Trade Liberalization and Labor Market Dynamics

Rafael Dix-Carneiro

University of Maryland

April 6th, 2012

Introduction

- Trade liberalization increases aggregate welfare by reallocating resources towards sectors in which countries have comparative advantage.
- Reallocation of resources following trade reform takes time and is costly.
- Little research attempting to model and measure these costs and analyze their implications for both individual workers and for the economy as a whole.
- The characterization of winners and losers crucially depends on assumptions regarding the mobility of factors of production.

Introduction 2

- This paper estimates a structural dynamic equilibrium model of the Brazilian labor market:
  - Heterogeneous workers
  - Sector-specific experience
  - Inter-sectoral mobility costs
- Counterfactual experiments: hypothetical trade liberalization.

Preview of Results

- Median costs of mobility are of 1.4 to 2.7 times annual average wages, but very dispersed across the population.
  - Female and Unskilled workers face substantially higher costs of mobility in terms of wages.
  - Costs of mobility in terms of wages is roughly flat with age.
  - Older workers are less mobile: Cost of mobility in terms of discounted present value is higher for older workers
- Sector-specific experience is imperfectly transferable across sectors.
  - Additional barriers to mobility
  - However, much less important than costs of mobility (in contrast with Coşar (2011))

Preview of Results 2

- It may take several years for the labor market to adjust following trade reform.
  - It may take 3 to 16 years for the reallocation to be 80% complete.
  - Exact figure depends on mobility of capital and size of shock.
- Workers initially employed in the adversely affected sector (HT) are the losers from trade reform (in contrast with Artuç, Chaudhuri and McLaren (2010).
  - Skilled and workers with experience in HT suffer larger losses.
  - Older workers with little experience in HT slightly benefit from trade reform.
- 16% to 42% of the gains from trade are mitigated due to the slow transition to the new steady state.
  - Exact figure depends on mobility of capital.

Preview of Results 3

- A moving subsidy that covers switching costs is more promising than a retraining program in compensating the losers, although at the expense of higher adjustment costs.
  - Moving subsidy better compensates Unskilled workers.
  - Retraining Program better compensates Skilled workers.

- Results highlight the sensitivity of the transitional dynamics to assumptions regarding the mobility of physical capital

Related Literature: Trade and Labor Market Adjustment

- Reduced-Form
  - Revenga (1992), Levinsohn (1999), Wacziarg and Wallack (2004), Goldberg and Pavcnik (2007), Menezes-Filho and Muendler (2011)
- Structural
  - Kambourov (2009), Artuç, Chaudhuri and McLaren (2010), Coşar (2011), Coşar, Guner and Tybout (2011), Ritter (2011)

Related Literature: Trade and Labor Market Adjustment

- Artuç, Chaudhuri and McLaren (2011)
  - Homogeneous workers
  - Sector-specific iid idiosyncratic preference shocks
  - Costs of switching sectors
  - Simple reduced-form equation
  - GMM estimation recovers structural parameters
- Average Costs of Mobility from ACM's methodology:
  - 6 times annual average wages in the US (ACM (2010))
  - 9.5 to 23 times annual average wages in Turkey (Artuç and McLaren (2010))
  - 15 times annual averages in Argentina (Peluffo (2010))
  - 50 times annual average wages in Brazil (Dix-Carneiro (2010))
- Gross flows do not react much to wage differentials $\Rightarrow$ high costs, high variance of idiosyncratic sector-specific preference shocks.

Related Literature: Methodology

- Equilibrium dynamic version of a Roy Model with costs of switching between sectors.
- Lee (2005): equilibrium effects of a college subsidy
- Lee and Wolpin (2006): growth of the service sector in the US

Empirical Framework

- Labor demand side features a multi-sector economy
  - Sector representative firms
- Labor supply side features
  - Overlapping generations
  - Worker heterogeneity
  - Idiosyncratic shocks
    - On sector-specific wages and preferences
  - Perfect foresight of sector-specific aggregate wages
  - Endogenous accumulation of sector-specific experience
  - Costly switching of sectors
  - Non-market option (labor supply decision)
- Wages equate labor demand to labor supply.
- Trade reform impacts the labor market through prices (labor demand).

A Multi-Sector Economy

0	Residual Sector
1	Agriculture and Mining (Primary)
2	Low-Tech Manufacturing
3	High-Tech Manufacturing
4	Non-Tradeables

Demand for Human Capital

Production

$$Y_t^s = p_t^s A_t^s \left(H_t^{0,s}\right)^{\alpha_t^{0,s}} \left(H_t^{1,s}\right)^{\alpha_t^{1,s}} (K_t^s)^{1-\alpha_t^{0,s}-\alpha_t^{1,s}} \quad s = 1, ..., 4$$

- Y_t^s : value added in sector s at year t
- $H_t^{0,s}$: human capital from "less than high school" workers (unskilled)
- $H_t^{1,s}$: human capital from "high school or higher" workers (skilled)
- K_t^s : physical capital

Demand for Human Capital

$$r_t^{0,s} = \alpha_t^{0,s} \frac{Y_t^s}{H_t^{0,s}}$$

$$r_t^{1,s} = \alpha_t^{1,s} \frac{Y_t^s}{H_t^{1,s}}$$

$$r_t^{K,s} = (1 - \alpha_t^{0,s} - \alpha_t^{1,s}) \frac{Y_t^s}{K_t^s}$$

- $r_t^{0,s}$: unskilled human capital price
- $r_t^{1,s}$: skilled human capital price
- $r_t^{K,s}$: physical capital rental price

