Adjusting to Trade Liberalization: Reallocation and Labor Market Policies

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*New Faces in International Economics*
*The Pennsylvania State University*

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Industry Level Tariff Rates Before and After Trade Reforms

Tariff Level in 1986

Tariff Level in 1994
Brazilian Trade Liberalization

Manufacturing Workforce Composition across 3-digit Industries

![Graphs showing employment share trends from 1990 to 1995.](image-url)
Motivation

Evidence:

1. *Labor market effect of trade liberalization in the short-run:* little inter-sectoral labor reallocation,

2. Sectoral switches are associated with longer than average unemployment spells and earning losses,

3. Higher adjustment burden for older workers.

Policy relevance: long-run gains vs. short-run costs

Need for dynamic structural models to analyze the transition
This paper

- Model
  - Two-sector small open economy
  - Random search and matching
  - Sector-specific learning-by-doing
  - Overlapping generations

- Calibration
This paper

- Transition
  - Determinants of sluggish adjustment: search frictions and sector-specificity of human capital
  - Policy experiments: unemployment insurance and employment subsidies
Related Literature

- **Sector-specificity of physical capital**

- **Adjustment costs for labor reallocation**

- **Worker displacements and policies**

- **Sector-specificity of human capital**

- **Search models**
THE MODEL
A measure one of workers and firms

Linear momentary utility in consumption with discount factor

\[ \beta \in (0, 1) \]

Workers own a balanced portfolio of firms
Demographics

Life-cycle Shocks
Production

- Two intermediate goods with world prices \((p_1, p_2) = (1, 1)\)
- Sector 2 is protected with ad-valorem import tariff \(\tau\),
  \[p_{2d} = (1 + \tau), \quad p_{1d} = 1\]
- Final good production
  \[Y = \sqrt{Q_1} \sqrt{Q_2}\]
- Price of the final good
  \[p_Y = 2\sqrt{p_{1d}} \sqrt{p_{2d}}\]
- Intermediate goods produced by worker-firm pairs (jobs)
Timing of Matching and Production
Newborn workers start with $h = (1, 1)$

The law of motion for $h$ (learning-by-doing):

$$h_{it+1} = \begin{cases} 
  h_{it} H^{1-\alpha} & \text{if employed in sector } i, \\
  \max\{1, (1 - \delta_h) h_{it}\} & \text{otherwise,} 
\end{cases}$$

where $\alpha \in [0, 1]$ and $\delta_h \in [0, 1)$.
Human Capital Formation

Diagram showing the relationship between Human Capital, $h_i$, and the number of periods employed in Sector $i$. The graph indicates an increasing trend with $h_i$ as the number of periods increases.
Newborn workers start with $h = (1, 1)$

The law of motion for $h$ (learning-by-doing):

$$h_{it+1} = \begin{cases} h_{it}^\alpha H^{1-\alpha} & \text{if employed in sector } i, \\ \max\{1, (1 - \delta_h)h_{it}\} & \text{otherwise}, \end{cases}$$

where $\alpha \in [0, 1]$ and $\delta_h \in [0, 1)$.

State space for $h_t$:

$$h_t \in \mathcal{H} = [1, H] \times [1, H]$$
Firms

Timing of Events for Idle Firms
Labor Markets

• Undirected search with aggregate matching function

\[ m(U, V) = \frac{UV}{(U^\lambda + V^\lambda)^{1/\lambda}} \]

• Composition of vacancies

\[ \mu_i = \frac{V_i}{V} \]

such that

\[ V = V_1 + V_2 \]
• matching probability for an unemployed worker:

\[ \phi_{w_i} = \mu_i \frac{m(U, V)}{U} \]

• matching probability for an idle firm:

\[ \phi_f = \frac{m(U, V)}{V} \]

