Capital Controls and Misallocation

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Motivation

- Capital Flows tend to quickly reverse ("sudden stops")
- Volatility in Capital flows is associated to lower productivity measures
- Capital controls are associated to productivity gains in countries with highly developed financial sectors

Data BKS

Flow Volatility affects negatively GDP growth

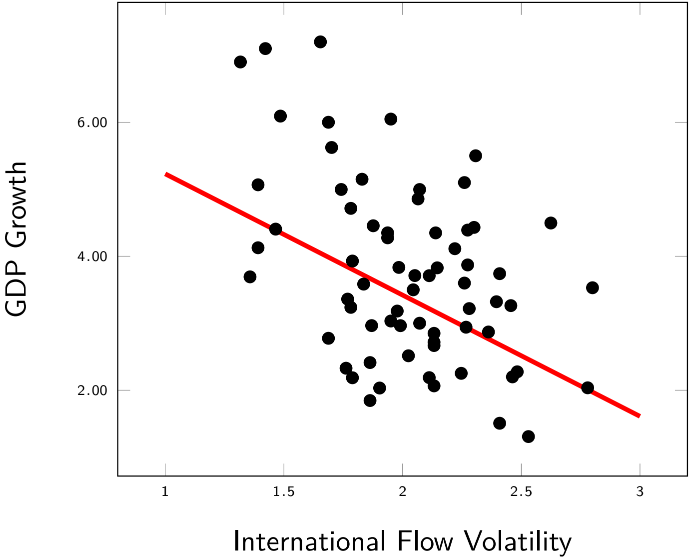


table.

Flow Volatility affects negatively TFP growth

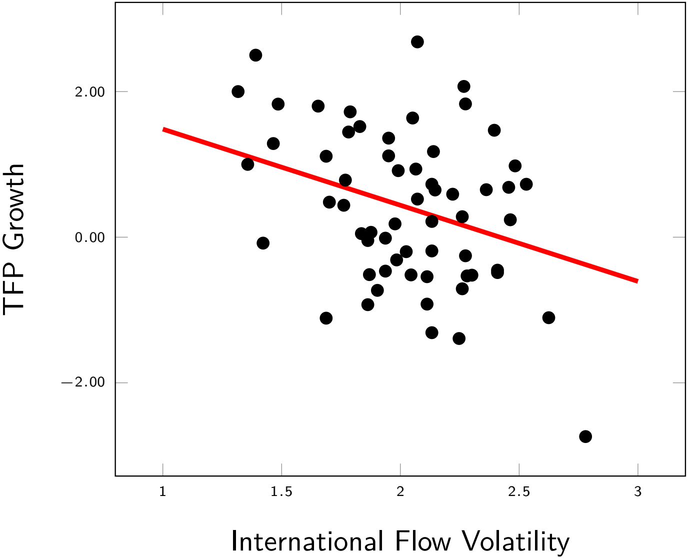
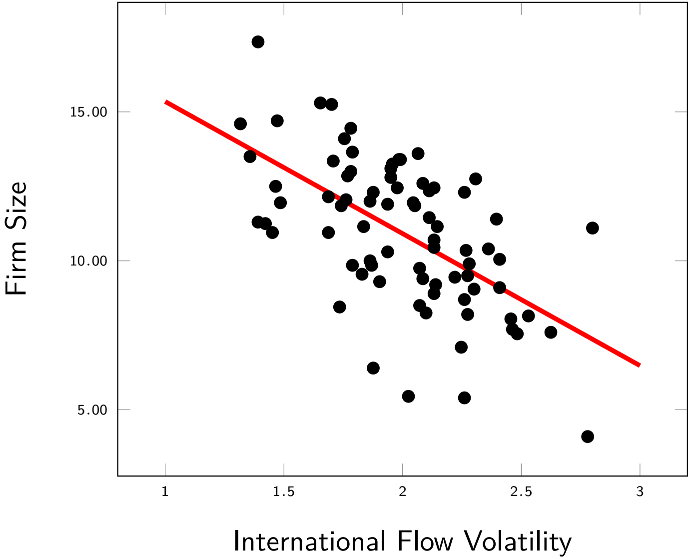


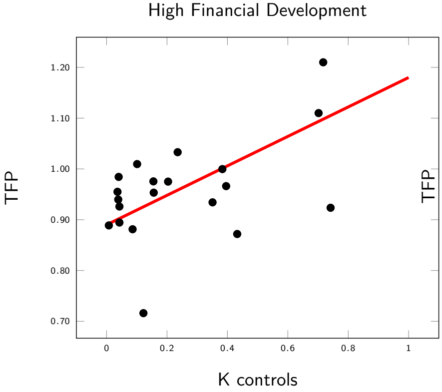
table.

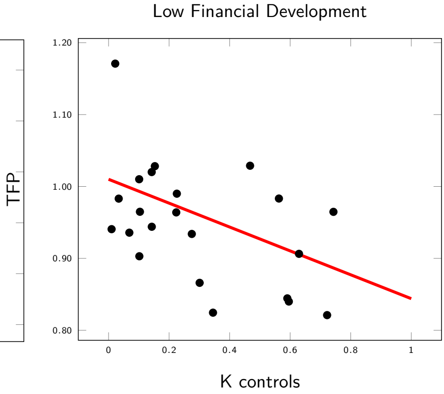
Flow Volatility affects negatively firm size



Firms are smaller in volatile countries

Relationship between K controls and TFP





Research Question

Positive How does volatility arising from the risk of sudden stop affect the misallocation of factors?

Normative (mean-variance tradeoff). Is there scope for a positive capital control, balancing the trade-off of more liquidity versus better liquidity?

Contribution

Simple theory of the interconnection between volatility, financial frictions and productivity.

We build a model of occupational choice, aggregate risk and international investors

We quantify the relationship between volatility and productivity extending Buera, Kaboski and Shin (2011)

We study the role of capital controls and the relationship with financial frictions

Literature Review

Volatility and Growth

- Mostly empirical, non quant
- Ramey and Ramey (1995), Aghion et al (2010)

Overborrowing and Capital Controls

- Exog. TFP, financial externalities
- Schmitt-Grohe & Uribe (2016), Bianchi (2011)

Misallocation.

