Petrodollars and Imports of Oil Exporting Countries

First Draft: January 2007

*Annette Kamps**
Kiel Institute for the World Economy, 24100 Kiel, Germany

Abstract

This paper investigates the determinants of import demand in oil exporting countries. With a large cross section of countries and a panel cointegration model analysis this paper shows that import demand in these countries depends positively on domestic demand and exports, the real exchange rate and the price of oil. Fiscal balances reduce the demand for imports. Results are robust over a set of specifications. With higher oil prices and real appreciations imports of oil exporting countries are significantly expanded. The impact on global imbalances is, however, limited. Due to the structure of trade the euro area rather than the United States benefits from the increased demand in the region.

JEL classification: F14; F01; Q43.

Keywords: Import Equation; Oil Exporting Countries; Panel Cointegration.

* *Email address*: annette.kamps@gmx.de. The first draft of this paper was written during my stay at the European Central Bank. I would like to thank the staff of the Directorate General of International and European Relations for their hospitality. In particular, I would like to thank Roland Beck for his ideas and his support. I would finally like to thank seminar participants in internal ECB seminars as well as Christophe Kamps for helpful comments.

1. Introduction

Oil prices have risen sharply since 1999. This seems to have exacerbated global imbalances. High oil prices have worsened the current account deficit in the United States through higher oil import bills. At the same time, oil exporting countries benefited from the higher oil prices and used their export revenue windfalls among others to buy foreign products. However, additional import spending seems to fall short of the export revenue windfall. Thus, while the current account deficit in the United States widens, oil exporting countries are running record current account surpluses. This has led to increased interest in the effect of higher oil prices on global imbalances.[1] There were voices to be heard in the international community that oil exporting countries should be made to participate in reducing global imbalances by increasing their import demand. First and foremost it was stated that oil exporting countries should let their exchange rates float which would lead to real appreciations and help reduce global imbalances by stimulating demand for foreign products in oil exporting countries. There are several questions arising from this statement. First of all, the direct impact of oil prices on import demand should be analyzed. How much do imports in oil exporting countries increase due to the higher oil revenues and the increased wealth? A further question is whether and to which extent a real appreciation stimulates imports in these countries. Third, it is important to look at other factors influencing import behaviour in oil exporting countries. In particular what distinguishes oil exporting countries' import behaviour from that of industrial countries? Finally, the possible import increase should be put into the perspective of global imbalances. How much can oil exporting countries contribute at all to reducing global imbalances?

The aim of this paper is to focus on the trade channel of petrodollar recycling.[2] Especially in times of high oil prices the use or "recycling" of these petrodollars attracts interest. Table 1 gives an overview of petrodollar recycling for the period from 2002 to 2005. Oil exporting countries can also spend their oil revenues in the domestic economy. However, as most of the oil exporting countries focus on the production of oil, the domestic economy cannot absorb all oil revenues. This is particularly true in times of high oil price increases when the domestic economy is unable to adjust to the higher demand in the short run.

[1] See for example IMF World Economic Outlook (2006), Reserve Bank of San Francisco (2006), Department of the Treasury (2006).

[2] The export revenues oil exporting countries gain with their oil exports are often referred to as petrodollars. It should be noted that throughout this study the word petrodollars is used in a neutral way to describe revenues earned by oil exports.

