Cross-regional Spillover of Economic Growth in China

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Contents (1)

◎"Unbalanced" economic growth: 1987-1997

"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. (1987–1997)

→ 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

Leontief (1941), Chenery et al. (1963), Carter (1970) ,
Feldman et al. (1987), Forssell (1989),
Oosterhaven and Linden (1997), Dietzenbacher and Los (1998)

- Applications

Single regional (national) level ： many
Interregional level ： Akita (1993) ，EU ： Oosterhaven and Hoen （1998) ，EU ： Dietzenbacher (2001)...

- Data limitation→

The technique has never been applied to China’s regional economies.

Review on Hirschmann's Theory

- Econometric Analyses

Zhang & felmingham(2002), Brun et al.(2002), Aoki(2003)...

- Inter-regional I-O Analyses (At one time-point)

Hioki(2004), Okamoto（2005）, Zhang & Zhao(2006)...

- Decomposition technique. (different benchmark years)

Data

- China's Interregional I-O table for 1987: Ichimura and Wang (2003)
- China's Multiregional I-O table for 1997: IDE-JETRO (2003)
- 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

$$X_i^r = \sum_s \sum_j x_{ij}^{rs} + \sum_s \sum_k y_{ik}^{rs} + E_i^r - M_i^r \qquad (1)$$

$$X_i'^r = \sum_s \sum_j x_{ij}^{rs}\theta_{ij}^{rs} + \sum_s \sum_k y_{ik}^{rs}\sigma_{ik}^{rs} + E_i^r\eta_i^r - M_i^r\nu_i^r \qquad (2)$$

$$\theta_i^r = \theta_{ij}^{rs} = \sigma_{ik}^{rs} = \eta_i^r \qquad (3)$$

$$\theta_i^r = \bar{\theta}_i(1+\alpha^r)(1+\beta_i) \qquad (4)$$

$$X_i'^r = (\sum_s \sum_j x_{ij}^{rs} + \sum_s \sum_k y_{ik}^{rs} + E_i^r)\theta_i(1+\alpha^r)(1+\beta_i) - M_i^r\nu_i^r \qquad (5)$$

$$V'^s = \sum_j X_j'^s - \sum_r \sum_i \sum_j x_{ij}^{rs}\bar{\theta}_i(1+\alpha^r)(1+\beta_i) \qquad (6)$$

$$\underset{\{grid\ search\ \ \alpha^r, \beta_i\}}{argmin} \quad \epsilon = \sum_s \left(\frac{V'^s - V^s\bar{\delta}^s}{V^s\bar{\delta}^s}\right)^2 \qquad (7)$$

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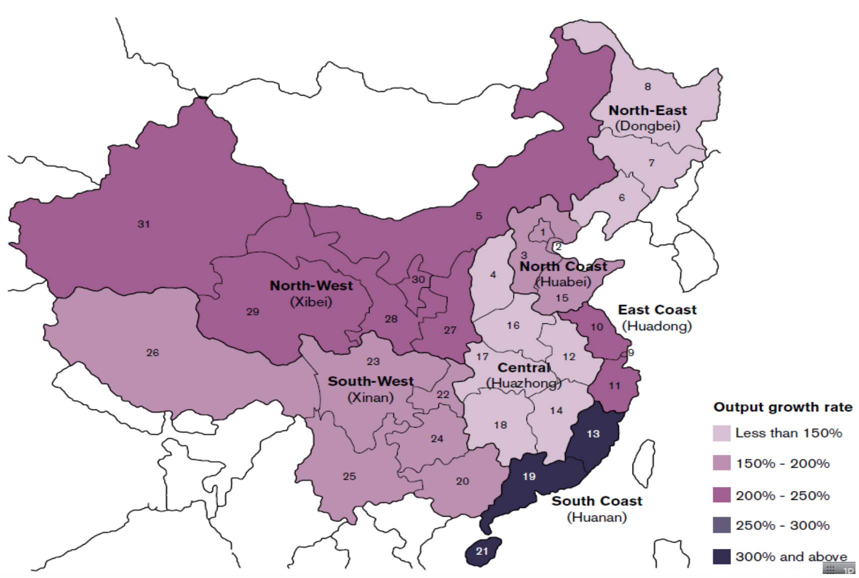
Output growth rates, 1987-1997 (percentage)



