Trade and Labor Market Institutions: A Tale of Two Liberalizations

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Conference on Firms, Trade, and Development

November 4-5, 2021

- In the last 40 years, several developing countries liberalized their trade regimes (Sachs and Warner 95, Wacziarg and Welch 03)
  - share of world population in open countries from 20 in 1970 to 62 percent in 2005 `more`

- Adverse - but heterogeneous - effects of trade reforms on labor market performance
  - increase in **unemployment** (Hoekman and Porto 10) `more`

- Labor institutions in place at the time of a trade reform (**firing costs**, **minimum wage** and **unemployment insurance**) vary greatly among countries (Heckman and Pages 04, Freeman 10) `more`

- **(How) Do labor market institutions affect the dynamic adjustments to trade?**

- **What are the implications of introducing labor market regulations on**
  - aggregate gains from trade?
  - distribution of gains from trade?

This paper

- Builds a two-sector model of international trade with search frictions in the labor market, and a rich set of labor institutions

- Disciplines the model to match firm-level moments in Mexico and Colombia, two countries that differed by the labor market regulations in place at the time of trade liberalization

- Simulates the effects of trade reform under observed labor institutions in both countries and characterize the dynamics of unemployment, sectoral employment, and income inequality

- Uses counterfactual experiments to unveil short- and long-run effects of minimum wage, firing costs and unemployment insurance

- Solves for the entire transition path towards the new steady state

Labor market regulations are key determinants of trade adjustments:

- institutions explain 30% of the short-run and up to 60% of the long-run cross-country difference in **unemployment** response to a fall in trade costs

Efficiency-equity trade-off arises as an economy reduces **employment rigidities** in favor of stronger downward **wage rigidities**:

- larger aggregate gains from trade and larger gains dispersion
- lower aggregate gains from trade and lower gains dispersion

Transfers to the unemployed reduce gains dispersion at a cost of lower aggregate gains from trade

Dynamics of unemployment

cross-section
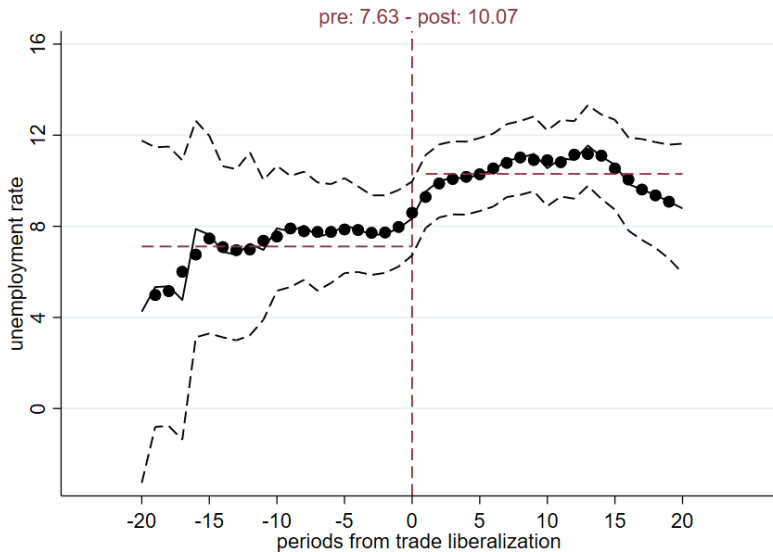
Average response of unemployment after trade openings:

$$\text{unemp}_{it} = \beta \ \text{open}_{it} + \boldsymbol{\xi} \ \text{open}_{it} \times z_i + \mu_i + \mu_t + \delta \ X_{it} + u_{it}$$

where

- unemp_{it} is the unemployment rate in country i at year t

- open_{it} is a country-specific indicator taking value 1 in any year t after trade liberalization (Sachs and Warner 95)

- z_i is a proxy for the labor market institution (firing costs, minimum wage and unemployment insurance) in place in country i at time of reform

- μ_i and μ_t and country and year fixed effects

- X_{it} are various controls, including country-specific trends.

data

- **Fact 1** - Unemployment increases on average following a trade reform
  $\implies$ +1.55 p.p.

- **Fact 2** - The response of unemployment is larger
  - the lower the firing costs: $\uparrow 1$ month $\implies -0.18$ p.p.
  - the larger the statutory minimum wage: $\uparrow 10\% \implies +0.40$ p.p.

- **Fact 3** - Labor market regulations capture cross-country variation in
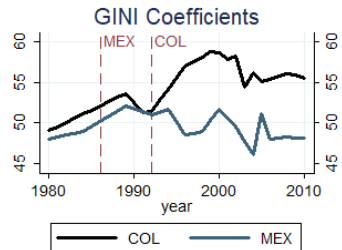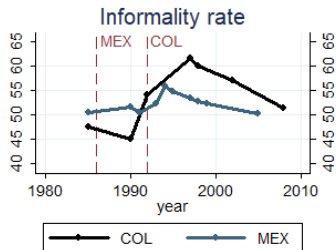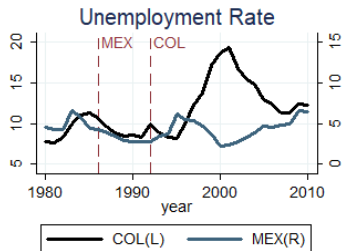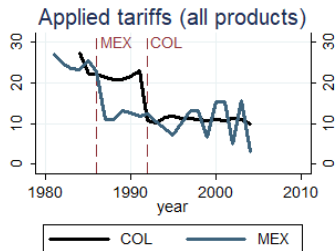 the average response of unemployment to a trade reform

estimates
robustness-1
robustness-2
inequality

A tale of two trade liberalizations...

Applied tariffs (all products)

Unemployment Rate

Informality rate

GINI Coefficients

...and two labor market institutions

	COLOMBIA		MEXICO	
	Pre	Post	Pre	Post
Trade barriers				
Tariffs (%)	21.1	11.0	23.0	12.5
NTB (%)	73.2	10.3	92.2	13.4
Export participation				
Export revenue share	0.134	0.225	0.212	0.267
Share exporting firms	0.119	0.301	0.216	0.359
Trade balance, % GDP	4.660	-3.289	6.283	-1.118
Employment dynamics				
Job turnover rate	0.165	0.226	0.168	0.181
Manufacturing share	0.313	0.273	0.260	0.249
Labor market institutions				
Firing costs	0.50	0.083	0.27	
Minimum wage	0.54		0.33	
Unemployment benefits	0		0	

Note: "Pre" and "Post" refer to pre- and post-liberalization periods as defined by Sachs and Warner (1995). Firing costs and minimum wages are expressed as multiple of the average yearly real wage (source: FRdB Database). The unemployment benefits refer to the coverage-weighted replacement rate (source: FRdB Database).

Three main building blocks:

- industry dynamics (Hopenhayn and Rogerson 93)
- frictional labor market (Bertola and Caballero 94)
- international trade (Melitz 03)

New key features:

- rich set of labor market institutions (firing costs, minimum wage, unemployment insurance)
- transitional dynamics

Small-open economy in discrete time

Two sectors: industrial (tradable) and service (non-tradable)

Three agents:

- Infinitely-lived, risk-neutral homogeneous workers/consumers
  - face **trade barriers** to import foreign industrial varieties
  - **sort** into service or industrial labor market.

- Homogeneous service sector firms
  - **perfect competition** in the product market
  - **frictionless** labor market for services

- Heterogeneous industrial firms
  - **monopolistic** competition and **trade barriers**
  - time-varying **idiosyncratic** productivity
  - **search and matching** frictions in labor market
  - labor market **institutions**

Industrial firms produce **differentiated varieties** ω, and are defined by

- idiosyncratic productivity, $z' = \rho_z z + \epsilon, \quad \rho_z \in (0,1), \epsilon \sim N(0, \sigma_z)$
- number of employees, $\ell \geq 1$.

Industrial firms' technology: $q(z, \ell, m) = z\ell^\alpha m^{1-\alpha}, \quad \alpha \in (0,1)$

Service firms' technology: $s = L^s + bL^u$

where

- m: intermediate inputs
- L^s, L^u: measures of workers in service sector and unemployed labor
- $b < 1$: value home production (relative efficiency)

Industrial product market subject to **monopolistic competition** and is **internationally segmented**

- Domestic demand for domestic variety ω with price $p_t(\omega)$:

$$q_t(\omega) = D_{h,t} p_t(\omega)^{-\sigma}$$

- Domestic demand for foreign variety ω^* with price $p_t(\omega^*)$:

$$q_t(\omega^*) = D_{h,t}[\boldsymbol{\tau_{a,t}\tau_{c,t}} k_t p_t(\omega^*)]^{-\sigma}$$

where

- $\sigma > 1$: elasticity of substitution between varieties

- $D_{h,t} > 0$: endogenous home demand shifter (more)

- $\boldsymbol{\tau_{a,t}}, \boldsymbol{\tau_{c,t}}, k_t$: tariffs, iceberg costs, and exchange rate (#LCU/FCU).

