The Output Effect of Trade Openness in China: Evidence from Provincial Data

Jang C. Jin (jcjin@cuhk.edu.hk)

Chinese University of Hong Kong, Hong Kong

Abstract

Unlike other studies that concentrate on country-level data for the openness and growth relations, this study investigates the validity of the relations for 21 provinces in China. Based on a production function, a linear regression model is specified to examine the effects of increasing openness on GDP growth in each province. To further investigate the short-run dynamic causal orderings between the two variables, a Granger causal model is constructed. For the robustness of the results, different lag lengths and alternative openness measures are further employed for each province. For east coastal provinces in China, increasing openness is found to have positive effects on output growth, and some of the positive effects are statistically significant. For inland provinces, however, the increased openness is found to have negative effects on GDP growth.

1. Introduction

The new interest in openness of an economy has re-ignited the debate on the openness and growth relations. The 'new' growth theories suggest that increasing openness of an economy have a favorable impact on economic growth. A country's openness to the world trade improves domestic technology, and hence productivity rises (Grossman and Helpman, 1991; Romer, 1992; Barro and Sala-i-Martin, 1995). Many cross-country studies provide evidence that increasing openness has a positive effect on GDP growth (Barro, 1991; Edwards, 1992, 1993, 1998; Sachs and Warner, 1995; Sala-i-Martin, 1997; Frankel and Romer, 1999, among others), whereas some studies indicate that robust positive relationships are difficult to find (Levine and Renelt, 1992; Harrison, 1996; Harrison and Hanson, 1999; O'Rourke, 2000, among others).

It is the increasing openness of a national economy that has been of central importance in economic growth. Yet provinces which do well in their trade performance also seem to do well in economic growth of the provinces. This co-movement between trade openness and provincial economic growth widely recognizes the importance of a foreign sector to provincial economies. What is the nature of this link? Is the openness-growth relation valid even for provincial economies? A number of studies have investigated regional economic development using state-level or provincial data (e.g. Smith, 1990, and Riefler, 1991, for the United States; Helliwell, 1996, and Rowlands, 1996, for Canada; and Prime, 1992, Perkins, 1997, and Lin, 1999, for China). No research, however, has been done for the policy implication of the openness-growth relations.

This paper aims to answer this question using provincial data in China. Some of the provinces, especially in east coastal areas, have achieved remarkable economic growth over the last two decades, and this growth has been accompanied

by persistent trade openness of the provinces. In particular, textile, industrial machinery, and electronics are major exporting industries in these provinces. The east coastal provinces are all outward-oriented economies, and hence the sources of high provincial economic growth are a matter of concern in these provinces. Employing cross-provincial data in China, Lin (1999) estimated the output effects of provincial exports within a structural model and found substantial effects of exports on economic growth in China. However, export expansion does not necessarily indicate increasing openness of provincial economies. Some provinces in China have been protected economies but expanded exports substantially. In addition, this sort of cross-sectional study cannot identify province-specific differences in China. Many east coastal provinces are rich and more open to trade, while most inland provinces are still underdeveloped. Their socio-economic characteristics may also be quite different among these provinces. It thus appears that the impact of trade openness must be studied on a province-by-province basis in China.

2. Data and Unit Roots

2.1 Data Sources

For each province, annual time-series over the period 1978 - 1998 are used for the analysis. The data begin in 1978 since an open-door policy has been implemented in China from this period. The data used for the analysis are the real gross domestic product (GDP) in each province, in 100 millions of Chinese yuan,[1] deflated by the consumer price index in each province (1995=100), and the (exports + imports)/GDP ratio as a proxy for the degree of trade openness (OPEN) in each province.[2] Based on a production function, real capital formation (K) and total employment (L) are also included in the model as control variables and allow to influence output growth.

The provincial data for all variables used are taken from the *Statistical Yearbook* of each province. There are total 27 provinces and 4 municipalities in China. Among them, 18 provinces and 3 municipalities are estimated for this study because time consistent data are not available for the rest of the provinces and municipalities. The data for exports and imports available in U.S. dollars were converted to the same currency in Chinese yuan using the nominal exchange rate that was obtained from *International Financial Statistics*. For the price level, the retail price index was used for some provinces if the consumer price index was not available. Different base years in different provinces were unified to the same base year (1995=100).

