A STUDY OF MANUFACTURED GOODS TRADE AND TRANSPORTATION TRENDS FOR ASIA

Manouchehr Vaziri, Professor, Department of Civil Engineering, Sharif University of Technology

Elahe Khademi, Researcher, Department of Civil Engineering, Sharif University of Technology

ABSTRACT

Transportation plays an important role in production, trade and consumption of goods. Freight facilitation enhances international trade. In this study, trend of manufactured goods trade distribution among major Asian countries was analyzed using relevant national socio-economic, geographical and transportation characteristics. The objective of the study was to determine possible relations between international manufactured goods trade and transportation trends within Asia continent. The relevant time-series data were extracted from centralized and international databases. The manufactured goods trade information, using the UN classification of SITC, covered the period 1965-2005. The national geographical and socio-economic characteristics included gross domestic product, population, area and landlocked variables. For transportation characteristics, the study focused on three regional transportation networks covering and connecting the selected countries. The first network consisted of highway, rail and sea modes, HRS network. The second network consisted of highway, rail, sea and air modes, the multimodal network, MM network. The last network was a hypothetical network that only allowed freight to be transported by air, taking into account the shortest air distance between any two transportation nodes, AR network. Trading centre of each country was assumed to be its capital. After collecting the pertinent data and creating the database for the study time span, gravity and linear programming models were developed. The models facilitated identifying possible relations between trade and transportation. The cross-sectional analyses for the gravity model, often introduced GDP and transportation variables as the most influential variables. The coefficients of gravity models reflected the elasticity's of dependent trade variables with respect to descriptive variables. The linear regression models of these elasticity's through time showed interesting trends. The comparisons between optimal trade distributions in Asia, based on developed linear programming models, and their observed distributions showed significant differences. During the study four decades covering 1965-2005 in Asia, the observed manufactured goods trade distributions often did not follow their distributions based on optimal linear programming solutions.

Keywords: Freight transport modeling, regional trade modeling, gravity modeling, linear programming, elasticity and sensitivity analyses.

1. INTRODUCTION

During the past four decades, the rise of international commerce has been a growing engine for national economic development all around the world. The thriving globalization has further enhanced international trade and the improving transportation technology has reduced the inhibiting effect of the distance. Nevertheless, the likelihood of international trade reduction due to distance has remained as a controversial topic. For example, Panahi confirmed the effect of distance on world trade during 1990 to 2004 for 16 countries [1]. The Disdier and Head study is another evidence of the effect of distance on world trade [2]. The Berthelon and Freund study showed the increasing relationships between distance and international trade [3]. The Burn and Carrere study addressed through time sensitivity of distance toward commodity trade, especially petroleum, using gravity models [4]. Still many questions about the impacts of increased transportation capacities and improved technologies on the level of international trade volumes have remained unanswered.
Considering the recent international trade developments and the freight transportation key role in the global economic development, in this research, the relationships between international manufactured goods trade and transportation were addressed. Indeed, the study objective was to clarify the sensitivity of Asian manufactured goods trade with respect to transportation through time. Using the UN classification of SITC for commodities, the Code 6 commodity of manufactured goods was studied for the period of 1965 to 2005. The study transportation network covering Asia consisted of a multimodal network with 617 transportation nodes for 31 Asian countries. Using study time-series database, firstly, cross-sectional spatial interaction models were developed. Then, the developed models were used to analyze the trends of Asian manufactured goods trade and transportation changes. The developed cross-sectional gravity and linear programming models were compared, and their changes through time were studied. The sensitivity of manufactured goods trade dependent variable with respect to independent variables such as socio-economic and transportation variables were identified. Finally, the optimal linear programming model solutions with the observed values were compared. Figure 1 shows the framework of this research.

2. DATABASE DEVELOPMENT

The appraisal of manufactured goods trade and transportation trends required collection of corresponding sets of time-series data. This section briefly introduces variables and sources which were used to gather reliable information needed for this research. The countries included: Afghanistan, Armenia, Azerbaijan, Bangladesh, Cambodia, China, Georgia, India, Indonesia, Iran, Japan, Kazakhstan, North Korea, South Korea, Kyrgyzstan, Laos, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Russia, Singapore, Sri Lanka, Tajikistan, Thailand, Turkey, Turkmenistan, Uzbekistan, and Vietnam. The study variables consisted of three categories of trade, transportation and socio-economic characteristics. Table 1 summarizes the 9 variables extracted from centralized sources for each study calendar year during 1965 to 2005.

