Occupational Choice, Human Capital, and Financing Constraints

Rui Castro – Université de Montréal
Pavel Ševčík – UQAM

June 29, 2015 – 20th ENSAI Economics Day
Motivation

- Economic development is about understanding quantitative cross-country differences in

\[ Y = AF(K, H) \]

and

\[ A, K, H. \]
Economic Development
Physical Capital

Raw correlation: 0.72
1996 years of schooling attainment

1996 PPP GDP per worker relative to U.S.

Raw correlation: 0.87
Economic Development
Total Factor Productivity

1996 Total Factor Productivity relative to U.S.
1996 PPP GDP per worker relative to U.S.

Raw correlation: 0.90
Motivation

Current (selective) view

   - cross-country differences in financing frictions generate differences in production: $K, A$.

2. Erosa, Koreshkova and Restuccia (REStud, 2010), Manuelli and Seshadri (AER, 2014)
   - cross-country differences in $A$ generate differences in human capital: $H$. 
Motivation
Current (selective) view

   - cross-country differences in \textit{financing frictions} generate differences in production: $K, A$.

2. Erosa, Koreshkova and Restuccia (REStud, 2010), Manuelli and Seshadri (AER, 2014)
   - cross-country differences in $A$ generate differences in human capital: $H$. 
Can financing frictions help understand $A$, $K$, and $H$?
Aggregate productivity effects of credit constraints

Overview

1. Misallocation of talent (adverse selection of firm-level productivities).

With endogenous human capital:

4. Less productive firms (schooling under-investment → lower firm-level productivity).
5. Schooling misallocation (high productivity entrepreneurs sacrifice schooling the most).
Aggregate productivity effects of credit constraints

Overview

1. Misallocation of talent (adverse selection of firm-level productivities).

With endogenous human capital:

4. Less productive firms (schooling under-investment → lower firm-level productivity).
5. Schooling misallocation (high productivity entrepreneurs sacrifice schooling the most).
Aggregate productivity effects of credit constraints

Overview

1. Misallocation of talent (adverse selection of firm-level productivities).

With endogenous human capital:

4. Less productive firms (schooling under-investment $\rightarrow$ lower firm-level productivity).
5. Schooling misallocation (high productivity entrepreneurs sacrifice schooling the most).
Aggregate productivity effects of credit constraints

Overview

1. Misallocation of talent (adverse selection of firm-level productivities).

With endogenous human capital:

4. Less productive firms (schooling under-investment → lower firm-level productivity).
5. Schooling misallocation (high productivity entrepreneurs sacrifice schooling the most).
Aggregate productivity effects of credit constraints

Overview

1. Misallocation of talent (adverse selection of firm-level productivities).

With endogenous human capital:

4. Less productive firms (schooling under-investment $\rightarrow$ lower firm-level productivity).
5. Schooling misallocation (high productivity entrepreneurs sacrifice schooling the most).
Model

Household decisions

- Child
  - household with initial wealth $\omega$, draws child’s abilities ($z, x$),
  - child’s schooling investment (time $s$, expenditures $e$),
  - savings $q$,
  - and household consumption $c$.

- Adult
  - either works for wage or manages a firm,
  - managing a firm requires raising capital, then hiring labor and producing.
Worker household

\[ v^w(\omega, z, x) = \max_{c,e,s,q} \left\{ u(c) + \beta \sum_{z',x'} \pi(z',x'|z,x) v(\omega', z', x') \right\} \]

subject to

\[ c + ws\bar{l} + e + \frac{1}{1+r} q = w\psi h (1 - s) + \omega \]

\[ h = z (s^\eta e^{1-\eta})^\xi \]

\[ s \in [0, \bar{s}] \]

\[ q \geq -\lambda \phi \omega \]

\[ \omega' \equiv wh + q. \]
Worker household

\[ v^w(\omega, z, x) = \max_{c,e,s,q} \left\{ u(c) + \beta \sum_{z',x'} \pi(z', x'|z, x) v(\omega', z', x') \right\} \]