- Fin. frictions, no international setting or agg. shocks
- Restuccia & Rogerson (2017), Allub & Erosa (2019), *Buera Kaboski & Shin (2011)*

Endogenous productivity in Int macro

- AK models, no risk
- Gornemann (2014), Ates and Saffie (2016), Maliar et al (2008)

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Endogenous productivity in Int macro

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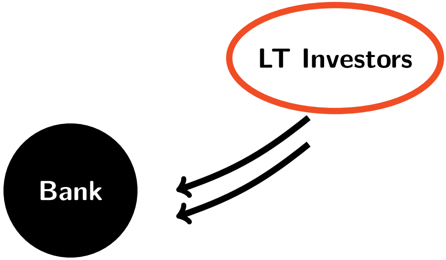
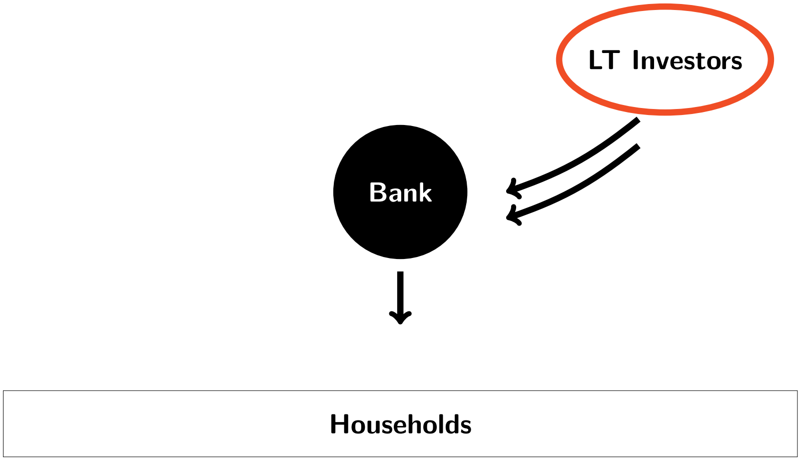
Our paper: Quant, International setting, Misallocation, aggregate risk ex ante.

LT Investors


LT Investors
Bank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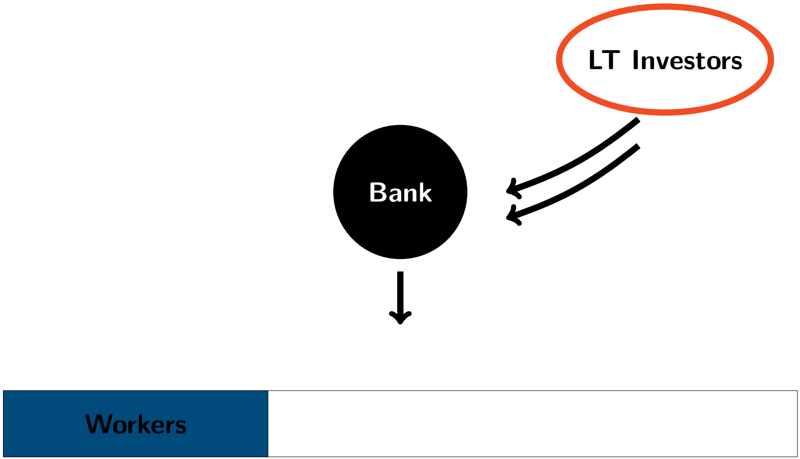
Households


LT Investors
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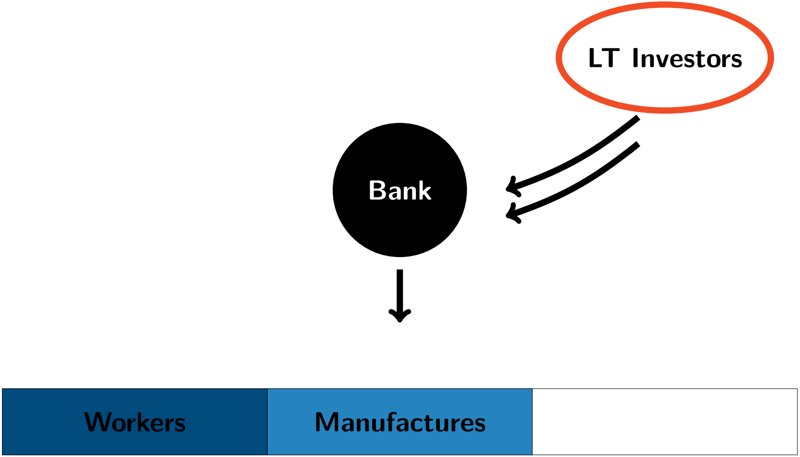
Workers


