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Analysis of Indo-Iranian Trade

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Abstract

This paper focuses on Indo-Iranian merchandise trade for a period of 30 years from1980-81 to 2009-10. Study is based on econometric modeling comprising 3 versions of RWM model and alternative forms and specification of regression functions. RWM model(s) evaluates stationary nature of time series data relating to GNP, exports, Imports and total merchandise Indo-Iranian trade. Dickey-Fuller unit root test and Engle-Granger test of co-integration on residuals derived from distributed lag model with partial adjustment hypothesis are used. Results of distributed lag model with partial adjustment hypothesis emerge empirically and theoretically valid. Indo-Iranian trade is found to be affected both by contemporary and lagged values of variables included in the model. But adjustment of actual to desired change in specific trade variables is spread over several periods. Current values of merchandise trade are the slowest to adjust to its desired value; but adjustment of Indian exports to Iran is instantaneous while adjustment of imports requires 2-3 periods. These findings suggest that any contemporary political exigencies or international economic aberrations should not and will not affect the long standing indo-Iranian trade relations. Institutional arrangements and their strengths are stronger than barriers to allow aberrations to be effective.

Keywords: India, Iran, Exports, Imports, Distributed Lag Model, RWM.

1- Introduction

Received knowledge revealed that national economies are whirlpools of inter-dependencies. But modern process of globalization, liberalization and privatization has transformed world economy into a whirlpool of inter-dependencies. Therefore, modern day national economies cannot sustain themselves in isolation by totally or even partially closing to the outside

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world for long. All countries are mutually dependent for imports of goods, services, technology, capital goods, venture capital and financial inflows. Technology, consumer goods, capital, physical, financial and intellectual, which are not available/produced within the country, and for exporting surpluses output of all goods and services, import and export trade becomes a necessity. There exist several forms and structures of international trade regimes in different countries which also affect foreign exchange regimes (cf. Bahamani-Oskooee, Mohsen, 2005). However, free trade had been recognized as the most potent engine of growth (Marshall, A. 1892). The realization and recognition of benefits of free trade and globalization led China, India, Brazil, South Africa, Russia and a host of other erstwhile socialist and developing countries to open up their national economies in seventies, eighties and nineties (See, Prakash, Shri, 1995, 2008, Nayyar, Deepak, 1994). Several alternative theories of incorporation of triple processes of globalization, liberalization and privatization in New Economic incorporation of triple processes of globalization, liberalization and privatization in New Economic Policy (1990-91) of India have been propounded by different authors (For detailed discussion see, Nayyar, Deepak, 1993, Prakash, Shri, 1995, 2003). Mutual inter-dependence of nations is reflected largely by Inter-national trade, inter-country financial flows, including FII, FDI, Venture capital, and establishment tual-fund companies across national borders.

Interestingly, base of Input output modeling is interdependencies among economic and business activities within the nations, which characterize all national and regional economies. In the wake of globalization, numerous economies, including the developing ones, opened up which resulted in the forging of stronger linkages between sectors of national economies. Thus globalization has led to the creation and strengthening of existing inter-dependencies among national economies on the one hand, and it strengthened transnational dependencies among sectors of national economies on the other. Merchandise trade within and between constitutes an important component of international and inter-sector linkages. Flows of financial and physical capital and technology constitute even greater linkages than merchandise trade between the countries (Cf. Leontief, W.W., 1965, Prakash, 1994). Such changes induced free flow of goods, services, technology, capital, financial resources, and even institutions- lock, stock

and barrel. Free merchandise trade and foreign capital have acquired much greater role in the growth of developing countries than ever before. Developed countries have been transferring even their production facilities to developing economies in order to avoid their goods being treated as imports and face certain policy and other barriers (Prakash, 1994). The process also takes them nearer to the markets and locations of raw materials and other natural resources. They get the captive markets of the host countries as a consequence of these changes. In fact, China has emerged as the factory of the World and greatest destination of foreign capital. China is followed by such countries like India, Brazil, Russia, Turkey, Mexico etc. (Among others, see, Prakash, Shri, 1995, 2003, and Deepak Nayyar, 1993, 1995). These changes transformed international Economic Order and induced United Nations' Department of Statistics to encourage the process of making an International Input Output Table.

Inter-national trade takes place due to uneven distribution of labor, human and physical capital, natural and other resources and resultant specialization in the production of traded goods. These resource differentials make factor endowment differ sharply between the countries. Consequently, cost of production, especially relative cost, varies from country to country and even among the commodities, which constitutes the base of international trade.