Table 1: Petrodollar Recycling, 2002 - 2005

Country	Exports[a] (mn bbl)	Oil export revenues (bn U.S. dollar)			Foreign reserves (bn U.S. dollar)			Imports[b] (bn U.S. dollar)			Government debt to GDP[c] (percent)		
	2005	2002	2005	Δ	2002	2005[d]	Δ	2002	2005	Δ	2002	2005	Δ
Algeria	1.8	18.1	45.6	27	23.5	54.6	31.1	12.01	19.50	7.5	53.5	28.53	-24.9
Angola	1.2	7.2	21.6	14	0.8	2.6	1.8	3.61	8.28	4.7	79.1	37.65	-41.5
Bahrain	na	2.5	3.6	1	1.4	1.7	0.3	3.01	3.44	0.4	41.6	53.21	11.6
Congo, Rep. of	0.3	1.9	4.1	2	0.03	0.78	0.8	1.04	2.08	1.0	200.9	98.73	-102.2
Ecuador	0.4	1.8	4.2	2	1.0	2.1	1.1	5.94	8.10	2.2	65.2	44.33	-20.9
Equatorial Guinea	0.4	2.0	7.0	5	0.6	2.9	2.4	0.48	1.81	1.3	10.2	3.59	-6.6
Gabon	0.2	1.8	4.2	2	0.1	0.7	0.6	0.70	1.01	0.3	66.0	47.27	-18.7
Iran, I.R. of	2.4	23.0	48.8	26	21.6	33.8	12.2	22.04	40.97	18.9	7.9	8.77	0.8
Kazakhstan	1.2	4.9	17.0	12	5.0	18.4	13.4	7.86	17.60	9.7	20.1	14.25	-5.8
Kuwait	2.4	14.0	42.1	28	9.3	9.5	0.2	8.11	13.52	5.4	32.4	16.93	-15.5
Libya	1.7	8.9	27.4	18	14.5	31.9	17.4	6.78	9.50	2.7	33.7	1.22	-32.5
Nigeria	2.6	14.8	41.6	27	7.4	24.0	16.6	12.56	20.48	7.9	67.2	20.65	-46.6
Norway	2.8	24.8	45.9	21	32.1	42.5	10.4	35.71	56.82	21.1	36.1	46.44	10.3
Oman	0.8	7.4	13.2	6	3.2	3.6	0.4	5.64	8.83	3.2	17.4	10.84	-6.6
Qatar	1.0	4.6	10.7	6	1.6	4.5	2.9	3.65	9.89	6.2	47.1	25.03	-22.0
Russia	6.8	40.3	117.2	77	44.7	162.3	117.6	60.97	125.30	64.3	44.1	33.85	-10.2
Saudi Arabia	9.1	63.7	162.2	98	20.8	23.5	2.7	29.66	54.58	24.9	96.9	39.59	-57.3
Sudan	0.4	1.7	3.9	2	0.1	1.9	1.8	2.02	5.62	3.6	161.2	106.81	-54.4
Syrian Arab Rep.	0.5	3.8	1.8	-2	9.9	11.3	1.4	4.27	5.71	1.4	60.1	60.20	0.1
Turkmenistan	0.1	0.8	2.0	1	na	na	na	1.83	2.95	1.1	19.1	6.07	-13.0
Trinidad and Tobago	0.2	1.2	4.8	4	1.9	4.8	2.9	2.66	3.71	1.1	33.9	20.90	-13.0
United Arab Emirates	2.4	16.6	43.5	27	15.2	19.9	4.7	37.53	80.80	43.3	22.4	28.14	5.8
Venezuela	2.5	21.5	48.1	27	na	na	na	13.36	23.95	10.6	44.9	36.39	-8.6
Yemen	0.4	2.9	5.4	2	4.4	5.8	1.4	2.87	4.08	1.2	11.6	14.50	2.9
Total	**41.3**	**290.3**	**725.9**	**435.6**	**219.1**	**463.1**	**244.04**	**284.3**	**528.5**	**244.2**	**na**	**na**	**na**

Notes: [a] Approximation of export volumes given as oil production minus oil consumption. [b] nominal import value. [c] Gross Central Government Debt. For Angola, Congo, Ecuador, Iran, Kazakhstan, Kuwait, Nigeria, Russia, Turkmenistan, United Arab Emirates and Venezuela numbers are for Total Debt Outstanding at Year End (IMF WEO). [d] Includes IMF staff estimates and projections for Angola, Bahrain, Congo, Ecuador, Equatorial Guinea, Gabon, Oman, Sudan, Syrian Arab Republic, Trinidad and Tobago and Yemen. Data for Oman and Syrian Arab Republic is 2004 data. Δ stands for the change in absolute numbers. na stands for not available.

