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MARSHALL-LERNER CONDITION ANALYSIS: TURKEY CASE

BİRGÜL CAMBAZOĞLU
cambirgul@yahoo.com
Adnan Menderes University
SEVCAN GÜNEŞ
sgunes@pau.edu.tr
Pamukkale University

ABSTRACT. Marshall-Lerner (ML) condition is a phenomenon that describes increase in net exports through depreciation of domestic currency. When the sum of export and import elasticities are greater than unity, the ML condition states that a deficit in the trade balance may be improved through currency depreciation at least in a long run. The aim of this study is to find whether the ML condition can be applied to Turkey. In this regard, price and income elasticities of export and import demands in Turkey and its most important bilateral trade partner Germany were studied for the period from January, 2010 to December, 2014. ARDL method was used to investigate a long-term co-integration relationship among the variables. Findings of this study support the applicability of the ML condition indicating that the sum of export and import price elasticities is higher than unity. The depreciation of domestic currency does indeed improve the trade balance of Turkey in a long run.
JEL codes: F1; F14

Keywords: Marshall-Lerner Condition; Turkey; ARDL (Bound Test)

1. Introduction

In formulating a commercial policy or an exchange rate policy, one of the major concerns of policy makers is the responsiveness of trade flows to relative price changes. For small open economies, it is a major concern whether devaluation or depreciation will have favorable effects on the trade balance or not. The Marshall-Lerner (ML) condition states that a deficit in the trade balance may be eliminated through currency depreciation, at least in a long-run provided that the absolute sum of the long-term export and import demand elasticities is greater than unity. Impacts of currency depreciation on trade balance are analyzed by considering both value and volume effects. Currency depreciation may cause import values to increase and export values to decrease in a short run. A country is expected to pay more for imports and to get less export revenue in a short run because trade contracts are signed prior to the depreciation. Both exporters and importers have to pay the price of goods and services in predetermined foreign prices. Therefore, there is partial pass-through from depreciation to prices. When there is a fall in the value of a domestic currency, a country is expected to pay more for its imports, and gets less export revenue in the short run. Price of foreign currency changes instantly but there is a time lag for goods and service-market prices before the change appears due to pre-existing contracts. As a cumulative effect, the trade balance deteriorates, and the value effect dominates. The deterioration of trade balance after the depreciation is explained through elasticities. The short-term income and price elasticities become smaller than the long-term elasticities. If the sum of the absolute values of the import and export demands relative to the price elasticity is greater than the unity in a long run, then the trade balance, as generally thought, will improve following the depreciation. The volume of export increases and volume of import decreases in a long run, therefore there would be an improvement in the trade. In this condition, the ML condition would be manifested as J-curve.

There are several studies concerning both long-term and short-term effects of currency devaluation on trade balance. A survey of available literature shows that short-run effects of currency devaluation are inconclusive. There are two separate empirical studies available to explain the effect of depreciation on trade balance. The first one investigated *J*-curve effect on devaluation. This indirect method estimates the dynamic reaction of the trade balance on a real domestic depreciation. If the trade balance eventually improves following depreciation, it is implicitly accepted that the ML condition is met. Bahmani-Oskooee and Ratha (2004) have published a comprehensive literature review on this topic.

The studies referred therein try to find changes in the trade balance by considering the income level and exchange rate variables of the concerned country. There is an implicit assumption that the total effect of depreciation fully pass through to export and import prices in a long run, while studying the emergence of J-curve after depreciation. However, in case of an imperfect competition, sellers may sacrifice their profit margin. This situation may prevent an improvement in trade balance. The studies implying J-curve use a trade balance equation given below:

$$TB = f(Y_h, Y_f, RER)$$

where TB, $Y_h Y_f$ and RER represent trade balance, home country income, foreign country income and real exchange rate, respectively.

The second line of the studies, henceforth, referred to as the elasticity method; involve a direct estimation of import and export demand prices and income elasticity. If the sum of absolute value of export and import price elasticities is higher than unity, it is considered that the ML condition is satisfied. Trade balance eventually improves after the depreciation. To test the existence of the ML condition, export and import demand functions need to be constructed separately at first as following:

$$Export\ Function{:}\ \ X = F(Y_{row}, P_{ex})$$
$$Import\ Function{:}\ M = [\![(Y]\!]_{h}, P_{im})$$

In the above functions, X, Y_{row}, P_{ex}, M, Y_h and P_{im} represent the variables: home country export volume, world income level, home country export price level, home country import volume, home country income level, and home country import price level, respectively.