subject to

\[ c + ws\bar{l} + e + \frac{1}{1 + r} q = w\psi h(1 - s) + \omega \]

\[ h = z \left(s^\eta e^{1-\eta}\right)^{\xi} \]

\[ s \in [0, \bar{s}] \]

\[ q \geq -\lambda \phi \omega \]

\[ \omega' \equiv wh + q. \]
Worker household

\[ v^w(\omega, z, x) = \max_{c, e, s, q} \left\{ u(c) + \beta \sum_{z', x'} \pi(z', x'|z, x) \nu(\omega', z', x') \right\} \]

subject to

\[ c + ws\bar{l} + e + \frac{1}{1 + r} q = w\psi h (1 - s) + \omega \]

\[ h = z \left( s^\eta e^{1-\eta} \right)^\xi \]

\[ s \in [0, \bar{s}] \]

\[ q \geq -\lambda \phi \omega \]

\[ \omega' \equiv wh + q. \]
Worker household

\[
\nu^w(\omega, z, x) = \max_{c,e,s,q} \left\{ \left. u(c) + \beta \sum_{z',x'} \pi(z', x'|z, x) \nu(\omega', z', x') \right\} \right. \\
\text{subject to} \\
\begin{align*}
0 & + w s \bar{l} + e + \frac{1}{1+r} q = w \psi h (1 - s) + \omega \\
\psi h & = z (s^\eta e^{1-\eta})^\xi \\
s & \in [0, \bar{s}] \\
q & \geq -\lambda \phi \omega \\
\omega' & \equiv wh + q.
\end{align*}
\]
Entrepreneurial household

\[ v^e(\omega, z, x) = \max_{c, e, s, q} \left\{ u(c) + \beta \sum_{z', x'} \pi(z', x'|z, x) v(\omega', z', x') \right\} \]

subject to

\[ c + ws\bar{l} + e + \frac{1}{1+r} q = w\psi h (1 - s) + \omega \]

\[ h = z \left( s^\eta e^{1-\eta} \right)^\xi \]

\[ s \in [0, \bar{s}] \]

\[ q \geq -\lambda \phi \omega \]

\[ \omega' \equiv \Pi(q, h, x) + q. \]
Entrepreneurial household

Profits

\[ \Pi(q, h, x) = \max_{k, l} \left\{ \left( A x h^{\theta} \right) \left( k^\alpha l^{1-\alpha} \right)^\gamma - (r + \delta) k - wl \right\} \]

subject to

\[ k \leq \lambda q. \]
Entrepreneurial household
Schooling disincentive for constrained entrepreneurs

Wealth ($q$) vs. Marginal return to education ($\partial \Pi / \partial h$)

$q^*$
Occupational choice

\[ v(\omega, z, x) = \max \{ v^w(\omega, z, x), v^e(\omega, z, x) \} . \]
Distortions from financing frictions

Highlights

1. Misallocation of talent
   - wealthy–low productivity agents become entrepreneurs, poor–high productivity don’t.

2. Production distortions
   - firms too small, dispersion in marginal products.

3. Investment distortions
   - poor–high productivity entrepreneurs under-invest in schooling.
Distortions from financing frictions

Highlights

1. Misallocation of talent
   - wealthy–low productivity agents become entrepreneurs, poor–high productivity don’t.

2. Production distortions
   - firms too small, dispersion in marginal products.

3. Investment distortions
   - poor–high productivity entrepreneurs under-invest in schooling.
Distortions from financing frictions

Highlights

1. Misallocation of talent
   - wealthy–low productivity agents become entrepreneurs, poor–high productivity don’t.

2. Production distortions
   - firms too small, dispersion in marginal products.

3. Investment distortions
   - poor–high productivity entrepreneurs under-invest in schooling.
Misallocation of talent

Occupational choice
Production distortions

Size

![Graphs showing production distortions for U.S. and India](image)
Production distortions

Capital misallocation

![Graph showing production distortions and capital misallocation]