(preferences)

Foreign market participation subject to per-period **fixed costs of exporting**, $c_x > 0$

- Foreign demand for domestic variety ω with price $p_t^*(\omega)$:

$$q_t^*(\omega) = D_{f,t}^* \boldsymbol{\tau_{c,t}}^{-1} k_t p_t^*(\omega)^{-\sigma}$$

- Revenue **premium from exporting**:

$$d_{f,t} = k_t^\sigma \boldsymbol{\tau_{c,t}}^{-(\sigma-1)} \frac{D_{f,t}^*}{D_{h,t}} > 0$$

- **Export share** of output:

$$\eta_t = 1 - [1 + d_{f,t}]^{-\sigma}$$

where $D_{f,t}^* > 0$ is an exogenous foreign demand shifter.

Industrial labor market subject to **search and matching frictions**

Job seekers, X_t and open vacancies, v_t, meet through a CRS matching function

$$h(v_t, X_t) = \frac{v_t X_t}{(v_t^\theta + X_t^\theta)^{\frac{1}{\theta}}} \qquad \theta > 0$$

Vacancy filling probability: $\phi_t = \frac{h(v_t, X_t)}{v_t}$

Job finding probability: $\widetilde{\phi}_t = (1 - \phi_t^\theta)^{\frac{1}{\theta}}$

Cost of **adjusting employment** from ℓ to ℓ',

$$C_t(\ell, \ell') = \begin{cases} C_t^+(\ell, \ell') = c^h \phi_t^{-\lambda_1} \left(\frac{\ell' - \ell}{\ell^{\lambda_2}} \right)^{\lambda_1} & \text{if} \quad \ell' > \ell \\[2mm] C_t^-(\ell, \ell') = \boldsymbol{c_t^f} (\ell - \ell') & \text{if} \quad \ell' < \ell \end{cases}$$

where

- c^h: scale parameter for hiring costs
- $\lambda_1 > 0$: parameter governing the convexity of C_t in employment
- $\lambda_2 > 0$: parameter governing the growth of small vs. large firms
- $\boldsymbol{c_t^f}$: firing costs

Extension of **intra-firm bargaining** problem,

$$\max_{w_t^q(z',\ell')} \quad \Pi_{w,t}^{\beta}(z',\ell')\Pi_{f,t}^{1-\beta}(z',\ell')$$

$$\text{s.t.}$$
$$\text{participation constraint:} \quad \Pi_{w,t}(z',\ell') \geq 0$$
$$\text{minimum wage constraint:} \quad w_t^q(z',\ell') \geq \underline{\boldsymbol{w_t}}$$

where

- $\Pi_{f,t}$: firm surplus from *marginal* worker
- $\Pi_{w,t}$: worker surplus from *employment*
- $\beta \in (0,1)$: worker's bargaining power
- $\underline{\boldsymbol{w_t}}$: minimum wage

surplus functions

Firm **exit decision** at the beginning of time t

$$\max \left\{ 0, -c_o + \frac{1-\delta}{1+r_t} \mathbf{E}_{t,z'|z} V_t(z',\ell) d\Gamma(z'|z) dz' \right\}$$

Firm **entry decision** at the beginning of time t

$$\int_z V_t(z,1) d\Gamma_e(z) \leq c_e$$

where

- $r_t > 0$: exogenous interest rate
- $\delta \geq 0$: exogenous firm exit probability
- Γ: productivity markov chain
- Γ_e: ergodic productivity distribution
- $c_o > 0$: fixed per-period operating costs
- $c_e > 0$: sunk entry costs

Parameters to calibrate: $\vartheta = \{b, c_o, c_x, c_e, c_h, \lambda_1, \lambda_2, \rho_z, \sigma_z, \alpha, \delta\}$

- home production, $b \in (0, 1)$
- per-period fixed cost of operating , $c_o \in \mathcal{R}_+$
- per-period fixed cost of exporting, $c_x \in \mathcal{R}_+$
- sunk cost of entry, $c_e \in \mathcal{R}_+$
- adjustment costs, $\{c_h, \lambda_1, \lambda_2\} \in \mathcal{R}_+^3$
- AR(1) process of productivity, $\{\rho_z, \sigma_z\} \in (0, 1) \times \mathcal{R}_+$
- labor elasticity of output, $\alpha \in (0, 1)$
- exogenous firms' exit rate, $\delta \in (0, 1)$

Calibration strategy: Method of Simulated Moments

$$\hat{\vartheta} = arg \min_{\vartheta \in \Theta} \quad [\overline{m} - m(\vartheta)]'[\overline{m} - m(\vartheta)]$$

where $\overline{m}$ is a vector of sample statistics, $m(\vartheta)$ is a vector of simulated statistics ⬤ details ⬤ external-parameters

Firm-level data for the manufacturing sectors:

- Colombia: Encuesta Anual Manifacturera (EAM-DANE)
  Coverage: universe of formal firms with 10+ employees
  Size: 152,580 firm-year observations over the period 1981-1990

- Mexico: Encuesta Industrial Anual (EIA-INEGI)
  Coverage: sample of formal firms with 5+ employees
  Size: 9,657 firm-year observations over the period 1984-1986

Moment selection:

- Firm-level moments: average log-employment and log-revenues, share of exporting firms, new entrants into export, auto-corr. of export participation

- Log-employment percentiles: 20th, 40th, 60th, 80th

- Firm-size distribution: 1-49, 50-99, 100-199, 200-499, 500+ employees

- Aggregate moments: average wage, exit rate, job turnover, labor payment share, vacancy rate

identification   fit

Targeted moments: employment and size distribution

	COLOMBIA		MEXICO	
Moments	Data	Model	Data	Model
Log-employment percentiles				
20th perctile	2.676	2.831	1.946	2.085
40th perctile	3.178	3.343	2.944	2.622
60th perctile	3.720	3.927	3.761	3.323
80th perctile	4.450	4.662	4.625	4.066
Firm size distribution				
1-49 employees	70.81	70.22	82.66	81.92
50-99 employees	14.01	14.77	9.18	8.42
100-199 employees	7.90	9.17	4.55	5.56
200-499 employees	5.21	4.95	2.30	3.00
500+ employees	2.07	0.89	1.31	1.10

Note: This table reports empirical and simulated moment statistics used in the estimation.

other moments   other non-targeted moments   distributions

Calibrated adjustment costs

Firms' hiring costs: $C^+(\ell', \ell) = c_h \phi^{-\lambda_1} \left(\frac{\ell' - \ell}{\ell} \right)^{\lambda_1} \ell^{-\lambda_1 \lambda_2}$

single worker

1% one percent workforce
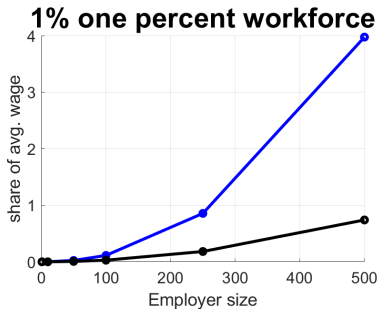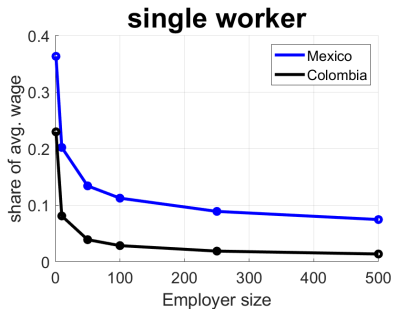
other-estimates

**Does the model explain the differences in labor market adjustments between Colombia and Mexico?**

- Compute steady state equilibria at $t = 0$ under observed initial policies

- Implement once-and-for-all *unexpected* reduction of tariffs τ_a, from 23% to about 11% in Colombia, from 21% to 12.5% in Mexico

- Implement once-and-for-all *unexpected* reduction of iceberg costs, τ_c, to match increase in revenues from exports (from 250% to roughly 202% in Colombia and 197% in Mexico)

- Implement once-and-for-all *unexpected* drop in firing costs, c^f, in Colombia from 50% to 8.3% of yearly real wage