The bulk of the empirical studies reviewed for this paper prefer using real exchange rate data instead of using export and import price independently. Elasticity as estimated in these empirical studies actually represents exchange rate elasticity of export and import or trade balance. As stated earlier, in case of partial or no impact of depreciation on export and import prices, there may not be any direct correlation between exchange rate and prices. In this context, export and import prices are used instead of exchange rate to calculate long-term price elasticity of export and import. Rose and Yellen (1989) stated that using aggregate data may result in “aggregation bias problem”. Compared to aggregate data, bilateral studies produce more supportive outcomes for long-term effects of currency devaluation on trade balance. Germany was the most important trade partner of Turkey during the period under study. Therefore, the trade pattern between Turkey and Germany is analyzed within the context of export and import price elasticities in this study.

This study aimed to investigate responsiveness of trade volume toward the change in relative prices. The remaining of this article is divided into following sections: Section II summarizes recent empirical studies; Section III describes variables and discusses empirical findings based on the model, and finally Section IV makes concluding remarks.

2. Literature Review

Bahmani-Oskooee and Niroomand (1998) were the first to estimate the long-term trade elasticity of almost 30 countries by employing Johansen and Juselius co-integration technique. They found that devaluation improves the trade balance. Bahmani-Oskooee and Kara (2003) investigated responsiveness of trade flows to a change in both relative prices and exchange rate for nine industrial countries for the period from 1973 to 1998. Their findings could not find that which of the variables (exchange rate or relative price level) has more effect on trade flows, because the effectiveness of a variable changes from one country another. Akal (2008) reported an increase in manufacturing good import demand for the period from 1982 to 2004 caused by a decrease in import prices.

Some studies used real exchange rate data to test price elasticity instead of relative price of export and import goods. Reinhart (1995) investigated price elasticity of export and import of 12 developing countries. His findings showed that elasticity tended to be less than unity. Pandey (2013) investigated factors affecting India's balance of trade account and concluded that the sum of export and import elasticities of exchange rate exceeds unity. Caporale et al. (2012) examined the MS condition for Kenya for the period of 1996 to 2011, and concluded that the relationship between balance of payments, real exchange rate and relative income satisfies ML condition in a long-run.

Şimşek and Kadılar (2005) studied a long-term relationship between export demand, income and relative prices for Turkey for the period from 1970 to 2002. Their findings validated the ML condition. The long-term income and relative price elasticities were found as 0.21 and −1.684, respectively. They also found price elasticity of import demand for Turkey for the same period as 0.68 (Şimşek and Kadılar, 2004). Aydın et al. (2007) observed a tendency of exchange rate elasticity for exports to decrease because the share of imported intermediate and inputs show increase in the production process of exports. Many studies based on Turkey state that the most important variable in the determination of export performance is the foreign demand and the strength of the effects of exchange rate movements due to both regional and sectoral differences (Berument et al., 2014; Uz, 2010; Dinçer and Kandil, 2011). Çulha and Kalafatçılar (2014) confirmed the aforementioned findings and their study found that while exchange rate elasticity of exports is higher in Middle East and Africa, demand elasticity of exports is considerably higher in advanced countries.

Doğanlar et al. (2015) investigated both short-term and long-term prices and income elasticities for Turkey and Germany from 1991 to 2004, and found that results support ML condition. Yavuz et al. (2010) tested the validity of ML condition for Turkey by analyzing the effect of real exchange rate on trade balance from 1988 to 2007. They found that the ML condition is not valid but J-curve effect does exist in concerned period. Bal and Demiralp (2012) investigated whether real exchange rate elasticity satisfies ML condition or not for Turkey by using bilateral trade data with Germany. The results supported the previous empirical findings and stated that ML condition is not valid in a short run but there is some evidence supporting J-curve effect in a long run. Türkay's (2014) is the most recent study in this field which investigated the existence of ML condition for Turkey from 1980 to 2012 by employing Johansen co-integration method. The study used domestic income, and relative export price variables in export demand function and the world income and relative import prices in import demand function. According to the results of the study, the ML condition is valid for Turkey. It is stated that although statistically insignificant relationship was found among the variables in a short run, the sum of export and import demand elasticities was higher than that in the long run.