2- Rationale of International Trade

Hecher-Ohlin theorem **of** international trade predicts that international trade of the countries is guided and governed by their respective factor endowment. Hence, countries with abundance of capital and scarcity of labor tend to specialize in production and export of goods which are relatively more capital and less labor intensive. Relative abundance of capital and scarcity of labor makes capital cheaper than labor. So, capital intensive goods are produced at relatively lower cost than labor intensive goods in such countries. As against this, countries with abundance of human and scarcity of physical capital specialize in production and export of labor intensive goods due to low wage and high capital cost of production. Besides, countries, which abound in natural resources, including land, forests, and minerals, specialize in production and export of such goods as require more land and/or other natural resources per unit of output. In the

present context, fossil fuels are among the scarce natural resources. Countries like Iran, Iraq, Kingdom of Saudi Arabia, Kingdom of Bahrain, Kuwait, Qatar, UAE, Oman, Russia, etc. have comparative advantage in the production and export of crude oil and its products like petroleum, and gas. Abundance of energy resources in general and petroleum products in particular has resulted in extremely high per capita income of petroleum producing and exporting countries of the world. OPEC/GCC group of petroleum producing and exporting countries have used their virtual monopoly to their own advantage by controlling supplies with a view to maintain high prices of oil in international markets. Iran is an important member of OPEC group of countries.

Leontief (1948), however, found the pattern of US international trade to diverge from the prediction of Hecher-Ohlin theory. His empirical findings, based on input-output modeling, showed that US exported labor intensive and imported capital intensive goods despite it being labor scarce and capital abundant country. This is known as *Leontief Paradox*, which inspired empirical research all over the globe.

R.N. Bharadwaj (1962), Bharadwaj and Bhagwati (1969) found India's foreign trade to conform to the prediction of H-O theory as India was exporting labor intensive and importing capital intensive goods. Prasad incorporated natural resources as an additional factor of production in his study but found to India's pattern of trade in conformity with H-O thesis. But Minhas in his study based on world trade data propounded the thesis of Factor reversibility to characterize trade which runs counter to H-O thesis. Debesh Chakravarty et al. used both Leontief and Models to show that India's foreign trade continued to conform to H-O theory. But Prakash, Sharma and Dhir (2010) contested the premises on which H-O theory is based. Hecher-Ohlin theory is based on static framework of analysis, and hence, dynamic growth of the economies renders it non-valid. They argue that pattern of trade, factor endowment and economic structure are mutually related; their inter-relations contain leads and lags in their action and reaction to changes in each other. This proposition is based on the assumption that both factor endowment and economic structure change with economic development; growth/development is guided and governed by economic policy designed to promote rapid industrialization to transform pattern of trade and economic structure. Consistent and rising proportion of

income overcomes scarcity of capital, while education and training base of human capital is also increased through time (2010, 2013).

This is also the theoretical framework of analysis of Indo-Iranian trade

Benefits of Free International Trade

Free International Trade has been designated by Robertson and Marshall (1891) as an engine of growth. Trade has become even more important in the globalised national economies of the world. Openness, resulting from Globalization, has contributed to the reduction of barriers to free trade. FTA's have emerged as instruments of not only strengthening bi-lateral trade relations but also to forge economic partnership between trade partners. FTAs of India with Thailand, Sree-Lanka and Bangladesh are examples of such bilateral agreements about free trade between the nations. Free trade and degree of openness of an economy are positively correlated. *It is hypothesized that greater the degree of openness of an economy, greater is its dependence on international trade, and greater is the growth of its GDP and per capita income.* A variant of this theory postulates export led growth strategy (ELG) as an instrument of rapid growth of national economies of developing countries. *However, empirical validity of ELG remains questionable* for most of the countries including India. Besides, ELG is not sustainable over long run for Indian economy (Prakash and Dhir , 2013). However, oil producing and exporting countries like Iran may have certain advantage in the pursuit of this strategy, though long run sustainability of oil based ELG needs empirical research.

Trade provides a bigger market for the disposal of surplus national products, physical and human capital, and technology. Bigger market facilitates larger scale of production, yielding greater economies of scale in production cost than what would be the case without exports, which enriches factor endowment and sharpens comparative advantage. Exploration and exploitation of economies of larger scale leads to greater degree of specialization in production of export goods, raises capacity to produce, and promotes innovations in export sectors of the economy. Gains from free trade may be gauged from the fact that share of international trade was only 2% during era of planning which rose to approximately 53 per cent of GDP

in 2009-10. This also indicates greater degree of openness of Indian economy during the era of globalization. Free trade era has also accelerated growth of GDP and per capita GDP.

Exporters can produce and export more quantities of goods to various countries to earn more profits for themselves and foreign exchange for country. Thus, export production is freed from limited market size in so far as larger proportion of increased output may be exported. But given the export surplus in any year, more export to one country will leave less for export to other countries and/or domestic use. Thus, exportable surplus acts as a limiting factor. There also exists possibility of substitution of domestic for international and international for domestic demand for export goods. The surplus production in a country, if not exported, may go waste, if domestic demand is inadequate, resulting in reduction in domestic prices, profits of companies and even output in the long run. For example, US farmers used to burn standing crops when expected output was unusually high, or they used to dump it in sea after harvesting till US started exporting wheat to India under PL 480. This measure was induced by expected sharp fall in price due to excess supply. Export of surplus goods and services to contributes to sustain the growth of export industries, yield more profit to producer, generates more employment and fetches foreign exchange for the country.