LT Investors
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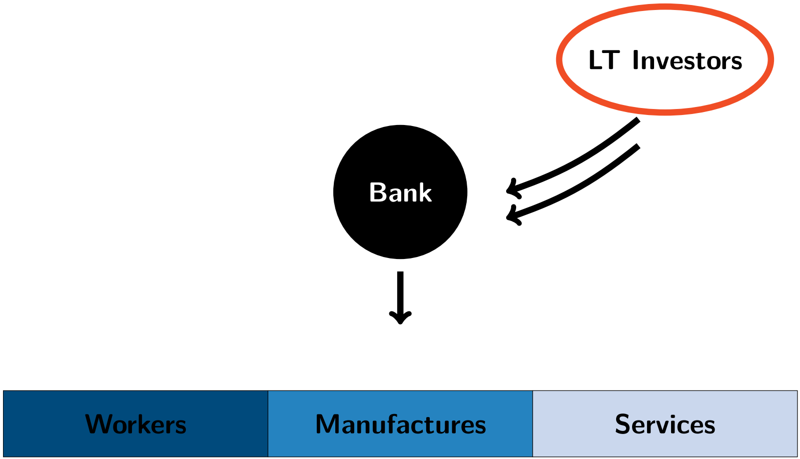
Manufactures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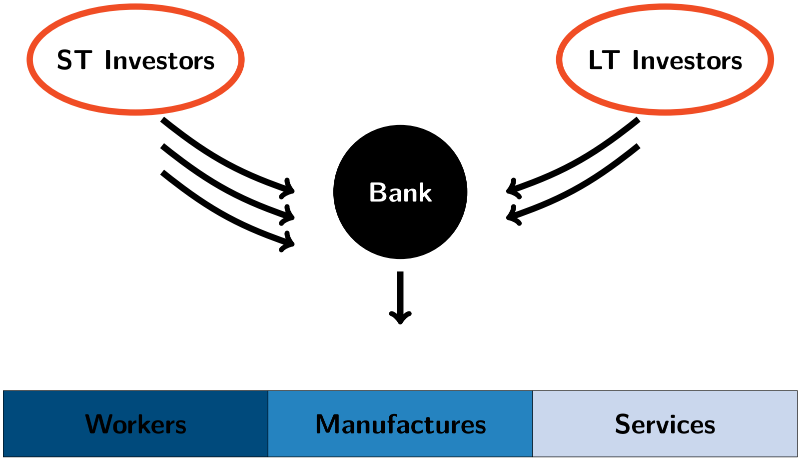
Services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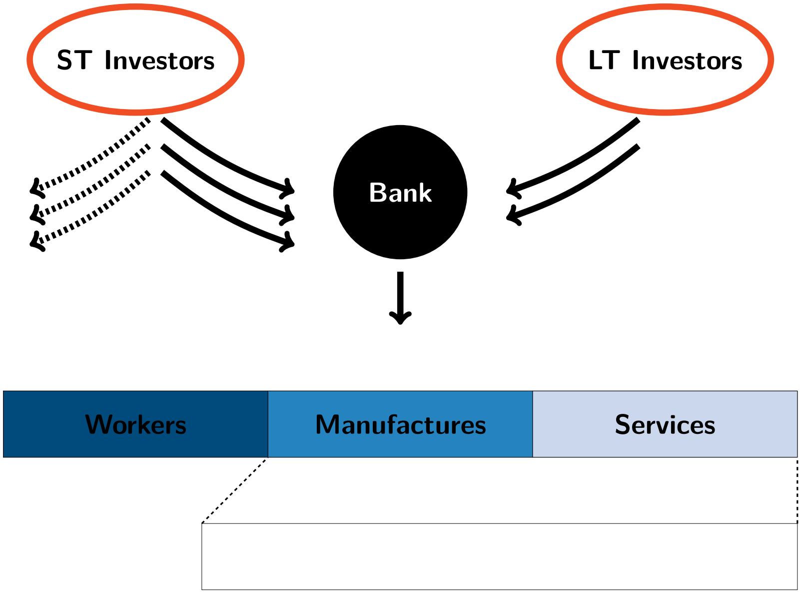
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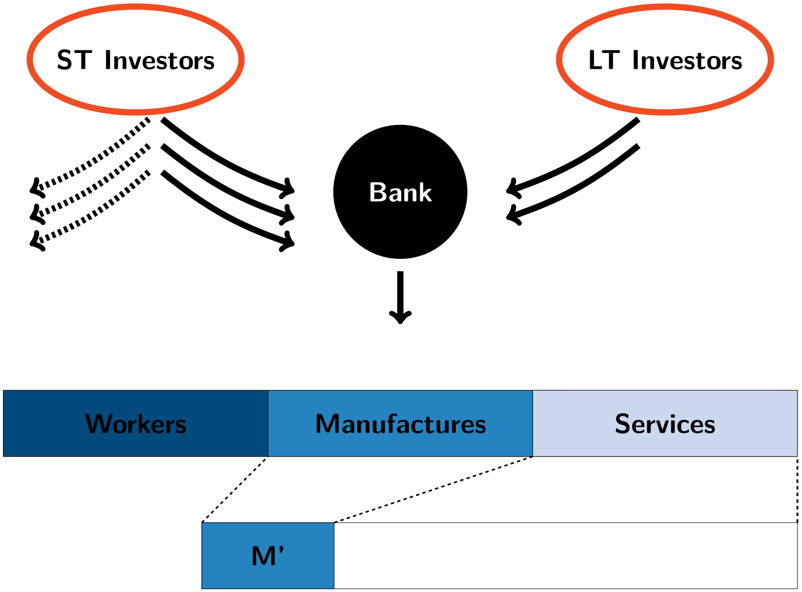
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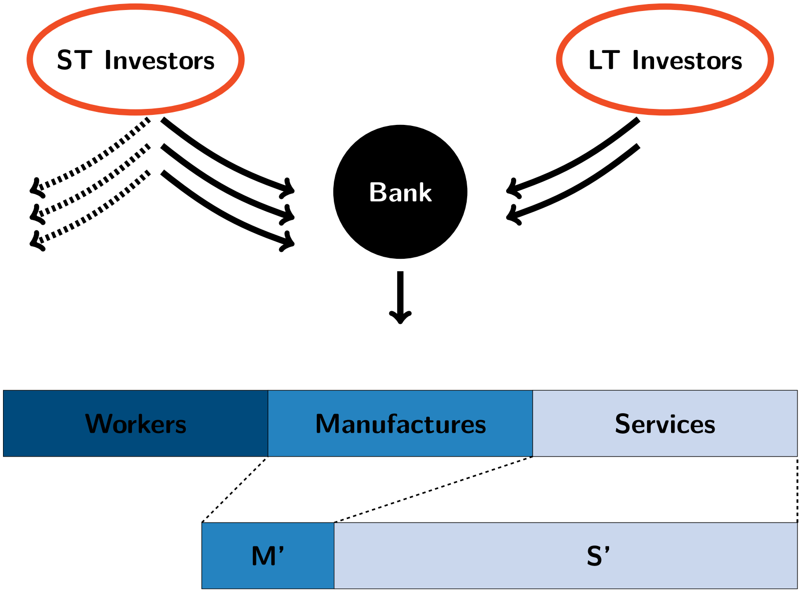
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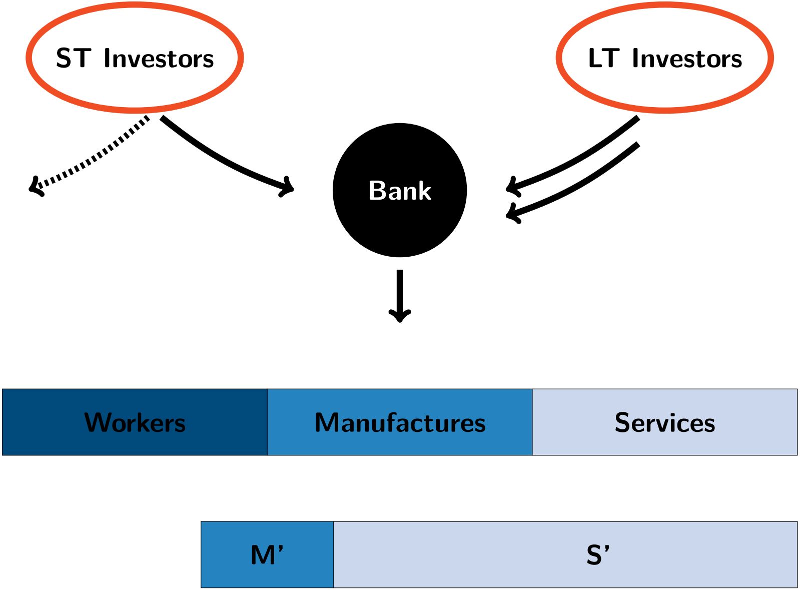
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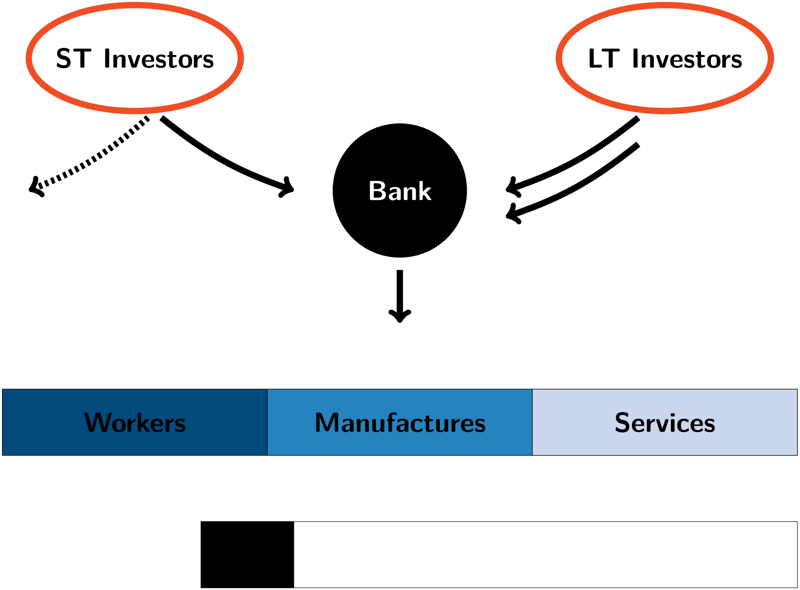
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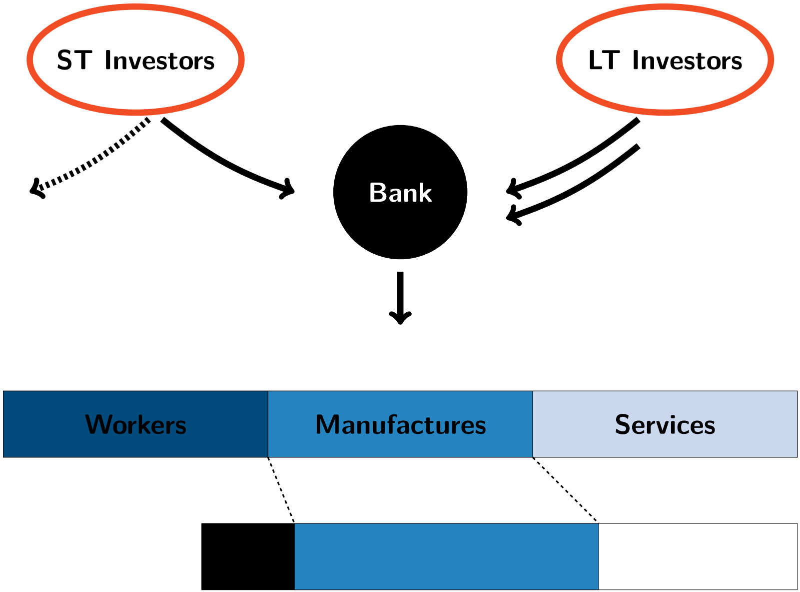
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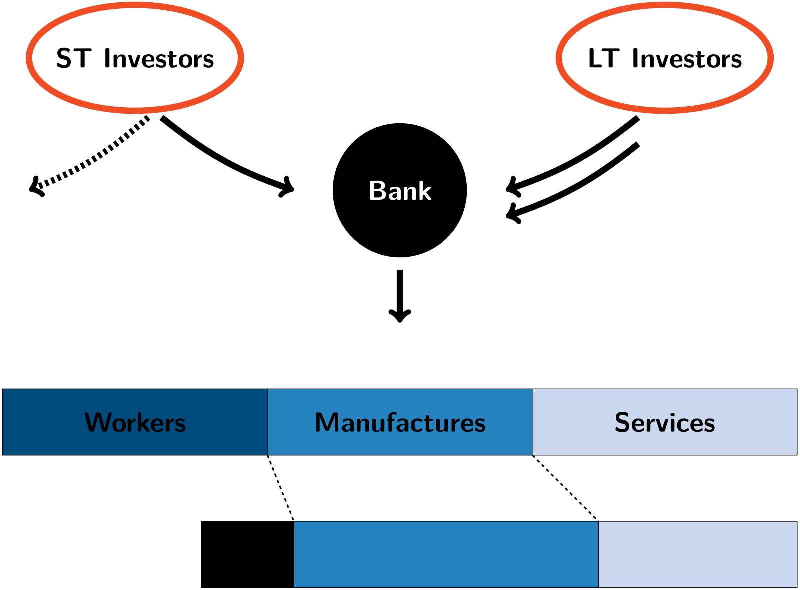
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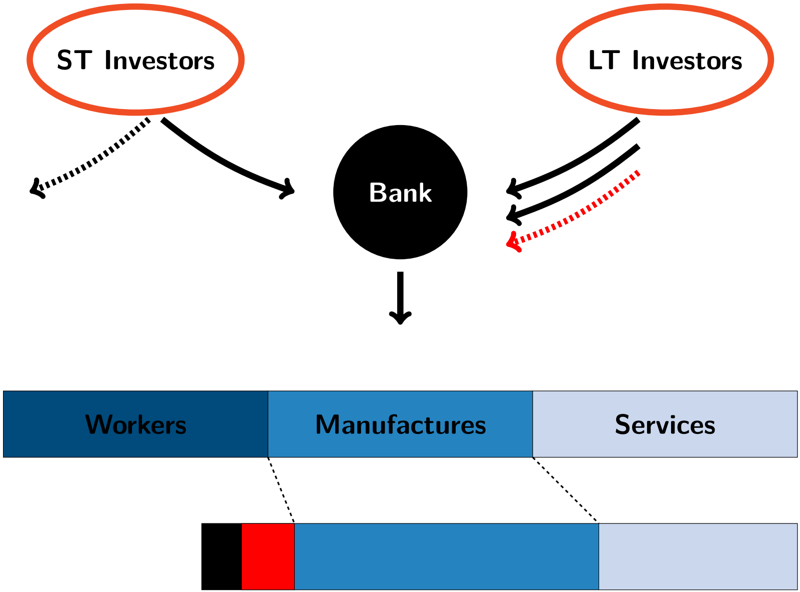

