Import Competition and Employment Dynamics

Hâle Utar

University of Colorado, Boulder

May 15, 2008

Objective

- Develop and estimate an industry dynamics model with monopolistic competition:
- Quantify the 'deep parameters' of the industry that affects firms adjustment to trade policies
- Describe responses to intensified import competition in terms of:
  1. job creation and destruction patterns
  2. productivity distributions
  3. entry and exit patterns
- isolate the roles of different macro environments and labor regulations

- To characterize effects of openness on intra-industry reallocations, we need to account for:
  - Labor market frictions — policy induced and others
  - Expectations on macroeconomic conditions, such as the possibility of regime change
  - Dynamic responses of firms, including entry/exit decisions

Methodology

- develop an industrial evolution model under monopolistic competition and aggregate uncertainty
- fit the model to plant-level panel data and macro data from Colombia
- obtain estimates of,
  - firing costs
  - the sunk cost of creating a new business
  - fixed per period cost
- simulate industrial evolution patterns under alternative assumptions about trade regimes and labor market frictions

Methodology

- develop an industrial evolution model under monopolistic competition and aggregate uncertainty
- fit the model to plant-level panel data and macro data from Colombia
- obtain estimates of,
  - firing costs
  - the sunk cost of creating a new business
  - fixed per period cost
- simulate industrial evolution patterns under alternative assumptions about trade regimes and labor market frictions

Methodology

- develop an industrial evolution model under monopolistic competition and aggregate uncertainty
- fit the model to plant-level panel data and macro data from Colombia
- obtain estimates of,
  - firing costs
  - the sunk cost of creating a new business
  - fixed per period cost
- simulate industrial evolution patterns under alternative assumptions about trade regimes and labor market frictions

Methodology

- develop an industrial evolution model under monopolistic competition and aggregate uncertainty
- fit the model to plant-level panel data and macro data from Colombia
- obtain estimates of,
  - firing costs
  - the sunk cost of creating a new business
  - fixed per period cost
- simulate industrial evolution patterns under alternative assumptions about trade regimes and labor market frictions

Simulation Experiments–Results

- Simulation experiments quantify
  - short-run response of industry to heightened import competition
    - 18 percent reduction in total employment
    - 15 percent reduction in mean firm size
    - 11 percent reduction in the number of operating plants
    - 19 percent increase in labor productivity
    - 8 percent increase in 'technical' productivity
  - role of severance payments
  - role of macro environment
- Industry-wide environments
  - stochastic process for the real exchange rate and wages
  - tariff policy

Simulation Experiments–Results

- Simulation experiments quantify
  - short-run response of industry to heightened import competition
    - 18 percent reduction in total employment
    - 15 percent reduction in mean firm size
    - 11 percent reduction in the number of operating plants
    - 19 percent increase in labor productivity
    - 8 percent increase in 'technical' productivity
  - role of severance payments
  - role of macro environment
- Industry-wide environments
  - stochastic process for the real exchange rate and wages
  - tariff policy

Simulation Experiments–Results

- Simulation experiments quantify
  - short-run response of industry to heightened import competition
    - 18 percent reduction in total employment
    - 15 percent reduction in mean firm size
    - 11 percent reduction in the number of operating plants
    - 19 percent increase in labor productivity
    - 8 percent increase in 'technical' productivity
  - role of severance payments
  - role of macro environment
- Industry-wide environments
  - stochastic process for the real exchange rate and wages
  - tariff policy

Simulation Experiments–Results

- Simulation experiments quantify
  - short-run response of industry to heightened import competition
    - 18 percent reduction in total employment
    - 15 percent reduction in mean firm size
    - 11 percent reduction in the number of operating plants
    - 19 percent increase in labor productivity
    - 8 percent increase in 'technical' productivity
  - role of severance payments
  - role of macro environment
- Industry-wide environments
  - stochastic process for the real exchange rate and wages
  - tariff policy

Simulation Experiments–Results

- Simulation experiments quantify
  - short-run response of industry to heightened import competition
    - 18 percent reduction in total employment
    - 15 percent reduction in mean firm size
    - 11 percent reduction in the number of operating plants
    - 19 percent increase in labor productivity
    - 8 percent increase in 'technical' productivity
  - role of severance payments
  - role of macro environment
- Industry-wide environments
  - stochastic process for the real exchange rate and wages
  - tariff policy

Why Colombia?

- Open, developing economy
- Change in policy regime (tariff, exchange rate, labor)
- Volatility & Policy Reversal
- Detailed plant-level panel data (77-91), macroeconomic data (77-98)

Why Metal Products Industry?

