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Estimating Import Demand Function for the United States

Il-Hyun Yoon[a], Yong-Min Kim[b]

[a]Division of Global Business Administration, Dongseo University, South Korea
[b]Department of Social Education, Busan National University of Education, South Korea

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Abstract

This paper aims to empirically examine the short-run and long-run aggregate demand for the US imports using quarterly economic data for the period 2000-2018 including aggregate imports, final expenditure components, gross fixed capital formation and relative price of imports. According to the results of both multivariate co-integration analysis and error correction model, the above variables are all cointegrated and significant differences are found to exist among the long-run partial elasticities of imports as regards different macro components of final expenditure. Partial elasticities with respect to government expenditure, gross fixed capital formation, exports and relative price of import are found to be positive while imports seems to respond negatively to changes in private consumption, implying that an increase in private consumption could result in a significant reduction in demand for imports in the long run. With regard to the relative import prices, the results appear to indicate a relatively insignificant influence on the aggregate imports in the US in the long run. However, an error correction model designed for predicting the short-term variability shows that only exports have an impact on the imports in the short run.

Keywords: Cointegration, Import Demand Function, Partial Elasticity, Error Correction Model
JEL Classifications: C50, F10

Ⅰ. Introduction

According to WTO (2018), the import by the US is US$2,410 billion in 2017, accounting for 13.4 percent of the world trade. The United States, the biggest importing country in the world, has become the land of opportunity to the countries which try to sell their merchandise abroad in order to achieve trade surplus. Recently the so-called trade war between the US and China has alerted the trading countries in the world as the country placed higher tariffs on goods imported from abroad. Amid a series of incidents taking

[a] First Author, E-mail: ihyoon58@gdsu.dongseo.ac.kr
[b] Corresponding Author, E-mail: kymin@bnue.ac.kr

place, it would be of great interest to revisit the import demand function focusing on the evidence of the US since import has been an important factor to the economic growth in an open economy.

This study, therefore, aims to build a model to estimate the aggregate import demand function for the US using the most recent data and identify factors determining the imports of the country. Consequently policymakers in Korea, of which the US is the biggest trading partners, will be able to understand the US import demand and deal with any uncertainties preparing for the bilateral balance in trade.

A large number of empirical studies have been conducted over the past decades on estimation of aggregate import demand based on the national income and relative price of imports in various countries across the world, reflecting the significance of import for trade policies not just to researchers but also to policymakers.

Studies have been conducted on the basis of both multi-country comparison and country-specific investigation. For multi-country examinations, there are Asseery and Peel (1991) for five developed economies, Bahmani-Oskooee (1998) for six less developed nations, Sinha (2001) for five nations in Asia, Alisa et al. (2001) for five ASEAN countries, and Matsubayashi and Hamori (2003) for G7 member countries. Examples of country-specific investigation, to name a few among many, include Salas (1982) for the Mexico, Doroodian et al. (1994) for Saudi Arabia, Abbott and Seddighi (1996) for the UK, Sinha (1997) and Ahad et al. (2017) for Pakistan, Arize et al. (2000) for Thailand, Alias and Tang (2000) for Malaysia, Arize and Walker (1992) and Tang (2003b/2006, 2008a/2008b/2015) for Japan, and Arize and Ndubizu (1992), Mah (1992/1993), Bahmani-Oskooee (1998), Min Byun-Seong et al. (2002), Tang (2005), Chang et al. (2005) for Korea.

Several studies have also been done for import demand for the US and China, though studies on the US are relatively rare in comparison with those on developing countries. Carone (1996) tried to estimate the aggregate demand for both total and non-oil merchandise imports of the United States over the last two decades applying cointegration techniques in order to estimate the long-run equilibrium relationship. Katsimi and Moutos (2006) attempted to examined empirically the impact of inquality on the US demand for imports using the Johansen procedure on US data for the period 1948-1996 and found that there is no evidence of a long run relationship among imports, income, and relative prices variables whereas, with application of a measure of inequality in the VAR specification, there exist a cointegrating equation in imports, income, relative prices and inequality.

