Industrial Structure and Corporate Finance

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Issues

- Traditional unit of analysis in corporate finance is the single firm.

- Instead, focus on relationships between firms in determining corporate financial decisions.

- Corporate balance sheets reflect interactions among firms (as suppliers and customers).
Developed Country Corporate Balance Sheets

Rajan and Zingales (J. of F. 1995)
• Why do firms lend and borrow so much from each other?

• Accounts payable seem large, relative to cash holding given discounts for prompt payment of invoices. For Japan, cash holdings exceed accounts payable

• Literature on trade credit has taken a bilateral contracting perspective:
  – Firms borrow from suppliers because they cannot obtain funding from elsewhere
  – Supplier firms have comparative advantage in acting as lenders due to information advantage, etc.

Can we partition firms into creditor firms and debtor firms?
Manufacturing firms in Japan, 2003 (1198 observations).

Slope of OLS regression $\approx 1$.
Can we say any more than noting that receivables/sales ratio is constant?
• Firms that *borrow more* are those that *lend more*.
• Most (manufacturing) firms are *net lenders*. 
Agenda

• Why do some firms simultaneously borrow more and lend more?

• Why are most (manufacturing) firms net lenders?

• What accounts for the difference across countries in the pattern of receivables and payables?

• What are the implications for the role of finance in industrial development?
Production Chain

Final output sold by firm 0 at price $q$.

Firm $i + 1$ supplies intermediate good to firm $i$.

There is a “time to build” in production process.

Success of project depends on effort of all firms in the production chain.
## Cash Flows before Transfers

<table>
<thead>
<tr>
<th>date ( t )</th>
<th>Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>( \vdots )</td>
<td></td>
</tr>
<tr>
<td>( N-1 )</td>
<td>( -w_1 )</td>
</tr>
<tr>
<td>( N )</td>
<td>( -w_0 )</td>
</tr>
<tr>
<td>( N+1 )</td>
<td>( q-w_0 )</td>
</tr>
<tr>
<td>( N+2 )</td>
<td>( q-w_0 )</td>
</tr>
<tr>
<td>( \vdots )</td>
<td>( \vdots )</td>
</tr>
</tbody>
</table>

Wage cost \( w_i \) cannot be deferred, and must draw on firm \( i \)'s cash holdings.
Obsolescence

- In each period, firm $i$ chooses from \{high effort, low effort\}

- Private benefit from low effort, $bw_i \ (b > 0)$

- Probability of obsolescence
  - $\pi^H$ if all exert high effort, $\pi^L$ if one or more exert low effort, $(\pi^L > \pi^H)$
  - Obsolescence implies zero cash flow forever
  - Obsolescence implies zero liquidation value of firms
  - Independence over time
Recursive Moral Hazard

Payment $p_i$ to firm $i$ by firm $i - 1$ for intermediate good.

Payoff to high effort conditional on high effort in the past

$$(p_i - p_{i+1} - w_i) \sum_{\tau=0}^{\infty} (1 - \pi^H)^{\tau}$$

Payoff to deviating for one period

$$bw_i + (p_i - p_{i+1} - w_i) \left( \sum_{\tau=0}^{i} (1 - \pi^H)^{\tau} + (1 - \pi^L) \sum_{\tau=i}^{\infty} (1 - \pi^H)^{\tau} \right)$$

Incentive compatibility constraint (recursive moral hazard)

$$p_i \geq p_{i+1} + (1 + b_i) w_i$$

(IC)
\[ b_i = b \cdot \frac{\pi^H}{(\pi^L - \pi^H) (1 - \pi^H)^i} \]

(IC) is sufficient to rule out other deviations.

\[ p_i \geq \sum_{k=i}^{N} (1 + b_k) w_k \]

Production chain sustainable only if recursive moral hazard is not too severe.

Length of production chains limited by recursive moral hazard, as well as logistical/technological problems (Kremer (93), Jones (06)).

Parallels with “disorganization” (Blanchard and Kremer (97)).
**Accounts Receivable and Payable**

Firm $i$ receives payment from firm $i - 1$ after delay of $d_i$ periods.

Accounts payable amortized at constant rate $a_i p_i$ (actuarially fair).

Payment gross of amortization is $(1 + a_i) p_i$.