Sources: BP (2006), Department of the Treasury (2006), IMF (2006).

Therefore a large share of the petrodollars is recycled abroad. Apart from the trade channel there are two financial channels of petrodollar recycling. The first is the asset accumulation channel. Oil exporting countries use part of their oil revenues to accumulate foreign reserves. In 2005 portfolio investment seems to have replaced reserve accumulation as most important source of capital outflow. The majority of the capital outflows are going to the United States. The second financial channel is the debt reduction channel. Many oil exporting countries accumulated a stock of debt in the past part of which is international debt. Lately, especially Russia used a large share of its petrodollars to repay outstanding international debt liabilities.[3] These two financial channels are often linked to the question of who is financing the U.S. current account deficit.

This paper, however, focuses on the trade channel of petrodollar recycling. Foreign asset accumulation only serves to finance global imbalances, while increased trade could serve to correct global imbalances. How much of petrodollars are recycled in increased demand for

[3] Only in the year 2005 Russia spent the equivalent of 3.33 billion U.S. dollar on early debt repayment to the IMF and the equivalent of 15.1 billion U.S. dollar for first debt repayments to the Paris Club countries..

foreign products? In the following, I briefly discuss the literature on import demand equations in general and on import behaviour of oil exporting countries in particular. In a next step I set up an empirical model of the import demand of oil exporting countries. The analysis is based on a panel cointegration model including 24 oil exporting countries for the period from 1980 to 2005. The results are extensively tested for their robustness before drawing conclusions on the impact of oil exporters' import demand on global imbalances. Estimation results show that import demand of oil exporting countries depends positively on domestic demand and exports, the real exchange rate and the price of oil. Fiscal balances reduce the demand for imports. With higher oil prices and a real appreciation imports in these countries are significantly expanded. The impact on global imbalances is, however, limited. Due to the structure of trade the euro area rather than the United States benefits from the increased demand in the region.

2. The Literature

How do the real exchange rate and the oil price affect the import behaviour of oil exporting countries? Import demand is driven by real demand and the relative price of domestic versus foreign goods (and services). Every import demand equation therefore contains an activity variable and a relative price variable. Most of the early studies on import equations were performed for industrial countries. [4] In a comparison of import demand estimations for seven industrial countries Thursby and Thursby (1984) found that only models including lagged dependent variables show a good performance. Using cointegration methods taking into account long-run relationships Clarida (1994) sets a benchmark model for import equations. The general findings of the empirical import demand literature is that the import demand elasticity with respect to the income or activity variable is higher than unity. This is contrary to predictions of the theory. In particular, an income elasticity of higher than unity would imply a gradually increasing share of imports in GDP. Ultimately this would mean that all income would be spent on imports. In an attempt to explain the puzzle of higher than unity income elasticities of imports, Barrell and Dées (2005) included a measure of foreign direct investment as an additional indicator of openness and globalization. This measure proves to have a significantly positive impact on import demand. In addition, it helps reduce income

[4] For an overview of the early literature see Goldstein and Kahn (1985).

elasticities to 1.2 and brings them, thus, closer to unity.[5] Their sample comprises the 22 countries with the highest share in merchandise imports in the world.[6]

In her analysis on 12 developing countries Reinhart (1995) finds results similar to Clarida (1994) concerning the long run elasticity of imports with respect to the income variable. When comparing the elasticity for industrial countries which is estimated at around 2 and the elasticity for developing countries estimated at 1.2 she comes to the conclusion that in the long-run this constellation would lead to deteriorating trade balances in industrial countries and would work for the benefit of developing countries. Her elasticities with respect to the relative prices of imports are in most cases significant and lower than Clarida's estimates and well below unity, which means that large swings in the real exchange rates are necessary to bring about changes in the trade pattern.