- **Production distortions**
- **Capital misallocation**

![Diagram with plots of capital-output ratio for U.S. and India]

- **Capital-output (k/y)**
  - U.S.: 40, 60, 80
  - India: 2, 4, 6

![Log-log graph comparing U.S. and India]

- **Log-log scale**
- **U.S.**
- **India**
Investment distortions
Build collateral, underinvest in schooling
Investment distortions

High vs low productivity

Diagram showing saving (q) and schooling expenditures (e) of entrepreneurs for U.S. and India.
Measuring TFP effects

Strategy outline

1. Derive model-based basic wedges.


3. Use stand-in framework to characterize extent of TFP differences (level and misallocation effects).
1. Saving subsidy $\tau_q^e$:

$$u'(c) = (1 + \tau_q^e)(1 + r) \beta \sum_{z', x'} \pi v_1 (')$$

2. Tax on schooling investment $\tau_h^e$:

$$ \left(1 - w\psi(1 - s)(1 - \eta)\xi^{\frac{h}{e}} \right) u'(c) = \beta (1 - \tau_h^e) \sum_{z', x'} \pi \frac{\partial \Pi^*}{\partial h} (1 - \eta) \xi^{\frac{h}{e}} v_1 ('')$$
Basic Model Wedges
Entrepreneur Household

1. Saving subsidy $\tau_q^e$:

$$u'(c) = (1 + \tau_q^e)(1 + r) \beta \sum_{z',x'} \pi \nu_1 ('')$$

2. Tax on schooling investment $\tau_h^e$:

$$\left(1 - w\psi (1 - s) (1 - \eta) \xi_{h-e} \right) u'(c) = \beta (1 - \tau_h^e) \sum_{z',x'} \pi \frac{\partial \Pi^*}{\partial h} (1 - \eta) \xi_{h-e} \nu_1 ('')$$
Production Wedges

Stand-in firm problem

\[
\max_{k,l} \left\{ \left(1 - \tau_a\right) A x \left( h^* \right)^\theta \left( k^{\alpha l^{1-\alpha}} \right)^\gamma - \left(1 + \tau_k\right) (r + \delta) k - wl \right\}.
\]

Mapping between proxy and basic wedges:

\[
1 - \tau_a \propto \left( \frac{1 + \tau^e_q}{1 - \tau^e_h} \right)^{1-\gamma} \left( \frac{e}{e^*} \right)^{1-\gamma}
\]

\[
1 + \tau_k = 1 + \frac{\tau^e_q}{\lambda (r + \delta)},
\]
Production Wedges
Stand-in firm problem

$$\max_{k,l} \left\{ (1 - \tau_a) Ax \left( h^* \right)^{\theta} \left( k_\alpha / l^{1-\alpha} \right)^{\gamma} - (1 + \tau_k) (r + \delta) k - wl \right\}. $$

Mapping between proxy and basic wedges:

$$1 - \tau_a \propto \left( \frac{1 + \tau^e_q}{1 - \tau^e_h} \right)^{1-\gamma} \left( \frac{e}{e^*} \right)^{1-\gamma}$$

$$1 + \tau_k = 1 + \frac{\tau^e_q}{\lambda (r + \delta)},$$
Production Wedges
Towards TFP computation

Firm-level revenue productivity:

\[ TFPR \equiv \frac{y}{k^{\alpha} l^{1-\alpha}} \propto (1 + \tau_k)^\alpha. \]

Firm-level physical productivity:

\[ TFPQ \equiv (1 - \tau_a) Ax (h^*)^\theta. \]
Misallocation
Proxy wedges and TFP

Aggregation:

\[ Y = TFP \left( K^\alpha L^{1-\alpha} \right)^\gamma \]

\[ TFP = \int_B \left( TFPQ \frac{TFPR'}{TFPR} \right)^{\frac{1}{1-\gamma}} d\psi \]

where

\[ TFPR' \equiv TFPR (1 + \tau_k)^{\alpha(\gamma - 1)} \propto (1 + \tau_k)^{\alpha \gamma} \]

\[ TFPQ \equiv Ax \left( h^* \right)^\theta (1 - \tau_a) \]
TFP effects
Hsieh and Klenow (QJE, 2009) decomposition