Imports also bestow benefits on importing countries. Imports enable the country to overcome scarcity of supply of the given goods at any time; imports constrain inflation by mitigating scarcity on the one hand, and facilitate avoidance of deprivation of consumers from scarce goods on the other. Besides, consumers obtain the imported goods at relatively lower prices, which promote welfare. India several times imported wheat and other agricultural goods such as edible oils to cope with such situations. Imports facilitate use of domestically unavailable intermediate, capital goods, and raw materials for producers. This reduces production cost, makes producers skirt the consequences of short supply or make do with products of inferior quality. Imports enable producers to shift resources from low to high productivity and profitability lines of production. Such gains from trade prompted P. N. Mathur (1962) to distinguish between trade and growth gains of international trade. We have added welfare gains to trade and growth gains which Mathur distinguished. But greater current dependence of a

country on trade tends to enhance its future dependence on trade. Thus, trade seems to grow on its own steam once barriers to trade are reduced or even removed. Indo-Iranian trade is analyzed in the above broad perspective.

Composition of Indo-Iranian Trade

Conventional political and economic relations between India and Iran and ever increasing energy requirement of consistently growing Indian economy have made Iran an important trade partner of India than ever before. It is observed that Iran's pattern and structure of trade with India and rest of the world continues to be governed and guided by its natural resources, especially fuels/energy. Consequently, Iran's economic structure and exports are dominated by oil. As against Iran, India has advantage in the production of several goods. India is rich in such mineral resources as iron ore, coal, mica, copper, zinc etc. India exports pallets of iron ore to Iran to keep the Iranian steel industry working. India imports approximately 12% of its total oil requirement from Iran annually. Iran is the second largest supplier of oil to India (The Times of India, 6 April, 2012). The sanctions imposed by US and European Union against trade with Iran have put lot of pressure on Indian Government which along with Russia, China, South Africa and Brazil decided to navigate an independent course in their politico-economic relations with Iran. But oil and its products are not the only good in the basket of Indo-Iranian trade. India and Iran are now important trade partners and the trade between the two countries goes much beyond crude oil and petroleum products.

For overcoming difficulties in trade with Iran in hard currency, a new mechanism of payment and receipts for imports and exports to Iran from India is evolved; a separate rupee account with UCO Bank for oil refineries has been opened which Indian exporters of merchandise did not find very helpful. So, the government of India formulated a new policy of duty drawback on exports to Iran under which 4 to 12 % customs and excise duties are refunded to exporters. This covers nearly 4000 export items from India to Iran, including food products, textiles and auto-parts. Incidentally, this highlights the diversified export basket to Iran. This has helped both countries skirt the difficulties in conducting their mutual trade in hard currency. This also highlights the value that Government of India attaches to its long standing historical diplomatic and economic relations with Iran.

In view of the strategic importance of trade relations between India and Iran, this paper focuses on Indo-Iranian trade since 1981.

Following are major export items from India to Iran: (i) diesel, (ii) cement, (iii) pharmaceutical products, (iv) aluminum, (vi) steel, and (vii) auto-mobile components etc. Besides, shipping and numerous services constitute a part of trading relations.

Iran basically exports crude oil to India and Imports diesel from India. Both countries' trade relations hinge mostly around the energy sector. Iran exports a considerable amount of petroleum and natural gas products to India. Installation of several major pipelines and liquefied natural gas (LNG) projects further strengthen trade in these goods between India and Iran. India also imports finished petroleum products to meet its growing energy needs. Indian oil refineries have gained considerable reputation in global markets. Consequently, Iran and India fulfill their complementary requirements from trade. India and Iran also have joint operations in the area of roads and railways.

Objectives of the Study

The study focuses on Indo-Iranian trade since 1980-81. Choice of such a long period for study is guided by following considerations.

At times, economic relations revolve round political relations, though economic relations mostly dominate political relations. With the changing Geo-political scenario, economic relations also undergo changes. Besides, changes in economic structure resulting from growth, also affect both structure and total trade. The period of study ranging over 30 years covers long enough period to have witnessed vicissitudes of both political and economic genre. The ever strengthening of trade relations in spite of temporary hurdles shows the strength of mutual relations between the two countries. Period of study also captures different phases of trade cycles within the two economies, which also affect trade and trade relations.

