The Price of Globalization

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Madrid – September 2019

Motivations

- How does the globalization affect workers?
- Import penetration has been shown to
  - have negative effects on employment and wages (Autor, Dorn, and Hanson 2013, 2016; Caliendo, Dvorkin and Parro 2019)
  - increase labor income risk (Krishna and Senses 2014)
  - increase household debt (Barrot et al 2018)
- Trade liberalization episodes in developing countries are usually associated with higher income inequality (Cosar, Guner and Tybout 2016. Grossman, Helpman and Kirscher 2017; Ruggieri 2019).

Trade and Welfare

- A growing literature in trade tries to understand how openness to trade affects labor markets and inequality
- But nothing on how trade affects workers' welfare
  - existing models abstract from saving and wealth accumulation decisions of workers and precautionary motives
- This is in contrast to heterogeneous agents model in macroeconomics
- Exceptions: Lyon and Waugh (2019)

What do we do

- Build a model of international trade a la Melitz (2003) with search frictions and heterogeneous agents who can save and smooth their consumption
- The model economy features firm level trade, industry dynamics, and search and matching frictions in the labor market
- Direct link between openness and uninsurable idiosyncratic unemployment risk
- Use the model economy to evaluate the welfare effects of trade liberalization
- Evaluate welfare properties of alternative policies supporting trade-displaced workers

Canonical Search and Matching Models

- One worker - one firm
- Abstracts from asset accumulation decisions by workers
- Krusell, Mukoyama and Sahin (2010) and Bils, Chang and Kim (2011) introduce asset accumulation decisions into the standard model
- The asset level of the workers enters into the Nash Bargaining problem between worker and the firm

Canonical Industry Dynamics Models

- Decreasing returns to scale production function and competitive labor markets
- With frictional labor markets, how do split the surplus? Surplus depend how many worker you already have
- In Stole and Zwiebel (1996) large firm model, the firm bargains with each worker treating them as the marginal worker
- Bertola and Caballero (1994) combine industry dynamics with search frictional and Stole-Zwiebel bargaining
- Works well with homogenous workers, the notion of a marginal worker is well defined.

What we need

- Firm revenue function linear in the number of employees - Fajgelbaum (2016)
- Nash Bargaining independent of asset holdings - Preston and Roca (2017)

Model

- Three key features: international trade and firm dynamics a la Melitz, labor market frictions a la DMP, and heterogeneous agents a la Aiyagari-Bewley-Huggett.
- Firms enter the economy with a given productivity level and decide how many workers to hire.
- In contrast to Melitz (2003), firms can't reach their optimal size right away due to search frictions.
- Search frictions create a surplus that has to be split between workers and firms.
- Firms can also loose workers due to exogenous separation shocks and have to post new vacancies to replenish them.
- Once unemployed, workers match with a new firm but that takes time due to search frictions.
- Workers smooth these employment shocks by saving in a safe asset.

Preferences (intratemporal)

- The economy is populated by a unit measure of workers/consumers
- Utility from consumption of a composite good, c:

$$c = \left(\int_{\omega \in \Omega} s(\omega)^{\frac{1}{\sigma}} c(\omega)^{1-\frac{1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1$$

  - $s(\omega)$ and $c(\omega)$ are quality and quantity of variety $\omega \in \Omega$
- Standard expenditure minimization:

$$c(\omega) = s(\omega) p(\omega)^{-\sigma} c$$

  - $p(\omega)$ is the price of variety ω

Preferences (intertemporal)

- Worker-consumers maximize the expected present value of their utility

$$\mathcal{U}_t = \sum_{j=0}^{\infty} \beta^j (1-\delta_w)^j \frac{c_{t+j}^{1-\gamma}}{1-\gamma}$$

  - $\gamma > 1$ is constant relative risk aversion
  - $\beta \in (0,1)$ is a discount factor
  - $\delta_w > 0$ is probability of death/retirement.

Revenues

- Each firm produces and sells $q(\omega)$ units of differentiated variety ω with quality $s(\omega)$
- The demand function for variety ω is:

$$q(\omega) = D(\omega)s(\omega)p(\omega)^{-\sigma}$$

  - $D(\omega)$ is equal to aggregate domestic consumption for non-exported varieties, plus aggregate foreign consumption net of iceberg costs, for exported varieties

$$D(\omega) = D_h + \mathbf{1}^x(\omega)\tau_c^{1-\sigma}D_f$$

    where $\mathbf{1}^x(\omega)$ is an indicator function taking value one if variety ω is exported

- The associated gross revenue function is given by

$$G(\omega) = p(\omega)q(\omega) = D(\omega)^{\frac{1}{\sigma}}s(\omega)^{\frac{1}{\sigma}}q(\omega)^{\frac{\sigma-1}{\sigma}}$$