If $TFPR$, $TFPQ$ jointly log-normally distributed:

$$
\log TFP = (1 - \gamma) \log(\text{entrp. rate}) \quad \text{Specialization}
$$

$$
+ (1 - \gamma) \log E_B \left( TFPQ^{\frac{1}{1-\gamma}} \right) \quad \text{Firm-level productivity}
$$

$$
- \frac{1}{2} \frac{\gamma (1 - \gamma + \alpha \gamma)}{\alpha (1 - \gamma)} \text{var}_B (\log TFPR) \quad \text{Capital misallocation}
$$
TFP: misallocation *and* firm-level productivity

Distribution of proxy wedges

TFPR and TFPQ in the U.S.  
TFPR and TFPQ in India
TFP effects

Generalized Hsieh and Klenow (QJE, 2009) decomposition

If $Ax(h^*)^\theta$, $(1 - \tau_a)$, and $(1 + \tau_k)$ jointly log-normally distributed:

$$\log \text{TFP} = (1 - \gamma) \log(\text{entrp. rate})$$

$\text{Specialization}$

$$+ (1 - \gamma) \log E_B \left[ Ax(h^*)^{\frac{\theta}{1-\gamma}} \right] + (1 - \gamma) \log E_B \left[ (1 - \tau_a)^{\frac{1}{1-\gamma}} \right]$$

$\text{Potential productivity}$

$$+ \frac{1}{1 - \gamma} \text{cov}_B \left( \log(Ax(h^*)^\theta), \log(1 - \tau_a) \right)$$

$\text{Schooling under-investment}$

$$- \frac{1}{2} \frac{\alpha \gamma (1 - \gamma + \alpha \gamma)}{1 - \gamma} \text{var}_B \left( \log (1 + \tau_k) \right)$$

$\text{Schooling misallocation}$

$\text{Capital misallocation}$
## Calibration

### External

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>1.0</td>
<td>standard</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.844</td>
<td>yearly depreciation rate of 6%</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>1/3</td>
<td>capital income share</td>
</tr>
<tr>
<td>$\bar{x}$</td>
<td>1.0</td>
<td>normalization</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.85</td>
<td>Atkeson and Kehoe (JPE, 05), others</td>
</tr>
<tr>
<td>$\bar{s}$</td>
<td>2/3</td>
<td>up to 20 years of formal schooling (6–26)</td>
</tr>
<tr>
<td>$\rho_z$</td>
<td>0.72</td>
<td>intergen. IQ score corr. (Bowles and Gintis, JEP 02)</td>
</tr>
</tbody>
</table>
## Calibration

### Internal

<table>
<thead>
<tr>
<th>Value</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.215</td>
<td>yearly real interest rate</td>
<td>0.04</td>
</tr>
<tr>
<td>$\bar{z}$</td>
<td>51.9</td>
<td>avg. years of schooling among entrepreneurs</td>
<td>13.9</td>
</tr>
<tr>
<td>$\xi$</td>
<td>0.85</td>
<td>avg. years of schooling among workers</td>
<td>13.7</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>0.09</td>
<td>earnings share of top 5%</td>
<td>0.3</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.81</td>
<td>output share of schooling expenditures</td>
<td>0.045</td>
</tr>
<tr>
<td>$l$</td>
<td>7.09</td>
<td>output share of teacher and staff compensation</td>
<td>0.05</td>
</tr>
<tr>
<td>$\psi$</td>
<td>0.6</td>
<td>ratio avg. labor earnings at age 46 vs age 25</td>
<td>1.75</td>
</tr>
<tr>
<td>$\theta$</td>
<td>0.16</td>
<td>entrepreneurship rate</td>
<td>0.1</td>
</tr>
<tr>
<td>$\rho_x$</td>
<td>0.45</td>
<td>intergenerational correlation of entrepreneurship</td>
<td>0.32</td>
</tr>
<tr>
<td>$\sigma_x$</td>
<td>0.25</td>
<td>employment share of top 5% establishments</td>
<td>0.57</td>
</tr>
<tr>
<td>$\sigma_{xz}$</td>
<td>-0.1</td>
<td>ratio of median earnings (entrepreneurs vs workers)</td>
<td>0.92</td>
</tr>
<tr>
<td>$\phi$</td>
<td>0.005</td>
<td>share of household credit in total external finance</td>
<td>0.19</td>
</tr>
<tr>
<td>$\lambda_{U.S.}$</td>
<td>9.22</td>
<td>ratio of external finance to output</td>
<td>2.9</td>
</tr>
</tbody>
</table>

