From Firm Productivity Dynamics to Aggregate Efficiency

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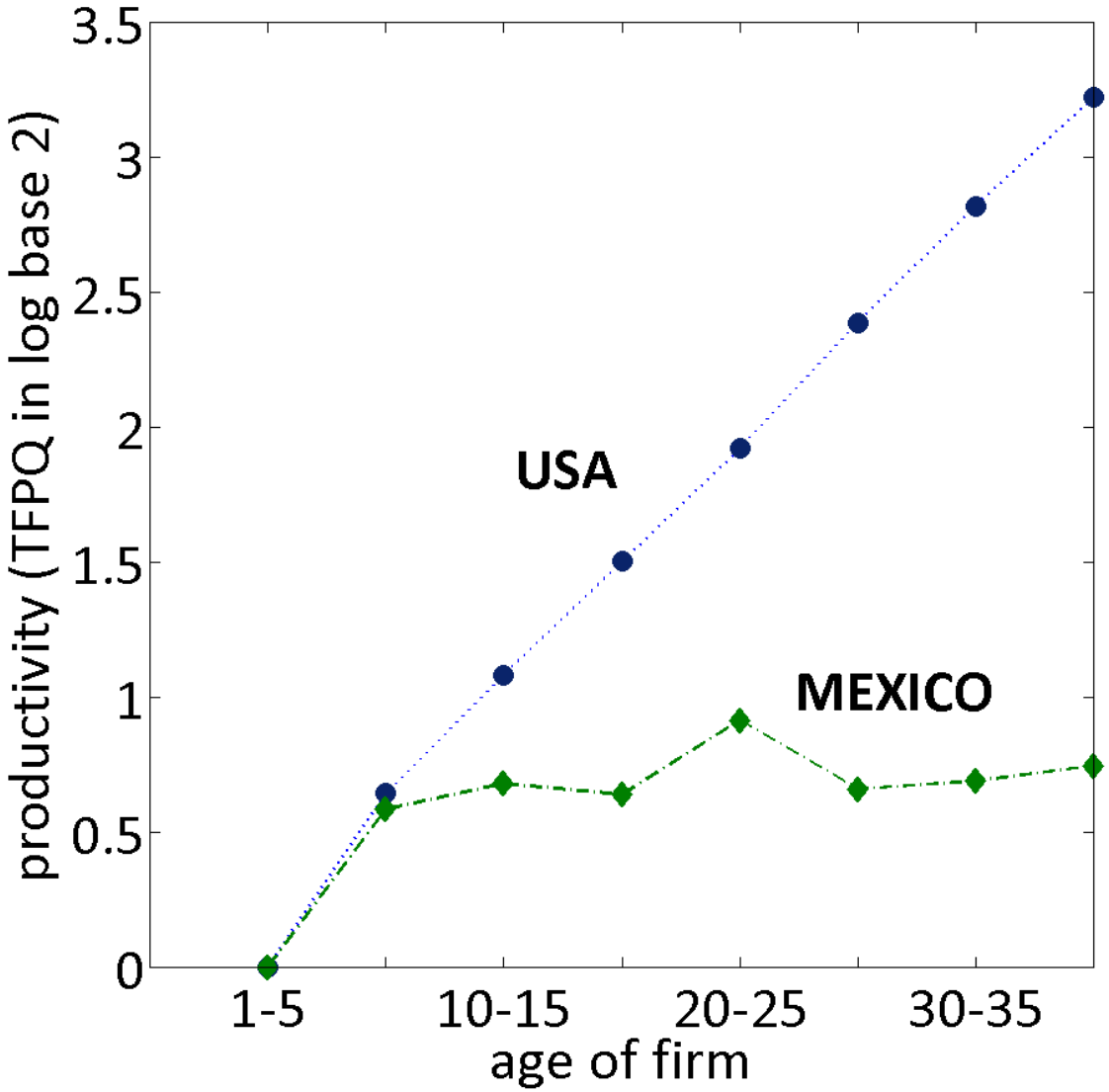
Productivity Growth of Firms over their Life Cycle



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What models (and frictions) can explain these observations?