Above macro-level growth rates 1987-1997, vis-à-vis "all industries"

	Agriculture	Mining	Light industry	Energy	Heavy industry	Construction	Transport	Trade	Other services	All industries
North-East	+				+			+	+	///
North Coast			+		+				+	///
East Coast			+		+	+			+	///
South Coast			+		+		+		+	///
Central			+		+				+	///
North-West					+	+	+		+	///
South-West			+		+	+			+	///
Whole country			+		+				+	///

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Decomposition technique (1)

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

$$\Delta X = f(\Delta B, \Delta Y, \Delta BY)$$

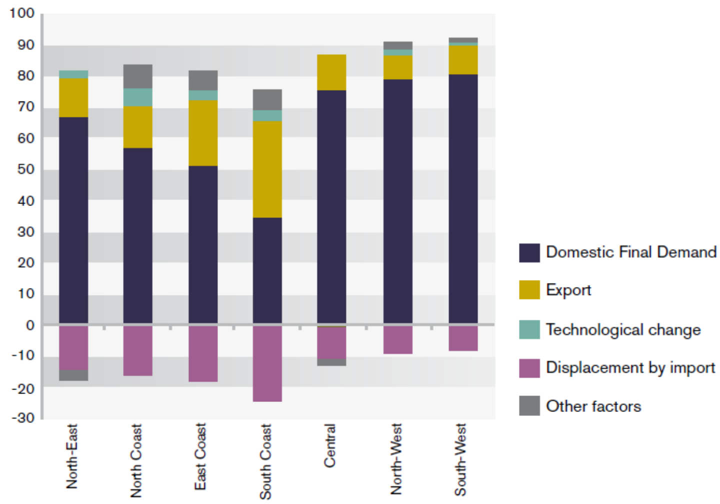
X: output, A: input coefficients, B: Leontief inverse

ΔB: change of technique

ΔY: change of final demand

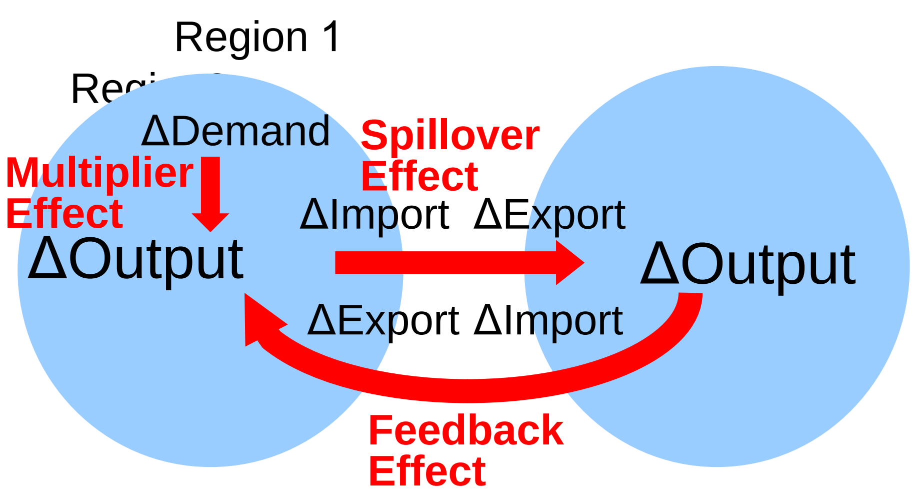
ΔBY: simultaneous change of B and Y

Decomposition of growth factors (percentage)



Sources: The Interregional Input-Output Tables of China, IRIO87 (Ichimura and Wang, 2003) and MRIO97 (IDE-JETRO 2003).