### Sources

1. U.S. 9.22 ratio of external finance to output 2.9 2.25
2. India 1.30 ratio of external finance to output 0.45 0.45
## Calibration

### Internal

<table>
<thead>
<tr>
<th>Value</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>yearly real interest rate</td>
<td>0.04</td>
<td>0.037</td>
</tr>
<tr>
<td>$\bar{z}$</td>
<td>avg. years of schooling among entrepreneurs</td>
<td>13.9</td>
<td>13.6</td>
</tr>
<tr>
<td>$\xi$</td>
<td>avg. years of schooling among workers</td>
<td>13.7</td>
<td>14.2</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>earnings share of top 5%</td>
<td>0.3</td>
<td>0.32</td>
</tr>
<tr>
<td>$\eta$</td>
<td>output share of schooling expenditures</td>
<td>0.045</td>
<td>0.047</td>
</tr>
<tr>
<td>$\bar{l}$</td>
<td>output share of teacher and staff compensation</td>
<td>0.05</td>
<td>0.046</td>
</tr>
<tr>
<td>$\psi$</td>
<td>ratio avg. labor earnings at age 46 vs age 25</td>
<td>1.75</td>
<td>1.75</td>
</tr>
<tr>
<td>$\theta$</td>
<td>entrepreneurship rate</td>
<td>0.1</td>
<td>0.05</td>
</tr>
<tr>
<td>$\rho_x$</td>
<td>intergenerational correlation of entrepreneurship</td>
<td>0.32</td>
<td>0.29</td>
</tr>
<tr>
<td>$\sigma_x$</td>
<td>employment share of top 5% establishments</td>
<td>0.57</td>
<td>0.51</td>
</tr>
<tr>
<td>$\sigma_{xz}$</td>
<td>ratio of median earnings (entrepreneurs vs workers)</td>
<td>0.92</td>
<td>1.0</td>
</tr>
<tr>
<td>$\phi$</td>
<td>share of household credit in total external finance</td>
<td>0.19</td>
<td>0.21</td>
</tr>
<tr>
<td>$\lambda_{U.S.}$</td>
<td>ratio of external finance to output</td>
<td>2.9</td>
<td>2.25</td>
</tr>
<tr>
<td>$\lambda_{India}$</td>
<td>ratio of external finance to output</td>
<td>0.46</td>
<td>0.45</td>
</tr>
</tbody>
</table>

### Sources
## Cross-country implications

### Preliminary Results

### Macro aggregates

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>K/Y</th>
<th>TFP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
</tr>
<tr>
<td>U.S.</td>
<td>1.00</td>
<td>1.00</td>
<td>2.21</td>
</tr>
<tr>
<td>India</td>
<td>0.63</td>
<td>0.09</td>
<td>1.85</td>
</tr>
</tbody>
</table>

### TFP

<table>
<thead>
<tr>
<th>Effect</th>
<th>% Loss India relative to U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialization</td>
<td>−0.039</td>
</tr>
<tr>
<td>Firm-level productivity</td>
<td>+0.092</td>
</tr>
<tr>
<td>Potential productivity</td>
<td></td>
</tr>
<tr>
<td>Schooling under-investment</td>
<td>−0.014</td>
</tr>
<tr>
<td>Schooling misallocation</td>
<td>+0.005</td>
</tr>
<tr>
<td>Physical capital misallocation</td>
<td>+0.101</td>
</tr>
<tr>
<td>Approximate <em>TFP</em></td>
<td>0.164</td>
</tr>
<tr>
<td>Actual <em>TFP</em></td>
<td>0.166</td>
</tr>
</tbody>
</table>
Cross-country implications

