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2018

Online at https://mpra.ub.uni-muenchen.de/124028/
MPRA Paper No. 124028, posted 28 Mar 2025 09:33 UTC

EXPORT, IMPORT DEMAND IN MONGOLIA: IMCOME AND PRICE ELASTICITIES

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Abstract

This empirical research estimates the long-term price and income elasticities of Mongolia's foreign trade using ARDL model and time series of foreign trade, GDP, prices, export and import prices from 2002 to 2018. The research findings confirm a long-term relationship between export and import demand and relative prices and income. Although the estimated price elasticities are relatively weak, with the import price elasticity at -0.65 and export price elasticity at 0.5, the Marshal-Lerner condition holds in the long run. This implies that the depreciation (appreciation) of Mongolian togrog improves (worsens) the trade balance. Moreover, the income elasticity of imports (1.6) is significantly higher than that of exports (0.46), indicating that an increase in domestic demand leads to a deterioration of the trade balance.

Keywords: Export demand, import demand, trade elasticity, ARDL model

JEL code: F14

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1. Introduction

Estimating the trade elasticities of income and prices is crucial for multiple applications, including analyzing the impact of external shocks on the balance of payments, assessing the effects of foreign trade policies (such as exchange rate adjustments and tariffs), and understanding the influence of fiscal and monetary policies on foreign trade. Furthermore, trade elasticities serve as key inputs in macroeconomic forecasting models.

This study aims to estimate the medium- to long-term price and income elasticities of Mongolia's exports and imports and to determine whether the Marshall-Lerner condition holds for Mongolia. Given the country's persistent current account deficit, an empirical evaluation is necessary for policy analysis[1].

Few studies have examined this topic in Mongolia. and Munkhzul B. (2014) estimated the demand for imported goods by sub-groups and found a 1% depreciation of the exchange rate led to a 0.28% decline in total import demand. The exchange rate change affected the demand for imported consumer and construction materials but had no significant impact on other imports. Gan-Ochir D. (2018) used a VECM model to analyze the impact of the real exchange rate on Mongolia's trade balance and concluded that exchange rate depreciation improves the trade balance in both the short and long run. The Marshall-Lerner condition was found to hold in the long run, but there was no evidence of the J-curve effect in the short run. However, no study has simultaneously examined both export and import elasticities for Mongolia's economy and analyzed their overall effect.

Vojnovic and Unevska (2007) compared Macedonia's trade elasticities with those of other countries, finding that the income elasticity of imports typically does not exceed 2, while the price elasticity of imports in developing economies is usually below 1. They also observed that the income elasticity of exports relative to global GDP is approximately 1 for most countries, while the price elasticity of exports is less than 1. Similarly, Khan, Khan, and Zaman (2013) used the ARDL model to estimate Pakistan's export elasticities and found that foreign demand significantly affects exports, while the real exchange rate has a minimal impact. Nwogwugwu, Maduka, and Madichie (2017) estimated Nigeria's import demand elasticities using a restricted ARDL model and found that the price and income elasticities of import demand in Nigeria were estimated around 0.03 and 0.55 respectively.

2. Methodology

2.1 Theoretical Framework

The income and price elasticities of exports and imports are defined by the following demand equations.

Export demand equation:

$$\ln EX_t = \alpha_0 + \alpha_1 \ln Y_t^* + \alpha_2 \ln RPX_t + \varepsilon_t^X, \quad (1)$$

Import demand equation:

$$\ln IM_t = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln RPM_t + \varepsilon_t^M \quad (2)$$

where EX_t and IM_t are real export and import volumes, Y_t and Y_t^* represent foreign and domestic demand, RPX_t and RPM_t are relative price of exports and imports, respectively.

[1] The current account was in a deficit in 14 of the last 18 years.

In the equation, ε_t^X and ε_t^M are residuals of the demand equation for exports and imports, respectively. The coefficients α_1 and β_1 represent the income elasticities of exports and imports, while α_2 and β_2 represent the respective price elasticities. According to the Marshall-Lerner condition, if $|\alpha_2| + |\beta_2| > 1$, a depreciation of the national currency should improve the trade balance by making imports relatively more expensive and exports relatively cheaper.

2.2 Empirical Model

The estimation methodology follows a two-step approach. First, the ARDL model is estimated using its ECM version to determine short- and long-term relationships between variables:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p-1} \beta_i \Delta y_{t-i} + \sum_{j=1}^{p-1} \beta_j \Delta x_{t-j} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + e_t \quad (3)$$

where y_t and x_t are time series variables, e_t is the error term, and β and λ coefficients represent short- and long-term relationships, respectively. The model is estimated by selecting the optimal lag length to ensure an unbiased and efficient estimation without autocorrelation.