Supply of Human Capital

Workers' Sectoral Choices

$$V_{at}\left(\Omega_{iat}\right) = \max_{s\in\{0,1,...,4\}} \left\{ V_{at}^{s}\left(\Omega_{iat}\right)\right\}$$

$$V_{at}^{s}\left(\Omega_{iat}\right) = \begin{cases} w^{s}\left(\Omega_{iat}\right) + \tau^{s} + \eta_{it}^{s} - Cost^{(s_{i,t-1})s}\left(\Omega_{iat}\right) + \\ \rho EV_{a+1,t+1}\left(\Omega_{ia+1,t+1} | \Omega_{iat}, s_t = s\right) \text{ if } a < 60 \\ \\ w^{s}\left(\Omega_{iat}\right) + \tau^{s} + \eta_{it}^{s} - Cost^{(s_{i,t-1})s}\left(\Omega_{iat}\right) \text{ if } a = 60 \end{cases}$$

$$s = 0, 1, ..., 4$$

$$\Omega_{iat} = \begin{cases} \left\{ Female_i, Educ_i, a, s_{i,t-9}, ..., s_{i,t-1}, \mathbf{r}_t^0, ..., \mathbf{r}_{t+60-a}^0, \boldsymbol{\theta}_i, \varepsilon_{it}, \eta_{it} \right\} \text{ if } skill(i) = 0 \\ \left\{ Female_i, Educ_i, a, s_{i,t-9}, ..., s_{i,t-1}, \mathbf{r}_t^1, ..., \mathbf{r}_{t+60-a}^1, \boldsymbol{\theta}_i, \varepsilon_{it}, \eta_{it} \right\} \text{ if } skill(i) = 1 \end{cases}$$

Supply of Human Capital

Specification for Formal Sector Wages

$$w^s\left(\Omega_{iat}\right) = \begin{cases} r_t^{0,s} h^{0,s}\left(\Omega_{iat}\right) & \text{if } skill(i) = 0 \\ r_t^{1,s} h^{1,s}\left(\Omega_{iat}\right) & \text{if } skill(i) = 1 \end{cases}$$

$$h^{0,s}\left(\Omega_{iat}\right) = \exp\left(\begin{array}{c} \beta_1^s Female_i + \beta_2^s I\left(Educ_i = 2\right) + \beta_4^s (a-25) + \\ \beta_5^s (a-25)^2 + \sum_{k=1}^{4} \beta_{5+k}^s Exper_{ikt} + \theta_i^s + \varepsilon_{it}^s \end{array} \right)$$

$$h^{1,s}\left(\Omega_{iat}\right) = \exp\left(\begin{array}{c} \beta_1^s Female_i + \beta_3^s I\left(Educ_i = 4\right) + \beta_4^s (a-25) + \\ \beta_5^s (a-25)^2 + \sum_{k=1}^{4} \beta_{5+k}^s Exper_{ikt} + \theta_i^s + \varepsilon_{it}^s \end{array} \right)$$

Supply of Human Capital

Residual Sector

$$w^0(\Omega_{iat}) = \exp\left(\begin{array}{c}\gamma_0 + \gamma_1 Female_i + \sum_{l=2}^{4}\gamma_l I\left(Educ_i = l\right) + \\ \gamma_5\left(a-25\right) + \gamma_6\left(a-25\right)^2 + \theta_i^0\end{array}\right) + \varepsilon_{it}^0$$

$$\varepsilon_{it}^s \overset{iid}{\sim} N\left(0, \sigma_s\right)$$

$$\eta_{it}^s \overset{iid}{\sim} Gumbel\left(-0.5772\nu, \nu\right)$$

$$\boldsymbol{\theta}_i \sim \left\{\left(\boldsymbol{\theta}_1, p_1\right), \left(\boldsymbol{\theta}_2, p_2\right), \left(\boldsymbol{\theta}_3, p_3\right)\right\}$$

Supply of Human Capital

Mobility Costs

$$Cost^{ss'}\left(\Omega_{iat}\right) = \exp\left(\begin{array}{c} \varphi^{ss'} + \kappa_1 Female_i + \sum_{l=2}^{4}\kappa_l I\left(Educ_i = l\right) + \\ \kappa_5(a-25) + \kappa_6(a-25)^2 \end{array}\right) \quad s \neq s',\ s' \neq 0$$

$$Cost^{ss'} = 0 \quad s = s',\ s' = 0$$

Labor Market Equilibrium

Perfect Foresight

$$\left(H_t^{0,s} \left(\left\{ \left(\mathbf{r}_{t+k}^{0} \right)^* \right\}_{k=0}^{35}, \widetilde{\Omega}_t \right) \right)_{Supply} = \alpha_t^{0,s} \frac{Y_t^s}{\left(r_t^{0,s} \right)^*} \quad s = 1, ..., 4$$

$$\left(H_t^{1,s} \left(\left\{ \left(\mathbf{r}_{t+k}^{1} \right)^* \right\}_{k=0}^{35}, \widetilde{\Omega}_t \right) \right)_{Supply} = \alpha_t^{1,s} \frac{Y_t^s}{\left(r_t^{1,s} \right)^*} \quad s = 1, ..., 4$$

Supply of Human Capital

- The model has three sources of mobility:
  - HC idiosyncratic shocks $\varepsilon_{it}^0, ..., \varepsilon_{it}^4$ induce two-way flows.
  - Preference shocks $\eta_{it}^0, ..., \eta_{it}^4$ also induce two-way flows.
  - Variation in human capital prices $r_t^1, ..., r_t^4$ induces net flows.