- Compute transitional dynamics at $t = 1, 2, ...$ and new stationary equilibrium at $t = 30$. Keep interest rate r fixed along transition

algorithm

|	COLOMBIA		MEXICO	
	Data	**Model**	**Data**	**Model**
Export participation				
Export revenue share, %	9.10	9.10	5.50	5.50
Share exporting firms, %	18.02	10.60	14.30	5.81
Employment dynamics				
Unemployment rate, p.p.	3.01	2.54	0.12	0.97
Manufacturing share, p.p.	-4.01	-4.62	-1.10	-0.29
Job turnover rate, p.p.	6.11	2.26	1.30	0.78
Income Inequality				
GINI, p.p.	4.45	1.39	0.53	0.48
$90^{th}/10^{th}$ ratio	0.79	0.23	0	0.08

Note: This table reports the average response observed within 20 years from a trade liberalization for Colombia and Mexico, and the model-simulated counterparts.
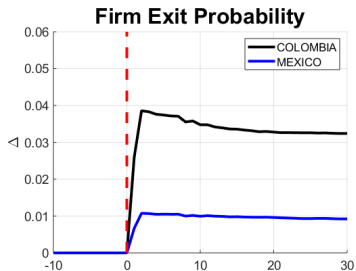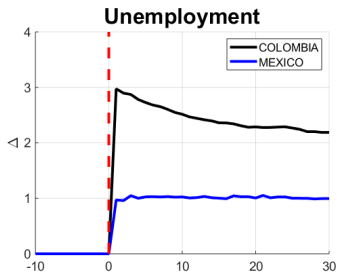
Margins of adjustments
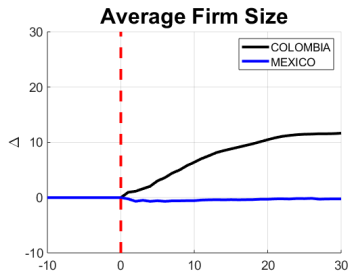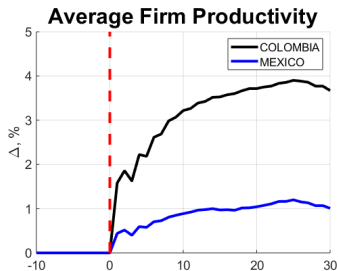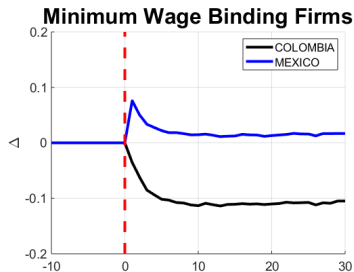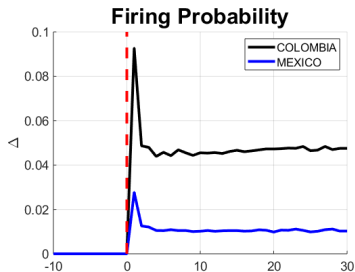
Trade induces **asymmetric changes** across countries:

Amplification effect in Colombia:
- larger workers' dismissal on impact
- larger gains in average firms' productivity
- larger but gradual employment growth along the transition

Stabilization effect in Mexico:
- larger wage cuts on impact
- lower gains in average firms' productivity
- lower employment growth along the transition

other-adjustments
wage-dynamics
income-dynamics

How do labor market institutions determine the dynamic response of unemployment to a trade liberalization?

- Compute steady state equilibria at $t = 0$ under counterfactual initial labor market institutions

- Implement same once-and-for-all *unexpected* change in tariffs τ_a (from 23% to about 11% in Colombia, from 21% to 12.5% in Mexico)

- Implement once-and-for-all *unexpected* reduction of iceberg costs, τ_c (from 250% to roughly 210% in Colombia and 215% in Mexico)

- Compute transitional dynamics at $t = 1, 2, ...$ and new stationary equilibrium at $t = 30$. Keep interest rate r fixed along transition
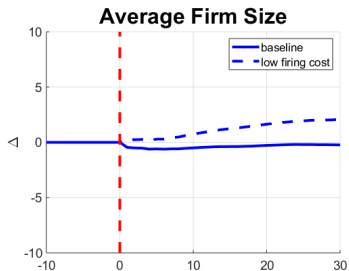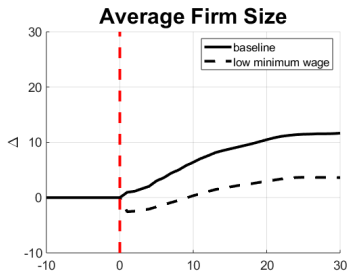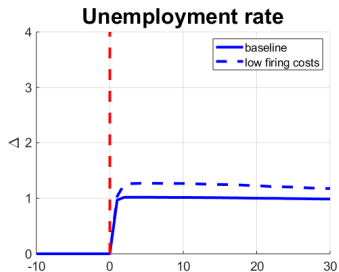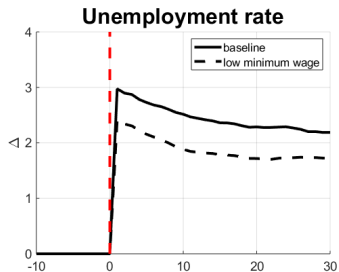
Role of labor market institutions
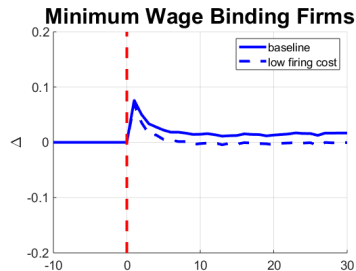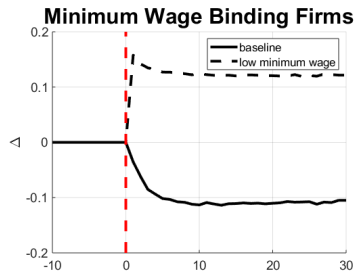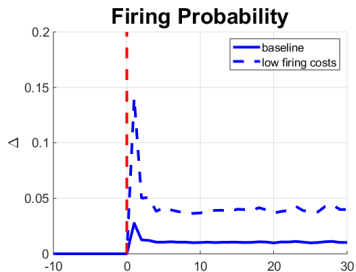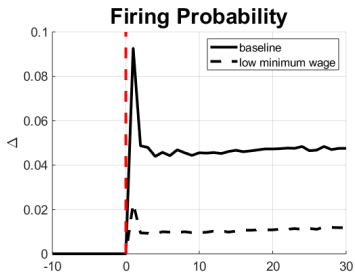
What are the implications of introducing labor market regulations on

- the gains from trade?
- distribution of gains from trade?

Industry gains from trade:

$$J_t^e(z,\ell) = \underbrace{p_t^o(z,\ell)}_{\substack{\text{firm exit} \\ \text{probability}}} \underbrace{J_t^u}_{\substack{\text{value of} \\ \text{unemployment}}} + (1 - p_t^o(z,\ell)) \int_{z' \in \mathcal{Z}} J_t^c(z',\ell)\Gamma(z'|z)$$

where

$$J_t^c(z',\ell) = \underbrace{p_t^f(z',\ell)}_{\substack{\text{firing} \\ \text{probability}}} J_t^u + \frac{(1 - p_t^f(z',\ell))}{1 + r_t}[\underbrace{c^e(z', L_t(z',\ell))}_{\text{consumption}} + J_{t+1}^e(z', L_t(z',\ell))]$$
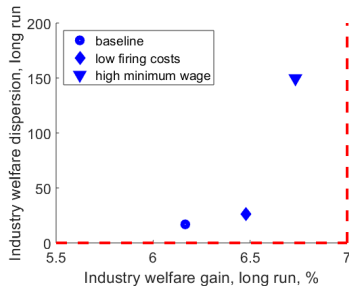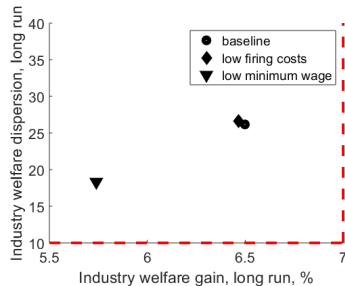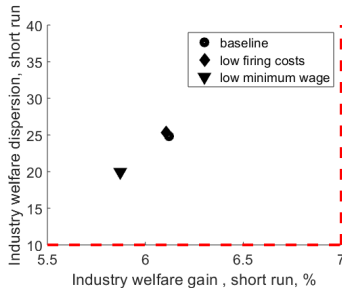
- Evaluate trade reforms implemented with positive transfer to the unemployed ($b^u = 0.05\bar{w}$) financed with payroll taxes

