Finance and Development:

Limited Commitment vs. Private Information

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Motivation

- Micro evidence: even within given economy, obstacles to trade may vary depending on location.

- For example, Karaivanov and Townsend (2011) using Townsend Thai data: moral hazard constrained financial regime fits best in urban areas and a more limited savings regimes in rural areas.

What We Do

• Ask: What difference do the micro financial foundations make for the macro economy? Will argue: a big one.

• Develop a general equilibrium model of entrepreneurship and financial frictions that is general enough to encompass:

(1) financial frictions stemming from limited commitment.

(2) financial frictions stemming from private information (moral hazard).

(3) Mixtures of different regimes in different regions.
What We Do

- Study aggregates: GDP, TFP, capital accumulation, wages and interest rates...
- ...but also micro moments: prod. distribution, size distribution of firms, dispersion in MPKs.
- Show: all of these look potentially very different, depending on the underlying financial regime.
Implications for Literature

• Large literature studies role of financial market imperfections in development.

• Most existing studies: limited commitment.

• Much fewer: moral hazard (Castro, Clementi and Macdonald, 2009; Greenwood, Sanchez and Wang, 2010a,b)

• We should use micro data to choose between the myriad of alternative forms of introducing a financial friction into our models.
Common Theoretical Framework

- Individuals: wealth, $a$, entrepreneurial ability, $z$. Markov process $\mu(z'|z)$.

- Preferences over consumption and effort:

  \[ E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, e_t). \]

- Occupational choice: entrepreneur ($x = 1$) or worker ($x = 0$).
Entrepreneurs and Workers

• **Entrepreneurs,** \(x = 1\): technologies

\[ y = f(z, \varepsilon, k, l) = z\varepsilon k^\alpha l^\gamma, \quad \alpha + \gamma < 1 \]

• \(\varepsilon\) ≡ idiosyncratic production risk, with distribution \(p(\varepsilon|e)\).

• **Workers,** \(x = 0\): supply \(\varepsilon\) efficiency units of labor, with distribution \(p(\varepsilon|e)\).

• Note: Depending on \(x = 0\) or \(x = 1\), \(\varepsilon\) is either firm productivity or worker’s efficiency units. Allow for differential responsiveness to \(e\) through appropriate scaling.
**Risk-Sharing**

- Households contract with risk-neutral intermediaries to form “risk-sharing syndicates”: intermediaries bear some of HH risk.
- “Risk-sharing syndicates” take \((w, r)\) as given.
- Assume: can only insure against production risk, \(\varepsilon\), but not against talent, \(z\).
- Optimal contract:

  (1) assigns occupation, \(x\), effort, \(e\), capital, \(k\), and labor, \(l\). After \(\varepsilon\) is drawn, assigns consumption and savings \(c(\varepsilon)\) and \(a'(\varepsilon)\).

  (2) leaves zero profits to intermediary \(\Leftrightarrow\) maximizes individual’s utility.
Timing

Value function \( v(a, z) \) recorded

\[ a_t, z_t \quad (e_t, x_t, k_t, l_t) \quad \varepsilon_t \quad (c_t(\varepsilon_t), a_{t+1}(\varepsilon_t)) \]

\( t \quad t + 1 \)
Optimal Contract: Bellman Equation

\[ \nu(a, z) = \max_{e,x,k,l,c(\varepsilon),a'(\varepsilon)} \sum_{\varepsilon} p(\varepsilon|e) \{ u[c(\varepsilon), e] + \beta \mathbb{E}\nu[a'(\varepsilon), z'] \} \]

s.t.

\[ \sum_{\varepsilon} p(\varepsilon|e) \{ c(\varepsilon) + a'(\varepsilon) \} \]

\[ \leq \sum_{\varepsilon} p(\varepsilon|e) \{ x[z\varepsilon k^\alpha l^\gamma - w] - (r + \delta)k \} + (1 - x)w\varepsilon \} \]

+ (1 + r)a

and s.t. regime-specific constraints
Private Information

- effort, $e$, unobserved $\Rightarrow$ moral hazard problem.

- Note: moral hazard for both entrepreneurs and workers.

