From Firm Producti ity Dynamics to Aggregate Efficiency
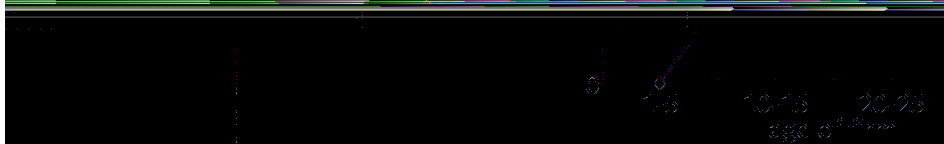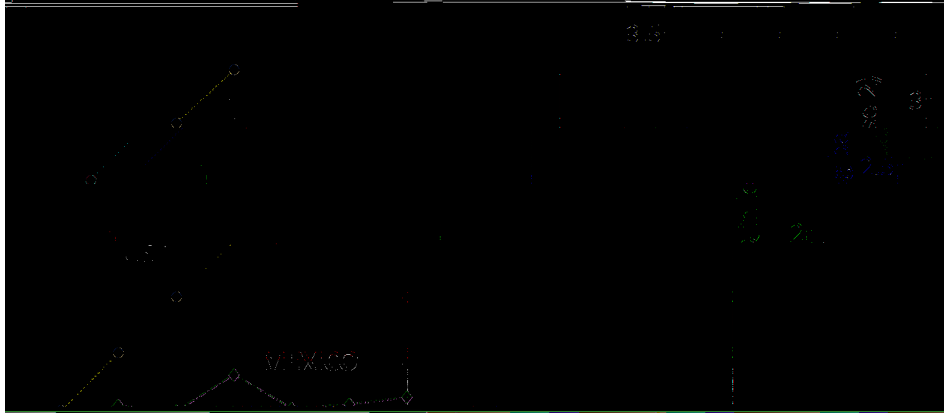
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Banco de México

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Larger dispersion of marginal product of capital and labor across firms in developing economies, **misallocation**.

- Evidence found in many countries: Hsieh & Klenow (2009), Busso, Madrigal & Pages (2013).
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What models (and frictions) can explain these observations?

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- then financial constraints reduce the growth of productivity at the firm level, reducing aggregate TFP.

Introduction

To analyze this mechanism we can extend previous models w/endogenous firm productivity accumulation:

firms make investments to improve productivity every period (Pakes & McGuire, 1994; Klette & Kortum, 2004), firm productivity evolves stochastically,
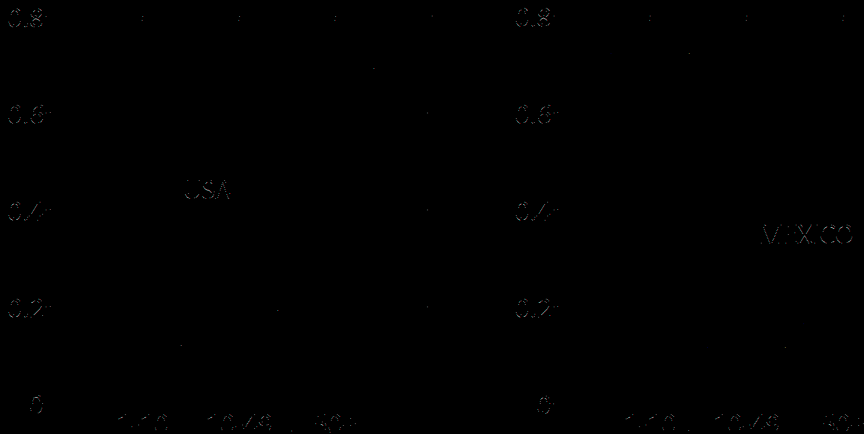
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Productivity Growth of Firms over their Life Cycle