For studies for China, Tang (2003a) examined the long-run relationship of China's aggregate import demand function for the period 1970 – 1999, employing the cointegration method based on variables such as gross domestic product (GDP), GDP minus exports, national cash flow and final expenditure components, to find that the volume of imports demanded responds to domestic activity and relative prices and that a long-run equilibrium relationship between these measures of domestic activity and China's import demand. Later, Yin and Hamori (2011) used the concept of cointegration, the autoregressive distributed lag (ARDL) and dynamic ordinary least square (DOLS) techniques on the annual data for the period 1978-2009 to analyze China's import demand functions and found strong evidence of the existence of a long-run stable relationship among the variables included both in the traditional model and the disaggregated expenditure model of import demand, which are substantially different from those obtained in existing studies such as Tang (2003a). Wang and Lee (2012) estimated the import demand elasticity for China using three fully efficient cointegrating regressions and the ARDL method. To indicate that real imports are cointegrated with domestic economic activity, real effective exchange rate, and the perception of global risk and Domestic income have a significantly positive effect on imports with the real effective exchange rate negative impact. More recently, Gozgor (2014) employed the dynamic ordinary least squares and ARDL method to reveal that there are positive effects of the domestic income on imports and negative impact of the real effective exchange rate, and that no aggregation bias for import demand has been found in China.

Large numbers of the above studies on the estimation of aggregate import demand have used total domestic income (GDP) and relative import price on the assumption that long-run elasticity of import demand relating to each component of aggregate demand is the same, thus using a single regressor to represent aggregate demand in the import is function. However, if each component of final expenditure has different import content, the use of a single variable in the aggregate import demand function could cause aggregation bias, hence leading to incorrect estimates (see Gorman (1953), Theil (1954) and Stoker (1993) for more details). Furthermore, there is some evidence from the EU member countries which appear to suggest aggregate imports react differently to changes to each component of aggregate demand (see, for example, Eurostat (2010)). Accordingly, this paper will distinguish between different categories of final expenditure in the import demand equation to investigate the response of aggregate imports to a change in expenditure in each one of final demand category. This type of disaggregation of final demand in the import function is consistent with the treatment of aggregate demand in a number of pioneering empirical studies which have found robust results on various elasticities of demand for imports (for example, Abbott and Seddighi (1996)). This study would follow this disaggregated GDP model to empirically examine the aggregate import demand in the United States and China.

The remainder of this paper is structured as follows. Section 2 discusses the model, data and methodology used. Section 3 reports the results of empirical analysis and implications. Section 4 presents additional analysis of the short-run error correction model before concluding the paper in Section 5.

Ⅱ. Theoretical Background and Data

Zhou and Dube (2011) well documented modeling framework estimating aggregate import demand function. Existing studies have mainly employed five types of models: (i) the traditional model with income measured as real GDP, (ii) the revised traditional model with income measured as the real value of

GDP minus exports, (iii) the disaggregated or decomposed GDP model, (iv) the dynamic structural import demand model, in which real GDP is replaced by a national cash flow and (v) the structural model that incorporates a binding foreign exchange constraint. The traditional model suggests that import demand can be modeled by two determinants: relative prices and real domestic activity (Carone, 1996; Gafar, 1988; Hong, 1999; Tang, 2003a). The second model is a variation of the traditional model, which replaces real GDP with real GDP minus exports as a measure for real domestic activity (Senhadji, 1998). The disaggregated or decomposed GDP model is employed by many studies to take into account the fact that different macro components of final expenditure have different import contents (Abbott and Seddighi, 1996; Giovannetti, 1989; Tang and Mohammad, 2000; Tang, 2003a). This approach decomposes GDP into three categories: final consumption expenditure, expenditure on investment goods, and exports. The dynamic structural import demand model is developed by Xu (2002). The model replaces real GDP with a national cash flow variable. The fifth structural model uses the Lagrange multiplier of a binding foreign exchange constraint at the administered prices of imports (Emran and Shilpi, 2010). However, these studies suffer from the problem that if foreign exchange availability is used as a regressor when the foreign exchange constraint is binding, it alone determines the volume of imports completely.[1]