Second, the long-term relationship is tested using the ARDL bound test (Pesaran et al., 2001) and the restricted F-test (Nwogwugwu, Maduka, and Madichie, 2017). This approach determines whether a long-term cointegration relationship exists, regardless of whether the variables are stationary or non-stationary. The F-test evaluates the null hypothesis $H_0 = \lambda_1 = \lambda_2 = 0$ for both I(0) and I(1) cases, where the lower bound applies to I(0) and the upper bound to I(1). If the test statistics fall below the lower bound, no long-term relationship is present. If it lies between the bounds, the result is inconclusive. If it exceeds the upper bound, a long-term relationship is confirmed. When all variables in the estimation are I(1), the presence of cointegration is determined by the upper-bound F-test value.

3. Data

For the estimation of the export and import demand equations, data from Q2 2002 to Q2 2018[2], consisting of 65 observations for 10 time series, were used (Table 1)

Table 1. Summary of Data Used for Estimation and Their Descriptions

	Notation	Variable	Description	Source
1	EX	Real volume of goods exports	Export (million $)/Export price index	Customs of Mongolia, Bank of Mongolia
2	IM	Real volume of goods imports	Import (million $)/Import price index	Customs of Mongolia, Bank of Mongolia
3	GDP	Real GDP of Mongolia	Real GDP/ ₮/$ average exchange rate	NSO
4	RPX	China Industrial Product Index[3]	Index of China's industrial product growth, base 2000Q1=100	OECD statistics
5	RPM	Relative export price	Export price index/World commodity price index	Bank of Mongolia, FRED database
6	SENS	Relative import price	Import price index/Consumer price index	Bank of Mongolia, NSO
7	SENS_N	Real sensitive imports	Consumer and construction material imports (million $)/Their import price index	Customs of Mongolia, Bank of Mongolia

[2] Since the price index for sensitive and non-sensitive imports was available starting from 2007, the estimation was conducted for the period 2007–2018.
[3] Since Mongolia exports 92% of its total exports to China, it is considered a valid representation of external demand for exports.

8	RSIM	Real non-sensitive imports	Imports of machinery, petroleum products, and industrial inputs (million $)/Their import price index	Customs of Mongolia, Bank of Mongolia
9	RPX	Relative price of sensitive imports	Import price index of consumer and construction materials/Consumer price index	Bank of Mongolia, NSO
10	CIP	Relative price of non-sensitive imports	Import price index of machinery, petroleum products, and industrial inputs/CPI	Bank of Mongolia, NSO

All variables are seasonally adjusted and log-transformed, with the ADF test results showing they are first-order stationary series I(1) (*Table 1*).

4. Findings

4.1 Estimation of Import Elasticity

The import demand equation was estimated using the Akaike criterion for optimal lag length, resulting in the ARDL(1,4,0,0) model, defined as follows:

$$\Delta \ln IM_t = b_0 + b_{21}\Delta \ln RPM_t + b_{22}\Delta \ln RPM_{t-1} + \\ + b_{23}\Delta \ln RPM_{t-2} + b_{24}\Delta \ln RPM_{t-3} + (\lambda_1^m \ln IM_{t-1} + \\ \lambda_2^m \ln GDP_{t-1} + \lambda_3^m \ln RPM_{t-1} + \lambda_4^m OT_{t-1}^{fdi}) + \varepsilon_t^M \quad (4)$$

The long-term relationship in the equation above was tested using the F-test and found to be statistically significant, indicating that import volume is influenced by relative import prices and income in the long run (Table 1, p.3). Additionally, the model's residuals follow a normal distribution and exhibit no autocorrelation.