Technology

- Heterogeneous firm-specific productivity level $z \sim f(z)$ drawn upon entry
- A firm with n worker and productivity level z produces zn
- And decided how to allocated it between quality s and quantity q

$$\max_{\{s,q\}} \quad D^{\frac{1}{\sigma}} s^{\frac{1}{\sigma}} q^{\frac{\sigma-1}{\sigma}} \quad \text{subject to} \quad \frac{1}{\sigma}s + \frac{\sigma-1}{\sigma}q = zn.$$

- Optimal allocation of tasks between producing quantity and quality:

$$s = q$$

- The gross revenue function can be written as a linear function of number of employees:

$$G(z,n) = \begin{cases} D_h^{\frac{1}{\sigma}} zn = g_h(z)n & \text{if} \quad \mathbf{1}^x(z,n) = 0 \\ [D_h + \tau_c^{1-\sigma} D_f]^{\frac{1}{\sigma}} zn = g_f(z)n & \text{if} \quad \mathbf{1}^x(z,n) = 1 \end{cases}$$

Labor Markets

- A firm is a collection of matches (jobs)
- Each firm wants to hire as many workers as possible since revenue function is linear
- The labor market is subject to search frictions
- To hire workers, firms need to post vacancies
- But posting vacancies is costly and matching takes time
- Matches are destroyed because of
  - worker separation, with probability δ_s
  - firm exit, with probability δ_f

Search frictions

- New matches are formed according to a constant return to scale matching function, $m(V, U)$.
- A probability of filling a vacancy for firms, ϕ_f

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

- A probability of finding a job for workers, ϕ_w

$$\phi_w = \phi_f \frac{V}{U}$$

Export Decision

- Exporting implies a per period cost, c^x
- Given its z and n, a firm might not export today but might find it optimal to export in the future
- Upon entry, each firm decide whether to export or not, and conditional on exporting, the optimal timing to export

Value of a filled position

- Consider a job in firm with productivity z filled by a worker with asset a
- Suppose this firm is currently exporting:

$$V(z,0,a) = g_f(z) - w(z,0,a) + \frac{(1-\delta_w)(1-\delta_f)(1-\delta_s)}{1+r} V(z,0,g_a^e(z,0,a))$$

  - If the match survives, the firm is in the same position next period and has the same worker with a new asset level given by $g_a^e(z,0,a)$
- Suppose this firm will start exporting in t periods:

$$V(z,t,a) = g_h(z) - w(z,t,a) + \frac{(1-\delta_w)(1-\delta_f)(1-\delta_s)}{1+r} V(z,t-1,g_a^e(z,t,a))$$

Vacancy Posting Decision

- Firms choose the amount of vacancies $v(z, t)$ to maximize the total value of new hires subject to convex costs

$$\pi(z, t) = \max_{v(z,t) \geq 0} \quad v(z, t)\phi_f \int_{a \in \mathcal{A}} V(z, t, a)\psi_u(a)da - \Gamma(v(z, t))$$

  - $\psi_u(a)$ is the distribution of unemployed workers
  - $\Gamma(v)$ is the vacancy cost $(\Gamma' > 0, \Gamma'' > 0)$

- Optimal number of vacancies is given by

$$v(z, t) = \phi_f \int_{a \in \mathcal{A}} V(z, t, a)\psi_u(a)da$$

Export Decision

- Upon entry, each firm decide whether to export or not, and conditional on exporting, the optimal timing to export.
- Each firm solve the following problem

$$\Pi(z) = \max\{\underbrace{\frac{1+r}{r+\delta_f}[\pi(z,0)-c^x]}_{\text{export right away}},$$

$$\underbrace{\max_{t\geq 1}\sum_{j=0}^{t-1}\left(\frac{1-\delta_f}{1+r}\right)^j \pi(z,j) + \left(\frac{1-\delta_f}{1+r}\right)^t \frac{1+r}{r+\delta_f}[\pi(z,0)-c^x]\}}_{\text{export in } t \text{ periods}}$$

  - c^x denotes the per-period cost of exporting.

Entry

- In general equilibrium, the measure of firms is determined through free entry.
- Firms face an entry cost with flow-equivalent value equal to c^e and expressed in units of the final good, and draw a productivity $z \sim f(z)$.
- Upon learn their type, firms decide whether to immediately exit or to keep operating in the industry.
- The entry condition reads as

$$\int_{z \in \mathcal{Z}} \max\{\Pi(z), 0\} f(z) dz \leq c^e$$

Unemployed Worker

- The value of being unemployed at the end of period reads:

$$J^u(a) = \max_{\{c,a'\}} \frac{c^{1-\gamma}}{1-\gamma} + \beta(1-\delta_w)\left[\phi_w \mathbf{E}J^e(a') + (1-\phi_w)J^u(a')\right],$$

subject to

$$c + a' \leq b + a(1+r)$$

- $\mathbf{E}J^e(a)$ is the expected value of a match with a firm, equal to

$$\mathbf{E}J^e(a') = \sum_{t=0}^{\infty} \int_{z\in\mathcal{Z}} J^e(z,t,a')\psi_v(z,t)dz$$

