Finance and Development: A Tale of Two Sectors

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Motivation

- Low TFP in poor countries lead to high income per capita differences across countries (Klenow and Rodriguez Clare (1997) and Hall and Jones (1999)).

\[ \frac{P^{LD}_M}{P^{LD}_S} > \frac{P^D_M}{P^D_S} \] and this is closely linked to sector-level relative productivity. In models with CRS production function and equal factor shares across sectors, relative prices equal the inverse of relative TFP.

- Relative TFP of manufacturing to services is positively correlated to output per worker and relative prices are negatively correlated.

- Large differences in scale across sectors. \( \text{Size}_M \gg \text{Size}_S \)

- There is a negative relation between relative prices and external finance to GDP ratio.
Facts

<table>
<thead>
<tr>
<th>Workers per Establishment</th>
<th>Workers per Enterprise</th>
<th>External Dependence</th>
<th>Capital Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>US</td>
<td>OECD</td>
<td>US</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>28</td>
<td>0.21</td>
</tr>
<tr>
<td>Services</td>
<td>14</td>
<td>8</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>0.31</td>
</tr>
</tbody>
</table>

Finance and Development: A Tale of Two Sectors
The authors contribute to a vast theoretical literature relating financial frictions, entrepreneurship, and economic development.

- Amaral and Quintin (2010) and Greenwood, J.M. Sanchez and Wang (2010) are recent contributions that quantify the long-run impact of financial frictions.
The main goal of this paper is to capture and quantify the role of financial markets in economic development.

**Main Contribution:** Present a rich quantitative framework and analyze the role of financial frictions in explaining a set of empirical regularities: Poor countries’ low per-capita income, low aggregate TFP, and large differences across industrial sectors in relative prices and implied sector-level productivity.
Economic Mechanism

With financial frictions wealth start determining also who become entrepreneur⇒ The average talent of active entrepreneurs fall while the dispersion of talent increase. This affect more M than S sector and we end up in an equilibrium with too many establishments that are too small.
Environment

- 2 Sectors, S (small scale) and M (large scale).
- Output of service is use only for consumption. Manufactured goods (numerarie) are used for consumption and investment.
- Measured N of infinitely-lived individuals.
- Heterogeneity comes from wealth and entrepreneurial talent \( z \) which are drawn from \( \mu(z) \).
- Entrepreneurial ideas die with hazard rate \( 1 - \gamma \). \( \gamma \) is the persistence of the entrepreneurial idea.
- Each period there is an occupational choice decision: to work or to be an entrepreneur in the S or M sector.
- Capital is limited by wealth through an endogenous collateral constraint.
- Each entrepreneur can only operate one establishment.
Preferences

(1)

\[ U(c) = E \left[ \sum_{t=0}^{\infty} \beta^t u(c_t) \right], \quad u(c_t) = \frac{1}{1-\sigma} \left( \psi c_{S,t}^{1-1/\epsilon} + (1-\psi) c_{M,t}^{1-1/\epsilon} \right)^{\frac{1-\sigma}{1-1/\epsilon}} \]

where \( \beta \) is the discount factor, \( \sigma \) is the coefficient or relative risk aversion, \( \epsilon \) is the intratemporal elasticity of substitution between S and M goods, and \( \psi \) controls the share of services in total consumption expenditure. The expectation is over \( z \) which depends on \( 1-\gamma \) and \( \mu(z) \)
There are sector specific fix cost $\kappa_j$ (in unit’s of the sector output) where $j = S, M$ to operate an establishment. Assume that $\kappa_M > \kappa_S$. This cost should be paid every period.

**Production function:** $z_j f(k, l) = z_j k^\alpha l^\theta$ where $\alpha + \theta < 1$

**Profit:** $\pi_j(k, l; R, w, p) = p_j z_j k^\alpha l^\theta - Rk - wl - (1 + r)p_j \kappa_j$

**Optimal Choices without Financial constraints:**

$$\left(k_j^u(z_j), l_j^u(z_j)\right) = \arg \max_{k, l} \{ p_j z_j k^\alpha l^\theta - Rk - wl \}$$

Fixed costs introduce a non-convexity. Technology is feasible only if $z_j k^\alpha l^\theta \geq (1 + r) \kappa_j$
Credit and Rental Markets