Table 2. Import Demand Equation: Long Run Relationship

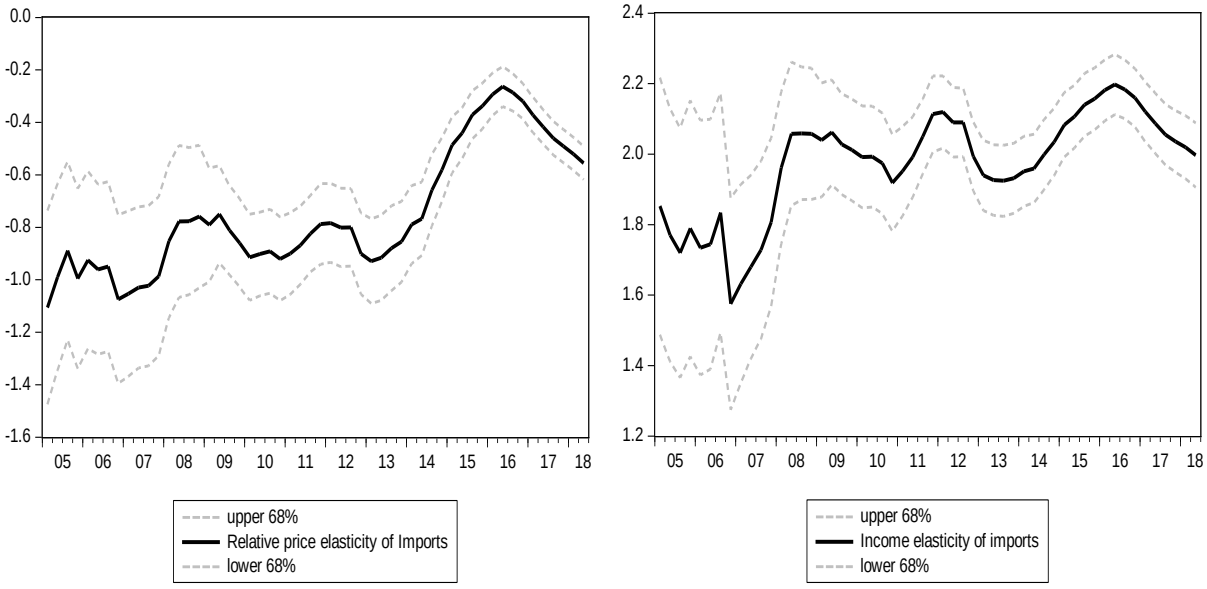
		1.ARDL(1,4,0)	2.ARDL(1,4,0,0)
1	Relative price of imports	-0.6503 (-4.76)***	-0.6482 (-5.77)***
2	Real GDP	1.7952 (8.66)***	1.5457 (-7.10)***
3	Dummy variable for OT investment		0.1885 (2.04)***

Note: ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

The results from the import demand equation (Table 2) indicate that the long-term elasticities of import demand with respect to domestic income and price are 1.80 and -0.65, respectively, both statistically significant at the 99% confidence level. The signs of these coefficients align with theoretical expectations. When dummy variables for the 2010–2014 and 2017–2018 periods, during which the Oyu Tolgoi construction occurred, are included, the income and price elasticities adjust to 1.55 and -0.65, respectively. The elasticity of imports concerning Oyu Tolgoi investment is estimated at 0.19. Specifically, a 1**% increase in domestic income leads to a 1.55% rise in import demand**, whereas **a 1% increase in the relative price of imports** (due to higher foreign prices or lower domestic prices) **results in a 0.65% decline in import demand**. These elasticity estimates for Mongolia are in line with those observed in other developing countries, as reported by Vojnovic and Unevska (2007). To assess the stability of these estimates over time, the sample size was extended quarterly, and a simple regression analysis was conducted (Figure 1). The income and price elasticities

remained relatively stable between 2008 and 2013. However, after 2013, price elasticity declined while income elasticity increased. Since 2016, price elasticity has slightly rebounded, whereas income elasticity has shown a minor decrease.

Figure 1. Income and price elasticities of imports, rolling estimation



Source: Authors' estimation

The above results *(income elasticity of 1.55–1.80)* indicate that Mongolia's import demand is strongly influenced by domestic demand, with income elasticity ranging from 1.55 to 1.80. As income increases, economic agents expand their consumption and investment, driving import growth. In 2018, due to the recovery of economic growth and the continued development of the Oyu Tolgoi underground mine, total imports surged by 38% in the first eight months compared to the same period the previous year. The majority of this growth (20 percentage points) was driven by imports of investment goods, diesel fuel, and construction materials, which contributed to expanding export capacity and strengthening the mining sector's production capabilities. Meanwhile, consumer imports accounted for 9 percentage points, and fuel imports contributed 4 percentage points, reflecting the overall rise in aggregate demand (Figure X.1).

The analysis of the import equation dynamics is presented in Table X.4. While relative import prices negatively affect imports in the long run, in the short run, changes in relative import prices (D(LRPM)) with lags of 1–3 quarters have a statistically significant positive effect on imports. The coefficient for the previous period's long-term relationship is 0.38, indicating that imports adjust slowly toward their long-term equilibrium. Specifically, 38% of the deviation from the long-term equilibrium in each quarter is corrected in the following quarter.

