A role of investment in intangibles
How can IT make it?

Conference on Economic Growth and Productivity

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Station Conference Tokyo, Japan

Akihiko SHINOZAKI (Kyushu University, Japan)
(1) Review of productivity paradox and new economy
(2) Measuring Japan’s IT-investment and capital stock
(3) Analysis of growth accounting model
(4) Estimation of production function model
(5) Firm-level analysis from questionnaire survey to examine the role of investment in intangibles, i.e., re-designing corporate structures and human resource management
Lessons from U.S. statistics

Solow paradox had turned to the new economy
Solow’s Productivity Paradox

Robert Solow, a Nobel laureate economist, put it

“We can see

the computer age everywhere

but in the productivity statistics.”

---“We’d Better Watch Out,”

*New York Times, July 12, 1987*
## Slow Down in the U.S. Productivity

[Private non-farm business sector; average annual rates ] (%)

<table>
<thead>
<tr>
<th></th>
<th>1948-73 (1)</th>
<th>1973-87 (2)</th>
<th>changes (2)-(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity growth rate (ALP)</td>
<td>2.94</td>
<td>1.02</td>
<td><strong>-1.92</strong></td>
</tr>
<tr>
<td>Multi factor productivity (TFP)</td>
<td>2.00</td>
<td>0.39</td>
<td><strong>-1.61</strong></td>
</tr>
</tbody>
</table>

Baily and Gordon(1988)
## Paradox in the U.S. Statistics

[Private non-farm business sector; average annual rates] (%)

<table>
<thead>
<tr>
<th></th>
<th>1959-73 (1)</th>
<th>1973-95 (2)</th>
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<tbody>
<tr>
<td>Productivity growth rate (ALP)</td>
<td>2.8</td>
<td>1.5</td>
<td>-1.3</td>
</tr>
<tr>
<td>IT capital deepening</td>
<td>0.2</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Multi factor productivity (TFP)</td>
<td>1.1</td>
<td>0.4</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

“New Economy” in the Productivity Statistics in the late 1990s

[ Private non-farm business sector: average annual rates (%) ]

<table>
<thead>
<tr>
<th></th>
<th>1973-95 (1)</th>
<th>95-2000 (2)</th>
<th>changes (2)-(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity growth rate (ALP)</td>
<td>1.5</td>
<td>2.7</td>
<td>1.2</td>
</tr>
<tr>
<td>IT capital deepening</td>
<td>0.4</td>
<td>1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Multi factor productivity (TFP)</td>
<td>0.4</td>
<td>1.0</td>
<td>0.6</td>
</tr>
</tbody>
</table>

…then, Solow finally admitted that

“You can now see computers in the productivity statistics”

----“Productivity Finally Shows the Impact of Computers”

*New York Times, March 12, 2000*
Solow added

…on top of that Solow put it,

“I will feel better about the endurance of the productivity improvement after it survives its first recession,”

----“Productivity Finally Shows the Impact of Computers,”
New York Times, March 12, 2000
“New Economy” in the Productivity Statistics Since 1995

<table>
<thead>
<tr>
<th>[Private non-farm business sector; average annual rates] (%)</th>
<th>1973-95 (1)</th>
<th>95-2006 (2)</th>
<th>changes (2)-(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity growth rate (ALP)</td>
<td>1.5</td>
<td>2.6</td>
<td>1.1</td>
</tr>
<tr>
<td>IT capital deepening</td>
<td>0.4</td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>Multi factor productivity (ALP)</td>
<td>0.4</td>
<td>1.0</td>
<td>0.6</td>
</tr>
</tbody>
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## Changes in productivity and IT contribution (%)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Productivity growth rate</td>
<td>-1.3</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>IT capital deepening</td>
<td>0.2</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Multi factor productivity</td>
<td>-0.7</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

*↑ Solow Paradox  
↑ New Economy*
Paradox Disappeared, Why?