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- Financial constraints: firms without sufficient collateral are not able to produce with optimal level of capital, then mg. product of capital is not equalized across firms.
- However: models of financial constraints and firm dynamics generate modest TFP losses through misallocation relative to data (4-5% in Midrigan & Xu, 2013).

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

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- firms make investments to improve productivity every period (Pakes & McGuire, 1994; Klette & Kortum, 2004), firm productivity evolves stochastically,
- the model can tell us how much of the differences in the productivity growth of firms and aggregate TFP across countries is accounted for by financial constraints.

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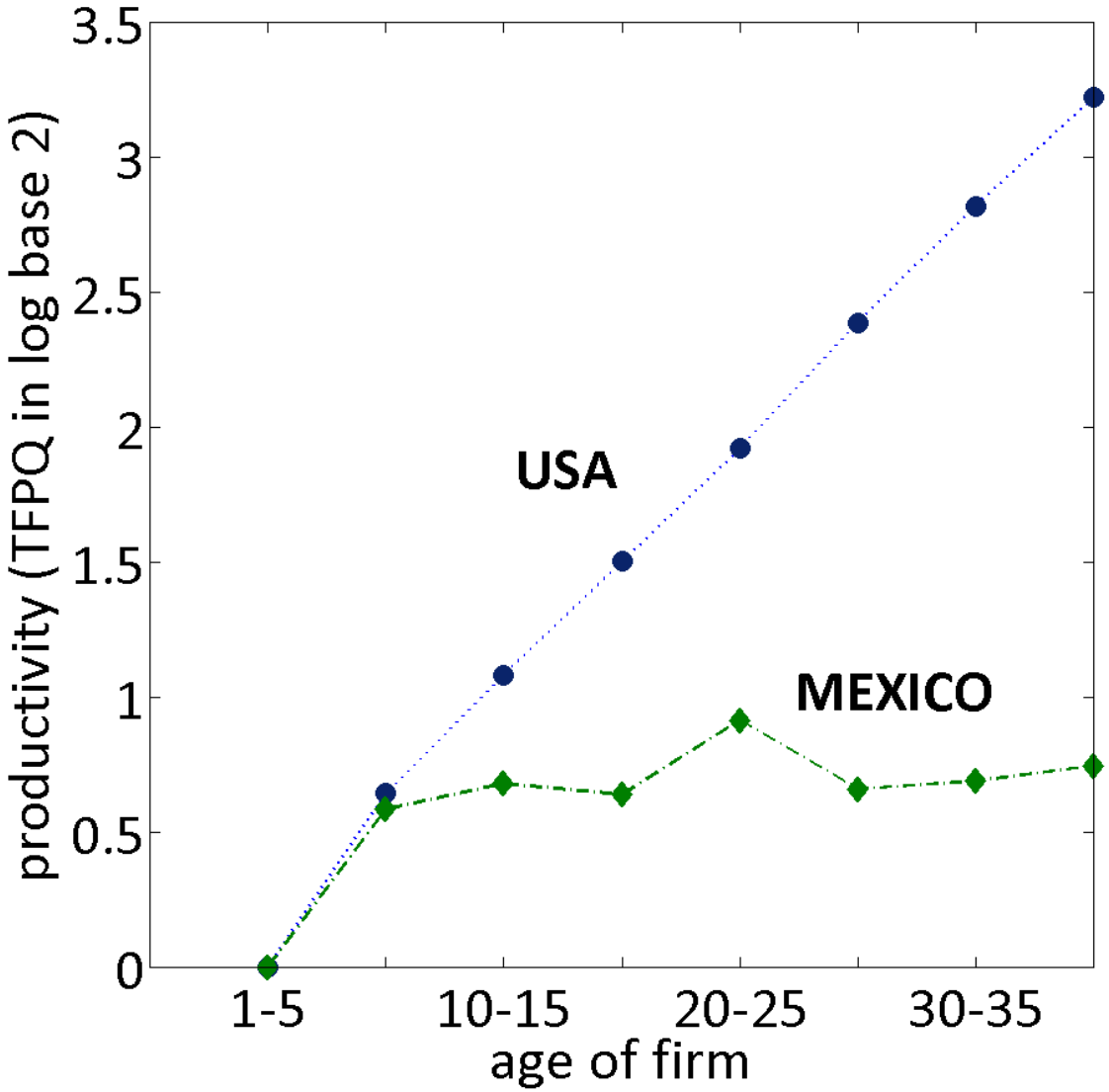
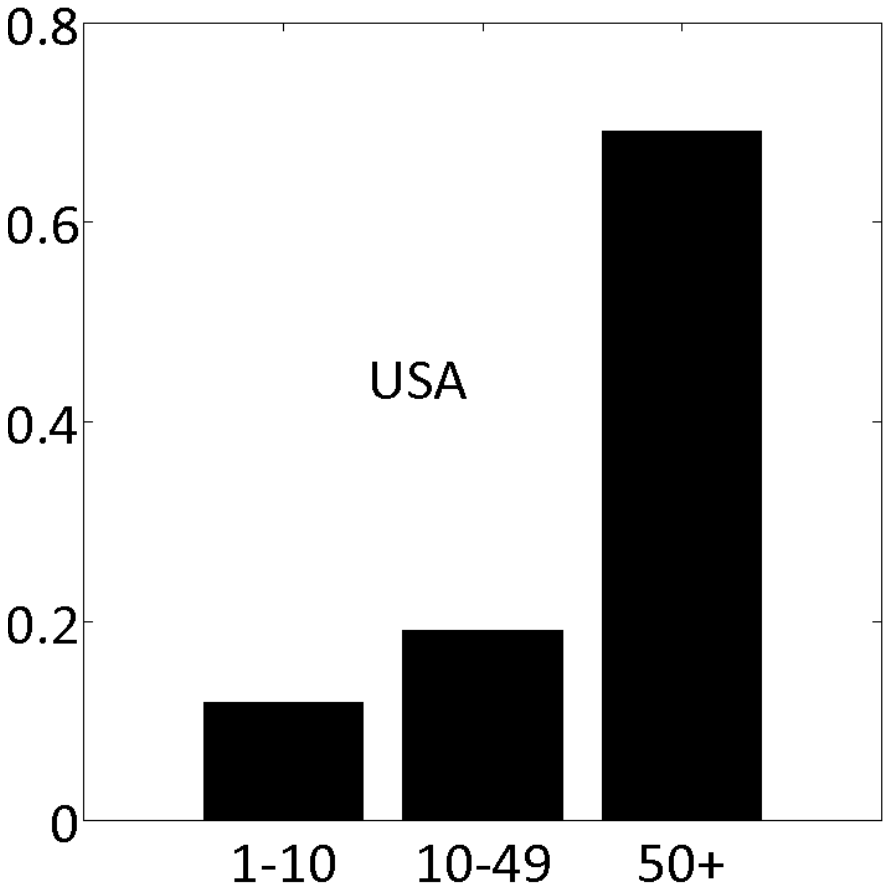
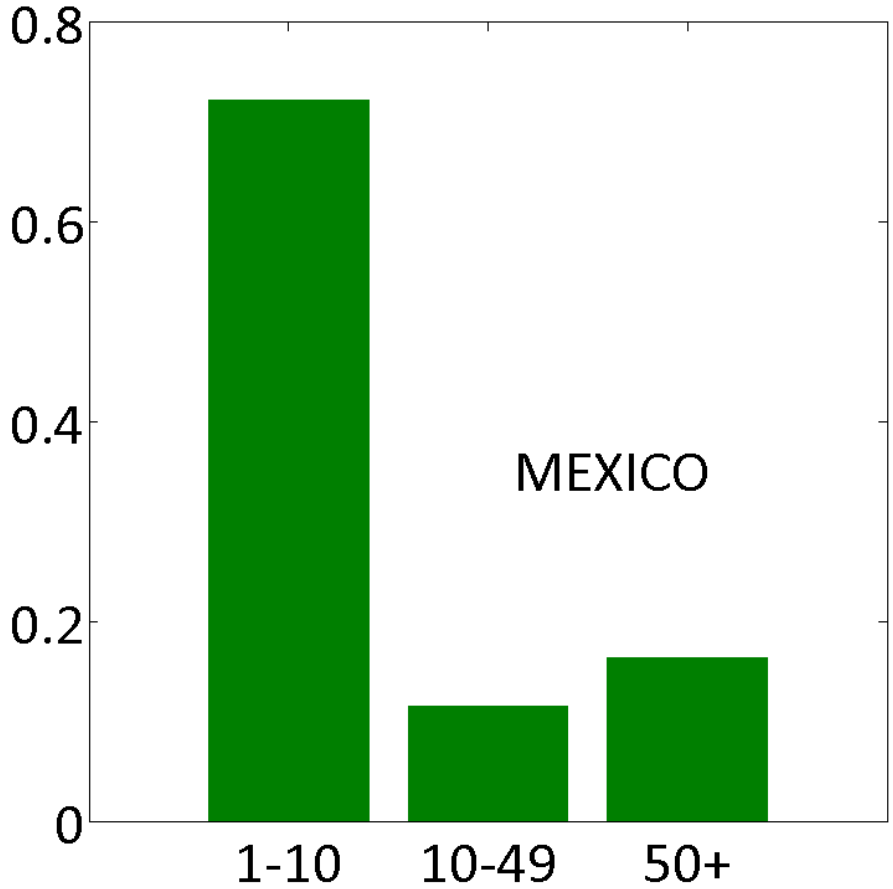