Based on the above third model, this paper disaggregated aggregate expenditure into its key components in the demand for import function as follows:

$$IMPORT = f(PRICON, GOVCON, GFCF, EXPORT, PRICE) \quad (1)$$

Where IMPORT is demand for aggregate imports, PRICON is the final consumption expenditure by private sector, GOVCON is the government final consumption expenditure, GFCF is expenditure on investment goods measured by gross fixed capital formation, and EXPORT is the total amount of exports, all measured in constant prices. PRICE represents the relative price of imports to domestic prices (PM/PD) measured by the ratio of import price deflator (PM) (defined as ratio of imports in current prices over imports in constant prices) by the index of domestic prices (PD) (measured by the GDP deflator). All variables are in natural logarithmic form. The data used in this study are quarterly from 2000:1 to 2018:3 obtained from Economic Data of Federal Reserve Bank of Saint Louis.

In order to test for the existence of the long-run relationship between demand for imports and variables specified by economic theory in the import demand function (Equation 1), this paper have employed a multivariate co-integration analysis previously used by Abbott and Seddighi (1996), which include augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests; co-integration tests with Trace and Eigen - value tests for identifying the existence of a unique cointegrating; finding out the long-run

1) For further details, please refer to Zhou and Dube (2011).

Table 1. Impact Descriptive Statistics

	IMPORT	PRICON	GOVCON	GFCF	EXPORT	PRICE
Mean	27.03352	28.53065	27.03181	27.35797	26.7478	0.23106
Median	27.13129	28.54301	27.12893	27.38074	26.82138	0.23015
Maximum	27.40716	28.88738	27.29696	27.70439	27.16817	0.44322
Minimum	26.47285	28.13385	26.58231	27.08787	26.18248	0.11357
Std. Dev.	0.27154	0.210448	0.203588	0.173227	0.33049	0.07907
Skewness	-0.61784	-0.22108	-0.74641	0.092164	-0.38047	0.40695
Kurtosis	1.989657	2.02073	2.229241	2.038762	1.618949	2.30306
Jarque-Bera	7.961579	3.607733	8.8206	2.993608	7.769794	3.587959
Probability	0.018671	0.164661	0.012152	0.223844	0.02055	0.166297
Sum	2027.514	2139.799	2027.386	2051.847	2006.085	17.32973
Sum Sq. Dev.	5.456302	3.277342	3.067165	2.220573	8.08256	0.462646
Observations	75	75	75	75	75	75

Note: The figures for IMPORT, PRICONS, GOVCON, GFCF and EXPORT are the natural log transformation of the volumes in US Dollar for the imports, the private final consumption expenditure, the government final consumption expenditure, the expenditure on investment goods denoting gross fixed capital formation and the exports. PRICE indicates the natural log of the value of the import price deflator divided by an index of domestic prices.

relationships between variables in the import demand function; and building a short-run error correction forecasting model. The results of the each step will be discussed below.

⟨Table 1⟩ shows the descriptive statistics of the variables used in this study. Normal distribution characteristics appear not to be present in the data series as it is indicated by the Jarque-Bera, Skewness and Kurtusis statistics. All the variables are shown as flat (platykurtic) with respect to the normal as the kurtosis is less than 3. The skewness statistics are negative, indicating a longer tail to the left than to the right side and the skewed distribution to the left.