- Individuals have access to competitive financial intermediaries who receive deposits (which returns is $r$), rent capital $k$ at rate $R$ to entrepreneurs and lend entrepreneurs the fixed cost $p_j \kappa_j$.
- Zero profit condition: $R = r + \delta$ where $\delta$ is depreciation.
- There are imperfect enforceable contracts $\implies$ Borrowing and capital rental is limited.
- After production take place entrepreneurs can renege on the contracts. They keep $p_j z_j k^\alpha l^\theta - R k - w l - (1 + r) p_j \kappa_j$. Only punishment is the garnishment of their financial assets $a$.
- Only consider equilibriums where the borrowing and capital rental contracts are incentive compatible and are hence fulfilled. Then $\bar{k}^j(a, z_j, \phi) \leq k^u_j(z_j)$
Proposition 1

Capital Rental $k$ in sector $j$ by an entrepreneur with wealth $a$ and talent $z_j$ is enforceable iff

$$
\max_l \{p_j z_j f(k, l) - w l\} - R k - (1 + r) p_j \kappa_j + (1 + r) a \geq \left(1 - \phi\right) \left[\max_l \{p_j z_j f(k, l) - w l\} + (1 - \delta) k\right]
$$

the upper bound on capital rental that is consistent with entrepreneurs choosing to abide by their contracts can be represented by a function $\bar{k}^j(a, z_j; \phi)$, which is increasing in all the arguments.

There is no default in equilibrium
Individuals’ Problem

\[ \nu(a, z) = \max \{ \nu^W(a, z), \nu^M(a, z), \nu^S(a, z) \} \]

\[ \nu^W(a, z) = \max_{c, a' \geq 0} u(c) + \beta \{ \gamma \nu(a', z) + (1 - \gamma) E_{z'} [\nu(a', z')] \} \]

\( \text{st } p \cdot c + a' \leq w + (1 + r) a \)

\[ \nu^j(a, z) = \max_{c, a', k, l \geq 0} u(c) + \beta \{ \gamma \nu(a', z) + (1 - \gamma) E_{z'} [\nu(a', z')] \} \]

\( \text{st } p \cdot c + a' \leq p_j z_j f(k, l) - wl - Rk - (1 + r) p_j k_j + (1 + r) a \)

\[ k \leq \bar{k}^j(a, z_j; \phi) \]

- Denote the optimal occupational choice

\[ o(a, z) \in \{ W, S, M \} \]
Stationary Competitive Equilibrium

A Stationary competitive equilibrium is composed of: an invariant distribution of wealth and entrepreneurial ideas $G(a, z)$ with the marginal distribution of $z$ denoted with $\mu(z)$; policy functions $c_S(a, z)$, $c_M(a, z)$, $a'(a, z)$, $o(a, z)$, $l(a, z)$, $k(a, z)$; rental limits $\bar{k}^j(a, z_j; \phi)$, $j = S, M$; and prices $w, R, r, p$ such that:

1. Given $\bar{k}^j(a, z_j; \phi)$ and prices, the individual policy functions solve the individuals' problem.

2. Financial intermediaries make zero profit: $R = r + \delta$.

3. Rental limits are the most generous satisfying condition 2, with $\bar{k}^j(a, z_j; \phi) \leq \bar{k}^u_j(z_j)$.

4. Capital rental, labor, services and manufactured goods markets clear.

5. The joint distribution of wealth and entrepreneurial ideas is a fixed point of the equilibrium mapping.
Perfect Credit Benchmark

- In this case $\phi = 1$ and $k_j^i(a, z_j, \phi) = k_j^u(z_j)$

**Proposition 2**
Assume that entrepreneurial talents for the two sectors follow mutually-independent Pareto distributions with the same tail parameter $\eta$, $(z_S, z_M) \sim \eta^2(z_S z_M)^{-(\eta+1)}$ for $z_j \geq 1$, $j = S, M$, and that active entrepreneurs are a small fraction of the population. Then the output of a sector, net of fixed costs, equals:

$$Y_j(K_j, L_j; N) = A_j N^{\frac{1}{\eta}} K_j^{\frac{\alpha}{\alpha+\theta+1/\eta}} L_j^{\frac{\theta}{\alpha+\theta+1/\eta}}$$

where $A_j$ is a function of $w, p_j, \kappa_j, \alpha, \theta, \eta$ and $N$ is total population.
Proposition 3