Many studies have followed this example and have estimated import equations for different countries. Senhadji (1998) presents a study on the import demand function of 77 countries.[7] He finds that most of the coefficients have the expected sign and are significant. He uses as the activity variable GDP minus exports. The elasticity with respect to this measure of income is relatively small for the oil exporting countries. It is below unity for all exporting countries and even below 0.1 for the case of Norway.[8]. Maybe the elasticity is so low because for theses countries the main source of income is export revenues.

With a longer time dimension Harb (2005) presents a study of 40 countries. He finds that for most countries, income and price variables have a significant effect on import demand and that the elasticities are higher in developing countries than in industrial countries.[9] The only oil exporting countries included in his sample are Norway, Syria and Venezuela, however. And for these countries the estimation results for the impact of the relative prices on import demand are inconclusive.

For the impact of oil prices on imports one has to look at the literature on oil exporting countries. In 2006 the IMF (2006) conducted an analysis on the import behaviour of oil exporting countries. This study asks the question whether the observation that the simple

[5] Although it is still significantly different from unity.
[6] This sample does not include any of the oil exporting countries as none of these countries have such high import shares.
[7] His sample includes some oil exporting countries; in particular, Algeria, Congo, Gabon, Nigeria, Norway, Sudan, and Trinidad and Tobago.
[8] When comparing his two estimation methods, he comes to the conclusion that Fully Modified Ordinary Least Squares (FMOLS) outperforms simple ordinary least squares (OLS) estimations.
[9] This finding is contrary to Reinhart's finding of lower income elasticities for developing countries.

marginal propensity to import out of oil revenues[10] seems to have decreased since the 1970s mirrors the behaviour of oil exporting countries to spend oil revenues more cautiously. To test whether the simple propensity to import of around 24 percent for the OPEC countries, 15 percent for the Golf Cooperation Council (GCC) countries and 31 percent for the non-OPEC oil exporting countries are similar to the past they estimate an error correction import function for several oil exporting countries. In an out of sample forecasting exercise it is found that the spending on imports in OPEC countries is only slightly lower than implied by past behaviour and that only the spending of the GCC countries seems to be significantly more conservative.

In a next step the IMF (2006) study also sets up a global, multiregion VAR model to estimate the impact of higher oil prices on the current account balances of several countries. As a reaction to a permanent 10 US dollar increase in oil prices the analysis finds a significant but short lived deterioration of the current account for oil importing countries and an increase in fuel exporters' current account by around 2 percent (of own GDP). It is stated that higher oil prices slow down growth and lead to real depreciations in oil importing countries while output growth is enhanced and oil price hikes lead to real appreciations in oil exporting countries. The impulse response functions of these reactions are, however, highly insignificant. The significant reaction of the current account might therefore only mirror price effects resulting from the oil price changes. It depends on volume effects and the Marshall-Lerner condition whether current accounts deteriorate in oil importing countries and whether the current account of oil exporting countries improves with increasing oil prices. In this case the reaction of the current accounts seems to be quite unambiguous because the demand for oil is in general very price inelastic and there are therefore almost no quantity adjustments to higher oil prices.

In the import demand literature no study focuses on the specific characteristics of oil exporting countries. In country by country studies, only very few oil exporting countries are included. In the literature on oil exporting countries many studies analyse the reactions of the current account to changes in the oil price or in the terms of trade. This way it is impossible to tell whether reactions of the current account are only driven by price effects due to higher export prices. I disentangle the price effects and the wealth effects by estimating the reaction of real imports to the exchange rate and to the price of oil. In particular, I estimated separate effects for the oil price and a measure of the real exchange rate which takes into account the

[10] Defined as the change in the current account (change in imports net of non-oil exports, investment income, and transfers) over the change in oil revenues (oil exports).

fact that exports and imports of oil exporting countries are no substitutes. At the same time I control for the specific characteristics of the oil exporting countries by including a measure of the fiscal balance as oil exporting countries are forced to use fiscal policies to guard against the high volatility of their export revenues.