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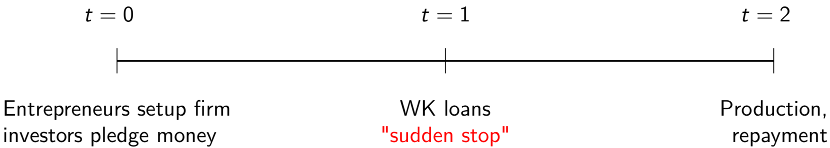
Simple Model



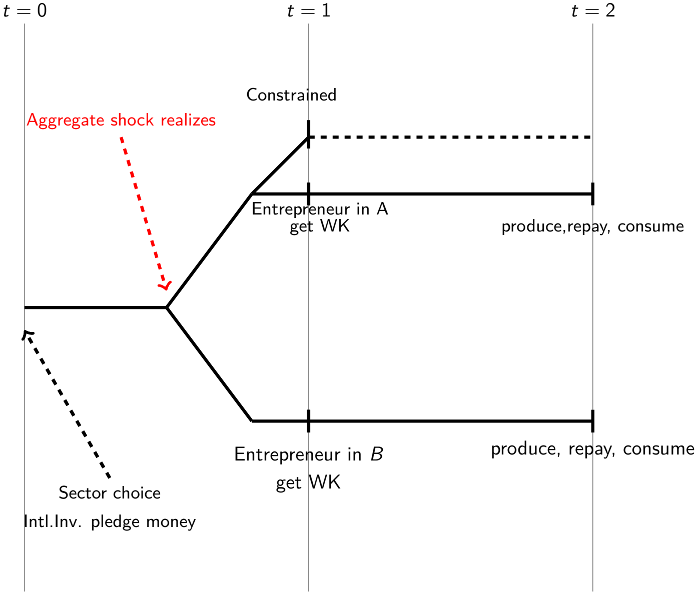
Entrepreneurs
May stay out, or do project A or B, different scales, need wk, random collateral
Het. skills and entry cost, commit to a project.

International Investors
Pledge at $t = 0$, not deep-pocket.
At $t = 0$, heterogeneous opportunity costs
Types: ST (receive r' with prob λ) or LT.

Bank: competitive, pools funds

Workers mass 1, supply labor inelastically

Simple Model



Entrepreneurs: Entry

Consume profits and derive happiness $u(\cdot)$, concave
Skills: $z_j^i \sim f(z_A, z_B)$, for $j \in \{A, B\}$.
Entry cost $c_e^i \sim C(\cdot)$, sunk.

