Capital-Reallocation Frictions and Trade Shocks

An extension from Lanteri, Medina and Tan (2023 AEJ:M)

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December 5, 2023

Motivation

This project is based on Lanteri et al. (2023)

- Effects of trade liberalization on domestic production
- Literature focuses on long-run productivity and welfare gains
  - Reallocation of factors, selection
- Pervasive evidence of "frictions" in capital reallocation
- What are short/medium-run effects of import-competition shock on
  - firm dynamics
  - and aggregate productivity?

What we are doing

Model
Household

* The household maximize

$$U_0 \equiv \sum_{t=0}^{\infty} \beta^t (\log C_t - \chi N_t)$$

subject to

$$\int_0^{M_t} p_{jt} c_{jt} = N_t + \Pi_t$$

where

$$C_t = \left(\int_0^{M_t} c_{jt}^{\theta} \, di \right)^{\frac{1}{\theta}}$$

$$P_t = \left(\int_0^{M_t} p_{jt}^{1-\epsilon} \, di \right)^{\frac{1}{1-\epsilon}}$$

Trade Shock and Aggregate Dynamics

- Trade shock is an unexpected change that hits the economy in its stationary equilibrium.
- After the shock, the foreign economy sells varieties $\left[M_t, M_t^F\right]$ in the domestic market at price p_t^F.
- New aggregate demand

$$C_t = \left(\int_0^{M_t} y_{jt}^{\theta} \, dj + \int_{M_t}^{M_t^F} c_{jt}^{\theta} \, dj \right)^{\frac{1}{\theta}}$$

- Goods clearing in international market

$$\int_0^{M_t} Q(i_{jt}) i_{jt} \, di + p_t^F \int_{M_t}^{M_t^F} c_{jt} \, dj = p^X X_t$$

Model

Firms

- Production function

$$y_{jt} = s_{jt} k_{jt}^{\alpha} n_{jt}^{1-\alpha}$$

- Capital accumulation

$$k_{j,t+1} = (1-\delta) k_{jt} + i_{jt}$$

  with marginal cost of investment

$$Q(i_{jt}) = \begin{cases} Q & \text{if } i_{jt} \geq 0 \\ q & \text{if } i_{jt} < 0 \end{cases}$$

  with $Q > q$
- Adjustment cost

$$\gamma(k', k) = \gamma_0 \left[\frac{k_{j,t+1} - k_{j,t}}{k_{jt}} \right]^2 k_{jt}$$

- Continuation cost $f_{jt} \sim G(f; s)$. If exit, recover scrap value

$$(1-\zeta) q (1-\delta) k$$

Model

The firms problem

- Static labor choice:

$$\pi(k,s,Z) \equiv \max_{n} P(Z)C(Z)^{\frac{1}{\epsilon}} s^{\theta} k^{\theta\alpha} n^{\theta(1-\alpha)} - n$$

- Incumbents: If firm continues,

$$V^{c}(k,s,f,Z) = \max_{i,k'} P(Z)^{-1}\left[\pi(k,s,Z) - f - Q(i)i - \gamma(k',k)\right] + \beta \mathbb{E}\left[\frac{C(Z)}{C(Z')} V(k',s',f',Z') \middle| s,Z\right]$$

Model

The firms problem

- If firm exits,

$$V^{x}(k,s,Z)=P(Z)^{-1}(\pi(k,s,Z)+q(1-\zeta)(1-\delta)k-\gamma(0,k))$$

- Value function

$$V(k,s,f,Z)=\max\left\{V^{c}(k,s,f,Z),V^{x}(k,s,Z)\right\}$$

- Entrants: Constant mass of potential entrants draw entry cost f^{e} and initial condition s^{e}

$$P(Z)^{-1}f^{e}\leq\max_{k'}-P(Z)^{-1}Qk'+\beta\mathbb{E}\left[\frac{C(Z)}{C\left(Z'\right)}V\left(k',s',f',Z'\right)\middle|s^{e},z\right]$$

Solving the model

Baseline solve $q < Q$ for some M that clears P

1. Given M, solve trade shock model by varying P
2. Taking the two end points as given, solve for the full transition path

Frictionless solve $q = Q$ by taking in M as given, and clearing the market using P

1. Given M, solve trade shock model by varying P
2. Taking the two end points as given, solve for the full transition path

Go to recursive stationary equilibrium

Peru under Covid

What happened?

