Outsourcing and Fragmentation in Singapore Manufacturing Industry

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"Production Networks and Changing Trade and Investment Patterns: The Economic Emergence of China and India and Implications for Asia and Singapore"

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by
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Introduction and Scope

• Key Trends in Singapore Economy

• Outsourcing Measures in Singapore Manufacturing Industries

• Outsourcing and Productivity Improvements in Singapore Manufacturing Industries
  – Outsourcing and Productivity: Electronics Cluster
  – Empirical Analysis of Outsourcing on Productivity in Manufacturing Industries

• Policy Conclusion
Trade, MNCs and the Economy

• Openness and Export Growth is very important crucial
• Heavily reliance on MNCs
• Open to external shocks

• Growth of Singapore economy moderate and volatile due to Asian financial crisis, slowdown in US and global economies, SARS, and terrorism

• From 1999-2003 - volatility in output \(\rightarrow\) rising unemployment, and structural adjustment of economy to higher value-added activities \(\rightarrow\) slower growth in employment

• Service sector led employment growth

• Manufacturing and services will form “twin engines” of growth
Key Trends in Singapore Economy

• Integrated into the global economy - Adopting cross-border sourcing in its development and growth strategy since the 1970s

• Policies to integrate into the regional and global economy:
  – Attracting MNCs
  – Integrating into the regional economies: ASEAN, APEC etc
  – Growth Triangle: “sub-regional economic zones” (Toh, 2006).

• The recent announcement of new initiatives of “closer economic partnerships” (CEPs), forming the Indonesia-Malaysia-Singapore growth triangle (IMS-GT), is an interesting economic strategy of consolidating the Singapore economy as part of the regional and global value-chain.

• With emergence of low-cost competitors in the region and in China, strong pressure for Singapore economy to move to higher value-added activities to sustain its competitiveness
### Key Trends in Singapore Economy

**Table 1: Key Macroeconomic Indicators: 1999-2005**

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real GDP (2000 market price &amp; % change)</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>13.6</td>
<td>15.3</td>
<td>-12.8</td>
<td>8.4</td>
<td>3.0</td>
<td>13.9</td>
<td>9.3</td>
</tr>
<tr>
<td>Services</td>
<td>6.0</td>
<td>9.0</td>
<td>1.9</td>
<td>4.0</td>
<td>3.3</td>
<td>7.6</td>
<td>6.0</td>
</tr>
<tr>
<td>Construction</td>
<td>-8.8</td>
<td>-1.7</td>
<td>-1.2</td>
<td>-14.0</td>
<td>-9.0</td>
<td>-6.1</td>
<td>-1.1</td>
</tr>
<tr>
<td><strong>Share of Gross Value Added (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>23.1</td>
<td>26.8</td>
<td>23.7</td>
<td>25.8</td>
<td>26.3</td>
<td>27.7</td>
<td>27.3</td>
</tr>
<tr>
<td>Services</td>
<td>63.6</td>
<td>61.9</td>
<td>64.5</td>
<td>63.5</td>
<td>63.4</td>
<td>63.0</td>
<td>63.8</td>
</tr>
<tr>
<td>Construction</td>
<td>7.9</td>
<td>6.3</td>
<td>6.1</td>
<td>5.4</td>
<td>5.0</td>
<td>4.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Others</td>
<td>5.1</td>
<td>5.0</td>
<td>5.7</td>
<td>5.3</td>
<td>5.3</td>
<td>5.0</td>
<td>5.2</td>
</tr>
<tr>
<td><strong>Employment Share (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>21.0</td>
<td>20.8</td>
<td>18.8</td>
<td>18.2</td>
<td>17.9</td>
<td>17.3</td>
<td>21.4</td>
</tr>
<tr>
<td>Services</td>
<td>71.1</td>
<td>65.5</td>
<td>74.2</td>
<td>75.0</td>
<td>75.6</td>
<td>76.3</td>
<td>69.6</td>
</tr>
<tr>
<td>Construction</td>
<td>6.9</td>
<td>13.1</td>
<td>6.1</td>
<td>5.9</td>
<td>5.6</td>
<td>5.5</td>
<td>8.1</td>
</tr>
<tr>
<td>Others</td>
<td>1.0</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Unemployment rate (average)</strong></td>
<td>3.5</td>
<td>3.1</td>
<td>3.3</td>
<td>3.6</td>
<td>4.0</td>
<td>3.4</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Source: Thangavelu and Toh (2005)