- Changes in Nature of IT
  From Legacy Transaction Machine
  To Effective Communication Tool

- Investment Boom in IT
  ITs are everywhere and open-networked

- Management Innovation
  Human Resource & Organizational Reforms

- Institutional Reforms
  Both Formal rule and Informal Constrains
Lessons from Japan’s statistics
Neither a paradox nor a new economy
Measuring and building IT investment and capital stock

- Key dataset: IT-investment and IT-capital stock
  - Analysis of growth accounting model
  - Estimation of production function model

- Unfortunately, no official statistics in Japan

- Useful source for measuring: Input-output table

Fixed-capital matrix in I-O table

<table>
<thead>
<tr>
<th>Item codes</th>
<th>capital goods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>industries</td>
</tr>
<tr>
<td>3111099</td>
<td>photocopy</td>
</tr>
<tr>
<td>3331011</td>
<td>personal computers</td>
</tr>
<tr>
<td>3331021</td>
<td>computers except personal computers</td>
</tr>
<tr>
<td>3331031</td>
<td>computers peripheral equipment</td>
</tr>
<tr>
<td>3321011</td>
<td>wired telecommunications equipment</td>
</tr>
<tr>
<td>3321021</td>
<td>cellular phones</td>
</tr>
<tr>
<td>3321031</td>
<td>other wireless telecommunications equipment</td>
</tr>
<tr>
<td>3321033</td>
<td>other telecommunications equipment</td>
</tr>
<tr>
<td>4132031</td>
<td>construction of telecommunications facilities</td>
</tr>
<tr>
<td>7331011</td>
<td>software</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>industry codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>agriculture</td>
</tr>
<tr>
<td>automobile industry</td>
</tr>
<tr>
<td>communications and broadcasting</td>
</tr>
</tbody>
</table>

| private sector total |

Source: Shinozaki (2011)
Nominal IT investment in Japan

- Investment boom in the 1980s: Legacy information system
- Cyclical fluctuation in the 1990s: PCs and internet economy
- Declining trend in the 2000s: Broadband and mobile

Source: Estimated extension based on Shinozaki (2011) and InfoCom Research
Growth accounting analysis

Less contribution of IT capital-deepening to the growth

<table>
<thead>
<tr>
<th></th>
<th>76-80</th>
<th>81-85</th>
<th>86-90</th>
<th>91-95</th>
<th>96-00</th>
<th>01-05</th>
<th>06-09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private output</td>
<td>4.8</td>
<td>3.3</td>
<td>5.0</td>
<td>1.3</td>
<td>0.8</td>
<td>1.5</td>
<td>-0.7</td>
</tr>
<tr>
<td>Hours worked</td>
<td>1.4</td>
<td>0.9</td>
<td>1.3</td>
<td>-0.2</td>
<td>-0.5</td>
<td>-0.6</td>
<td>-0.0</td>
</tr>
<tr>
<td>Output per hour</td>
<td>3.4</td>
<td>2.4</td>
<td>3.7</td>
<td>1.5</td>
<td>1.3</td>
<td>2.1</td>
<td>-0.7</td>
</tr>
<tr>
<td>Business cycle effect</td>
<td>1.2</td>
<td>-0.0</td>
<td>0.3</td>
<td>-0.8</td>
<td>0.1</td>
<td>0.2</td>
<td>-1.6</td>
</tr>
<tr>
<td>Fundamental trend</td>
<td>2.2</td>
<td>2.4</td>
<td>3.4</td>
<td>2.4</td>
<td>1.2</td>
<td>1.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Capital deepening</td>
<td>1.7</td>
<td>1.5</td>
<td>1.7</td>
<td>1.5</td>
<td>1.0</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>of non ICT-assets</td>
<td>1.7</td>
<td>1.4</td>
<td>1.4</td>
<td>1.3</td>
<td>0.7</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>of ICT assets</td>
<td>0.0</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Labor quality</td>
<td>0.3</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Total factor productivity</td>
<td>0.3</td>
<td>0.5</td>
<td>1.3</td>
<td>0.5</td>
<td>-0.1</td>
<td>0.9</td>
<td>0.4</td>
</tr>
</tbody>
</table>