Table 2. Unit Root Test

Variables	At Level		At First Difference	
	ADF t-statistic	p-value	ADF t-statistic	p-value*
IMPORT	-1.34487	0.6041	-3.63132	0.0075
PRICON	-0.90573	0.7812	-5.35548	0
GOVCON	-3.70157	0.0060	-3.17311	0.0257
GFCF	-0.42936	0.8978	-3.60846	0.0078
EXPORT	-0.98308	0.7549	-4.62356	0.0003
PRICE	-1.65322	0.4505	-6.89951	0
	PP t-statistic	p-value	PP t-statistic	p-value*
IMPORT	-1.24754	0.6496	-13.0163	0.0001
PRICON	-1.13659	0.6972	-5.32075	0
GOVCON	-4.54576	0.0004	-5.41789	0
GFCF	-0.28415	0.9214	-3.60846	0.0078
EXPORT	-0.80568	0.8115	-7.12707	0
PRICE	-1.80399	0.3759	-6.11412	0

*MacKinnon (1996) one-sided p-values.

Table 3. Cointegration Test

Null Hypothesis		Trace			Max-Eigen		
No. of CE(s)	Eigenvalue	Statistic	5% Critical Value	Prob.**	Statistic	5 % Critical Value	Prob.**
None*	0.73746	250.21510	95.75366	0	90.94010	40.07757	0
At most 1*	0.59831	159.27500	69.81889	0	62.02072	33.87687	0
At most 2*	0.48554	97.25428	47.85613	0	45.19557	27.58434	0.0001
At most 3*	0.43518	52.05872	29.79707	0	38.84453	21.13162	0.0001
At most 4	0.17533	13.21419	15.49471	0.1072	13.10856	14.26460	0.0755
At most 5	0.00155	0.10563	3.84147	0.7452	0.10563	3.84147	0.7452

Both Maximum-eigenvalue test and Trace test indicates 4 cointegrating equations at the 0.05 level.

* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) p-values.

Cointegrating Coefficients					
IMPORT	PRICON	GOVCON	GFCF	EXPORT	PRICE
-177.6188	-161.7095	178.4906	131.402	72.45478	50.39485
Normalized Cointegrating Coefficients (standard error in parentheses)					
IMPORT	PRICON	GOVCON	GFCF	EXPORT	PRICE
1	0.91043	-1.00491	-0.73980	-0.40792	-0.28372
	(0.27676)	(0.1085)	(0.08878)	(0.07584)	(0.11828)

Ⅲ. Empirical Findings

〈Table 2〉 displays the results of the ADF unit root tests at level and first difference series of each variable. The test results confirm that all series are stationary after first differencing.

As a result of VAR lag order selection criteria, optimal lag length was found to be six based on sequential modified LR test statistic, final prediction error (FPE), Akaike information criterion (AIC) and Hannan–Quinn information criteria. In order to implement the Johansen's cointegration test (Johansen (1988), the appropriate lag length is to be selected for the VAR. With the optimal lag length of six, results of the trace test are shown in 〈Table 3〉. These results appear to indicate that at most four cointegrating vectors to exist with regard to variables specified in the model. The maximum eigenvalue test, which is considered to be more powerful than the trace test (Johansen and Juselius, 1990), is also presented. According to the results of both the trace and the maximum eigenvalue tests, there appears to be at most four statistically significant cointegrating vector with regard to the variables specified in the model. This cointegrating vector is also shown in Table 3 with corresponding coefficient estimates, normalized on aggregate imports.

According to the above results, the long-run relationship among components specified in the model is represented in Equation 2 as follows:

$$\begin{aligned} IMPORT = & -0.91043 PRICON \\ & + 1.00491 GOVCON \\ & + 0.73980 GFCF \\ & + 0.40792 EXPORT \\ & + 0.28372 PRICE \end{aligned} \quad (2)$$

The estimated coefficients represent estimates of long-run partial elasticities of demand for imports. According to these results, demand for imports with respect to private consumption expenditure and government expenditure are both inelastic with a value of -0.91 and 1.00, approximately, for partial elasticity in either cases, implying that in the long run for each 1% increase in either of these two types of expenditure imports are likely to rise by -0.91 and 1.00 of one percent. Similarly partial elasticity of demand with respect to a change in exporting expenditure is found to be approximately 0.41, indicating to an inelastic demand for imports with respect to this category of final expenditure. Furthermore, the partial elasticity of demand for imports with respect to a relative price change is found to be only 0.28 which indicates to a highly inelastic nature of demand for imports with respect to relative prices. The sign of this coefficient is expected to be negative, according to economic theory, however, this estimate could indicate that imports are considered to be a type of Giffen goods (Spiegel, 1994), although it appears that imports are highly inelastic with respect to changes in relative price term. This result implies that exchange rate policies which design to impact trade via changes in relative prices might be ineffective policy tool in reducing demand for imports in the US in the long run.