Services sector includes: Wholesale and Retail trade, Hotels and Restaurants, Transport and Communication, Financial Services, Business Services, other services
Outsourcing Measures in Singapore Manufacturing Industries

• Study impact of outsourcing on productive performance of manufacturing industries in Singapore,
  – panel data of 5-digit manufacturing industries from 1995-2004 (around 170 industries)

• Data obtained from Census of Industrial Production and the Census of Manufacturing Activities (CIP), Singapore Economic Development Board (EDB).

• Singapore Input-Output (IO) tables in 1995 and 2000. All data is based on year 2000 prices.

• Developed outsourcing measure based on narrow definition of intermediate imports given by Feenstra and Hanson

• 5 outsourcing measures - total import of goods and services, intra-industry imports, inter-industry imports, imports of services, imports of IT services and imports of business and services.
Outsourcing Measures in Singapore Manufacturing Industries

• Key industries that are involved in outsourcing activities are:
  – manufacture of coke and refined petroleum products,
  – manufacture of chemical and chemical products,
  – manufacture of pharmaceutical and biological products,
  – manufacture of electronic products and components
# Outsourcing Measures in Singapore Manufacturing Industries

**Table 2: Trends in Outsourcing Measures for Singapore Manufacturing Industries: 1995-2004**

<table>
<thead>
<tr>
<th>Industry</th>
<th>Share of Imports</th>
<th>Share of Intra-Industry Imports</th>
<th>Share of Inter-Industry Imports</th>
<th>Share of Imports of Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of coke and refined petroleum products</td>
<td>9.61</td>
<td>16.23</td>
<td>1.06</td>
<td>0.28</td>
</tr>
<tr>
<td>Manufacture of chemicals and chemical products</td>
<td>4.79</td>
<td>8.92</td>
<td>4.04</td>
<td>5.91</td>
</tr>
<tr>
<td>Manufacture of pharmaceutical and biological products</td>
<td>0.96</td>
<td>1.97</td>
<td>0.35</td>
<td>0.57</td>
</tr>
<tr>
<td>Manufacture of electronic products and components</td>
<td>64.44</td>
<td>53.45</td>
<td>71.70</td>
<td>70.88</td>
</tr>
</tbody>
</table>
### Table 3: Trends in Outsourcing Measures for Singapore Manufacturing Industries: 1995-2004

<table>
<thead>
<tr>
<th>Industry</th>
<th>Share of Imports of IT Services</th>
<th>Share of Imports of Business Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of chemicals and chemical products</td>
<td>11.17</td>
<td>6.53</td>
</tr>
<tr>
<td>Manufacture of pharmaceutical and biological products</td>
<td>15.34</td>
<td>48.42</td>
</tr>
<tr>
<td>Manufacture of electronic products and components</td>
<td>44.66</td>
<td>15.01</td>
</tr>
</tbody>
</table>
Outsourcing and Productivity Improvements in Singapore Manufacturing Industries

- Based on theoretical framework, cross-border sourcing activities should have positive impact on productivity and efficiency of the outsourcing country.

- The overall impact on productivity and efficiency is still based on how well the economy adjusts to outsourcing activities (Feenstra and Hanson, 1998).

- Labour productivity (total output per worker) is used as measure of productivity.

- The following charts show that imports tend to have positive impact on the productive performance for most of the manufacturing industries, including those not involved in cross-border sourcing.
Outsourcing and Productivity Improvements in Singapore Manufacturing Industries

Labour Productivity and Imports at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity Improvements in Singapore Manufacturing Industries

Labour Productivity and Intra-industry Imports at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity Improvements in Singapore Manufacturing Industries

Labour Productivity and Inter-industry Imports at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity Improvements in Singapore Manufacturing Industries

Labour Productivity and Inter-industry Imports of services at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity Improvements in Singapore Manufacturing Industries

Labour Productivity and Import of Business Services at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity: Electronics Cluster