Distribution of Employment by Size of Firm





Quantitative Model: Economics Forces at Work

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).

Production Technology

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

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

where:

- q is production of final good,
- $f(k, l) = k^{\alpha}\, l^{1-\alpha}$, $\nu \in (0, 1)$ decreasing returns-to-scale,
- φ is permanent ability of the entrepreneur, distribution $h(\varphi)$,
- *knowledge capital* n, accumulated through investment in innovation good x.

Innovation Technology

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

$$P(n' = n(1+\Delta) \mid n, x) = (1-\gamma)\frac{(1-\lambda)\, a(x/n)}{1 + a(x/n)} + \gamma$$

Innovation Technology

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

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

$$P(n' = n/(1+\Delta) \mid n, x) = \frac{(1-\gamma)\,\lambda}{1+a(x/n)}$$

- With remaining probability, remains **unchanged**.

Workers

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

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

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

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and occupation decision with random opportunity $z \in \{0, 1\}$:

$$v(s) = \max\{v_e(z\,\varphi, n_w, b), v_w(s)\}$$

initial level of knowledge capital available to the worker is n_w.

Entrepreneurs

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

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

subject to budget constraint:

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

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profits are $\pi(s) = q - (\delta + r)\,k - w\,l$ subject to constraint (next slide): $k \leq \overline{k}(s)$.

Financial Enforcement Constraint

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

$$\max_{\{l\}} \; q - w\,l - (r+\delta)\,k - x + (1+r)\,b$$

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

$$\max_{\{l\}} \; (1-\psi)\,(q - w\,l + (1-\delta)\,k) - x$$

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

Predetermined Parameters.

parameter	value	description
$\beta(1-\mu)$	0.92	effective discount factor
σ	1.50	risk aversion
r	0.04	interest rate (small open economy)
ν	0.85	span-of-control
α	1/3	income share of capital
δ	0.08	capital depreciation rate
a	3.00	innovation technology
λ	0.70	innovation technology

Calibrated Parameters - US Moments.		
parameter	symbol	value
exogenous exit rate	μ	0.05
firm entry probability	ϑ	0.04
Pareto dist.	θ	4.34
innovation technology	γ	0.24
initial knowledge capital	$n_w/\underline{n}$	1.91
size innovation steps	Δ	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 Exercise