3. Empirical Findings

This section presents empirical evidence on the import demand of oil exporting countries for a panel of 24 oil exporting countries based on a panel cointegration model. The challenge of estimating import demand functions for oil exporting countries is twofold. First of all, data is not as readily available as for industrial countries. On a quarterly basis there is no data for a large cross section of oil exporting countries available. The next problem is to find a specification suitable for the specific characteristics of oil exporting countries. Oil exporting countries are likely to differ from industrial countries because their economies are in general not well diversified and highly dependent on the oil sector. At the same time, these countries know that their most important source of revenue is finite, so that they have to put aside revenues for future generations. In addition, most of the oil industry in oil exporting countries is state owned or at least partially state own. This gives the state a central role in influencing import demand in oil exporting countries. In particular, the government balance is likely to play a role in determining import demand. The following estimation tries to make the best of the data available by using panel estimation methods. Also, the estimations control for the role of government by including a measure of government balances.

3.1 The Data

The estimations are based on annual data for a balanced panel of 24 oil exporting countries for the period from 1980 to 2005. The sample of countries consists of Algeria, Angola, Bahrain, Republic of Congo, Ecuador, Equatorial Guinea, Gabon, Islamic Republic of Iran, Kazakhstan, Kuwait, Libya, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, Sudan, Syrian Arab Republic, Trinidad and Tobago, Turkmenistan, United Arab Emirates, Venezuela and Yemen. The sample includes all countries listed as “Fuel Exporters” in the September 2006 edition of the IMF World Economic Outlook with the addition of Norway and Kazakhstan and without Azerbaijan. The definition is based on the criteria that the main

source of exports consists of fuel, i.e. over the past five years the average share of fuel exports in total exports exceeds 40 percent and that the average value of exports exceeds 500 million U.S. dollar. Kazakhstan is included even though it is not possible to verify whether it meets these criteria. Azerbaijan which would also qualify is excluded from the sample because of the unavailability of data on fiscal balances. Note that this panel does not include all members of the Organization of Petroleum Exporting Countries (OPEC). For Iraq[11] the data quality is not sufficiently high and Indonesia's oil trade balance turned negative in 2004. Other large oil exporters such as Canada, Mexico, and the United Kingdom are not part of the sample because oil is not their main source of export revenues.

Table A2 in the appendix gives an overview of source and the availability of data. The variable to be explained is real imports. Other studies such as the IMF (2006) have analysed the behaviour of the current account of oil exporting countries. Because the price of oil and the exchange rate create price effects in the current account from which I want to abstract my main focus will be on the reaction of real imports. For this purpose real imports (in 2000 constant prices) are taken from the IMF World Economic Outlook database. National Accounts data is taken as opposed to Balance of Payments data due to better comparability with the explanatory variables.[12]

The first explanatory variable is a variable capturing real demand. It includes real domestic demand (including private consumption, investment, government consumption and investment, and changes in inventories) and real exports. Therefore a variable including domestic demand and exports is created. Goldstein and Kahn (1985) label the use of domestic demand as explanatory variable for imports the real expenditure approach. More recently and in the theoretical literature the approach is referred to as the absorption approach.[13] In addition to domestic demand real exports are included. Especially for oil exporting countries, the inclusion of exports as explanatory variable can be justified because their oil export revenues make up a big part of their income. While the price effect of export revenues will be estimated separately with the inclusion of the oil price, the volume of exports could also play a role. The data for the domestic demand and exports is taken from the national accounts and it is