2.2 Unit Root Test

Because choice of a wrong transformation or failure to account for nonstationarities has far-reaching consequences

in interpreting the time series model, a unit root test is conducted to evaluate whether the time series used are difference-stationary or trend-stationary. As indicated by Nelson and Plosser (1982), if the series are trend-stationary, use of levels with inclusion of a time trend will meet stationarity; if the series contain unit roots, differencing often converts the process to a stationary one. The stationarity of the series used is investigated by employing the unit root test developed by Fuller(1976) and Dickey and Fuller (1979).

For the augmented Dickey-Fuller unit root test, each variable is regressed on a constant, a linear deterministic time trend, a lagged dependent variable, and q lags of first differences:

$$X_t = a + b \text{ TIME} + rho\ X_{t-1} + d_1 (X_{t-1} - X_{t-2}) + ... + d_q (X_{t-q} - X_{t-q-1}) + u_t, \qquad (1)$$

where X_t is the level of the variable under consideration. Following Schwert (1987), the lag length, q, is set at 2 years, so that residuals u_t can be white noise. The marginal significance levels of the Ljung-Box Q statistics range between 0.76 and 0.99, indicating that the serial correlation of residuals does not appear to be serious. Choice of other lag lengths merely reduces the significance levels of the Q-statistics.

Table 1 present the results of the unit root test in levels. All series are transformed to natural logs, and the model for each variable is estimated by least squares. The numbers are t-values under the null hypothesis H_0: rho=1. In most cases, the null hypothesis of one unit root cannot be rejected at the 5% significance level. Although there are a few exceptions in Fujian, Hebei, and Anhui, nonstationary individual series may turn out to be stationary if transformed to first differences.

2.3 Cointegration Test

Engle and Granger (1987), however, state that nonstationary individual series can be cointegrated if the two nonstationary individual series are combined together and turn out to be stationary. In such a case, the formulation in differences may cause model misspecification because a linear combination of nonstationary individual series may itself be stationary in levels. Utilizing the technique of Engle and Granger (1987), the cointegration test is performed by regressing the following two equations separately.[3]

$$X_{1t} = b_1 + b_2 \text{ TIME} + b_3 X_{2t} + b_4 X_{3t} + b_5 X_{4t} + u_t \qquad (2)$$

$$u_t = rho\ u_{t-1} + d_1(u_{t-1} - u_{t-2}) + ... + d_q(u_{t-q} - u_{t-q-1}) + v_t, \qquad (3)$$

where X_{it}, i=1, ... , 4, are the levels of the variables under consideration, and u_t and v_t are white-noise disturbance terms. The residuals u_t from the cointegrating regression (2) are used for the augmented Dickey-Fuller test of the residuals in equation (3). The unit root regression uses the same lag length (q=2) as in the unit root test.

Table 1 also reports the results of the cointegration test for each series. Since the test statistics are in most cases smaller than the critical value, we cannot reject the null hypothesis of no cointegration at the 5% significance level. Although there is one exception in Jiansu, a linear combination of GDP and other model variables does not share a common stochastic trend over time. Thus, first differencing is appropriate for data transformation, and it is not necessary to include error correction terms in the model.

3. Basic Results

Having characterized the difference-stationarity of the data, the effects of openness on economic growth are estimated using a regression model. The regression model is specified based on a production function. Assuming constant returns to scale across all inputs used, the production function can be written as:

$$Y = f(K, L, T), \tag{4}$$

where Y represents output, K stands for capital input, and L is labor input. Technology (T) is then assumed to be dependent of the openness of an economy, among others:

$$T = f(OPEN), \tag{5}$$

where T represents domestic technology, and OPEN stands for the degree of openness of an economy. If an economy is more open to the world, the domestic economy will be more active in international trade. In other words, foreign goods and services will be imported with less restrictions and barriers. In this case, imports of goods and services from industrialized countries introduce new technology to the domestic economy, and hence productivity rises.

An empirical model is thus specified as:

$$y_t = b_1 + b_2 k_t + b_3 L_t + b_4 OPEN_t + u_t, \tag{6}$$

where y = real GDP, k = real capital formation, L = total employment, and OPEN = trade/GDP ratio, and residuals u_t. As noted earlier, all model variables are measured in first differences of logarithm. Following a conventional method, OPEN is measured in levels because the trade/GDP ratios are in most provinces less than one.