• Period-by-period Nash bargaining over rents with worker’s share

\[ \sigma \in (0, 1) \]
Workers’ state:
- generation: young or old, \{y, o\}
- human capital: \((h_{1t}, h_{2t})\)
- labor market status: \([\ell_1(z), \ell_2(z), \ell_u]\)
Value of a Job

Sector-\(i\) job

- with an old worker:
  \[
  \Pi_{it}(z, h_t, o) = p_{id} q_{i}(z, h_t) + \beta (1 - \delta^o_{JD}) (1 - \delta_{m}) \Pi_{it+1}(z, h_{t+1}, o)
  \]

- with a young worker:
  \[
  \Pi_{it}(z, h_t, y) = p_{id} q_{i}(z, h_t) + \beta (1 - \delta^y_{JD}) \left[ \delta_{a} \Pi_{it+1}(z, h_{t+1}, o) 
  + (1 - \delta_{a}) \Pi_{it+1}(z, h_{t+1}, y) \right]
  \]
Job Acceptance Policy

- Outside options: \( W_{ut}(h, y) \) for a young worker and \( J_t \) for the firm

- Surplus of a sector-\( i \) job of productivity \( z \)

\[
\Delta_{it}(z, h_t, y) = \Pi_{it}(z, h_t, y) - [W_{ut}(h_t, y) + J_t]
\]

- Worker’s problem

\[
W_{it}[z, h_t, y] = \max_{\text{accept, reject}} \left\{ \sigma \Delta_{it}(z, h_t, y) + W_{ut}(h_t, y), W_{ut}(h_t, y) \right\}.
\]

- Jointly accept the job if \( z \geq \tilde{z}_{it}(h_t, y) \)
Firms: Vacancy Posting Policy

- Non-specialization through heterogeneous vacancy posting cost draws
- Taking the expected value conditional on matching as given, enter sector 1 if

\[ \phi_{ft}\beta[EJ_{1t+1} - J_{t+1}] \geq p_{yt}c_1, \]

\[ \phi_{ft}\beta EJ_{1t+1} - p_{yt}c_1 \geq \phi_f\beta EJ_{2t+1} - p_{yt}c_2. \]

- which defines a cutoff cost level

\[ \tilde{c}_{1t} = \frac{\phi_{ft}\beta(EJ_{1t+1} - J_{t+1})}{p_{yt}} \]
Firms: Vacancy Posting Policy

Figure: Sectoral Entry Decision

- The cutoff rules define \((\mu_1, \mu_2)\), the fraction of vacancies in each sector.
Given world prices and trade policy $\tau$, an \textit{equilibrium} is a collection of paths such that

- agents optimize,
- aggregates are consistent with individual behavior,
- markets clear,
- trade balance holds,
- the distribution of workers evolves consistently with the decision rules and idiosyncratic shocks.
Excess job turnover with simultaneous job creation and destruction
  - Davis, Haltiwanger and Schuh (1998)

Wages are increasing in job tenure and labor market experience
  - Murphy and Welch (1990), Topel (1991)

Inter-sectoral mobility declines over the life-cycle
  - Kambourov and Manovskii (2008)
CALIBRATION
Calibration Strategy

- Model period: quarter
- Calibrate the steady state to Brazilian pre-liberalization data
- Parameters Set Without Solving the Model
- Parameters Obtained by Solving the Model
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Value</th>
<th>Source/Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta_m$</td>
<td>death probability</td>
<td>$1/80$</td>
<td>20 years of youth</td>
</tr>
<tr>
<td>$\delta_a$</td>
<td>aging probability</td>
<td>$1/80$</td>
<td>20 years of old-age</td>
</tr>
<tr>
<td>$F_z(z)$</td>
<td>productivity</td>
<td>uniform $[0, 1]$</td>
<td>-</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>worker’s bargaining share</td>
<td>$0.50$</td>
<td>-</td>
</tr>
<tr>
<td>$A_2$</td>
<td>sector 2 productivity</td>
<td>$1$</td>
<td>normalization</td>
</tr>
<tr>
<td>$\tau$</td>
<td>import tariff</td>
<td>$0.63$</td>
<td>Pavcnik et al.(2004)</td>
</tr>
<tr>
<td>$\beta$</td>
<td>discounting rate</td>
<td>$0.97$</td>
<td>real interest rate, IPEA</td>
</tr>
<tr>
<td>$\delta_{JD}^y$</td>
<td>job destruction for young</td>
<td>$0.018$</td>
<td>Bosch and Maloney(2007)</td>
</tr>
<tr>
<td>$\delta_{JD}^o$</td>
<td>job destruction for old</td>
<td>$0.012$</td>
<td>Bosch and Maloney(2007)</td>
</tr>
<tr>
<td>$\delta_h$</td>
<td>depreciation of HC</td>
<td>$0$</td>
<td>Browning et al.(1999)</td>
</tr>
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</table>
Parameters Obtained by Solving the Model