Entry.
Value of entry is,

$$v^e = \int \max \left\{ E_r u \left(\max \left(\pi(z_A^i, r) \right., \pi(z_B^i, r) \right) \right), \underline{u} \right\} f(z_A, z_B) dz_A dz_B, \quad (1)$$

Entrepreneurs: Occupational Choice

Linar tech.: $y_j = z_j n_j$, fixed cost $\kappa_A \geq \kappa_B = 0$.

$$E\pi_A^i = \max_{n_A} E_r \left\{ \left(z_A n_A - w n_A - \kappa_A (1+r) \right) z_A^i, 0 \right\}$$
$$E\pi_B^i = \max_{n_B} \left\{ \left(z_B n_B - w n_B \right) z_B^i, 0 \right\}$$

subject to

$$wn \leq a_0$$
$$\kappa_A (1+r) \leq \phi a^i$$

with $a^i \sim P(\cdot)$, uniform.
Occupational choice

$$\max Eu(\pi) = \max_{A,B} E \left\{ u(\pi_A), u(\pi_B), \underline{u}, \right\}$$

International Investors

Types

- ST: receive r' with prob λ (sudden stop). Must pay τ to do it
- LT, cannot remove the money

Pledge at $t = 0$, not deep-pocket.
Het. opportunity costs $R^i \sim \Gamma^j$, $j \in \{ST, LT\}$

Short Term Investors

$$\Pi^i_{ST} = \max\left\{\lambda(\max\{r' - \tau, r^{SS}\}) + (1-\lambda)r^{NS}, R_0^{*i}\right\}$$

Long Term investors

$$\Pi^i_{LT} = \max\left\{\lambda r^{SS} + (1-\lambda)r^{NS}, R_0^{*i}\right\}$$

Equilibrium

Assumption for Tractability

1. $1 + r' \in [\kappa_A, \frac{\psi a_0(z_A - \phi a_0)}{\kappa_A}]$.
2. $(\Gamma^L)'$ is "small"
3. $\lambda \leq 0.5$

- Ensures all ST investors leave, and
- Project A never makes negative profits
- Long term investor react moderately
- Sudden stop is "rare"

Equilibrium: Entry

Entry

$z_B^i / z_A^i \equiv \tilde{z} \sim H(\tilde{z})$ is a sufficient statistic for the relative project decision

Value of entry is,

$$v^e = \int \max \left\{ E_r u \left(\max \left(\pi(z_A^i, r) , \pi(z_B^i, r) \right) \right\} \right\} f(z_A, z_B) dz_A dz_B, \qquad (2)$$

$$\tilde{z} \propto \frac{u(E\pi_B^i)}{u(E\pi_A^i)} = \frac{u\left(z_B n_B - w n_B\right)}{Eu\left(\left(z_A n_A - w n_A - \kappa(1+r)\right)\right)}$$

Entrants

$$M = C(\tilde{c})$$

Active Entrants

$$M_A = H(\tilde{z}) M(\tilde{c}) P(a^i \geq \frac{1}{\phi} \kappa_A (1+r)) \qquad M_B = \left(1 - H(\tilde{z})\right) M(\tilde{c})$$

Equilibrium

Interest Rates

- There are two interest rates: r^H (prob λ) and r^L (prob $1-\lambda$).
- ST investors never stay under sudden stop
- $r^H \geq r^L$

Funds Market Clearing

$$\Gamma^L\left(\bar{R}^*_{LT}\right)(1+r^H) = \kappa_A M_A(r^H)$$

$$\left(\Gamma^S\left(\bar{R}^*_{ST}\right) + \Gamma^L\left(\bar{R}^{*'}_{LT}\right)\right)(1+r^L) = \kappa_A M_A(r^L)$$

where $\bar{R}^*_{ST} \equiv \lambda(r'-\tau) + (1-\lambda)r^L$ and $\bar{R}^*_{LT} \equiv \lambda r^H + (1-\lambda)r^L$

Equilibrium

Surge pre-sudden stop (liquidity)

An increase in ST increases the mass of entrepreneurs and decreases $\tilde{z}$.

$$\tilde{z} \propto \frac{u(E\pi_B^i)}{u(E\pi_A^i)} = \frac{u\left(z_B n_B - w n_B\right)}{E u\left(\left(z_A n_A - w n_A - \kappa(1+r)\right)\right)}$$

$$M_A = H(\tilde{z})C(\tilde{c})P(a^i \geq \frac{1}{\phi}\kappa_A(1+r))$$

Capital controls

Imposing a capital control of $\tau' = \frac{\kappa_A}{\lambda}$,

1. Increases r^L (decreases liquidity)
2. Decreases $r^H - r^L$ (decreases volatility)

Equilibrium

Liquidity and Productivity

- For low ϕ, a capital control of $\tau' = \frac{\kappa_A}{\lambda}$ decreases productivity
- For high ϕ, a capital control of $\tau' = \frac{\kappa_A}{\lambda}$ increases productivity

Misallocation,

$$\tilde{z} \propto \frac{u(E\pi^i_B)}{u(E\pi^i_A)} = \frac{u\left(z_B n_B - w n_B\right)}{Eu\left((z_A n_A - w n_A - \kappa(1+r))\right)}$$

Liquidity,

$$M_A = H(\tilde{z})C(\tilde{c})P(a^i \geq \frac{1}{\phi}\kappa_A(1+r))$$

Quantitative Model

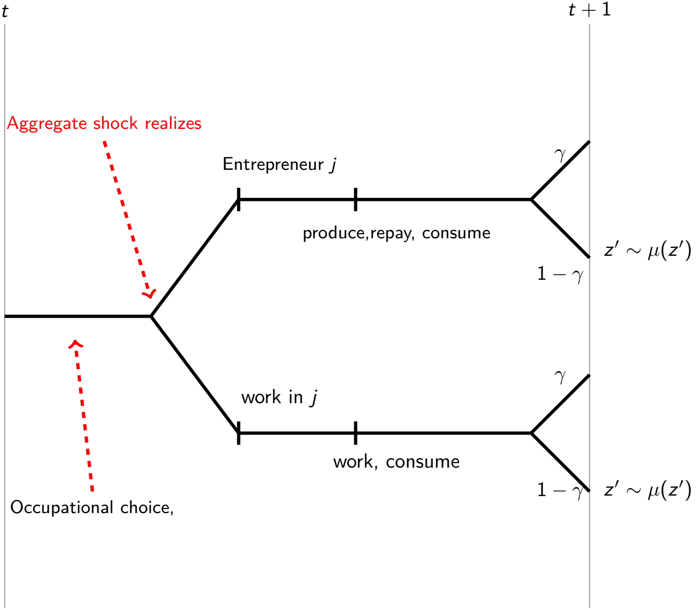
BKS (2012) with foreign investors and aggregate risk

Households.
Occupational choice: W, S, M.
Differ in wealth a and talent $\mathbf{z} = (z_M, z_S) \sim \mu(z)$, persists with γ.
Sectors: S (small, only cons.), M (also investment).
Financial friction $1 - \phi$

International Investors
Infinite one period problems.
Shock ($\xi \in \{0, 1\}$) comes with probability λ, iid.

Bank intraperiod loan, zero profits, pools funds from HH and int. lenders.

