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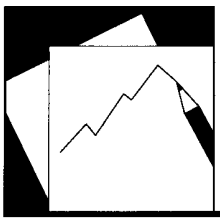

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Trade Elasticities in the Middle East and Central Asia: What is the Role of Oil?

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Trade Elasticities in the Middle East and Central Asia: What is the Role of Oil?

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Abstract

The analysis in this paper suggests that import and export volume elasticities are markedly lower in oil-exporting Middle East and Central Asian countries than in non-oil countries in the region. A key implication of this finding is that a real appreciation of the exchange rate in oil-exporting countries would achieve little in terms of expenditure switching: an appreciation does not boost imports and non-oil exports constitute only a small share of GDP and total trade in these countries. Therefore, while a real appreciation lowers the current account surplus of oil-exporting countries through valuation effects, the contribution to lowering global imbalances may be more limited.

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I. INTRODUCTION

The persistent rise in oil prices over the past few years has caused a major strengthening of the current accounts of Middle East and Central Asian oil-exporting countries. Countries that experience improvements in their terms of trade can typically sustain a more appreciated real exchange rate. A real appreciation, by boosting imports and holding back exports, can worsen the current account to the point that it offsets the effect of the initial terms-of-trade-related improvement in the current account. But the currencies of oil-exporting Middle East and Central Asian countries, which for the most part remained pegged to the U.S. dollar, have barely appreciated in real terms in the past few years, despite the improvement in their terms of trade due to oil-price increases.

This paper examines the potential role a substantial real appreciation of the currencies of oil-exporting countries in the Middle East and Central Asia, could play in moderating these countries' current account surpluses and, in the process, contribute to a narrowing of global imbalances. The existing empirical literature focuses mostly on the impact of exchange rate changes on either imports or exports (see e.g., Goldstein and Khan (1985) for a summary) rather than on the impact of exchange rate changes on overall trade or current account balances. A recent study analyzes the impact of nominal exchange rate changes on the trade balance, including in emerging market countries (IMF 2006b), but with limited coverage of Middle East and Central Asian countries.

The response of the trade balance to real exchange rate changes is examined for a panel of 27 Middle East and Central Asian countries for the period 1990–2006.[2] The sample includes 13 oil-exporting countries, six of which are members of the Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates), and 14 low-income and emerging-market countries. Similar to previous work by the IMF's Consultative Group on Exchange Rate Issues (CGER)[3] and IMF (2006b), the analysis in the paper makes a distinction between oil and non-oil exporters to allow for differences in the response of the trade balance to exchange rate movements that might arise from the different structure of exports in the two groups of countries. Two approaches are used to obtain estimates of the trade balance elasticities for the Middle East and Centra1 Asian countries:[4]

- The first approach follows the methodology used by the IMF's CGER to derive the trade balance elasticities with respect to the real effective exchange rate (REER). This essentially involves using (a) elasticities of import and export volumes with respect to the real exchange rate; and (b) the shares of imports and exports in GDP. The

[2] The trade balance is defined in the paper to cover trade in goods and nonfactor services.

[3] See IMF (2006a), which builds on earlier work by Isard and Faruqee (1998) and Isard and others (2001).

[4] An alternative approach to obtain the overall trade balance REER elasticities that is not explored in the paper is to estimate regressions of the overall trade balance to GDP ratios of individual countries on the REER.

calculation of the trade balance elasticities assumes that exchange rate changes are fully reflected in import prices; and export prices in local currency terms are unaffected by changes in the real exchange rate for non-oil exporting countries but exchange rate changes are fully reflected in export prices of oil-exporting countries.

- The second approach extends the previous methodology by making use of empirical estimates of the pass-through of real exchange rate changes to the relative import and export prices. This is important in view of the growing empirical evidence which suggests that there is incomplete exchange rate pass-through for many economies, including developing countries.[5] The degree of exchange rate pass-through also determines the strength of the "expenditure-switching" or "volume" effects from the exchange rate.

The remainder of this paper is organized as follows. Section II provides a brief overview of the derivation of the elasticity of the trade balance with respect to the REER following the CGER methodology. Section III.A discusses the specification of the trade equations and the empirical strategy. Section III.B presents the estimation results for the trade equations, and Section III.C discusses their implications for trade balance elasticities for the Middle East and Central Asian countries. Section IV presents an alternative, more generalized approach to estimating the trade balance elasticities that makes no assumptions regarding the exchange rate pass-through to relative import and export prices, discusses the estimation of the exchange rate pass-through relations, and presents the alternative trade balance elasticities. Section V concludes.

II. METHODOLOGY

This section derives the elasticity of the trade balance with respect to the REER following the approach taken by CGER and explains the underlying theoretical relations. The trade-balance-to-GDP ratio (TB/GDP) can be expressed in terms of prices and volumes of exports and imports:

$$TB/GDP = (P_X X/GDP) - (P_M M/GDP) \qquad (1)$$

where M and X are import and export volumes, and P_M and P_X are prices of imports and exports in local currency terms. Equation (1) can be rewritten as:

$$TB/GDP = p_x(X/Y) - p_m(M/Y) \qquad (2)$$

[5] See, for example, Goldberg and Knetter (1997), and Frankel, Parsley, and Wei (2005). A number of explanations have been put forward for incomplete exchange rate pass-through, including factors such as market segmentation (pricing to market), the presence of nominal rigidities and local currency pricing, and local distribution costs (see e.g. Choudhri, Faruqee, and Hakura, 2005).

where Y is real GDP, p_m and p_x are prices of imports and exports relative to the domestic price level (i.e. $p_m = P_M / P$ and $p_x = P_X / P$), and exports (X) are specified as a function of the relative price of exports in terms of foreign output (i.e. $p_x^f = p_x E$, where E, the real exchange rate, is defined as the domestic price level relative to the foreign price level expressed in the same currency units, with an increase denoting a real appreciation). Taking the total differential with respect to the real exchange rate, E, yields,

$$\begin{aligned}\partial(TB/GDP)/\partial E = {} & (\partial X/\partial E)(p_x/Y) \\ & + (\partial p_x/\partial E)(X/Y) \\ & - (\partial M/\partial E)(p_m/Y) \\ & - (\partial p_m/\partial E)(M/Y)\end{aligned}$$

This equation suggests that the response of the trade balance to changes in the exchange rate (i.e. the sign of $\partial(TB/GDP)/\partial E$) depends on the structure of a country's exports. It is typically assumed that exporters of manufactured goods face a downward sloping demand curve in foreign markets. It follows that a real depreciation will produce a fall in the export price (foreign currency terms), thereby facilitating an increase in market share while simultaneously eliciting no change in the local currency price of exports, $\partial p_x / \partial E = 0$.
For countries which mainly export oil and/or other commodities, the demand for their exports is likely to be fully elastic at given world prices, implying that a real depreciation will not change export prices in foreign currency terms.

The Case of Non-Oil Exporting Countries

For the low-income and emerging market countries in the Middle East and Central Asia, it is assumed that exports are priced in local currency, so that export prices do not respond to the exchange rate ($\partial p_x / \partial E = 0$). It is also assumed that imports are priced in foreign currency, so that they are unit elastic with respect to the real exchange rate ($\partial p_m / \partial E = -p_m / E$).
Applying these assumptions to the total differential of the trade balance to GDP with respect to the real exchange rate, gives:

$$\partial(TB/GDP)/(\partial E/E) = \eta_X (p_x X/Y) - (\eta_M - 1)(p_m M/Y)$$

or

$$\partial(TB/GDP)/(\partial E/E) = \eta_X (P_X X/GDP) - (\eta_M - 1)(P_M M/GDP) \qquad (3)$$

where $\eta_X = (\partial X/\partial E)(E/X)$ and $\eta_M = (\partial M/\partial E)(E/M)$ and $\eta_X < 0$ and $\eta_M > 0$.
The elasticities, η_X and η_M, are interpreted as export volume demand and import volume demand responses to a change in the real exchange rate, respectively. For non-oil exporting

countries or exporters of manufacturing products, which typically face a downward-sloping demand curve, a real appreciation will, for a given local currency price of exports, raise the foreign currency price and reduce the demand for exports. A real appreciation lowers the local currency price of imports and raises the demand for imports.