Methods and Models

The study uses Random Walk Model for evaluating stationary nature of time series data pertaining to trade related variables. Dickey-Fuller test is used to examine unit root. Dickey Fuller test of unit root is supplemented by Engle-Granger test of unit root of the residuals of preferred regression model to examine co-integration of variables in chosen regression model. Like other unit root tests, Dickey-Fuller test is also weak in power and low in small sample properties. Consequently, Dickey-Fuller test embodies probability of type I or II error being committed by the acceptance of the result of the test. Besides, even if time series of two or more individual variables is non-stationary, their linear combination in a regression function may still be stationary, if the residuals of the regression function are stationary. This is why this study also uses Engel-Granger test of co-integration. Incidentally, Yule (1927) highlighted the fact that, if time series data are not stationary, coefficients of regression and correlation will be spurious. However, econometrics of time series emerged as a distinct branch of econometrics only in 1980s. Ever since then, time series models have gained in popularity in empirical research. These models are considered to be a part of advance econometric modeling.

Validity of following Random Walk Models is evaluated to assess stationary facet of variables under consideration:

Random Walk Model without Drift

The basic assumption of the model is that the changes in the values of the variable are governed and guided by random rather than systematic factor. Therefore, the following regression model of change in the particular variable is specified:

$$Y_t - Y_{t-1} = \Delta Y_t = U_t \quad (1)$$

In the above relation, U represents influence of random factors on change in the values of variable Y from one to another point in time.

Random Walk Model with Drift

Random Walk Model with Drift is a variant of model without drift:

$$\Delta Y_t = \beta_0 + U_t$$

Or

$$Y_t = \beta_0 + Y_{t-1} + U_t \quad (2)$$

β_0, the coefficient of drift, takes cognizance of a fixed factor/value that is loaded additionally on the influence of random factors on Y_t. Drift takes the value of Y_t away from Y_{t-1} and U_t. Model 2 is derived from the following auto-regression model of first order, if $\beta_1 = 1$ is substituted in relation 3 (See, Harvey, 1981):

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + U_t \quad (3)$$

If either model 1 or 2 fits the data well, that series emerges non-stationary. But ΔY_t, first differences of Y_t, may be stationary. If ΔY_t also constitute non-stationary series, it may encompass stochastic trend. In that case, first order differences with trend are taken in regression model:

Random Walk Model with Stochastic Trend

$$\Delta Y_t = \beta_1 Y_{t-1} + \beta_2 T + U_t \quad (4)$$

As non-spurious nature of time series regression modeling depends on stationary nature of the series, Dickey-Fuller unit root test is used as a preliminary step of analysis. Application of unit root test is outlined below by modified forms of relations 1, 2 and 4:

$$\Delta Y_t = (\rho - 1) Y_{t-1} + U_t$$
$$= \delta Y_{t-1} + U_t \quad (5)$$

Δ denotes first order difference operator.Model 5 is obtained if we substitute $\beta_0 = 0$, and $(\rho - 1) = \delta$, where $\delta = \beta_1$ in model 3/4. ρ is the root of equation 5. If $\rho < 1$, then, the time series of Y_t is stationary. Other condition of stationarity is that δ is statistically significant, and hence, it differs statistically from zero. If $(\rho - 1) = \delta = 0$ in model equation 5, $\rho = 1$. This condition defines unit root problem. In this case, both Y_t and ΔY_t are non stationary. If, however, $\delta < 0$, that is, its value is negative, then,

$\rho = \{1 + (-\delta)\} < 1$, time series is stationary. If $\delta > 0$, then, $\rho > 1$, time series approximates explosively non-stationary.

Values of non-stationary time series may be smoothed by link relatives: (Y_t / Y_{t-1}), as was shown by Henry Moore (1914). Link relatives are proxies of first order differences of modern day econometric analysis. Ratios of preceding and succeeding values of one or more inter-related variables of

time series are freed both from auto-correlation and non stationary feature. Series of link relatives may be used as substitute of first order differences in regression models. **Current literature emphasizes** that, even if two or more original series are non-stationary, their linear combination in a regression model may still be stationary (Green, 2006). Residuals of such regression models are subjected to Engel-Granger test. If residuals of a regression model are stationary, it is treated as genuine rather than pseudo. As all stationary root tests, including Dickey Fuller test, are small in size and low in power, this leaves probability of committal of both type I and II errors. It is advisable to use Engel-Granger test to supplement Dickey-Fuller test. Basic assumption of Engel-Granger test is that even if two or more individual time series are non stationary, their linear combination in a regression function may be stationary.

Engel-Granger Test

If the following regression model is used in a study, then, Engel-Granger test will be as follows:

$$Y_t = \beta_0 + \beta_1 X_t + U_t \qquad (6)$$

$$\Delta U_t = \delta U_{t-1} + e_t$$

Residuals of regression function (6) are subjected to Dickey Fuller test of unit root If the residuals are stationary, regression function (6) is accepted as genuine rather than spurious. In all above relations, Y represents a general class of variables, while G shows general class of explanatory factors.