| [Income shares (percentage)] |       |       |       |       |       |       |       |
| share Ko (\(\alpha\))       | 32.1  | 30.5  | 30.7  | 26.6  | 23.4  | 23.3  | 23.3  |
| share Ki (\(\beta\))        | 2.0   | 1.8   | 2.5   | 2.9   | 3.5   | 4.5   | 4.9   |
| share L (\(\gamma\))        | 66.0  | 67.7  | 66.8  | 70.5  | 73.1  | 72.3  | 71.8  |

| [Annual growth rate of inputs] |       |       |       |       |       |       |       |
| dKo                              | 6.6   | 5.5   | 5.9   | 4.5   | 2.4   | 1.3   | 1.4   |
| dki                              | 3.9   | 7.0   | 13.8  | 8.7   | 7.6   | 4.8   | 3.0   |
| dedu                             | 0.4   | 0.6   | 0.5   | 0.4   | 0.5   | 0.4   | 0.2   |

Source: Shinozaki (2011)
Neither a Solow paradox nor a new economy in Japan

Changes in productivity and IT contribution (%)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity growth rate</td>
<td>0.1</td>
<td>1.0</td>
<td>-1.0</td>
<td>-1.2</td>
<td>0.7</td>
<td>-0.9</td>
</tr>
<tr>
<td>IT capital deepening</td>
<td>0.1</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Total factor productivity</td>
<td>0.4</td>
<td>0.7</td>
<td>-0.8</td>
<td>-0.5</td>
<td>0.9</td>
<td>-0.6</td>
</tr>
</tbody>
</table>
Surge in Productivity toward Higher Growth Trends

- Emerging Information Age
- Investment Boom
- Matured Industrial Age

Growth Trend

Time Span
IT Capital Deepening

Legacy Information System
Open Network System

Investment Boom in the U.S.
Investment Boom in Japan

(1995=100)
## IT Investment and Its Nature

### Annual Average Growth Rate in Nominal IT Investment

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Japan</strong></td>
<td>18.7</td>
<td>14.5</td>
<td>2.2</td>
<td>7.2</td>
</tr>
<tr>
<td><strong>USA</strong></td>
<td>14.0</td>
<td>5.6</td>
<td>8.7</td>
<td>13.2</td>
</tr>
<tr>
<td><strong>transaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>machinery</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>communication</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>tools</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Potential of IT investment: Evidence from estimations of production function models

(1) Base model (non-IT model)

\[ Q = A(\text{edu}L)^{\alpha} (K_{\text{all}})^{\beta} \quad \text{where } \alpha + \beta = 1 \]

(2) IT model (incorporate IT capital)

\[ Q = A(\text{edu}L)^{\alpha} (K_o)^{\beta} (K_i)^{\gamma} \quad \text{where } \alpha + \beta + \gamma = 1, \ K_o + K_i = K_{\text{all}} \]

(3) Information flow model (IT capital + information flows)

\[ Q = A(\text{edu}L)^{\alpha} (K_{\text{all}})^{\beta} (\text{ubq}K_i)^{\gamma} \quad \text{where } \alpha + \beta = 1, \ K_o + K_i = K_{\text{all}} \]

(4) Cross-industry analysis (IT_variable as a proxy of tech improvement)

\[ Q = A(K_{\text{all}})^{\alpha} (L)^{\beta} e^{\gamma(IT\text{\_variable})} \quad \text{where } \alpha + \beta = 1, \ K_o + K_i = K_{\text{all}} \]

Notes: \( Q \): GDP, \( \text{edu} \): labor quality, \( L \): labor input, \( K_{\text{all}} \): capital stock, \( K_i \): ICT capital stock, \( K_o \): non-ICT capital stock, \( \text{ubq} \): circulation volume of information flows.
(1) IT model explains the economy better than the base model
(2) Accumulation of IT capital stock is statistically positive
(3) Information flows as well as network infrastructure are important for economic growth