  - $\psi_v(z,t)$ is the endogenous distribution of vacancies posted by hiring firms with productivity z and exporting in t period

Employed Worker

- The value of being employed at the end of the period in a firm with productivity z and currently exporting:

$$J^e(z,0,a) = \max_{\{c,a'\}} \frac{c^{1-\gamma}}{1-\gamma} + \beta(1-\delta_w)[(\delta_f + (1-\delta_f)\delta_s)J^u(a') + (1-\delta_f)(1-\delta_s)J^e(z,0,a')]$$

subject to

$$c + a' \leq w(z,0,a)(1-\tau_w) + a(1+r)$$

- The value of being employed at the end of the period in a firm with productivity z and exporting in t periods:

$$J^e(z,t,a) = \max_{\{c,a'\}} \frac{c^{1-\gamma}}{1-\gamma} + \beta(1-\delta_w)[(\delta_f + (1-\delta_f)\delta_s)J^u(a') + (1-\delta_f)(1-\delta_s)J^e(z,t-1,a')]$$

subject to

$$c + a' \leq w(z,t,a)(1-\tau_w) + a(1+r)$$

Nash Bargaining

- In each match, the firm and the worker bargain

$$\max_{w(z,t,a)} \quad [J^e(z,t,a) - J^u(a)]^{\zeta}\, V(z,t,a)^{1-\zeta}$$

where $\zeta \in (0,1)$ is the workers′ bargaining power.

- A solution to this problem is implicitly defined by the standard Nash splitting rule

$$(1-\zeta)[J^e(z,t,a) - J^u(a)] = \zeta V(z,t,a) g_c^e(z,t,a)^{-\gamma}(1-\tau_w)$$

Nash Bargaining

- Following Preston and Roca (2007), it can be shown that, for an infinitesimal time interval, the total worker′ surplus collapses to the flow surplus evaluated at the instantaneous marginal utility of consumption

$$J^e(z,t,a) - J^u(a) = g_c^e(z,t,a)^{-\gamma}[w(z,t,a)(1-\tau_w) - b](1-\tau_w)$$

- Using this expression, the wage solution at the interior becomes independent of individual assets

$$w(z,t) = \frac{(1-\zeta)}{1-\tau_w(1-\zeta)} b + \frac{\zeta}{1-\tau_w(1-\zeta)} V(z,t-1)$$
$$w(z,0) = \frac{(1-\zeta)}{1-\tau_w(1-\zeta)} b + \frac{\zeta}{1-\tau_w(1-\zeta)} V(z,0)$$

Unemployment Insurance

- Unemployment Insurance if financed by taxes on workers

$$\tau_w L_e \int_{z\in\mathcal{Z}} \sum_{t=0}^{\infty} \int_{a\in\mathcal{A}} w(z,t,a)\psi_e(z,t,a)dzda = bL_u$$

  - L_e is the measure of workers employed
  - L_u is the measure of workers unemployed
  - $\psi_e(z,t,a)$ is the distribution of employed workers across states.

Calibration

- Model-period is a month and population is normalized to one
- Parameters are calibrated to the period 2001-2005
- PDF for firm-level productivity

$$z \sim \log \mathcal{N}(0, \sigma_z^2), \qquad \sigma_z > 0$$

- Matching function

$$m(V, U) = \frac{VU}{(V^\eta + U^\eta)^{\frac{1}{\eta}}}, \qquad \eta > 0$$

- Vacancy cost function

$$\Gamma(v) = \lambda_1 \frac{v^{\lambda_2}}{\lambda_2}, \qquad \lambda_1, \lambda_2 > 0$$

Calibration

Parameters taken from literature

Parameters	Description	Value	Source
σ	Elasticity of substitutions	2.98	Eaton et al. (2013)
ζ	Workers' bargaining power	0.5	Pissarides (2009)
γ	Workers' risk aversion	1.5	De Nardi (2004)
b	Unemployment transfers	$0.40\overline{w}$	Shimer (2005)
$\underline{A}$	Borrowing constraints	$-\overline{w}$	standard
λ_0	Hiring cost, scalar	1	normalization