- The model has three sources of barriers to mobility:
  - Costs of switching
  - Sector-specific experience may not be perfectly transferable across sectors
  - Individual permanent unobserved comparative advantage ($\boldsymbol{\theta}_i$)

Data

- Matched employer-employee data from Brazil (RAIS).
- Universe of formal firms: 1986 to 2005.
- Firms must provide information on themselves: unique firm ID, industry, location, etc.
- Firms must provide information on each employee: unique worker ID, age, gender, education, monthly earnings, contracted hours, etc.
- I use RAIS in order to obtain a 1% random sample of workers who showed up in RAIS at least once and follow them over time ($\sim$600,000 workers)

Data: Residual Sector

- Very frequent transitions out of the dataset
- Unknown precise status: unemployment, informality, out of the labor force, self employed
- The Residual Sector bundles together all of the above

Data: Transition Rates

Table: Average Transition Rates (in %) 1995 to 2005

	Residual	Agr/Mining	Low-Tech	High-Tech	NT
Residual	79.50	1.69	2.79	0.59	15.43
Agriculture/Mining	17.33	75.98	2.26	0.54	3.89
Low-Tech	13.91	0.80	79.35	0.78	5.16
High-Tech	10.48	0.60	2.25	81.26	5.40
Non-Tradeables	12.25	0.26	0.88	0.31	86.31

Data: Employment Rates

Table: Sectoral Choices (%) 1995-2005

Residual	39.0
Agr/Mining	3.3
Low-Tech	8.3
High-Tech	2.8
Non-Tradeables	46.5

Data: Wage Differentials

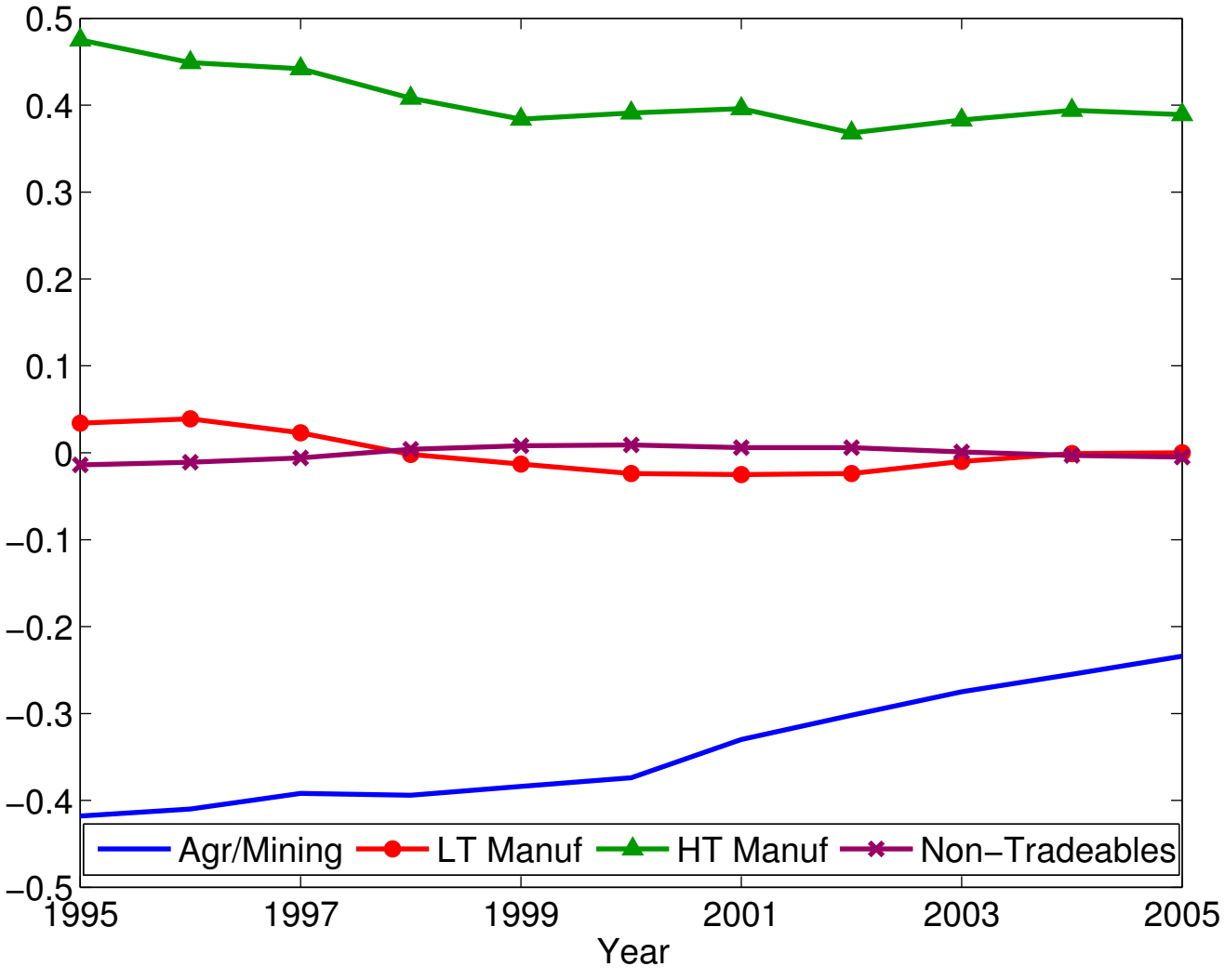


Figure: Evolution of wage differentials, 1995 to 2005

Estimation: Indirect Inference

- Auxiliary models:
  - log wage regressions
  - cross-sectional wage dispersion
  - within individual wage dispersion
  - linear probability models for sectoral choices
  - linear probability models for transition rates
  - sectoral choices in 1998, 2000 and 2005 regressed on initial conditions
  - fraction of time spent in each sector on initial conditions

- Explanatory variables include:
  - time dummies, gender dummy, education dummies, $(a-25)$, $(a-25)^2$, $Exper_1$, $Exper_2$, $Exper_3$, $Exper_4$, lagged sector dummies.