Preliminary Results

Macro aggregates

<table>
<thead>
<tr>
<th></th>
<th>$Y$</th>
<th></th>
<th>$K/Y$</th>
<th></th>
<th>$TFP$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
</tr>
<tr>
<td>U.S.</td>
<td>1.00</td>
<td>1.00</td>
<td>2.21</td>
<td>2.90</td>
<td>1.00</td>
</tr>
<tr>
<td>India</td>
<td>0.63</td>
<td>0.09</td>
<td>1.85</td>
<td>1.98</td>
<td>0.83</td>
</tr>
</tbody>
</table>

TFP

<table>
<thead>
<tr>
<th>Effect</th>
<th>% Loss India relative to U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialization</td>
<td>$-0.039$</td>
</tr>
<tr>
<td>Firm-level productivity</td>
<td>$+0.092$</td>
</tr>
<tr>
<td>Potential productivity</td>
<td></td>
</tr>
<tr>
<td>Schooling under-investment</td>
<td>$-0.014$</td>
</tr>
<tr>
<td>Schooling misallocation</td>
<td>$+0.005$</td>
</tr>
<tr>
<td>Physical capital misallocation</td>
<td>$+0.101$</td>
</tr>
</tbody>
</table>

Approximate $TFP$ | 0.164
Actual $TFP$      | 0.166
### Cross-country implications

#### Preliminary Results

#### Firms

<table>
<thead>
<tr>
<th></th>
<th>ent.rate</th>
<th>avg. firm size</th>
<th>size skew</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
</tr>
<tr>
<td>U.S.</td>
<td>0.050</td>
<td>0.100</td>
<td>1.00</td>
</tr>
<tr>
<td>India</td>
<td>0.065</td>
<td>0.470</td>
<td>0.64</td>
</tr>
</tbody>
</table>

#### Years of Schooling

<table>
<thead>
<tr>
<th></th>
<th>aggregate</th>
<th>workers</th>
<th>entrepreneurs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
</tr>
<tr>
<td>U.S.</td>
<td>14.16</td>
<td>13.70</td>
<td>14.19</td>
</tr>
<tr>
<td>India</td>
<td>13.68</td>
<td>6.00</td>
<td>13.69</td>
</tr>
</tbody>
</table>
Cross-country implications
Preliminary Results

Firms

<table>
<thead>
<tr>
<th></th>
<th>ent.rate</th>
<th>avg. firm size</th>
<th>size skew</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
</tr>
<tr>
<td>U.S.</td>
<td>0.050</td>
<td>0.100</td>
<td>1.00</td>
</tr>
<tr>
<td>India</td>
<td>0.065</td>
<td>0.470</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Years of Schooling

<table>
<thead>
<tr>
<th></th>
<th>aggregate</th>
<th>workers</th>
<th>entrepreneurs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Data</td>
<td>Model</td>
</tr>
<tr>
<td>U.S.</td>
<td>14.16</td>
<td>13.70</td>
<td>14.19</td>
</tr>
<tr>
<td>India</td>
<td>13.68</td>
<td>6.00</td>
<td>13.69</td>
</tr>
</tbody>
</table>
Concluding remarks

Role of credit constraints for economic development:

- Reduce $K/Y$ by constraining firm-size.
- Reduce $H$ by lowering schooling incentives (lower working wages).
- Reduce $TFP$ by
  - Increasing physical capital misallocation.
  - Reducing firm-level productivity levels (entrepreneurial schooling under-investment).
  - Increasing entrepreneurial schooling misallocation.
Concluding remarks

Role of credit constraints for economic development:

- Reduce $K/Y$ by constraining firm-size.