	COLOMBIA			
	Baseline		UI	
	Short-run	Long-run	Short-run	Long-run
$\Delta\mathbf{E}[J_t^e], \%$	+6.14	+6.49	+6.05	+6.44
$\Delta\mathbf{std}[J_t^e], p.p.$	+24.83	+26.16	+23.38	+24.78
$\Delta\mathrm{L}_u, p.p.$	+2.97	+2.19	+3.68	+2.78

	MEXICO			
	Baseline		UI	
	Short-run	Long-run	Short-run	Long-run
$\Delta\mathbf{E}[J_t^e], \%$	+6.00	+6.17	+5.99	+6.12
$\Delta\mathbf{std}[J_t^e], p.p.$	+15.16	+16.88	+10.23	+10.95
$\Delta\mathrm{L}_u, p.p.$	+0.99	+0.99	+1.43	+1.23

Principles of the Washington Consensus:

- *"Quantitative trade restrictions should be rapidly replaced by tariffs, and these should be progressively reduced until a uniform low rate of 10 percent is achieved." (Williamson 89)*

- *"We place particular emphasis on the desirability of liberalizing the labor market" (Kuczysnki and Williamson 03)*

This paper

- unveils and quantify the role of labor market institutions on the dynamic response of unemployment to a trade reform

- evaluates welfare implications of trade reform jointly implemented with labor market reform

Appendix
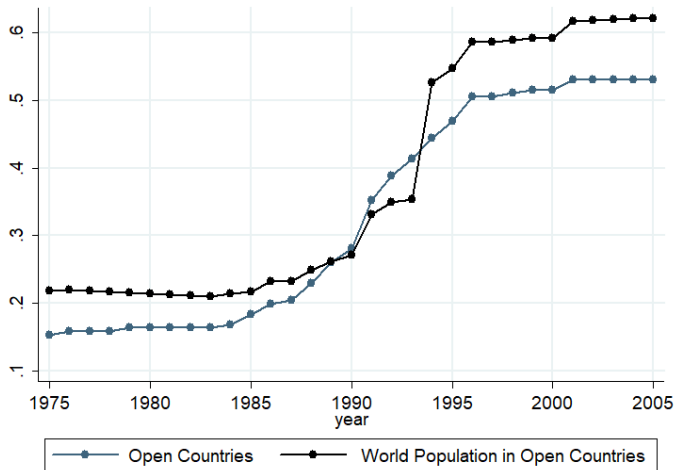
Note: This figure reports the share of countries in the world that liberalized their trade regime (black line) and the share of world population in those countries (grey line). Source: Sachs and Warner (1995) and author's calculations.

Trade agreements in the world
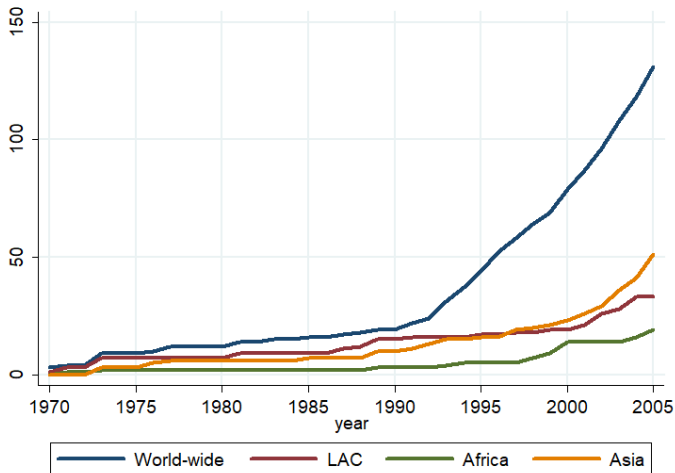
Note: This figure reports the number of trade agreements in place in each year world-wide and by selected region. Source: RTA database (WTO) author's calculations.

Extensive trade reforms in LAC countries between the 80′s and the 90′s

- regional average tariffs on imports from 45% in 1986 to 13% in 1995 (Lora, ′97)
- the average tariff dispersion declined from 24% to 5% (IADB ′97)
- non-tariff restrictions affecting 38% of imports in the early 80′s covered only 6% of imports in 1995 (IADB ′97)

Slope: 0.458 (0.181) - Corr: 0.402

Trade reform and unemployment back

Slope: 0.458 (0.181) - Corr: 0.402

Scatter plot of import penetration, change (x-axis) versus unemployment, change (y-axis). Labeled points include: Albania, Latvia, Hungary, Poland, Chile, South Africa, Romania, Kyrgyzstan, Argentina, Lithuania, Serbia, Venezuela, New Zealand, Brazil, Israel, Pakistan, Peru, Nicaragua, Georgia, Malta, Tajikistan, El Salvador, Mozambique, Cote d'Ivoire, Egypt, Tanzania, Paraguay, Mexico, Uruguay, Turkey, Dominican Republic, Honduras, Jamaica.

Data

Panel of 40 developing countries spanning on average 40 years

- *De-jure* Liberalization Dates (source: Sachs and Warner 95)

- Unemployment Rate (source: ILO-stat)

- Institutions (source: FrdB - Labor Institutions v.1 database):
    - firing costs (advance notice + severance payments)
    - statutory minimum wage (fraction of average wage)
    - unemployment insurance (coverage-weighted replacement rate)

- Robustness analysis:
    - Import penetration (source: WDI)
    - Average tariffs on imports (source: IMF)

	Min/Mean	EPL		UI	
	wage	AN	SP	benefits	coverage
Average	0.37	1.14	4.86	15.63	17.22
St. Dev.	0.18	0.77	4.35	21.52	27.16
LAC	0.39	1.07	7.35	6.04	5.45
East Europe	0.36	1.44	3.09	19.95	18.05
Asia	0.43	0.92	3.91	11.35	20.10
Africa	0.24	1.16	2.71	16.62	8.05

Note: The minimum wage is expressed as share of the average yearly wage. AN refers to the months of advance notice, SP refers to level of severance payment: both are expressed as a multiple of average real monthly wage. UI benefits refers to the average gross replacement ratio after one year of dismissal, UI coverage refers to the share of unemployed workers entitled to benefits after dismissal: both are expressed in percentage. Source: FRdB Labor Institution v.1 database and authors' calculation.

De-jure Liberalization Dates `back`

The *de-jure* liberalization dates, taken from Sachs and Warner (1995) and Wacziarg and Weich (2003), are constructed to be the first year from which the following characteristics are all continuously met, i.e.

- **Average Nominal Tariff Rates** (TAR) below of 40%

- **Non-Tariff Barriers** (NTB) covering less than 40% of trade

- **Black Market Exchange Rate** (BMP) depreciated by less than 20% relative to the official exchange rate `more`

- **Absence of Monopoly** (XMB) on major exports `more`

- **No Socialist Economic System** (SOC) is in place (Kornai, 1992) `more`

Caveats:

- Harrison and Hanson (1999) and Rodriguez and Rodrik (2000) critiques

- A BMP on the exchange rate could have effects equivalent to formal trade restrictions. If exporters have to purchase foreign inputs using foreign currency obtained on the black market but remit their foreign exchange receipts from exports to the government at the official exchange rate, the BMP acts as a form of trade restriction.

- The domestic price of import-competing goods relative to exportable goods can be expressed as

$$\frac{p^m}{p^x} = \frac{e^m p^{m*}(1 + t^m)(1 + t^x)}{e^x p^{x*}}$$

If $e^m/e^x = 1 + BMP > 1$, the black market premium has the same resource-allocation consequence as a trade restriction

- Source: Kowitt (1986), Easterly and Sewadeh (2002) plus World Bank update from Ross Levine

- Organization set up by a government to regulate the buying and selling of a certain commodity within a specified area, controlling the price of products by forming a legal cartel. XMB works as a tax on exports. On the basis of Lerner symmetry between import tariffs and export taxes, Sachs and Warner (1994) included the state monopoly on exports criterion as a form of trade restriction.