Distribution of Employment by Size of Firm

Quantitative Model: Economic Force at Wor
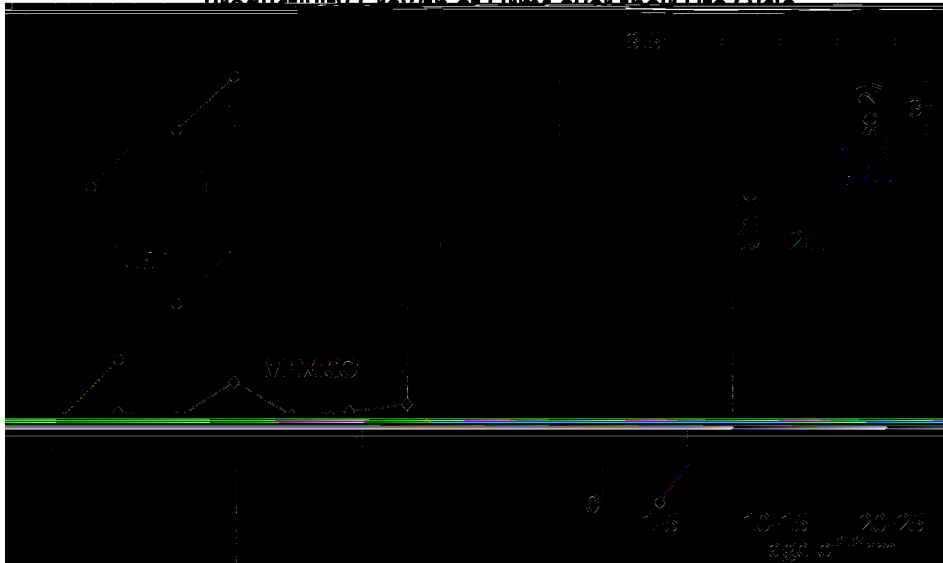
In the model the following mechanisms come into play:

- financial constraints lower the incentives of entrepreneurs to invest in productivity (entrepreneur will not be able to produce at optimal level and reap benefits of higher productivity),

- lower wages lead to lower ability individuals entering the economy (a standard result since Lucas, 1978).

Quantitative Model: Outline

Main elements of the model:

- occupational choice: entrepreneur or worker,
- financial constraints,
- investment in knowledge capital (stochastic),
- small open economy,
- (extended model with productivity shocks, informal sector in paper).

Builds upon Lucas (1978), Hopenhayn (1992), Pakes & McGuire (1994), Klette & Kortum (2004), Buera, Kaboski & Shin (2011).

Entrepreneur w/ability j (fixed) has access to the technology:

$$q = (j\,n)^{1-n} f(k,l)^n$$

where:

q is production of final good,

$f(k,l) = k^a l^{1-a}$, $n \in (0,1)$ decreasing returns-to-scale,

j is permanent ability of the entrepreneur, distribution $h(j)$,

knowledge capital n, accumulated through investment in innovation good x.

Innovation Technology

Every period knowledge capital n can **increase**:

$$P(n^{\emptyset} = n\,(1 + D)\,j\,n, x) = (1 \quad g)\frac{(1 \quad l)\,a\,(x/n)}{1 + a\,(x/n)} + g$$

Innovation Technology

Every period knowledge capital n can **increase**:

$$P(n^\prime = n\,(1 + \Delta)\,j\,n, x) = (1 - g)\frac{(1 - l)\,a\,(x/n)}{1 + a\,(x/n)} + g$$

Probability of a **decrease** (*bad shock*) in knowledge capital:

$$P(n^\prime = n/(1 + \Delta)\,j\,n, x) = \frac{(1 - g)\,l}{1 + a\,(x/n)}$$

With remaining probability, remains **unchanged**.

$s = \{j, n_w, b\}$, problem of worker is a savings $b' \geq 0$ decision:

$$v_w(s) = \max_{\{b' \geq 0\}} u(c) + \beta(1 - m) \sum_{\{z'\}} Q(z') v(s')$$

$$s.t. \quad c + b' = w + (1 + r) b$$

Entrepreneur

$s = \{j, n, b\}$, entrepreneurs choose $b' \geq 0$ and $x \geq 0$ to max:

$$v_e(s) = u(c) + b\,(1 - m)\sum_{\{n'\}} P(n' \mid n, x)\,\max\{v_w(s'), v_e(s')\}$$

subject to budget constraint:

$$c + b' = p(s) - x + (1 + r)\,b$$

Entrepreneur

$s = \{j^{\ell}, n, b\}$, entrepreneurs choose $b^{\ell} \geq 0$ and $x \geq 0$ to max:

$$v_e(s) = u(c) + \beta(1 - m) \sum_{\{n^{\ell}\}} P(n^{\ell} | n, x) \max\{v_w, 0\} d$$