Incentive compatibility constraint with accounts receivable/payable

\[(1 + a_i) p_i \geq (1 + a_{i+1}) p_{i+1} + (1 + b_i) w_i\]

Hurdle prices

\[p_i \geq \frac{1}{1 + a_i} \sum_{k=i}^{N} (1 + b_k) w_k\] \hspace{1cm} (IC)

IC constraint can be relaxed by accumulating receivables.
But IR constraint limits how far IC constraint can be relaxed.

**Intuition:** \(i\)'s accounts receivable is \(i\)'s stake in the project as a whole. By choosing a high enough stake, IC constraint can be relaxed as long as participation constraint is slack.

Firms are *creditors* to downstream firms, but *debtors* to upstream firms.

*Net* accounts receivable is stake in project (recall the chart for Japan...)

Opposite direction from cross-holding of equity stakes
Participation Constraint

Firm $i$’s cash flows are a combination of three risky perpetuities.

• wage cost $-w_i$ per period, starting immediately

• revenue $(1 + a_i)p_i$ per period, starting with delay of $d_i$ periods

• input cost $-(1 + a_{i+1})p_{i+1}$ per period, starting with delay of $d_{i+1} - 1$ periods.

Expected net present value of firm $i$’s cash flows is

$$V_i \equiv -\frac{w_i}{\pi H} + (1 - \pi^H) \frac{d_i}{\pi H} (1 + a_i)p_i - (1 - \pi^H) \frac{d_{i+1} - 1}{\pi H} (1 + a_{i+1})p_{i+1}$$
Participation constraint

\[ V_i \geq 0 \] \hspace{1cm} \text{(IR)}

Optimal contract maximizes surplus for firm 0 subject to (IC) and (IR) for upstream firms.

Equivalent to recursive bilateral contracts where firm \( i \) is principal, firm \( i + 1 \) is agent.

Any slack in the IR constraint is fungible in relaxing IC constraint.

\[ \Rightarrow \text{ Both IC and IR constraints bind with equality in optimal contract (subject to integer constraints).} \]
\[
\begin{align*}
a_i p_i &= a_{i+1} p_{i+1} + b_i w_i - (p_i - p_{i+1} - w_i) \\ &= a_{i+1} p_{i+1} + (b_i - \delta_i) w_i
\end{align*}
\]

- Net receivables must be large enough to overcome moral hazard

- \(p_i - p_{i+1}\) large enough to compensate for fair value of working capital.

Model passes two key tests.

1. Net receivables are positive for durable production chains (\(\delta_i \approx 0\)).

2. Firms that borrow more are those that lend more.
Elasticity of Receivables w.r.t. Payables

\[ \rho_i \equiv \frac{a_i}{1 + a_i} \propto \frac{\text{receivables}}{\text{sales}}, \quad \pi_i \equiv \frac{a_{i+1}p_{i+1}}{(1 + a_i)p_i} \propto \frac{\text{payables}}{\text{sales}} \]

Define cross-section elasticity:

\[ \varepsilon(i, i + 1) \equiv \frac{\left( \rho_{i+1} - \rho_i \right) / \rho_i}{\left( \pi_{i+1} - \pi_i \right) / \pi_i} \]

\[ = \frac{\frac{a_{i+1}}{a_i} - 1}{(1 + a_i)p_i\frac{a_{i+2}p_{i+2}}{a_{i+1}p_{i+1}^2} - 1 - a_{i+1}} \]

\[ \rightarrow 0 \quad \text{as } w_i \text{ becomes large} \]

Choose profile of firm sizes so that \( \varepsilon(i, i + 1) = \varepsilon \), for all \( i \).
More vertically integrated production chain has lower $\varepsilon$.

**Intuition.** Firm $i$ must have sufficiently large stake ($= $ net receivables). If firm $i$ is large relative to $i + 1$, payables are small relative to sales. Receivables are due to mainly to firm $i$’s own value added, rather than value of intermediate input.
\[
\frac{\Delta \rho_i / \rho_i}{\Delta \pi_i / \pi_i} = \varepsilon
\]

\[
\log \left( \frac{\text{receivables}}{\text{sales}} \right) \simeq \alpha + \varepsilon \log \left( \frac{\text{payables}}{\text{sales}} \right)
\]

Cobb-Douglas representation of receivables:

\[
\log (\text{receivables}) \simeq \alpha + \varepsilon \log (\text{payables}) + (1 - \varepsilon) \log (\text{sales})
\]