Starting from a situation of balanced trade, it follows that a depreciation leads to an improvement in the trade balance provided that: $|\eta_X| + |\eta_M| > 1$. This is the familiar Marshall-Lerner condition. While the situation of balanced trade provides a useful benchmark, it is clear from equation (3) that for given values of the export and import volume elasticities (η_X and η_M), the impact of a real exchange rate change on the trade balance will depend on the initial trade position (the ratios of exports and imports to GDP). In this case, even if $|\eta_X| + |\eta_M| > 1$, a depreciation can lead to a worsening of the trade balance if $S_X < \frac{(\eta_M - 1)}{\eta_X} S_M$ and $|\eta_M| < 1$ and $|\eta_X| < 1$.

The Case of Oil Exporters

In line with earlier research (see e.g. IMF 2006b), it is assumed that the oil-exporting Middle East and Central Asian countries face an infinitely elastic demand for their exports at given international prices. In this case, relative export prices will respond with unitary elasticity to the real exchange rate ($\partial p_x / \partial E = -p_x / E$), yielding the following expression for the elasticity of the trade balance to GDP ratio with respect to the real exchange rate:

$$\partial(TB/GDP)/(\partial E/E) = (\eta_X - 1)(P_X X/GDP) - (\eta_M - 1)(P_M M/GDP) \qquad (4)$$

where $\eta_X < 0$ and $\eta_M > 0$. In this case, the elasticity of export volumes, η_X, should now be interpreted as a supply elasticity and not a demand elasticity, since the price paid by purchasers of exports is fixed in foreign currency terms and there is no constraint on demand. So for example, in the case of an oil exporter, the assumptions made here imply that a real depreciation has no effect on demand, but provides an incentive to boost supply as it raises the domestic currency price of exports. Assuming initial trade balance, the trade balance will improve with a real depreciation if $|\eta_X| + |\eta_M| > 0$.

III. Empirical Analysis of Middle East and Central Asian Countries Elasticities

This section describes the specification of the import demand and export demand (in the case of oil-exporting countries: oil export supply) equations and the estimation strategy used to obtain the trade volume elasticities. The estimated trade volume elasticities are then substituted into the relevant expression for the elasticity of the trade balance to the REER to arrive at the country-specific elasticities of the trade balance.

A. Model Specification and Empirical Strategy

The specification of the trade volume equations follows closely the specification used in IMF (2006b), as well as in earlier research (e.g. Senhadji, 1997, and Senhadji and Montenegro, 1998). In line with the existing work, relative import and export prices are used as proxies for the real exchange rate. Therefore, import volumes are related to relative import prices and export volumes are related to relative export prices.[6, 7]

Import volume equation

The theoretical relationship that is being estimated is that the demand for imports is negatively related to the relative price of imports and positively related to economic activity or aggregate demand. Accordingly, the demand for imports is specified as a function of (a) the relative price of imports, defined as the ratio of the log of the import price deflator divided by the CPI; and (b) real domestic demand constructed as the log of real GDP minus net exports. An important innovation compared to previous work, including IMF (2006b), is that the response of import demand to changes in the relative price variable is allowed to differ by country group; oil-exporting countries versus low-income and emerging market countries in the Middle East and Central Asia. This is important to be able to capture the impact of the more limited scope for import substitution in the oil-exporting countries in response to changes in the real exchange rate due to their narrow productive bases. Given that these countries only produce oil and non-tradables, a real appreciation (i) induces little substitution of imported tradables for domestic non-tradables (housing and cars are complements more than substitutes) and (ii) does not induce withdrawal of factors of production from domestic import-competing industries because there are none, and hence would not be expected to affect import demand to the same degree as other countries.

Total export volume equation

The specification of the export volume equations is in line with the relevant country group specifications in IMF (2006b):

- As noted earlier in the paper, it is assumed that the demand for oil is perfectly elastic at the world price, i.e. that the Middle East and Central Asia oil exporting countries are price takers, and, therefore, that the theoretical relationship that is being estimated

[6] Prima facie, it would seem more straightforward to relate changes in import and export volumes directly to changes in the REER. In fact, this is the approach followed by CGER which applies estimation results from Isard and Faruqee (1998) based on MULTIMOD. However, this paper does not follow this approach because it fails to yield robust direct estimates of the REER elasticities for the sample of Middle East and Central Asia countries.

[7] There is not always a one to one relation between real exchange rate changes and relative prices (see the discussion in Section IV).

is the exporters' supply response. The export supply equation is specified as a function of (a) the price of oil in local currency divided by the CPI (as a measure of the relative price of exports); (b) foreign income measured as the real GDP of partner countries weighted by their share in total exports;[8] (iii) the output gap measured as the log difference between actual and trend output; and (iv) the scope for expanding production through improvements in productivity, proxied by the change in GDP per capita in PPP terms. Given the price taking assumption, a real depreciation will increase the domestic currency price of exports relative to nontradables—proxied by the CPI—and could increase the supply of exports. However, this effect is likely to be limited reflecting OPEC production quotas and nearly binding capacity constraints. The foreign income variable captures increases in foreign demand and is expected to elicit a positive export supply response. The output gap and the scope for expanding production through improvements in productivity variables are included to capture that the supply response depends on resource availability. The former is expected to be negatively related to the relative export price and the latter is expected to be positively related.

- The Middle East and Central Asian low-income and emerging market countries are not main exporters of other primary (non-oil) commodities. Therefore, the specification of the export equation for this group of countries follows the one for exporters of manufactures in IMF (2006b). The volume of exports is specified as a function of (a) the relative price of exports defined as the export price deflator divided by the trade-weighted average of the (domestic currency equivalent) of unit labor costs in the country's trading partners; and (b) foreign income measured as the output of partner countries weighted by their share in the exports of the exporting country. It is assumed that for exporters of manufactured products, the export demand function is captured by the estimation. An increase in the price of exports relative to the foreign currency price will reduce the demand for exports.

Non-oil export volume equation

A non-oil export volume equation is also estimated to leave open the possibility that not all exports of oil-exporting countries are oil and that some countries classified in the group of low-income and emerging market countries export some oil. The non-oil export volume equation is expected to be (a) negatively related to the relative price of non-oil exports defined as the non-oil export price deflator divided by the trade-weighted average of the (domestic currency equivalent) of unit labor costs in the country's trading partners; and

[8] While the assumption that the price of oil is set in international markets implies that foreign demand should only affect market price, the latter is included in the export volume equation to capture the possibility that the oil exporters face a downward sloping demand curve, in which case demand may not be fully reflected in the price and the output of partner countries could have an effect on the export supply response (see IMF (2006b)).

(b) positively related to foreign income measured as the output of partner countries weighted by their share in the exports of the exporting country.

Empirical estimation of trade equations

The import demand and export volume equations are estimated using the Generalized-Method-of-Moments (GMM) dynamic panel estimator developed by Arellano and Bond.[9] The panel consists of 27 countries in the Middle East and Central Asia (13 oil exporters and 14 low-income and emerging-market countries, see Table A3) for the period 1990–2006. Data sources and variable definitions are provided in Appendix 1.
The Arellano and Bond GMM dynamic system estimator used here avoids potential issues related to nonstationarity of the data because the number of cross section units (27 countries) is large relative to the number of time periods (16 annual observations). Interaction terms are included in the estimations on the full panel to allow the impact of the relative price variables and other key variables on import volumes and export volumes to vary by country group. The GMM system estimator controls for the potential endogeneity of the relative import and export price variables by using their lagged values as instruments. Real domestic demand is also instrumented in the import demand function by lags of the real exchange rate and disposable income.