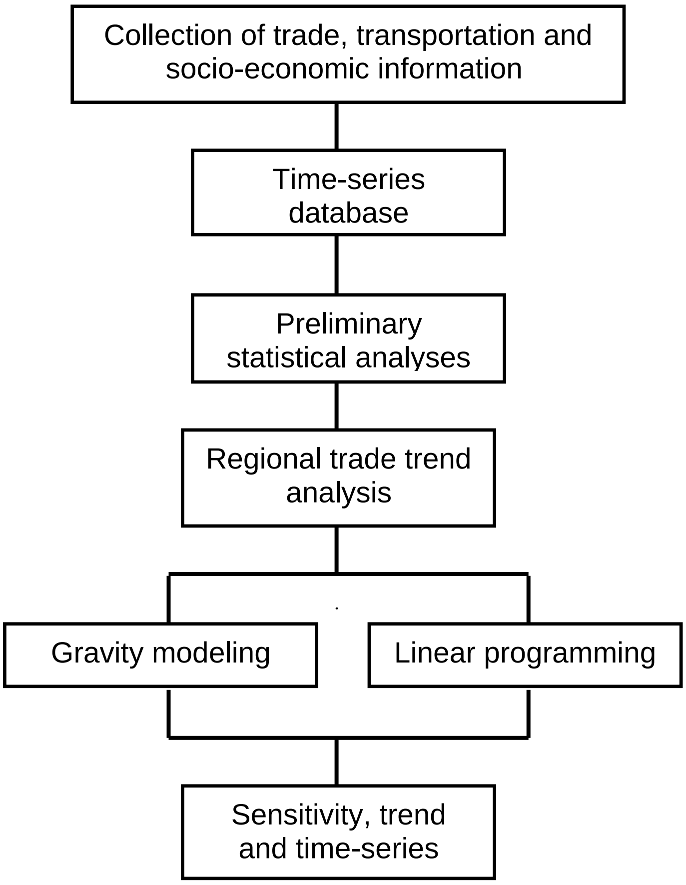

Figure 1- *The study framework*

Table 1- *The study database variables description*

Variable group	Symbol	Description	Dimension	Number of observations
Trade variables	T_{ij}^{EX}	Export of manufactured goods from i to j	Million dollars	31x31
	T_{ij}^{IM}	Import of manufactured from j to i	Million dollars	31x31
Transportation variables	D_{ij}^{HRS}	Distance between i and j by modes H, R and S	Kilometer	31x31
	C_{ij}^{MM}	Multimodal transport cost between i and j	Dollar per unit transported	31x31
	D_{ij}^{Air}	Distance between i and j by mode air	Kilometer	31x31
Socio-economic variables	P_i	Population of i	Thousand persons	31
	A_i	Area of i	Thousand square	31

Variable group	Symbol	Description	Dimension	Number of observations
	GDP_i	Gross domestic product of i	Million dollars	31
	LL_i	Landlockedness of i	Dummy	31

The first category was the trade category. The commodity description of international trade flows are presented by various internationally adopted classifications. The basic reason for applying a commodity nomenclature was to specify its details in order to satisfy a variety of purposes, including customs, statistical and analytical purposes, particularly for the presentation of external trade statistics with the most detailed and pertinent characteristics. For the purpose of this study, manufactured goods trades between each pair of origin and destination were extracted using Code 6 of the United Nations SITC system. In this system, commodities are divided into 10 general groups. The information about the manufactured goods trade among countries was extracted from the United Nations Commodity Trade Statistics Division, COMTRADE, web page, http://www.comtrade.un.org. Accordingly, trade information in 5 year intervals from 1965 to 2005 was extracted. The trade information covered both imports and exports, consequently resulting in 18 matrices for the period 1965 to 2005. There were few missing values in the matrices.