Distributed Lag Models

It is note-worthy that auto-regression and distributed lag models are parts of dynamic econometric modeling. These models play pivotal role in economic analysis. Distributed lag models (DLM) are derivable as an extension of auto-regression model (ARM), though DLM represents an advance version of econometric modeling in current literature. DLM has, however, 4 different specifications (Gujarati, et al.,2012, Intriligator, 1986, Harvey, 1981, E.J. Kane,1996), whereas there are numerous factors that necessitate incorporation of lagged value of the dependent variable among the explanatory factors. Determination of the length of the lag requires the use of Auto-Correlation Function and use of Q and Q* tests of joint

hypotheses. Inclusion of one lag of the dependent variable is the simple version of such models. If, however, one lag of dependent variable suffices on empirical grounds, incorporation of longer lags will emerge redundant. This has been found to be the case in this study. DLM with partial adjustment hypothesis is outlined hereunder:

Let Y_t^* denote the desired value of the variable under consideration at time t; which is postulated to be the function of explanatory/pre-determined variable, X_t. This is represented by the following regression function of these two variables:

$$Y_t^* = \beta_0 + \beta_1 X_t + U_t \quad (7)$$

But due to ignorance, inertia and bottlenecks is the process of adjustment of actual to desired change in the value of the variable from preceding to current period, adjustment actually realized is only a friction of desired adjustment. This is show below:

$.(Y_t - Y_{t-1}) = \square(Y_t^* - Y_{t-1})$

Above function may also be written as follows:

$.(Y_t - Y_{t-1}) = \square(Y_t^* - Y_{t-1})$

$Y_t = \square Y_t^* + (1 - \square)Y_{t-1}$ (8)

Alternative form of this model is as follows

$Y_t^* = (1/\square)\, Y_t + (1/\square)\{1 - \square\}Y_{t-1}$ (9)

Substitution of value of Y_t^* in relation 8 from 7 yields the following realtion:

$$Y_t = \square\beta_0 + \square\beta_1 X_t + \square U_t + \square\,(1 - \square)Y_{t-1} \quad (10)$$

Or

$$Y_t = II_0 + II_1 X_t + II_2\, Y_{t-1} + II_3 \quad (11)$$

Identification of DLM

The parameters of relation 10 are defined as follows:

$II_0 = \square\beta_0$; $II_1 = \square\beta_1$, $II_2 = (1 - \square)$; $II_3 = \square U_t$.

II_s may be defined as reduced form parameters of the simultaneous equations model, outlined above.\OLS estimates of reduced form parameters of relation 10/11 are used to determine the values of structural parameters of relation 7 as follows:

$\lambda=1-II_2$, $\mathbf{II_0/\lambda}=\beta_0$, $\beta_1=II_1/\ \lambda$. These known values of /reduced form parameters are then used to generate estimates of random error II_3 division of which by λ then furnish estimates of unknown random errors of relation 7. As all structural parameters can be determined easily in terms of reduced form parameters, the DLM model is exactly identifiable. This facilitates use of OLS for estimating all 3 distributed lag models in the study. It is note-worthy that relation 7 depicts long run relatin between Y and X, while relation 10/11 captures short run relationship between Y and X.

λ is defined as the coefficient of adjustment in partial adjustment hypothesis and coefficient of adaptation in adaptive expectation hypothesis; but in both specifications it is subject to the following condition: $0< \lambda =<1$.

If λ is unit, adjustment or adaptation of expectations is instantaneous rather than lagged; it means that there is no difference between desired and actual values as adjustment of actual to desired value does not involve any time lag. If value of λ is 0, then there exists no process of adjustment in operation and current value equals its past value. Its value generally lies between zero and 1. Therefore, lower the value of λ, slower is the adjustment of actual to desired value and longer is the time period involved in completion of adjustment. As against it, greater the value of λ, quicker is the adjustment is smaller is the time period involved in adjustment.

Regression relation depicts long term relation between Y and X. In case of this study, such models will represent long term dependence of trade related variables on their determinants. As against relation 7, relation 10 depicts short term functional relation between the variables of the model. It is the short run model 10 which is estimated. From the estimates of parameters of this model, the value of λ is derived from the coefficient attached to Y_{t-1}. Then, the division of the coefficients by λ of all other parameters of relation 10 furnishes the estimate of parameters of long run function.