B. Estimation Results

Import volume equation

The estimates of the short-run (-0.46) and long-run (-0.66) price elasticities of import demand for emerging market and low-income Middle East and Central Asian countries are negative and statistically significant (see Table 1).[10] They are also in the same range as those found in other studies (see the survey table in IMF(2006b)). By contrast, the short-run (0.29) and long-run price (-0.09) elasticities of import demand for oil exporters are statistically insignificant. And the long-run price elasticities of import demand are significantly different between the two country groupings. As expected, real domestic demand has a positive and significant long run effect on import demand.

[9] See Arellano and Bond (1991) and Blundell and Bond (1998).

[10] This implies that a 1 percent increase in the local-currency price of imports relative to non-tradables reduces the volume of imports by 0.66 percent in the long run.

Table 1. Volume of Imports: Coefficient Estimates and Implied Elasticities

	Coefficient estimates	Long-run elasticities
Import volume		
First lag	0.53 ***	
Relative price for import demand 1/		
Oil exporters		
Contemporaneous	0.29	-0.09
First lag	-0.34	
Emerging markets and low income countries		
Contemporaneous	-0.46 ***	-0.66 ***
First lag	0.15	
Real domestic demand		
Contemporaneous	0.05	0.84 ***
First lag	0.35	
Diagnostic Statistics		
Number of observations	425	
Number of countries	27	
Maximum number of observations per country	16	
Tests		
Hansen test	19.1	
A-B test for AR(1)	-1.9 *	
A-B test for AR(2)	0.4	
Number of instruments	34	

Source: IMF staff estimates.

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Estimation with intercepts. Sample 1990–2006. The long-run price elasticities are significantly different across the two country groups.

1/ Using CPI as the deflator.

Export volume equation

The estimates of the short-run (-0.39) and long-run (-0.47) price elasticities of export demand for emerging market and low-income Middle East and Central Asian countries are negative and statistically significant (see Table 2). They are also in the same range as those found in other studies (see the survey table in IMF (2006b)). The long-run price elasticity for oil exporters is positive and low in magnitude which is consistent with a supply response. However, the statistical insignificance of the coefficient indicates that the supply of oil is relatively inelastic to price changes. The responses of export volumes to foreign income is positive and larger in the long run than in the short run for the two country groups, but only significant for the emerging market and low-income countries. The income elasticity of supply for the group of oil-exporting countries is significant at the 12 percent level only.

Table 2. Export Volumes: Coefficient Estimates and Implied Elasticities

	Oil exporters (supply)		Emerging market and low-income exporters (demand)	
	Coefficient estimates	Long-run elasticities	Coefficient estimates	Long-run elasticities
Volume				
First lag	0.62 ***		0.62 ***	
Relative price 1/				
Contemporaneous	-0.06	0.13	-0.39 ***	-0.47 **
First lag	0.11		0.20	
Income effects 2/				
Contemporaneous	0.19	1.18	1.37 **	1.69 *
First lag	0.26		-0.73	
Change in per capita GDP (PPP terms)				
Contemporaneous	0.86			
First lag	0.25			
Output gap				
First lag	-0.07			
Diagnostic statistics				
Number of observations	432			
Number of countries	27			
Tests (all country groups are estimated jointly)				
Hansen test	16.55			
A-B test for AR(1)	-2.55 **			
A-B test for AR(2)	0.57			

Source: IMF staff estimates.

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Estimation with intercept.

1/ World oil price divided by CPI for oil exporters; and export deflator divided by the ULC of trading partners for manufacturing exporters. For oil exporters the relative price is a 3-year moving average.
2/ Real GDP of trading partners for all export equations.

Non-oil export volume equation

As expected, the short (-0.61) and long-run (-0.67) price elasticities of non-oil exports are negative and significant (Table 3).[11] The short-run and long-run elasticities are larger than the price elasticities of total exports for emerging market and low income countries reported in Table 2. This may reflect possible biases caused by the inclusion of oil exports in total exports in the case of low-income and emerging market economies. The response of non-oil exports to foreign demand is large in both the short and long runs for both country groups. For the oil exporters, the long-run elasticity of non-oil exports to foreign demand is larger than the long-run elasticity of total exports (i.e. including oil).

[11] The relative non-oil export price variables are restricted to be the same for the two country groups since an estimation distinguishing between the oil and non-oil exporting countries suggests no significant difference in the price response of non-oil exports.

Table 3. Non-Oil Export Volumes: Coefficient Estimates and Implied Elasticities

	Oil exporters		Emerging market and low-income exporters (demand)	
	Coefficient estimates	Long-run elasticities	Coefficient estimates	Long-run elasticities
Volume				
First lag	0.62 ***		0.62 ***	
Relative price 1/				
Contemporaneous	-0.61 ***	-0.67 ***	-0.61 ***	-0.67 ***
First lag	0.35 ***		0.35 ***	
Income effects 2/				
Contemporaneous	2.34 ***	2.54 ***	0.83 ***	1.44 **
First lag	-1.36 ***		-0.28	
Diagnostic statistics				
Number of observations	392			
Number of countries	27			
Tests (all country groups are estimated jointly)				
Hansen test	20.20			
A-B test for AR(1)	-2.62 ***			
A-B test for AR(2)	-0.9			

Source: IMF staff estimates.

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Estimation with intercept. The price elasticity is restricted to be the same across the two groups.

1/ Non-oil export deflator divided by the ULC of trading partners.
2/ Real GDP of trading partners for all export equations.

Robustness of estimation results

The estimated elasticities of trade volume with respect to relative prices are fairly robust to alternative empirical specifications, including an additional lag dependent variable and using GDP instead of real domestic demand in the import volume regression. The estimated elasticities are also robust to dropping one country at a time from the sample.

C. Trade Balances

This section derives the trade balance elasticities to the REER (equations (3) and (4)) by applying the relevant estimated volume elasticities for the two groups of countries discussed in the previous section. Two key issues need to be noted. First, the non-oil export volume elasticity is used in the calculations for the group of low-income and emerging market countries because of the suspected downward bias of the total export volume elasticity, Second, for the group of oil-exporting countries, the exchange rate elasticities of the non-oil trade balance and the overall trade balance are calculated.

For the group of emerging market and low-income Middle East and Central Asian countries, the estimated elasticities imply that a 10 percent real depreciation is associated with a 1.2 percent of GDP trade balance improvement (Table 4). This assumes balanced trade (i.e. import of goods and services equal to exports of goods and service) and exports (and imports) equivalent to 35 percent of GDP. These results are broadly in line with the findings for developing countries reported by CGER but somewhat lower than their result for advanced countries.[12] The CGER studies find that a 10 percent real depreciation is associated with a 2.2 percent of GDP improvement in the trade balance for the advanced countries. The breakdown in Table 4 illustrates that the adjustment in the trade balance is driven by the increase in the value of exports, as the value of imports actually increases, with a price effect outweighing the volume effect.

Table 4. Decomposition of the Impact of a 10 Percent Real Depreciation on the Trade Balance of Middle East and Central Asia Countries

(Changes in percent) 1/

	Exports			Imports			Trade balance-to-GDP ratio 2/
	Price	Volume	Value	Price	Volume	Value	
Non-oil exporter	0.0	6.7	6.7	10.0	-6.6	3.4	1.2
Oil exporter	10.0	0.0	10.0	10.0	0.0	10.0	0.0
Memorandum items:							
CGER estimates for advanced countries	0.0	7.1	7.1	10.0	-9.2	0.8	2.2

Source: IMF staff estimates.

1/ The numbers are to be interpreted as follows. For a country such as Egypt with an export-to-GDP ratio of 0.31 and an import-to-GDP of 0.36, a 10 percent real depreciation will increase the value of exports by 2.1 percent of GDP (6.7*.31) and will also increase the value of imports by 1.2 percent of GDP (3.4*0.36). As a result, the trade balance will improve by 0.8 percent of GDP.

2/ Assumes a trade balance in equilibrium, exports equivalent to 35 percent of GDP, and non-oil exports equal to zero for the oil exporters.