The second category covered transportation variables. The defined networks, reflecting transportation variables, were land, sea and air multimodal networks. The land networks were defined based on two established regional networks: The Asian Highway Network, AH, and the Trans-Asian Railway, TAR. Two other networks, the air and sea networks, were defined using the AH and TAR nodes with airport and/or seaport facilities. The AH and TAR are cooperative projects among Asian countries with the aim of promoting transnational land transportation, services and facilities [5-6]. Using nodes from these networks, multimodal networks were defined with 617 “main” nodes [7]. To facilitate transportation distance and cost analysis, uni-model nodes and their pertinent links were added. The extended matrix represented 1008 uni-modal nodes consisting of 535 uni-modal highway nodes, 362 uni-modal railway nodes, 62 uni-modal seaway nodes, and 49 uni-modal airway nodes, respectively. The extended network had 3804 uni-modal links, consisting of 613 AH links, 409 TAR links, 1606 waterway links and 1176 airway links. Afghanistan, Japan and Philippines were not among TAR members. The AH and TAR links presented more than 250 thousand kilometers of land links. The lengths of links consisting of inter-modal and main-uni-modal were negligible and assumed to be zero. Lack of centralized cost information led to adoption of 14 cost rates, extracted from limited sources [7]. The cost rates were deployed in determining least cost routes and links. The characteristics of the study extended network are summarized in Figure 2. The figure reflects the study extended matrix, a 1625*1625 matrix. The adjacency sub-matrices, AD sub-matrices, reflected the link existence. The information of this matrix, utilizing relevant shortest path algorithms, provided the optimal distance and cost between study “main” nodes. Trading centre or node of each country was assumed to be its capital. Table 1 transportation variables for i and j pair nodes for DijHRS, CijMM and DijAir were as a consequence determined.

	Main nodes	Unimodal road	Unimodal rail nodes	Unimodal sea nodes	Unimodal air nodes
Main nodes	Main nodes, no link connections	Connection between main unimodal road nodes	Connection between main unimodal rail nodes	Connection between main unimodal sea nodes	Connection between main unimodal air nodes
Unimodal road nodes	Connection between main unimodal road nodes	AD matrix for the road sub network	Road-rail intermodal links connections	Road-sea intermodal links connections	Road-air intermodal links connections
Unimodal rail nodes	Connection between main unimodal rail nodes	Road-rail intermodal links connections	AD matrix for the rail sub network	Rail-sea intermodal links connections	Rail-air intermodal links connections
Unimodal sea nodes	Connection between main unimodal sea nodes	Road-sea intermodal links connections	Rail-sea intermodal links connections	AD matrix for the sea sub network	Sea-air intermodal links connections
Unimodal air nodes	Connection between main unimodal air nodes	Road-air intermodal links connections	Rail-air intermodal links connections	Sea-air intermodal links connections	AD matrix for the air sub network

Figure 2- *The study extended transportation matrix*

The socio-economic variables indicated innate properties of countries that could influence manufactured goods trades and were easily accessible. These included: gross domestic product, GDP, population, P, Area A, and landlockedness, reflecting the existence of international seaports, LL. The information about GDP was extracted from the United Nations World Development Indicators databases, WDI [8]. The population was collected from the Internet site http://esa.un.org. The information about country's area was obtained from the Internet site http://www.dfat.gov.au. Accessibility or inaccessibility to international waters, reflected by dummy variable 1 or 0, was gathered from the Internet site http://www.cepii.fr.

3. PRELIMINARY STATISTICAL ANALYSES

After collecting the relevant information and creating the study time-series database, primary statistical analyses were performed. This covered both uni-variate and multivariate analyses. The uni-variate analysis provided the number of missing data, average, minimum, maximum, standard deviation and coefficient of variation. Table 2 shows one of the nine developed tables, reflecting the year 2000 statistics for the capital of the 31 countries, for i different from

Table 2- *The results of the uni-variate analysis for year 2000*

Variable group	Symbol	Dimension	Min	Max	Mean	Standard deviation	Coefficient of variation	Number of valid data
Transportation variables	D_{ij}^{HRS}	Kilometer	242	11363	5260.75	2695.71	0.51	930
	C_{ij}^{MM}	Dollar	759	13651	6577.02	2846.05	0.43	930
	D_{ij}^{Air}	Kilometer	170	9309	3882.48	2041.68	0.53	930
Trade variables	T_{ij}^{EX}	Million dollars	5	10253	176.88	741.62	4.19	750
	T_{ij}^{IM}	Million dollars	1	11657	183.02	837.10	4.57	750
Socio-economic variables	P_i	Thousand persons	2497	1281060	119683.16	277873.04	2.32	31
	A_i	Thousand square of	1	181035	7284.96	31915.16	4.38	31
	GDP_i	Million dollars	969	4841600	296540.67	909592.97	3.07	31
	LL_i	Dummy	0	1	0.65	0.48	0.73	31

Multivariate analysis provided clues to possible relationships among variables. The nine correlation matrices often showed the existence of significant relations between trade, GDP and transportation variables.

