Cross-regional Spillover of Economic Growth in China

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Regional Seminar on International Trade Statistics (UNSD & NBS)

Contents (1)

  “An economy, to lift itself to higher income levels, must and will first develop within itself one or several regional centres of economic strength” - Hirschman (1958):
  ◎Applying Input-Output decomposition technique to check Hirschman’s theory.
  → cross-regional spillover of economic growth
Contents (2)

◎ Rebalancing the regional disparities: 1998 to the present

Regional disparities → stable and sustainable development

◎ Using a case study to show how the impacts of 2008 Global Financial Crisis and the four trillion yuan fiscal expenditure on Chinese regional economies. (1997 to the present:)

About Input-Output Decomposition Technique

• The pioneering Theoretical Works

• Applications
  Single regional (national) level: many

• Data limitation
  The technique has never been applied to China’s regional economies.
Review on Hirschmann’s Theory

• Econometric Analyses
• Inter-regional I-O Analyses (At one time-point)
  Hioki(2004), Okamoto (2005), Zhang & Zhao(2006)...
• Decomposition technique. (different benchmark years)

Data

• The Transitional Interregional I-O Table between China and Japan for 2000, IDE-JETRO (2007)
How to Deflate IRIO Table
Grid Search Method for IRIO Table

\[ X_i' = \sum_{s} \sum_{j} x_{ij}' + \sum_{s} \sum_{k} y_{ik}' + E_i' - M_i' \]  
(1)

\[ X_i'' = \sum_{s} \sum_{j} x_{ij}' \theta_{ij}^{rs} + \sum_{s} \sum_{k} y_{ik}' \sigma_{ik}^{rs} + E_i' \eta_i' - M_i' \nu_i' \]  
(2)

\[ \theta_i' = \theta_i^{rs} = \sigma_{ik}^{rs} = \eta_i' \]  
(3)

\[ \theta_i'' = \theta_i(1 + \alpha')(1 + \beta_i) \]  
(4)

\[ X_i''' = (\sum_{s} \sum_{j} x_{ij}'' + \sum_{s} \sum_{k} y_{ik}'' + E_i'' \theta_i(1 + \alpha')(1 + \beta_i) - M_i'' \nu_i'' \]  
(5)

\[ V'' = \sum_{j}^{n} X_j'' - \sum_{s} \sum_{j} x_{ij}'' \theta_i(1 + \alpha')(1 + \beta_i) \]  
(6)

\[ \arg\min_{\{\text{grid search} \ \alpha', \beta_i\}} \epsilon = \sum_{s} \left(\frac{V'' - V''\delta_s}{V''\delta_s}\right)^2 \]  
(7)
Decomposition technique (1)

\[ X = (I-A)^{-1} \cdot Y = B \cdot Y \]
\[ \Delta X = f(\Delta B, \Delta Y, \Delta BY) \]

X: output, A: input coefficients, B: Leontief inverse
\( \Delta B \): change of technique
\( \Delta Y \): change of final demand
\( \Delta BY \): simultaneous change of B and Y
Decomposition technique (2):

Region 1
REGION 2

ΔDemand → Multiplier Effect → ΔOutput

Spillover Effect

ΔImport  ΔExport

ΔExport  ΔImport

Feedback Effect
Decomposition technique (2):

A two-country Output IO model can be given as follows:

\[ X = (I - A)^{-1} Y = B \cdot Y \]  
(1)

\[ \Delta X = \Delta Y \]  
(2)

\[ B = \begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix} \]

Matrix B can be decomposed into the following three parts.

\[ \begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix} = \begin{pmatrix} B_{11} & 0 \\ 0 & B_{22} \end{pmatrix} + \begin{pmatrix} 0 & B_{12} \\ B_{21} & 0 \end{pmatrix} + \begin{pmatrix} (I - A^{11})^{-1} & 0 \\ 0 & (I - A^{22})^{-1} \end{pmatrix} \begin{pmatrix} B_{11} - (I - A^{11})^{-1} \\ 0 \end{pmatrix} \begin{pmatrix} 0 \\ B^{22} - (I - A^{22})^{-1} \end{pmatrix} \]

Results of spatial decomposition

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<tr>
<th>Region</th>
<th>Spillover effect</th>
<th>Feedback effect</th>
<th>Intra-regional multiplier effect</th>
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Shares of growth contribution from each region, 1987-1997 (percentage)

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<th>East Coast</th>
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Note: The average rate of cross-regional contribution is 2.72, and the number in a cell is highlighted if it exceeds this average, showing that the cell indicates the important channel of cross-regional growth contribution.

