

The Import Patterns of the Korean Agro-manufactures

Exploring the Short-run and Long-run Granger Causal Relationship

Yu Hong¹, Yumeng Yang² and Xiaowei Mu^{3,*}

¹ Jilin University of Finance and Economics, Changchun 130117, China

² College of Humanities & Sciences, Northeast Normal University, Changchun 130117, China

*Corresponding author

Abstract—Using annual trade data during the period of 1976-2016, this study conducted co- integration analysis of the Korean trade pattern in the imports of agricultural manufactures. We find that Korea has comparative disadvantage and trade deficits in the imports of agricultural manufactures. Granger causality tests indicates that in short-run, there is no Granger causality between the improvements in trade balance and comparative advantages in the Korean imports of agricultural manufactures; in the long-run, the efforts adversely hurt the comparative advantages.

Keywords—Korea; import pattern; agricultural manufactures; granger causal relationship

I. INTRODUCTION

Ricardian theory points out that a country should specialize in produce and export the products with comparative advantages, while importing the products with comparative disadvantages. However, the theory of dynamic comparative advantage emphasizes that a country, especially a developing country, should improve its comparative advantage by promoting the export of emerging industries with important strategic significance and restricting the import [1]. Export promotion and import restriction usually involve large-scale production of domestic related industries, these industries also benefit from the "learning from export" effect, and technology spillover will promote the formation and development of their dynamic comparative advantages [2]. It should be noted that both export promotion and import restriction are also distortions to trade patterns. Therefore, it is worth pondering what direction South Korea's trade policies will distort its trade patterns compared with the equilibrium state in addition to the analysis of export promotion.

This study focuses on the impact of the Korean import patterns of the agricultural manufactures. Moreover, we also test the nexus between the policy intervention and the changes of comparative advantage, in both short-run and long-run.

II. METHODOLOGIES AND DATA

A. Revealed Comparative Advantage

The indicator of "revealed comparative advantage" (RCA) is well used to measure the comparative advantages of a country in the export of specific product(s):

$$RCA_{ik} = (X_{ik} / X_i) / (X_{wk} / X_w) \quad (1)$$

where X represents exports, X_{ik} is the exports of k -th products from country i , X_{wk} represents total exports of k products from countries around the world, and X_w represents total exports of all products from the world. $RCA_{ik} > 1$ indicates that country i has comparative advantage in the exports of product k .

B. Symmetric Revealed Comparative Advantage

The range of RCA is zero to infinity, besides, its average value is uncertain and the distribution is asymmetric. Dalum et al. (1998) address the problems by a logarithmic transformation of RCA index [3]:

$$RSCA_{ik} = (RCA_{ik} - 1) / (RCA_{ik} + 1) \quad (2)$$

$RSCA_{ik}$ is "symmetric revealed comparative advantage" index (RSCA) for the export of k products in country i , with a value range of $[-1, 1]$ and an average value of 0. When $RSCA_{ik} > 0$, there must be $RCA_{ik} > 1$, indicating that country i has a comparative advantage in the export of k products. When $RSCA_{ik} < 0$, $RCA_{ik} < 1$, indicating that country i is at a comparative disadvantage in the export of k products. When $RSCA_{ik} = 0$, the comparative advantage of k 's exports by country i is the same as that of other part of the world, and there is neither comparative advantage nor disadvantage of k exports of country i .

This paper aims to exploring the trade patterns of imports. We thus employ the measurement of

$$RCA_{ik}^M = (M_{ik} / M_i) / (M_{wk} / M_w) \quad (3)$$

to capture the revealed comparative advantage in import. M stands for import, while subscripts i , k and w stand for country i , product k and the world. The symmetric revealed comparative advantage in import is

$$RSCA_{ik}^M = -(RCA_{ik}^M - 1) / (RCA_{ik}^M + 1) \quad (4)$$

We deliberately add a negative sign in Eq. (4) to keep the logical consistency. In Ricardian theory, the more the imports, the less the comparative advantage.