4. REGIONAL TRADE TREND ANALYSIS

To get a picture of manufactured goods overall regional trade trends through time, the aggregate trade for total national imports and exports were modeled. Trade versus time scatter-grams were drawn, providing clues for simple models. Subsequently, the developed simple trend models included time variable in linear, growth, compound, quadratic, logarithmic, cubic, S shape, exponential, inverse, power and logistic forms. Twenty two models were developed and evaluated. Based on the coefficient of determination, better fits were observed for linear and exponential forms. In these models, the AET, Asia export total in million dollars, and the AIT, Asia import total in million dollars, were dependent variables, and t was the independent time variable. The AET and AIT were computed by following summation relationships:

$$AET = \sum_i \sum_j T_{ij}^{EX} \qquad (1)$$

$$AIT = \sum_i \sum_j T_{ij}^{IM} \qquad (2)$$

As previously defined in Table 1, the TijEX is the export from country i to country j, and TijIM is the import from country j to country i. Table 3 shows the results of linear and exponential modeling. The t statistics estimates for the model coefficients' are shown in parentheses. The t variable for year 1950 was assumed to be zero.

Table 3- *Asian regional manufactured goods trade export and import trend models*

Type of model	Linear			Exponential		
	Model	R^2	F	Model	R^2	F
Export	AET = -86835.01 + 3917.39 t (-3.1) (5.3)	0.80	28.6	AET = 251.05 e $^{0.124\ t}$ (3.0) (13.8)	0.97	190.3
Import	AIT = -90181.90 + 3997.55 t (-3.2) (5.3)	0.80	27.7	AIT = 195.02 e $^{0.129\ t}$ (3.4) (16.2)	0.97	261.1

The models confirmed the overall growth of manufactured goods trades in the Asia during the study period of 1965 to 2005. Nevertheless, the country's growth was not similar for the 31 countries.

5. SPATIAL INTERACTION MODELING

The trade modeling can often be classified into three groups or approaches. These include: an approach with microeconomics point of view, the spatial interaction modeling, and an approach with macroeconomics point of view. The spatial interaction modeling approach was found more suitable for the study database when the influence of transportation could be explicitly addressed. The models often used for spatial interaction modeling are based on gravity distribution and linear programming modeling.
The gravity model is a special form of experimental models which was originated by Newton gravity rule of mechanical physics. The gravity modeling of international trade was developed more than half a century ago by Tinbergen and Pöyhönen. In its basic form, the trade between two countries is assumed to be increasing with their sizes, often being measured by their national incomes, and decreasing with their spatial impedances, often being measured by their transportation distance and costs [9]. The model for trade between two geographic units i and j can be presented by:

$$T_{ij} = G \frac{M_i^{\eta} M_j^{\theta}}{D_{ij}^{\rho}} \qquad (3)$$

Where the Tij is the trade flow between i and j, Mi and Mj are economic characteristics for i and j, Dij is the spatial impedance between i and j, and G, η, θ and ρ are model coefficients. The logarithm of this relation has a linear form that presented by Equation 4. With regression least square method, this model can easily be calibrated:

$$Ln\ T_{ij} = Ln\ G + \eta\ Ln\ M_i + \theta\ Ln\ M_j - \rho\ Ln\ D_{ij} \qquad (4)$$

For trade export and imports, cross-sectional gravity models were calibrated and developed. Several forms of gravity models were investigated. For the first group, the 2 trade variables and all other 7 variables of Table 1 were used to develop models based on Equation 4, for 9 periods, based on stepwise regression analysis. The first group resulted in 18 models. For the second group, the 2 trade variables, the GDP and the 3 transportation variables of Table 1 were used to develop models based on Equation 4, for 9 periods, based on regression analysis. The second group resulted in 18 models. For the third group, the 2 trade variables, the GDP and each time one of the 3 transportation variables of Table 1 were used to develop models based on Equation 4, for 9 periods, based on regression analysis. The third group resulted in 54 models. For the fourth group, the 2 trade variables and each time only one of the 3 transportation variables of Table 1 were used to develop models based on Equation 4, for 9 periods, based on regression analysis. The fourth group resulted in 54 models. These four groups resulted in 144 gravity type models. Table 4 shows the results of developed models for the first group, based on stepwise regression analysis. All coefficients were statistically significant at level 0.05.

