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Revisiting the Import Demand Function: A Comparative Analysis

A b s t r a c t. This study attempts to revisit import demand function across three panels of frontier, emerging, and developed economy from 1980 to 2016. Long-run relationship exists among import demand, relative price, exchange rate, and real GDP in economy. Due to increase in real GDP, import demand responds positively across economies. It responds in same direction in short-run in frontier and emerging economies with relative price unlike that of long-run in same economies. However, it responds in same direction with relative price in developed economy. It moves in opposite direction with respect to movement in exchange rate of frontier economy unlike that of developed economy. Next, the behavior of import demand in short-run due to change in exchange rate varies from that of long-run in emerging economy. This study will help to predict the dynamics of import due to change in income level, relative price, and exchange rate at national and international level.

Keywords: Exchange Rate; Import Demand Function; Real GDP; Relative Price

JEL Classification: C01; C23; F13; F31

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Introduction

Open economy with confined production base due to the trend of globalization stimulates foreign trade, resulting high interdependent linkage among different economies. The economies of scale in a particular product is given priority to few countries to become dominant in the international market, increasing the import level of that particular product around the world. Besides, the World Trade Organization (WTO) paves the way to shrink the trade barriers and implement rules and regulations among, especially, frontier and emerging economies, rapidly raising the import level.

The estimation of import demand function has drawn a considerable attention among the researchers and policy makers due to the movement in import demand across different countries with respect to the movement in a few key macroeconomic variables namely exchange rate, relative prices, and income level etc. Moreover, macroeconomic policies designed by the policymakers affect the trend of import due to the development in foreign trade in frontier and emerging economies. The elasticity of import with respect to income and relative price is convenient for the policy makes to design commercial policies and the elasticity of import with respect to exchange rate is essential to ensure good position in international trade. In this regard, two notable studies conducted by Orcutt (1950) and Kreinin (1967) can be mentioned. They attempted to explain import elasticity with respect to changes in price level for a number of countries. Later econometric analysis revealed that apart from the price level, income level plays a role in explaining the import demand especially in developing economy. Houthakker and Magee (1969) validated the situation in the way that improvement or decline in trade balance in some countries was affected by differences in income elasticities of their demand for imports. With the collapse of Bretton Woods Systems, fixed exchange rate regime has been disappeared. During the existence of Bretton Woods Systems, policy makers and researchers were not familiar with the changes in imports due to movement in exchange rate. It is however believed that the extent and timing of foreign exchange rate effect on import reflected the reaction of relative prices. A few notable studies which tried to find out the impact of relative prices and exchange rate on imports are Junz and Rhomberg (1973), Wilson and Takacs (1979), Warner and Kreinin (1983), Bahmani-Oskooee (1986), Bahmani-Oskooee and Niroomand (1998), and Bahmani-Oskooee and Kara (2003, 2005).

The main objective of this paper is to estimate the import demand function across three panels of frontier, emerging, and developed economies. More specifically this paper attempts to reinvestigate how the import changes with

respect to changes in gross income level (gross domestic product), relative price, and average exchange rate across frontier, emerging, and developed economies. Finally, this study will recommend some policies to policy makers and economists at national and international level to forecast the dynamics of important demand due to change in income level, relative price, exchange rate for all economies.

In the following part, this study starts with literature review, after which a few models for estimating import demand function are briefly explained. Next, this study specifies the data and model. Subsequently, this study presents econometric methodology, estimated results, and discussion. Finally, this study concludes the findings with policy implications.

1. Literature Review

A growing curve of import, pushed by the air of globalization, is stimulated by the desire to gain rapid speed of economic growth with maximum utilities from foreign trade. Hence, considering the significance of international trade, the large number of empirical studies are found investigating the import demand function in numerous economies. For example, investigating the aggregate import demand function of Pakistan, Rehman (2007) revealed that in the long run movements in import price and real income significantly affect import. Studying in detailed the import demand function of developing countries, Rana (1983) deduced that the increase in exchange rate had a significant negative impact on import demand. Inspecting the import demand of Thailand, Sinha (1997) revealed that import depends on the import price, domestic price, and gross domestic product. Estimating import demand of Italy over the period 1970 to 1986, Giovannetti (1989) revealed that the components of different expenditures have a significant impact on the import demand. Erlat and Erlat (1991) studied that international reserve plays the key role to explain import demand. However, relative price has no significant impact on import demand. Kotan and Saygili (1999) found that domestic income is the most significant variable in explaining import demand. Mwega (1993) found insignificant impact of relative prices and domestic income on import demand by using annual data for the period 1964–91 for Kenya. Investigating the import demand of Pakistan for the period 1960–1999, Afzal (2001) identified that relative price has insignificant negative impact on import demand unlike domestic income. Anyemedu (1995) argued that policies to liberalize trade will increase the aggregate import demand. Egwaikhide (1999) found that previous import had insignificant impact on current import and lagged foreign exchange rate, relative price, and real income have significant impact