- vacancy cost function $F_c(c)$: assume log-$c$ is normally distributed with mean 0, and standard deviation $C_{sd}$

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<th>Parameter</th>
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</tr>
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<tbody>
<tr>
<td>$\alpha$</td>
<td>0.974</td>
<td>ave. earnings at 5 years of experience / ave. beginning of the career earnings = 1.41</td>
<td>Menezes Filho et al. (2008)</td>
</tr>
<tr>
<td>$H$</td>
<td>2.6</td>
<td>ave. earnings at 40 years of experience / ave. beginning of the career earnings = 2.43</td>
<td>Menezes Filho et al. (2008)</td>
</tr>
<tr>
<td>$A_1$</td>
<td>1.71</td>
<td>Export / (Value Added) = 0.263</td>
<td>Pavcnik et al. (2004), OECD</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>2.16</td>
<td>elasticity of hiring to unemployment = 0.25</td>
<td>Hoek (2007)</td>
</tr>
<tr>
<td>$C_{sd}$</td>
<td>1.49</td>
<td>transition probability from U to E = 0.37</td>
<td>Domeland et al. (2006)</td>
</tr>
</tbody>
</table>
THE TRANSITION
The Transition

- Trade Liberalization:
  - Unexpected, permanent decrease in $\tau$.

- Transitional dynamics
  - Quantitative exploration of sluggish adjustment
    -> Search frictions vs. sector-specificity of human capital

- Labor Market Policies:
  -> Actual policy: unemployment insurance
  -> Counter-factual policy: targeted employment subsidy
Sources of Sluggish Adjustment

Figure: Employment Share Reallocation During the Transition
Brazilian Labor Market Policies

- 1988 Labor Market Reform in Brazil.

- Public expenditure on labor market policies ≈ 1% of GDP,
  - 70% on unemployment insurance,
  - 15% on wage supplement program,
  - remaining on active labor market policies.

→ Actual policy experiment: introduce unemployment insurance jointly with trade liberalization, financed by a 1% tax on all match revenues
Actual Policy: Short Run

Figure: Unemployment During the Transition
Actual Policy: Long Run

Figure: Net Output under Actual Policy
**Actual Policy: Long Run**

**Figure:** Comparison of Net Output Paths
**Counter-factual Policy: Employment Subsidy**

- 2002 Alternative Trade Adjustment Assistance, and 2009 Reemployment Trade Adjustment Assistance in the US

- Insure 50% of earnings losses for trade-displaced workers older than 50 up to $10,000 over 2 years

→ Counter-factual policy experiment: a targeted limited-duration employment subsidy paid to old workers initially employed in sector 2 upon employment in sector 1.

→ Revenue neutral policy.
Counter-factual Policy: Employment Subsidy

Figure: Net Output under Labor Market Policies
Role for Policy: Externalities

- Search externality between firms
- Human capital externality between workers and firms: sub-optimally low investment in skill acquisition in frictional labor markets


**Conclusion**

- Policy implications for the design of trade adjustment programs: 2002 US Alternative TAA

- Future work:
  - Analysis of welfare effects on different groups of workers
  - General versus sector-specific human capital
THE END
Fact 1: Inter-sectoral Reallocation

  
  “...tariff cuts and additional imports trigger worker displacements, but neither comparative-advantage sectors nor exporters absorb trade-displaced workers for years.”