Although the price elasticity of imports is statistically significant, the estimated coefficient is below 1, indicating weak price responsiveness. This can be attributed to the fact that some essential goods, such as petroleum products, have no domestic substitutes and are consumed regardless of price changes. To verify this, following Munkhzul (2014), total imports were categorized into two groups: sensitive imports (including consumer and construction materials) and non-sensitive imports (including machinery, equipment, investment goods,

petroleum products, and industrial inputs). The price and income elasticities of each category were then estimated using the same methodology as above.

Table 3. Sensitive and Non-sensitive Import Demand: Long Run Relationship

		3. ARDL(4,1,0,2) 2018Q1-2018Q2	4.ARDL(3,0,0,1) 2007Q4-2018Q2
1	Relative price of sensitive imports	-0.6262 (-8.48)***	
2	Relative price of non-sensitive imports		-0.3802 (-4.54)***
3	Real GDP	0.9847 (5.57)***	0.5036 (1.75)*
4	Dummy variable for OT investment	0.2590 (4.73)***	0.4161 (5.00)***

Note: ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

The results indicate that the price elasticity of sensitive imports (-0.63) is higher than that of non-sensitive imports (-0.38) (Table X.8, Table X.9). However, both coefficients are below 1, suggesting weak price elasticity. Similarly, in terms of income elasticity, sensitive imports (0.98) exhibit a higher income elasticity than non-sensitive imports (0.50). However, as the estimation is based on a limited sample (2007–2018), it may not fully capture long-term relationships.

4.2 Estimation of Export Elasticity

When estimating the export demand equation based on the optimal lag selection using the Akaike criterion, the ARDL(1,3,0,2) model, which best explains the dynamics of the export time series, is specified as follows:

$$\Delta \ln EX_t = a_0 + a_{11}\Delta \ln RPX_t + a_{12}\Delta \ln RPX_{t-1} + a_{13}\Delta \ln RPX_{t-2} + a_{14}\Delta OT_t + a_{15}\Delta OT_{t-1} + (\lambda_1^x \ln EX_{t-1} + \lambda_2^x \ln CIP_{t-1} + \lambda_3^x \ln RPX_{t-1} + \lambda_4^x OT_{t-1}) + \varepsilon_t^X \quad (5)$$

The long-run relationship of the equation was tested using the F-test and found to be statistically significant (Table X.2). This result suggests that, in the long run, export volume is driven by the relative export price, foreign demand, and Oyu Tolgoi's production (Table 4). Additionally, the model's residuals are normally distributed and show no signs of autocorrelation.

Table 4. Export Demand Equation: Long Run Relationship

		ARDL(1,3,0,2)
1	Chinese industrial production index	0.4616 (0.12)***
2	Relative price of exports	-0.5029 (-0.20)**
3	Dummy variable for Oyu Tolgoi copper production	0.5522 (0.05)***

Note: ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

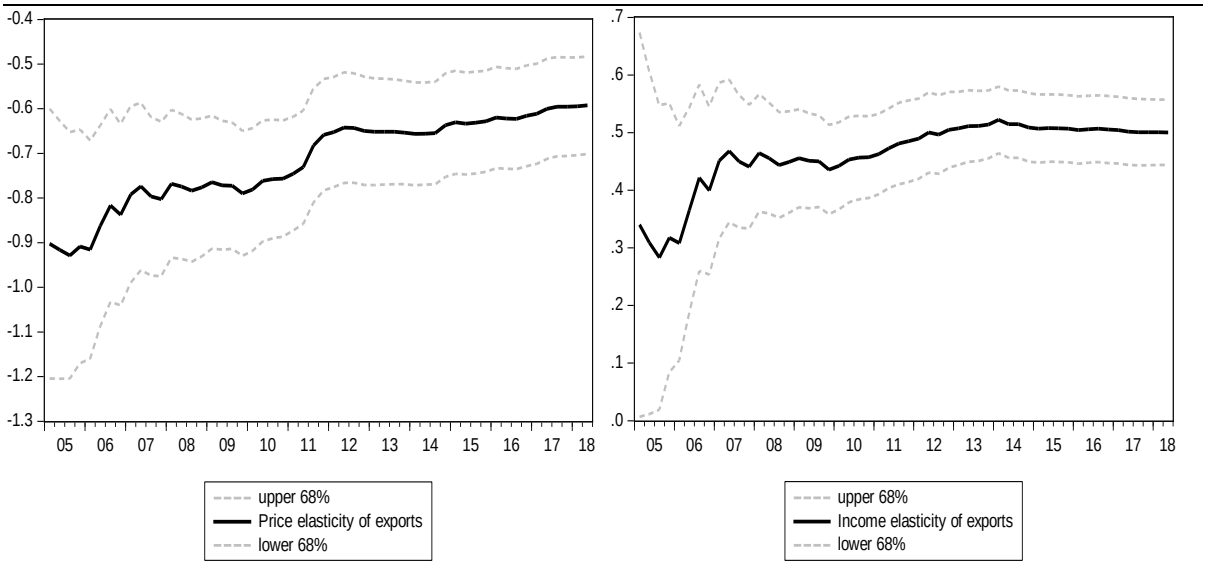
The results from the long-run relationship in the export demand equation (Table 4, X.6) indicate that the elasticity of export demand with respect to foreign demand and export price is 0.46 and -0.50, respectively, both statistically significant at the 95% confidence level. The coefficient signs align with theoretical expectations. Specifically, a **1% increase in China's industrial production leads to a 0.46% rise in Mongolia's export demand**. Likewise, a **1% decline in the relative export price** (due to a sharper drop in border prices compared to global prices or a smaller increase in border prices relative to global prices) **makes Mongolian exports more competitive, increasing export demand by 0.50%.**