The trade balance improves with a real depreciation for nearly all non-oil exporting Middle East and Central Asian countries (Table 5). Using trade data for 2006, a 10 percent real depreciation leads to an improvement in the trade balance by about 0.9 percent of GDP on average for those countries, with numbers varying from 0.2 percent of GDP for Armenia, Pakistan, and Sudan, to 1.6 percent of GDP for Mauritania, Tunisia, and Uzbekistan. As implied by equation (3), the larger the trade deficit, the smaller the overall trade balance elasticity, reflecting that relatively higher imports cause a larger offsetting impact from higher import prices. Given the estimated elasticities of imports and exports with respect to relative prices of 0.66 and -0.67 respectively, the condition that governs whether a real exchange rate depreciation (appreciation) will improve (deteriorate) the trade balance is $S_X > 0.5S_M$. The larger the initial trade deficit, the less likely that this condition will be fulfilled.

[12] As reported in Chapter 5 of Isard and Faruqee (1998).

Table 5. Trade Balance Elasticities for Non-Oil Exporting Middle East and Central Asia Countries, 2006 and 2013 1/

	2006		Proj. 2013		CGER-type elasticities 2/		Alternative elasticities 3/	
	Imports	Exports	Imports	Exports	2006	Proj. 2013	2006	Proj. 2013
Afghanistan	1.05	0.27	0.51	0.18	0.17	0.05	0.02	-0.03
Armenia	0.40	0.24	0.30	0.14	-0.02	0.01	-0.11	-0.05
Djibouti	0.62	0.41	0.60	0.45	-0.06	-0.10	-0.20	-0.24
Egypt	0.36	0.31	0.36	0.29	-0.08	-0.07	-0.18	-0.16
Georgia	0.57	0.33	0.38	0.24	-0.03	-0.04	-0.15	-0.12
Jordan	0.94	0.58	0.89	0.61	-0.07	-0.10	-0.27	-0.31
Kyrgyz Republic	0.80	0.49	0.75	0.53	-0.06	-0.10	-0.23	-0.27
Lebanon	0.70	0.58	0.80	0.68	-0.15	-0.18	-0.33	-0.39
Mauritania	0.58	0.54	0.42	0.50	-0.16	-0.19	-0.32	-0.32
Morocco	0.39	0.33	0.47	0.39	-0.09	-0.10	-0.19	-0.22
Pakistan	0.26	0.16	0.22	0.14	-0.02	-0.02	-0.07	-0.07
Sudan	0.27	0.17	0.17	0.14	-0.02	-0.04	-0.08	-0.08
Tajikistan	0.58	0.23	0.50	0.16	0.04	0.06	-0.06	-0.01
Tunisia	0.52	0.51	0.66	0.64	-0.16	-0.20	-0.31	-0.39
Uzbekistan	0.26	0.38	0.28	0.30	-0.16	-0.11	-0.26	-0.19
Yemen	0.41	0.41	0.23	0.17	-0.14	-0.03	-0.26	-0.09

Sources: IMF, *World Economic Outlook* and *Balance of Payments* databases; and Fund staff calculations.

1/ Aghanistan is included in this table but not in the estimations of the volume and prices elasticities.
2/ The following long-run elasticities are used in calculating the trade balance elasticites under the CGER approach: import volume elasticity 0.66; and export volume elasticity: -0.67. It is assumed that exchange rate changes are fully passed through into import prices and foreign currency-denominated export prices.
3/ The following estimated long-run elasticities are used in calculating the trade balance elasticities: relative import price elasticity = -0.71; relative nonoil export price elasticity = 0.42; import volume elasticity 0.66; nonoil export volume elasticity: -0.67.

For the group of oil-exporting Middle East and Central Asian countries, equation (4) in conjunction with the very limited response of import demand and (oil) export supply reported in Section B, imply that the trade balance elasticities for oil exporting countries are approximately equal to the share of imports in GDP minus the share of exports in GDP.[13] Therefore, while a country with balanced trade will have a zero trade balance elasticity, the more unbalanced trade is, i.e. the larger the share of exports compared to the share of imports, the larger the positive impact a real depreciation will have on the trade balance to GDP ratio.[14] The change in the trade balance to GDP ratios of oil exporting countries induced by an exchange rate change will only be driven by price effects. An exchange rate appreciation in an oil exporting country with a large trade surplus does not boost imports or increase oil exports (and non-oil exports constitute a small share of GDP), but results in a reduction in the current account to GDP ratio as the fall in the local currency price of exports will contribute more to reduce the trade surplus than the positive contribution from the decline in the local currency price of imports since exports constitute a larger share of GDP.[15]

For most of the oil-exporting countries in the sample the trade balance shows very large surpluses in recent years. Accordingly, a 10 percent real depreciation would improve the trade balance by 2.1 percent of GDP, on average, ranging from 5.9 percent of GDP for Libya to 0.3 percent of GDP for Kazakhstan (see Table 6). Since the trade surpluses are projected to narrow in nearly all the oil-exporting countries over the medium term, the estimated trade balance elasticities would also decline from an average of 2.1 percent in 2006 to 1 percent in 2013.[16]

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[13] Applying the empirical estimates of η_X and η_M equal to zero, reduces the trade balance to GDP elasticity to:

$$\partial(TB/GDP)/(\partial RER/RER) = -(P_X X/GDP) + (P_M M/GDP)$$

There is also an additional effect from non-oil exports that is not shown here.

[14] If the share of imports in GDP is larger than the share of exports in GDP, a real depreciation will worsen the trade balance to GDP ratio.

[15] The idea here is that the export to GDP ratio is larger than the import to GDP ratio and both import and export prices are set in foreign currency. Therefore, when the exchange rate appreciates, oil export and import volumes do not change, but the fall in the local currency price of exports will have a larger effect than the fall in the local currency price of imports since exports constitute a larger share of GDP.

[16] It can be argued that the oil-exporting Middle East and Central Asia countries, particularly the GCC countries and other OPEC members, have pricing power in the oil market. However, even if we were to assume that oil exporters have market power, the implied trade balance relation would suggest that a real appreciation of the domestic currency could have a positive effect on the trade balance or a smaller negative effect than is suggested by the estimates in Table 6 to the extent that the demand for oil is inelastic.

Table 6. Trade Balance Elasticities for Middle East and Central Asia Oil Exporters, 2006 and 2013 1/

	Share of GDP					CGER-type elasticities 2/				Alternative elasticities 3/			
	2006			Proj. 2013		Non-oil trade balance		Overall trade balance		Non-oil trade balance		Trade balance	
	Imports	Exports	Oil exports	Imports	Exports	2006	Proj. 2013	2006	Proj. 2013	2006	Proj. 2013	2006	Proj. 2013
Algeria	0.22	0.50	0.47	0.33	0.40	0.20	0.32	-0.27	-0.06	0.19	0.31	-0.27	-0.06
Azerbaijan	0.39	0.67	0.58	0.35	0.36	0.33	0.32	-0.25	0.01	0.31	0.31	-0.27	0.00
Bahrain	0.71	0.97	0.58	0.40	0.50	0.45	0.25	-0.13	-0.03	0.37	0.20	-0.21	-0.07
Iran	0.28	0.37	0.28	0.23	0.21	0.22	0.19	-0.06	0.04	0.21	0.17	-0.08	0.02
Iraq	0.53	0.58	0.56	0.43	0.64	0.51	0.43	-0.05	-0.20	0.51	0.43	-0.05	-0.21
Kazakhstan	0.41	0.51	0.29	0.29	0.37	0.26	0.20	-0.03	-0.04	0.21	0.18	-0.08	-0.06
Kuwait	0.25	0.67	0.56	0.41	0.52	0.18	0.34	-0.38	-0.07	0.16	0.32	-0.40	-0.09
Libya	0.20	0.81	0.77	0.38	0.83	0.17	0.35	-0.59	-0.43	0.17	0.34	-0.60	-0.44
Oman	0.38	0.63	0.49	0.42	0.52	0.29	0.30	-0.20	-0.03	0.26	0.26	-0.23	-0.07
Qatar	0.40	0.74	0.59	0.45	0.75	0.31	0.35	-0.28	-0.26	0.28	0.32	-0.31	-0.29
Saudi Arabia	0.33	0.62	0.54	0.45	0.56	0.27	0.39	-0.27	-0.08	0.26	0.37	-0.28	-0.10
Syria	0.43	0.36	0.12	0.44	0.34	0.27	0.26	0.15	0.19	0.22	0.21	0.11	0.14
Turkmenistan	0.16	0.34	0.13	0.35	0.60	0.02	0.01	-0.11	-0.09	-0.02	-0.09	-0.15	-0.18
U.A.E.	0.68	0.91	0.43	0.62	0.77	0.35	0.33	-0.08	0.00	0.26	0.24	-0.17	-0.08

Sources: IMF, *World Economic Outlook* and *Balance of Payments* databases; and Fund staff calculations.