With regard to the investment expenditure (measured by gross domestic fixed capital formation), according to the above results, elasticity of import with respect to this category of expenditure is found to be approximately 0.74, which implies a rise of 0.74 % in imports for every 1% rise in this category of expenditure. This is an anticipated result, as one expects this partial elasticity to be positive and similar in magnitude to other estimated coefficients of final expenditure. The estimated coefficients appear to indicate to the key role of private consumption expenditure and government expenditure as a key policy tool in reducing dependency on imports in the US in the long run. As more resources are allocated to private consumption expenditure, the result seems to suggest that imports decrease as a result of growth in domestic productive capacity of the economy while imports increase as government expenditure increases. Moreover, as imports appear to be price inelastic, increase in government expenditure seems to be most effective policy tool for reducing imports in the long run.

Ⅳ. Error Correction Forecasting Model

Since variables employed in our modeling framework are confirmed to be non-stationary series and co-integrated, this study can investigate the short-run behavior of the demand for imports via an error correction forecasting model (ECM). For this purpose, the lagged residual error derived from the cointegrating vector was incorporated into a general error correction model as follows (Engle and Granger, 1987):

Table 4. Vector Error Correction Estimates

Cointegrating Coefficients						
IMPORT(-1)	PRICON(-1)	GOVCON(-1)	GFCF(-1)	EXPORT(-1)	PRICE(-1)	C
1	0.91043	-1.00491	-0.73980	-0.40792	-0.28372	5.37276
	(0.27676)	(0.1085)	(0.08878)	(0.07584)	(0.11828)	
	[3.28960]	[-9.26205]	[-8.33332]	[-5.37898]	[-2.39874]	
Standard errors in ( ) & t-statistics in [ ]						
CointEq1	Δ(IMPORT(-1))	Δ(IMPORT(-2))	Δ(IMPORT(-3))	Δ(IMPORT(-4))	Δ(IMPORT(-5))	Δ(IMPORT(-6))
-0.750159	0.176631	-0.310831	-0.25652	0.600844	-0.188253	0.187
Δ(PRICON(-1))	Δ(PRICON(-2))	Δ(PRICON(-3))	Δ(PRICON(-4))	Δ(PRICON(-5))	Δ(PRICON(-6))	Δ(GOVCON(-1))
2.022881	0.061905	-0.339295	-2.065642	2.377791	2.013122	-0.310668
Δ(GOVCON(-2))	Δ(GOVCON(-3))	Δ(GOVCON(-4))	Δ(GOVCON(-5))	Δ(GOVCON(-6))	Δ(GFCF(-1))	Δ(GFCF(-2))
-1.430108	1.18362	-1.579368	0.385473	1.695382	0.233701	0.35734
Δ(GFCF(-3))	Δ(GFCF(-4))	Δ(GFCF(-5))	Δ(GFCF(-6))	Δ(EXPORT(-1))	Δ(EXPORT(-2))	Δ(EXPORT(-3))
0.237169	0.335068	-0.241453	-0.186224	0.999548	0.014893	0.145547
Δ(EXPORT(-4))	Δ(EXPORT(-5))	Δ(EXPORT(-6))	Δ(PRICE(-1))	Δ(PRICE(-2))	Δ(PRICE(-3))	Δ(PRICE(-4))
0.356607	-0.639208	0.112767	-0.272435	-0.157062	0.036834	-0.327009
Δ(PRICE(-5))	Δ(PRICE(-6))	C				
-0.338842	-0.452696	-0.051977				