Both the foreign demand and relative price elasticities of Mongolia's exports are below 1, indicating inelastic responses. However, the price elasticity is slightly stronger than that of foreign demand. The impact of Oyu Tolgoi's copper concentrate production, which began in 2014, was accounted for using a dummy variable. The coefficient for Oyu Tolgoi's production on total export volume is 0.55, indicating a structural positive shift in Mongolia's export levels following the company's commencement of copper production and exports. For example, in the first eight months of 2018, copper exports accounted for 28% of Mongolia's total exports, with Oyu Tolgoi contributing 60% of this amount, or approximately 17% of total exports (Figure X.2).

Mongolia's export price elasticity aligns with estimates for developing countries by Vojnovic and Unevska (2007). However, the income elasticity is relatively low at 0.46. This may be because foreign demand was represented solely by China's industrial production rather than global GDP, reflecting Mongolia's heavy reliance on a single export market.

To assess whether the estimated coefficients remained stable over time, a simple regression analysis was conducted by extending the sample size on a quarterly basis (Figure 3). The coefficients for export income and price elasticity exhibited an increasing trend until 2011 but have remained stable since then. This suggests that, compared to import income and price elasticities, export elasticities are more rigid, with reduced fluctuations over time.

Figure 3. Income and price elasticities of exports, rolling estimation*



Note: * In the rolling estimation, the impact of Oyu Tolgoi's production since 2014 was accounted for using a dummy variable.

Source: Authors' estimation

The dynamic analysis of the export equation is presented in Table X.7. In the short run, export volume fluctuates in response to changes in export prices over the previous three quarters and variations in Oyu Tolgoi's production, both of which are statistically significant. The coefficient for the previous period's long-run relationship is 0.84, also statistically significant, suggesting that exports adjust relatively quickly toward their long-run equilibrium. Specifically, 84% of any deviation from the long-run equilibrium in a given quarter is corrected in the following quarter, facilitating a rapid return to equilibrium.

5. Conclusion

This research estimates the long-term price and income elasticities of Mongolia's foreign trade using ARDL model and time series of foreign trade, GDP, prices, export and import prices from 2002 to 2018.

The empirical finding reveals that the price elasticity of imports is -0.6, while that of exports is -0.5. Since the absolute sum of these elasticities exceeds one, the Marshall-Lerner condition holds for Mongolia. This implies that a depreciation (appreciation) of the Mongolian togrog improves (worsens) the trade balance, reinforcing the role of exchange rate adjustments as a key policy tool for external stability.

Moreover, the income elasticity of imports (1.6) is substantially higher than that of exports (0.46), indicating that rising domestic demand tends to deteriorate Mongolia's trade balance. A closer examination of imports shows that price-sensitive imports exhibit greater elasticity compared to non-sensitive imports.

In terms of dynamics, exports adjust relatively quickly to their long-term equilibrium following short-term fluctuations, while imports take longer to stabilize. The coefficient of export elasticity remains stable throughout the sample period, whereas import elasticity displays greater variability over time.

Overall, Mongolia's foreign trade elasticities align with patterns observed in other developing economies, providing insights into the country's external trade dynamics and emphasizing the importance of exchange rate policies in managing trade imbalances.