Sources: The Intergional Input-Output Tables of China, RIO97 (Ichimura and Wang, 2003) and MIO97 (IDE-JETRO 2003).

Selected channels of cross-regional growth spillover (based on Table 4)

Note: Arrows indicate the selected channels with above-average contribution rates of growth spillover. Thicker arrows are assigned to the channels with more than 6% contribution rates.
Impacts of 2008 Global Financial Crisis and the four trillion yuan fiscal expenditure

Allocation of four trillion yuan (RMB) fiscal expenditure

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<tr>
<td>Reconstruction of the Sichuan region</td>
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<tr>
<td>Construction of low rent/price housing</td>
<td>10.0</td>
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<tr>
<td>Construction of countryside infrastructure</td>
<td>9.3</td>
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<tr>
<td>Investment for R&amp;D to adjust the industrial structure</td>
<td>9.3</td>
</tr>
<tr>
<td>Investment for energy saving, environmental protection and to restore ecosystem</td>
<td>5.3</td>
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<tr>
<td>Investment for health, education, culture and social work</td>
<td>3.8</td>
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</tbody>
</table>

Note: Investment is to be carried out in both 2009 and 2010.


Comparison of crisis and policy impacts (in millions of US$)

Note: Crisis impact is the total value of the simulated amount of output declines from the third quarter of 2008. Policy impact is the additional output resulting from two years' expenditure.

Sources: The Transitional Interregional Input-Output Table between China and Japan, 2008, IDE-JETRO.
Summary

• The coastal regions of China, in particular the East Coast and the South Coast, have demonstrated outstanding growth as a result of preferential development policies strongly orientated towards exports.

• These two coastal regions have made a significant contribution to regional development elsewhere, although other regions also played different and specific parts in transferring growth momentum from one to the other.

• The “unbalanced growth” strategy has fostered regional disparities, which have gradually pushed the government to look for more stable and sustainable development models.

Reference 1
Reference 2

- [http://www.wto.org/english/res_e/statis_e/miwi_e/miwi_e.htm](http://www.wto.org/english/res_e/statis_e/miwi_e/miwi_e.htm)

Appendix: Sector Classification

1. Agriculture (AGR)
2. Mining and Processing (MIN),
3. Light Industry (LIG),
4. Energy Industry (ENE),
5. Heavy Industry and Chemical Industry (HEA),
6. Construction (CON),
7. Transportation (TRA),
8. Commerce (COM),
9. Services (SER)
How to Deflate IRIO Table
Comparison with Other Methods

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<td><strong>Information</strong></td>
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<td>normal</td>
<td>super large</td>
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<td>composition price</td>
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<td><strong>Theoretical Foundation</strong></td>
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*: Compare to DD

Spatial Decomposition

\[ X = (I - A)^{-1}Y = B \cdot Y \]  \hspace{1cm} (8)

Matrix B can be decomposed into the following three parts.

\[
\begin{pmatrix}
B^{11} & B^{12} & B^{13} \\
B^{21} & B^{22} & B^{23} \\
B^{31} & B^{32} & B^{33}
\end{pmatrix} = \begin{pmatrix}
(I - A^{11})^{-1} & 0 & 0 \\
0 & (I - A^{22})^{-1} & 0 \\
0 & 0 & (I - A^{33})^{-1}
\end{pmatrix} + \\
\begin{pmatrix}
B^{11} - (I - A^{11})^{-1} & 0 & 0 \\
0 & B^{22} - (I - A^{22})^{-1} & 0 \\
0 & 0 & B^{33} - (I - A^{33})^{-1}
\end{pmatrix} + \\
\begin{pmatrix}
0 & B^{12} & B^{13} \\
0 & B^{21} & 0 \\
0 & B^{31} & B^{32}
\end{pmatrix}
\]