Empirical Analysis

Exports, imports and total merchandise trade are most important facets of foreign trade of any country. These facets influence not only balance of trade but net foreign exchange earnings, terms of trade (See, Prakash, S., Sharma, Shalini. and Sharma, A., 1995, Prakash, S. and Dhir Anand, Sonia, 2013), and balance of payments is also greatly affected by merchandise trade. As it is imperative to evaluate stationary/non-stationary nature of time series models, results of Random Walk Model of (I) Imports, (ii) Exports, (iii) Total Merchandise Trade, and (iv) India's GNP are analyzed first. Table I contains the OLS estimates of these models:

Table 1: OLS Estimates of Random Walk Models

Variable	β_0	β_1	β_2	R^2	τ_1	τ_2	τ_3	F	F*	P
IMPT 1	-	0.8706	-	0.41	4.41	-	-	19.5	0.0002	1.871>1
IMPT 2	-1477.3	0.509	-	0.409	-0.784	4.32	-	18.7	0.002	1.51>1
IMPT 3	-5183.3	0.4145	597.26	0.18	-1.18	-2	2.11	2.85	0.075	0.59<1
EXPT 1	-	0.5156	-	0.29	3.35	-	-	11.24	0.0024	1.52
EXPT 2	2256.14	-0.63	-	0.31	1.43	-3.5	-	12.3	0.002	0.368
EXPT 3	-1975.6	-0.6804	235.7	0.69	-0.96	-7.76	1.93	30.1	1.71E-07	0.32
MT 1	-	0.565	-	0.732	8.76	-	-	76.75	2.24E-09	1.565>1
MT 2	6874.14	-1.523	-	0.67	2.1	-7.4	-	55.38	5.26	-0.523<0
MT 3	-1975.6	-0.68	235.7	0.69	-0.96	-7.7	1.93	30.09	-0.6804	-0.71
GNP 1	-	0.148	-	0.97	30.7	-	-	941.4	1.58E-22	1.148
GNP 2	-16739	0.154	-	0.95	-1.2	22.38	-	499	6.07E-19	1.154
GNP 3	-10419	-1.7117	1199.23	0.78	-1.92	-9.7	3.7	47.3	2.19E-09	-0.712

IMPT denotes imports, T denotes time in calendar years, EXPT shows exports, MT displays merchandise trade, G represents GNP of India, τ is test statistics which is equivalent to t-statistics but its table is separate, and ρ is root of equations of RWMs.

Perusal of results in table above show that (i) imports with stochastic trend, (ii) exports with drift and with drift and trend, (ii) merchandise trade with drift and with drift and trend constitute stationary time series; (iv) all three versions of RWM reveal GNP to be non-stationary, and (V) imports, exports, merchandise trade and GNP depict explosively divergent variation in the values in one or the other version of RWM, though at least one version

depicts the series to be stationary. Incidentally, lower than one value of the root rather than the value of R^2 of these functions is the critical criterion for acceptance of results as valid or non-valid. Even otherwise, it is a well known feature of regression modeling that large the number of observations, smaller tends to be the value of the coefficient of determination. Besides, as the coefficient of determination is also a measure of goodness of the fit of the given RWM model, a low value of R^2 is an indicator that the time series a the base of the model is stationary. Consequently, a significantly high value of R^2 is an indicator of underlying time series being non-stationary. It is observed that all the model equations root of which is less than one also have a low value of R^2. The above results suggest that the models used for analyzing Indo-Iranian trade data which involve GNP as an explanatory factor require evaluation of stationarity of their residuals as per Engel-Granger test criterion.

Determination of Indo-Iranian Trade

This section deals with the determination of imports, exports and merchandise trade of India and Iran. During the era of planned development from 1951 to 1989-90, India focused on self-reliant, self-sustained and self-propelling growth of the economy. Foreign trade was accorded low priority. Imports of goods essential for growth alone were allowed and import of consumer goods, luxury goods in particular were either banned outright, or very heavily taxed. In some cases, 300-500 percent import duties were levied. Import substitution was part of growth strategy. Policy of Substitution of imports, particularly imports of heavy and capital goods by domestic production was pursued vigorously on an increasing scale as a matter of priority. But foreign trade accounted for very low proportion of GDP. Foreign trade, especially free trade was not a part of growth strategy. Trade was treated as a necessary evil to be endured for the sake of development. Exports were encouraged as pivotal means of earning foreign exchange to pay for imports. Export basket was, however, constrained to comprise limited number of primary and mineral products, and some simple manufactures like textiles, tea, coffee, etc. Terms of trade were obviously not favorable to India.

Above policies were reversed in 1990-91 as policy of imports substitution was replaced by export led growth strategy (Prakash, Shri and Anand, Sonia, 2013). Policy reversal led to explosive rise in the share of trade in GDP which rose to 37% of India's GDP in 2004. But in 2011, the Rapid growth of foreign trade raised the share of trade to 53% in GDP 2011, an increase of 16 percentage points in a period of 6 years. It amounts to an annual increase of 2.67 percentage points.

Share of India's foreign trade in total global trade also increased from a meager 0.7% in 2000 to 2% in 2011-2012. Consequently, Indian economy is much more open and globally integrated than ever before. Rising share of foreign trade in GDP is spread over entire trade of India with all its trading partners, including Iran.