Identification

- Given wage differentials, transition rates (data) depend on the ratio between volatility of shocks and costs of mobility.
- Human Capital Production Functions: selection + exclusion restriction
- Within-individual wage volatility $\rightarrow$ variance of HC idiosyncratic shocks ε
- Exclusion restriction: experience affects wages but not costs of mobility. The coefficients on experience identify the volatility of preference shocks.

Parameter estimates

Human Capital Production Function

	Agr/Mining	LT Manuf.	HT Manuf.	Non-Tradeables
β_1^s: *Female*	-0.4124	-0.3134	-0.3083	-0.2965
	(0.0056)	(0.0035)	(0.0044)	(0.0033)
β_2^s: $I(Educ = 2)$	0.1151	0.2721	0.2790	0.3057
	(0.0068)	(0.0043)	(0.0069)	(0.0041)
β_3^s: $I(Educ = 4)$	0.9594	0.9294	0.8119	0.9402
	(0.0077)	(0.0066)	(0.0067)	(0.0058)
β_4^s: $(age - 25)$	0.0327	0.0330	0.0402	0.0246
	(0.0011)	(0.0007)	(0.0007)	(0.0004)
β_5^s: $(age - 25)^2$	-0.0007	-0.0008	-0.0011	-0.0004
	(0.00003)	(0.00002)	(0.00002)	(0.00001)
β_6^s: $Exper_{Agr/Min}$	0.1127	0.0409	0.0189	0.0008
	(0.0016)	(0.0037)	(0.0041)	(0.0033)
β_7^s: $Exper_{LT}$	0.0187	0.0886	0.0597	0.0240
	(0.0026)	(0.0015)	(0.0018)	(0.0014)
β_8^s: $Exper_{HT}$	0.0549	0.0717	0.0977	0.0439
	(0.0024)	(0.0017)	(0.0022)	(0.0017)
β_9^s: $Exper_{NT}$	0.0568	0.0582	0.0429	0.0847
	(0.0016)	(0.0012)	(0.0015)	(0.0010)
σ^s: *SD of Shock*	0.2191	0.1735	0.1707	0.2575
	(0.0059)	(0.0033)	(0.0051)	(0.0013)

Parameter Estimates

Costs of Mobility

A. Costs in terms of wages		
Median Cost of Entry Into ↓	From a Formal Sector	From the Residual Sector
Agr/Mining	1.64	11.78
Low-Tech	1.88	12.15
High-Tech	2.70	13.74
Non-Tradeables	1.41	11.12
B. Costs of Switchers in terms of Wages		
Median Cost of Entry Into ↓	From a Formal Sector	From the Residual Sector
Agr/Mining	-1.67	1.53
Low-Tech	-0.50	2.84
High-Tech	0.49	2.81
Non-Tradeables	-0.26	3.02

A. $\frac{Cost^{ss'}(X_i)}{\hat{w}(X_i)}$

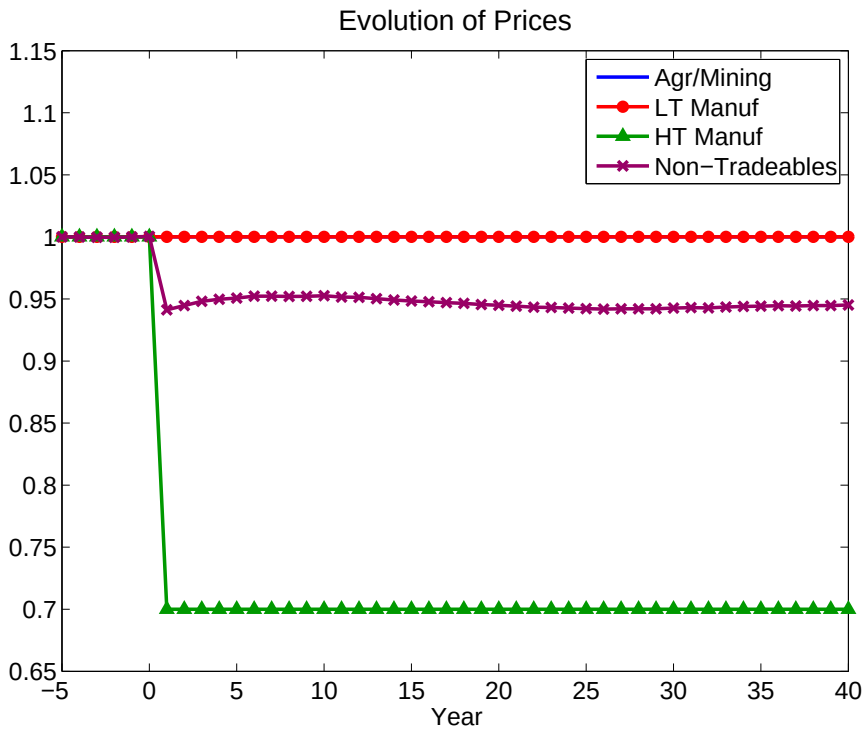
B. $\frac{Cost^{ss_{opt}}(X_i)+\tau^{s_{opt}}-\tau^{s}+\eta_{it}^{s_{opt}}-\eta_{it}^{s}}{\hat{w}(X_i)}$ for $s \neq s_{opt}$