For a given final demand vector, in accordance with Eq. (8) and the above equation, the output of region 1 can be expressed by the following equation.

\[ X^1 = (I - A^{11})^{-1}Y^1 + [B^{11} - (I - A^{11})^{-1}]Y^1 + [B^{12}Y^2 + B^{13}Y^3] \]  \hspace{1cm} (9)
Economic Growth

\[ X^t = (I - A^{11})^{-1}Y^1 + [B^{11} - (I - A^{11})^{-1}]Y^1 + [B^{12}Y^2 + B^{13}Y^3] \]  \hspace{1cm} (9)

For ease of exposition, here we let \( M^1 = (I - A^{11})^{-1} \) and \( F^1 = B^{11} - (I - A^{11})^{-1} \), which respectively represent the intraregional multiplier and feedback effects shown above. Then the outputs of region 1 in the base year (0) and target year (t) can be given as follows.

\[ X_0^1 = M_0^1 \cdot Y_0^1 + F_0^1 \cdot Y_0^1 + B_0^{12} \cdot Y_0^2 + B_0^{13} \cdot Y_0^3 \]  \hspace{1cm} (10)

\[ X_t^1 = (M_t^1 + \Delta M^1)(Y_t^1 + \Delta Y^1) + (F_t^1 + \Delta F^1)(Y_t^1 + \Delta Y^1) + (B_t^{12} + \Delta B^{12})(Y_t^2 + \Delta Y^2) + (B_t^{13} + \Delta B^{13})(Y_t^3 + \Delta Y^3) \]  \hspace{1cm} (11)

Contribution Ratio by Different Factor

\[ \frac{\Delta X^1}{X_0^1} = (X_t^1 - X_0^1)/X_0^1 \]
\[ = F_{D^1} + F_{T^1} + F_{DT^1} \]
\[ = (M_t^1 \cdot \Delta Y^1 + F_t^1 \cdot \Delta Y^1 + B_t^{12} \cdot \Delta Y^2 + B_t^{13} \cdot \Delta Y^3)/X_0^1 \]
\[ + (\Delta M_t^1 \cdot Y_t^1 + \Delta F_t^1 \cdot Y_t^1 + \Delta B_t^{12} \cdot Y_t^2 + \Delta B_t^{13} \cdot Y_t^3)/X_0^1 \]
\[ + (\Delta M_t^1 \cdot \Delta Y^1 + \Delta F_t^1 \cdot \Delta Y^1 + \Delta B_t^{12} \cdot \Delta Y^2 + \Delta B_t^{13} \cdot \Delta Y^3)/X_0^1 \].  \hspace{1cm} (12)

\[ \frac{\Delta X^1}{X_0^1} = (X_t^1 - X_0^1)/X_0^1 \]
\[ = F_{M^1} + F_{F^1} + F_{S^1} \]
\[ = (M_t^1 \cdot \Delta Y^1 + \Delta M_t^1 \cdot Y_t^1 + \Delta M_t^1 \cdot \Delta Y^1)/X_0^1 \]
\[ + (F_t^1 \cdot \Delta Y^1 + \Delta F_t^1 \cdot Y_t^1 + \Delta F_t^1 \cdot \Delta Y^1)/X_0^1 \]
\[ + (B_t^{12} \cdot \Delta Y^2 + \Delta B_t^{12} \cdot Y_t^2 + B_t^{13} \cdot \Delta Y^2 + \Delta B_t^{13} \cdot Y_t^3 + \Delta B_t^{12} \cdot \Delta Y^2 + \Delta B_t^{13} \cdot \Delta Y^3)/X_0^1 \].  \hspace{1cm} (13)

For simplification, let \( X^1/X_0^1 = (\Delta X_t^1/X_0^1, \Delta X_{t0}^1/X_0^1, \ldots, \Delta X_{t0}^1/X_0^1)' \).
### Real Growth Rate of Output

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<th>ENR</th>
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Table 4.2: Growth Tendency Compared with Industrial Average

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Table 4.3: Growth Tendency Comparing with Regional Average

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