Decomposition technique (2):



Decomposition technique (2):

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

$$X = (I - A)^{-1} Y = B \cdot Y \qquad (1)$$

$$\Delta X = B \cdot \Delta Y \qquad (2)$$

$$B = \begin{pmatrix} B^{11} & B^{12} \\ B^{21} & B^{22} \end{pmatrix}$$

Matrix B can be decomposed into the following three parts.

$$\begin{pmatrix} B^{11} & B^{12} \\ B^{21} & B^{22} \end{pmatrix} = \begin{pmatrix} B^{11} & 0 \\ 0 & B^{22} \end{pmatrix} + \begin{pmatrix} 0 & B^{12} \\ B^{21} & 0 \end{pmatrix}$$

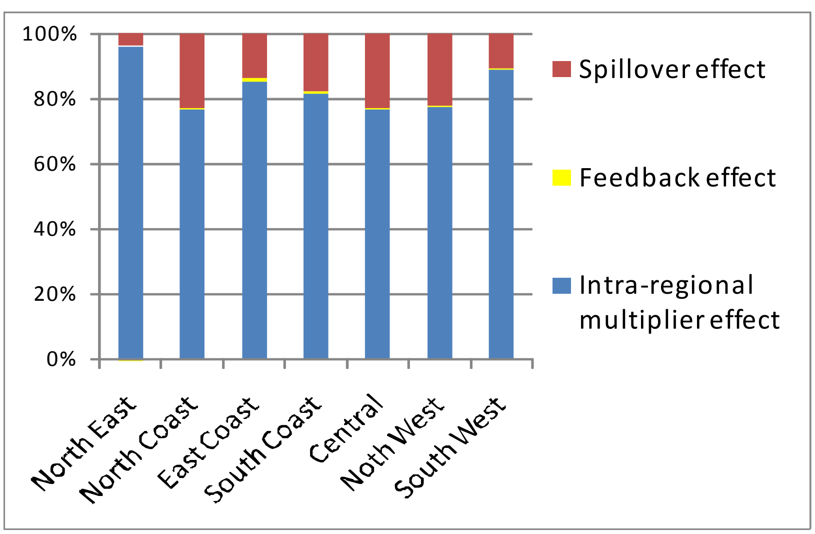
Spillover Effect

$$\begin{pmatrix} B^{11} & 0 \\ 0 & B^{22} \end{pmatrix} = \begin{pmatrix} (I - A^{11})^{-1} & 0 \\ 0 & (I - A^{22})^{-1} \end{pmatrix} + \begin{pmatrix} B^{11} - (I - A^{11})^{-1} & 0 \\ 0 & B^{22} - (I - A^{22})^{-1} \end{pmatrix}$$

Intra-regional Multiplier Effect

Feedback Effect

Results of spatial decomposition



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Shares of growth contribution from each region, 1987-1997 (percentage)

	North-East	North Coast	East Coast	South Coast	Central	North-West	South-West	Total
North-East	95.8	-1.1	2.0	1.1	0.0	1.6	0.8	100.0
North Coast	1.6	77.0	7.9	4.5	4.1	2.7	2.3	100.0
East Coast	1.8	2.0	86.3	6.0	1.2	1.3	1.4	100.0
South Coast	1.7	1.8	6.6	82.4	3.0	1.5	3.1	100.0
Central	1.3	0.8	8.5	6.7	77.2	2.5	3.0	100.0
North-West	2.2	4.8	4.8	3.0	5.5	78.0	1.7	100.0
South-West	0.7	0.6	2.8	4.8	1.3	0.6	89.3	100.0

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 Interregional Input-Output Tables of China, IRIO87 (Ichimura and Wang, 2003) and MRIO97 (IDE-JETRO 2003).

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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 5% contribution rates.

Impacts of 2008 Global Financial Crisis and the four trillion yuan fiscal expenditure

Allocation of four trillion yuan (RMB) fiscal expenditure

Allocation to:	%
Priority projects on roads, railways, airways, water supply and improvement of city electric networks	37.5
Reconstruction of the Sichuan region	25.0
Construction of low rent/price housings	10.0
Construction of countryside infrastructure	9.3
Investment for R&D to adjust the industrial structure	9.3
Investment for energy saving, environmental protection and to restore ecosystem	5.3
Investment for health, education, culture and social work	3.8

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

Source: 21st Century Business Herald (in Japanese, 21 Shiji Jingji Baodao), 22 May 2009.