**Hypothesis.** Coefficient on \( \log (\text{payables}) \) in Cobb-Douglas representation is small for manufacturing sectors with greater vertical integration.
<table>
<thead>
<tr>
<th>Country</th>
<th>log payables</th>
<th>log sales</th>
<th>$R^2$</th>
<th>obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>0.18(0.08)</td>
<td>0.80(0.06)</td>
<td>0.90</td>
<td>162</td>
</tr>
<tr>
<td>France</td>
<td>0.37(0.06)</td>
<td>0.57(0.06)</td>
<td>0.95</td>
<td>226</td>
</tr>
<tr>
<td>Germany</td>
<td>0.24(0.06)</td>
<td>0.78(0.06)</td>
<td>0.93</td>
<td>261</td>
</tr>
<tr>
<td>Italy</td>
<td>0.34(0.09)</td>
<td>0.53(0.09)</td>
<td>0.92</td>
<td>93</td>
</tr>
<tr>
<td>Japan</td>
<td>0.40(0.02)</td>
<td>0.58(0.02)</td>
<td>0.94</td>
<td>1198</td>
</tr>
<tr>
<td>Korea</td>
<td>0.15(0.08)</td>
<td>0.85(0.08)</td>
<td>0.95</td>
<td>162</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.46(0.05)</td>
<td>0.44(0.06)</td>
<td>0.87</td>
<td>223</td>
</tr>
<tr>
<td>U.K.</td>
<td>0.17(0.06)</td>
<td>0.81(0.06)</td>
<td>0.91</td>
<td>298</td>
</tr>
<tr>
<td>U.S.A</td>
<td>0.19(0.03)</td>
<td>0.81(0.03)</td>
<td>0.92</td>
<td>1199</td>
</tr>
</tbody>
</table>

Source: Compustat Global, manufacturing firms, 2003 accounts.
Electronics industry (NAICS 334) in Japan and the U.S.
## Automobile Industry

<table>
<thead>
<tr>
<th></th>
<th>log payable</th>
<th>log sales</th>
<th>$R^2$</th>
<th>obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>0.492 (0.136)</td>
<td>0.494 (0.137)</td>
<td>0.956</td>
<td>91</td>
</tr>
<tr>
<td>USA</td>
<td>0.104 (0.217)</td>
<td>1.105 (0.248)</td>
<td>0.932</td>
<td>41</td>
</tr>
</tbody>
</table>

![Graph showing relationships between Payables and Receivables for different companies.](image)
**Receivables/Assets.** Ratio of receivables to wage cost is proportional to

\[
\frac{a_i+1 p_{i+1}}{w_i} + \beta_i
\]

Receivables depend on relative position in production chain. Wage cost depends on size of firm.

Assets \(\propto\) wage costs \(\Rightarrow\) economy with less vertical integration has larger receivables/assets ratio.
Net Receivables.

\[
\frac{\text{net receivable}}{\text{wage costs}} \propto \frac{a_i p_i - a_{i+1} p_{i+1}}{w_i} = \beta_i
\]

\(\beta_i\) is high for upstream firms. Longer production chains give rise to higher net receivables on average.
Industrial Development

How can developing countries with poorly capitalized firms achieve lengthening of production chain?

Two hurdles:

• Working capital to finance the initial “triangle of costs”

• Sustaining long production chain

Both can be solved if firms have sufficient initial capital (by using IR slack to relax IC).

Both are problematic when firms are poorly capitalized, and outside financing is infeasible.
Korean Experience

Korean firms seem to operate with slender working capital...

How do they sustain long production chains?
Financial Innovation

Transferable promissory notes (Uh-um (어음))

Short term corporate liabilities, with

- Transferability
- Endorsement
- Possibility of discount
- Promise to pay, rather than order to pay (for promissory Uh-um)
  Unlike banker’s acceptance or bill of exchange accepted by bank
Mechanics of Promissory Notes

Making creditworthiness of firm 0 available to whole production chain.

Firm 0 secures credit line of $2p$, pass down the chain.

Cash flow table:

<table>
<thead>
<tr>
<th>Date</th>
<th>Firms</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t + 1$</td>
<td></td>
<td></td>
<td>$p - w$</td>
<td></td>
<td>$-p$</td>
</tr>
<tr>
<td>$t + 2$</td>
<td></td>
<td>$-w$</td>
<td></td>
<td>$p - w$</td>
<td>$-p$</td>
</tr>
<tr>
<td>$t + 3$</td>
<td></td>
<td>$3p - 2p$</td>
<td></td>
<td></td>
<td>$2p$</td>
</tr>
<tr>
<td>Working capital</td>
<td>$w + 2p$</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Consequences of Promissory Notes

• Balance sheets are small relative to economic activity.