<table>
<thead>
<tr>
<th>Dependent Variable: ln(Q/L)</th>
<th>Base model</th>
<th></th>
<th>IT model</th>
<th></th>
<th>Information flow model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>coefficient</td>
<td>t-statistics</td>
<td>coefficient</td>
<td>t-statistics</td>
<td>coefficient</td>
</tr>
<tr>
<td>Const.</td>
<td>-2.303 **</td>
<td>-16.010</td>
<td>-0.888</td>
<td>-1.814</td>
<td>-1.542 **</td>
</tr>
<tr>
<td>Kall/eduL</td>
<td>0.537 **</td>
<td>23.510</td>
<td></td>
<td></td>
<td>0.359 **</td>
</tr>
<tr>
<td>K0/eduL</td>
<td></td>
<td></td>
<td>0.229 *</td>
<td>2.250</td>
<td>0.018 *</td>
</tr>
<tr>
<td>Ki/eduL</td>
<td></td>
<td></td>
<td>0.149 **</td>
<td>3.725</td>
<td>0.952 **</td>
</tr>
<tr>
<td>ubq*Ki</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.570 **</td>
<td>3.316</td>
<td>0.662 **</td>
<td>3.008</td>
<td>0.641</td>
</tr>
<tr>
<td>Labor share</td>
<td>0.463</td>
<td></td>
<td>0.622 **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital share (of non-ICT)</td>
<td>0.537</td>
<td></td>
<td>0.378</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital share (of ICT)</td>
<td>0.229</td>
<td></td>
<td>0.149</td>
<td></td>
<td></td>
</tr>
<tr>
<td>adjR²</td>
<td>0.994</td>
<td></td>
<td>0.996</td>
<td></td>
<td>0.993</td>
</tr>
<tr>
<td>D.W.</td>
<td>1.728</td>
<td></td>
<td>1.654</td>
<td></td>
<td>1.519</td>
</tr>
</tbody>
</table>

**growth rate %**
- (2010-20): 1.6
- (2010-25): 1.6

Source: Shinozaki (2009)
Note: ubq represents the volume of information flow.
(4) Positive impact of IT_variable in the cross-industry analysis

(a) IT_variable=Ki/L

<table>
<thead>
<tr>
<th>Dependent Variable: ln(Q/L)</th>
<th>Pool OLS</th>
<th>Fixed</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated Coefficient</td>
<td>t-statistics</td>
<td>Estimated Coefficient</td>
</tr>
<tr>
<td>ln(Kall/L)</td>
<td>0.5034 [13.85]***</td>
<td></td>
<td>0.4457 [15.36]***</td>
</tr>
<tr>
<td>Ki/L</td>
<td>0.0150 [6.10]***</td>
<td></td>
<td>0.0045 [4.24]***</td>
</tr>
<tr>
<td>Const.</td>
<td>1.2712 [7.63]***</td>
<td></td>
<td>1.6646 [12.27]***</td>
</tr>
</tbody>
</table>

Diagnostic Test

<table>
<thead>
<tr>
<th></th>
<th>Pool OLS</th>
<th>Fixed</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observations</td>
<td>484</td>
<td>484</td>
<td>484</td>
</tr>
<tr>
<td>Number of groups</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>R-sq: within</td>
<td></td>
<td>0.5162</td>
<td>0.5162</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4941</td>
<td>0.4941</td>
</tr>
<tr>
<td>overall</td>
<td></td>
<td>0.5058</td>
<td>0.4917</td>
</tr>
</tbody>
</table>

(b) IT_variable=Ki/Ko

<table>
<thead>
<tr>
<th>Dependent Variable: ln(Q/L)</th>
<th>Pool OLS</th>
<th>Fixed</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>Estimated Coefficient</td>
<td>t-statistics</td>
<td>Estimated Coefficient</td>
</tr>
<tr>
<td>ln(Kall/L)</td>
<td>0.6739 [21.96]***</td>
<td></td>
<td>0.3781 [15.73]***</td>
</tr>
<tr>
<td>Ki/Ko</td>
<td>1.4233 [5.65]***</td>
<td></td>
<td>1.8637 [12.02]***</td>
</tr>
<tr>
<td>Const.</td>
<td>0.4767 [2.99]***</td>
<td></td>
<td>1.8832 [16.83]***</td>
</tr>
</tbody>
</table>

Diagnostic Test

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<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>R-sq: within</td>
<td></td>
<td>0.6174</td>
<td>0.6173</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4509</td>
<td>0.4589</td>
</tr>
<tr>
<td>overall</td>
<td></td>
<td>0.5007</td>
<td>0.4456</td>
</tr>
</tbody>
</table>

* p<0.1, ** p<0.05, *** p<0.01

Source: Shinozaki, et al. (2012)
Why promised IT-investment has been stagnant?