on import in Nigeria. Therefore, he deduced that foreign exchange rate, relative price, and real income play important role in influencing import behavior of Nigeria. Estimating import demand function for the UK, Abbott and Seddighi (1996) revealed that followed by investment and export expenditures, consumption expenditure has the highest impact on import demand. Estimating South Korea's import demand over the 1963–1998 period, Min et al. (2002) found long-run significant elastic impact of final consumption expenditure on import demand, significant inelastic impact of export expenditure on import demand, the insignificant negative impact of investment expenditure on import demand, and the significant negative impact of relative price on import demand. Dutta and Ahmed (2004) estimated the Indian import demand function and revealed that real GDP explains import demand to a significant extent and import demand is less sensitive to changes in import price. Tang (2004) revealed through estimation of import demand function of ASEAN 5 that exchange rate policy such as devaluation can be used to improve trade balance in Malaysia, Singapore, Philipine, and Thailand but not in Indonesia. Islam and Hassan (2004) revealed that the impact of income on import is positive and significant where the impact of relative price is significantly negative in Bangladesh import demand function. Hye and Mashkoor (2010) found the significant positive impact of income and significant negative impact of relative price on import in Bangladesh. Ghorbani and Motallebi (2009) found significant positive impact of gross domestic income on import. They reported that import is elastic with respect to income. Yin and Hamori (2011) revealed that price plays a significant role in explaining the import demand unlike the exchange rate in the long run. Assessing import demand function of Malaysia for 1970 to 1998, Mohammed and Tang (2000) revealed a negative inelastic relationship between relative price and import demand. They also revealed that all expenditures have an inelastic effect on import demand in the long-run. However, investment expenditure is highly correlated with import demand. Assessing the import demand function of South Fiji, Narayan and Narayan (2005) found that consumption expenditure, investment expenditure, and exports have positive impact on import demand unlike that of relative price on import. Estimating China import demand function, Tang (2003) found that export expenditure has the highest correlation with import. Investigating US data from 1948 to 2007, Katsimi and Moutous (2011) found evidence of a long-run cointegration of a standard import demand function including income inequality (see also, Adam et al., 2008). Analyzing Jamaica's import demand function with US and UK, Hibbert et al. (2012) found that real GDP, relative price, foreign reserves, and volatility of exchange rate

have positive impact on the import demand. Ahad et al. (2017) found that financial development increases the import demand unlike economic growth and relative price in Pakistan. A negative and significant relationship between exchange rate and import but a positive and significant relationship between the value of merchandise import and gross domestic product have been revealed by Ibrahim (2017) (see also Ibrahim, 2015). Arize and Malindretos (2012) found the significant positive impact of foreign exchange reserve and domestic income on import demand both in the short run and in the long run. Mishra and Mohanty (2017) found the evidence of negative impact of relative price on import demand unlike increase of domestic income and foreign exchange reserve in India in the long run.

This paper attempts to estimate whether the import demand function varies across frontier, emerging, and developed economies by using Bahmani-Oskooee (1986) model. Even of this issue is studied extensively, it requires in depth analysis due to variation in results across different countries and economies. Therefore, the principle objective is to revisit the import demand function across three panels of frontier, emerging, and developed economies by using econometric tools and techniques. Due to use of different econometric tools and variation of sample size in a few previous studies, the conclusion on the results of import demand function are very mixed. This study will also uncover reasons of variation in import demand function across frontier, emerging, and developed economies.

2. Models of Import Demand Function

A few models are suggested by the researchers to estimate the import demand function.

For example, Khan (1974) suggested the following model:

$$X_{ijt} = A_1 P_{ijt}^{\theta_1} Y_{ijt}^{\theta_2} e^{\omega_{ijt}} \tag{1}$$

The logarithmic transformation of equation (1) is given below:

$$\ln X_{ijt} = \theta_0 + \theta_1 \ln P_{ijt} + \theta_2 \ln Y_{ijt} + \omega_{ijt} \tag{2}$$

Where X_{ijt} is the value of merchandise import of country *i* imported from country *j*. Y_{ijt} is the real GNP (Gross National Product) of country *i* different from country *j*. P_{ijt} is the ratio of world price to domestic price. θ_1 and θ_2 are

the elasticities of import with respect to relative price and real GNP. ω_{ijt} denotes the random error term and t denotes time period. Warner and Kreinin (1983) suggested the following model:

$$X_{ij,t} = A_1 (P_{ijt}^F)^{\delta_1} (P_{ijt}^D)^{\delta_2} Y_{ijt}^{\delta_3} e^{\upsilon_{ijt}} \tag{3}$$

The logarithmic transformation of equation (3) is given below:

$$\ln X_{ijt} = \delta_0 + \delta_1 \ln P_{ijt}^F + \delta_2 \ln P_{ijt}^D + \delta_3 \ln Y_{ijt} + \upsilon_{ijt} \tag{4}$$

Where X_{ijt} is the value of merchandise import of country *i* imported from country *j*. P_{ijt}^F is the price level of goods in foreign country needs to be imported in country i different from country *j*, P_{ijt}^D denotes price level in domestic country *i* different from country *j*, and Y_{ijt} denotes real GNP (Gross National Product) of country *i* different from country *j*. δ_1 and δ_2 denote elasticities of import with respect to price level in foreign country and domestic country respectively. δ_3 denotes elasticity of import with respect to real GNP of country *i* different from country *j*. υ_{ijt} denotes random error term and *t* denotes time period. Bahmani-Oskooee (1986) suggested the following model:

$$X_{ijt} = A_0 Y_{ijt}^{\lambda_1} P_{ijt}^{\lambda_2} E_{ijt}^{\lambda_3} e^{\eta_{ijt}} \tag{5}$$

The logarithmic transformation of equation (5) is given below:

$$\ln X_{ijt} = \lambda_0 + \lambda_1 \ln Y_{ijt} + \lambda_2 \ln P_{ijt} + \lambda_3 \ln E_{ijt} + \eta_{ijt} \tag{6}$$