Labour Productivity and Imports in Electronic Products and Components at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity: Electronics Cluster

Outsourcing and Productivity: Electronics Cluster

Labour Productivity and Inter-Industry Imports in Electronic Products and Components at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity: Electronics Cluster

Labour Productivity and Inter-Industry Import of Services in Electronic Products and Components at 5-digit Singapore Manufacturing Industries: 1995-2004

Log (import of services) vs. Log (lp)
Outsourcing and Productivity: Electronics Cluster

Labour Productivity and Import of IT Services in Electronic Products and Components at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Productivity: Electronics Cluster

Labour Productivity and Import of Business Services in Electronic Products and Components at 5-digit Singapore Manufacturing Industries: 1995-2004
Outsourcing and Cost-Competitiveness

Figure 14: Operating Cost to Sales Ratio to Imports at 5-digit Manufacturing Industries in Singapore: 1995-2004
Outsourcing and Cost-Competitiveness: Intra-Industry

Figure 15: Operating Cost to Sales Ratio to Intra-Industry Imports at 5-digit Manufacturing Industries in Singapore: 1995-2004
Outsourcing and Cost-Competitiveness: Inter-Industry

Figure 16: Operating Cost to Sales Ratio to Inter-Industry Imports at 5-digit Manufacturing Industries in Singapore: 1995-2004
Figure 17: Operating Cost to Sales Ratio to Import of Services at 5-digit Manufacturing Industries in Singapore: 1995-2004
Outsourcing and Profitability

Figure 18: Operating Surplus to Sales ratio to Imports at 5-digit manufacturing Industries in Singapore: 1995-2004
Outsourcing and Profitability: Import of Services

Figure 19: Operating Surplus to Sales ratio to Import of Services at 5-digit manufacturing Industries in Singapore: 1995-2004
Empirical Analysis of Outsourcing on Productivity in Manufacturing Industries

- Adopt a simple Cobb-Douglas production function framework to analyze the impact of cross-border outsourcing on productivity at the 5-digit manufacturing industries

\[ Y_{it} = A_{it} L_{it}^{\alpha_1} K_{it}^{\alpha_2} \]  
\[ \text{, } i=1, \ldots, n; \ t=1, \ldots, T; \]  
\[ (1) \]

where \( i \) denotes cross-sections and \( t \) denotes time-periods. Real output is given as \( Y_{it} \), number of workers is \( L_{it} \), the real capital stock is \( K_{it} \), and \( A_{it} \) is the technology parameter.

- Assume outsourcing affects efficiency of firms through technology factor

- When constant returns to scale is assumed, the production function can be written in the form that shows the dependence of labour productivity on capital-labour ratio and the technology parameter:

\[ \left( \frac{Y_{it}}{L_{it}} \right) = A_{it} \left( \frac{K_{it}}{L_{it}} \right)^{\alpha} \]  
\[ (2) \]
Empirical Analysis of Outsourcing on Productivity in Manufacturing Industries

• In logarithmic form, we can rewrite the equation (2) as:

\[ \ln\left( \frac{Y_{it}}{L_{it}} \right) = \ln A_{it} + \alpha \ln \left( \frac{K_{it}}{L_{it}} \right) \]  

(3)

• Given that outsourcing affects efficiency of firms, we model the impact through the technology parameter. Thus, the technology parameter, \( \ln A_{it} \), is dependent on a set of factors including outsourcing (OSI)

\[ \ln A_{it} = \beta_o + \beta_1 \ln(OSI_{it}) \]  

(4)

• Hence the empirical equation for our estimation is given as:

\[ \ln\left( \frac{Y_{it}}{L_{it}} \right) = \beta_0 + \beta_1 \ln(OSI_{it}) + \alpha \ln\left( \frac{K_{it}}{L_{it}} \right) + \lambda_t + \mu_i + \nu_{it} \]  

(5)

where \( \lambda_t \), \( \mu_i \) and \( \nu_{it} \) are the time-specific effects, the unobserved industry-specific effects and the standard error term respectively.
Empirical Analysis of Outsourcing on Productivity in Manufacturing Industries