$$\triangle IMPORT = \alpha_1 + \alpha_2 U_{t-1} + \sum_{i=1}^{n} \alpha_{3i} \triangle IMPORT_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \triangle PRICON_{t-i} + \sum_{i=1}^{n} \alpha_{5i} \triangle GOVCON_{t-i} + \sum_{i=1}^{n} \alpha_{6i} \triangle GFCF_{t-i} + \sum_{i=1}^{n} \alpha_{7i} \triangle EXPORT_{t-i} + \sum_{i=1}^{n} \alpha_{8i} \triangle PRICE_{t-i} + e_t \quad (3)$$

Where α_1 is the intercept, α_2 is the coefficient of the error correction term, α_3~ α_{8i} are the short-run coefficients of independent variables and e_t is the white noise error term. U_{t-1} is one period lag residual of the long-run model expressed as Equation 2, also known as the error correction term. Equation 3 represents that changes in the import demand are a function of the level of disequiribrium in the cointegrating relationship represented by the error correction term along with changes in independent variables. The U_{t-1} guides each variable to restore the equilibrium relation, i.e., to correct disequilibrium.

The coefficient α_2 measures at what rate it corrects the previous period disequilibrium of the system, i.e., the speed of the adjustment towards the long-run equilibrium relationship. This general model was estimated by using a specific methodology, and the results of the vector error correction estimation are shown in ⟨Table 4⟩. The appropriate number of lags was set as six periods in accordance with the Akaike information criterion (Akaike, 1978)

Table 5. Error Correction Model Estimates

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.750159	0.696711	-1.076715	0.2902
C(2)	0.176631	0.578069	0.305554	0.7621
C(3)	-0.310831	0.401161	-0.774829	0.4445
C(4)	-0.25652	0.393694	-0.651572	0.5196
C(5)	0.600844	0.383176	1.56806	0.1274
C(6)	-0.188253	0.406058	-0.463611	0.6463
C(7)	0.187	0.451126	0.414519	0.6814
C(8)	2.022881	1.851443	1.092597	0.2833
C(9)	0.061905	1.94939	0.031756	0.9749
C(10)	-0.339295	2.056334	-0.165	0.8701
C(11)	-2.065642	1.987493	-1.039321	0.307
C(12)	2.377791	2.408089	0.987418	0.3313
C(13)	2.013122	2.227094	0.903923	0.3732
C(14)	-0.310668	1.336227	-0.232496	0.8177
C(15)	-1.430108	1.199008	-1.192743	0.2423
C(16)	1.18362	1.27737	0.926607	0.3615
C(17)	-1.579368	1.601736	-0.986035	0.332
C(18)	0.385473	1.204711	0.319971	0.7512
C(19)	1.695382	1.286415	1.317912	0.1975
C(20)	0.233701	0.754709	0.309657	0.759
C(21)	0.35734	0.704591	0.50716	0.6158
C(22)	0.237169	0.72074	0.329063	0.7444
C(23)	0.335068	0.677316	0.4947	0.6244
C(24)	-0.241453	0.725811	-0.332666	0.7417
C(25)	-0.186224	0.595422	-0.31276	0.7566
C(26)	0.999548**	0.370615	2.696996	0.0114
C(27)	0.014893	0.454316	0.032781	0.9741
C(28)	0.145547	0.351648	0.413898	0.6819
C(29)	0.356607	0.386663	0.922268	0.3637
C(30)	-0.639208	0.452501	-1.41261	0.1681
C(31)	0.112767	0.414054	0.272349	0.7872
C(32)	-0.272435	0.410549	-0.663587	0.512
C(33)	-0.157062	0.303769	-0.517044	0.6089
C(34)	0.036834	0.377557	0.097559	0.9229
C(35)	-0.327009	0.338909	-0.964888	0.3423
C(36)	-0.338842	0.390687	-0.867298	0.3927
C(37)	-0.452696	0.39578	-1.143807	0.2617
C(38)	-0.051977	0.03334	-1.559007	0.1295