X_{ijt} denotes the value of merchandise imports to country *i* from *j*, Y_{ijt} denotes the real GDP (Gross Domestic Product) of country *i* different from country *j*, P_{ijt} denotes relative price measured as the ratio of foreign over domestic price index of country *i* different from country *j*, and E_{ijt} denotes the average exchange rate of country *i* different from country *j*. λ_1, λ_2, λ_3 denote import elasticity with respect to real GDP, relative price, and exchange rate (DC/USD). η_{ijt} denotes random error term and *t* denotes time period. Bahmani-Oskooee and Niroomand (1988) suggested the following model specification for a study period of 1960–1992:

$$X_{ijt} = A_2 Y_{ijt}^{\gamma_1} P_{ijt}^{\gamma_2} e^{\xi_{ijt}} \tag{7}$$

The logarithmic transformation of equation (7) is given below:

$$\ln X_{ijt} = \gamma_0 + \gamma_1 \ln Y_{ijt} + \gamma_2 \ln P_{ijt} + \xi_{ijt} \tag{8}$$

X_{ijt} denotes the value of merchandise imports to country *i* from *j*, Y_{ijt} denotes the real GDP of country *i* different from country *j*, P_{ijt} denotes relative price measured as the ratio of foreign over domestic price index of country *i* different from country *j*. γ_1 and γ_2 denote import elasticity with respect to real GDP and relative prices. ξ_{ijt} denotes random error term and *t* denotes time period.

3. Data, Variables, and Descriptive Statistics

This study uses data of three panels of 8 frontier countries, 8 emerging countries, and 10 developed countries from 1980 to 2016. Economies have been classified as per the annual market classification by MSCI[1] (MSCI, 2019). Frontier economy includes Bangladesh, Pakistan, Kenya, Nigeria, Jordan, Trinidad, Sri Lanka, and Cameroon. Emerging economy includes China, India, South Africa, Mexico, Thailand, Malaysia, South Korea, and Philippines. Developed economy includes United States, United Kingdom, Canada, Japan, Switzerland, Denmark, Australia, New Zeeland, Sweden, and Norway. However, Pakistan, included in frontier market up to May 2017, currently belongs to emerging market (MSCI, 2019). Selected frontier countries represents African, Middle East, and Asian countries. Next, selected emerging countries represent Americas, African, and Asian countries. Finally, developed countries represent Americas, United Kingdom and European, and pacific Countries. The characteristics of economies have been provided in Table 1 and the definitions of key variables have been provided in Table 2, and descriptive statistics of the data set have been provided in Table 3.

[1] MSCI Inc., which formerly Morgan Stanely Capital International and MSCI Barra, is an global provider of equity, fixed income, hedge fund stock market indexes, and muti-asset portfolio analysis tools. It prepares MSCI BRIC, MSCI World and MSCI EAFE indexes.

Table 1. Characteristics of Economies

Economies	Definition
Frontier Economy (Characteristics)	▪ Earlier stages of development. ▪ Lot of scope of improvement in GDP. ▪ Very young population. ▪ Low level of urbanization. ▪ Embracing economic growth. ▪ Growing middle class as income rises. ▪ Low level of internal and foreign debt. ▪ Government pursuing policies of liberalization and reform. ▪ High political risk. ▪ Per capita income is less than $4,035.
Emerging Economy (Characteristics)	▪ Investing in more productive capacity. ▪ Moving away from traditional economy that have relied on agriculture and the export of raw materials. ▪ Rapidly industrializing and adopting a free market or mixed economy. ▪ Lower per capita income than the average world per capita income (as per the World Bank). ▪ Rapid economic growth. ▪ Per capita income is greater than $4,035 and less than $12,236 as per the World Bank.
Developed Economy (Characteristics)	▪ High level of security. ▪ High per capita income is above $12, 236 as per the World Bank. ▪ High human development measured by Human Development Index (HDI) (greater than 0.8). ▪ High level of industrialization. ▪ Supremacy of capital. ▪ Large scale production. ▪ Human efforts are directed towards earning more and more income.

Table 2. Definition of Key Variables

Variables	Definition	Data Sources
Import demand (IMP)	The import value of each country of different economies in USD.	World Bank Development Indicators
Real GDP (GDP)	The real value of final goods and services in particular financial year adjusted for inflation and deflation.	World Bank Development Indicators and International Monetary Fund
Relative prices (RP)	World Price Index /Consumer Price Index.	World Bank Development Indicators, and UNTACD statistics
Exchange rate (ER)	Domestic Currency (DC) of each country per USD (DC/USD).	World Bank Development Indicators, and UNTACD statistics

Table 3. Descriptive Statistics

Frontier Economy					
Variables	Minimum	Maximum	Mean	Standard Deviaton	JB Statistic
Import (mn USD)	1,420	88,378	10,708	13,292	1139.07*** (0.00)
Real GDP (mn USD)	4,601	207,172	38,284	40,065	267.46*** (0.00)
Relative Price	0.63	50.58	3.34	7.35	8377.21*** (0.00)
Exchange Rate	0.3	733.03	94.21	151.81	569.31*** (0.00)
Emerging Economy					
Variables	Minimum	Maximum	Mean	Standard Deviaton	JB Statistic
Import (mn USD)	11,010	2,261,248	181,892	309,789	6772.05*** (0.00)
Real GDP (mn USD)	45,773	8,909,478	741,768	1,244,385	5381.71*** (0.00)
Relative Price	0.5	266.2	4.4	23.68	97342.64*** (0.00)
Exchange Rate	0.02	1401.44	134.7	320.74	565.06*** (0.00)
Developed Economy					
Variables	Minimum	Maximum	Mean	Standard Deviaton	JB Statistic
Import (mn USD)	702	2,814,841	329,657	510,871	1634.48*** (0.00)
Real GDP (mn USD)	982	16,597,446	2,147,298	3,571,335	732.77*** (0.00)
Relative Price	0.46	11.13	1.47	1.01	17381*** (0.00)
Exchange Rate	0.43	249.08	16.71	42.5	2798.82*** (0.00)

Note: ***Significant at 1% level, **Significant at 5% level, *Significant at 10% level.