3. Data and Methodology

3.1. Data selection

The aim of this study was to investigate whether the ML condition is observable in Turkey and its bilateral trade partner Germany from January, 2010 to December, 2014 by employing the Export and Import Models. The empirical estimation of the ML condition based on the study of Bahmani-Oskooe and Niroomand (1998) are shown in Equation 3.1 and 3.2. Existence of the ML condition is tested either with aggregate or bilateral trade balance data. While the former examines the relationship between exchange rate and trade performance for the home country with the rest of the world, the latter examines this relationship for the home country's trade performance with major trading partners individually.

Export Model:

$$\ln exq_t^{Tur} = \beta_0 + \beta_1 \ln\left(\frac{exp_t^{Tur}}{exp_t^{Ger}}\right) + \beta_2 \ln ipi_t^{Ger} + \varepsilon_t \qquad (3.1)$$

The variables and their symbols used in the Model I are: manufacturing export volume index of Turkey, "exq^{Tur}"; manufacturing export unit value index of Turkey, "exp^{Tur}"; export price level of Germany, "exp^{Ger}"; industrial production index of Germany, "ipi^{Ger}". "exp^{Ger}" and "ipi^{Ger}" are used to represent world export price level and world income, respectively.

Import Model:

$$\ln imq_t^{Tur} = \alpha_o + \alpha_1 \ln\left(\frac{imp_t^{Tur}}{cpi_t^{Tur}}\right) + \alpha_2 \ln ipi_t^{Tur} + \mu_t \qquad (3.2)$$

The variables and their symbols used in the Model II are: manufacturing import volume index of Turkey, "imq^{Tur}"; manufacturing import unit value index of Turkey, "imp^{Tur}"; consumer price index of Turkey, "cpi^{Tur}"; industrial production index of Turkey "ipi^{Tur}"."cpi^{Tur}" and "ipi^{Tur}" are used to represent domestic prices and domestic income levels, respectively.

The variables of these models were collected from the following databases: "ipi^{Tur} and "ipi^{Ger}" (the seasonally adjusted series, *2005=100* was converted to *2010=100* by the authors) series were takenfrom United Nations Economic Commission for Statistical Database. The series "imq^{Tur}", "imp^{Tur}, "cpi^{Tur}" (*2003=100* was converted to *2010=100* by the authors) and "exq^{Tur}", "exp^{Tur}" all series base year is equal to 100 on 2010.

Industrial Production Index for both Turkey and Germany can be used as a proxy variable to measure income because the size of domestic and foreign economies can also represent supply capacities of Turkey and Germany. Therefore, these industrial production indicators capture the effects of domestic and foreign output (Bal and Demiralp, 2012).

3.2. Methodological process

3.2.1. Preliminary tests

Before estimation, it is necessary to normalize all the variables for the sake of convenience. Firstly, all the variables were transformed into natural logarithms to obtain flexibility of variables. Secondly, since data used in this study include a monthly series, the variations due to seasonality were investigated; except for the variables ipi^{Tur} and ipi^{Ger} (the series are already seasonally adjusted). Thirdly, in order to avoid the potential problem of spurious relationships and incorrect inferences, all variables need to be stationary. Thereby, we can decide on the appropriate methods for model analysis. After searching stationarity, as shown in Table 1, we decided to use ARDL analysis (Auto Regressive Distributed Lags/Bound Test).

As stated in Table 1, for the Augmented Dickey-Fuller (ADF) test the stability levels of the variables for Model I and II are as follows: exq^{Tur} *I(I);* exp^{Tur}/exp^{Ger} *I(0);* ipi^{Ger} *I(0);* imq^{Tur} *I(0);* imp^{Tur}/cpi^{Tur} *I(I)* and ipi^{Tur} *I(I).* In addition to that, PP Test results are also given in Table 1 for Model I and II. The levels of variables are as follows respectively: exq^{Tur} *I(0);* exp^{Tur}/exp^{Ger} *(I);* ipi^{Ger} *I(0);* imq^{Tur} *I(0);* imp^{Tur}/cpi^{Tur} *I(I)* and ipi^{Tur} *I(0).* According to stationary test results of both ADF and PP Tests, all variables are stationary either in their level *I(0)* or *I(I).* So, ARDL method was chosen for this analysis. Furthermore, diagnostic test results support our conclusions.

