTS FROM MEXICO
Evidence of Technology Transfer

- Royalties payments in Mexican data are payments for technological transfer
- Will use evidence on royalties to pin down key parameter of the model
- If technology transfer is occurring, should see increase in royalties over output
Evidence of Technology Transfer

- Royalties payments in Mexican data are payments for technological transfer

- Will use evidence on royalties to pin down key parameter of the model

- If technology transfer is occurring, should see increase in royalties over output
  - Does this happen in the data?
TIME PATH FOR ROYALTIES

Summary of Evidence
The return to renting $Z_{ki}$ to the intermediate good producer in country $j$ can be expressed as:

$$r_{jki} = \frac{p_{jki}(\omega)(1-\rho)A_k}{\tau_{zj}\tau_{jki}} \left[ \theta_i \left( Z_{ki}^\alpha h_{jki}(\omega)^{1-\alpha} \right)^{\frac{\sigma-1}{\sigma}} + (1-\theta_i)l_{jki}(\omega)^{\frac{\sigma-1}{\sigma}} \right]^\frac{\sigma}{\sigma-1}-1$$

So if $\tau_{zj}$ or $\tau_{jki}$ ↓, the return to investing ↑ ⇒ $Z_{ki}$ ↑
RESULTS: SKILL PREMIUM (1985 =1)
DISCUSSION OF PARAMETERS

Key parameters governing the change in skill premium:

- **\(\alpha\)**: Share of technology in production
  - Impact of trade on skill premium is rising in \(\alpha\)
  - Use royalties to discipline

- **\(\sigma\)**: Substitutability between skilled and unskilled workers
  - Estimates in the data from 1.2 to 2+
  - Impact of trade on skill premium is rising in \(\sigma\)
  - Use initial skill premia to discipline
VARYING $\alpha$
VARYING $\sigma$
VARYING $\alpha$ AND $\sigma$
SENSITIVITY TO CHANGES IN $\tau_z$
Data: Canada

![Graph showing wage ratios for Canada and the U.S. from 1970 to 2010. The graph compares the wage ratio of Canada to the U.S., with both countries showing fluctuations over time.](image)
Broader Implications of the Model

Mexico

- Does majority of trade with U.S.
- Very closed before trade liberalization
- Large differences in productivity & supply of skilled workers
- Synchronized policy changes
  - Dramatic reduction of trade barriers
  - Adoption of U.S. IP protection laws

What about other cases, such as Chile and Canada?
Broader Implications of the Model

Mexico

- Does majority of trade with U.S.
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What about other cases, such as Chile and Canada?
CHILE

- Many trade partners
- Relatively closed before liberalization
- Lower productivity & supply of skilled workers than U.S.
- Trade liberalization (1979)
  - Reduction of trade barriers
  - No change in IP protection laws
Data: Chile
**Experiment: Chile**

- Hold fixed parameters of production function
- Match the relative productivity of manufacturing
- Set supply of high-skilled workers to match the data
- Set initial distortions \((\tau_y, \tau_z)\) to match skill premium in 1979
**Experiment: Chile**

- Hold fixed parameters of production function
- Match the relative productivity of manufacturing
- Set supply of high-skilled workers to match the data
- Set initial distortions ($\tau_y, \tau_z$) to match skill premium in 1979
- Reduce tariffs in Chile to mimic trade liberalization
Theory Predictions: Chile

Basic H-O
- Chile specialized in unskilled-intensive good
- Skill premium in Chile ↓

Supply Chain:
- Less specialization since reduction in tariffs allows Chile to supply to U.S. Sector Y
- Skill premium in Chile ↑ if sufficient integration
RESULTS: CHILE

![Graph showing wage ratio trends in Chile over years 1980 to 1995.](image-url)
Canada

- Large portion of trade is with U.S.
- Relatively open before liberalization
- Similar productivity & supply of skilled workers as U.S.
- Free trade agreement (1988)
  - Slight reduction of trade barriers
  - Existing IP protection laws similar to those of the U.S.
DATA: CANADA

Normalized to 1 in 1970

Wage Ratio

Year


U.S.

Canada
EXPERIMENT: CANADA

- Hold fixed parameters of production function
- Match the relative productivity of manufacturing
- Set supply of high-skilled workers to match the data
- Set initial distortions \((\tau_y, \tau_z)\) to match skill premium in 1985
Experiment: Canada

- Hold fixed parameters of production function
- Match the relative productivity of manufacturing
- Set supply of high-skilled workers to match the data
- Set initial distortions ($\tau_y, \tau_z$) to match skill premium in 1985
- Reduce distortions in both countries to mimic FTA
**Theory Predictions: Canada**

Basic H-O

- No specialization since both countries have same relative supply of skilled labor
- No change in skill premium

Supply Chain:

- Both countries invest more in Sector Y since the technology can be used in more locations once countries open
- Skill premium ↑ in both countries
RESULTS: CANADA

[Graph showing the wage ratio over years for U.S. and Canada, with a peak around the year 2000 for the U.S. and a steady increase for Canada.]