- Impact of cross-border sourcing is positive on labour productivity
- Inter-industry effects are slightly stronger
- Impact of cross-border sourcing of service is also positive with about an 8-percent impact on labour productivity
- As observed with the scatter plots, cross-border sourcing of business services has strong positive impact on labour productivity of manufacturing industry with 4.5 percent
- In contrast, cross-border sourcing of IT services having only a 3-percent impact on manufacturing productivity
Empirical Analysis of Outsourcing on Productivity in Manufacturing Industries

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Empirical Analysis of Outsourcing on Productivity in Manufacturing Industries

Table 4: The Impact of Outsourcing on Labour Productivity in Singapore Manufacturing Industries (fixed effects): Independent variable – \( \ln(Y_{it}/L_{it}) \)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ln(K_{it}/L_{it}) )</td>
<td>0.181 (10.731)*</td>
<td>0.172 (10.250)*</td>
<td>0.186 (10.900)*</td>
<td>0.188 (10.800)*</td>
</tr>
<tr>
<td>( \ln(imports_{it}) )</td>
<td>0.117 (14.430)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \ln(intra-industry imports_{it}) )</td>
<td></td>
<td>0.061 (8.890)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \ln(inter-industry imports_{it}) )</td>
<td></td>
<td>0.062 (6.700)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \ln (import of services_{it}) )</td>
<td></td>
<td></td>
<td>0.086 (13.350)*</td>
<td></td>
</tr>
<tr>
<td>( \ln (import of IT services_{it}) )</td>
<td></td>
<td></td>
<td></td>
<td>0.032 (4.660)*</td>
</tr>
<tr>
<td>( \ln (import of Business services_{it}) )</td>
<td></td>
<td></td>
<td></td>
<td>0.045 (7.940)*</td>
</tr>
<tr>
<td>Constant</td>
<td>1.323 (30.830)*</td>
<td>1.429 (33.290)*</td>
<td>1.607 (44.490)*</td>
<td>1.808 (55.090)*</td>
</tr>
<tr>
<td>R-square</td>
<td>0.385</td>
<td>0.407</td>
<td>0.418</td>
<td>0.429</td>
</tr>
<tr>
<td>Obs</td>
<td>1883</td>
<td>1883</td>
<td>1883</td>
<td>1883</td>
</tr>
</tbody>
</table>

Note: t-values in the parenthesis, all regressions include time dummies, * - 5% level of significance
Policy Conclusion

- Studied the impact of cross-border sourcing on the productive performance of manufacturing industries of the Singapore economy

- Electronic, Chemicals, Pharmaceutical, and Biological industries are the major industries that are outsourcing their components and services, thereby strongly integrated in the global value-chain

- Observed a rising trend of greater outsourcing of services in the manufacturing industries.

- Empirical results also clearly indicate that outsourcing tend to have positive impact on the productive performance of the manufacturing industries.

- The decomposition of the outsourcing measure by IT and business services indicates that manufacturing firms are more responsive to business services outsourcing than IT services.

- As the economy matures and move into higher value-added activities, productive performance of the economy crucial for the Singapore economy to sustain its long-run growth in the global economy.
  - Results suggest that productive performance of the industries improves as its embrace the global competition from production fragmentation and cross-border production sharing.
Policy Conclusion

• Important issues crucial for the Singapore economy as it adjusts the industrial structure to the cross-border sourcing and production sharing:
  – The need to integrate its economy to the regional economies, and the role of ASEAN, Indonesia-Malaysia-Singapore growth triangle, China and India
  – In this respect, implementation of flexible labour market policy and initiatives to upgrade skills of workers will play a crucial role to create flexibility in the economy
    • The aim of Workforce Development Agency (WDA) to enhance the productivity and employability of the workers through training, retraining, and retaining workers in the labour market
  – Two key areas of concern as the industrial structure matures and companies fragment its components and production line:
    • The displacement effect of outsourcing on wage gap (skilled and unskilled wages) and on employment has not been thoroughly investigated in the economy
    • Sustainable productive improvements of the Singapore economy is the development of strong small and medium size enterprises (SMEs):
      – Formation of a cluster of SMEs that support the activities of the larger conglomerates → These enterprises will provide employment to high VA workers providing commodities and services demanded by companies within and beyond Singapore
Thank You