Table 2 shows estimation results of the model for each province over the period 1978-98. Since serial correlation is a most common statistical problem in time series data, Durbin-Watson (D-W) statistics are reported in the table together with adjusted R^2. If the D-W statistics are not close to two, the lagged dependent variable GDP_{t-1} is included in the model to reduce the first-order serial correlation. In this case, Ljung-Box Q statistics are employed to check with higher-order serial

correlation problems that may exist in the model. For most provinces, the serial correlation problem appears not to be serious. D-W statistics are in most cases close to two, and the significance levels of Q statistics are also greater than 10% for the provinces that include GDP_{t-1} as an additional regressor.

First of all, the growth rate of capital input (k) has, in most provinces, significant positive effects on output growth at the conventional significance levels. The significant effects of k are a sharp contrast with insignificant output effects of labor input (L) in most provinces. The results thus suggest that China is, in general, a labor-intensive country in which capital is more productive and significant than labor in most provinces. Second, increasing openness to trade has positive effects on output growth for most east coastal provinces. Among them, about a half of the provinces that include Guangdong, Fujian, Hebei, Tianjin, and Heilongjian show that the positive effects are statistically significant at the conventional significant levels. Not surprisingly, however, in most inland provinces, increasing openness is found to reduce GDP growth, and some of the negative effects are statistically significant for the provinces including Hubei, Guizhou, and Qinghai. The significant negative effects appear to be consistent with the argument of Aitken and Harrison (1999) and Levine and Renelt (1992) that the increased international competition due to openness may cause domestic investment to decline and its decrease would be greater than an increase in capital inflows from abroad. In this case, net investment falls, so does the output.

4. Granger Causality

To further investigate the short-run dynamics, their causal orderings between openness and growth are investigated in a Granger causal model. Granger (1969) defines the causality such that x causes y if the prediction of y can be improved with the help of past values of x.[4] Based upon the definition of Granger causality, a simple bivariate autoregressive (AR) model is specified as:

$$y_t = c + \sum_{i=1}^{p} \alpha_i \, y_{t-i} + \sum_{j=1}^{q} \beta_j \, x_{t-j} + u_t \qquad (7)$$

$$x_t = c + \sum_{i=1}^{r} \gamma_i \, x_{t-i} + \sum_{j=1}^{s} \delta_j \, y_{t-j} + v_t \qquad (8)$$

where y is real GDP and x is the trade/GDP ratio; u and v are serially uncorrelated white noise residuals; and p, q, r, and s are lag lengths for each variable in each equation. To determine the causal orderings, the Granger test employs the F-statistics within a framework of restricted and unrestricted models. Granger causality may run from x to y if the past values of x have significant effects on y in equation (7). For one-way causality from x to y, a sufficient condition would be that the effects of y should be insignificantly different from zero in equation (8). Similarly, Granger causality will run backward

from y to x if the null of no causality is rejected in (8), but not in (7). A bidirectional causal relationship can be supported if the null is rejected in both equations (7) and (8).[5]

Table 3 shows the results of the Granger test with common lag lengths for all variables. Although the sample period begins from 1978, estimation begins from 1980 and 1981, respectively, due to different lag lengths used. Thus, the degrees of freedom reduce by two in each model. The lag length longer than 2 years is not used here, since the degree-of-freedom problem appears to be serious. When the model includes only one or two lags for both variables, the Ljung-Box Q statistics indicate that the serial correlation problem is not serious.[6]

For most provinces, trade openness does not appear to Granger-cause output growth. The F statistics are, in general, insignificant at the conventional significance levels. There are a few exceptions. For Hebei, Heilongjiang, and Hunan, increasing openness Granger-causes GDP growth at the conventional significance levels. The results of the first two provinces are consistent with the findings in Table 2. For most provinces, however, policy implications from the results in Tables 2 and 3 are slightly different perhaps due to contemporaneous relationships in the regression model; however, the Granger-causal model uses only past values of openness that appear not to precede current GDP growth in most provinces.

For the robustness of the results, Tables 3 further employs an alternative openness measure. Following Romer (1993), the import share in GDP is used as a proxy for openness of an economy. Since even protected economies like Japan, Korea, and China have expanded exports to other countries, the import share in GDP removes the export share from total trade. Unlike trade share in GDP, the import share reveals import penetration that represents the degree of a country's openness. When the imports/GDP ratio is used as an alternative openness measure, a reverse Granger causality is found from GDP growth to openness in several provinces including Shanghai, Shandong, Shanxi, Liaoning, and Sichun. Other than that, the causal relationships, particularly from changes in openness to GDP growth, are in general insignificant at the conventional significant levels.