The 144 developed models confirmed the strong dependence of manufactured goods trade during the time period of 1965-2005 on GDP and transportation descriptive variables. Sensitivity analysis of trade exports and imports with respect to the other 7 variables facilitated their trend analysis through time. The elasticity E of a variable Y with respect to a variable X represents the percent the variable Y changes with respect to one percent change of variable X, as shown by Equation 5:

$$E_{Y/X} = (\partial Y / \partial X) / (Y/X) \qquad (5)$$

Where EY/X is the elasticity of variable Y with respect to variable X, ∂Y/ ∂X is partial derivative of Y with respective to X. If the absolute value of elasticity is greater than one, then the behaviour of Y with respect to the X is elastic. If the absolute value of elasticity is smaller than one, then the behaviour of Y with respect to the X is inelastic. Unit elasticity occurs when the elasticity is equal to one. It can easily be determined that the power coefficient of a variable in a gravity model such as η, θ and ρ in Equation 3, is the elasticity of the trade Tij dependent variable with respect to any independent variable such as Mi, Mj and Dij. Through time variation of gravity model coefficients provided the pertinent independent variable trend and influence on trade. For the 9 points in time during 1965 to 2005, simple linear regression analysis of the third group gravity models for transportation coefficients are summarized in Table 5. The table confirms that the trades were increasingly sensitive to transportation variables.

***Table** 4- First group models based on stepwise regression analysis*

Year	Export		Import	
	Model	R^2	Model	R^2
1965	$10^{2.502}\frac{GDP_i^{1.631}GDP_j^{0.423}10^{1.279LL_j}}{D_{ij}^{Air\,1.399}A_i^{0.401}}$	0.58	$10^{-0.695}\frac{GDP_j^{1.651}10^{1.229LL_i}}{A_j^{0.413}}$	0.62
1970	$10^{6.546}\frac{GDP_i^{2.885}GDP_j^{0.845}}{C_{ij}^{MM\,2.253}POP_i^{1.530}A_j^{0.225}}$	0.67	$10^{4.549}\frac{GDP_i^{1.419}GDP_j^{1.598}}{D_{ij}^{HRS\,1.552}POP_i^{0.979}A_j^{0.374}}$	0.58
1975	$10^{4.226}\frac{GDP_i^{1.783}GDP_j^{1.019}}{A_i^{0.578}POP_j^{0.554}C_{ij}^{MM\,0.799}D_{ij}^{Air\,0.915}}$	0.39	$10^{4.367}\frac{GDP_i^{1.069}GDP_j^{1.454}}{D_{ij}^{Air\,1.131}POP_i^{0.861}A_j^{0.490}}$	0.39
1980	$10^{4.218}\frac{GDP_i^{1.621}GDP_j^{0.542}}{C_{ij}^{MM\,1.709}A_i^{0.491}}$	0.51	$10^{4.735}\frac{GDP_j^{1.590}POP_i^{1.031}}{C_{ij}^{MM\,2.066}A_i^{0.651}A_j^{0.503}}$	0.55
1985	$10^{1.637}\frac{GDP_i^{1.526}GDP_j^{0.906}POP_j^{0.650}}{C_{ij}^{MM\,0.891}A_i^{0.428}A_j^{0.673}D_{ij}^{Air\,0.979}}$	0.58	$10^{1.092}\frac{GDP_i^{0.902}GDP_j^{1.317}POP_j^{0.793}}{C_{ij}^{MM\,1.642}A_i^{0.206}A_j^{0.868}}$	0.51
1990	$10^{2.960}\frac{GDP_i^{1.411}GDP_j^{1.011}}{C_{ij}^{MM\,1.530}POP_i^{0.281}A_j^{0.270}}$	0.69	$10^{3.068}\frac{GDP_i^{0.909}GDP_j^{1.436}}{C_{ij}^{MM\,1.709}A_i^{0.220}A_j^{0.232}}$	0.70
1995	$10^{6.960}\frac{GDP_i^{1.046}GDP_j^{0.898}}{C_{ij}^{MM\,2.554}}$	0.67	$10^{3.665}\frac{GDP_i^{0.926}GDP_j^{1.226}}{C_{ij}^{MM\,1.954}}$	0.69
2000	$10^{7.538}\frac{GDP_i^{1.333}GDP_j^{0.810}A_i^{0.238}}{POP_i^{0.255}C_{ij}^{MM\,2.026}D_{ij}^{Air\,0.866}}$	0.64	$10^{6.001}\frac{GDP_i^{0.938}GDP_j^{1.265}}{C_{ij}^{MM\,1.799}D_{ij}^{Air\,0.812}10^{0.375LL_j}}$	0.66
2005	$10^{6.993}\frac{GDP_i^{1.554}GDP_j^{0.889}A_i^{0.290}10^{0.371LL_j}}{POP_i^{0.426}C_{ij}^{MM\,1.753}D_{ij}^{Air\,1.359}}$	0.76	$10^{5.723}\frac{GDP_i^{0.983}GDP_j^{1.590}A_i^{0.107}}{C_{ij}^{MM\,2.652}D_{ij}^{Air\,0.503}10^{0.452LL_j}}$	0.76