* The COVID-19 pandemic in Peru has resulted in 4,520,102 confirmed cases of COVID-19 and 221,564 deaths. The highest death rate in South America
* Curfew. From 2020 to 2022, the government implemented a curfew from 8 pm to 5 am where citizens were not allowed to leave their homes
* Mask mandate

Peru under Covid

Imports

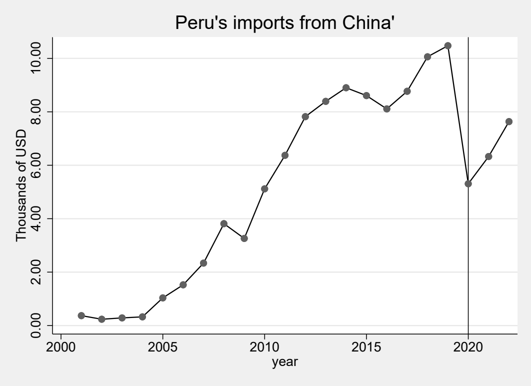


Figure Peru's imports from China. Source: IMF

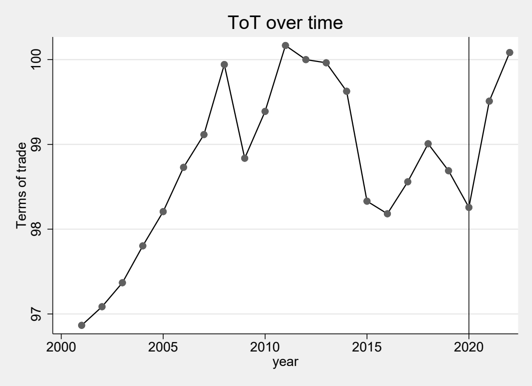


Figure Terms of trade for Peru. ToT $= 100$ at 2012. Source: IMF

Peru under Covid

Entry and exit rate

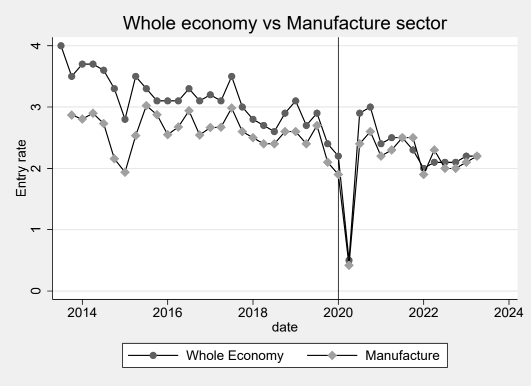


Figure Entry rate of firms for the whole economy and the manufacture sector. Own elaboration. Data source: INEI, Demografía Empresarial

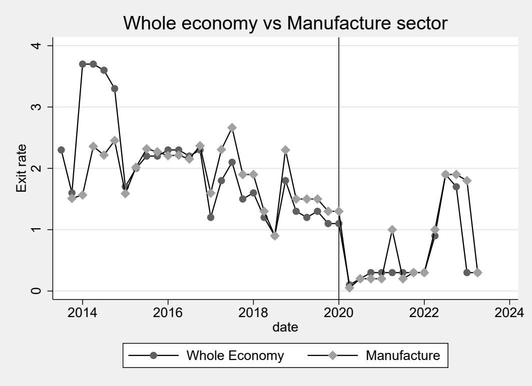


Figure Exit rate of firms for the whole economy and the manufacture sector. Own elaboration. Data source: INEI, Demografía Empresarial