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Appendix

Table X.1. Unit Root ADF Test

Notation	Variables	t-statistic	Stat.significance		Rank
LEX	Exports, real	-8.306004	1%	constant	I(1)
LIM	Imports, real	-9.413677	1%	constant	I(1)
LGDP	Real GDP	-8.351213	1%	constant	I(1)
LCIP	Chinese industrial production index	-3.292465	5%	constant	I(1)
LRPX	Relative export price	-9.551769	1%	constant	I(1)
LPX	Export price index	-7.390377	1%	constant	I(1)
LRPM	Relative import price	-9.469503	1%	constant	I(1)
LRSIM	Relative price of sensitive imports	-2.860432	10%	constant	I(1)
LRNSIM	Relative price of non-sensitive imports	-6.326611	1%	constant	I(1)
LSENS	Real sensitive imports	-8.105150	1%	constant	I(1)
LSENS_N	Real non-sensitive imports	-6.939190	1%	constant	I(1)

Table X.2. Import ARDL (1,4,0,0) Estimation: Cointegration Test

Null Hypothesis: No long-run relationship

Sample size 65

F-bound test $\lambda_1^m = \lambda_2^m = \lambda_3^m = \lambda_4^m = 0$

Test statistic	Value	Stat.significance	I(0)	I(1)
F-statistic	7.042	5%	2.976	3.896
K	2.00	1%	4.096	5.158

*Table X.3.*Import ARDL (1,4,0,0) Estimation: Long Run Relationship

Dependent Variable: LIM (log of real imports)

65 observations (2002Q2-2018Q2)

Variables	Coefficient	Std	t-statistic	Probability
LRPM	-0.648207	0.112387	-5.767636	0.0000
LGDP	1.545685	0.217640	7.102016	0.0000
OT	0.188460	0.092376	2.040142	0.0461
C	-4.550526	1.625310	-2.799789	0.0070

EC = LIM - (-0.6482*LRPM + 1.5457*LGDP+0.1885*OT - 4.5505)

*Table X.4.*Import ARDL (1,4,0,0) Estimation: Short Run Dynamics

ARDL(1, 4, 0,0) Error Correction Regression

Dependent Variable: DLIM (growth of real imports)

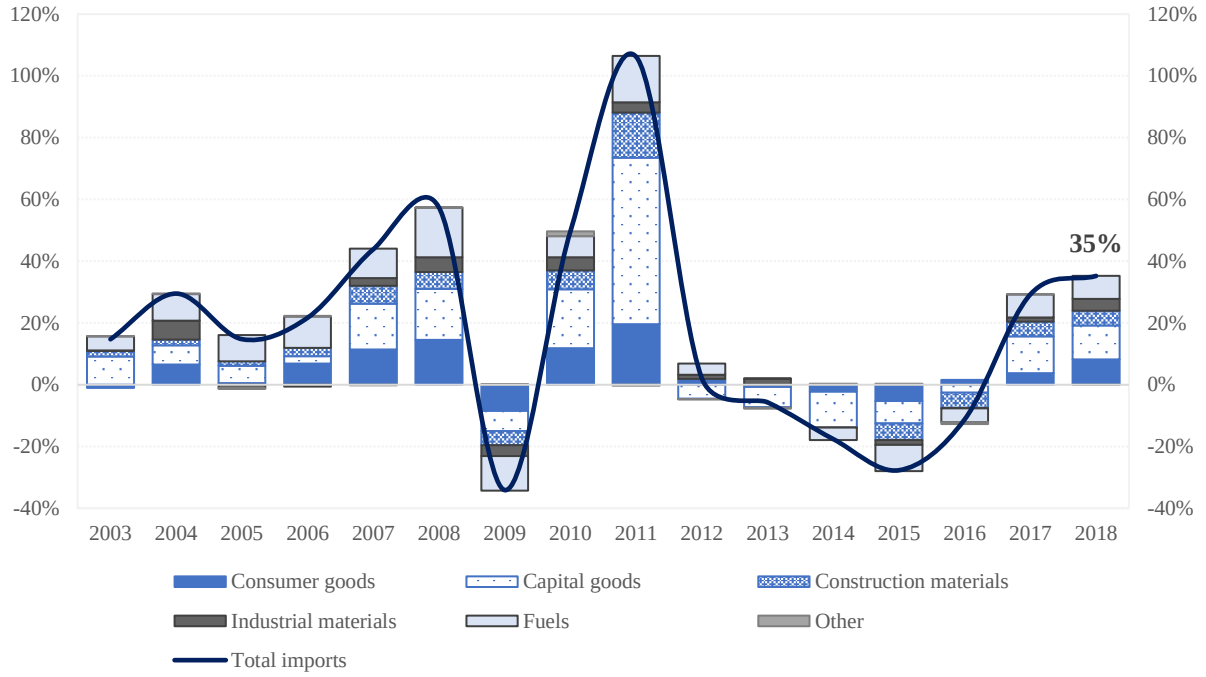
65 observations (2002Q2 2018Q2)