- Moderate to small scale producers (approximately 160 enterprises)
- High entry and exit rate — 22% and 21%
- High Import-Penetration Ratio — above 25%
- Insignificant Export-Orientation — 6%

Basic Features of the Model

- Monopolistically competitive product market

Basic Features of the Model

- Monopolistically competitive product market
- Small, open industry — firms take prices of imported varieties and wages as given

Basic Features of the Model

- Monopolistically competitive product market
- Small, open industry — firms take prices of imported varieties and wages as given
- Heterogeneous firms in terms of productivity produce uniquely differentiated varieties

Basic Features of the Model

- Monopolistically competitive product market
- Small, open industry — firms take prices of imported varieties and wages as given
- Heterogeneous firms in terms of productivity produce uniquely differentiated varieties
- Changing the level of employment requires adjustment costs

Basic Features of the Model

- Monopolistically competitive product market
- Small, open industry — firms take prices of imported varieties and wages as given
- Heterogeneous firms in terms of productivity produce uniquely differentiated varieties
- Changing the level of employment requires adjustment costs
- Starting up a business is costly and so is closing down

Environment

- Infinite Horizon – Discrete Time Model
- Two Types of Firms:
  - Incumbents
    - Production and Exit decision
  - Potential Entrants
    - Entry and initial size decision
- State of the Industry: Distribution of firms on employment and productivity, Γ_t.

Demand System

Demand System

- quasi-linear preferences on horizontally differentiated products, domestic or imported.
-
$$U(q_o, q_1, q_2, .., q_N) = q_o + \alpha \sum_{i=1}^{N} q_i - \frac{1}{2}\gamma \sum_{i=1}^{N} q_i^2 - \frac{1}{2}\eta(\sum_{i=1}^{N} q_i)^2$$
-
$$q_i = (\frac{\alpha}{\eta N + \gamma} - \frac{1}{\gamma}p_i + \frac{\eta N}{\eta N + \gamma}\frac{1}{\gamma}\overline{P})$$

Demand System

$$\overline{P}_t = \frac{N_{D,t}\overline{P}_{D,t} + N_{F,t}\overline{P}_{F,t}}{N_{D,t} + N_{F,t}}$$

where

- $\overline{P}_{D,t}$ denotes the average price among the domestic varieties;
- $\overline{P}_{F,t}$ denotes the average price of imported varieties, determined by the exchange rate and tariffs;
- $N_{D,t}$ and $N_{F,t}$ are the number of domestic and foreign varieties, respectively.

Production

- $$q_{it} = e^{\mu_{it}} l_{it}^{\theta}, \quad 0 < \theta \leq 1$$

- $$\mu_{it} = a_0 + a_1 \mu_{it-1} + \varepsilon_{\mu}, \qquad \varepsilon_{\mu} \sim N(0, \sigma_{\mu}^2)$$

- The transition density for the firm specific productivity is denoted by $M(\mu_{it+1}|\mu_{it})$.

Costs

- Firms are price takers in the factor market, and wages are denoted by w_t.
- Firing costs, c_f per dismissed employee.
- Fixed per period costs, f.

Exogenous Aggregate Shocks

- Average imported prices, $\overline{P}_{F,t}$
- The number of imported varieties, $N_{F,t}$
- Wages, w_t

$s_t = (\overline{P}_{F,t}, w_t)$ evolves according to a first order Markov Process with transition density $\Phi(s_{t+1}|s_t)$.
$N_{F,t} = \overline{N}_F + \epsilon_t$, with $\epsilon_t \sim N(0, \sigma_\epsilon^2)$

Incumbents' Decision Problem

- Incumbents' Problem is to choose labor and whether to exit or continue next period

$$V(\mu_{it}, l_{it-1}; \Gamma_t, s_t) = \max_{l_{it}} P_i(\Gamma_t, l_{it}, \mu_{it}) e^{\mu_{it}} l_{it}^{\theta} - w_t l_{it} - c(l_{it}, l_{it-1}) - f$$
$$+\beta \max(EV(\mu_{it+1}, l_{it}; \Gamma_{t+1}, s_{t+1} | \mu_{it}, s_t), -c(0, l_{it}) + x(l_{it}))$$

subject to

$$\Gamma_{t+1} = H(\Gamma_t, s_{t+1}),$$

and

$$c(l_{it}, l_{it-1}) \quad = \quad Max\{0, c_f(l_{it-1} - l_{it})\},$$

where $P_i(\Gamma_t, l_{it}, \mu_{it})$ is the inverse demand function.