IMPT = C(1) + C(2)*Δ(IMPORT(-1)) + C(3)*Δ(IMPORT(-2)) + C(4)*Δ(IMPORT(-3)) + C(5)*Δ(IMPORT(-4)) + C(6)*Δ(IMPORT(-5)) + C(7)*Δ(IMPORT(-6)) + C(8)*Δ(PRICON(-1)) + C(9)*Δ(PRICON(-2)) + (10)*Δ(PRICON(-3)) + C(11)*Δ(PRICON(-4)) + C(12)*Δ(PRICON(-5)) + C(13)*Δ(PRICON(-6)) + C(14)*Δ(GOVCON(-1)) + (15)*Δ(GOVCON(-2)) + C(16)*Δ(GOVCON(-3)) + C(17)*Δ(GOVCON(-4)) + C(18)*Δ(GOVCON(-5)) + C(19)*Δ(GOVCON(-6)) + C(20)*Δ(GFCF(-1)) + C(21)*Δ(GFCF(-2)) + C(22)*Δ(GFCF(-3)) + C(23)*Δ(GFCF(-4)) + C(24)*Δ(GFCF(-5)) + C(25)*Δ(GFCF(-6)) + C(26)*Δ(EXPORT(-1)) + C(27)*Δ(EXPORT(-2)) + C(28)*Δ(EXPORT(-3)) + C(29)*Δ(EXPORT(-4)) + C(30)*Δ(EXPORT(-5)) + C(31)*Δ(EXPORT(-6)) + (32)*Δ(PRICE(-1)) + C(33)*Δ(PRICE(-2)) + C(34)*Δ(PRICE(-3)) + C(35)*Δ(PRICE(-4)) + C(36)*Δ(PRICE(-5)) + C(37)*Δ(PRICE(-6)) + C(38)*

*where = IMPORT(-1) + 0.91043*PRICON(-1) - 1.00491*GOVCON(-1) - 0.73980*GFCF(-1) - 0.40792*EXPORT(-1) - 0.28372*PRICE(-1) + 5.37276*

Note: *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

Table 6. Autocorrelation Test

Breusch-Godfrey Test			
F-statistic	0.575123	Prob. F(6,24)	0.7462
Obs*R-squared	8.548051	Prob. Chi-Square(6)	0.2006

Table 7. Heteroscedasticity Test

Breusch-Godfrey Test			
F-statistic	1.075348	Prob. F(42,25)	0.4322
Obs*R-squared	43.77126	Prob. Chi-Square(42)	0.3962

and Hannan-Quinn information criterion (Hannan and Quinn, 1979) etc. The top panel illustrates the results from the first step Johansen procedure. The bottom panel shows the coefficients of the error correction term, which is denoted CointEq1, and other independent variables estimated by Equation 3.

〈Table 5〉, in addition, reports the results of the significance test of each variable including its standard error and t-statistic. According to the test results, it is understood that there is no short-run causality running from private consumption, government spending, investment expenditure and relative import price to import demand while only exports have short-run impact. In order to measure goodness-of-fit of the model, the result of the F-test for the overall significance of the model is presented, which is assumed to be satisfactory. Based on the above results, the short-run behavior of the US aggregate imports is defined as a following simplified equation:

$$\triangle IMPORT_t = 0.9995\, EXPORT_{t-1} - 0.7502\, ECM \tag{4}$$

where the *ECM* is an error correction term. According to this short-run forecasting model, the current period changes in the demand for imports are related to the previous period changes in demand for exports and an ECM term. This result may be taken to imply that policies for exports could provide an effective policy tool for targeting a desired change in demand for imports in the short run.

〈Table 6〉 and 〈Table 7〉 illustrate the results of autocorrelation test and heteroscedasticity test, which suggest that the dynamic error correction model estimated in this study has neither serial correlation nor heteroscedasticity, as test results of Breusch-Godfrey test and Breusch-Pagan- Godfrey test for residuals shows that null hypothesis of no autocorrelation and no heteroskedasticity cannot be rejected as p value is 0.2006 and 0.3962, respectively.