Peru under Covid

Stock of firms

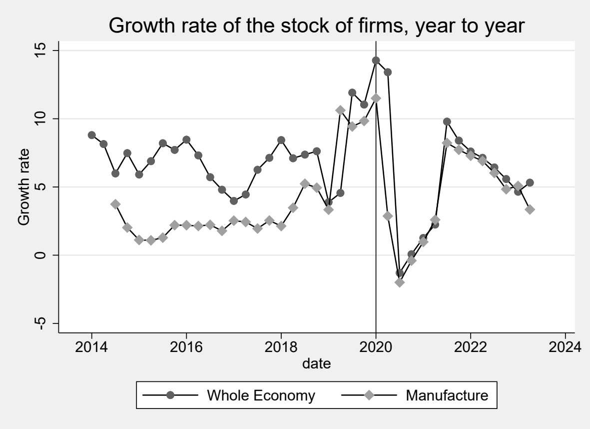
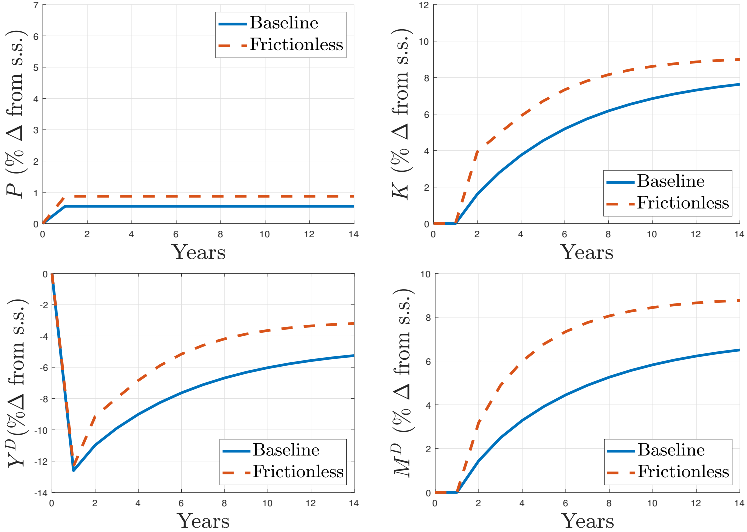


Figure Growth rate year-to-year for the stock of firms in the whole economy and the manufacture sector

Calibration parameters

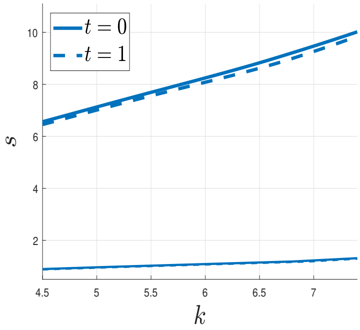
Parameter	Value	Covid values	Target / Source
β	0.96	0.96	Standard, Annually
ϵ	4.00	4.00	Literature
α	0.396	0.396	Capital Share
δ	0.105	0.105	Depreciation Rate
χ	2.08	5.00	Hours worked
M^f	.	reduced by half	International mass of firms
P^f	0.5*P	0.7*P	Import prices
ρ	0.783	0.783	Auto-correlation of ω
σ	0.797	0.797	Standard deviation of ω
$\frac{q}{Q}$	0.567	0.567	Frequency of negative investment
ζ	0.186	0.186	Slope of Exit thresholds
η_1	0.0744	0.0744	Exit Rate
η_2	4.861	4.861	Relative size at exit
η_3	4.864	4.864	Relative productivity at exit

Aggregate responses

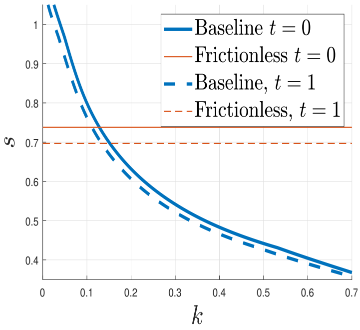


Firms dynamics

- Increasing Price + lower invest threshold = Active investment
- Lower exit threshold -> more active firms