5. Summary and Conclusions

Unlike other studies that concentrate on country-level data for the openness and growth relations, this study investigates the validity of the relations for 21 provinces in China. Based on a production function, a linear regression model is specified to examine the effects of increasing openness on GDP growth in each province. To further investigate the short-run dynamic causal orderings between the two variables, a Granger causal model is constructed. For the robustness of the results, different lag lengths and alternative openness measures are further employed for each province.

For east coastal provinces in China, increasing openness is found to have positive effects on output growth, and some of the positive effects are statistically significant. The findings of short-run positive output effects appear consistent

with the new growth theories that increasing openness has a significant positive impact on output growth. These findings are not surprising because major exporting and importing industries in China are located in east coastal provinces. The increased openness in these provinces will enhance domestic technology, which in turn stimulates productivity. In this case, provincial economies grow. For inland provinces, however, the increased openness is found to have negative effects on GDP growth. The negative effects are perhaps due to the lack of international competitiveness of inland provinces. In particular, some inland provinces are not strong enough to compete with new foreign technology, and hence domestic investment of these provinces may shrink if the economies are more open to the world.

Finally, we stress the importance of including capital and labor inputs when modeling the provincial economies. For most provinces, the capital input is found to have significant effects on economic growth, whereas the effect of the labor input is insignificant. These two different effects are broadly consistent with a proposition that China is a labor-intensive country so that capital is more significant and productive than the labor input.

FOOTNOTES

1. Strictly speaking, GDP means the gross regional product (GRP) in each province.

2. The provincial exports (imports) are defined as total exports (imports) of goods shipped from a province through its customs office. It thus includes trade between provinces, as well as trade with foreign countries. For example, if the goods are manufactured in different provinces but shipped out through a particular province, they are considered as exports of that particular province.

3. One may suggest to use the system based test of Johansen (1988) that has been widely used for multivariate cases. Hansen (1990), however, pointed out that the power of this test, as well as the test proposed by Engle and Granger (1987), falls substantially as the size of the system increases. Recently, Gonzalo and Lee (1998) further indicated that the Johansen test tends to find 'spurious' cointegration if probability approaches one asymptotically. In most of the situations investigated in their study, the Engle-Granger test is found more robust than Johansen tests.

4. The Granger's definition of causality is, however, not causality as it is usually understood. The Granger causality is a 'precedence' of one series to another, and some critics suggest to use the term 'precedence' rather than Granger causality (Basmann, 1988, among others). In practice, however, we would like to know whether a time series X precedes a time series Y, or Y precedes X. This is the purpose of Granger causality. Thus, the test for Granger causality can be used for policy evaluation, but its interpretation should be done with care (Granger, 1988).

5. It would be desirable to use a multivariate causal model, e.g. vector autoregressive (VAR) model, but the VAR model depletes the degrees of freedom quickly if one more variable is included in the model.

6. No attempt has been made to select optimal lag lengths for the causal model, since the degree-of-freedom

problem is especially serious. For the robustness of the results, different lag lengths have been employed but the results are materially unchanged.

REFERENCES

Aitken, Brian J. and Harrison, Ann E. (1999) "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela," American Economic Review 89, 605-618.

Barro, Robert (1991) "Economic Growth in a Cross Section of Countries," Quarterly Journal of Economics 106, 407-443.

Barro, Robert and Sala-i-Martin, Xavier (1995) Economic Growth, New York: McGraw-Hill.

Basmann, R. L. (1988) "Causality Tests and Observational Equivalent Representations of Econometric Models," Journal of Econometrics, 69-104.

Dickey D.A. and Fuller, W.A. (1979) "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," Journal of the American Statistical Association, 427-431.

Edwards, S. (1992) "Trade Orientation, Distortions, and Growth in Developing Countries," Journal of Development Economics 39, 31-57.

Edwards, S. (1993) "Openness, Trade Liberalization and Growth in Developing Countries," Journal of Economic Literature 31, 1358-1393.

Edwards, S. (1998) "Openness, Productivity and Growth: What Do We Really Know?" Economic Journal 108, 383-398.

Engle, R. F. and Granger, C.W.J. (1987) "Cointegration and Error Correction: Representation, Estimation, and Testing," Econometrica 55, 251-276.

Frankel J. A. and Romer, D. (1999) "Does Trade Cause Growth?" American Economic Review 89, 379-399.