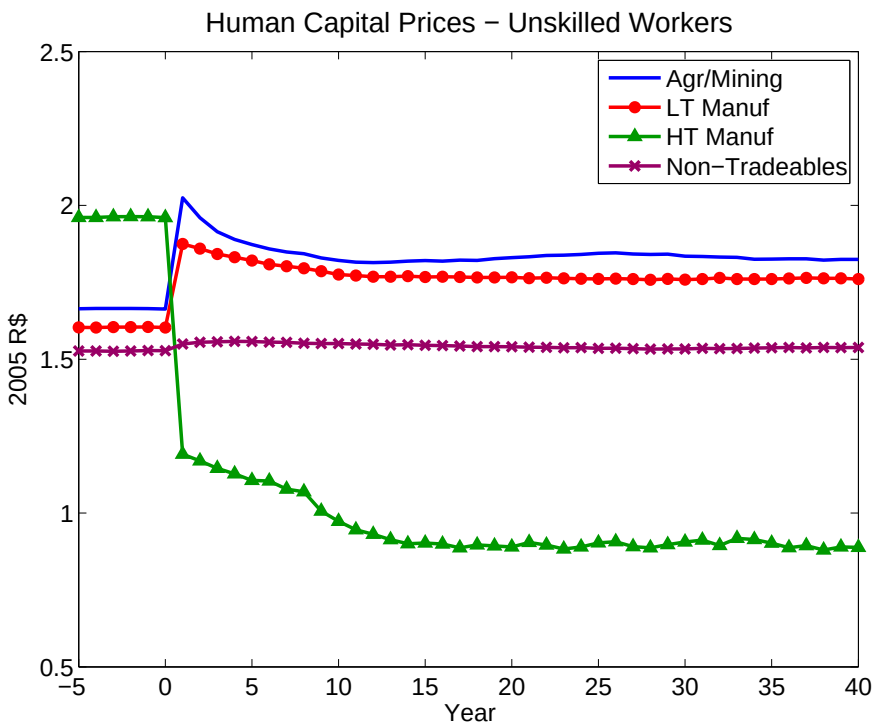
Counterfactual Experiments

1. Generate a stable economic environment
   - Cobb-Douglas shares, total physical capital, prices and productivities are all fixed over time.
   - Entering generations all look alike.
   - Simulate the economy until steady state is reached.
2. Simulate a 30% adverse shock in the price of High-Tech Manufacturing
3. Prices in other Tradeable sectors are not affected (small open economy assumption)
4. Price of Non-Tradeables adjusts in equilibrium