ECM Regression (Restricted Constant and No Trend)				
Variables	Coefficient	Std	t-statistic	Probability
D(LRPM)	-0.181913	0.187317	-0.971153	0.3356
D(LRPM(-1))	0.645547	0.185332	3.483198	0.0010
D(LRPM(-2))	0.443149	0.193790	2.286744	0.0260
D(LRPM(-3))	0.456232	0.192121	2.374714	0.0210
EC(-1)*	-0.380224	0.061904	-6.142113	0.0000

EC = LIM - (-0.6482*LRPM + 1.5457*LGDP+0.1885*OT - 4.5505)

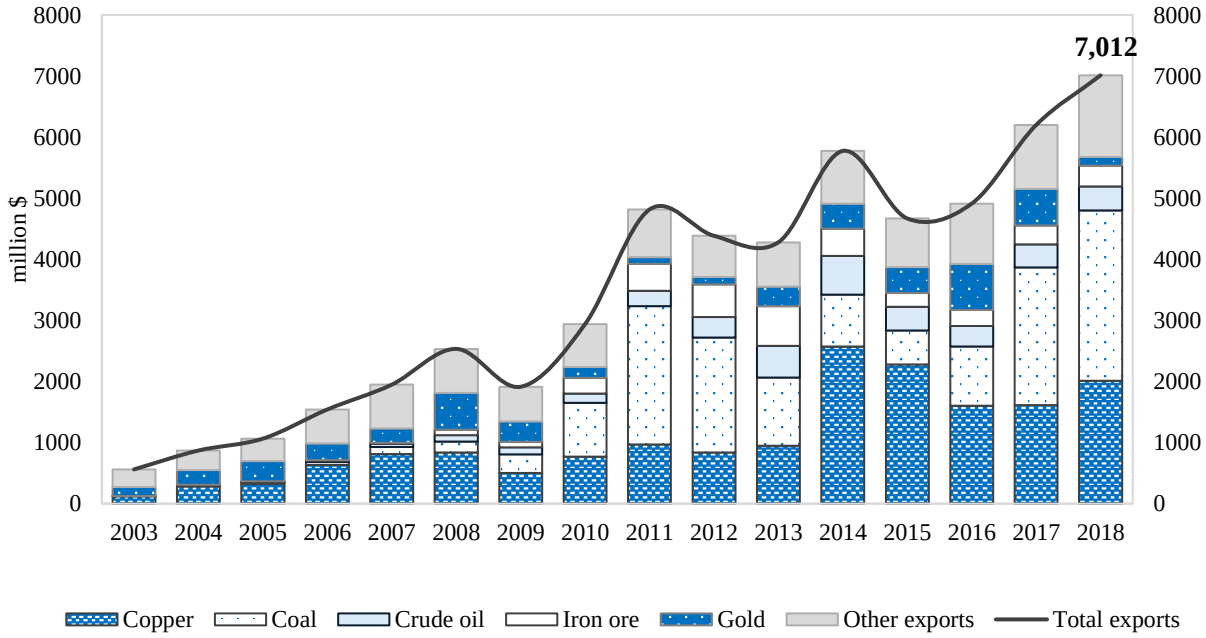
R-squared 0.9739

*Figure X.1.*Annual Growth of Imports, by components



Source: The Bank of Mongolia, The Customs of Mongolia

*Figure X.2.*Exports, by main commodities



Source: The Bank of Mongolia, The Customs of Mongolia

*Table X.5.*Export ARDL (1,3,0,2) Estimation: Cointegration Test

Null Hypothesis: No long-run relationship

Sample size 65

F-bound test $\lambda_1^x = \lambda_2^x = \lambda_3^x = \lambda_4^x = 0$

Test statistic	Value	Stat.significance	I(0)	I(1)
F-statistic	11.042	5%	2.976	3.896
k	2.00	1%	4.056	5.158