- Source: World Bank Export Marketing Index (Husain and Faruqee, 1994) plus comprehensive review of country case studies (Wacziarg and Welch, 2003)

Kornai (1992) classifies the key characteristics of the socialist systems as follow:

- State and quasi-state ownership
- Bureaucratic coordination
- Soft budget constraint; weak responsiveness to prices; plan bargaining; quantity drive
- Chronic shortage economy; sellers′ market; labor shortage; unemployment on the job

Source: Kornai (1992, 2000)

Dynamics of import penetration back

pre: 12.42 - post: 21.55
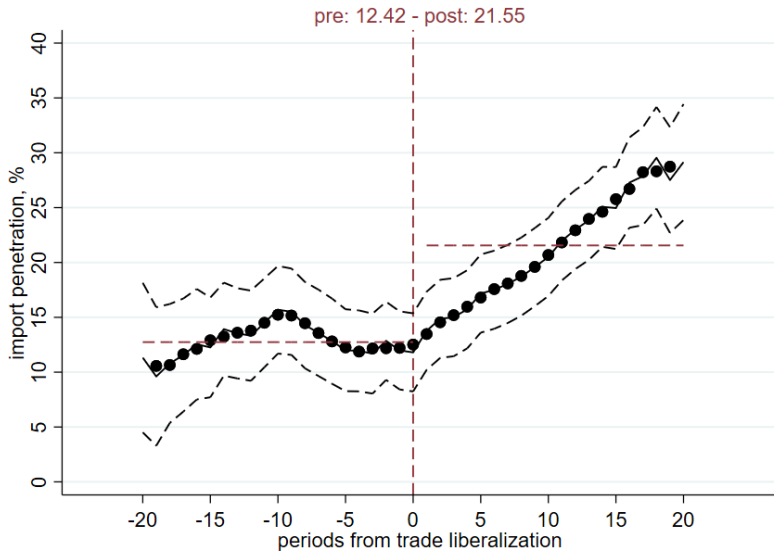
Tariffs rates taken from the IMF Sructural Reform database (Furceri et al. 18)

- product-level tariff from WITS, WDI, WTO, GATT and Brussels Customs Union database
- tariffs are aggregated at country level by calculating weighted averages, with weights given by the import share of each product, measured as fractions of value

pre: 20.55 - post: 8.42
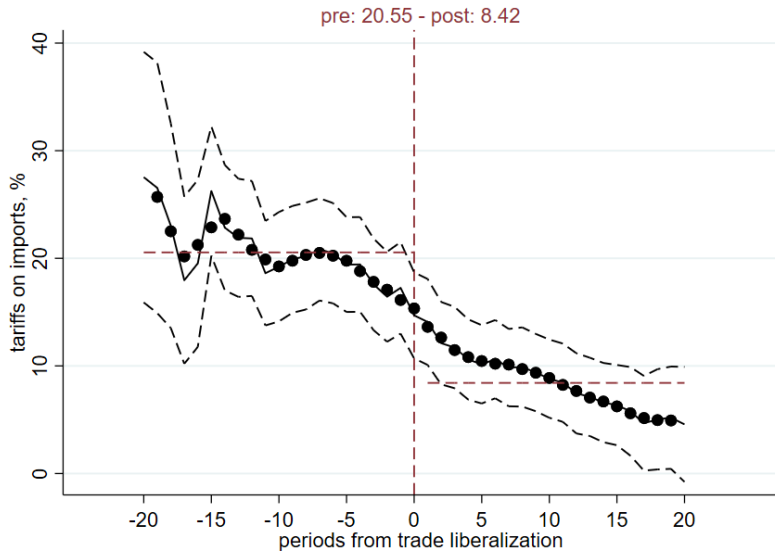
ILO-Stat defines unemployed a person of working age (from 16 to 64 y.o.) who was

- without work during the reference period, i.e. was not in paid employment or self-employment

- currently available for work, meaning available for paid employment or self-employment during the reference period

- eeking work, i.e. had taken specific steps in a specified recent period (previous four weeks) to seek paid employment or self-employment

The unemployment rate is the ratio of people who are unemployed during the reference period to the total number of employed and unemployed people (i.e., the labor force)

	Min/Mean	EPL		UI	
	wage	AN	SP	benefits	coverage
Average	0.37	1.14	4.86	15.63	17.22
St. Dev.	0.18	0.77	4.35	21.52	27.16
LAC	0.39	1.07	7.35	6.04	5.45
East Europe	0.36	1.44	3.09	19.95	18.05
Asia	0.43	0.92	3.91	11.35	20.10
Africa	0.24	1.16	2.71	16.62	8.05

Note: The minimum wage is expressed as share of the average yearly wage. AN refers to the months of advance notice, SP refers to level of severance payment: both are expressed as a multiple of average real monthly wage. UI benefits refers to the average gross replacement ratio after one year of dismissal, UI coverage refers to the share of unemployed workers entitled to benefits after dismissal: both are expressed in percentage. Source: FRdB Labor Institution v.1 database and authors' calculation.

VARIABLES	unemp$_{it}$	
	(1)	(2)
$\mathbf{1}_{\{t \geq t_i^*\}}$	1.551	0.240
	[0.308]***	[0.792]
$\mathbf{1}_{\{t \geq t_i^*\}} \times \text{FC}_i$		-0.181
		[0.069]***
$\mathbf{1}_{\{t \geq t_i^*\}} \times \underline{\text{w}}_i$		4.002
		[1.372]***
$\mathbf{1}_{\{t \geq t_i^*\}} \times \text{UI}_i$		0.0571
		[0.0435]
Observations	1086	791
R-squared	0.888	0.933
Country FE	yes	yes
Year FE	yes	yes
Country trend	yes	yes
Controls	yes	yes

Note: The coefficients are estimated using a linear panel data model. Heteroskedastic-robust standard errors are reported in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	unemp$_{it}$	
	(1)	(2)
$\mathbf{1}_{\{t \geq t_i^*\}}$	1.013	1.066
	[0.497]**	[0.365]***
$\mathbf{1}_{\{t \geq t_i^*\}} \times \tau_{it}$	-3.927	
	[2.140]*	
$\mathbf{1}_{\{t \geq t_i^*\}} \times \text{IMP}_{it}$		0.788
		[2.106]
Observations	772	960
R-squared	0.927	0.906
Country FE	yes	yes
Year FE	yes	yes
Country trend	yes	yes
Controls	yes	yes

Note: The coefficients are estimated using a linear panel data model. Heteroskedastic-robust standard errors are reported in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1.*

VARIABLES	unemp$_{it}$	
	(1)	(2)
$\mathbf{1}_{\{t \geq t_i^*\}} \times \mathbf{1}_{\{\Delta \text{IMP}_{it} \geq 5\%\}}$	2.118	0.230
	[0.670]***	[1.812]
$\mathbf{1}_{\{t \geq t_i^*\}} \times \mathbf{1}_{\{\Delta \text{IMP}_{it} \geq 5\%\}} \times \text{FC}_i$		-0.223
		[0.125]*
$\mathbf{1}_{\{t \geq t_i^*\}} \times \mathbf{1}_{\{\Delta \text{IMP}_{it} \geq 5\%\}} \times \underline{\text{w}}_i$		5.293
		[2.820]*
$\mathbf{1}_{\{t \geq t_i^*\}} \times \mathbf{1}_{\{\Delta \text{IMP}_{it} \geq 5\%\}} \times \text{UI}_i$		0.154
		[0.057]**
Observations	998	734
R-squared	0.892	0.935
Country FE	yes	yes
Year FE	yes	yes
Country trend	yes	yes
Controls	yes	yes

Note: The coefficients are estimated using linear panel data model. Heteroskedastic-robust standard errors are reported in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

VARIABLES	GINI$_{it}$	
	(1)	(2)
$\mathbf{1}_{\{t \geq t_i^*\}}$	1.887	1.119
	[0.468]***	[0.795]
$\mathbf{1}_{\{t \geq t_i^*\}} \times \mathrm{FC}_i$		-0.165
		[0.073]***
$\mathbf{1}_{\{t \geq t_i^*\}} \times \underline{w}_i$		3.387
		[1.684]***
$\mathbf{1}_{\{t \geq t_i^*\}} \times \mathrm{UI}_i$		-0.127
		[0.135]
Observations	881	717
R-squared	0.930	0.938
Country FE	yes	yes
Year FE	yes	yes
Country trend	yes	yes
Controls	yes	yes

Note: The coefficients are estimated using a linear panel data model. Heteroskedastic-robust standard errors are reported in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1.