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

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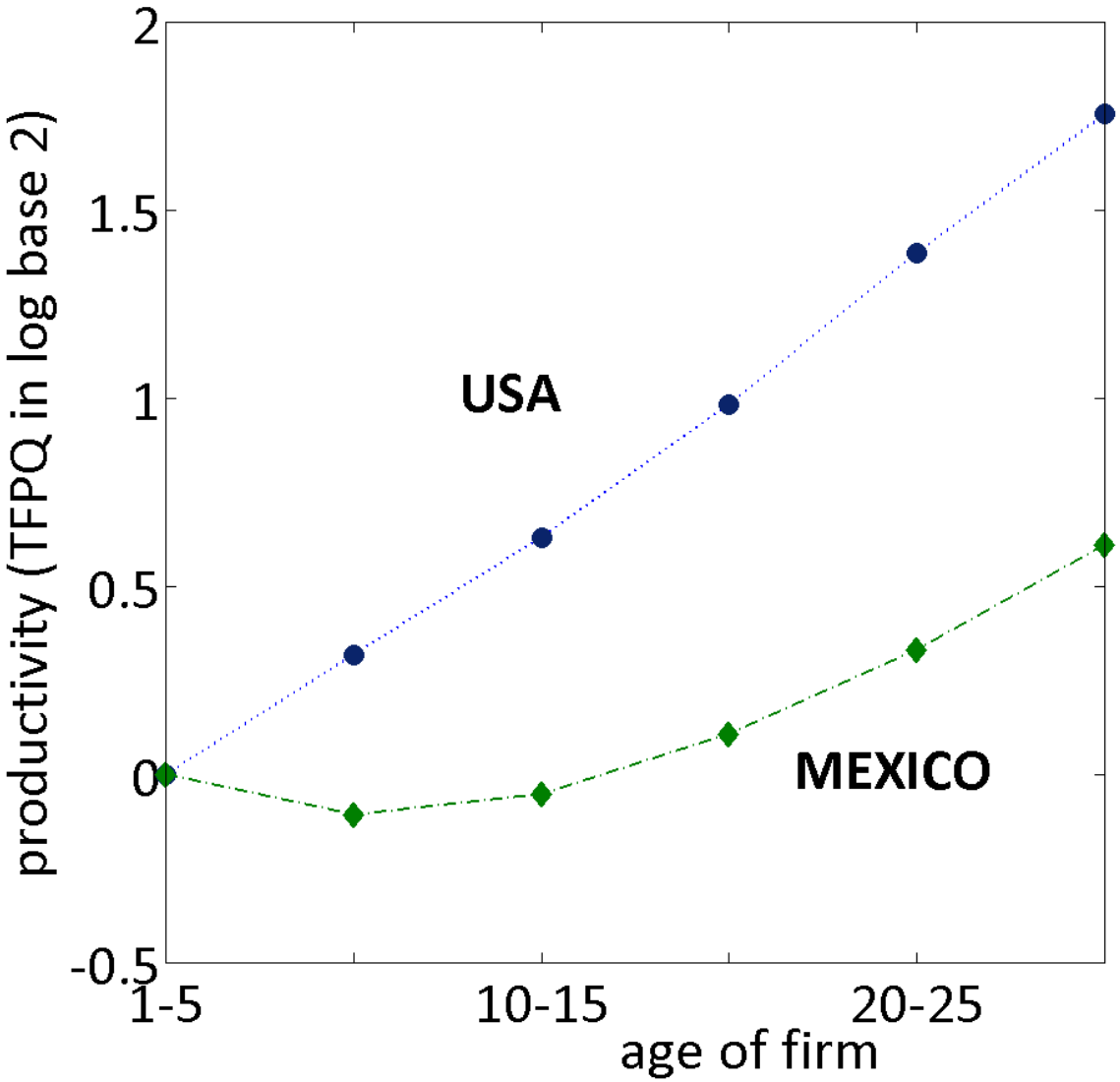

Main Results.		
statistics	US	EE
weighted firm productivity	1.00	0.80
TFP	1.00	0.92
aggregate output	1.00	0.66
firm productivity [20-25]/[1-5] years	2.61	1.26

Final Comments

- 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!