Calibration

Calibrated parameters

Parameters	Description	Value	Targets
r	Interest rate	0.0050	annual real return = 6%
δ_f	Firms' exit rate	0.0107	yearly firm entry rate = 12.09%
η	Matching functions	0.6010	market tightness = 0.72
$c_e/\overline{w}$	Entry cost (%)	17.24	monthly U-E rate = 26.56%
$c_x/\overline{w}$	Export cost (%)	413.66	share of exporting firms = 5.1%
$\frac{\tau_c^{1-\sigma} D_f}{D_h}$	Export revenue premium	0.1060	V.A. x emp premium of exporters = 26%
σ_z	Productivity dispersion	0.6536	average firm size = 22.7
λ_1	Hiring cost, convexity	1.8524	share of firms with $\geq$ 200 employees = 0.7%
δ_w	Workers' retirement rate	0.0020	years in labor market = 40
δ_s	Workers' destruction rate	0.0032	average unemployment rate = 5.4%
β	Workers' discount factor	0.9967	median net worth to family earning ratio = 18

Untargeted moments

Firm size distribution

Moment	Model	Data	Source
Firm size - 10th percentile cutoff	23	22	Song et al. (2018)
Firm size - 25th percentile cutoff	29	26	
Firm size - 50th percentile cutoff	46	39	
Firm size - 75th percentile cutoff	83	79	
Firm size - 90th percentile cutoff	143	189	

Untargeted moments

Wage dispersion

Moment	Model	Data	Source
1 - across firms			
log-wage st.dev.	0.242	0.357	Song et al. (2018)
25th pct - 50th pct wage ratio	0.8653	0.5978	
75th pct - 50th pct wage ratio	1.1560	1.4553	
2 - across workers			
log-wage st.dev.	0.254	0.652	Song et al. (2018)
25th pct - 50th pct wage ratio	0.8422	0.5333	
75th pct - 50th pct wage ratio	1.1603	1.7556	
wage C.V.	0.2242	0.35	Hornstein et al. (2011)
mean-min wage ratio	2.4467	2.74	
mean-1st pct. wage ratio	2.1185	2.49	
mean-5th pct. wage ratio	1.8337	1.92	
mean-10th pct. wage ratio	1.5867	1.66	

Untargeted moments

Wealth distribution

Moment	Model	Data	Source
GINI	0.4878	0.78	De Nardi (2004)
Share of wealth - top 10 percentile	0.3314	0.53	
Share of wealth - top 20 percentile	0.5398	0.80	
Share of wealth - top 40 percentile	0.7941	0.93	
Share of wealth - top 60 percentile	0.9350	0.98	
Share of wealth - top 80 percentile	0.9945	1.00	
# no asset, %	8.06	5.8-15.0	

Experiments

- Increase of 100% in export revenue premium, $d_f = \tau_c^{1-\sigma} \frac{D_f}{D_h}$
- Reduction of 30% in cost of exporting, c^x

Counterfactuals

	Baseline	Experiment 1	Experiment 2
d_f (export revenue premium)	10.60	20.00	10.60
c_x (cost of export)	84.13	84.13	58.90
Firm-size distribution			
10th percentile cutoff	23	23	23
25th percentile cutoff	29	27	29
50th percentile cutoff	46	41	46
75th percentile cutoff	83	71	82
90th percentile cutoff	143	130	146
Average firm size	22.7	20.5	22.6
Labor market			
L_u	5.40	4.48	5.31
ϕ_f	0.369	0.310	0.363
ϕ_w	0.266	0.321	0.270

Counterfactuals

	Baseline	Experiment 1	Experiment 2
d_f (export revenue premium)	10.60	20.00	10.60
c_x (cost of export)	84.13	84.13	58.90
Wage distribution			
$\overline{w}$	20.34	22.93	20.47
$\sigma_{\log w}$ (across workers)	0.253	0.271	0.248
$\sigma_{\log w}$ (across firms)	0.242	0.259	0.245
Consumption distribution			
$\overline{C}$	20.41	23.52	20.50
$\sigma_{\log C}$	0.231	0.235	0.227

Counterfactuals

	Baseline	Experiment 1	Experiment 2
d_f (export revenue premium)	10.60	20.00	10.60
c_x (cost of export)	84.13	84.13	58.90
Wealth distribution			
$\overline{A}$	367.29	538.06	347.50
GINI	0.488	0.457	0.463
Share of wealth - top 10 percentile	0.331	0.278	0.303
Share of wealth - top 20 percentile	0.540	0.492	0.512
Share of wealth - top 40 percentile	0.794	0.773	0.781
Share of wealth - top 60 percentile	0.935	0.926	0.932
Share of wealth - top 80 percentile	0.995	0.991	0.995
# no asset, %	8.06	6.12	8.53

Next Steps

- What is the missing piece?
  - endogenous job destruction
  - workers' heterogeneity in skill/education
  - offshoring
- Calibrate more seriously and using only changes in import penetration, ask how well the model predicts changes in wealth distribution
- Consider counterfactual experiments with alternative taxation schemes and trade-displaced worker subsidies