***Table 5**- Time trends of gravity model coefficients for transportation variables*

Elasticity	Model	R^2	Trend	Elasticity	Model	R^2	Trend
$T_{ij}^{EX}/ D_{ij}^{AIR}$	0.655 + 0.028 t	0.68	Increasing	$T_{ij}^{IM}/ D_{ij}^{AIR}$	0.565 + 0.025 t	0.61	Increasing
$T_{ij}^{EX}/ D_{ij}^{HRS}$	0.921 + 0.020 t	0.46	Increasing	$T_{ij}^{IM}/ D_{ij}^{HRS}$	0.812 + 0.019 t	0.42	Increasing
T_{ij}^{EX}/ C_{ij}^{MM}	1.048 + 0.030 t	0.66	Increasing	T_{ij}^{IM}/ C_{ij}^{MM}	0.596 + 0.037 t	0.63	Increasing

For third group gravity models, Figures 3 and 4 show the trends of the export and import of manufactured goods elasticity with respect to transportation variables for AR, MM and HRS networks.

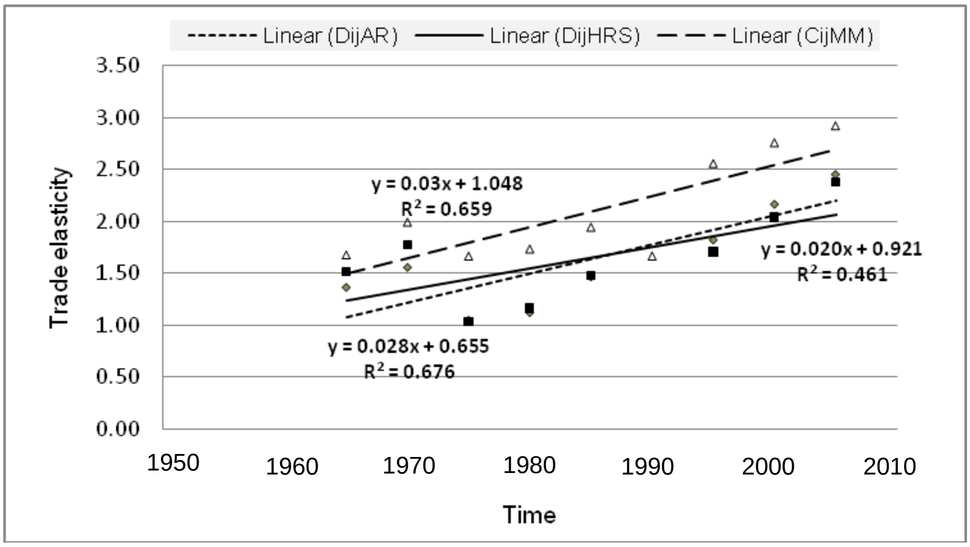

Figure 3- *The trends of export of manufactured goods elasticity with respect to transportation variables for AR, MM and HRS networks*

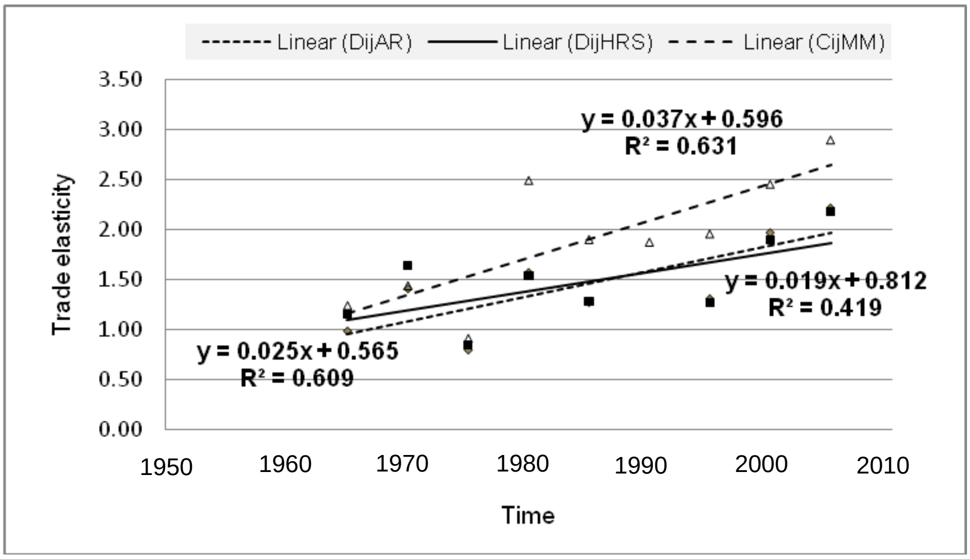

Figure 4- *The trends of import of manufactured goods elasticity with respect to transportation variables for AR, MM and HRS networks*