*Table X.6.*Export ARDL (1,3,0,2) Estimation: Long Run Relationship

Dependent Variable: LRX (log of real exports)

65 observations (2002Q2-2018Q2)

Variables	Coefficient	Std	t-statistic	Probability
LRPX	-0.502782	0.197019	-2.551952	0.0135
LCIP	0.461563	0.125773	3.669798	0.0005
OT_prod	0.552217	0.050819	10.86627	0.0000
C	6.047733	0.233630	25.88594	0.0000

EC = LRX - (-0.503*LRPX + 0.462*LCIP + 0.552*OT_PROD + 6.048)

*Table X.7.*Export ARDL (1,3,0,2) Estimation: Short Run Dynamics

Dependent Variable: DLRX (growth of real exports)

65 observations (2002Q2 2018Q2)

ECM Regression (Restricted Constant and No Trend)				
Variables	Coefficient	Std	t-statistic	Probability
D(LRPX)	-0.739362	0.120281	-6.146969	0.0000
D(LRPX(-1))	0.057508	0.123401	0.466023	0.6430
D(LRPX(-2))	-0.294723	0.118935	-2.478019	0.0163
D(OT_PROD)	0.165484	0.099605	1.661406	0.1023
D(OT_PROD(-1))	-0.297250	0.108964	-2.727963	0.0085
EC(-1)*	-0.838272	0.108927	-7.695741	0.0000

EC = LRX - (-0.503*LRPX + 0.462*LCIP + 0.552*OT_PROD + 6.048)

R-squared 0.655684

*Table X.8.*Sensitive Imports ARDL (1,4,0,2) Estimation

Dependent Variable: D(LRSIM) (growth of sensitive imports)

42 observations (2008Q1 2018Q2)

ECM Regression (Restricted Constant and No Trend)				
Variables	Coefficient	Std	t-statistic	Probability
D(LRSIM(-1))	0.315134	0.105657	2.982605	0.0055
D(LRSIM(-2))	0.259195	0.108840	2.381429	0.0236
D(LRSIM(-3))	0.170252	0.105433	1.614792	0.1165
D(LSENS)	-0.991998	0.318919	-3.110503	0.0040
D(OT)	0.041985	0.048828	0.859854	0.3965
D(OT(-1))	-0.120594	0.055875	-2.158284	0.0388
EC(-1)*	-0.780199	0.104819	-7.443260	0.0000

* p-value incompatible with t-Bounds distribution.

** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation (Restricted Constant and No Trend)				
Variables	Coefficient	Std	t-statistic	Probability
LSENS	-0.626250	0.073883	-8.476188	0.0000
LGDP	0.984663	0.176871	5.567126	0.0000
OT	0.258966	0.054777	4.727662	0.0000
C	1.533541	1.360729	1.127000	0.2684

EC = LRSIM - (-0.626*LSENS + 0.985*LGDP + 0.259*OT + 1.5335)
R-squared 0.9447

F-Bounds Test			Null Hypothesis: No levels relationship	
Test statistic	Value	Stat.significance	I(0)	I(1)
			n=40	
F-statistic	9.814090	10%	2.592	3.454
k	3	5%	3.1	4.088
		1%	4.31	5.544

Table X.9. Non-Sensitive Imports ARDL (3,0,0,1) Estimation

Dependent Variable: D(LRNSIM) (growth of non-sensitive imports)
42 observations (2007Q4 2018Q2)

ECM Regression (Restricted Constant and No Trend)				
Variables	Coefficient	Std	t-statistic	Probability
D(LRNSIM(-1))	0.212665	0.124809	1.703921	0.0973
D(LRNSIM(-2))	0.437910	0.131583	3.328015	0.0021
D(OT)	0.073085	0.060484	1.208329	0.2350
EC(-1)*	-0.543414	0.109244	-4.974333	0.0000

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation (Restricted Constant and No Trend)				
Variables	Coefficient	Std	t-statistic	Probability
LSENS_N	-0.380248	0.083775	-4.538939	0.0001
LGDP	0.503571	0.287716	1.750239	0.0888
OT	0.416096	0.083244	4.998527	0.0000
C	4.536403	2.137307	2.122485	0.0409

EC = LRNSIM - (-0.380*LSENS_N + 0.504*LGDP + 0.416*OT + 4.536)
R-squared 0.9058

F-Bounds тест			Null Hypothesis: No levels relationship	
Test statistic	Value	Stat.significance	I(0)	I(1)
			n=40	
F-statistic	4.441229	5%	3.1	4.088
k	3	1%	4.31	5.544