[11] Iraq would also qualify as fuel exporter according to the above definition.
[12] It should be noted that imports from the balance of payments statistics are the basis for the statistics on imports in the national accounts. These concepts can different because they take different concepts as basis. National accounts data is based on the time it arises (accrual principle) and the Balance of Payments statistics are based on the transactions when payment is effected. In general, the two concepts differ only marginally.
[13] Theoretical models using this approach are among others Backus, Kehoe, Kydland (1994); Chari, Kehoe and McGrattan (2002)

therefore appropriate to estimate real imports taken from the national accounts. As can be seen in Table A2 in the appendix for some countries national accounts data for components of GDP is not available over the whole period. For these countries real imports are approximated by the the volume of imports taken from the BoP.[14] For Sudan and Kazakhstan no real data on components of GDP is available. For these countries the nominal national accounts data for imports is deflated with import prices from the balance of payments.[15]

An alternative approach is to use gross domestic product (GDP) as the activity variable in the estimation of import demand. This approach is labelled income approach by Goldstein and Kahn (1985). This variable is often more readily available and it measures the total income of an economy. Some authors, e.g. Senhadji (1998), also use GDP excluding exports as an activity variable. For this large variety in the possibilities to specify the activity variable for import demand there seems to be no theoretical guidance on what variable is most appropriate to use as activity variable. The focus of this study will be on domestic demand and exports. Because of the different possibilities in specifying this variable, estimations with all of the concepts are performed and it is shown that the use of a different activity measure does not change the results. The activity variable is expected to have a positive impact on real import demand. With higher domestic demand the demand for imports will also rise. With higher real exports the oil exporting countries have more revenues to spend on foreign products.

The second explanatory variable is a measure of the real exchange rate. This study builds on the real effective exchange rate as a measure of the real exchange rate. This exchange rate which takes into account the relative trading shares is not available for all the countries in the sample.[16] Therefore, I calculated an approximation of the real effective exchange rate. This approximation is based on the bilateral nominal exchange rates of each country with the United States and the Euro Area deflated with the relative consumer price indices weighted with the relative import shares from these regions. In this specification all fluctuation in the real exchange rate is assumed to come from fluctuations in the real exchange rates with respect to the United States and the Euro Area. This approximation captures on average around half of the countries' import flows. It should be a very good approximation of the real effective exchange rate because many countries have a fixed exchange rate vis-à-vis the U.S.

[14] For Turkmenistan only the value of non-oil imports is available.
[15] Where the base year of the price index between BoP and national accounts GDP differs the data is transformed to have the same base year.
[16] The real effective exchange rate from the IMF WEO data source is only available for the following countries: Algeria, Bahrain, Republic of Congo, Ecuador, Equatorial Guinea, Gabon, Iran, Nigeria, Norway, Russia, Saudi Arabia, Trinidad and Tobago and Venezuela. See Table A2 of data availability in appendix.

dollar (e.g. Asia) and the euro (e.g. Eastern Europe). Also, a comparison of this approximation and the real effective exchange rate of the IMF for those countries where data is available proved that the approximation performs well.[17] The share of imports is chosen as this is believed to be the relevant trade share as compared to the share of overall trade as the focus of the analysis is on imports. Another consideration is that the exports of oil exporting countries are almost exclusively invoiced in U.S. dollar so that nominal exchange rate fluctuations vis-à-vis the United States do not play a role for the demand of exports (besides the fact that the demand for oil is very price inelastic in any case).[18] Thus, exports of oil exporting countries are likely not to depend on the real exchange rate. This should not be the case for imports. Even though there is almost no data available, it is likely that imports to oil exporting countries are invoiced in the currency of the producer (trading partner of oil exporters' imports). The case of Algeria where data on the structure of currency invoicing in trade is available supports this claim.[19] Thus, fluctuations in the real effective exchange rate of imports should lead to a direct expenditure switching effect; in the case of an appreciation away from domestic products towards foreign products. As reported below in the section on robustness, I also experimented with including an approximation of the real effective exchange rate where the assumption is that the real exchange rate with all trading partners outside the US and the Euro Area stays constant and therefore the fluctuations of the real effective exchange rate are less pronounced.[20] The results indicate that using different real exchange rate approximations yields very similar results.