Results of Distributed Lag Model

Results of Random Walk Model to all four time series data suggest involvement of lead and lag structure in inter-relations among the variables. Capturing of lead-lag structure of inter-relations requires use of distributed lag model (DLM). DLM specifies GNP as main determinant of imports, exports and trade. The choice of the explanatory variable is guided by the fact that exports depend on availability of exportable surpluses. Exportable surpluses and their export depend on the level and growth of GDP. Similarly, imports also expand with the growth of GDP. Affordability of imports depends upon (i) Export earnings; (ii) Inflows of foreign exchange from sources other than exports; and (iii) capacity to pay for imports rises with economic growth. Besides, imports also tend to rise with increasing degree of openness, increasing demand for diversification of consumption baskets, intermediate inputs, investment/capital and more advance technology. As merchandise trade comprises both imports and exports, it is also postulated to be closely related to GDP and its growth.

Placement/receipt of orders for imports/exports involves time, which generates lags. Therefore, close relation of current imports, exports and trade with GNP encompasses relationship with their lagged values due to ignorance, institutional rigidities, inertia, and policy related bottlenecks. Import and export flows are preceded by advance orders for supply. This facet makes multi-collinearity to creep into estimated distributed lagged regression models of above variables. This is taken care by step wise

regression, as suggested by L.R. Klein (1963). Besides, explanatory variable (s) as usual may be assumed to be non-stochastic and/or uncorrelated with errors, use of OLS is permissible for estimating DLMs and they suggest step-wise regression (Alt, F.F., 1942, Tinbergen, Jan, 1949). Distributed lag model is evaluated in conjunction with bi-variate regression models of these variables in step wise analysis. The estimates of these models are reported below:

Table: 2: OLS Estimates of Distributed Lag Model

Variables	β_0	B_1	B_2	t_1	t_2	t_3	R^2	F	F*
1.$IMPT_1$	-5039.4	0.0071	-	-2.14	6.85	-	0.63	46.96	1.91E-07
2.$IMPT_2$	-4805.5	0.165	0.0064	-1.85	0.78	4.2	0.64	22.95	1.80E-06
3.$EXPT_1$	-1879.3	0.0032	-	-1.13	4.4	-	0.41	19.37	0.0001
4.$EXPT_2$	-2312.4	-0.1252	0.0037	-1.25	-0.61	4.6	0.42	9.24	0.0009
5.MT_1	-4609	0.0088	-	-1.1	4.71	-	0.443	22.258	6.00E-05
6.MT_2	-2709.9	0.855	0.00602	-0.6	1.7	2.35	0.5	12.9	0.0013

Results reported in the table reveals that (i) Functions 1, 3 and 5 fit the data f imports, exports and total merchandise trade of India with Iran reasonably well; and the proportion of total change in these variables over a period of 30 years explained by these functions ranges from 41% for exports to 44.3% and 63% for imports and total trade; (ii) GNP emerges as an important determinant of imports, exports and total trade; (iii) Imports appear to be much more dependent on GNP of India than exports and total trade. Indian exports to Iran seem to be influenced a bit more by demand in Iran than the available exportable surpluses in India; GNP is a proxy of these surpluses. GNP of Iran is probably an equally effective proxy of demand for Indian exports. Authors have not been able to get access to data relating to Iran's GNP; (iv) Regression coefficient attached to GNP in all three functions is also highly significant statistically which lends credence to the hypothesis that GNP is among the major determinants of Indo-Iranian trade; (v) All 3 functions suggest inclusion of an additional explanatory variable to enhance the explanatory power of these functions.

In view of the above results and theoretical postulations put forward in earlier part of the study, lagged value of imports, exports and total trade are

incorporated in the above functions to transform them into DLM. Regression functions 2, 4, and 6 represent short run DLM import, export and trade functions.

It may be inferred that **(i)** Introduction of lagged values of imports, exports and total trade into functions 1, 3 and 5 improves the explanatory power of the functions exactly by 1% for imports and exports and 7% for total trade. As pointed out by Tinbergen (1949), an increase in the value of coefficient of determination by at least 1% may be treated as adequate to accept the validity of DLM, all 3 DLM functions may be taken to be valid on empirical grounds; **(ii)** Corresponding to an increase of Rs 10 million in GNP, short run import and trade propensities of India lead to an increase of Rs1.65 and Rs 8.6 million; **(iii)** Incorporation of lagged values of imports, exports and total trade into functions 1, 3 and 5 creates serious multi-collinearity in DLM. This is evident, if Klien's (1965) twin criteria of multi-collinearity are applied. He suggests that, if Incorporation of an additional explanatory variable in step-wise regression transforms either a significant into not-significant or positive into negative coefficient attached to the variable(s) present before the addition of extra variable to the function, it signals presence of serious multi-collinearity. But the inclusion or exclusion of an additional explanatory variable is determined on theoretical rather than empirical or econometric grounds. Therefore, functions 2, 4 and 6 are acceptable as valid both on empirical and theoretical grounds, which are explained in the section dealing with models.