Fuller, W.A. (1976) Introduction to Statistical Time Series, New York: Wiley.

Gonzalo, J. and Lee, T. H. (1998) "Pitfalls in Testing for Long Run Relationships," Journal of Econometrics, 129-154.

Granger, C. W. J. (1969) "Investigating Causal Relations by Econometric Models and Cross-spectral Methods," Econometrica, 424-438.

Granger, C. W. J. (1988) "Some Recent Developments in a Concept of Causality," Journal of Econometrics, 199-211.

Grossman, G. M. and Helpman E. (1991) Innovation and Growth in the Global Economy, Cambridge, Massachusetts: MIT Press.

Hansen, B. E. (1990) "A Powerful Simple Test for Cointegration Using Cochrane-Orcutt," Working Paper, University of Rochester.

Harrison, A. (1996) "Openness and Growth: A Time-series, Cross-country Analysis for Developing Countries," Journal of

Development Economics 48, 419-447.

Harrison, A. and Hanson G. (1999) "Who Gains from Trade Reform? Some Remaining Puzzles," Journal of Development Economics 59, 125-154.

Helliwell, John F. (1996) "Convergence and Migration among Provinces," Canadian Journal of Economics, S324-30.

Johansen, S. (1988) "Statistical Analysis of Cointegrating Vectors," Journal of Economic Dynamics and Control, 231-254.

Levine, R. and Renelt, D. (1992) "A Sensitivity Analysis of Cross-Country Growth Regressions," American Economic Review 82, 942-963.

Lin, S. (1999) "Export Expansion and Economic Growth: Evidence from Chinese Provinces," Pacific Economic Review 4, 65-77.

O'Rourke, K. H. (2000) "Tariffs and Growth in the Late 19th Century," Economic Journal 110, 456-483.

Perkins, F. C. (1997) "Export Performance and Enterprise Reform in China's Coastal Provinces," Economic Development and Cultural Change, 501-39.

Plosser, C.I. (1982) "Government Financing Decisions and Asset Returns," Journal of Monetary Economics 9, 325-52.

Prime, Penelope B. (1992) "Industry's Response to Market Liberalization in China: Evidence from Jiangsu Province," Economic Development and Cultural Change, 27-50.

Riefler, Roger F. (1991) "An Assessment of Economic Development Policy: Nebraska in the 1980s," Regional Science Perspectives, 3-26.

Romer, David (1993) "Openness and Inflation: Theory and Evidence," Quarterly Journal of Economics 108, 869-903.

Romer, Paul M. (1992) "Two Strategies for Economic Development: Using Ideas and Producing Ideas," World Bank Annual Conference on Economic Development, Washington, DC, The World Bank.

Rowlands, Dane (1996) "Regional Development in Canada: Problems and Prospects," Canadian Journal of Economics, S340-343.

Sachs, J. and Warner, A. (1995) "Economic Reform and the Process of Global Integration," Brookings Papers Economic Activity 1, 1-117.

Sala-i-Martin, X. (1997) "I Just Ran Two Million Regressions," American Economic Review 87, 178-183.

Schwert, G.W. (1987) "Effects of Model Specification on Tests for Unit Roots in Macroeconomic Data," Journal of Monetary Economics, 73-103.

Smith, Tim R. (1990) "Regional Export Growth: Lessons from the State-Level Foreign Trade Data," Regional Science Perspectives, 21-38.