Assume that entrepreneurial talents for the two sectors follow mutually-independent Pareto distributions with the same tail parameter $\eta$, $(z_S, z_M) \sim \eta^2 (z_S z_M)^{-(\eta+1)}$ for $z_j \geq 1$, $j = S, M$, and that active entrepreneurs are a small fraction of the population. Then the establishment size distributions in each sector follows the power law:

$$ Pr[\tilde{l}_j > l] = \left( \frac{l(\hat{z}_j)}{l} \right)^{\eta(1-\alpha-\theta)}, \quad l \geq l(\hat{z}_j) $$

where $l(\hat{z}_j)$ is the employment in the marginal establishment of sector $j$. Furthermore, the establishment size distribution in the aggregate economy is given by a mixture of Pareto distributions:

$$ Pr[\tilde{l}_j > l] = \eta_S \left( \frac{l(\hat{z}_S)}{l} \right)^{\eta(1-\alpha-\theta)} + \eta_M \left( \frac{l(\hat{z}_M)}{\max\{l, l(\hat{z}_M)\}} \right)^{\eta(1-\alpha-\theta)}, \quad l \geq l(\hat{z}_j) $$

where $\eta_S$ and $\eta_M$ are respectively the fraction of service and manufacturing establishments in the economy, with $\eta_S + \eta_M = 1$. Also, the ratio of the average establishments sizes of the two sectors is:

$$ \frac{\bar{l}_j}{\bar{l}_j'} = \frac{p_j \kappa_j + w}{p_j' \kappa_j' + w} $$
Calibration

- Calibrate the perfect-credit benchmark to the US economy. Then vary $\phi$ to generate variation in external finance to GDP ratios to compare between different countries.
- Hold fixed all technological parameters across countries.
- They find that starting with the same potential pool of entrepreneurs, financial frictions distort the selection into entrepreneurship.
- Calibrate 11 parameters: $\alpha, \theta, \kappa_S, \kappa_M, \delta, \gamma, \eta, \beta, \sigma, \epsilon, \psi$.
- They set $\sigma = 1.5, \epsilon = 1.0, \delta = 0.06$ and capital income share $\alpha/(1/\eta + \alpha + \theta) = 0.3$ standard values in the literature.
<table>
<thead>
<tr>
<th>Target Moments</th>
<th>US Data</th>
<th>Model</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10-percentile employment share</td>
<td>0.69</td>
<td>0.69</td>
<td>$\eta = 4.84$</td>
</tr>
<tr>
<td>Top 5-percentile earnings share</td>
<td>0.30</td>
<td>0.30</td>
<td>$\alpha + \theta = 0.79$</td>
</tr>
<tr>
<td>Average scale in services</td>
<td>14</td>
<td>14</td>
<td>$\kappa_S = 0.00$</td>
</tr>
<tr>
<td>Average scale in manufacturing</td>
<td>47</td>
<td>47</td>
<td>$\kappa_M = 4.68$</td>
</tr>
<tr>
<td>Establishment exit rate</td>
<td>0.10</td>
<td>0.10</td>
<td>$\gamma = 0.89$</td>
</tr>
<tr>
<td>Manufacturing share of GDP</td>
<td>0.25</td>
<td>0.25</td>
<td>$\psi = 0.91$</td>
</tr>
<tr>
<td>Interest rate</td>
<td>0.04</td>
<td>0.04</td>
<td>$\beta = 0.92$</td>
</tr>
</tbody>
</table>
Results

- The equilibrium external finance to GDP ratio is monotonically increasing in $\phi$.
- Variation in financial frictions bring down output per worker to less than half of the perfect credit economy.
- Financial frictions can reduce aggregate TFP by 36% in the model.
- Financial frictions reduce $K/Y$ by 15%.
- The pattern of relative productivity leads to $P_M$ relative higher to $P_S$ in countries with underdeveloped financial markets.
- With financial frictions wealth start determining also who become entrepreneur ⇒ The average talent of active entrepreneurs fall while the dispersion of talent increase. This affect more M than S sector.
- Financial frictions lead to an equilibrium with too many establishments that are too small.
Sector-Level Results

- Financial frictions reduce TFP by 26% in the Service sector and 55% in the Manufacturing sector.
- Because of their larger scale and financing needs, establishments in manufacturing are more vulnerable to financial frictions.
- There is more capital misallocation of capital and entrepreneurial talent in M than in S.
- The distortions of entry and exit decisions of entrepreneurs matter vastly more for manufacturing.
Conclusion

- Developed a quantitative theory linking financial development to output per worker, TFP, sector level productivity and relative prices.

- Financial frictions distort the allocation of capital and entrepreneurial talent, and have sizable adverse effects on a country’s output per worker and TFP.

- Sectors operating at large scales suffer more from this financial frictions.

- The results are consistent with the empirical work previously done.