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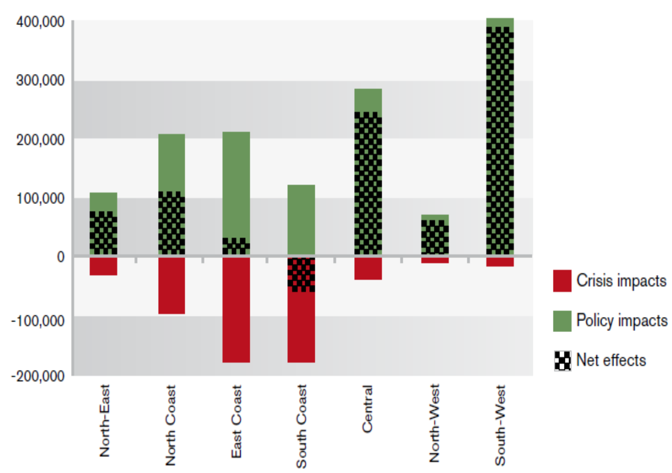
Comparison of crisis and policy impacts (in millions of US$)



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, 2000, 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.

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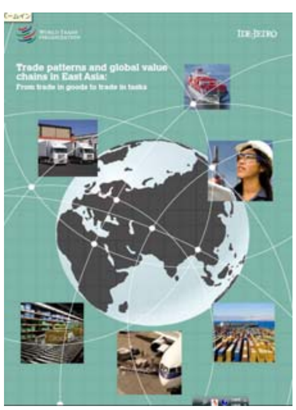
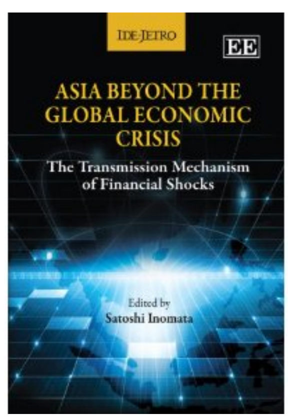
Reference 1





Reference 2

- Bo MENG and Chao QU (2008), "Application of the Input-Output Decomposition Technique to China's Regional Economies", Journal of Applied Regional Science, No. 13, pp. 27-46.
- Okamoto, N. and Inomata, S. (2011), "To what extent will the shock be alleviated? The evaluation of China's counter-crisis fiscal expansion", in Inomata, S. (ed), Asia Beyond the Global Economic Crisis, The transmission mechanism of financial shocks, IDE-JETRO and Edward Elgar Publishing.
- 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

	DD	RAS-based	GS
Accuracy	low	high	high*
Exogenous Information	normal	large	small
Calculation Scale	small	normal	super large
Theoretical Foundation	one price per good	composition price	composition price

*: Compare to DD

Spatial Decomposition

$$X = (I - A)^{-1}Y = B \cdot Y \tag{8}$$

Matrix B can be decomposed into the following three parts.

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

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

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.

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

Economic Growth

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

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.

$$X_0^1 = M_0^1 \cdot Y_0^1 + F_0^1 \cdot Y_0^1 + B_0^{12} \cdot Y_0^2 + B_0^{13} \cdot Y_0^3 \quad (10)$$

$$\begin{aligned} X_t^1 &= (M_0^1 + \Delta M^1)(Y_0^1 + \Delta Y^1) + (F_0^1 + \Delta F^1)(Y_0^1 + \Delta Y^1) \\ &+ (B_0^{12} + \Delta B^{12})(Y_0^2 + \Delta Y^2) + (B_0^{13} + \Delta B^{13})(Y_0^3 + \Delta Y^3) \end{aligned} \quad (11)$$