From descriptive statistics, we have observed that developed economy with the lowest mean relative price and exchange rate has the highest mean import and mean real GDP than those of frontier and emerging economies. The high level of import in developed economy is due to the high level of industrialization and supremacy of capital. However, if we see the mean import to mean GDP ratio, frontier economy has the highest mean import to mean GDP ratio (28%) relative to that of emerging economy (25%) and developed economy (15%). Since emerging and frontier economies have the scope for more industrialization and economic growth, still high dependency on import exists in those economies. The developed economy's real GDP and import are 56 times and 31 times higher than those of frontier economies and the emerging economy's real GDP and import are 19 times and 16 times

higher than those of frontier economies. All the variables are not normal suggested by the significant JB statistic. Therefore, natural logarithm of all variables is considered to ensure the normalization.

4. Model Specification

Following Bahmani-Oskooee (1986), the following model is specified to estimate the long-run elasticities of import with respect to gross domestic product, relative prices, and exchange rate:

$$IMP_{ijt} = A_0 . GDP_{ijt}^{\lambda_1} . RP_{ijt}^{\lambda_2} . ER_{ijt}^{\lambda_3} . e^{\eta_{ijt}}, \tag{9}$$

IMP_{ijt} denotes the value of merchandise imports to country i from j at time t, GDP_{ijt} denotes the real gross domestic product of country i different from country j at time t, RP_{ijt} denotes relative price measured as the ratio of foreign over domestic price index of country i different from country j at time t, and ER_{ijt} denotes the average exchange rate of country i different from country j at time t. Relative price is measured by the world price index divided by the consumer price index of a particular country.

5. Econometric Methodology, Estimated Results, and Discussion

5.1. Unit Root Test

Before estimation of the long-run equation (9), at first step, we need to ensure that whether each variable contains unit root problem or not. In this regard, Im, Peasaran, and Shin (2003), Choi (2006), and Hadri (2000) tests have been applied. Under Im, Peasaran, and Shin (2003) and Choi (2006) tests, the null hypothesis represents the variable under investigation is non-stationary and under Hadri (2000) test, the null hypothesis represents the variable under investigation is stationary. Several tests have been applied to reach at an overwhelming conclusion. Sometimes a few tests may not give the same conclusion. It is merely due to the power of the tests. The appropriate lag length for each unit root test is selected by AIC and SBIC criteria. The tests results have been highlighted in Table 4, Table 5, and Table 6.

Table 4. Unit Root Test Results Summary for Frontier Economies

Variables	Model with Constant and Trend Term [Level Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
ln *IMP*	–1.4820*	0.069	–0.9770	0.164	6.4289***	0.000
ln *RP*	0.1508	0.559	0.6623	0.746	3.4681***	0.000
ln *ER*	–224.59***	0.000	–5.138***	0.000	7.6544***	0.000
ln *GDP*	1.7592	0.960	1.6461	0.950	6.8065***	0.000
Variables	Model with Constant Term [Level Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
ln *IMP*	6.0043	1.000	5.6546	1.000	8.6388***	0.000
ln *RP*	1.8279	0.966	1.8306	0.966	5.5959***	0.000
ln *ER*	–230.60***	0.000	–5.083***	0.000	8.8289***	0.000
ln *GDP*	9.3871	1.000	8.5589	1.000	9.5433***	0.000
Variables	Model with Constant Term [Difference Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
Δ ln *IMP*	–12.541***	0.000	–10.66***	0.000	0.7721	0.211
Δ ln *RP*	–8.5375***	0.000	–8.124***	0.000	–0.7008	0.758
Δ ln *ER*	–79.671***	0.000	–6.468***	0.000	0.7621	0.223
Δ ln *GDP*	–6.5192***	0.000	–6.261***	0.000	0.7105	0.259

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively.

Table 5. Unit Root Test Results Summary for Emerging Economies

Variables	Model with Constant and Trend Term [Level Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
ln *IMP*	–0.0165	0.4934	0.1011	0.5403	5.1054***	0.0000
ln *RP*	–1.2681	0.1024	–0.5948	0.2760	4.8657***	0.0000
ln *ER*	0.6615	0.7485	0.7029	0.7589	6.0481***	0.0000
ln *GDP*	0.8914	0.8136	1.1927	0.8835	6.0000***	0.0000
Variables	Model with Constant Term [Level Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
ln *IMP*	3.0899	0.9990	3.0726	0.9989	9.7945***	0.0000
ln *RP*	–1.0222	0.1533	–0.8869	0.1876	5.0464***	0.0000
ln *ER*	–4.06***	0.0000	49.987***	0.0000	8.0623***	0.0000
ln *GDP*	4.7299	1.0000	4.2505	1.0000	10.116***	0.0000
Variables	Model with Constant Term [Difference Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
Δ ln *IMP*	–10.8***	0.0000	–9.594***	0.0000	0.0387	0.4846
Δ ln *RP*	–7.69***	0.0000	–7.403***	0.0000	–0.0118	0.5074
Δ ln *ER*	–8.27***	0.0000	–7.709***	0.0000	0.7411	0.2233
Δ ln *GDP*	–8.93***	0.0000	–8.128***	0.0000	1.0156	0.1549

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively.