Utility function: Cobb-Douglas in services, s_t, and industrial composite good, c_t, i.e.

$$U_t = c_t^\gamma s_t^{1-\gamma} \quad \gamma \in (0,1)$$

Industrial composite goods: CES function aggregate of N_t differentiated varieties available at time t

$$c_t = \left(\int_0^{N_t} c_t(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \qquad \sigma > 1$$

Domestic demand for services and industrial consumption goods

$$s_t = (1-\gamma)I_t(i) \qquad c_t = \gamma \frac{I_t(i)}{P_t}$$

The home-economy demand shifter is endogenously determined in equilibrium by the sum of consumers and producers demands for differentiated varieties

$$D_{ht} = \gamma \underbrace{\int_{i\in[0,1]} I_t(i)di}_{\text{consumers' demand}} + \underbrace{(1-\alpha)\frac{\sigma-1}{\sigma} \int_{z\in\mathcal{Z}} \int_{\ell\in\mathcal{L}} R_t(z,\ell)\psi_t(z,\ell)dzd\ell}_{\text{firms' demand}}$$

The firm surplus from a *marginal worker* reads as follows:

$$\Pi_{f,t}(z', \ell') = \frac{\partial R_t(z', \ell')}{\partial \ell'} - \frac{\partial w_t^q(z', \ell')\ell'}{\partial \ell'} + \frac{\partial V_{t+1}(z', \ell')}{\partial \ell'}$$

The worker surplus from *employment* reads as follows:

$$\Pi_{w,t}(z', \ell') = w_t^q(z', \ell') + J_{t+1}^q(z', \ell') - (b + \boldsymbol{b_t^u} + J_{t+1}^o)$$

Value of firm with productivity z' and employment ℓ at interim stage of time t

$$\tilde{V}_t(z',\ell) = \max\{\tilde{V}_t^x(z',\ell) - c_x, \tilde{V}_t^d(z',\ell)\}$$

Value of exporting firm

$$\tilde{V}_t^x(z',\ell) = \max_{\ell'} \quad R_t^x(z',\ell') - w_t^q(z',\ell')\ell' - C_t(\ell,\ell') + V_{t+1}(z',\ell')$$

Value of not-exporting

$$\tilde{V}_t^d(z',\ell) = \max_{\ell'} \quad R_t^d(z',\ell') - w_t^q(z',\ell')\ell' - C_t(\ell,\ell') + V_{t+1}(z',\ell')$$

where

- c_x: fixed per-period cost of exporting
- $w_t^q(z',\ell')$: wage rate
- $C_t(\ell,\ell')$: employment adjustment costs

Value of firm with productivity z' and employment ℓ at interim stage of time t

$$\tilde{V}_t(z',\ell) = \max\{\tilde{V}_t^x(z',\ell) - c_x, \tilde{V}_t^d(z',\ell)\}$$

Value of exporting firm

$$\tilde{V}_t^x(z',\ell) = \max_{\ell'} \quad R_t^x(z',\ell') - w_t^q(z',\ell')\ell' - C_t(\ell,\ell') + V_{t+1}(z',\ell')$$

Value of not-exporting

$$\tilde{V}_t^d(z',\ell) = \max_{\ell'} \quad R_t^d(z',\ell') - w_t^q(z',\ell')\ell' - C_t(\ell,\ell') + V_{t+1}(z',\ell')$$

where

- c_x: fixed per-period cost of exporting
- $w_t^q(z',\ell')$: wage rate
- $C_t(\ell,\ell')$: employment adjustment costs

Firm's exit decision at the beginning of time t

$$V_t(z,\ell) = \max\left\{0, -c_o + \frac{1-\delta}{1+r_t}\mathbf{E}_{z'|z}\tilde{V}_t(z',\ell)\right\}$$

Value of entrant firm at the beginning of time t

$$V_t^e = \int_z \tilde{V}_t(z,1)\psi_e(z)dz \le c_e$$

where

- $r_t > 0$: exogenous interest rate
- $\delta \ge 0$: exogenous firm exit probability
- ψ_e: ergodic productivity distribution
- $c_o > 0$: fixed per-period operating costs
- $c_e > 0$: sunk entry costs

Value of non-employed workers at beginning of time t

$$J_t^o = \frac{1}{1 + r_t} \left[T_t + \max\{J_t^s, J_t^u\} \right]$$

Value of working in the service sector

$$J_t^s = w_t^s + J_{t+1}^o$$

Value of searching for an industrial job

$$J_t^u = (1 - \widetilde{\phi}_t)(b + \boldsymbol{b_t^u} + J_{t+1}^u) + \widetilde{\phi}_t \int_{z'} \int_{\ell} [w_t^q(z', \ell) + J_{t+1}^q(z', \ell')] g_t(z', \ell) dz' d\ell$$

where

- T_t: lump-sum transfers, including government transfers and aggregate profits
- w_t^s : wage rate in service sector ($= 1$, numeraire)
- $\boldsymbol{b_t^u} \geq 0$: unemployment benefits (financed with payroll taxes)
- g_t: distribution of vacancies

Value of employed worker at the beginning of period t

$$J_t^q(z, \ell) = p_t^o(z, \ell) J_t^u + (1 - p_t^o(z, \ell)) \mathbf{E}_{z'|z} \max \left\{ J_t^u, J_t^c(z', \ell) \right\}$$

Value of employed worker at the interim stage of period t

$$J_t^c(z', \ell) = p_t^f(z', \ell) J_t^u + \frac{(1 - p_t^f(z', \ell))}{1 + r_t} [w_t^q(z', \ell) + J_{t+1}^q(z', \ell')]$$

where

- p_t^o: probability of large dismissal (firm exit)
- p_t^f: probability of individual dismissal (firing)

Panel A: Parameters taken from the data

Description	Symbol	COLOMBIA Value	MEXICO Value	Source
Discount rate (%)	r	10.63	6.46	IFS (18) / Riano (11)
Service share (%)	γ	52.4	49.9	ECLAC-CEPAL
Service wage (2012 USD)	w_s	3165.67	5680.13	author's calculation
Exporter revenue premium	d_f	0.135	0.271	DANE / INEGI

Panel B: Parameters taken from the literature

Description	Symbol	COLOMBIA Value	MEXICO Value	Source
Elasticity varieties	σ	6.43		Baier and Bergstrand (01)
Matching elasticity	θ	1.84		Fajgelbaum (16)
Bargaining power	β	0.50		standard

Panel C: Policy parameters

Description	Symbol	COLOMBIA Value	MEXICO Value	Source
Tariffs	τ_a-1	0.21	0.23	WTO-dataset (17)
Iceberg costs	τ_c-1	1.52		Anderson and van Wincoop (01)
Firing costs	c^f	0.50	0.27	FRdB-dataset (17)
Minimum wage	$\underline{w}$	0.54	0.33	FRdB-dataset (17)
Unemployment benefit	b^u	0		FRdB-dataset (17)

Note: This table reports the list of parameters directly calibrated using aggregate data, policy parameters and parameters taken from the literature.

Assumption: the economies are in steady-state before trade reform
`equilibrium`

Algorithm details:

- aggregate domestic expenditure, D_h, treated as a parameter to calibrate

- entry cost treated as endogenous object (in equilibrium, $c_e = V^e$)

- model-based moments obtained using a simulated panel of 5000 firms over 1000 periods

- search and select new guesses over the parametric space Θ using a genetic algorithm

- penalize set of parameters delivering $V^e < 0$

Stationary Recursive Competitive Equilibrium back

Given values for the exogenous foreign expenditures, D_f, exogenous interest rates, r, policy instruments, $\{c^f, \underline{w}, b^u, \tau_w, \tau_a\}$, and iceberg costs, τ_c, a small open economy Stationary Recursive Competitive Equilibrium (soe-SRCE) is composed of

- measure of domestic differentiated goods, N_h;
- price index for composite good, P, and exchange rates, k;
- domestic demands for industrial goods, D_h, and income, I;
- measures of workers in service, L^s, and industrial sector, L^q;
- measures of job seekers, X, and unemployed, L^u;
- job finding rates, $\widetilde{\phi}$, and vacancy filling rates, ϕ;
- exit rates, μ^o, and measures of entrants, N_e;
- value and policy functions for the industrial firms and for workers;
- schedules for industrial wages, w^q;
- firm densities over idiosyncratic states, $\{\tilde{\psi}(z', \ell), \psi(z', \ell')\}$;

such that:

Stationary Recursive Competitive Equilibrium

- the distributions of firms reproduce themselves through the Markov processes on productivity, the policy functions, and the productivity draws upon entry,

$$\widetilde{\psi}(z',\ell) = \frac{N_e}{N_h}\psi_e(z')\mathbf{1}_{\ell=1} + (1-\delta)\int_z \Gamma(z'|z)\psi(z,\ell)(1-\mathbf{1}^o(z,\ell))dz,$$

$$\psi(z',\ell') = \frac{\int_\ell \widetilde{\psi}(z',\ell)\mathbf{1}_{L(z',\ell)=\ell'}d\ell}{\int_z \int_\ell \widetilde{\psi}(z'',\ell)\mathbf{1}_{L(z'',\ell)=\ell'}dz''d\ell};$$

- a positive measure of entrants replaces exiting firms every period so that free entry condition holds,

$$N_e = N_h\mu^o;$$

- no arbitrage between value of service and value of job seeking;

$$J^o = J^u = J^s = w^s/r;$$

- the wages are determined by the bargaining solution;
- the flows in and out of unemployment match;
- trade is balanced;
- gov't budget is balanced;
- market for services clear.