Counterfactual Experiments - Labor Market Dynamics

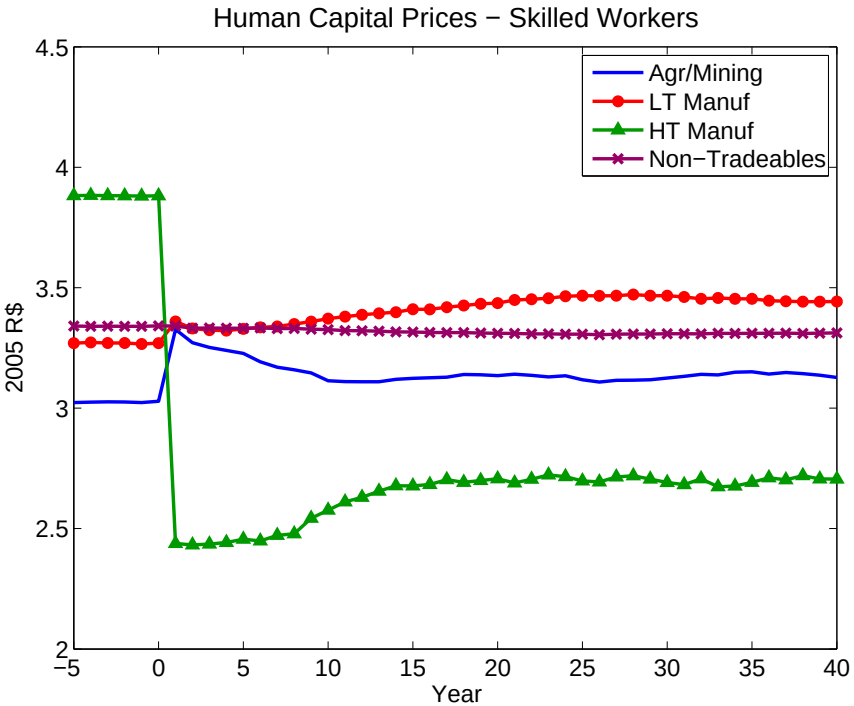
Perfect Capital Mobility

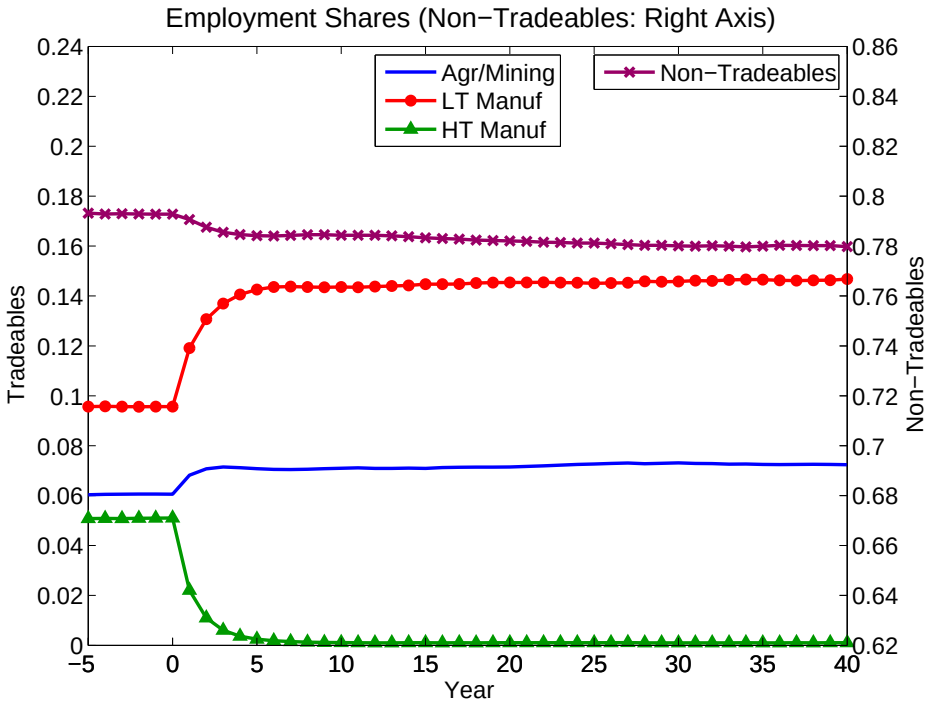




Counterfactual Experiments - Labor Market Dynamics

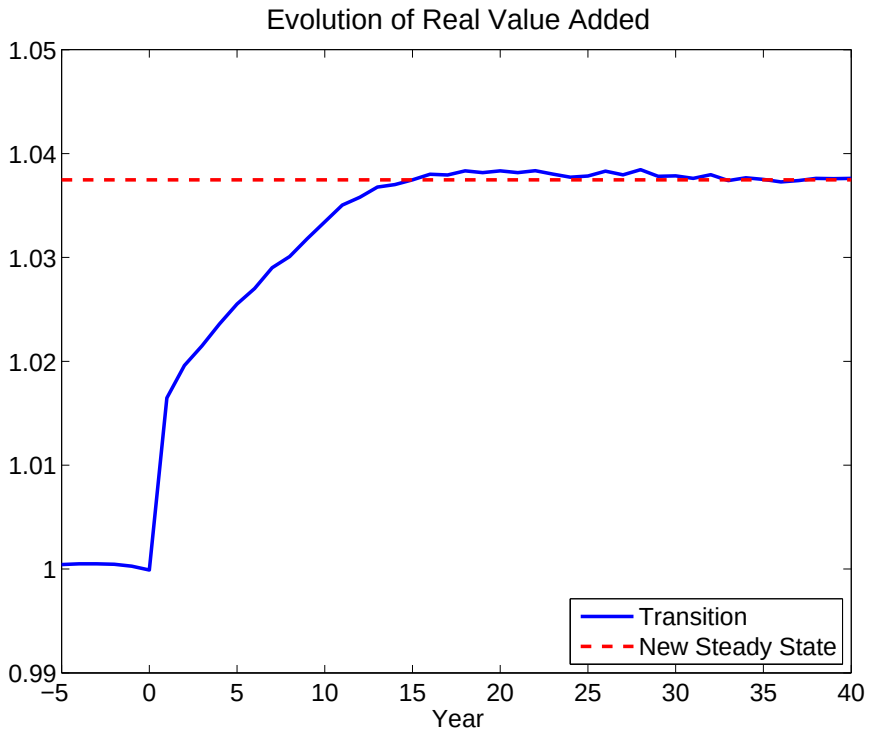
Perfect Capital Mobility

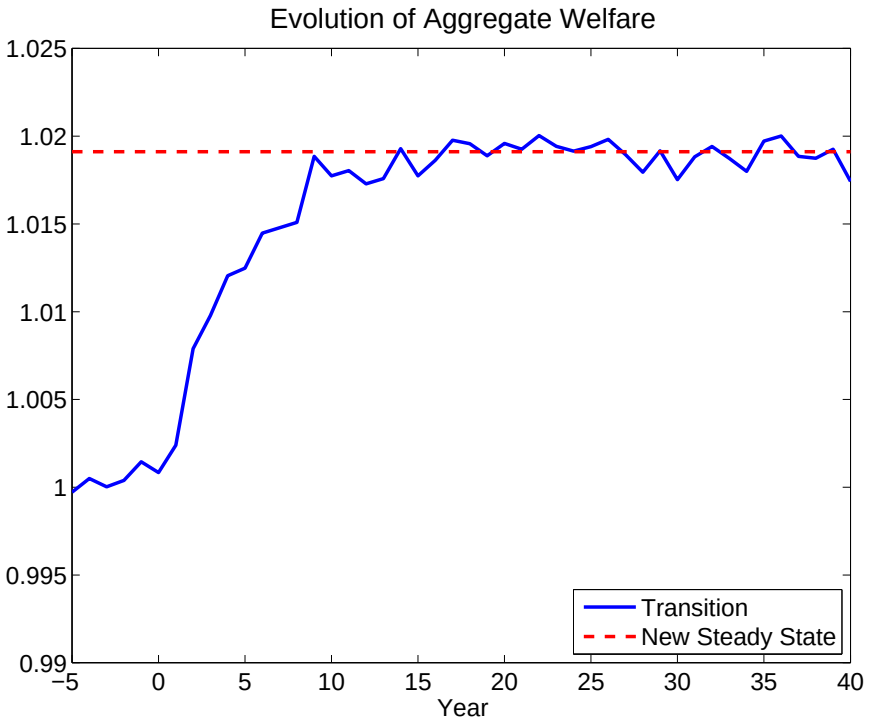




Counterfactual Experiments - Labor Market Dynamics

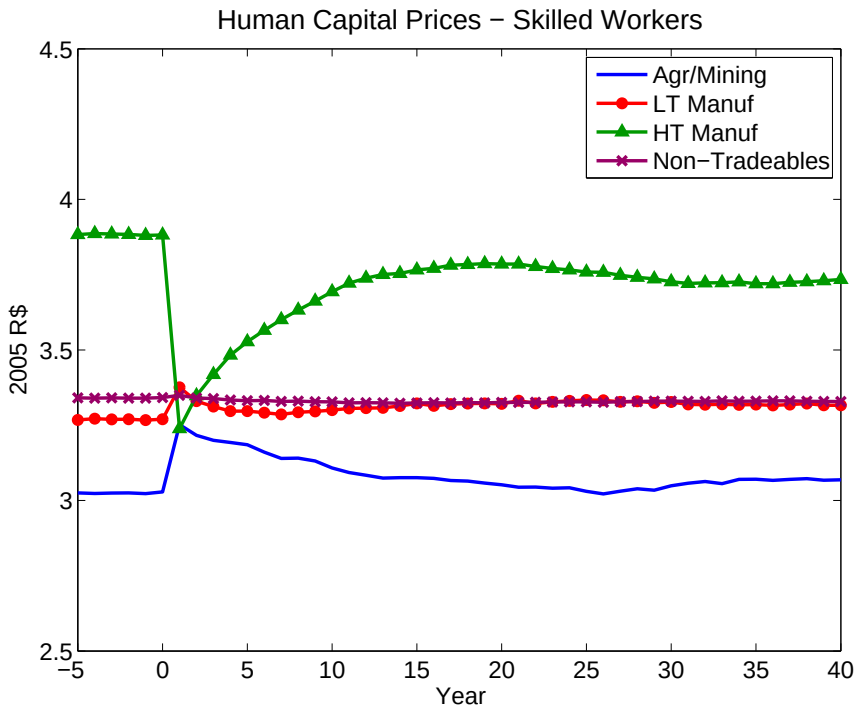
Perfect Capital Mobility

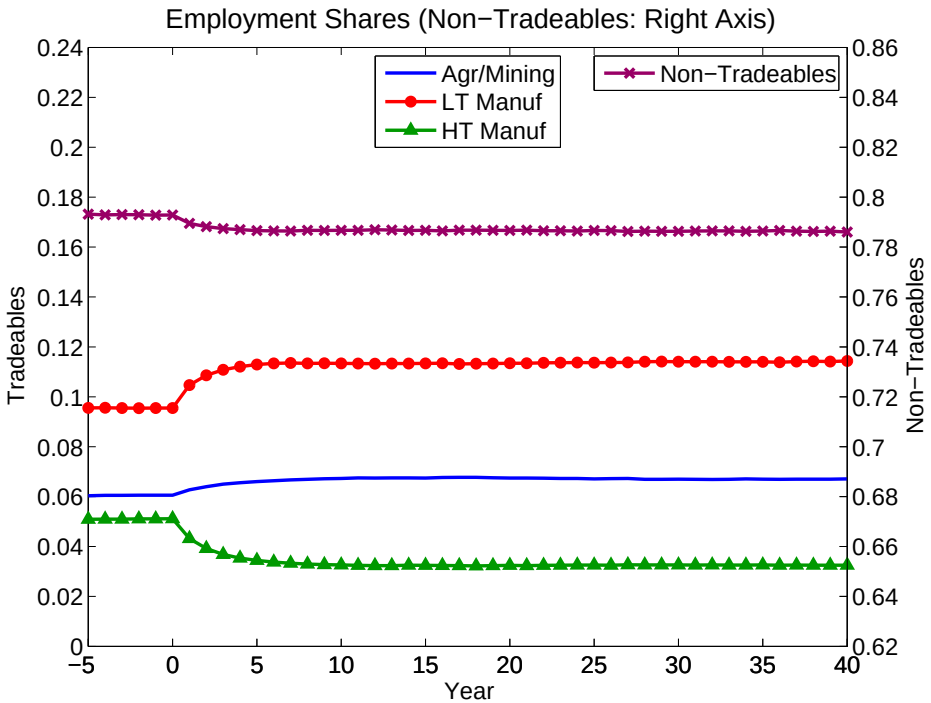




Counterfactual Experiments - Labor Market Dynamics

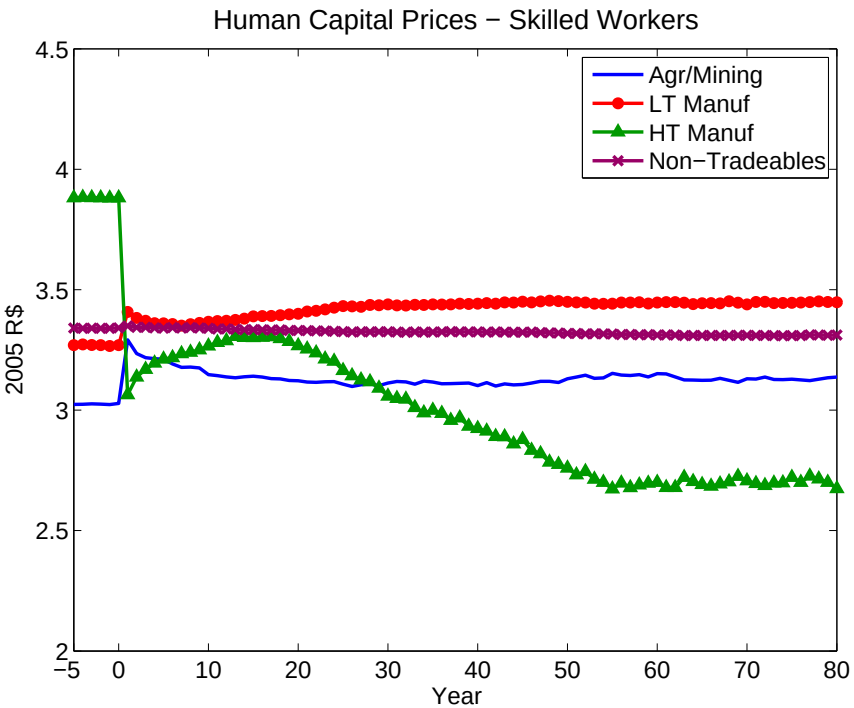
No Capital Mobility

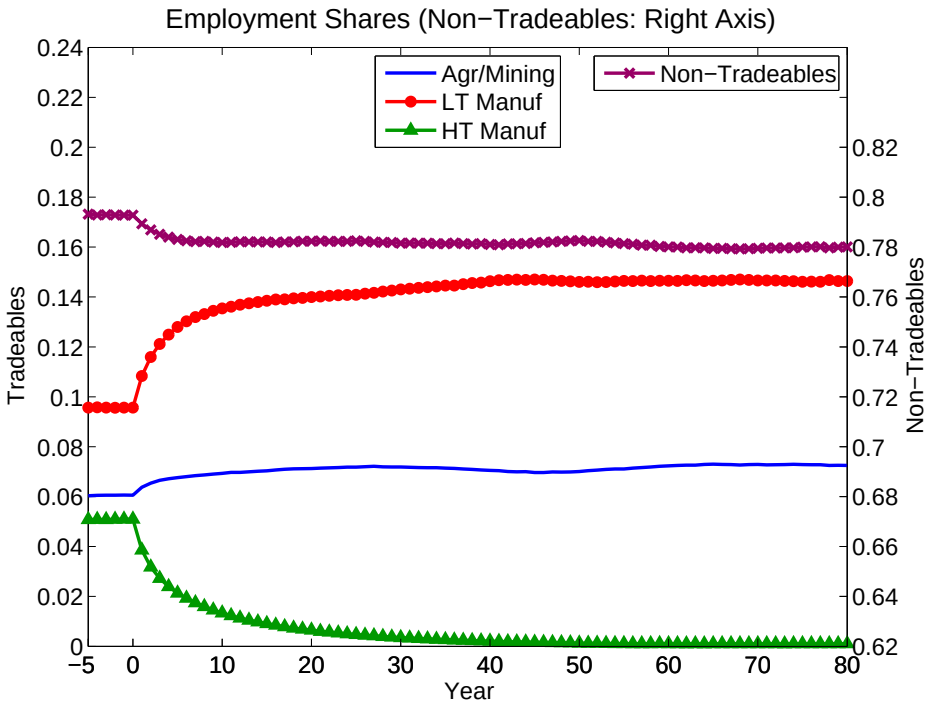




Counterfactual Experiments - Labor Market Dynamics

Imperfect Capital Mobility





Welfare Losses

Table: Welfare Losses - Workers in HT Manufacturing Prior to the Shock

	Perfect K Mob.	No K. Mob.	Imperfect K. Mob.
Overall	-8.9	-5.3	-8.0
By Demographics			
Old/Unskilled	-6.4	-3.8	-5.0
Old/Skilled	-10.7	-6.8	-8.5
Young/Unskilled	-5.4	-3.8	-5.3