Estimated values of adjustment coefficient λ_i; (i=1,2,3 for imports, exports and total trade) are as follows: λ_1=0.835; λ_2=1.12; and λ_3=0.145.

The following table depicts the completed proportion of total desired adjustment of actual to desired values of imports, exports and total trade

Table 3: Percentage of Total Desired Adjustment Completed in Different Periods

Percentage of Completed Adjustment					
	I	II	III	IV	V
IMPT	83.5	97.3	99.6	-	-
EXPT	100	-	-	-	-
MT	0.6	1.2	Remaining:98.8%		

These values of adjustment coefficients show that (i) adjustment coefficient of imports is as high as 0,835; thus adjustment of actual to desired level of imports is completed within 3 years. In fact, 83.5% of total desired adjustment involved in making actual equal to desired value of imports is accomplished within 1 year,; remaining 16.5% adjustment is spread over 2.years; (ii) Adjustment of actual to desired value of Indian exports to Iran is completed within the period itself. In other words, Indian actual and desired exports approximately equal each other year on year; (iii) But adjustment of actual total trade to its desired level is spread over a very long period of time, since the value of the adjustment coefficient is very small. Above results imply that there is **high potential** for future growth of total Indo-Iranian trade.

Above results facilitate the transformation of short into long run import, export and trade functions as follows:

$IMPT^*_t = -5755.14+0.1976G_t$

$EXPT^*_t=-2064.64+0.0035G_t$

$\mathbf{MT^*_t} =-18682.76+0.0044.1G_t$**,**

These results show that short run propensities of imports, exports and total trade are Rs 19.76, Rs 0.04 and Rs 0.44 million per annum; these long run marginal propensities of imports and total trade are much greater than the corresponding short run marginal propensities to import nd trade with Iran but the long and short run marginal propensities of exports are approximately equal to each other. Short run propensities are subject to the vicissitudes of short run fluctuations of GNP, and hence, trade related variables also fluctuate with GNP in the short run. But long run trade is guided and governed by long run stable trend of growth of Indo-Iranian trade with the growth of Indian economy. Thus, both the trading partners derive growth gains from their mutual trade.

Test of Co-integration

As Dickey-Fuller test has revealed time series of GNP to be non-stationary and GNP is used as a determinant in all 3 DLM functions, it needs to be examined whether linear combinations of variables included in the functions 2, 4 and 6 are stationary. Following functional relations of their residuals are taken into consideration:

Imports

ΔU_t = -95.97-0.837)U_{t-1} R^2 = 0.39, F=17.32 > F*=0.0003
t= (-0.06), (-4.1),

Exports

ΔU_t = -0.196989 U_{t-1} R^2 = 0.634, F = 39.99 > F* = 1.88E-06
t = (-6.33)

Merchandise Trade

ΔU_t = -0.0276 U_{t-1} R^2 = 0.01, F = 2.2 >F* = 0.673
t = (-4.43)

The above models show that the residuals or random errors of the regression functions of imports, exports and total trade on their respective lagged values and GNP are stationary. Therefore, all these functions are genuine rather than spurious. This inference is consistent with the finding that time series of imports, exports and total trade are stationary. All variables, included in regression functions, 2, 4 and 6 are well co-integrated.

Conclusions

Following are the main findings of the paper:

1- Time series of trade and its constituent imports and exports, which are used for analysis, are stationary on application of Dickey-Fuller test;

2- D-F test reveals the time series of India's GNP to be non-stationary;

3- Distributed lag models, involving imports, exports and total trade as dependent with GNP as independent variable are revealed to be well co-integrated by Engel-Granger test;

4- Introduction of lagged values of imports, exports and total trade in their respective bi-variate regressions improves the explanatory power of 3 initial functions by 7 and 1 percent respectively which makes the distributed lag models acceptable;

5- Distributed lag models with the specification of partial adjustment hypothesis are found appropriate for analyzing Indo-Iranian trade;

6- Adjustment of actual to desired exports is practically instantaneous, adjustment of actual to desired imports of India from Iran involves 2-3 periods, while adjustment of actual to desired total merchandise trade is spread over a pretty long time periods;

7- Short and long run India's marginal propensities to import, export and trade with Iran differ greatly from corresponding values of short run marginal propensities. But these propensities reveal huge scope for growth of Indo-Iranian trade, which may probably require greater degree of diversification of import-export baskets of these two trade partners;

8- Indian exports to Iran appear to be driven more by Iranian demand for the same than the available supply constraints on Indian side.

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