- What happens to workers displaced from import-competing industries at a four-year horizon?
  
  → 30% rehired into the same sectors,
  
  → 30% employed at formal non-traded sectors,
  
  → 26% not employed at any formal job,
  
  → only 14% is hired into export-oriented industries.
**Fact 1: Inter-sectoral Reallocation**

- Rayner and Lattimore (1990) for New Zealand
- Ros (1994) for Mexico
- Currie and Harrison (1997) for Morocco
- Levinsohn (1999) for Chile
- IDB (2009) for a group of Latin American countries
- Wacziarg and Wallack (2004) for a panel of liberalizers
FACT 2: COSTLY MOBILITY FOR DISPLACED WORKERS

- Menezes-Filho (2004), Hoek (2007) for Brazil
- Krebs, Krishna and Maloney (2008) for Mexico
- US data
  - Murphy and Topel (1987)
  - Kletzer (2001)
  - Artuc, Chaudhuri and McLaren (2008)
  - Krishna and Senses (2009)
**Fact 3: Life-cycle Effects of Adjustment Burden**

- Older workers face a higher risk of not finding reemployment after being displaced from import competing industries.
- Evidence from Brazil by Menezes-Filho and Muendler (2008):

![Failed Reallocation Within a Year of Displacement in Brazil](chart.png)

- Failed Reallocation Within a Year of Displacement in Brazil
- **Average**
- **Young Workers (≤ 10 years of experience)**
More Evidence

- Little inter-sectoral reallocation of labor:
  - Levinsohn (1999) for Chile
  - Currie and Harrison (1997) for Morocco
  - Menezes-Filho and Muendler (2007) for Brazil
  - Wacziarg and Wallack (2004) for a panel of liberalizers

- Effect on displaced workers:
  - Krishna and Senses (2009) for Mexico

- Effect on old workers:
  - Boeri and Terrell (2002) for Eastern Block countries
  - Maloney (2003) and IDB (2009) for Brazil
For $\ell_w = \ell_{w_i}$, the value of a job to a worker of state $(z, h, g)$ equals the sum of her share of the surplus $\Sigma_{it}(z, h, g)$, and the value of her outside option of unemployment:

$$W_t(\ell_{w_i}, z, h_t, g) = \sigma \Sigma_{it}(z, h_t, g) + W_t(\ell_{w_u}, z, h_t, g)$$

The value of unemployment ($\ell_w = \ell_{w_u}$) for an old worker is:

$$W_t(\ell_{w_u}, h_t, o) = p_{ft} \cdot b$$

$$+ \beta(1 - \delta_m) \left[ \sum_{i=1}^{2} \phi_{wi}f_{\ell_{w_i}} \int_{0}^{\bar{z}} W_{t+1}(\ell_{w_i}, z, h_{t+1}, o)I_{z_i}(z, h_{t+1}, o)f_z(z)dz 
+ (1 - \phi_{w_1t} - \phi_{w_2t})W_{t+1}(\ell_{w_u}, h_{t+1}, o) \right]$$
For a young worker:

\[ W_t(\ell_{w_t}, h_t, y) = p_{ft} \cdot b \]

\[ + \beta (1 - \delta_a) \left[ \sum_{i=1}^{2} \phi_{w_i t} \int_{0}^{\bar{z}} W_{t+1}(\ell_{w_i}, z, h_{t+1}, y) I_{\bar{z}_i}(z, h_{t+1}, y) f_z(z) dz \right. \]

\[ + (1 - \phi_{w_{1t}} - \phi_{w_{2t}}) W_{t+1}(\ell_{w_u}, h_{t+1}, y) \]