Table 6: Unit Root Test Results Summary for Developed Economies

Variables	Model with Constant and Trend Term [Level Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
ln *IMP*	0.0070	0.5028	–0.0254	0.4899	4.6409***	0.0000
ln *RP*	–2.7329***	0.0031	–2.788***	0.0026	5.4084***	0.0000
ln *ER*	–2.7232***	0.0032	–2.840***	0.0023	4.3680***	0.0000
ln *GDP*	1.4253	0.9230	1.4443	0.9257	5.4194***	0.0000
Variables	Model with Constant Term [Level Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
ln *IMP*	2.7557	0.9971	2.8139	0.9976	11.123***	0.0000
ln *RP*	2.4554	0.9930	2.5089	0.9939	9.4156***	0.0000
ln *ER*	–4.0277***	0.0000	–4.095***	0.0000	2.8644***	0.0021
ln *GDP*	–0.1334	0.4469	–0.0863	0.4656	11.218***	0.0000
Variables	Model with Constant Term [Difference Form]					
	IPS Test		Choi Test		Hadri Test	
	Statistic	P-value	Statistic	P-value	Statistic	P-value
Δ ln *IMP*	–12.019***	0.0000	–10.50***	0.0000	0.5951	0.2759
Δ ln *RP*	–12.242***	0.0000	–10.79***	0.0000	0.4064	0.3422
Δ ln *ER*	–7.6854***	0.0000	–7.341***	0.0000	0.1940	0.4231
Δ ln *GDP*	–8.9506***	0.0000	–8.391***	0.0000	0.8064	0.2100

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively.

From Table 4, Table 5, Table 6, it can be concluded that under Im, Peasaran, and Shin (2003) and Choi (2006) tests a few variables are stationary at level form. After making first difference, all variables become more stationary. However, to reach at an overwhelming conclusion, Hadri (2000) test has been applied. This test reveals that no variable is stationary at level form. All variables are integrated of order one (I(1)). Since each test suggests all variables are stationary at integrated of order one, this study doesn't need to go for higher order integration. This study gives emphasis on the result of Hadri (2000) test. This test works well in panel data models with fixed effects, individual deterministic trends, and heterogeneous errors across cross-sections (Hadri, 2000). Besides, the test can be used for the more general case of serially correlated disturbance terms (Hadri, 2000).

5.2. Panel Cointegration Test

At the second step, we need to ensure that whether there exists any cointegrating relationship or not. Since all variables are integrated of order one (I(1)), therefore, Johansen Fisher Panel Cointegration test (Johansen, 1995) and Kao Residual Based Cointegration test (Kao, 1999) have been applied. Johansen Fisher Panel Cointegration test (Johansen, 1995, 1988) can only be

applied if all variables are integrated or order one (I(1)). The test results are provided in Table 7. The appropriate lag length of Johansen and Fisher Panel Cointegration test (Johansen, 1995, 1988) is selected by the AIC and SBIC criteria. Kao Residual Based Panel Cointegration test (Kao, 1999) is applied to make sure the existence of cointegrating relationship suggested by Johansen Fisher Panel Cointegration test (Johansen, 1995, 1988). The test results are provided in Table 8.

Table 7. Johansen and Fisher Panel Cointegration Test Results

CEs	Test Results for Frontier Economies							
	Case-1: Intercept (no trend) in CE and VAR				Case-2: Intercept and Trend in CE and No Trend in VAR			
	Trace Test		Max-Eigen Test		Trace Test		Max-Eigen Test	
	Statistic	p-value	Statistic	p-value	Statistic	p-value	Statistic	p-value
None	84.34***	0.000	77.43***	0.000	86.58***	0.000	68.10***	0.000
At most 1	26.42**	0.048	28.34**	0.028	33.07***	0.007	33.10***	0.007
At most 2	9.24	0.903	7.08	0.972	11.47	0.779	12.67	0.697
At most 3	20.23	0.209	20.23	0.209	6.84	0.976	6.84	0.976
CEs	Test Results for Emerging Economies							
	Trace Test		Max-Eigen Test		Trace Test		Max-Eigen Test	
	Statistic	p-value	Statistic	p-value	Statistic	p-value	Statistic	p-value
None	140.7***	0.000	114.5***	0.000	132.0***	0.000	161.5***	0.000
At most 1	47.20***	0.000	36.41***	0.002	31.82**	0.011	30.84**	0.014
At most 2	25.15*	0.067	16.25	0.435	12.46	0.712	9.85	0.874
At most 3	33.84***	0.005	33.84***	0.005	11.30	0.790	11.30	0.790
CEs	Test Results for Developed Economies							
	Trace Test		Max-Eigen Test		Trace Test		Max-Eigen Test	
	Statistic	p-value	Statistic	p-value	Statistic	p-value	Statistic	p-value
None	96.55***	0.000	66.78***	0.000	160.8***	0.000	124.1***	0.000
At most 1	44.77***	0.000	33.01**	0.016	61.61***	0.000	44.59***	0.001
At most 2	26.39*	0.091	22.82	0.197	31.15**	0.027	24.89	0.128
At most 3	26.42*	0.091	26.42*	0.091	19.08	0.387	19.08	0.387

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively. Appropriate lag length for this test has been selected by AIC and SBIC. Case-1 and Case-2 suggest one cointegrating equation.

Table 8. Kao Residual Based Panel Cointegration Test Results

	Frontier Economies	Emerging Economies	Developed Economies
ADF Test	–4.9828***	–4.6298***	–4.1689***
	(0.000)	(0.000)	(0.000)

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively.