- Fixed operating costs, c_o, identified by the firm exit decision, $\mathbf{E}[\mathbf{1}^o]$

$$\frac{1-\delta}{1+r}\mathbf{E}_{z'|z^o}\tilde{V}(z', L(z')) = c_o$$

- Fixed exporting costs, c_x identified by the firm export decision, $\mathbf{E}[\mathbf{1}^x]$

$$\tilde{V}^x(z^x, L(z^x)) - \tilde{V}^d(z^x, L(z^x)) = c_x$$

- Sunk entry costs, c_e, identified by the average log-revenues, $\mathbf{E}[\ln g]$

$$\int_z V^e(z, 1)\psi^e(z)dz = c_e$$

- The value of home production, b, is identified by the average wage in the industrial sector, $\mathbf{E}[w^q]$, through the bargaining process for hiring and firing firms

- The direct cost of hiring, c_h, is identified by the vacancy rate

- The parameters of adjustment cost profile, $\{\lambda_1, \lambda_2\}$, are identified by moments on log-employment, i.e. average firm size $\mathbf{E}[\ln l]$, together with 20th, 40th, 60th and 80th percentiles

- The parameters of the productivity process, $\{\rho_z, \sigma_z\}$, are identified the firm distribution across size bins, i.e. $1-49$, $50-99$, $100-199$, $200-499$ and $500+$ and the higher-order moment on export participation, i.e $\text{corr}[\mathbf{1}_t^x, \mathbf{1}_{t-1}^x]$ and $\mathbf{E}[\mathbf{1}_t^x | \mathbf{1}_{t-1}^x = 0]$

- The employment elasticity of revenues, α, is identified by the wage share of revenues

- The exogenous exit rate, δ, is identified by the job turnover rate
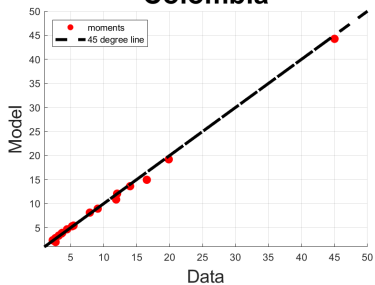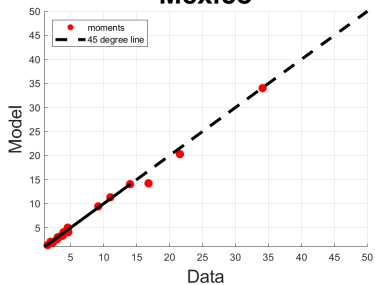
Firms' fixed costs and wages

Description	COLOMBIA		MEXICO	
	Value	USD (2012)	Value	USD (2012)
Numeraire, w^s	1	3,165.67	1	5,680.13
Manufacturing Wage, w^q	1.205	3,814.63	1.035	6,065.23
Home Production, b	0.419	1326.135	0.405	2300.45
Cost of operating, c_o	7.094	22,447.8	5.991	34,029.7
Cost of exporting, c_x	120.59	381,748.1	52.82	300,024.5
Cost of entry, $c_e (= V^e)$	55.63	176106.22	69.01	391976.8

Note: The parameters are estimated using data for the pre-liberalization periods in the respective country, i.e. 1984-1986 for Mexico, 1981-1990 for Colombia. The confidence intervals are at 95 percent level.

Firm dynamics and elasticity

| | COLOMBIA | MEXICO |
Description	Value	Value
Persistence productivity, ρ_z	0.963	0.959
Volatility productivity, σ_z	0.143	0.164
Firm exit, δ	0.037	0.010
Elasticity employment, α	0.224	0.164

Note: The parameters are estimated using data for the pre-liberalization periods in the respective country, i.e. 1984-1986 for Mexico, 1981-1990 for Colombia. The confidence intervals are at 95 percent level.

	COLOMBIA		MEXICO	
Moments	**Data**	**Model**	**Data**	**Model**
Firm-level moments				
$\mathbf{E}[\ln \ell]$	3.619	3.740	3.303	3.239
$\mathbf{E}[\ln g]$	5.430	4.676	4.559	5.106
$\mathbf{E}[\mathbf{1}^x]$	11.89	11.20	21.56	21.16
$\text{corr}[\mathbf{1}^x_t, \mathbf{1}^x_{t-1}]$	9.10	8.953	14.0	14.05
$\mathbf{E}[\mathbf{1}^x_t | \mathbf{1}^x_{t-1} = 0]$	2.71	2.018	3.91	4.041
Aggregate moments				
Exit rate, $\mathbf{E}[\mathbf{1}^o]$	12.04	13.05	11.01	13.14
Average wage, $\mathbf{E}[w^q]$	1.199	1.205	1.030	1.035
Job turnover rate	16.54	15.41	16.08	17.43
Labor share	45.01	46.41	34.10	35.72
Vacancy rate	2.27	2.17	1.51	1.50

Note: This table reports empirical and simulated moment statistics used in the estimation.

Non-targeted moments: aggregate implications `back`

	COLOMBIA		MEXICO	
	Data	**Model**	**Data**	**Model**
Relative market size to ROW	0.006	0.009	0.022	0.021
Employment share, manufacturing	0.355	0.323	0.260	0.194
Unemployment rate	0.098	0.072	0.049	0.046

Note: The manufacturing share of employment is taken from Attanasio et al (2005) for Colombia (source: National Household Survey - Encuesta Nacional de Hogares, ENH) and from Fairris and Levine (2004) for Mexico (source: National Survey of Household Income and Expenditure - Encuesta Nacional de Ingresos y Gastos de los Hogares, ENIGH).

	COLOMBIA		**MEXICO**	
	Data	**Model**	**Data**	**Model**
Exporters shares				
Revenue share of exporters	0.521	0.646	0.860	0.834
Employment share of exporters	0.360	0.441	0.631	0.698
Exporters wage-premium: $\ln w_{it} = \beta_1 \mathbf{1}^x_{it} + \epsilon_{it}$				
β_1	0.416	0.646	0.314	0.499
	[0.001]***	[0.002]***	[0.023]***	[0.001]***
R^2	0.088	0.035	0.025	0.213
Size-wage relationship: $\ln w_{it} = \beta_1 \log l_{it} + \epsilon_{it}$				
β_1	0.215	0.050	0.114	0.088
	[0.000]***	[0.001]***	[0.000]***	[0.000]***
R^2	0.283	0.035	0.090	0.214

Note: For Colombia, both regressions are run using 152,580 observations. For Mexico using 9,657 observations. Standard errors are bootstrapped over 3000 repetitions with replacement. *** p<0.01, ** p<0.05, * p<0.1

Non-targeted moments: wage dispersion back

	COLOMBIA		MEXICO	
	Data	**Model**	**Data**	**Model**
Firms				
St.Dev. log wage	0.461	0.392	0.456	0.288
Max-Mean log wage	8.261	2.755	5.457	2.167
Workers				
St.Dev. log wage	0.800	0.717	0.760	0.373

Source: Colombian National Household Survey (DANE) and Mexican Household Income and Expenditure Survey (ENIGH).
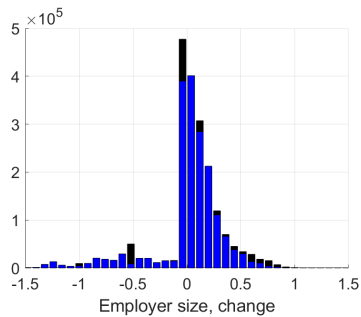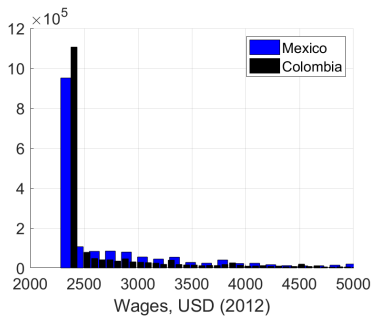
At time $t = 0$ the economy is in a stationary equilibrium with limited openness to trade. At $t = 1$ a trade reform is implemented. Workers cannot forecast the date of the reform, which takes the form of unexpected shock. I assume by the time $T = 100$ the transition towards the new steady state is complete. From period T onward, the economy converges to the new stationary equilibrium with a larger trade exposure. The numerical strategy is the following:

- solve for the initial and the final stationary equilibria (as in GCT 16)

- impose a path for the revenue premium of exporters, $\{d_{f,t}\}_{t=1}^{T-1}$

- guess a path for the following equilibrium objects:

  - probability of filling a vacancy, $\{\phi_t\}_{t=1}^{T-1}$;
  - domestic demand shifter, $\{D_{h,t}\}_{t=1}^{T-1}$;
  - wage function, $\{w_t^q(z,\ell)\}_{t=1}^{T-1}$;
  - measure of entrant firms, $\{N_{e,t}\}_{t=1}^{T-1}$;
  - aggregate price index, $\{P_t\}_{t=1}^{T-1}$.