1. Positive investment spiral

$$\text{IT-investment} + \text{intangibles} = \text{effective use of IT}$$

2. Negative investment spiral

$$\text{IT-investment} + \text{non intangibles} = \text{useless technology}$$
Lessons from firm-level analysis

Critical role of the investment in intangibles
Questionnaire surveys for firm-level analysis
IT-investment, corporate reforms, human resource management, and their outcomes

- **Questionnaire surveys**
  
<table>
<thead>
<tr>
<th>Year Collected</th>
<th>Sample Size</th>
<th>Target Firms Located In</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>3,141</td>
<td>Japan</td>
</tr>
<tr>
<td>2007</td>
<td>1,288</td>
<td>Japan, US, Germany, Korea</td>
</tr>
<tr>
<td>2012</td>
<td>3,188</td>
<td>Japan</td>
</tr>
</tbody>
</table>

- **Major points of questionnaire items**
  - intensiveness of investment in IT
  - corporate reforms and human resource management
  - outcomes from IT investment
Strong complementary relationship among corporate reforms, IT investment, and its outcomes

IT has the potential for economic and productivity growth in Japan, but…
(1) without corporate reforms, less outcomes from ICT investment
(2) without positive outcomes, less incentives for ICT investment

Take survey in 2003, for example…

<table>
<thead>
<tr>
<th>Outcome scores of IT investment</th>
<th>Degree of IT investment</th>
<th>Degree of corporate reform</th>
</tr>
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<tr>
<td>4.0</td>
<td>(high)</td>
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<tr>
<td>3.6</td>
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<tr>
<td>2.6</td>
<td>(low)</td>
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<tr>
<td>2.0</td>
<td>(low)</td>
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<tr>
<td>1.0</td>
<td>(low)</td>
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</table>
Summary of time line results in Japanese firms

Note: Size of outcome scores cannot be compared with those in different years due to the differences of questionnaire items and methodology of scoring in each survey.
Lessons from cross-country analysis
Are Japanese firms outliers?
A result of survey: outcomes of IT by categories among four countries

% of firms which achieve positive outcomes from IT investment by 6 categories

Note: 18 questionnaire items in outcomes of IT investment, and 17 questionnaire items in corporate reforms
Yet, do not worry!

Similarities with firms outside Japan
International comparisons in 2007 survey

USA

Germany

Korea

Outcome score

Degree of IT investment (high)

Degree of IT investment (low)

Cop. reform (low)

Cop. reform (high)

Cf

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Outstanding features of Japanese firms

- In the group of firms which DO conduct corporate reforms, ⋯ ⋯
  ⇒ Japanese firms seem to achieve as high outcomes as firms in the USA, Germany, and Korea.

- However, in the group of firms which do NOT conduct corporate reforms, ⋯ ⋯
  ⇒ Japanese firms appear to be an outlier among four countries.

E.g.
Outcomes in “improvement of top management’s decision-making,” by group of firms separated by whether they conduct corporate reforms in “signature process” or not.

% of “Yes, we improved.”

![Graph showing outcomes by group of firms.](Image)
Check the outstanding features of Japanese firms

- In respective country
  - Reformed firms
  - Non-reformed firms
  \[ \Rightarrow \chi^2 \text{ test in 306 items of questionnaire} \]

- Among four countries
  - Multiple comparisons in a group of reformed firms only
  \[ \Rightarrow \text{multiple comparisons test} \]
  \[ \Rightarrow \text{How different from all respondent?} \]
$\chi^2$ test of 306 questionnaire items in respective country

Number of significant difference in questionnaire items between reformers and non-reformers

![Bar chart showing the number of significant differences in questionnaire items between reformers and non-reformers in Japan, USA, Germany, and Korea.](chart.png)
Japanese firms show significantly less effectiveness compared with other countries’ firms.