- IC constraint:

\[
\sum_{\varepsilon} p(\varepsilon|e) \{ u[c(\varepsilon), e] + \beta \mathbb{E} v[a'(\varepsilon), z'] \} \\
\geq \sum_{\varepsilon} p(\varepsilon|\hat{e}) \{ u[c(\varepsilon), \hat{e}] + \beta \mathbb{E} v[a'(\varepsilon), z'] \} \quad \forall e, \hat{e}, x
\]
Formulation with Lotteries

- Notation: control variables $d = (c, \varepsilon, e, x)$.
- Lotteries: $\pi(d, a'|a, z) = \pi(c, \varepsilon, e, x, a'|a, z)$

$$v(a, z) = \max_{\pi(d,a'|a,z)} \sum_{D,A} \pi(d,a'|a,z) \{ u(c, e) + \beta E v(a', z') \} \quad \text{s.t.}$$

$$\sum_{D,A} \pi(d, a'|a, z) \{ a' + c \}$$

$$= \sum_{D,A} \pi(d, a'|a, z) \{ x \Pi(\varepsilon, e, z; w, r) + (1 - x)w\varepsilon \} (1 + r)a.$$ 

$$\sum_{(D \setminus E), A} \pi(d, a'|a, z) \{ u(c, e) + \beta E v(a', z') \}$$

$$\geq \sum_{(D \setminus E), A} \pi(d, a'|a, z) \frac{p(\varepsilon|\hat{e})}{p(\varepsilon|e)} \{ u(c, \hat{e}) + \beta E v(a', z') \} \quad \forall e, \hat{e}, x$$

$$\sum_{C, A} \pi(d, a'|a, z) = p(\varepsilon|e) \sum_{C, \varepsilon, A} \pi(d, a'|a, z), \quad \forall \varepsilon, e, x$$
Limited Commitment

• effort, \( e \), observed \( \Rightarrow \) perfect insurance against production risk, \( \varepsilon \).

• But collateral constraint:

\[
k \leq \lambda a, \quad \lambda \geq 1.
\]
**Factor Demands**

- Denote optimal occupational choice and factor demands by
  
  \[ x(a, z), \quad l(a, z; w, r), \quad k(a, z; w, r) \]

- and individual (average) labor supply:
  
  \[ n(a, z; w, r) \equiv [1 - x(a, z)] \sum_{\varepsilon} p[\varepsilon | e(a, z)] \varepsilon. \]
Steady State Equilibrium

- Prices $r$ and $w$, and corresponding quantities such that:

(i) Taking as given $r$ and $w$, quantities are determined by optimal contract

(ii) Markets clear

\[
\int l(a, z; w, r)dG(a, z) = \int n(a, z; w, r)dG(a, z)
\]
\[
\int k(a, z; w, r)dG(a, z) = \int a dG(a, z).
\]
**Parameterization**

- **Preferences**
  \[ u(c, e) = U(c) - V(e), \quad U(c) = \frac{c^{1-\sigma}}{1 - \sigma}, \quad V(e) = \frac{\chi}{1 + \varphi} e^{1+\varphi} \]

- **Recall production function** \( \varepsilon z k^{\alpha} l^{\gamma} \).

- **Parameters:**
  \[ \alpha = 0.3, \quad \gamma = 0.4, \quad \delta = 0.06 \]
  \[ \beta = 1.05^{-1}, \quad \sigma = 1.5, \quad \chi = .5, \quad \varphi = .2 \]

  \[ \varepsilon \in \{2, 4\}, \quad e \in \{0, 1\}, \quad p(\varepsilon | e) = \begin{bmatrix} 0.8 & 0.2 \\ 0.2 & 0.8 \end{bmatrix} \]

- **Parameters same (range) as those estimated from micro data by Karaivanov and Townsend (2011)**
Limited Commitment vs. Moral Hazard

- Savings behavior very different in two regimes.
- Limited commitment: borrowing constrained.

\[ U'(c_t) = \beta \mathbb{E}_{z,t} [U'(c_{t+1})(1 + r) + \mu_{t+1}\lambda] \]

\[ U'(c_t) > \beta(1 + r)\mathbb{E}_{z,t} U'(c_{t+1}) \]
Limited Commitment vs. Moral Hazard


\[ U'(c_t) = \beta(1 + r)E_{z,t} \left( E_{\varepsilon,t} \frac{1}{U'(c_{t+1})} \right)^{-1} \]

- Jensen \( \Rightarrow \) savings constrained

\[ U'(c_t) < \beta(1 + r)E_{z,t}E_{\varepsilon,t} U'(c_{t+1}) \]

- Note: presence of uninsurable ability \( z \).

- Difference in savings reflected in equilibrium \( r \) among others.
**Limited Commitment vs. Moral Hazard**

Figure: Distribution of Marginal Products of Capital.

- Why are MPKs equalized?
**Limited Commitment vs. Moral Hazard**

*Figure:* Distribution of Firm-level TFP.

- Recall $y = z\varepsilon k^{\alpha} l^{\gamma}$. 
Limited Commitment vs. Moral Hazard

**Figure:** Firm-Size Distribution (Employees).
Mixtures of Moral Hazard and Limited Commitment

• Combine the two regimes in one economy. 50% of pop. subject to moral hazard, 50% to limited commitment.

• Motivation: no reason why economy as a whole should be subject to only one friction.