• Accounts receivable are “liquified” and transferred rather than sitting idly on firm’s balance sheet

• But the cost is contingent liability of promissory notes
  – firms that pass on promissory notes are tied together in a common destiny
  – contingent liabilities $\propto$ scale of firm 0
  – contingent liabilities $\gg$ accounts receivable

• Incentives aligned through “stick” of contingent liability rather than “carrot” of accounts receivable
# Prevalence of Promissory Notes in Korea

## Share of total payments received by SMEs (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash</th>
<th>Prom. Notes</th>
<th>Trade Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>29.4</td>
<td>56.2</td>
<td>14.4</td>
</tr>
<tr>
<td>1994</td>
<td>28.2</td>
<td>56.6</td>
<td>15.2</td>
</tr>
<tr>
<td>1995</td>
<td>30.3</td>
<td>57.5</td>
<td>12.2</td>
</tr>
<tr>
<td>1996</td>
<td>29.4</td>
<td>55.7</td>
<td>14.9</td>
</tr>
<tr>
<td>1997</td>
<td>28.2</td>
<td>59.5</td>
<td>12.3</td>
</tr>
<tr>
<td>1998</td>
<td>32.0</td>
<td>53.6</td>
<td>14.4</td>
</tr>
<tr>
<td>1999</td>
<td>34.4</td>
<td>49.8</td>
<td>15.8</td>
</tr>
<tr>
<td>2000</td>
<td>38.9</td>
<td>43.1</td>
<td>18.0</td>
</tr>
</tbody>
</table>

## Use of Promissory Notes in 1998 (in %)

<table>
<thead>
<tr>
<th>Hold to maturity</th>
<th>Transfer as means of payment</th>
<th>Discount for cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.6</td>
<td>17.0</td>
<td>57.4</td>
</tr>
</tbody>
</table>
## Discount Rates

<table>
<thead>
<tr>
<th></th>
<th>&lt;12%</th>
<th>12–18%</th>
<th>18–24%</th>
<th>24–30%</th>
<th>30–36%</th>
<th>36–42%</th>
<th>&gt;42%</th>
<th>average annualized discount rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>4.0</td>
<td>13.1</td>
<td>46.6</td>
<td>30.3</td>
<td>5.5</td>
<td>0.5</td>
<td>0</td>
<td>24.3</td>
</tr>
<tr>
<td>1996</td>
<td>0.4</td>
<td>17.5</td>
<td>42.5</td>
<td>32.8</td>
<td>6.1</td>
<td>0.3</td>
<td>0.4</td>
<td>25.3</td>
</tr>
<tr>
<td>1997</td>
<td>5.1</td>
<td>3.5</td>
<td>16.4</td>
<td>26.4</td>
<td>25.8</td>
<td>7.9</td>
<td>14.9</td>
<td>34.5</td>
</tr>
<tr>
<td>1998</td>
<td>10.7</td>
<td>26.7</td>
<td>18.0</td>
<td>20.9</td>
<td>21.1</td>
<td>1.4</td>
<td>1.2</td>
<td>24.5</td>
</tr>
<tr>
<td>1999</td>
<td>20.9</td>
<td>3.7</td>
<td>33.0</td>
<td>24.0</td>
<td>17.6</td>
<td>0.8</td>
<td>0</td>
<td>23.3</td>
</tr>
</tbody>
</table>
Dark Side of Promissory Notes

• If final product firm borrows on behalf of whole production chain, then leverage of final product firm is extremely high
  − Before financial crisis of 1997, debt/equity ratios of Chaebol many times OECD average

• “Common destiny” that has desirable incentive effects in normal times is agent of contagion during financial distress
  − Fragility of corporate balance sheets to contagion resulting from aggregate shocks
Comparative Industrial Structure

• Economies that attempt to lengthen production chains must overcome:
  – shortage of initial working capital
  – sustainability in steady state

• Alternative strategies
  – If SME sector is financially strong, use greater stakes through large balance sheet interlinkages
  – Otherwise, greater degree of vertical integration
  – Or, refrain from lengthening production chain altogether, and concentrate on building up equity of SME sector.