Japanese firms show no significant differences in effectiveness from other countries’ firms.

Japanese firms show significantly more effectiveness compared with other countries’ firms.
Distribution of firms by degree of corporate reforms
Characteristics of Japanese firms

- Corporate reforms affect the performance of IT investment similarly among four countries.
- Yet, clear differences of performance between reformed and non-reformed observed especially in Japanese firms.
- Disadvantages of Japanese firms reduced among reformed firms.
- Yet, Japanese firms look more reluctant to conduct reforms.
Japan’s economic system revisited
Integrality vs. modularity
Strengths of Japanese System in Industrial Age

• **Strengths** --- Economic Planning Agency (1990)

  - homogeneous and intensive human network
  - share information informally by human network
  - complicated organizational structure
  - long term relationship with life time employment
Integrality vs. Modularity

Economies of Scope

Integrated organization

“general purpose company”
“long-term relationship”

Economies of Alliance

Modular organization

“new combination” “diversity”
“switch-able transaction”
Four Categories of Economies

- **Emerging Information Age**
  --Network Effects
  --Economies of Alliance

- **Matured Industrial Age**
  --Economies of Scale
  --Economies of Scope
# Economies in the information age

<table>
<thead>
<tr>
<th></th>
<th>Emerging Information Age</th>
<th>Matured Industrial Age</th>
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<tr>
<td><strong>Scale Merit</strong></td>
<td><strong>Network Effects</strong></td>
<td><strong>Economies of Scale</strong></td>
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<tr>
<td></td>
<td>- consumer’s scale merit</td>
<td>- producer’s scale merit</td>
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<tr>
<td><strong>Resource Merit</strong></td>
<td><strong>Economies of Alliance</strong></td>
<td><strong>Economies of Scope</strong></td>
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<tr>
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<td>- outside resources</td>
<td>- in-house resources</td>
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<tr>
<td></td>
<td>- multiple organization</td>
<td>- integrated-organization</td>
</tr>
<tr>
<td></td>
<td>- synergy effect</td>
<td>- cost saving</td>
</tr>
<tr>
<td></td>
<td>- innovation</td>
<td>- learning by doing</td>
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<tr>
<td></td>
<td>(new combination)</td>
<td>(kaizen, QC)</td>
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<tr>
<td><strong>Desirable Industrial</strong></td>
<td><strong>Multiple small players</strong></td>
<td><strong>Larger organization</strong></td>
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<td>Organization**</td>
<td>Competitive market</td>
<td><strong>Oligopoly or monopoly</strong></td>
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<td>Compatibility &amp; diversity</td>
<td><strong>Continuity &amp; homogeneity</strong></td>
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<tr>
<td></td>
<td>Modularity</td>
<td><strong>Integrity</strong></td>
</tr>
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</table>

Weaknesses of Japanese System in Emerging Information Age

• Weaknesses
  - geographical (locational) limitation
  - longer time to make decisions
  - difficulty of drastic reorganization
  - small chance of new combination
Stickiness of organizational structure
Changeability of corporate resources

Rice cake (integrated)
Steamed rice (separable)
Rice grain (changeable)
The production function analysis demonstrates that the investment in IT has the potential to contribute to Japan’s economic and productivity growth.

However, IT investment and IT capital-deepening have been declining since the late 1990s.

Firm-level analysis implies that there is a strong complementary relationship among drastic corporate reforms, IT investment, and its positive outcomes.

Japanese firms tend to hesitate to carry out drastic reforms when they invest in IT, which has caused a sluggish investment trend in Japan.

Our analysis suggests that if the intensive IT investment and consequent corporate reforms proliferate across industries, the economy will have the potential to grow at a higher rate.
For further information: access these references

http://catalog.lib.kyushu-u.ac.jp/handle/2324/19154/p033.pdf

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Thank you!