Table 1. Tests for Stationarity of Time Series: 1978-1998

Provinces	Dickey-Fuller Test				Engle-Granger Test			
	GDP	K	L	Open	GDP	K	L	Open
Guangdong	-2.78	-2.37	-0.67	-0.99	-1.32	-2.54	-1.66	-1.66
Shanghai	-0.71	-2.35	-3.18	-3.20	-0.50	-1.73	-3.00	-1.96
Shandong	-2.45	-2.36	-2.35	-2.91	-2.77	-2.48	-2.46	-3.21
Jiangsu	-3.22	-3.37	-1.70	-1.08	-4.21	-5.93	-2.38	-3.32
Zhejiang	-3.27	-3.32	-2.96	-1.77	-2.70	-4.00	-0.87	-1.59
Fujian	-1.21	-3.67	-0.14	-2.06	-2.85	-3.55	-1.69	-2.04
Hebei	-2.35	-3.77	-0.19	-2.09	-3.17	-3.31	-2.61	-3.50
Beijing	-1.66	-2.13	-0.87	-2.87	-1.63	-2.69	-1.59	-1.83
Tianjin	-1.88	-2.17	-2.02	-1.80	-3.03	-2.11	-3.73	-3.45
Shanxi	-2.66	-2.88	-2.59	-2.66	-1.64	-3.06	-1.76	-2.79
Anhui	-3.68	-3.30	0.28	-2.43	-2.10	-2.63	-1.94	-2.01
Hubei	-2.03	-2.08	-0.03	-2.46	-2.58	-2.92	-2.26	-3.14
Hunan	-1.03	-2.50	-0.45	-2.32	-1.89	-2.77	-2.15	-2.77
Liaoning	-2.23	-1.91	-0.42	-2.53	-0.51	-1.91	-1.73	-2.24
Jilin	-2.31	-2.09	0.65	-1.79	-1.80	-2.99	-2.30	-3.21
Heilongjiang	-0.79	-3.12	-1.89	-1.88	-2.22	-2.87	-3.13	-3.02
Sichuan	-2.30	-2.37	1.74	-2.25	-2.01	-2.08	-1.10	-2.76
Guizhou	-1.66	-3.24	-1.18	-2.14	-2.11	-2.67	-2.02	-1.91
Gansu	-2.51	-3.03	-1.49	-2.42	-1.59	-2.12	-2.27	-2.61
Qinghai	-2.56	-2.11	-2.92	-2.15	-1.37	-1.43	-2.30	-3.29
Shaanxi	-1.72	-1.74	1.23	-2.92	-3.88	-2.79	-3.51	-2.44

Table 2. Regression Results: GDP as a dependent variable, 1978-1998

Provinces	GDP$_{t-1}$	K	L	Open	Adj R^2	D-W	Q
Guangdong	-0.42 (0.19)*	0.30 (0.09)*	2.41 (1.19)*	0.02 (0.01)+	0.48	1.82	13.70 (0.12)
Shanghai	0.48 (0.28)+	-0.01 (0.07)	0.79 (0.76)	0.08 (0.08)	0.24	1.62	6.85 (0.65)
Shandong		0.41 (0.12)*	-0.02 (0.19)	-0.10 (0.21)	0.33	2.03	11.97 (0.28)
Jiangsu	0.06 (0.15)	0.35 (0.07)*	0.51 (1.42)	0.18 (0.18)	0.55	2.65	13.24 (0.15)
Zhejiang		0.25 (0.06)*	0.80 (0.85)	0.05 (0.16)	0.47	1.85	7.78 (0.65)
Fujian	-0.22 (0.22)	0.22 (0.09)*	0.40 (0.89)	0.11 (0.06)+	0.36	2.23	14.37 (0.11)
Hebei	0.19 (0.14)	0.33 (0.07)*	0.67 (0.96)	1.21 (0.63)+	0.69	1.93	11.85 (0.22)
Beijing		0.10 (0.06)+	-0.19 (0.39)	-0.14 (0.13)	0.08	1.90	18.33 (0.05)
Tianjin	-0.18 (0.29)	0.11 (0.06)+	1.89 (1.01)+	0.24 (0.11)*	0.13	2.52	14.05 (0.12)
Shanxi	-0.38 (0.17)*	0.36 (0.08)*	0.49 (0.90)	0.13 (0.37	0.48	1.84	4.81 (0.85)
Anhui		0.21 (0.08)*	0.61 (1.16)	0.05 (0.45)	0.23	2.10	8.13 (0.61)
Hubei		0.29 (0.06)*	-3.14 (1.27)*	-0.89 (0.34)*	0.56	1.91	6.17 (0.80)
Hunan		0.23 (0.08)*	-4.54 (1.76)*	-0.55 (0.38)	0.42	2.40	10.75 (0.37)
Liaoning		0.32 (0.07)*	0.21 (0.44)	-0.17 (0.23)	0.52	1.76	7.26 (0.70)
Jilin	0.06 (0.23)	0.21 (0.12)+	-0.64 (0.51)	-0.13 (0.26)	0.03	1.71	14.28 (0.11)
Heilongjiang		0.10 (0.10)	0.89 (0.60)	0.38 (0.17)*	0.09	2.16	9.90 (0.44)
Sichuan		0.57 (0.10)*	-0.18 (0.54)	-0.07 (0.25)	0.64	1.94	15.10 (0.12)
Guizhou	-0.32 (0.21)	0.24 (0.08)*	0.21 (0.84)	-1.13 (0.59)+	0.35	2.12	9.6 (0.37)
Gansu		0.38 (0.09)*	0.49 (0.34)	0.13 (0.43)	0.41	2.09	8.24 (0.60)
Qinghai	-0.21 (0.18)	0.13 (0.05)*	0.44 (0.76)	-0.74 (0.44)+	0.24	2.22	8.92 (0.44)
Shaanxi	-0.07 (0.20)	0.18 (0.06)*	0.42 (1.40)	-0.08 (0.33)	0.22	1.89	4.13 (0.90)