The results from both tests suggests that there exists cointegrating relationship among the variables. Johansen Fisher Panel Cointegration test (Johansen, 1988, 1995) is applied for two cases. At first this test is applied by incorporating only intercept in cointegrating equation and VAR (Vector Auto

Regressive) model and later by incorporating intercept and trend in cointegrating equation and only intercept in VAR (Vector Auto Regressive) model. In both cases we have found the existence of cointegrating relationship among the variables for frontier, emerging, and developed economies. Therefore, in the long-run, import, relative price, real GDP, and exchange rate will move together in frontier, emerging, and developed economies. The same conclusion has been drawn from Kao Residual Based Panel Cointegration test (Kao, 1999).

5.3. Granger Causality

Here all variables are integrated of order one (I(1)). Hence, F-test under a multivariate VECM framework (Engel and Granger, 1987) is used to identify the direction of causal relationship among the variables. To account for the long-run causality, an error correction term (ECM) is added in the VAR system. The multivariate VECM framework to check the direction of causality is given below:

$$\begin{bmatrix} \Delta \ln IMP_{ijt} \\ \Delta \ln RP_{ijt} \\ \Delta \ln ER_{ijt} \\ \Delta \ln GDP_{ijt} \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix} + \sum_{K=1}^{M} \begin{bmatrix} \theta_{11k} & \theta_{12k} & \theta_{13k} & \theta_{14k} \\ \theta_{21k} & \theta_{22k} & \theta_{23k} & \theta_{24k} \\ \theta_{31k} & \theta_{32k} & \theta_{33k} & \theta_{34k} \\ \theta_{41k} & \theta_{42k} & \theta_{43k} & \theta_{44k} \end{bmatrix} \begin{bmatrix} \Delta \ln IMP_{ijt-k} \\ \Delta \ln RP_{ijt-k} \\ \Delta \ln ER_{ijt-k} \\ \Delta \ln GDP_{ijt-k} \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \end{bmatrix} ECM_{ijt-1} + \begin{bmatrix} \mu_{1ijt} \\ \mu_{2ijt} \\ \mu_{3ijt} \\ \mu_{4ijt} \end{bmatrix} \tag{10}$$

The parameters – $C's, \theta's$, and $\lambda's$ are to be estimated. The one period lagged error term, ECM_{ijt-1}, is derived from long-run equation (11). μ_{ijt} are random error terms being serially independent with mean zero and finite variance-covariance matrix. The causality analysis results have been provided in Table 9.

From the estimated results, it can be said that there is a short-run unidirectional causality from import to relative price $(\Delta \ln IMP \Rightarrow \Delta \ln RP)$ in case of frontier economy, bidirectional causality between import and relative price $(\Delta \ln IMP \Leftrightarrow \Delta \ln RP)$ in case of emerging economy, and unidirectional causality from relative price to import $(\Delta \ln RP \Rightarrow \Delta \ln IMP)$ in case of developed economy. Next, it is found that there is a short-run bidirectional causality between import and real GDP $(\Delta \ln IMP \Leftrightarrow \Delta \ln GDP)$ in case of frontier economy, short-run unidirectional causality from real GDP to import

Table 9. Granger Causality Results

	Frontier Economies				
	$\Delta \ln IMP$	$\Delta \ln RP$	$\Delta \ln ER$	$\Delta \ln GDP$	$ECM_1(-1)$ [*t-statistic*]
$\Delta \ln IMP$		0.4004 (0.5274)	0.0327 (0.8566)	20.0404*** (0.0000)	–3.0632*** (0.0024)
$\Delta \ln RP$	3.4822* (0.0631)		1.1838 (0.1768)	3.4256* (0.0653)	–3.1559*** (0.0018)
$\Delta \ln ER$	0.0060 (0.9383)	0.5769 (0.4482)		3.5163* (0.0618)	–1.2876 (0.1989)
$\Delta \ln GDP$	5.2600** (0.0226)	4.2718** (0.0397)	2.7622* (0.0977)		2.0019** (0.0463)
	Emerging Economies				
	$\Delta \ln IMP$	$\Delta \ln RP$	$\Delta \ln ER$	$\Delta \ln GDP$	$ECM_2(-1)$ [*t-statistic*]
$\Delta \ln IMP$		6.0414*** (0.0027)	5.2807*** (0.0057)	3.5862** (0.0291)	–3.8686*** (0.0000)
$\Delta \ln RP$	3.2367** (0.0409)		22.2954*** (0.0000)	4.0832** (0.0179)	–2.7320*** (0.0067)
$\Delta \ln ER$	0.6587 (0.5184)	4.0616** (0.0184)		0.3600 (0.6980)	0.0420 (0.9665)
$\Delta \ln GDP$	0.4153 (0.6606)	5.4684*** (0.0047)	5.4327*** (0.0049)		–3.6400*** (0.0000)
	Developed Economies				
	$\Delta \ln IMP$	$\Delta \ln RP$	$\Delta \ln ER$	$\Delta \ln GDP$	$ECM_3(-1)$ [*t-statistic*]
$\Delta \ln IMP$		2.3797* (0.0703)	4.1415*** (0.0069)	1.1445 (0.3318)	–2.2492** (0.0254)
$\Delta \ln RP$	0.5974 (0.6173)		7.5760*** (0.0001)	3.2305** (0.0231)	–0.9746 (0.3307)
$\Delta \ln ER$	0.3635 (0.7794)	0.6554 (0.5803)		0.5817 (0.6275)	0.0628 (0.9499)
$\Delta \ln GDP$	2.5610* (0.0556)	1.4997 (0.2152)	2.3786* (0.0704)		–1.1614 (0.1078)

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively. In the parentheses (), the p-values of the Wald statistics is presented. Here, the $\Rightarrow$ represents the unidirectional causality and $\Leftrightarrow$ represents the bidirectional causality.