1/ Iraq is included in this table but excluded in the estimations of the volume and prices elasticities.
2/ The following long-run elasticities are used in calculating the (non-oil) trade balance elasticites under the CGER approach: export volume (supply) elasticity for oil = 0; import volume elasticity = 0; nonoil export volume elasticity = -0.67. It is assumed that exchange rate changes are fully passed through into import prices and domestic-currency-denominated oil export prices, and there is no pass through to domestic-currency-denominated non-oil export prices.
3/ The following estimated long-run elasticities are used in calculating the (non-oil) trade balance elasticites: relative nonoil export price elasticity = 0.42; export volume (supply) elasticity for oil = 0; import volume elasticity = 0; export volume elasticity for nonoil goods = -0.67. It is assumed that exchange rate changes are fully passed through into import prices and domestic-currency-denominated oil export prices.

A 10 percent real depreciation is associated with a 2.7 percent of GDP non-oil trade balance *deterioration*. This assumes non-oil exports equal to 8 percent of GDP, oil exports equal to 54 percent of GDP and imports equal 33 percent of GDP (Saudi Arabia in 2006). This prima facie counterintuitive result can be explained by the small share of non-oil exports (about 10 percent of GDP on average in the oil exporting Middle East and Central Asian countries) causing the losses from the higher import prices to outweigh the gain from the increase in the value of non-oil exports with a real depreciation.

IV. A Generalized Approach

The CGER-type analysis in the previous section hinges on implicit assumptions regarding the exchange rate pass-through to import and export prices. This section discusses a generalization of the CGER equation that accounts explicitly for these relative price elasticities, and shows that the need for the generalized formula arises from the fact that CGER's pass through assumptions are not supported by the data for non-oil exporting countries in the Middle East and Central Asia.

A. Generalized CGER Methodology

While this section focuses on the elasticity of the trade balance to the REER for the case of non-oil exporters, the complete derivation of the equation for the non-oil and oil exporting countries is provided in Appendix II. The equation for oil exporters is not discussed here as the empirical estimates of the elasticities of import and export prices with respect to the REER do not reject the CGER pass through assumptions (full pass through to import prices and domestic-currency denominated export prices) for the oil-exporting economies in the Middle East and Central Asia, implying that the generalized equation collapses into CGER's equation (4) in Section II.

As before, non-oil exporters are assumed to face a downward sloping demand curve which is a function of the relative price of exports in terms of foreign output:

$$X = X(p_x^f) \text{ where } \partial X / \partial p_x^f < 0$$

The trade balance to GDP ratio is expressed in terms of prices and volumes of exports and imports:

$$TB / GDP = (P_X X / GDP) - (P_M M / GDP)$$

or

$$TB / GDP = p_x (X / Y) - p_m (M / Y) \qquad (5)$$

Taking the total derivative of equation (5) with respect to the real exchange rate, E, and decomposing the elasticity of the import (export) volume with respect to the REER into the elasticity of the import (export) volume with respect to relative import price (relative export

prices) and the elasticity of relative import (export) price with respect to the REER, μ_M (μ_X), yields the following expression for the response of the trade balance-to-GDP ratio to a percentage change in the real exchange rate:

$$\frac{\partial(TB/GDP)}{\partial E/E} = (-1+\mu_X)S_X + (\mu_X\eta_X)S_X - \mu_M S_M + (\mu_M\eta_M)S_M \qquad (6)$$

where

$$S_X = \frac{P_X X}{GDP}$$
$$S_M = \frac{P_M M}{GDP}$$
$$\mu_X = \frac{\partial p_x^f / p_x^f}{\partial E/E}$$
$$\mu_M = \frac{\partial p_m / p_m}{\partial E/E}$$
$$\eta_M = \frac{\partial M/M}{\partial p_m / p_m}$$
$$\eta_X = \frac{\partial X/X}{\partial p_x^f / p_x^f}$$

and $\eta_X < 0$ and $\eta_M > 0$.[17] *A priori,* one would expect:

- μ_X to be positive reflecting the fact that a real depreciation would be associated with a decrease in the foreign currency price of exports. Moreover, contrary to CGER, one could expect $\mu_X < 1$ as a real depreciation could be associated with an increase in the price of exports relative to domestic prices of goods (in other words, there could be some response of the local currency price of exports to a real depreciation, e.g. if there is some degree of price taking in international markets); and

- μ_M to be negative reflecting the fact that a real depreciation would be associated with an increase in the price of imports relative to domestic goods prices.

[17] The complete derivation of equation (6) is shown in Appendix II. From equation (5), it is clear that the relative prices of imports and exports are defined in terms of ratios to the GDP deflator ($\frac{P_M}{P}$ and $\frac{P_X}{P}$ where P is the GDP deflator). However, the empirical analysis in this paper defines the relative prices of imports and exports in terms of ratios to the CPI or world price. Application of the relative price elasticities defined as such in equation (6), therefore, impose the assumption that the elasticities of the relative prices to the exchange rate are similar to the elasticities of $\frac{P_X}{P}$ or $\frac{P_M}{P}$ to the exchange rate.

Adopting the CGER assumptions of $\mu_X = 1$ and $\mu_M = -1$, reduces the formula to the CGER formula for non-oil exporters in the previous section. Equation (6) for the elasticity of the trade balance-to-GDP ratio vis-à-vis the RER is amenable to an easy interpretation:

- The first term ($(-1 + \mu_X)S_X$) represents a price effect, which captures the positive effect on the trade balance from the increase in the local currency price of exports associated with a real depreciation assuming $0 \leq \mu_X < 1$;

- The second term represents a volume (or expenditure-switching) effect, which captures the positive effect on the trade balance of the increase in the volume of exports as their relative price vis-à-vis the price of foreign output falls with a real depreciation;

- The third term represents a price effect, which captures the negative impact on the trade balance from the increase in the price of imports relative to domestic prices of goods associated with a real depreciation; and

- The last term represents a volume (or expenditure-switching) effect, which captures the positive impact on the trade balance of the decrease in the volume of imports associated with a real depreciation.

Thus, as a result of a real depreciation, the trade balance improves as a result of the increase in the volume of exports, the decline in the volume of imports, and the increase in the relative price of exports relative to domestic prices of goods. Some of these positive effects will be offset by the increase in the relative price of imports. Starting from balanced trade, the condition for the trade balance to improve as a result of a real depreciation is given by:

$$\mu_X(1+\eta_X) + \mu_M(\eta_M - 1) < 1 .^{18}$$

B. Empirical Estimation of the Elasticities of the Relative Import and Export Prices to the Real Exchange Rate

The responsiveness of relative import and export prices to changes in the REER are estimated using the mean-group (MG) estimator developed by Pesaran and Smith (1995).[19] This estimator is valid for estimating nonstationary dynamic panels where the number of countries and time periods are both large. The MG estimator involves estimating separate autoregressive distributive lag models parameterized as an error-correction equation for each

[18] The estimates derived in the paper are consistent with this condition: 0.42*(1-0.67)-0.71*(0.66-1)=0.38.