Table 1 Results of Unit Root Tests (with constant)

Variables	ADF		PP	
	Level	1ST Difference	Level	1ST Difference
exq^{Tur}	−2.8051(1)	−4.4997 (10)	−3.8804 (3)	
exp^{Tur}/exp^{Ger}	−3.6618 (6)		−1.8721 (4)	−6.4965 (3)
ipi^{Ger}	−4.6044 (1)		−3.7457 (2)	
imq^{Tur}	−4.4721 (0)		−4.3723 (2)	
imp^{Tur}/cpi^{Tur}	−1.2079 (0)	−3.8246 (1)	0.9952 (2)	−6.9256(2)
ipi^{Tur}	−2.7919 (1)	−13.1891(0)	−3.2230(6)	

Note: The optimal lags of the variables are shown in parentheses at 5% level

3.2.2. ARDL test (bound test) process

Kremers et al. (1992) stated that if the observation period is limited and variables are stationary at level *I (I)*, it could be misleading to investigate co-integration relationship. In addition to that, Mah (2000) denoted that estimating Error Correction Model by employing co-integration technique of Johansen (1988) and Johansen and Juselius (1990) may not produce consistent results when sample is small (Şimşek and Kadılar, 2005). Therefore, we chose the ARDL Model. It can be applied to a small sample size such as the one used in this study. Turkey's export and import demand function for the concerned period included 60 observations. In this context, the bound test approach of Pesaran et al. (2001) was employed to find out long-run relationship between the variables. In addition to that, the ARDL methodology was freed from the burden of establishing the order of integration amongst the variables. The ARDL Test (Bound Test) methodology of Pesaran et al. (1999, 2001) provides several advantages to the researchers over conventional co-integration testing. According to this approach, even if a few time series are integrated in order *I (0)* or *I(1)*, a long-term relationship between the series can be investigated. It involves just a single-equation set-up, making it simple to implement and interpret. In addition to that, different variables can be assigned to different lag-lengths as they enter into the model (Giles, 2013).

ARDL analysis involves few steps to obtain long-term coefficients of the variables. The steps that are applied for the estimation of long-term coefficients of equations are based on the study of Şimşek and Kadılar (2005). First of all, appropriate lag structure for Model I (unrestricted intercept and no trend) and Model II (unrestricted intercept and no trend) was chosen according to Akaike Info Criterion (AIC). The minimum AIC level was reached at the sixth lag level for first equation and the third lag level for the second equation. Unrestricted Error Correction Model was estimated with OLS for Model I and II both, and estimation results are given in Table 2 and 3, respectively. The models satisfied the stability condition as seen in Graph 1. Moreover diagnostic tests for no auto-correlation, constant variance and normal distribution of errors are given in Table 4.

The ARDL (Bound Test, *k=6*) model was found as an appropriate model for export demand function among the alternatives. The equation and estimation results are written as (Equation 3.3):