\[ + \beta \delta_a \left[ \sum_{i=1}^{2} \phi_{w_i t} \int_{0}^{\bar{z}} W_{t+1}(\ell_{w_i}, z, h_{t+1}, o) I_{\bar{z}_i}(z, h_{t+1}, o) f_z(z) dz \right. \]

\[ + (1 - \phi_{w_{1t}} - \phi_{w_{2t}}) W_{t+1}(\ell_{w_u}, h_{t+1}, o) \]
Entrepreneur's Value Function

\[ J_t = \beta \left[ \sum_{i=1}^{2} \bar{\mu}_{it} [\phi_{ft} E J_{it+1} - p_{ft} \hat{c}_{it}] + (\bar{\mu}_{1t} + \bar{\mu}_{2t})(1 - \phi_{ft}) J_{t+1} + (1 - \bar{\mu}_{1t} - \bar{\mu}_{2t}) J_{t+1} \right] \]

The surplus is:

\[ \Sigma_{it}(z, h_t, g_t) = \Pi_{it}(z, h_t, g_t) - [W_t(\ell_{wu}, h_t, g_t) + J_t]. \]
Sector 1 Job Acceptance Rule, $\tilde{z}_{1t}(h_t, o)$

Figure: Cutoff Productivity in Sector 1
Computation of Steady State Equilibrium

Step 1. Start iteration \( j \) with a pair of values for entrants’ expected values of matching \( (EJ^{j}_1, EJ^{j}_2) \) in the two sectors.

Step 2. Calculate \( (J(m_u), \phi_f, \phi_w, \tilde{\mu}_1, \tilde{\mu}_2) \) by simulating a large number of cost draws for firms from the distribution \( F_c(c) \), using relevant expressions, and the fact that market tightness \( \theta \) is equal to \( \tilde{\mu}_1 + \tilde{\mu}_2 \).

Step 3. Solve for the job acceptance cutoffs \( \tilde{z}_{it}(h, g) \), and the value functions using the following subroutine:
   I. Start with old workers. Assume initial set of values for unemployment \( W(\ell_u, \cdot, o) \) and matches \( \Pi_i(z, \cdot, o) \) for both sectors. Find the job acceptance cutoffs, and update \( \Pi_i(z, \cdot, o) \).
   II. To update \( W(\ell_u, \cdot, o) \), use the job acceptance cutoffs. Iterate until convergence.
   III. Repeat the same steps for young workers.

Step 4. Simulate the economy with a large number of workers drawing demographic shocks, labor market shocks (matching and separating), and match-specific productivity terms. Aggregate the cross-sections of workers to find the distribution of workers \( \Psi \).

Step 5. Use the distributions to update \( (EJ^{j+1}_1, EJ^{j+1}_2) \), iterate until the distances \( |EJ^{j+1}_1 - EJ^{j}_1| \), and \( |EJ^{j+1}_2 - EJ^{j}_2| \) are sufficiently small.
## Steady State Results

<table>
<thead>
<tr>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of youth unemployment</td>
<td>0.71</td>
<td>0.71</td>
<td>IDB, ILO</td>
</tr>
<tr>
<td>Annual excess job reallocation</td>
<td>0.34</td>
<td>0.33</td>
<td>Haltiwanger et al.(2004)</td>
</tr>
<tr>
<td>Earning losses of old switchers</td>
<td>0.12</td>
<td>0.22</td>
<td>Hoek(2007)</td>
</tr>
</tbody>
</table>
**Computation of the Transition**

Solve for the transition using an algorithm similar to Costantini and Melitz (2009)

1. Start with \( \{EJ_{1t}, EJ_{2t}\}_{t=0}^{T} \)
2. Solve value functions backwards
3. Simulate the model forward to generate distributions \( \{\Psi_t\}_{t=0}^{T} \)
4. Update \( \{EJ_{1t}, EJ_{2t}\}_{t=0}^{T} \), iterate until convergence