[19] REERs based on consumer price indices are obtained from the IMF's *Information Notice System* for each country in the study where the data is available.

country, where dependent and independent variables enter the right-hand side. The MG estimator then derives the full panel estimates as simple averages of individual country coefficients. The number of lags used to obtain the MG estimates is set to a maximum of 1. The relative import price regressions include real GDP as an additional explanatory variable to capture domestic demand conditions. The estimations are conducted separately for the oil exporting countries and the low-income and emerging market countries in the Middle East and Central Asia, thereby allowing the relative price elasticities with respect to the REER to vary between the two groups of countries. The estimation period is 1990–2006 where the data is available for each country in the sample.

The assumption used by CGER that exchange rate changes are fully passed through to import prices ($\mu_M = -1$) is not rejected for the oil-exporting countries, but is rejected for the low-income and emerging market countries (Table 7).[20] The evidence suggests that a 1-percent increase in the REER reduces the relative import price by 1.07 percent in the oil exporting countries compared to 0.71 percent in the low-income and emerging-market countries. The pass-through coefficient for the latter group of countries is significantly different from -1 at the 10-percent level.

The assumption used by CGER of full pass-through of changes in the REER to export prices (in foreign currency terms), $\mu_X = 1$, for non-oil exporters is rejected. The estimated long-run price elasticity of exports with respect to a change in the real exchange rate in the low-income and emerging market countries of 0.55 is significantly different from 1 at the 10 percent level. Similarly, the assumption of full pass-through of changes in the REER to non-oil exports prices (in foreign currency terms), $\mu_X = 1$, is rejected for both the oil exporting and low-income and emerging market countries. The estimated long-run elasticity of non-oil export prices to a real exchange rate appreciation of 0.42 is significantly different from 1 at the 1 percent level.[21]

Table 7. Relative Import and Export Price Elasticities to the Real Effective Exchange Rate

	Long-run effect of a real appreciation on:		
	Relative import prices 1/	Relative export prices 2/	Relative non-oil export prices
Oil Exporters	-1.07		0.42 ***
	(0.31)		(0.21)
Emerging market and low-income countries	-0.71 *	0.55 *	0.42 ***
	(0.18)	(0.27)	(0.21)

Source: IMF staff estimates.

Note: Estimates are obtained using the mean group estimator of Pesaran and Shin (1995). Domestic real GDP is included in the equation for the relative import price. Standard errors are in parentheses. * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level for given coefficient test, see footnotes 1, 2, and 3. The responsiveness of relative export prices to a change in the exchange rate is not estimated for oil exporters since exports are priced in foreign currency and will not respond to a change in the real exchange

1/ Import deflator divided by the CPI. Asterisks indicate that the coefficient is significantly different from -1.
2/ Export deflator divided by the ULC of trading partners for manufacturing exporters. Asterisks indicate that the coefficient is significantly
3/ Non-oil export deflator divided by the ULC of trading partners. Asterisks indicate that the coefficient is significantly different from 1.

[20] Outliers (defined as countries which have very large and/or incorrectly-signed long-run price elasticities with respect to the REER) are dropped from the sample.

[21] By definition, oil exports are priced in foreign currency.

C. Alternative Trade Balance Elasticities

The estimates of the elasticities of the trade volumes with respect to relative prices in Section IIIB and the estimates of the elasticities of the relative prices with respect to the REER obtained in Section IVB in the cases where the CGER assumptions are rejected are substituted into equation (6) to obtain alternative estimates of the trade balance elasticities.

The alternative trade balance elasticity with respect to the REER is higher for a non-oil exporting country than the CGER-based trade balance elasticity, assuming balanced trade and exports equivalent to 35 percent of GDP (Table 8). The estimated non-oil export price elasticity with respect to the REER implies that a 10 percent real depreciation does not reduce export prices relative to foreign goods by the full 10 percent, but only by 4.2 percent as the elasticity is estimated to be 0.42. In terms of domestic goods, the export price rises by 5.8 percent, and the export volume increases by 2.8 percent (5.8* 0.67). Hence, the overall value of exports (in terms of domestic goods) increases by 8.6 percent with the price effect outweighing the volume effect. The incomplete pass-through on the import side has a similar effect: the price of imports in terms of domestic goods increases by 7.1 percent only, triggering a volume response of -4.7 percent (7.1*0.66). Overall, the value of imports rises by 2.4 percent, leading to a 2.2 percent improvement of the trade balance in response to a 10 percent depreciation (assuming balanced trade and an export-to-GDP ratio of 35 percent). This result is comparable to the result found by CGER for advanced countries using the standard pass through assumptions.

Table 9 compares the key results for the oil exporting countries with the CGER benchmark. The CGER assumptions regarding the pass through of a real exchange rate change with respect to oil export prices and import prices cannot be rejected. As a result, the calculated impact of a real exchange rate change on the oil exports and imports components of the trade balance elasticity is the same using the generalized and strict CGER equations. As noted earlier, the CGER assumption that the pass-through of a real exchange rate change to prices of non-oil exports is 1 is rejected. Given the small share of non-oil exports to GDP in oil exporting countries, however, the overall and non-oil trade balance elasticities obtained from the two methods are only marginally different.

Table 8. Decomposition of the Impact of a 10 Percent Real Depreciation on the Trade Balance of Non-Oil Exporting Middle East and Central Asia Countries

(Changes in percent)

	Exports			Imports			Trade Balance-to-GDP ratio 1/
	Price	Volume	Value	Price	Volume	Value	
CGER pass through assumptions 2/	0.0	6.7	6.7	10.0	-6.6	3.4	1.2
Estimated pass through coefficients 3/	5.8	2.8	8.6	7.1	-4.7	2.4	2.2
Memorandum items:							
CGER estimates for advanced countries	0.0	7.1	7.1	10.0	-9.2	0.8	2.2

Source: IMF staff estimates.

1/ Assumes a trade balance in equilibrium and exports equivalent to 35 percent of GDP.
2/ Exchange rate changes are assumed to be fully passed through into import prices and foreign currency-denominated export prices. Import and export volume elasticities are 0.66 and 0.67 in absolute values, respectively.
3/ Relative import price elasticity = -0.71 and relative nonoil export price elasticity = 0.42. Import and export volume elasticities are 0.66 and 0.67 in absolute values, respectively.

Table 9. Decomposition of the Impact of a 10 Percent Real Depreciation on the Trade Balance of Oil-Exporting Middle East and Central Asia Countries

(Changes in percent)

	Oil-exports			Non-oil Exports			Imports			Trade Balance-to-GDP ratio 1/	Non-oil trade balance to GDP ratio 1/
	Price	Volume	Value	Price	Volume	Value	Price	Volume	Value		
CGER pass through assumptions 2/	10.0	0.0	10.0	0.0	6.7	6.7	10.0	0.0	10.0	2.7	-2.7
Estimated pass through coefficients 3/	10.0	0.0	10.0	5.8	2.8	8.6	10.0	0.0	10.0	2.8	-2.6

Source: IMF staff estimates.

1/ Assumes non-oil exports equal to 8 percent of GDP, oil exports equal to 54 percent of GDP and imports equal 33 percent of GDP (Saudi Arabia in 2006).
2/ Exchange rate changes are assumed to be fully passed through into import prices and domestic-currency-denominated oil export prices, and there is no pass through to domestic-currency-denominated non-oil export prices. Export volume (supply) elasticity for oil = 0; import volume elasticity = 0; and non-oil export volume elasticity = -0.67.
3/ Relative non-oil export price elasticity = 0.42; export volume (supply) elasticity for oil = 0; import volume elasticity = 0; export volume elasticity for non-oil goods = -0.67. It is assumed that exchange rate changes are fully passed through into import prices and domestic-currency-denominated oil export prices.