Financial Enforcement Con traint

In the case of no-default the entrepreneur receives **ND**:

$$\max_{f,l,g} \quad q \quad w\,l \quad (r+d)\,k \quad x + (1+r)\,b$$

while in the case of default the entrepreneur would receive **D**:

$$\max_{f,l,g} (1 \quad y)\,(q \quad w\,l + (1 \quad d)\,k) \quad x$$

capital level is **enforcea le** if it satisfies **ND D**, implying a bound $\overline{k}(s)$ on capital rental (a reduced form of capturing di erences in property rights/creditor protection).

Predetermined Parameters.

parameter	value	description
$b\,(1-m)$	0.92	effective discount factor
s	1.50	risk aversion
r	0.04	interest rate (small open economy)
n	0.85	span-of-control
a	1/3	income share of capital
d	0.08	capital depreciation rate
a	3.00	innovation technology
l	0.70	innovation technology

Cali rated Parameters - US Moments.

parameter	symbol	value
exogenous exit rate	m	0.05
firm entry probability	J	0.04
Pareto dist.	q	4.34
innovation technology	g	0.24
initial knowledge capital	$n_w/\underline{n}$	1.91
size innovation steps	D	0.38

target statistics	data	model
death rate large firms	0.05	0.05
total firm entry/exit rate	0.10	0.11
std. deviation growth rates	0.25	0.25
relative size firms [20-25]/[1-5] years	2.48	2.46
employment at firms w/50+ workers	0.69	0.60
knowledge capital investment/total output	4.40	3.83

Quantitative Exerci e

We lower y to target the ratio of private credit/output in an emerging economy of 20%.

Productivity Growth of Firms over their Life Cycle
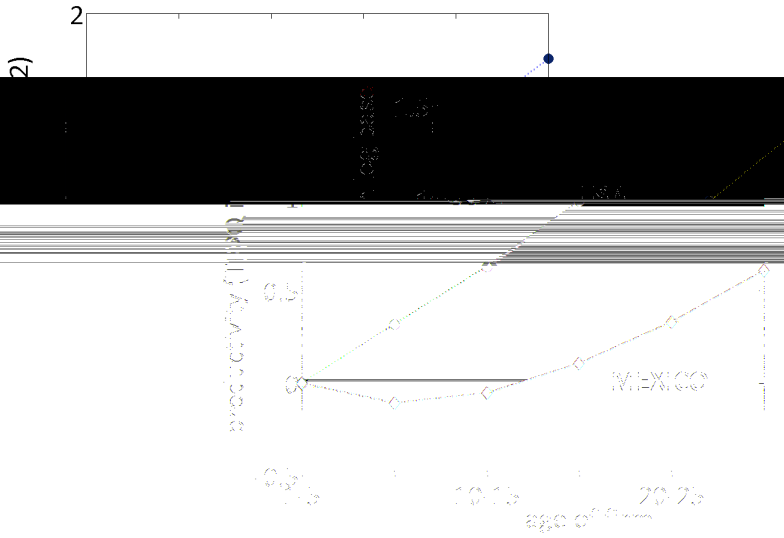
Main Results.		
statistics	US	EE
weighted firm productivity	1.00	0.80
TFP	1.00	0.92
aggregate output	1.00	0.66
firm productivity [20-25]/[1-5] years	2.61	1.26

Final Comment

We have explored a new channel through which financial constraints have an impact on aggregate TFP: they distort the incentives to invest in productivity at the firm level.

Extended model with informal sector (low productivity and low growth firms w/no access to credit) and forthcoming: quantitative relevance of size dependent distortions vs. financial constraints.

Buera, Kaboski and Shin (2015): more research is needed in endogenous entrepreneurial productivity!