(a) Investment and disinvestment thresholds

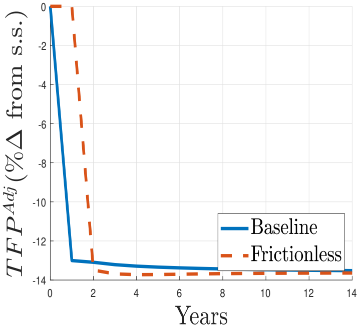


(b) Exit thresholds

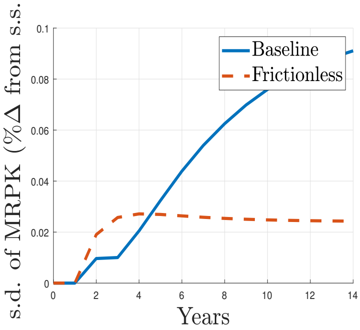
Productivity dynamics

Two indices of productivity:

$$TFP^{adj} = \frac{Y_t^D}{K_t^{\alpha} N_t^{1-\alpha}} \times (M_t^D)^{-\frac{1-\theta}{\theta}} \qquad MRPK_{jt} = \frac{\partial p_{jt} y_{jt}}{\partial k_{jt}} = \alpha\theta \frac{p_{jt} y_{jt}}{k_{jt}}$$



(a) Adjusted Aggregate TFP



(b) Standard deviation of MRPK

Conclusions

* We use a GE model of firm dynamics to study how frictions in reallocation affect the impact from trade shocks
* For the most parts, over the long term, the Covid shock offsets the impact from the previous liberalisation trade shock: Aggregate price slightly increases; Aggregate capital and the mass of firms slowly increase as production bounces back.
* Reallocation frictions greatly impact the transition speed; making MRPK more diverse

References

Lanteri, Andrea, Pamela Medina, and Eugene Tan, "Capital-Reallocation Frictions and Trade Shocks," *American Economic Journal: Macroeconomics*, April 2023, *15* (2), 190–228.

Appendix

Definition of Recursive Stationary Equilibrium

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Recursive Stationary Equilibrium

In a stationary equilibrium, the aggregate state Z is constant. Given exogenous probability distributions (idiosyncratic productivity transition $F(s,s')$ and operation cost $G(f;s)$, a recursive stationary equilibrium is defined as:

* Household's decision for consumption C and labor N ;
* Value functions
$$V(k,s,f), V^x(k,s), V^c(k,s,f)$$
* Firms' decision rules: entry $e(s^e,f)\in\{0,1\}$, initial capital for entrants $k'=g^e(s^e)$, future capital for continuing firms $k'=g(k,s)$, exit $x(k,s,f)\in\{0,1\}$, labor demand $n(k,s)$;
* Aggregate price index P;
* Employment N^X and output X in the commodity sector;
* Equilibrium distributions: producing firms $\lambda(k,s)$, continuing firms $\mu(k,s)$; total measure of producing firms $M=\sum_k\sum_s\lambda(k,s)$;

Definition of Recursive Stationary Equilibrium

Recursive Stationary Equilibrium

such that

- Household's decision rules satisfy the first order condition for labor supply;
- Firms' value functions and decision rules solve the dynamic program
- Output market and labor market clear, that is

$$C = \left(\sum_k \sum_s (sk^{\alpha} n(k,s)^{1-\alpha})^{\theta} \lambda(s,k) \right)^{1/\theta}$$

$$N = \sum_k \sum_s n(k,s)\lambda(s,k) + N^x + \bar{f} + \bar{f}^e$$

- The value of imports, i.e. aggregate domestic investment, equals the value of exports, i.e. commodity output;

$$\sum_k \sum_s Q(i(k,s))i(k,s)\lambda(s,k) = p^x X$$

Definition of Recursive Stationary Equilibrium

Recursive Stationary Equilibrium

- The equilibrium distributions satisfy

$$\mu(k,s) = \sum_k \sum_s \sum_f \lambda(k,s)G(f;s)(1-x(k,s,f))$$

$$\lambda(k,s) = \sum_k \sum_s \mu(k,s)F(s,s')\mathcal{I}(k' = g(k,s))$$

$$+ M^p \sum_{s^e} \sum_f F^e(s^e)G(f;s^e)F(s^e,s')e(s^e,f)I(k' = g^e(s^e)).$$