The country-specific alternative trade balance elasticity estimates (generalized CGER) are reported in Tables 5 and 6 along with the CGER trade balance elasticities (strict-CGER) for the non-oil and oil exporting countries in the sample, respectively. Table 5 shows that, for the non-oil exporting Middle East and Central Asian countries, the alternative trade balance elasticities are considerably larger than the CGER trade balance elasticities. Using trade data for 2006, a 10 percent real depreciation would improve the trade balance by 2 percent of GDP, on average for the countries in the sample, according to the generalized CGER, compared to only 0.9 percent of GDP using strict-CGER. Given the estimated elasticities of imports and exports with respect to relative import and export prices of 0.66 and -0.67, respectively, and the pass through estimates of -0.71 and 0.42 for relative imports and export prices respectively, the condition that governs whether a real exchange rate depreciation will improve the trade balance is $S_X > 0.78S_M$. The larger the initial trade deficit, the less likely that this condition will be fulfilled. A comparison with the condition derived for the standard CGER approach that is reported on page 11, clearly shows that the generalized equation requires a larger initial trade deficit for a depreciation to worsen the trade balance.

The overall trade balance elasticities for oil exporters are broadly the same under the generalized and strict-CGER methods—a result of almost identical assumptions on pass-through coefficients. Given the relative small ratio of non-oil exports to GDP and the limited response of imports to relative price changes, a real depreciation is still found to worsen the non-oil trade balance of the oil-exporting countries as the loss from higher import prices outweighs the gain from the increase in the value of non-oil exports. Using trade data for 2006, a 10 percent real depreciation would worsen the non-oil trade balance by 2.4 percent of GDP, on average, under the generalized-CGER method, compared to 2.7 percent of GDP using strict-CGER.

V. CONCLUSIONS

In the context of its surveillance work, the IMF and its CGER have relied on the macroeconomic balance and external sustainability approaches to derive current account norms. Trade balance elasticities are crucial to translate the deviations of actual current account positions from these norms into the exchange rate adjustments that would be necessary to contain possible external disequilibria.

The empirical estimation results for 27 Middle East and Central Asian countries for the period 1990–2006 indicate that import and export volume elasticities with respect to relative import and export prices critically depend on the composition of exports of these countries. The emerging-market and low-income countries in the Middle East and Central Asia are estimated to have long-run import and export volume elasticities with respect to relative import and export prices of 0.66 and 0.67, respectively. This is broadly in line with CGER estimates for developing countries (0.69 and 0.53, respectively) and somewhat lower than CGER estimates for industrial countries (0.92 and 0.71, respectively). Under CGER assumptions of full pass-through of real exchange rate changes to import prices and no

pass-through to domestic-currency denominated export prices, the estimated volume elasticities imply that a 10 percent real depreciation is associated with a 1.2 percent of GDP trade balance improvement, assuming balanced trade and exports equivalent to 35 percent of GDP.

In line with other research, the paper finds evidence of incomplete exchange rate pass-through to relative trade prices in the low-income and emerging market countries in the Middle East and Central Asia. Using estimates of the respective pass-through elasticities in a generalized-CGER equation for the elasticity of the trade balance to GDP ratio suggests that, for given ratios of imports and exports to GDP, a depreciation (appreciation) would generally have a stronger positive (negative) impact on the trade balance to GDP ratios of low-income and emerging market countries in the Middle East and Central Asia.

In all, the estimation results suggest that import and export volume elasticities are much smaller in the oil-exporting Middle East and Central Asia countries than in the low-income and emerging market countries in the region. The main findings are:

- The supply response of oil exports to a change in the exchange rate is economically and statistically insignificant. This likely reflects that oil exporters cannot usually raise production and exports of oil and gas in the short run, either because they are already at full capacity or they are a member of OPEC which imposes production ceilings.

- Unlike in other countries, import demand in oil-exporting countries does not vary systematically with real exchange rate changes. But the response of import demand to increases in domestic demand is positive and significant in all countries.

- A real appreciation reduces the volume of non-oil exports in the oil exporting Middle East and Central Asia countries, (the estimated long run elasticity is 0.72). However, non-oil exports represent only about 10 percent of GDP, on average, in these countries. Consequently, the moderating effect of a real appreciation on the trade balance is limited.

The estimated trade volume elasticities have important implications for the ongoing policy debate as to whether the oil-exporting countries in the Middle East and Central Asia, and particularly the Gulf countries should revalue their exchange rates in order to moderate their current account surpluses, boost imports and contribute to reduce global imbalances. In particular, the estimation results reported in the paper suggest that the large current account surpluses observed in many of the Middle East and Central Asia countries resulting from the increases in oil prices in recent years will decline in response to a real appreciation of the exchange rate, but the adjustment will not come through expenditure switching, but rather from a valuation effect. Since a real appreciation would not boost import demand and non-oil

exports constitute a small share of GDP and total trade, it can also not be expected to contribute significantly to alleviating global imbalances.

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Appendix I. Data Appendix

This appendix provides the definition and data sources for the variables used in the paper. It also defines the country groupings.

Data definitions and sources

The construction of the variables follows closely IMF (2006b). The source of the data for all the variables is the WEO database. All variables are expressed in logarithms in the estimations with the exception of the output gap variable which is as a percent of GDP.

Export volume refers to exports of goods and services.

Non-oil export volume is calculated as the export volume of goods and services minus oil export volume.

Oil export deflator is defined as the average spot oil price converted into domestic currency.

Non-oil export deflator is measured as the non-oil export value divided by non-oil export volume.

Domestic prices are represented by the consumer price index.

Foreign income is the real GDP of partner countries weighted by their share in total exports.

The change in capacity is measured by the change in GDP per capita in PPP terms.

The output gap is measured as the log difference between the actual and trend output calculated using a Hodrick-Prescott filter over 16 years.

Relative export price for low-income and emerging-market Middle Eastern and Central Asia countries is the export deflator divided by the trade-weighted average of the domestic currency equivalent of unit labor costs in the country's trading partners.

Relative export price for oil exporting Middle Eastern and Central Asian countries is the three-year moving average of the oil export deflator divided by the CPI.

Relative non-oil export price is calculated as the non-oil export deflator divided by the unit labor cost of trading partners.

Real domestic demand is calculated as output minus net exports expressed in domestic currency at 2000 prices.

Real disposable income is calculated as nominal output minus government revenues deflated by the CPI index.

Import volume refers to imports of goods and services.

Import deflator is calculated as the import of goods and nonfactor services value divided by import volume.

Relative import price is calculated as the import deflator divided by the CPI.

Country groupings

Twenty seven Middle Eastern and Central Asian countries are included in the sample. The countries are divided into oil exporting and emerging market and low income countries following the IMF's Middle East and Central Asia Departments *Regional Economic Outlook* publications.

Table A1. Middle East and Central Asia Countries in the sample

Oil Exporters	Emerging market and low income countries
Algeria	Armenia
Azerbaijan	Djibouti
Bahrain	Egypt
Iran	Jordan
Kazakhstan	Kyrgyz Republic
Kuwait	Lebanon
Libya	Mauritania
Oman	Morocco
Qatar	Pakistan
Saudi Arabia	Sudan
Syria	Tajikistan
Turkmenistan	Tunisia
U.A.E.	Uzbekistan
	Yemen

Appendix II. Derivation of the Formula for the Elasticity of the Trade Balance Vis-à-vis the Real Exchange Rate

The economy is modeled as having four goods: domestic and foreign nontraded goods, and exportable and importable goods. A unit of domestic output is defined as a representative basket of nontraded and traded goods produced domestically and a unit of foreign output as a representative basket of nontraded and traded goods produced abroad. In this world, there are three key relative prices:

- $E = SP / P^*$ is the real exchange rate defined as the relative price of domestic output in terms of foreign output, where S is the nominal exchange rate in units of foreign currency per unit of domestic currency, P is the domestic GDP deflator and P* is the foreign GDP deflator.
- $p_x = P_X / P$ is the relative price of exportables in terms of domestic output
- $p_m = P_M / P$ is the relative price of importables in terms of domestic output

In this setup, and letting Y be real GDP, the trade balance-to-GDP ratio can be expressed as:

$$TB / GDP = p_x (X / Y) - p_m (M / Y) \qquad \text{(A1)}$$

where GDP is nominal GDP, P is the GDP deflator, and Y is real GDP. Let $P_X^F = SP_X^D$ be the price of exports in foreign currency and S be the nominal exchange rate (foreign currency units per unit of domestic currency). Dividing by the foreign GDP deflator, P^*, this can be written as:

$$\frac{P_X^F}{P^*} = S\frac{P_X^D}{P^*}\frac{P}{P} = \frac{SP}{P^*}\frac{P_X^D}{P} \Rightarrow \frac{P_X^D}{P} = \frac{P_X^F / P^*}{SP / P^*}.$$

Let $p_x^f = \frac{P_x^F}{P^*}, p_x = p_x^d = \frac{P_x^D}{P}, p_m = \frac{P_M}{P}, E = \frac{SP}{P^*}$ be, respectively, the relative price of exports in terms of foreign goods, the relative price of exports in terms of domestic goods, the relative price of imports in terms of domestic goods, and the real exchange rate. The superscript *d* is omitted for simplicity. Hence, the relative price of exports in units of domestic goods can be written as $p_x = \frac{p_x^f}{E}$. The trade balance as a ratio of (nominal) GDP is hence given by:

$$tb = \frac{TB}{GDP} = p_x \frac{X}{Y} - p_m \frac{M}{Y},$$

- **For non-oil exporters:** $X = X\left(p_x^f\right), \partial X / \partial p_x^f < 0, p_x^f = p_x E$.