Potential Entrants' Decision Problem

- Potential entrants draw entry costs, F, from a commonly known distribution, Ψ
- They choose to start-up a business or stay out.

$$V^E(\Gamma_t, s_t|M_0) = \beta EV(\mu_{i,t+1}, 0; \Gamma_{t+1}, s_{t+1})$$

subject to

$$\Gamma_{t+1} = H(\Gamma_t, s_{t+1})$$

where M_0 is the productivity distribution for potential entrants.

- They enter if the value of entering is higher than the cost associated with starting up a business, $V^E(\Gamma_t, s_t|M_0) > F$.

Decision Rules

- The optimization problems will generate policy functions,
  - one for employment, $l_{it} = e(\mu_{it}, l_{it-1}; \Gamma_t, s_t)$
  - one for exit,

$$\chi(\mu_{it}, l_{it-1}; \Gamma_t, s_{t+1}) = \begin{cases} 0 & \text{if} \quad EV > -c(0, l_{it}) + x(l_{it}) \\ 1 & \text{otherwise} \end{cases}$$

  - one for entry rule for potential entrants, EN_t.

Equilibrium

Given transition densities for firm specific productivity M, M_0, for exogenous aggregate shocks,Φ, for the distribution of firms, H, and the distribution of entry costs,Ψ, an equilibrium is a value function V for incumbents, a value function V^E for potential entrants, and a set of decision rules $e(.)$, $\chi(.)$ and EN_t such that

1. Given M, Φ, and H each incumbent solves her decision problem and the resulting decision rules are given by $e(.)$ and $\chi(.)$.
2. Given V, M_0 and H, V^E characterizes the problem of potential entrants.
3. H is consistent with firm's optimal decision rules.

Estimation Methodology

- Solving the model (Krusell and Smith,1998)
  - Profits depend on $[\overline{P}_t, N_t]$, which depends on $[\Gamma_t, s_t]$
  - So agents use $\Gamma_{t+1} = H(\Gamma_t, s_t)$ to solve the optimization problem
  - But an agent who knows $[\overline{P}_t, N_t]$ process behaves the same as an agent who knows Γ_t process
  - Approximate H with $\widetilde{H}(m_t, s_t)$ where $m_t = [\overline{P}_{D,t}, N_{D,t}]$.

Estimation Methodology

- The law of motion for average price

$$\ln \overline{P}_{D,t+1} = a_0 + a_1 \ln \overline{P}_{D,t} + a_2 \ln N_{D,t} + a_3 \ln \overline{P}_{F,t+1} + a_4 \ln w_{t+1}$$

  - $R^2 = 0.9725$

- The law of motion for the second moment, number of operating firms,

$$\ln N_{D,t+1} = b_0 + b_1 \ln \overline{P}_{D,t} + b_2 \ln N_{D,t} + b_3 \ln \overline{P}_{F,t+1} + b_4 \ln w_{t+1}$$

  - $R^2 = 0.9709$

Estimation of Aggregate Shock Processes

- Using Data between 1980-1998
- The Markov Switching VAR:

$$s_t = \beta_o^r + \beta_1^r s_{t-1} + \epsilon_t^r$$

where $E(\epsilon_t^r \epsilon_t^{r'}) = \Sigma^r$.Switches between regimes are governed by the transition matrix

$$\Pi = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix},$$

where p_{ij}, $i \in \{1, 2\}$ is the probability of moving to regime j, given that the economy is currently in regime i.

Regime Switching VAR Processes

	Wage	Price
Intercept β_0^1(regime 1)	1.9229 (0.3296)	0.4470 (0.1493)
Intercept β_0^2 (regime 2)	0.0520 (0.1520)	-0.8942 (0.5112)
AR coefficients β_1^1 (regime 1)	0.5131 (0.0819)	-0.0847 (0.0376)
	-0.0149 (0.0083)	0.9700 (0.0037)
AR coefficients β_1^2 (regime 2)	0.9905 (0.0410)	0.2892 (0.1377)
	-0.0035 (0.0050)	0.9538 (0.0175)
Covariance matrix Σ^1(regime 1)	4.5240e-4	-1.5667e-5
	-1.5667e-5	9.5084e-5
Covariance matrix Σ^2 (regime 2)	1.2329e-4	6.0883e-5
	6.0883e-5	1.5470e-3
Switching probabilities Π	0.9842	0.0158
	0.0185	0.9815

Estimation of Structural Parameters

- Embed the dynamic model in a method of moments estimator
- Choose the set of parameters, $\delta = (F_H, f, c_f, x, \alpha, \eta, \gamma, N_f, a_0, a_1, \sigma_\mu^2, z, \theta)$ that minimizes a measure of distance between moments implied by model simulations and their sample counterparts, i.e.