Quantitative Model



Quantitative Model: Occupational Choice

Let $\mathbf{s} = (a, \mathbf{z})$, $\mathbf{S} = (\xi, \chi)$, $\mathbf{c} = (c_S, c_M)$

$$v(\mathbf{s}; \mathbf{S}) = \max_{o} E \left\{ v^W(\mathbf{s}; \mathbf{S}), v^S(\mathbf{s}; \mathbf{S}), v^M(\mathbf{s}; \mathbf{S}) \right\}$$

$$v^W(\mathbf{s}; \mathbf{S}) = \max_{c, a > 0} u(\mathbf{c}) + \beta \{ \gamma v(\mathbf{s}'; \mathbf{S}') + (1 - \gamma) E_{z'} v(\mathbf{s}'; \mathbf{S}') \}$$

$$s.t$$

$$\mathbf{p} \cdot \mathbf{c} + a' \leq w + (1 + r')$$

$$v^j(\mathbf{s}; \mathbf{S}) = \max_{c, a > 0, k, l \geq 0} u(\mathbf{c}) + \beta \{ \gamma v(\mathbf{s}'; \mathbf{S}') + (1 - \gamma) E_{z'} v(\mathbf{s}'; \mathbf{S}') \}$$

$$s.t$$

$$\mathbf{p} \cdot \mathbf{c} + a' \leq p_j z_j f(k, l) - Rk - wl - (1 + r') p_j \kappa_j + (1 + r') a$$

$$k \leq \bar{k}(\mathbf{s}, \phi)$$

Quantitative Model: International Investors

Short Term Investors

$$\Pi^i_{ST} = \max\left\{\lambda(r' - \tau) + (1-\lambda)r^L, R_0^{*i}\right\}$$

Long Term investors

$$\Pi^i_{LT} = \max\left\{\lambda r^H + (1-\lambda)r^L, R_0^{*i}\right\}$$

Entry

$$LT = \Gamma^L\left(\bar{R}^{*'}_{LT}\right)$$

$$ST = \Gamma^S\left(\bar{R}^{*}_{ST}\right)$$

where $\bar{R}^*_{ST} \equiv \lambda(r' - \tau) + (1-\lambda)r$ and $\bar{R}^*_{LT} \equiv \lambda r^H + (1-\lambda)r$

Competitive Equilibrium

A C.E. is a distribution of wealth and ideas $\chi(\mathbf{s};\mathbf{S})$ with marginal distribution of z, $\mu(z)$, policy functions $\{c_S(\mathbf{s};\mathbf{S}), c_M(\mathbf{s};\mathbf{S}), a'(\mathbf{s};\mathbf{S}), o(\mathbf{s};\mathbf{S}), l(\mathbf{s};\mathbf{S}), k(\mathbf{s};\mathbf{S})\}$, rental limits $\bar{k}_j$ for $j = S, M$, and prices $\{p(\mathbf{S}), r(\mathbf{S}), R(\mathbf{S}), w(\mathbf{S})\}$:

1. Given rental limit and prices, HH solves (1); intermediaries make zero profits,
2. Markets clear

$$\int k(\mathbf{s};\mathbf{S})\chi(d\mathbf{s};\mathbf{S}) = \int a\chi(d\mathbf{s};\mathbf{S}) + \Gamma^S(\mathbf{s};\mathbf{S}) + \Gamma^L(\mathbf{s};\mathbf{S})$$

$$\int c_S(\mathbf{s};\mathbf{S})\chi(d\mathbf{s};\mathbf{S}) = \int_S [f(k(\mathbf{s};\mathbf{S})l(\mathbf{s};\mathbf{S})]\chi(d\mathbf{s};\mathbf{S})$$

3. Distribution of wealth and ideas follows

$$\chi(\mathbf{s};\mathbf{S}) = \gamma \int \chi(d\mathbf{s};\mathbf{S}) + (1-\gamma)\mu(z) \int \chi(d\mathbf{s};\mathbf{S},\chi)$$

rental limit.

Solution Method: Anti-MIT shock

Instead of Krussel-Smith algorithm.

- Solve consumption, investment, labor for two steady states: normal times and sudden-stop
- Occupational choice happens ex ante, depending on equilibrium prices in both scenarios
- Sudden stop state is a “threat"
- Two wealth distributions

Quantitative Model under Anti-MIT

$$v(a,\mathbf{z}) = \max_{o} E_{\xi}\left\{v^{W}(a,\mathbf{z},\xi), v^{S}(a,\mathbf{z},\xi), v^{M}(a,\mathbf{z},\xi)\right\}$$

$$\begin{aligned} v^{W}(a,\mathbf{z},\xi) = \quad & \max\nolimits_{c,a} E_{\xi}\left\{u(\mathbf{c}) + \beta\left\{\gamma v(a',\mathbf{z},\xi') + (1-\gamma)E_{z'}v(a',\mathbf{z}',\xi')\right\}\right\} \\ s.t \quad & \mathbf{p}\cdot\mathbf{c} + a' \le w + (1+r')a \end{aligned}$$

$$\begin{aligned} v^{j}(a,\mathbf{z},\xi) = \quad & \max\nolimits_{c,a,k,l} E_{\xi}\left\{u(\mathbf{c}) + \beta\left\{\gamma v(a',\mathbf{z},\xi') + (1-\gamma)E_{z'}v(a',\mathbf{z},\xi')\right\}\right\} \\ s.t \quad & \mathbf{p}\cdot\mathbf{c} + a' \le p_j z_j f(k,l) - Rk - wl - (1+r')p_j\kappa_j + (1+r')a \\ & k \le \phi a \end{aligned}$$

where $o(a,z) \in \{W,S,M\}$, $\mathbf{c} = (c_M, c_S)$, $\mathbf{p} = (p_M, p_S)$, $j \in \{M,S\}$

Parametrization

$$u(\mathbf{c}_t) = \frac{1}{1-\sigma}\left(\psi c_{S,t}^{1-\frac{1}{\epsilon}} + (1-\psi)c_{M,t}^{1-\frac{1}{\epsilon}}\right)^{\frac{1-\sigma}{1-\frac{1}{\epsilon}}}$$

$$z_i k^{\alpha} l^{1-\theta}$$

Distribution of abilities is Pareto with tail η.

Calibration

Moments	Model	ARG	Parameter
Average scale in services	6	4	κ_S
Average scale in manufacturing	21	17	κ_M
Establishment exit rate	.10	.8	γ
Manufacturing share of GDP	.33	.25	ψ
Interest rate	.02	.05 / .07	β
Credit/GDP	35 %	35%	ϕ
Probability of sudden stop	.20	.20	λ
Interest rate under SS	.11	.14 / .15	τ, Γ
Foreign Investors/Credit	35 %	30%	Non targeted
Share of LT	68%	70%	Non targeted
Share of ST	32%	30%	Non targeted