C. Net Export Ratio

The relative status of import and export of product k in country i can be reflected by net export ratio:

$$NX_{ik} = (X_{ik} - M_{ik}) / (X_{ik} + M_{ik}) \quad (5)$$

It is obvious that the range of NX is the same as that of $RSCA$ and the average is also 0. When $NX_{ik} > 0$, it means that country I is in a favorable position in the trade of product k ; When $NX_{ik} < 0$, country I is in deficit in the trade of product k . More importantly, the range and average values are the same, which makes it possible to analyze both RCA_{ik} and NX_{ik} .

D. Index of Policy Intervention

According to the hechel-orlin model, a country should specialize in production and export the products with abundant factors and comparative advantage. According to Ricardian free trade theory, the stronger comparative advantage of a country in a certain product, the more it should export and import less of a certain product. [4] in equilibrium, NX_{ik} should be consistent with $RSCA_{ik}$. Therefore,

$$RSCA_{ik}^M = NX_{ik} \quad (6)$$

is the necessary and sufficient condition for free trade. The difference between NX_{ik} and $RSCA_{ik}$.

$$h_{ik} = NX_{ik} - RSCA_{ik}^M \quad (7)$$

is the policy intervention index of country i in the import trade of product k , which reflects whether the net export capacity of country i in product k being consistent with the comparative advantage. In equilibrium, there should be $h_{ik} = 0$; If $h_{ik} > 0$, the net export capacity exceeds the degree that determined by the comparative advantages, indicating that country i has adopted restrictive import policies; If $h_{ik} < 0$, the implication is on the opposite, country i are taking import facilitating or encouraging policies.

E. Weighted Average Index of Policy Interventions

The agricultural manufactures include n specific products. It is necessary to assess the trade policy intervention for the product category by weighting.

$$H_{ij} = \sum_{k=1}^n W_{ik} (NX_{ik} - RSCA_{ik}) \quad (8)$$

is the weighted average of policy intervention. The weight

$$W_{ik} = (X_{ik} + M_{ik}) / \sum_{i=1}^n (X_{ik} + M_{ik}) \quad (9)$$

is the proportion of each specific product k in the total imports and exports of the Korean agricultural manufactures [5].

This is because that the part of NX is involving both of the exports and the imports. Accordingly, the weighting is the same as Eq. (8) when obtaining the weighted average of NX ; for the weighting average $RSCA$, however, the weight is the proportion of product k in the total imports of the category [6].

F. Data and Classification

This uses yearly trade data of 1976-2016 from U.N. Comtrade Database, under the Standard International Trade Classification Revision 2 (SITC Rev.2).

Following Lall (2000), we classified the three-digit classification products under SITC rev.2 according to the technical structure. [7] 35 agricultural manufactured goods were identified in the import and export trade products of South Korea as the reporting country between 1976 and 2016. Table 1 shows the SITC rev.2 code for all 35 agricultural manufactured products involved.

TABLE I. 3-DIGIT SITC REV.2 CODES OF AGRO-MANUFACTURES

012, 014, 023, 024, 035, 037, 046, 047, 048, 056, 058, 061, 062, 073, 098, 111, 112, 122, 233, 247, 248, 251, 264, 265, 269, 423, 424, 431, 621, 625, 628, 633, 634, 635, 641

III. RESULTS FOR THE KOREAN IMPORT PATTERNS

A. The Time Path of the Import Patterns

Fig. I illustrates the weighted average NX_{ij} , $RSCA_{ij}$ and H_{ij} index of Korea during the period from 1976 to 2016.

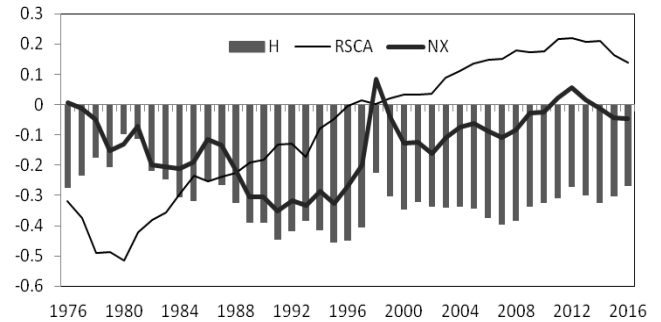


FIGURE I. THE IMPORT PATTERNS OF THE KOREAN AGRICULTURAL MANUFACTURES (1976-2016)

First, $RSCA_{ij}$ was negative from 1976 to 1996, and it changed from negative to positive in 1997, showing an increasing year by year, indicating that the import of agricultural manufactured goods in South Korea changed from comparative disadvantage to comparative advantage.