$$X(\delta) = (\mathbf{d} - \mathbf{m}(\delta))' W (\mathbf{d} - \mathbf{m}(\delta))$$

  - $\mathbf{d}$: moments based on industry data
  - $\mathbf{m}$: simulated moments based on model
  - W : matrix of weights

Model Fit

	Simulated Moments	Sample Moments
Expected Value of Labor	3.111	3.094
Variance of Log Labor	0.7658	1.060
Expected Value of Log Operating Profit	6.9598	6.968
Variance of Log Operating Profit	2.4907	2.3630
Expected Growth in Labor	0.0150	-0.0140
Variance of Growth in Labor	0.1049	0.0860
Expected Entry Rate	0.1633	0.2110
Expected Exit Rate	0.1641	0.2200
Variance of Entry Rate	0.0042	0.0110
Variance of Exit Rate	0.0072	0.0140

Model Fit

	Simulated Moments	Sample Moments
Covariance Log Labor and Lagged Log Labor	1.0613	0.9874
Covariance Log Labor and Log Profit	1.2178	1.1846
Covariance Labor Growth and Log Profit	-0.035	0.020
Covariance Labor Growth and Log Labor	-0.0923	0.048
Expected Log Number of Firms	5.0777	5.016
Variance of Log Firms	0.0408	0.0330
Expected % of Firms with No Change in Labor	0.240	0.230
Expected Import Penetration Rate	0.5189	0.2540
Expected Job Creation Rate Through Entry	0.0883	0.0850
Expected Job Destruction Rate Through Exit	-0.0614	-0.1040

Estimation Results

- Cost Parameters

	Parameters		Standard Errors
Sunk Entry Cost F_H	7370*	(100,218)	97.1423
Fixed Cost, f	1032*	(28,066)	7.6165
Scrap Value, x	45*	(1,223)	5.2782
Firing Cost, c_f	23.69*	(644)	0.4193

*In thousand 1977 peso. (1977 USD)

Simulation Experiments

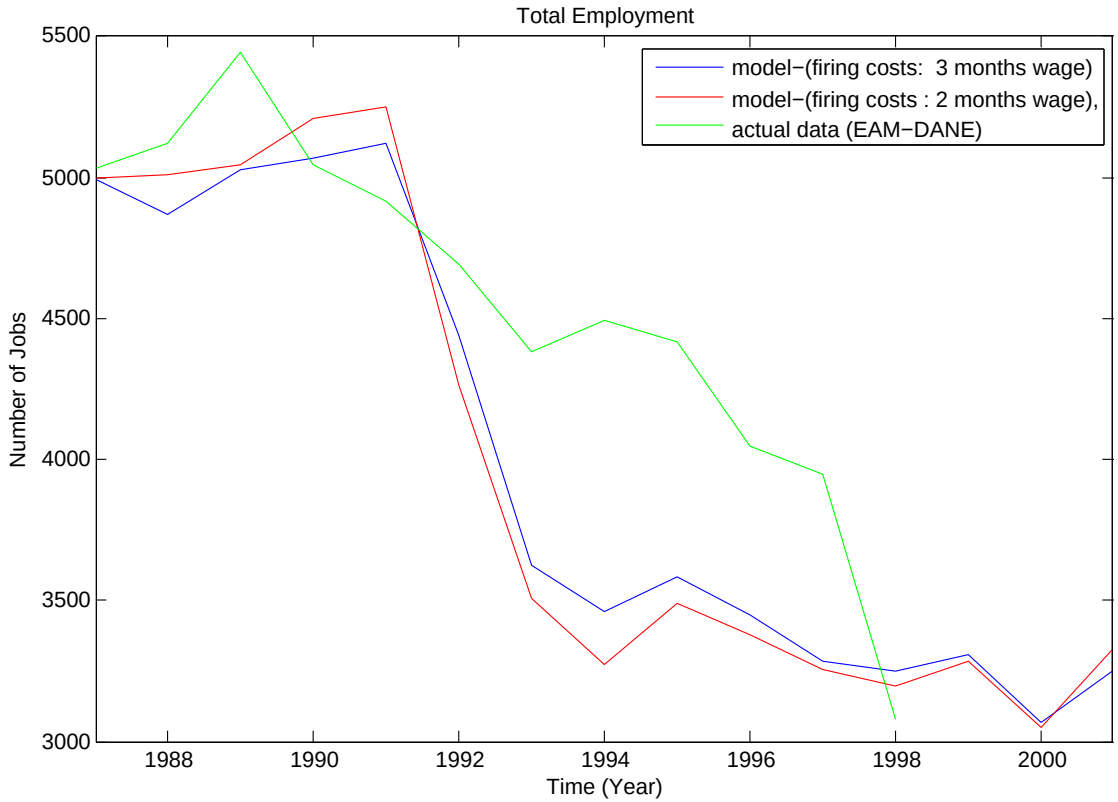
1. Using the two identified macro regimes in Markov-Switching VAR estimation, characterize the transition from the relatively closed regime to the low import price regime
2. Characterize the role of severance payments