Table: Calibration

Results

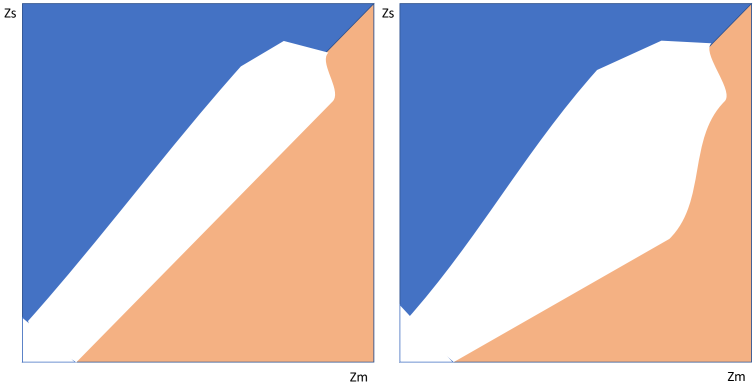


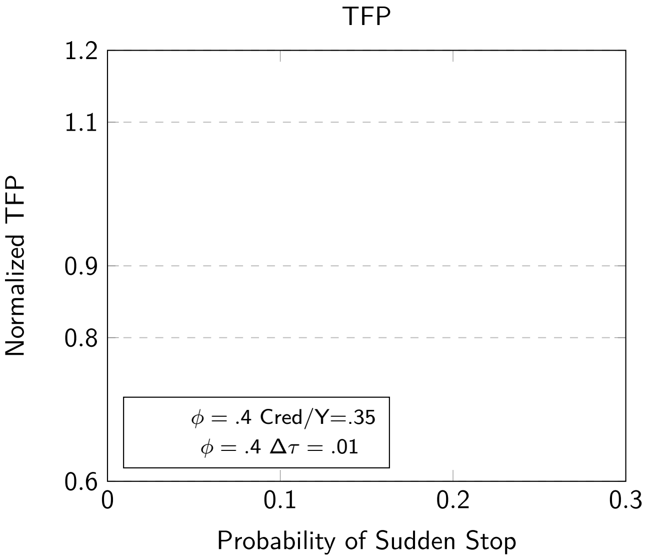
Figure: Occupational map. Left panel is without aggregate risk, and right panel has aggregate risk, same level of liquidity. Blue represents services, orange manufacturing.

Results

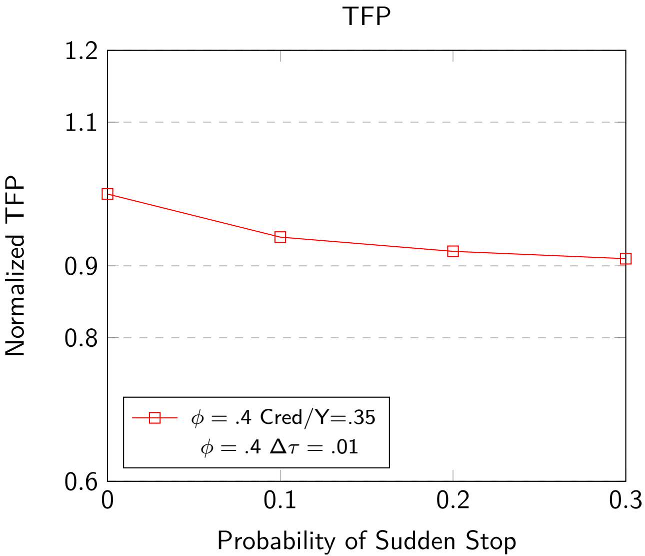
Moments	No Agg Uncertainty	SS Risk
Workers	93.21	93.15
Entrepeneurs M	0.14	0.15
Entrepreneurs S	6.64	6.71
Output M	0.63	0.64
Output S	1.15	1.17
Δ TFP	0	$+6\%$

Table: Results for Argentina's calibration ($\phi = .4$)

Results


TFP
1.2
1.1
0.9
0.8
0.6
Normalized TFP
$\phi = .4$ Cred/Y=.35
$\phi = .4$ $\Delta\tau = .01$
0
0.1
0.2
0.3
Probability of Sudden Stop

Results



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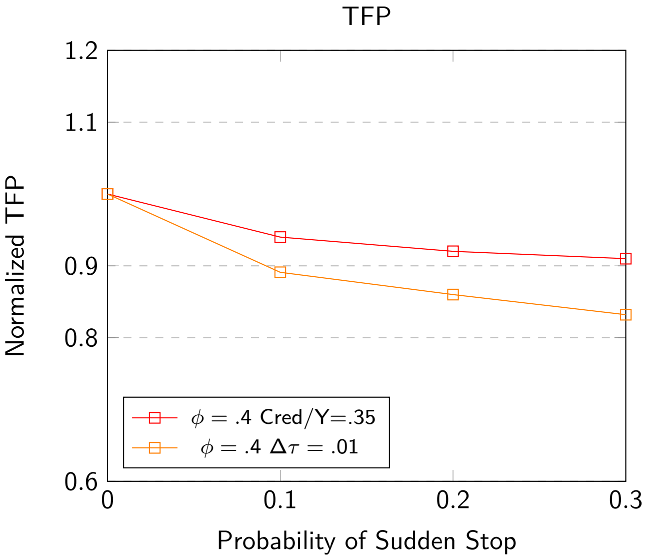
$\phi = .4$ Cred/Y=.35
$\phi = .4$ $\Delta\tau = .01$

Results


TFP
Normalized TFP
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0.8
0.6
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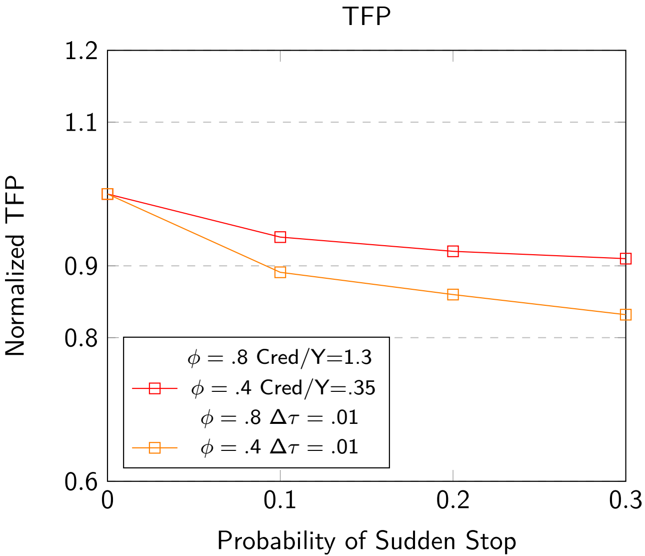
0.1
0.2
0.3
Probability of Sudden Stop
$\phi = .4$ Cred/Y=.35
$\phi = .4$ $\Delta\tau = .01$

Varying "Financial Depth"



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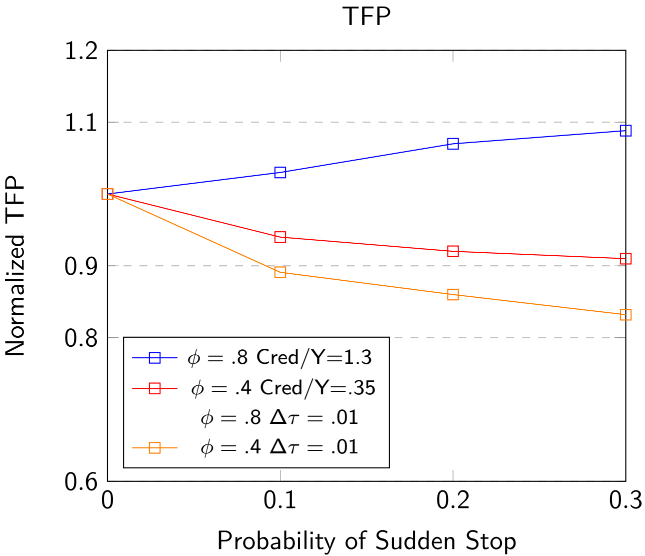