- update these guesses until convergence so to be consistent with a number of equilibrium conditions. In the specific, along the transition path:

Numerical algorithm back

- guesses for domestic sales, $\{D_{h,t}\}_{t=1}^{T-1}$, are updated until convergence *period by period backward*, so to ensure that the firm entry condition holds at any t;

- guesses for industrial wages, $\{w_t^q(z, \ell)\}_{t=1}^{T-1}$, are updated until convergence *period by period backward*, using the closed form solutions available;

- guesses for the measure of entrant firms, $\{N_{e,t}\}_{t=1}^{T-1}$, are updated until convergence *period by period forward*, so to ensure that supply and demand in the service sector are equal at any period t;

- guesses for the probability of filling a vacancy, $\{\phi_t\}_{t=1}^{T-1}$, are updated *after simulating forward*, to ensure equilibrium in the labor market of the industrial sector in any period t;

- guesses for the aggregate price index, $\{P_t\}_{t=1}^{T-1}$, are updated *after simulating forward*, to ensure that product market clears any period t;

- once convergence is achieved, use the equilibrium condition in the foreign market to back up the unique sequence of exchange rates, $\{k_t\}_{t=1}^{T-1}$ that ensures trade balance, for an exogenous series of iceberg costs and tariffs, , $\{\tau_{c,t}, \tau_{a,t}\}_{t=1}^{T-1}$.
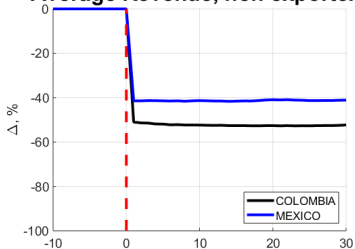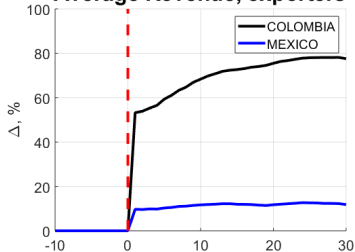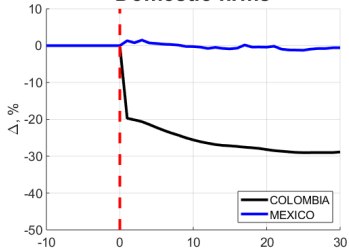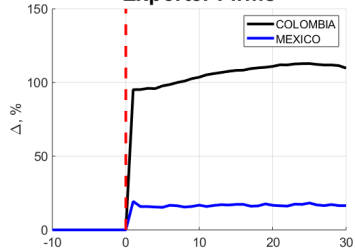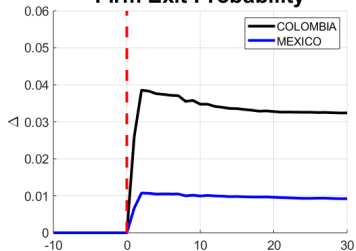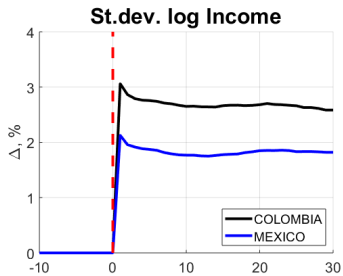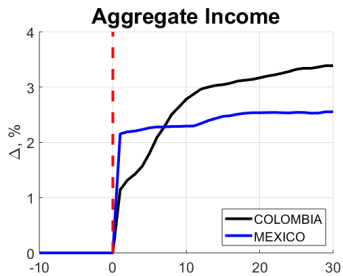
Firm Exit Probability, Aggregate Vacancy, Average Firm Size non exporters, Average Firm Size exporters — COLOMBIA and MEXICO
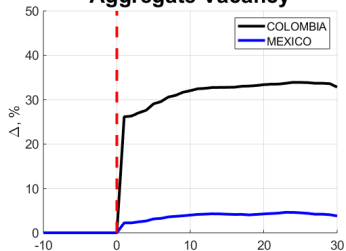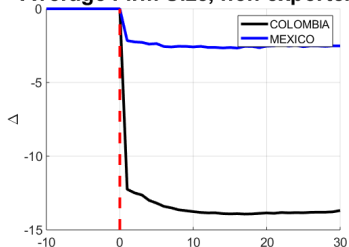
Role of labor market institutions
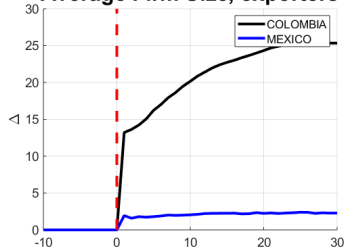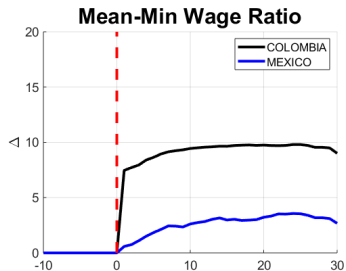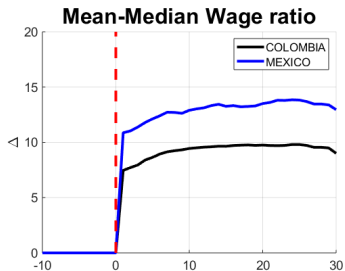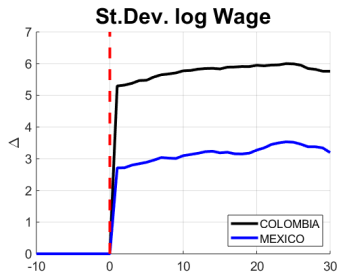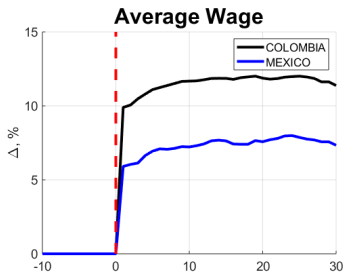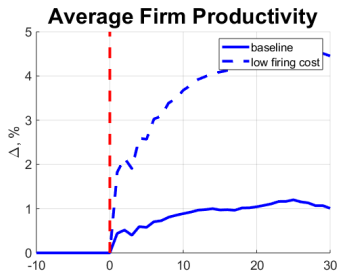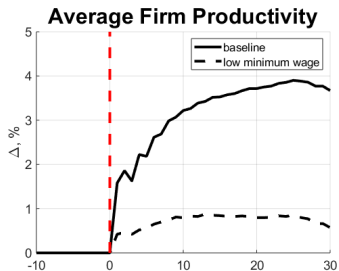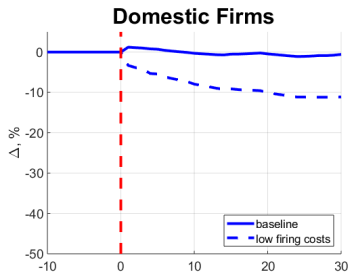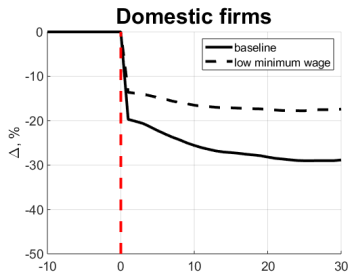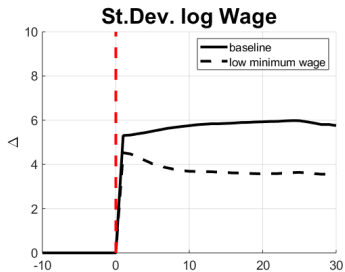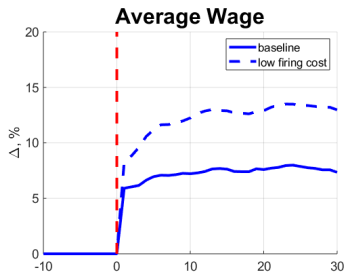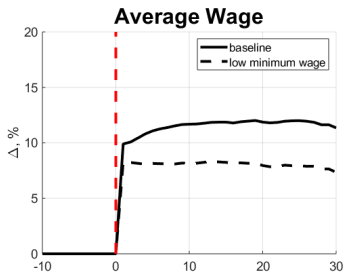
Welfare gains vs unemployment rate `back`