6. LINEAR PROGRAMMING

The linear programming was deployed to compare observed distribution of trade with its optimal distribution. The total cost function for the trade exports and imports were minimized for each of the 9 points in time during 1965 to 2005. By deploying Simplex algorithm, the optimal solutions to the following linear programming model were determined for export and import trades:

$$
\begin{aligned}
&\textit{Minimize} \quad Z = \sum\sum C_{ij}\, T_{ij} \\
&\textit{Subject to:} \\
&\sum T_{ij} \geq D_j \ \textit{ for all } j\text{'s}, \qquad (6) \\
&\sum T_{ij} \leq S_i \ \textit{ for all } i\text{'s} \\
&T_{ij} \geq 0 \ \textit{ for all } i\text{'s and } j\text{'s}
\end{aligned}
$$

The problem here, often known as the transportation problem, is a form of the LP problems that minimizes total cost or target function Z by distribute Tij form i to j in such a way that the production Si of i meets the demand Dj of zone j when all i and j are considered. The Cij is the impedance or cost of transportation of one unit from i to j. For each of the points in time, 4 LP's were solved. The Dj's and Si's were obtained base on export and import information. The Cij were obtained base on DijHRS and CijMM, respectively. The problem was solved separately for each year based on relations 6 and the Z function was minimized for the two impedance variables. Subsequently, for each point in time, the difference of Z function based on observed Tij's and LP optimal Tij's was determined. The comparison of differences through time showed interesting trends. Figures 5 and 6 illustrate the normalized differences for 9 points in time.

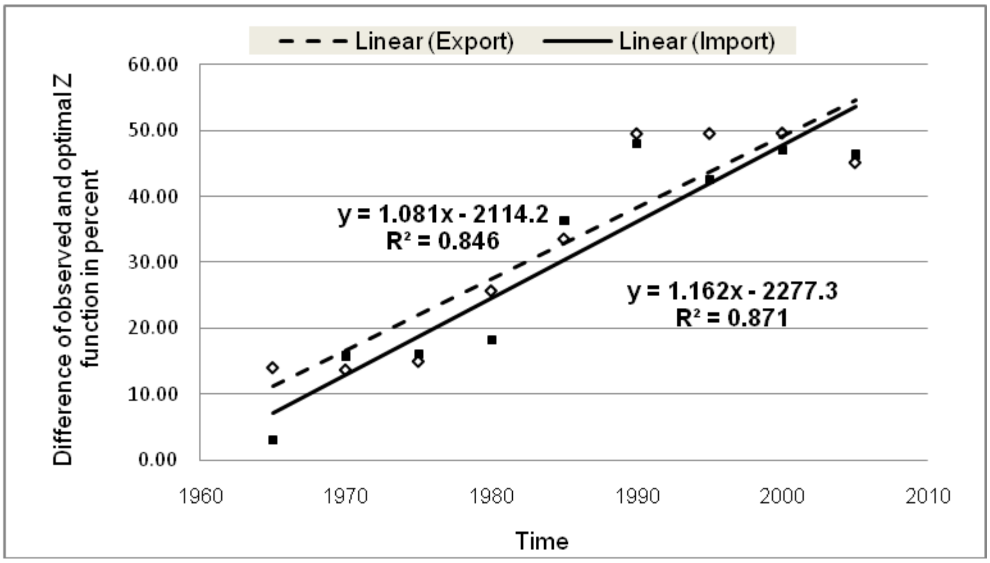

Figure 5- *The trends of the difference of observed and optimal Z function in HRS network*