Taking the total derivative with respect to E yields:

$$\frac{\partial(TB/GDP)}{\partial E} = \frac{\partial p_x}{\partial E}\frac{X}{Y} + \frac{\partial X}{\partial E}\frac{p_x}{Y} - \left[\frac{\partial p_m}{\partial E}\frac{M}{Y} + \frac{\partial M}{\partial E}\frac{p_m}{Y}\right] =$$

$$= \frac{\partial\left(p_x^f(E)/E\right)}{\partial e}\frac{X}{Y} + \frac{\partial X}{\partial p_x^f}\frac{\partial p_x^f}{\partial E}\frac{p_x}{Y} - \left[\underbrace{\frac{\partial P_M}{\partial E}\frac{E}{p_m}}_{\mu_M}\frac{p_m}{E}\frac{M}{Y} + \frac{\partial M}{\partial p_m}\frac{\partial p_m}{\partial E}\frac{p_m}{Y}\right] =$$

$$= \frac{\frac{\partial p_x^f}{\partial e}E - p_x^f}{E^2}\frac{X}{Y} + \underbrace{\frac{\partial X}{\partial p_x^f}\frac{p_x^f}{X}}_{\eta_X}\underbrace{\frac{\partial p_x^f}{\partial E}\frac{E}{p_x^f}}_{\mu_X}\frac{1}{E}\underbrace{X\frac{p_x}{Y}}_{S_X} - \left[\mu_M\underbrace{p_m\frac{M}{Y}}_{S_M}\frac{1}{E} + \underbrace{\frac{\partial M}{\partial p_m}\frac{p_m}{M}}_{\eta_M}\underbrace{\frac{\partial p_m}{\partial E}\frac{Ee}{p_m}}_{\mu_M}\frac{M}{E}\frac{p_m}{Y}\right] =$$

$$= \left(\frac{\partial p_x^f}{\partial e}\frac{1}{E}\frac{X}{Y} - \underbrace{\frac{p_x^f}{E}}_{p_x}\frac{1}{E}\frac{X}{Y}\right) + \eta_X\mu_X S_X\frac{1}{E} - \left[\mu_M S_M\frac{1}{E} + \eta_M\mu_M S_M\frac{1}{E}\right] =$$

$$= \left(\underbrace{\frac{\partial p_x^f}{\partial e}\frac{E}{p_x^f}}_{\mu_X}\underbrace{\frac{p_x^f}{E}}_{p_x}\frac{1}{E}\frac{X}{Y} - \underbrace{p_x\frac{X}{Y}}_{S_X}\frac{1}{E}\right) + \eta_X\mu_X S_X\frac{1}{E} - \mu_M\left[1+\eta_M\right]S_M\frac{1}{E} =$$

$$= \left(\mu_X\underbrace{p_x\frac{X}{Y}}_{S_X}\frac{1}{E} - S_X\frac{1}{E}\right) + \eta_X\mu_X S_X\frac{1}{E} - \mu_M\left[1+\eta_M\right]S_M\frac{1}{E} =$$

$$= \mu_X S_X\frac{1}{E} - S_X\frac{1}{E} + \eta_X\mu_X S_X\frac{1}{E} - \mu_M\left(1+\eta_M\right)S_M\frac{1}{E} =$$

$$= \frac{1}{E}\left[-S_X + \mu_X S_X + \eta_X\mu_X S_X - \mu_M\left(1+\eta_M\right)S_M\right] =$$

$$= \frac{1}{E}\left[-S_X + \mu_X\left(1+\eta_X\right)S_X - \mu_M\left(1+\eta_M\right)S_M\right]$$

$$\Rightarrow \frac{\partial(TB/GDP)}{\partial E/E} = -S_X + \mu_X\left(1+\eta_X\right)S_X - \mu_M\left(1+\eta_M\right)S_M.$$

where $\eta_X < 0$ and $\eta_M < 0$. Or, alternatively,

$$\Rightarrow \frac{\partial(TB/GDP)}{\partial E/E} = -(1+\mu_X)S_X + \left(\mu_X\eta_X\right)S_X - \mu_M\left(1-\eta_M\right)S_M. \qquad \text{(A.2)}$$

where $\eta_X < 0$ and $\eta_M > 0$.[1]

Here, $S_X = p_x \frac{X}{Y} = \frac{P_X^D}{P}\frac{X}{Y}$, $S_M = p_m \frac{M}{Y} = \frac{P_M}{P}\frac{M}{Y}$ are the shares of exports and imports in GDP.

- For oil exporters: $X = X(p_x)$, $\partial X / \partial p_X > 0$, and $\frac{\partial p_x / p_x}{\partial E / E} = -1$

Taking the total derivative with respect to E:

$$\frac{\partial(TB/GDP)}{\partial E} = \frac{\partial p_x}{\partial E}\frac{X}{Y} + \frac{\partial X}{\partial E}\frac{p_x}{Y} - \left[\frac{\partial p_m}{\partial E}\frac{M}{Y} + \frac{\partial M}{\partial E}\frac{p_m}{Y}\right] =$$

$$= \frac{\partial(p_x)}{\partial E}\frac{X}{Y} + \frac{\partial X}{\partial p_x}\frac{\partial p_x}{\partial E}\frac{p_x}{Y} - \left[\underbrace{\frac{\partial P_M}{\partial E}\frac{E}{p_m}}_{\mu_M}\frac{p_m}{E}\frac{M}{Y} + \frac{\partial M}{\partial p_m}\frac{\partial p_m}{\partial E}\frac{p_m}{Y}\right] =$$

$$= \frac{\partial p_x}{\partial E}\frac{E}{p_x}\frac{p_x}{E}\frac{X}{Y} + \underbrace{\frac{\partial X}{\partial p_x}\frac{p_x}{X}}_{\eta_X}\underbrace{\frac{\partial p_x}{\partial E}\frac{E}{p_x}}_{\mu_X}\frac{1}{E}\underbrace{X\frac{p_x}{Y}}_{S_X} - \left[\mu_M \underbrace{p_m\frac{M}{Y}}_{S_M}\frac{1}{E} + \underbrace{\frac{\partial M}{\partial p_m}\frac{p_m}{M}}_{\eta_M}\underbrace{\frac{\partial p_m}{\partial E}\frac{Ee}{p_m}}_{\mu_M}\frac{M}{E}\frac{p_m}{Y}\right]$$

The rest of the derivation is as in the previous case and leads to:

$$\frac{\partial(TB/GDP)}{\partial E/E} = -S_X - (\eta_X)S_X - \mu_M S_M - (\mu_M \eta_M)S_M$$

where $\eta_X > 0$ and $\eta_M < 0$.

[1] It is easy to see that $-1 + \mu_X$ represents the change in the relative price of exports to domestic output by recalling that the relative price of exports to domestic output is equal to the relative price of exports to foreign output divided by the RER.