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Contribution Ratio by Different Factor

$$\begin{aligned} \Delta X^1/X_0^1 &= (X_t^1 - X_0^1)/X_0^1 \\ &= FD^1 + FT^1 + FDT^1 \\ &= (M_0^1 \cdot \Delta Y^1 + F_0^1 \cdot \Delta Y^1 + B_0^{12} \cdot \Delta Y^2 + B_0^{13} \cdot \Delta Y^3)/X_0^1 \\ &+ (\Delta M^1 \cdot Y_0^1 + \Delta F^1 \cdot Y_0^1 + \Delta B^{12} \cdot Y_0^2 + \Delta B^{13} \cdot Y_0^3)/X_0^1 \\ &+ (\Delta M^1 \cdot \Delta Y^1 + \Delta F^1 \cdot \Delta Y^1 + \Delta B^{12} \cdot \Delta Y^2 + \Delta B^{13} \cdot \Delta Y^3)/X_0^1. \end{aligned} \quad (12)$$

$$\begin{aligned} &\Delta X^1/X_0^1 = (X_t^1 - X_0^1)/X_0^1 \\ &= FM^1 + FF^1 + FS^1 \\ &= (M_0^1 \cdot \Delta Y^1 + \Delta M^1 \cdot Y_0^1 + \Delta M^1 \cdot \Delta Y^1)/X_0^1 \\ &+ (F_0^1 \cdot \Delta Y^1 + \Delta F^1 \cdot Y_0^1 + \Delta F^1 \cdot \Delta Y^1)/X_0^1 \\ &+ (B_0^{12} \cdot \Delta Y^2 + \Delta B^{12} \cdot Y_0^2 + B_0^{13} \cdot \Delta Y^3 + \Delta B^{13} \cdot Y_0^3 + \Delta B^{12} \cdot \Delta Y^2 + \Delta B^{13} \cdot \Delta Y^3)/X_0^1 \end{aligned} \quad (13)$$

For simplification, let $X^1/X_0^1 = (\Delta X_1^1/X_{1,0}^1, \Delta X_i^1/X_{i,0}^1, ..., \Delta X_n^1/X_{n,0}^1)'$.

Real Growth Rate of Output

	AGR	MIN	LIG	ENE	HEA	CON	TRA	COM	SER	AVE.
DB	131.09	11.33	114.16	53.20	151.54	106.56	79.10	168.83	230.60	119.34
HB	107.19	56.33	201.95	62.18	261.84	192.84	136.83	136.33	398.01	193.01
HD	96.34	82.19	259.36	122.86	266.77	258.34	119.37	186.49	525.73	241.96
HN	126.19	112.76	477.83	287.04	569.27	323.79	368.57	165.87	603.06	368.09
HZ	79.07	73.31	209.17	82.80	200.42	120.50	121.11	82.54	199.94	141.70
XB	181.54	141.88	184.80	144.89	228.22	252.64	251.56	178.23	298.89	208.66
XN	118.20	49.47	194.90	81.01	246.42	212.61	129.89	113.71	279.91	175.91
AVE.	108.44	58.24	234.23	100.36	258.10	197.00	152.49	141.44	351.33	203.16

Table 4.2: Growth Tendency Compared with Industrial Average

	AGR	MIN	LIG	ENE	HEA	CON	TRA	COM	SER	AVE.
DB	+	−	−	−	−	−	−	−	−	−
HB	−	−	−	−	+	+	−	+	+	−
HD	−	+	+	+	+	+	−	+	+	+
HN	+	+	+	+	+	+	+	+	+	+
HZ	−	+	−	−	−	−	−	−	−	−
XB	+	+	−	+	−	+	+	+	−	+
XN	+	−	−	−	−	+	−	−	−	−
AVE.	0	0	0	0	0	0	0	0	0	0

Table 4.3: Growth Tendency Comparing with Regional Average

	AGR	MIN	LIG	ENE	HEA	CON	TRA	COM	SER	AVE.
DB	+	−	−	−	+	−	−	+	+	0
HB	−	−	+	−	+	−	−	−	+	0
HD	−	−	+	−	+	+	−	−	+	0
HN	−	−	+	−	+	−	+	−	+	0
HZ	−	−	+	−	+	−	−	−	+	0
XB	−	−	−	−	+	+	+	−	+	0
XN	−	−	+	−	+	+	−	−	+	0
AVE.	−	−	+	−	+	−	−	−	+	0