• Estimated “on the ground” by Paulson, Townsend and Karaivanov (2006) and Ahlin and Townsend (2007): for Thailand, MH fits better in and around Bangkok and LC better in Northeast (see also Karaivanov and Townsend, 2011)

• Also: factor prices different in two regimes ⇒ potentially interesting GE effects.
# Mixtures of Moral Hazard and Limited Commitment

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<th>FB</th>
<th>LC</th>
<th>MH</th>
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<th>Mix - MH</th>
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<td>% Entrepreneurs</td>
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<td>37.36</td>
<td>35.33</td>
<td>6.67</td>
<td>52.58</td>
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*Table:* Comparison of Regimes
Individual Transitions

- Speed of individual transitions is also very different.
- Examine eigenvalue of transition matrix $\Pr(a', z'|a, z)$ that governs speed of convergence.
- Limited commitment: eig. = 0.9465 $\Rightarrow$ half life = 12.6 years.
- Moral hazard: eig. = 0.994 $\Rightarrow$ half life = 115.2 years.
- Note: these are of course numerical examples rather than general proofs.
A Transition Experiment

- Start economy in steady state with 100% of pop. subject to moral hazard.
- At time $t = 10$, friction changes: entire pop. now subject to limited commitment.
- Possible interpretation: big migration from area where moral hazard is prevalent to one with limited commitment.
Transition Dynamics

- Similar to before but $w_t$, $r_t$ vary over time. Bellman:

$$V_t(a, z) = \max_{e, x, k, l, c(\epsilon), a'(\epsilon)} \sum_{\epsilon} p(\epsilon|e) \{u[c(\epsilon), e] + \beta \mathbb{E}_z V_{t+1}[a'(\epsilon), z']\} \text{ s.t.}$$

$$\sum_{\epsilon} p(\epsilon|e) \{c(\epsilon) + a'(\epsilon)\} \leq \sum_{\epsilon} p(\epsilon|e) \{x[z\epsilon f(k, l) - w_tl - (r_t + \delta)k] + (1 - x)w_t\epsilon]\} + (1 + r_t)a$$

and s.t. regime-specific constraints

- Market clearing analogous to before.
Algorithm

- Adaptation of Buera and Shin (2010).
- Begin with initial guesses \(\{(w_t^0, r_t^0)\}_{t=1}^T\). Then for \(j = 0, 1, 2, \ldots\) we follow

1. Set \(V_T^j(a, z) = V_\infty^j(a, z)\). Given \(V_T^j(a, z)\), find \(V_{T-1}^j(a, z)\) and so on.

2. Compute factor demands and supplies
   \(\{k_t^j(a, z), l_t^j(a, z), n_t^j(a, z)\}_{t=0}^T\)

3. Compute excess demand \(ED_t^j(\{(w_t^j, r_t^j)\}_{t=1}^T), t = 1, \ldots, T\).

4. Construct \(\{(w_t^{j+1}, r_t^{j+1})\}_{t=1}^T\): find \((\hat{w}_t^j, \hat{r}_t^j)\) that sets \(ED_t^j = 0\) and set
   \[(w_t^{j+1}, r_t^{j+1}) = \eta(w_t^j, r_t^j) + (1 - \eta)(\hat{w}_t^j, \hat{r}_t^j), \quad \eta \in (0, 1)\]

- Repeat (1)-(4) until \(ED_t^j = 0\) for all \(t\).
Transition

(a) Capital Stock

(b) GDP

(c) TFP

(d) Fraction of Entrepreneurs
Transition: Prices

(a) Wage

(b) Interest Rate
Transition: Wealth Distribution

Figure: Initial (solid line) and terminal (dashed line) wealth distribution
Conclusion

- Details of financial sector matter for the macro economy.
- Needed: more research that makes use of micro data and takes seriously the micro financial underpinnings of macro models.
- Join what have been largely two distinct literatures – macro development and micro development – into a coherent whole:
  - Macro development needs to take into account the contracts we see on the ground.
  - Micro development needs to take into account GE effects of interventions.


Representative capital producing firm solves

\[ V_0 = \max \sum_{t=0}^{\infty} \frac{D_t}{(1 + r)^t} \] \[ \text{s.t.} \]

\[ B_{t+1} + I_t + D_t = R_t K_t + (1 + r_t) B_t, \quad K_{t+1} = I_t + (1 - \delta) K_t \]

\[ \Rightarrow \] no arbitrage: \( R_t = r_t + \delta \).

Bond market clearing

\[ B_t + \int adG_t(a, z) = 0, \quad \text{all } t \]

Can show:

\[ V_t = (1 + r)(K_t + B_t), \quad \text{all } t \]

Zero profits + bond market clearing \( \Rightarrow \)

\[ K_t = \int adG_t(a, z), \quad \text{all } t. \]