Secondly, the NX_{ij} index was negative during the sample period except for 1998, indicating that the import of

agricultural manufactured goods in South Korea was always in a position of trade deficit, which was consistent with the findings and conclusions of existing literature.

Thirdly, the H_{ij} index reflecting the Koren policy intervention in the import of agricultural manufactured goods is always negative, indicating that the net export capacity of South Korea's agricultural manufactured goods is always lower than the level corresponding to its comparative advantage. South Korea's import trade policy for agricultural manufactured goods is likely to be encouraging rather than restrictive.

B. ADF Unit Root Tests

ADF unit root tests for the time series of the Korean import patterns, namely RSCA and NX, is completed in the following steps, and the econometric analysis software used is Eviews5.1.

1) *Step one*: The model form of the first test is to assume that the generation process of time series is "both intercept and deterministic linear time trend". If the intercept or time trend are insignificant at the 0.05 level of confidence, then the second step is taken.

2) *Step two*: The model form of the second test assumes that the time series "has an intercept but no deterministic linear time trend". If the intercept cannot pass the significance test at the significant level of 0.05, then the third step is taken.

3) *Step three*: The model form of the third step test assumes that the production process of the time series has no additional terms, that is, "no intercept and no deterministic linear time trend". The results are shown in table II.

TABLE II. RESULTS OF ADF UNIT ROOT TEST

	variable	Specification	t-stats	Prob.
Level Seiries	$RSCA_{ij}$	$N, N, 0$	-1.221	0.200
	NX_{ij}	$N, N, 0$	-1.237	0.195
First Differences	$\Delta RSCA_{ij}$	$N, N, 0$	-4.767	0.000
	ΔNX_{ij}	$N, N, 0$	-6.110	0.000

None of the level series of RSCA and NX is stationary. However, the first differences of them both reject the null hypothesis and are significantly stationary. These results enable us to perform co-integration test and further short-run and long-run Granger causality tests without spurious regression.

C. Johansen Co-integration Test

Johansen co-integration relationship test is used to investigate whether there is a co-integration relationship between RSCA and NX sequences. The first key problem of Johansen co-integration test is to determine the optimal co-integration lag interval. In order to guarantee the objectivity of the study, the author firstly established the self-regression (VAR) model of unconstrained vector including RSCA and NX sequences, and set the maximum lag period of VAR to 8 according to the number of samples. Secondly, the VAR model is estimated and its lag results are analyzed. The optimal lag period of VAR is selected according to Akaike minimum information criterion (AIC) and Schwarz minimum information criterion (SIC). If the discrimination results of AIC and SIC were inconsistent, the comprehensive judgment was made according to FPE and HQ criteria. Finally, p-1 is determined as

the optimal lag period of the co-integration test. The test results show that the optimal co-integration lag interval of the whole sample from 1976 to 2016 is (1-1).

The second key problem of Johansen co-integration relation test is to determine the optimal test form. Johansen co-integration test is based on the error correction model (VECM), and there are five possible model secifications of co-integration test. Tab. III reports the summary results of the co-integration relationship test during the sample period.

TABLE III. JOHANSEN COINTEGRATION TEST SUMMARY

Data Trend	None	None	Trend	Trend	Quadratic
Test Type.	No Const.	Const.	Const	Const	Const
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	0	0	0	2*
Max-Eig.	0	0	0	0	1*
AIC	-6.783	-6.805	-6.812	-6.892	-6.860*
SC	-6.442	-6.422	-6.386	-6.423	-6.348*

The optimal model specification of cointegration test, as well as of the vector error correction model (VECM), is therefore the one with quadratic trend, as noted by the asterisk. We therefore estimated the VECMs for the optimal model specification and performed both short-run and long-run Granger causality tests.

IV. GRANGER CAUSALITY TEST RESULTS

A. Short-run Granger Causality test

The results of short-run Granger causality test are given in table IV.