Young/Skilled	-10.3	-6.0	-9.8

Table: Welfare Adjustment Costs

	Long Term Gain (%)	Adjustment Cost (%)
Perfect Capital Mobility	1.9	16.3
Imperfect Capital Mobility	1.9	30.7
No Capital Mobility	0.3	8.3

5-year Elasticities

Table: 5-year Price Elasticities of Wages and Employment in High-Tech Manufacturing

	Perfect Capital Mobility	No Capital Mobility	Imperfect Capital Mobility
Wage	1.3	0.3	0.5
Employment	3.2	1.1	1.9

- 5-year elasticities with Incomplete Capital Mobility and No Capital Mobility are very similar to the ones found in Revenga (1992) for the US: 1.74 for employment and 0.4 for wages.
- Goldberg and Pavcnik (JEL 2007): very little reallocation following trade reform in developing countries.
- Low pass-through from tariffs to prices? Faster productivity growth in adversely affected sectors? Government subsidies? Large share of fixed capital?

Conclusion 1

- The paper estimates a structural dynamic equilibrium model of the Brazilian labor market in order to study the transitional dynamics following trade reform.
- Costs of mobility are on average high (1.4 to 2.7 times annual average wages) but are very dispersed across the population. Gender, Education and Age are important determinants of costs of mobility.
- There is a large labor market response to trade reform, but the adjustment may be slow.

Conclusion 2

- Losers from trade liberalization are those initially employed in the adversely affected sector.
- 16% to 42% of potential gains are mitigated due to the slow transition.
- The model provides a rich framework with which we can assess the performance of different labor market policies.

Future Work

- What constitutes these costs of mobility? What components may be reduced with governmental assistance / policy reform?
- Local labor market effects, geographic mobility and implications for the long-run gains of trade.
- Trade reform, unemployment and informality.
- Estimate mobility of capital jointly with mobility of workers.