- Reduce $H$ by lowering schooling incentives (lower working wages).

- Reduce $TFP$ by
  - Increasing physical capital misallocation.
  - Reducing firm-level productivity levels (entrepreneurial schooling under-investment).
  - Increasing entrepreneurial schooling misallocation.
Concluding remarks

Role of credit constraints for economic development:

- Reduce $K/Y$ by constraining firm-size.

- Reduce $H$ by lowering schooling incentives (lower working wages).

- Reduce $TFP$ by
  - Increasing physical capital misallocation.
    - Reducing firm-level productivity levels (entrepreneurial schooling under-investment).
    - Increasing entrepreneurial schooling misallocation.
Concluding remarks

Role of credit constraints for economic development:

- Reduce $K/Y$ by constraining firm-size.
- Reduce $H$ by lowering schooling incentives (lower working wages).
- Reduce $TFP$ by
  - Increasing physical capital misallocation.
  - Reducing firm-level productivity levels (entrepreneurial schooling under-investment).
  - Increasing entrepreneurial schooling misallocation.
Concluding remarks

Role of credit constraints for economic development:

- Reduce $K/Y$ by constraining firm-size.

- Reduce $H$ by lowering schooling incentives (lower working wages).

- Reduce $TFP$ by
  - Increasing physical capital misallocation.
  - Reducing firm-level productivity levels (entrepreneurial schooling under-investment).
  - Increasing entrepreneurial schooling misallocation.
### Calibration

#### Data sources

<table>
<thead>
<tr>
<th>Target</th>
<th>Data</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>yearly real interest rate</td>
<td>0.04</td>
<td>NIPA</td>
</tr>
<tr>
<td>avg. years of schooling among entrepreneurs</td>
<td>13.9</td>
<td>Levine &amp; Rubinstein (13)</td>
</tr>
<tr>
<td>avg. years of schooling among workers</td>
<td>13.7</td>
<td>Levine &amp; Rubinstein (13)</td>
</tr>
<tr>
<td>earnings share of top 5%</td>
<td>0.3</td>
<td>Buera and Shin (JPE, 13)</td>
</tr>
<tr>
<td>output share of schooling expenditures</td>
<td>0.045</td>
<td>Manuelli &amp; Seshadri (AER, 14)</td>
</tr>
<tr>
<td>output share of teacher and staff compensation</td>
<td>0.05</td>
<td>Erosa et al (REStud, 10)</td>
</tr>
<tr>
<td>ratio avg. labor earnings at age 46 vs age 25</td>
<td>1.75</td>
<td>Kambourov &amp; Manovskii (09)</td>
</tr>
<tr>
<td>entrepreneurship rate</td>
<td>0.1</td>
<td>Levine &amp; Rubinstein (13)</td>
</tr>
<tr>
<td>intergenerational correlation of entrepreneurship</td>
<td>0.32</td>
<td>Dunn &amp; Holtz-Eakin (JoLE, 00)</td>
</tr>
<tr>
<td>employment share of top 5% establishments</td>
<td>0.57</td>
<td>Henly &amp; Sanchez (StLouis, 09)</td>
</tr>
<tr>
<td>ratio of median earnings (entrepreneurs vs workers)</td>
<td>0.92</td>
<td>Levine &amp; Rubinstein (13)</td>
</tr>
<tr>
<td>share household credit in total external finance</td>
<td>0.19</td>
<td>IMF (06)</td>
</tr>
<tr>
<td>ratio of external finance to output</td>
<td>2.9/0.46</td>
<td>Beck et al (World Bank, 00)</td>
</tr>
</tbody>
</table>
Firm-size distribution

**U.S.**

- Mean: 1.0
- Standard deviation: 1.66
- Skewness: 1.04

**India**

- Mean: 0.7
- Standard deviation: 1.27
- Skewness: 1.28
Employment-Establishment Lorenz Curves

Model

Data
Schooling distribution

U.S. mean = 14.2
s.d. = 1.45

India mean = 13.7
s.d. = 2.1