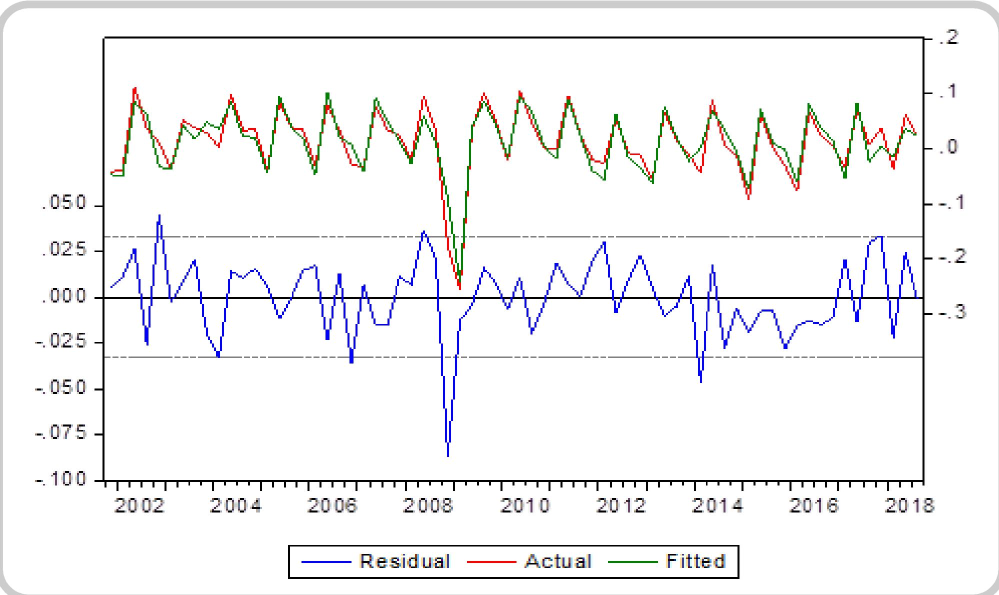
The result of the diagnostic tests is shown in 〈Fig. 1〉, which suggests that the short-run model appears to be well behaved with a white noise error term, confirming that the model tracks the data well.

Ⅴ. Conclusion

This study examined the import demand function in United States using the quarterly data for the period 2000 to 2018. In order to identify how each component of final expenditure has an impact on aggregate imports, final expenditure was disaggregated into private sector consumption expenditure, government spending, investment expenditure and expenditure on exports and tested for the existence of both the long-run and short-run relationship between demand for imports and variables specified in the import demand function in the biggest economy in the world by use of the multivariate co-integration analysis and the error correction forecasting model.

The results suggested that cointegration relationship exist among aggregate imports, final expenditure components and relative price of imports to imply variables used in this study explain the US import demand behavior in the long term. The findings also showed that there are significant differences among the long-run partial elasticities of imports with reference to different components of final expenditure. Particularly, while partial elasticities with respect to government expenditure, gross fixed capital formation, exports and relative price of import appear to be positive and inelastic, imports seems to respond negatively and significantly to changes in private consumption, indicating that an increase in private consumption could result in a significant reduction in demand for imports in the long term. Concerning the relative import prices, the results appeared to indicate a relatively substantial influence on the aggregate imports in the US in the long term. However, an error correction model designed for predicting the short-tern

Fig. 1. The Structure of Supply with Foreign Commercial Presence



variability shows that only exports have an effect on the imports in the short term.

These findings can provide some significant implications for policy makers in a nation in their pursuit to improve the country's trade balances with the US in the long term. Particularly, exchange rate policies that have a direct influence on import prices are found to have significant long-term effect on the US import demand, but no significant impact in the short term. Policies targeted to increase the final consumption expenditure by private sector could play a crucial role in reducing aggregate imports in the long term, leading to further enhancement in the balance of trade in the United States.

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