Simulate the economy over 40 periods with 15 periods burn-in, repeat 40 times and average

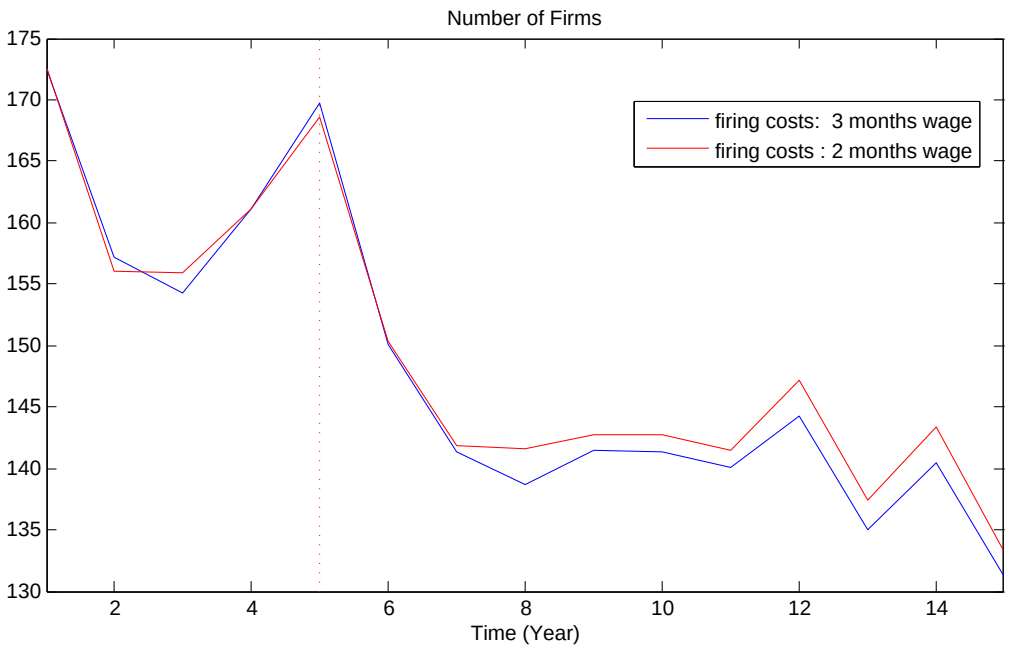
Simulation Results: Short-Run Impact of a Regime Change/Intensified Import Competition

	Relatively Open (Regime 1)	**Relatively Closed** (Regime 2)
Total Employment	3695	4518
Mean Log Operating Profit	6.8725	7.0789
Variance Log O. Profit	1.6749	2.7942
Mean Log Size	2.9617	3.1099
Variance Log Size	0.6427	0.9036
Mean Demand Elasticity	9.1914	11.6248
Mean Productivity, μ	0.7480	0.6689
Mean S-W Productivity	1.1570	1.1526
Mean Number of Firms	140.55	158.03
Mean Entry Rate	0.1518	0.1792

Simulation Results: Transition



Simulation Results: Transition



Simulation Results: Long-Run Impact of Firing Costs

	firing costs (2 months wage)	firing costs (3 months wage)
Mean Log Size	3.0602	3.0415
Mean Profit	7.3277	6.9877
Mean Number of Firms	150.54	147.10
Mean Total Employment	4179.2	4089.9
Mean S-W Productivity	3.8261	3.7939
Mean Entry Rate	0.1651	0.1637
Mean Exit Rate	0.1694	0.1678
Mean Job Creation	0.1951	0.1575
Mean Job Destruction	-0.1860	-0.1534
Mean Total Layoff Costs	12311†	14959†

†In thousand 1977 pesos.

Concluding Remarks

- Developed and estimated a dynamic structural model with firm heterogeneity and employment frictions
- Established a link between macroeconomic environment and the benefits of openness.
- The response of industry to tariff policy particularly depend on
  - underlying labor market policies
  - associated changes in aggregate environment