Table 3. Granger Causality: 1978-1998

Provinces	H_0: GDP ←×— Open			H_0: GDP —×→ Open		
	1 Lag	2 Lags	Imp/GDP	1 Lag	2 Lags	Imp/GDP
Guangdong	0.04	0.06	0.01	0.01	0.16	0.35
	(0.82)	(0.93)	(0.98)	(0.89)	(0.85)	(0.70)
Shanghai	0.35	0.90	1.34	0.79	0.94	3.00
	(0.26)	(0.42)	(0.29)	(0.38)	(0.41)	(0.08)+
Shandong	1.34	0.75	0.48	0.17	0.17	3.11
	(0.26)	(0.48)	(0.62)	(0.67)	(0.84)	(0.07)+
Jiangsu	0.21	1.54	2.27	0.02	0.61	0.82
	(0.64)	(0.24)	(0.14)	(0.96)	(0.55)	(0.45)
Zhejiang	0.02	0.78	0.16	0.02	0.08	1.74
	(0.88)	(0.47)	(0.85)	(0.96)	(0.92)	(0.21)
Fujian	0.55	0.74	0.44	0.81	0.99	1.91
	(0.46)	(0.49)	(0.64)	(0.37)	(0.39)	(0.18)
Hebei	11.31	1.92	0.29	0.32	0.39	0.88
	(0.01)*	(0.18)	(0.75)	(0.57)	(0.68)	(0.43)
Beijing	0.14	0.27	0.35	0.92	1.72	1.14
	(0.71)	(0.76)	(0.70)	(0.35)	(0.21)	(0.34)
Tianjin	0.38	0.10	0.13	0.53	1.16	0.74
	(0.54)	(0.90)	(0.87)	(0.47)	(0.34)	(0.49)
Shanxi	0.02	0.14	0.62	0.04	0.56	3.73
	(0.87)	(0.86)	(0.55)	(0.83)	(0.57)	(0.05)*
Anhui	0.06	0.73	2.10	0.28	0.09	0.42
	(0.79)	(0.49)	(0.16)	(0.59)	(0.91)	(0.66)
Hubei	0.16	0.54	0.26	0.24	0.77	0.20
	(0.68)	(0.59)	(0.77)	(0.62)	(0.47)	(0.81)
Hunan	3.32	0.59	0.68	0.12	0.23	0.69
	(0.08)+	(0.56)	(0.52)	(0.73)	(0.79)	(0.51)
Liaoning	0.90	1.03	1.51	0.09	0.06	6.31
	(0.35)	(0.38)	(0.25)	(0.76)	(0.93)	(0.01)*
Jilin	0.09	0.20	0.71	0.16	0.03	0.94
	(0.76)	(0.81)	(0.50)	(0.68)	(0.96)	(0.91)
Heilongjiang	2.04	2.78	3.77	1.32	0.76	0.55
	(0.17)	(0.09)+	(0.05)*	(0.26)	(0.48)	(0.58)
Sichuan	0.04	0.04	0.01	1.70	0.62	2.69
	(0.82)	(0.95)	(0.98)	(0.20)	(0.54)	(0.10)+
Guizhou	2.79	2.35	1.88	0.19	0.05	0.12
	(0.11)	(0.13)	(0.19)	(0.66)	(0.95)	(0.87)
Gansu	0.20	0.27	0.36	0.17	0.35	0.82
	(0.65)	(0.76)	(0.70)	(0.68)	(0.70)	(0.45)
Qinghai	0.88	0.18	0.05	0.30	0.09	0.04
	(0.36)	(0.83)	(0.95)	(0.58)	(0.91)	(0.95)
Shaanxi	0.79	1.45	1.81	2.03	1.15	0.88
	(0.38)	(0.26)	(0.20)	(0.17)	(0.34)	(0.43)