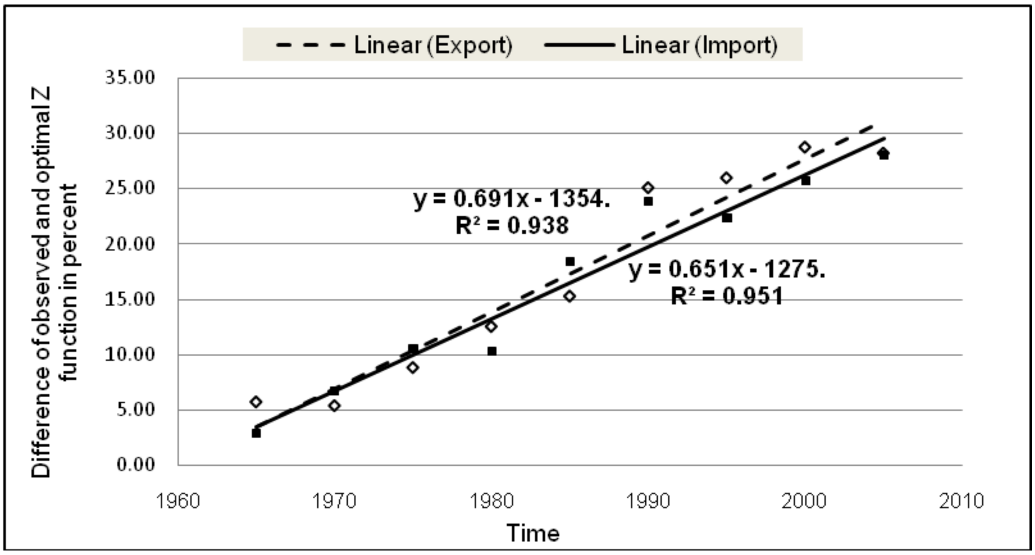

Figure 6- *The trends of the difference of observed and optimal Z function in MM network*

In Figures 5 and 6, the impedances are DijHRS and CijMM, respectively. These figures showed that although developed gravity models had confirmed that trade was becoming increasingly sensitive toward distance and transportation variables, the overall cost functions increasingly distant themselves from the optimal distributions in the LP models. This result was confirmed by positive slopes of the regression models shown in both figures.

7. CONCLUSIONS

In this research, trends of trade and transportation of the UN-SITC system commodity Code 6 were analyzed. The manufactured goods national import and export trades for major countries in the Asian region during the last 4 decades were studied. The study confirmed strong cross-sectional and time-series relations between manufactured goods trade and transportation characteristics. This study consisted of several stages. Firstly, the time-series database was created for 31 countries for 9 national trade, transportation and socio-economic variables. Secondly, preliminary statistical analyses of the data, including uni-variate and multivariate analyses, showed significant variations through time and space. The results of these analyses also showed strong relations between manufactured goods trade, GDP, and transportation. To identify regional manufactured goods trade changes during last 40 years, simple models were developed. They confirmed overall regional growing trade trends with exponential and/or linear forms through time. Several cross-sectional spatial distribution models during 9 time periods were developed. Elasticity of trade variables with respect to independent variables was also studied through time. The results suggested increasing sensitivity of manufactured goods trade with respect to transportation variables. In the contrary, the linear programming solutions of the trades showed that the overall cost functions for observed trade's distributions did not follow the LP optimal solutions through time. In international trades, especially for manufactured goods, many factors are influential;

nevertheless, countries could deploy spatial modeling to enhance their trade policies. This study is a preliminary step toward better understanding of spatial manufactured goods trade distribution through Asia.

ACKNOWLEDGEMENT

The authors wish to thank the Office of Research of the Sharif University of Technology for its financial supports for this study.

REFERENCES

1. Panahi, H. (2007). Distance, International Trade and Economic Growth, the Business School, University of Hull, UK.
2. Disdier, A.C.; Head, K. (2003). Exaggerated Reports on the Death of Distance: Lessons from a Meta-Analysis, Journal of International Economics.
3. Berthelon, M.; Freund, C. (2004). On the Conservation of Distance in International Trade, World Bank Policy Research Working Paper 3293.
4. Brun, J.F.; Carrere, C. (2002). Has Distance Dead? Evidence from a Panel Gravity Model, Journal of International Economics.
5. http://www.unescap.org/ttdw/index.asp?MenuName=AsianHighway. Accessed Sept 9, 2007.
6. http://www.unescap.org/ttdw/common/TIS/TAR/identification.asp. Accessed Sept 9, 2007.
7. Tafazolli, M. (2005). An Assessment of the Asian Multimodal Transportation Network. Civil Engineering Department, Sharif University of Technology, M.S. Thesis.
8. World Bank. The 2005 World Development Indicators, CD-ROM. International Bank of Reconstruction and Development, the World Bank, Washington DC, 2006.
9. Cheng H.; Wall, H.J. (2004). Controlling for Heterogeneity in Gravity Models of Trade and Integration. Federal Reserve Bank of St. Louis, Research Division. Working Paper 1999-010E.