TABLE IV. RESULTS OF SHORT-RUN GRANGER CAUSALITY TEST

Dependent Independent	$\Delta RSCA_t$		ΔNX_t	
	χ^2	Prob.	χ^2	Prob.
$\Delta RSCA_{t-1}$	—	—	2.426	0.119
ΔNX_{t-1}	0.283	0.595	—	—

There is no significant short-term causal relationship between comparative advantages (RSCA) and net export ratio (NX) of the Korean agro-manufactures, of any direction.

B. Long-run Granger Causality Test

Long-run Granger causal relationships are examined by Wald coefficient restriction tests for the error correction term (e_{t-1}) and corresponding independent variable ($\Delta RSCA_{t-1}$ or ΔNX_{t-1}). The results are reported in table V.

TABLE V. RESULTS OF LONG-RUN GRANGER CAUSALITY TEST

Dependent Independent	$\Delta RSCA_t$			ΔNX_t		
	F- stats	Prob.	LE	F- stats	Prob.	LE
e_{t-1}	10.00	0.003		3.526	0.069	
$\Delta RSCA_{t-1}$	2	—	—	2.113	0.136	-
ΔNX_{t-1}	5.066	0.012	-	—	—	—

Note: LE is the long-run effect determined by the convergence value after 20 periods of general, impulse-response function, and + or - indicates the long-run effect is positive or negative

The long-run Granger causality runs from ΔNX_{t-1} to $\Delta RSCA_t$, via the long-run equilibrium co-integration relationship, or the error correction term (e_{t-1}). The long-run effect (L.E.), however, is negative at 0.05 confidence level. For the Korean imports of agricultural manufactures, an increase in the net export ratio (NX) will adversely reduce the revealed symmetric comparative advantages (RSCA).

V. CONCLUSION

This paper classifies the three-digit classification products under SITC Rev.2 according to the technical structure. The net export ratio, revealed comparative advantage, and the weighted average policy intervention index for the Korean agricultural manufactured goods between 1976 and 2016 were calculated and analyzed using the import and export trade data from the UN Comtrade database. We conclude that:

First, in the short-run, there is no significant Granger causality between net export ratio and indicative comparative advantage of any direction.

Second, in the long run, the net export ratio has a significant long-term negative effect on the Korean revealed comparative advantages in the agricultural manufactures. The strategic trade policies or the ambition to improve the comparative advantages of domestic industries by import restriction will be counterproductive.

The conclusion challenges the protectionism the theories of strategic trade policy and the theories of dynamic comparative advantage, but confined in the import patterns of the Korean imports of agricultural manufactures. Conclusions for wider scope call for more empirical studies.

ACKNOWLEDGMENT

This study is financially supported by National Social Science Fund (14BJY233), National Soft Science Project (2013GXS4D112), Social Science Fund of Jilin province (2014B321; 2015BS42; 2016JD49), Education, Science & Cultural Co-operation Project No. 137 [2014] and No.505 [2016] from the Education Department of Jilin Province, and Scientific Research Project of Jilin University of Finance and Economics (2016Z02).

REFERENCES

- [1] H.B. Chenery, and M. Bruno, Development alternatives in an open economy: the case of Israel, *The Economic Journal*, vol. 72, pp.79-103, 1962.
- [2] H.B. Chenery, and A.M. Strout, Foreign assistance and economic development, *American Economic Review*, vol. 56, pp.679-733, 1966.

- [3] B. Dalum, K. Laursen, and G. Villumsen, Structural change in OECD export specialisation patterns: De-specialisation and 'stickiness', *International Review of Applied Economics*, vol. 12, pp.423-443, 1998.
- [4] P.M. Morrow, Ricardian-Heckscher-Ohlin comparative advantage: theory and evidence, *Journal of International Economics*, vol. 82, pp. 137-151, 2010.
- [5] D. Pang, and Y. Hong, Measuring distortions of trade patterns: an application to China. IEEE International Conference on Service Operations and Logistics, and Informatics, pp.424-429, 2010.
- [6] Y. Hong, H. Su, A test of dynamic comparative advantage hypothesis using panel data of the Chinese trade in medium-technology products, 2010 International Conference of Management, Science and Engineering, pp. 1600-1605, 2010.
- [7] S. Lall, The technological structure and performance of developing country manufactured exports, 1985-98, *Oxford Development Studies*, vol. 28, pp.337-369, 2000