$(\Delta \ln GDP \Rightarrow \Delta \ln IMP)$ in case of emerging economy, and short-run unidirectional causality from import to real GDP $(\Delta \ln IMP \Rightarrow \Delta \ln GDP)$ in case of developed economy. Further, it is found that there is a short-run bidirectional causality between relative price and exchange rate $(\Delta \ln RP \Leftrightarrow \Delta \ln ER)$ in case of emerging economy and short-run unidirectional causality from exchange rate to relative price $(\Delta \ln ER \Rightarrow \Delta \ln RP)$ in case of developed economy. In addition, it is found that there is a short-run bidirectional causality between

real GDP and relative price $(\Delta \ln GDP \Leftrightarrow \Delta \ln RP)$ in case of both frontier and emerging economies, and short-run unidirectional causality from real GDP to relative price $(\Delta \ln GDP \Rightarrow \Delta \ln RP)$ in case of developed economy. Again, it is found that there is a short-run unidirectional causality from exchange rate to import $(\Delta \ln ER \Rightarrow \Delta \ln IMP)$ in case of both emerging and developed economies. Finally, it is found that there is a short-run bidirectional causality between exchange rate and real GDP $(\Delta \ln ER \Leftrightarrow \Delta \ln GDP)$ in case of frontier economy and short-run unidirectional causality from exchange rate to real GDP $(\Delta \ln ER \Rightarrow \Delta \ln GDP)$ in case of both emerging and developed economies. Besides, The significance of $ECM_1(-1)$, $ECM_2(-1)$, and $ECM_3(-1)$ confirmed the existence of long-run causality. Therefore, exchange rate, relative price, and real GDP cause import demand in the long-run.

5.4. Long-run Elasticities

The long-run import elasticities with respect to real gross domestic product, relative prices, and exchange rate are estimated from the following equation:

$$\ln IMP_{ijt} = \lambda_0 + \lambda_1 \ln GDP_{ijt} + \lambda_2 \ln RP_{ijt} + \lambda_3 \ln ER_{ijt} + \sum_{k=-p}^{p} \theta_{1k} \Delta \ln GDP_{ijt-k} + \sum_{k=-q}^{q} \theta_{2k} \Delta \ln RP_{ijt-k}$$

$$+ \sum_{k=-r}^{r} \theta_{3k} \Delta \ln ER_{ijt-k} + \eta_{ijt} \qquad (11)$$

The equation 11 is estimated by Panel Dynamic Ordinary Least Square (DOLS) approach (Stock and Watson, 1993). The appropriate lead and lag differences of independent variables have been used to control the endogenous feedback. The lead and lag length $([-p,+p],[-q,+q],[-r,+r])$ are selected by the AIC and SBIC criteria. The panel DOLS models of all economies are free from serial correlation. The long-run elasticities have been provided in Table 10.

Table 10. Long-run Elasticities [Dependent Variable – ln *IMP*]

	Frontier Economy	Emerging Economy	Developed Economy
ln *GDP*	0.9295*** (0.0000)	0.9078*** (0.0000)	0.9022*** (0.0000)
ln *RP*	–0.3636*** (0.0000)	–0.2999*** (0.0000)	0.6415*** (0.0000)
ln *ER*	–0.1137*** (0.0000)	0.0093*** (0.0095)	–0.0467*** (0.0000)
Constant	1.0122 (0.2429)	1.0470 (0.2468)	0.9085*** (0.0043)

Note: ***, **, * denote significance at 1%, 5% and 10% level respectively.

From the above analysis, it can be concluded that real GDP has a significant positive impact on import demand across frontier, emerging, and developed economies in the long-run (see also Dutta and Ahmed, 1999; Tang, 2003; Narayan and Narayan, 2005; Hye and Mashkoor, 2010). Irrespective of the nature of the economy, increase in real GDP always boosts the import level of an economy. Again, the relative price has a significant negative impact on the import demand in case of frontier (Hye and Mashkoor, 2010; Ahad *et al.*, 2017) and emerging economies (Mishra and Mohanty, 2017) but has a significant positive impact on developed economy in the long-run (see also Hibbert *et al.,* 2012; Tang, 2003). Therefore, import in developed economy is less sensitive to the increase in price level. This indicates the existence of differential human characteristics between frontier and developed economies. However, the economic theory argues that raise in relative price of import dampens the level of import (see also Narayan and Narayan, 2005; Chang *et al.*, 2005; Thaver and Ekanayake, 2010). Hence, in case of emerging and frontier economies, the increase in relative price diminishes the demand of high price goods from abroad. However, the customers of the developed economy have different attitude towards foreign goods with respect to price, quality, brand value, excellence, safety etc., resulting a high demand in mentioned feature products even in high relative prices. Finally, the exchange rate (DC/USD) has a significant negative impact on import in case of frontier economy (Omotor, 2010) and developed economy but has a significant positive impact on import demand in case of emerging economy in the long-run. Therefore, in case of developed and frontier economies, the level of import decreases due to the raise in import cost, originated from the depreciation of the domestic currency. However, the growing demand for raw materials and capital assets in emerging economy is not affected by exchange rate movement, increasing the import level even in the depreciation of exchange rate.