$$exp^T \qquad (3.3)$$

Table 2 Model I-Unrestricted ECM-OLS Results

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	–0.430722	0.845974	–0.509144	0.6143
$\Delta(lnexq^{Tur}(-1))$	–0.363539	0.244604	–1.486235	0.1473
$\Delta(lnexq^{Tur}(-2))$	–0.355253	0.250942	–1.415677	0.1668
$\Delta(lnexq^{Tur}(-3))$	–0.415286	0.240338	–1.727927	0.0940
$\Delta(lnexq^{Tur}(-4))$	–0.288921	0.229459	–1.259142	0.2174
$\Delta(lnexq^{Tur}(-5))$	–0.157380	0.210821	–0.746509	0.4610
$\Delta(lnexq^{Tur}(-6))$	–0.106774	0.153584	–0.695217	0.4921
$\Delta(lnexp^{Tur}/exp^{Ger}(-1))$	1.125785	1.139453	0.988005	0.3308
$\Delta(lnexp^{Tur}/exp^{Ger}(-2))$	1.291519	0.992356	1.301467	0.2027
$\Delta(lnexp^{Tur}/exp^{Ger}(-3))$	0.554343	0.952986	0.581691	0.5650
$\Delta(lnexp^{Tur}/exp^{Ger}(-4))$	–0.828385	0.969226	–0.854687	0.3993
$\Delta(lnexp^{Tur}/exp^{Ger}(-5))$	1.144830	0.956326	1.197113	0.2403
$\Delta(lnexp^{Tur}/exp^{Ger}(-6))$	–0.148101	0.956285	–0.154871	0.8779
$\Delta(lnipi^{Ger}(-1))$	–0.025600	0.014588	–1.754907	0.0892
$\Delta(lnipi^{Ger}(-2))$	–0.018837	0.014372	–1.310647	0.1996
$\Delta(lnipi^{Ger}(-3))$	0.002601	0.012614	0.206227	0.8380
$\Delta(lnipi^{Ger}(-4))$	–0.007422	0.012112	–0.612772	0.5445
$\Delta(lnipi^{Ger}(-5))$	–0.011920	0.011989	–0.994249	0.3278
$\Delta(lnipi^{Ger}(-6))$	–0.025851	0.009644	–2.680450	0.0117
$lnexq^{Tur}(-1)$	–0.780002	0.247475	–3.151838*	0.0036
$lnexp^{Tur}/exp^{Ger}(-1)$	–2.088983	0.934093	–2.236377**	0.0327
$lnipi^{Ger}(-1)$	0.039967	0.011637	3.434433*	0.0017
R-squared	0.722708	Mean dependent var		0.005299
Adjusted R-squared	0.534865	S.D. dependent var		0.106012
S.E. of regression	0.072301	Akaike info criterion		–2.122078
Sum squared resid	0.162050	Schwarz criterion		–1.304221
Log likelihood	78.23508	Hannan-Quinn criter.		–1.807570
F-statistic	3.847408	Durbin-Watson stat		2.057279
Prob.(F-statistic)	0.000355			

Note: (*) and (**) indicate that the corresponding coefficient is significant at 5% and 2% levels, respectively.

ARDL (Bound Test, *k=3*) model was found as an appropriate model for import demand function among the alternatives. The equation and estimation results are given as (Equation 3.4):

imp^T

(3.4)

Table 3 Model II- Unrestricted ECM-OLS Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.126014	1.836030	0.068634	0.9456
$\Delta(lnimq^{Tur}(-1))$	0.060015	0.203493	0.294925	0.7695
$\Delta(lnimq^{Tur}(-2))$	0.094514	0.168746	0.560098	0.5783
$\Delta(lnimq^{Tur}(-3))$	0.168417	0.140854	1.195682	0.2384
$\Delta(lnimp^{Tur}/cpi^{Tur}(-1))$	0.299634	0.753760	0.397519	0.6930
$\Delta(lnimp^{Tur}/cpi^{Tur}(-2))$	1.062900	0.710365	1.496273	0.1419
$\Delta(lnimp^{Tur}/cpi^{Tur}(-3))$	1.664763	0.778994	2.137068	0.0383
$\Delta(lnipi^{Tur}(-1))$	–2.245365	0.856325	–2.622095	0.0120
$\Delta(lnipi^{Tur}(-2))$	–0.393900	0.975601	–0.403751	0.6884
$\Delta(lnipi^{Tur}(-3))$	0.129335	0.813049	0.159074	0.8744
$lnimq^{Tur}(-1)$	–0.877464	0.223378	–3.928159*	0.0003
$lnimp^{Tur}/cpi^{Tur}(-1)$	–0.157021	0.188759	–0.831860	0.4101
$lnipi^{Tur}(-1)$	0.860804	0.503583	1.709358***	0.0946

R-squared	0.521576	Mean dependent var	0.007449
Adjusted R-squared	0.388062	S.D. dependent var	0.106973
S.E. of regression	0.083681	Akaike info criterion	–1.923470
Sum squared resid	0.301110	Schwarz criterion	–1.453299
Log likelihood	66.85715	Hannan-Quinn criter.	–1.741185
F-statistic	3.906530	Durbin-Watson stat	1.928499
Prob.(F-statistic)	0.000456		

Note: (*), (**) and (***) indicate that the corresponding coefficient is significant at 1%, 5% and 10% levels, respectively.