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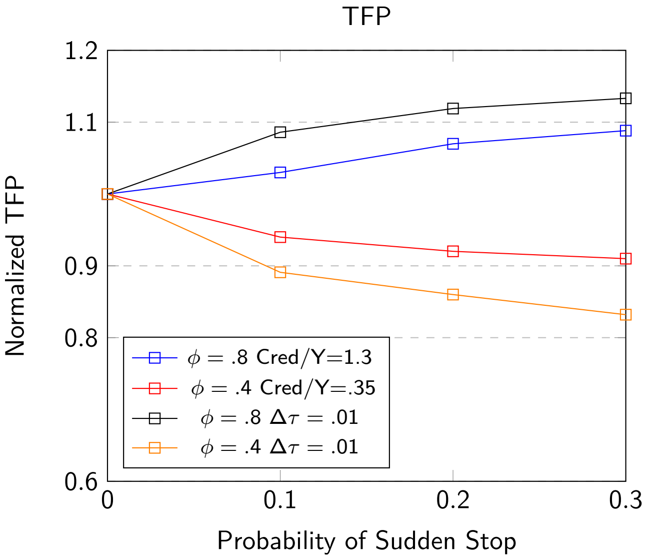


Varying "Financial Depth"

Moments	No Agg Uncertainty	SS Risk
Workers	93.78	92.6
Entrepeneurs M	0.125	0.121
Entrepreneurs S	6.09	7.25
Output M	0.72	0.71
Output S	1.15	1.19
Δ TFP	0	-7%
Δ TFP, $\tau = 1\%$		-1%

Table: Results changing financial friction to $\phi = .7$

Conclusion

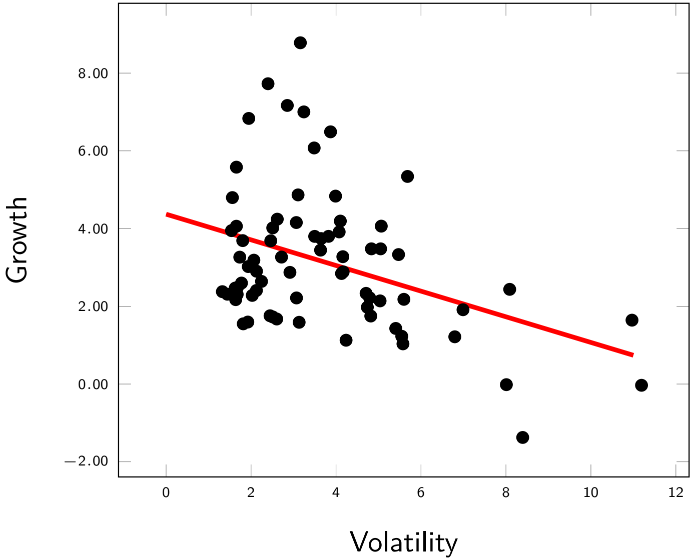
A model with occupational choice and aggregate uncertainty.

Interaction between volatility of international flows, productivity, and financial frictions.

Mean-Variance Tradeoff: More liquidity versus better liquidity.

Calibration still preliminary. suggests for a middle income country with high financial frictions liquidity is stronger. Korea?

Sudden stop volatility is not main source of volatility in these countries.


8.00
6.00
4.00
2.00
0.00
−2.00
0
2
4
6
8
10
12
Growth
Volatility

Future Research

Enriching the model with TFP shocks

$$y_i = \boldsymbol{Z} z_i k^{\alpha} l^{1-\theta}$$

where $\boldsymbol{Z} \in \{\boldsymbol{Z}^H, \boldsymbol{Z}^L\}$.

Hypothesis: main cause of volatility is TFP, and international lenders react to this.

	GDP Growth	Mean K growth	TFP
Mean Flows	0.125***	0.137***	0.0108
	(0.0176)	(0.0240)	(0.0105)
Flow Volatility	-0.0795***	-0.144***	-0.0272***
	(0.0146)	(0.0200)	
GDP Volatility	-0.120***	-0.128***	-0.245***
	(0.00931)	(0.0127)	(0.0126)
Observations	2,501	2,501	2,501
R-squared	0.385	0.341	0.362

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table: Fact 1.

$$y_i = \alpha_1 VAR(GDP)_i + \alpha_2 VAR(IF) + \alpha_3 \bar{IF} + \mathbf{X}\beta$$

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	Above median	Below median
K Control	0.004***	-0.017***
	(0.0001)	(0.001))
Mean Flows	0.261***	0.221***
	(0.0142)	(0.0123)
GDP Volatility	0.0341	0.0312
	(0.019)	(0.02)
Observations	610	610
R-squared	0.279	0.289

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table: Fact 2.

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Data

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PWT for productivity, growth, characteristics
Fernandez et al (2015) for capital controls
Reinhart and Rogoff (2009) for crises, flows
Over 80 countries in 1995-2015

$$y_i = \alpha_1 VAR(GDP)_i + \alpha_2 VAR(IF) + \alpha_3 \bar{IF} + \mathbf{X}\beta$$

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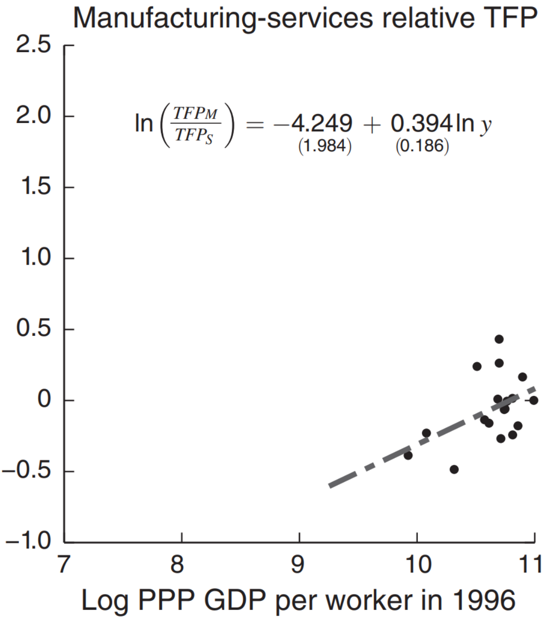

Manufacturing-services relative TFP
$\ln\left(\frac{TFP_M}{TFP_S}\right) = \underset{(1.984)}{-4.249} + \underset{(0.186)}{0.394}\ln y$
2.5
2.0
1.5
1.0
0.5
0
–0.5
–1.0
7
8
9
10
11
Log PPP GDP per worker in 1996

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Rental limits $\bar{k}_j$ are the most generous satisfying

$$\max_{l} \{p_j z_j f(k,l) - wl\} - Rk - (1+r)p_j\kappa_j + (1+r)a \geq (1-\phi)\max_{l} \{p_j z_j f(k,l) - wl\} + (1$$

implicitly defines $\bar{k}(\phi, a, z)$ increasing in all their arguments Back to back.