5.5. Short-run Analysis

To find out the short-run elasticities of imports demand, the following error correction model is estimated:

$$\Delta \ln IMP_{ijt} = \phi_1 \Delta \ln GDP_{ijt} + \phi_2 \Delta \ln RP_{ijt} + \phi_3 \Delta \ln ER_{ijt} + \lambda ECM_{ijt-1} + \omega_{ijt}, \quad (12)$$

To check the existence of cross sectional dependence, Presaran Cross Sectional Dependency test is applied. After detecting cross sectional dependence, the cross sectional seemingly unrelated regression (SUR) is applied. When cross sectional SUR is used, the estimation become devoid of cross sectional dependence and other diagnostic problems such as autocorrelation, heteroscedasticity, and functional misspecification. Next ECM_{ijt-1} denotes one period lagged error term derived from long run cointegration equation. λ denotes the speed of adjustment with the expected negative value and magnitude less than or equal to one ($|\lambda| \leq 1$) towards the long run equilibrium if there is any shock in the import demand due to change in real GDP, relative price, and exchange rate.

Table 11. Short-run Results [Dependent Variable – $\Delta \ln IMP$]

	Frontier Economies	Emerging Economies	Developed Economies
$\Delta \ln GDP$	0.7715***	1.6852***	0.6771***
	(0.0020)	(0.0000)	(0.0000)
$\Delta \ln RP$	0.3071***	0.0738**	0.4559***
	(0.0000)	(0.0301)	(0.0000)
$\Delta \ln ER$	–0.1820**	–0.1550***	0.0682*
	(0.0139)	(0.0005)	(0.0674)
$ECM(-1)$	–0.0368*	–0.0260***	–0.0222***
	(0.0625)	(0.0008)	(0.0072)
χ^2_{CD}	0.0156	0.0235	0.0187
	(0.4561)	(0.3569)	(0.8523)

Note: Values in () represent *p*-value. ***, **, * denote significance at 1%, 5% and 10% level respectively. For panel equation estimation, panel autocorrelation and heteroscedasticity consistent estimation has been used and only cross sectional dependence test statistic has been reported. CD represents cross sectional dependence.

From the above analysis (Table 11), it can be concluded that real GDP has a significant positive impact on import in case of frontier, emerging, and developed economies in the short-run (see also Dutta and Ahmed, 1999; Tang, 2003; Narayan and Narayan, 2005; Hye and Mashkoor, 2010). Moreover, relative price has a significant positive impact on imports regardless of frontier, emerging, and developed economies in the short-run. Therefore, in the short-

run import is less sensitive with respect to increase in relative price in all economies. More specifically, it can be said that excessive dependency on the import in short-run in all economies cannot even decrease import level due to increase in price level. Moreover, increase in relative prices stimulates the imports of foreign products in all economies considering foreign products as superior in reference to quality, safety, features and so on. Next, it can be said that exchange rate (DC/USD) has a significant negative impact on import demand in case of frontier and emerging economies and a significant positive impact on import demand in case of developed economy in the short-run. It may be occurred that high exchange rate or depreciation in the domestic currency may lessen the import level in short run in case of both frontier and emerging economies but those economies require the high level of import in long run due to the large scale demand in raw materials, capital goods and so on. However, the developed economy is less affected by exchange rate in the short-run due to the existence of fascination over foreign products. The coefficient of error correction term $ECM(-1)$, is significant with an expected negative sign and magnitude. If there is any shock to import demand due to change in real GDP, relative price, and exchange rate, it will adjust by 3.68%, 2.6%, and 2.22% in the first year in case of frontier, emerging, and developed economies respectively. The entire convergence process will take approximately 27.17 years, 38.46 years, and 45.45 years in case of frontier, emerging, and developed economies respectively to approach into the long-run equilibrium, if there is any shock in the import demand.

Conclusions and Policy Implications

This study revisits the import demand function across frontier, emerging and developed economies using the panel variables- import, real GDP, relative price, and exchange rate from 1980–2016. The panel cointegration test suggests that long-run relationship exists among import demand, real GDP, relative price, and exchange rate across all the economies. The long-run and short-run estimation results reveal the impact of real GDP, relative prices, and exchange rate on import demand. For example, real GDP has a significant positive impact on import demand irrespective of the nature of the economy in the long-run and in the short-run. Therefore, from the estimated results, it can be said that increase in GDP in the long run accelerates the import demand in all economies. The relative price has a significant negative impact on the import demand in case of frontier and emerging economies in the long run but has a significant positive impact in the short run whereas relative price has a significant positive impact on import demand in case of developed economy in

the long-run and in the short run. The exchange rate (DC/USD) has a significant negative impact on import demand in case of frontier economy both in short-run and in the long-run but has a significant positive impact on import demand in case of developed economy both in the short-run and in the long-run. However, the exchange rate has a significant positive impact on import demand in the long-run and a significant negative influence in the short run in case of emerging economy. Thus it can be said at the early stage of economic development the relative price and exchange rate have significant negative impacts on import demand. Due the development of the economy, the human characteristics will be changed as a result the nature of important demand function will also be changed.

Form the policy perspectives, exchange rate of the frontier and emerging economies should be regulated to increase the import level. However, to control the loopholes of this policy, import of luxury goods rather than capital goods and raw materials should be controlled from getting benefits of lower exchange rate. The relative prices of the frontier and emerging economies should be kept in a certain level to strengthen the competitive position of the domestic products whereas the relative prices of developed economies should be kept at a certain level to protect the invasion of the foreign products which in turn will make the domestic products more popular.

This research is very much deductive in nature. We have tested an established import demand function (Bahmani-Oskooee, 1986) at different context. However, an inclusion of another macroeconomic variables like financial development and foreign exchange reserve in the existing import demand function can make the findings more trustworthy and draw a sheer attention of the economists and policy makers. The level of relative price making the domestic products of frontier and emerging economy more competitive is a matter of further investigation.

Finally it can be concluded that this study plays significant role for policy makers at national and international level to forecast the dynamics of important demand due to change in income level, relative price, exchange rate for all economies.

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