Table 4 Residual Diagnostic Test Results

Diagnostic Tests	*P-Values**	
	Model I	Model II
Jarque-Bera Normality Test	*0.754*	*0.551*
Breusch-Godfrey Serial Correlation LM Test	*0.758*	*0.805*
Heteroskedasticity Test: ARCH	*0.092*	*0.117*

Note: * indicate that the corresponding coefficient is significant at 5% level.

Graph 1 CUSUM Test Results

Model I	Model II

Note: The corresponding coefficient is significant at %5 level.

To implement the Bounds testing procedure, we started with modeling of Equation (3.3) and (3.4) following Pesaran et al. (2001); two separate statistics were employed to 'Bounds test' to determine the existence of a long-term relationship. The calculated *F*-statistics was obtained by using unrestricted ARDL-ECM. Critical values of *F*-statistics were tabulated as described by Pesaran et al. (2001). If the calculated *F*-test exceeds the upper critical value, the null hypothesis of no co-integration can be rejected. The results in Table 5 show that calculated *F*-test statistics is higher than the upper critical value. According to Wald Test (*F*-statistics) results as shown in Table 5, a long-term co-integration relationship exists for Model I and II both.

Table 5 Results of Bound Test for Cointegration

Model	F-Statistic Calculated	Upper Bound Value*	Conclusion
Model I	4.580966	3.61	Co integration exists
Equation (3.3)	(0.0091)	(0.05)	
Model II	5.983807	4.35	Co integration exists
Equation (3.4)	(0.0017)	(0.05)	

Note: *Pesaran et al. (2001: 300). Table C1 (iii) Case III.

The next step is to find out long-term elasticity coefficients of export and import function. For this, lagged value of independent variable is multiplied with a negative sign and divided by lagged value of dependent variable (Şimşekve and Kadılar, 2005). The calculated long-term income and price elasticities and lagged value of error correction term of each equation are given in Table 6.

Table 6 Long-run coefficients of variables and error correction term for Model I and II

Variables	Coefficient	
	Model I	Model II
$lnexp^{Tur}/lnexp^{Ger}$	–2,678	
$lnipi^{Ger}$	0,051	
ec–1	–0.667	
$lnimp^{Tur}/cpi^{Tur}$		–0.179
$lnipi^{Tur}$		0.981
Ec'–1		–0.378

Subsequently, a long-term model was constructed for each model. Then the error correction term lagged value for each model was included as a variable in the ARDL Model. ECM was estimated to find out short-term relationship between the variables. Whether these variables are statistically significant or not was tested through Wald Tests. The test results showed that there is no statistically significant relationship between the variables in the short run. The theory states that the coefficient of lagged error correction term should carry a negative sign. This coefficient shows how fast an adjustment is achieved from the short-term values to long-term values. The findings of this study support the theory because the lagged value of error correction term of both the models is statistically significant and have a negative sign. In other words, Model I and II both adjust toward the long-term equilibrium at a speed of 66.7% and 37.8%, respectively.

4. Conclusion

Most of the countries in the world suffer from current account deficit. Export performance is one of the most important variables in open macroeconomics that can improve the trade balance. There are various ways for the countries to increase their national competitiveness such as through productivity improvement, innovation, product differentiation, marketing, etc. Beside these factors, the price of goods and services is usually the main factor in the determination of market share of goods in the international market. The easiest and fastest way to improve net exports is the depreciation or devaluation of the domestic currency against the trade partners. After a fall in the value of a currency, goods and services become relatively cheaper than the products of other countries, and, as a result, the exports increase. Countries may interfere with their foreign exchange market to keep the value of their domestic currency depreciated. This is called as the 'beggar thy neighbor' strategy. Whether an improvement in the trade balance through depreciation is achieved or not depends on the price and income elasticities of exports and imports. If export and import prices do not lead to a change in the demand, no improvement is achieved. In this context, this study tried to investigate whether the sum of export and import price elasticities of Turkey is higher than unity or not. The findings of this study support the idea that price elasticity of trade between Turkey and Germany is sufficiently high; and therefore depreciation is expected to improve the trade balance of Turkey at least in a long-run. Furthermore, our results indicate that the export prielasticity is higher than the import price elasticity. The production structure of Turkey overwhelmingly relies on imported inputs. Therefore, the imports tend to be less elastic than the exports.

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