One problem when estimating an import demand function for oil exporting countries is how to take into account the special role of oil on import demand. It is therefore interesting to see whether standard measures of the real exchange rate can perform equally well when put into the context of oil exporting countries. Many studies including the IMF (2006) study on import behaviour of oil exporting countries use the terms of trade as a measure of the real exchange rate. However, for our purpose it is crucial to distinguish between relative price effects and wealth effects. Price effects are exchange rate effects that make the import good cheaper (or more expensive) relative to the domestic good. In this sense, movements of the exchange rate lead to expenditure switching effects towards the relatively cheaper good. Using the terms of

[17] The correlation between the approximation and the IMF real effective exchange rate is 92 percent on average.
[18] Iran has proposed to introduce an Iranian Oil Burse where contracts are invoiced in euro rather than U.S. dollar. So far, the project has been postponed several times, however.
[19] For exports almost all trade is invoiced in U.S. dollar (as very high share of oil). For imports around 50 are invoiced in euro which is not much lower than the relative import share with the euro area.
[20] In the comparison with the real effective exchange rate available from the IMF this exchange rate approximation showed less correlation than the base approximation described above.

trade as a real exchange rate measure, the relative price is based on import and export prices, i.e. imports and exports are assumed to be substitutes. While the terms of trade are in general quite a good approximation of this price effect it does not make sense to set import prices relative to export prices for oil exporting countries as imports and exports are no substitutes. Thus, the terms of trade would not be a good measure of the relative price effect but rather show the wealth effect of the very volatile price of their main export good oil.[21]

The third explanatory variable is the price of oil in U.S. dollar. Data is taken from the IMF WEO series. This oil price is an average of three sorts of oil, namely Brent, West Texas Intermediate, and the Dubai Fateh. The basic specification with the nominal U.S. dollar oil price is chosen because it is the main point of reference when talking about oil price fluctuations. As discussed below in the section on robustness, I also performed estimations with two different concepts of real oil prices. The first one is the real U.S. dollar price of oil, where the nominal price of oil is deflated with the U.S. CPI. The second concept is a real oil price for which the nominal oil price is converted to local currency using the nominal exchange rate towards the U.S. dollar and then deflated with each country's CPI. The oil price is expected to have a positive impact on real imports. For oil exporting countries higher oil prices translate into higher export revenues so that more resources can be spent on imports. In addition, all existing oil resources can be evaluated at higher prices. The resulting higher wealth should also stimulate import demand.

The fourth explanatory variable is the share of government balances in nominal GDP. Where available the general government balance is used, otherwise the central government balance is used.[22] As this variable is reported as share of GDP and not in logarithmic terms like all other variables the coefficient of this variable can therefore not directly be interpreted as an elasticity. This variable is expected to have a negative effect on import demand. As suggested above, oil revenues can be used either for import demand, for demand of financial assets or for the reduction of debt. The latter would mean that the countries run a fiscal surplus. [23] Indeed many countries such as Norway and Russia even have an own stabilisation

[21] This is not to say that in the long run oil prices could not have an impact on the real exchange rate. For the link between oil prices and the real exchange rate see the discussion and analysis in the section on Russia's oil dependency. On the link between terms of trade and the real exchange rate see for example Cashin, Cespedes and Sahay (2004). They find that for a third of the 58 commodity exporting countries they analyse the commodity price has a significant long run effect on the real exchange rate. However, only Ecuador, Norway, Sudan and the Syrian Arab Republic from our sample are considered.

[22] This is the case for Algeria, Congo and Gabon, Bahrain and Saudi Arabia. For Nigeria, Trinidad and Tobago and Venezuela some periods in the early 80s are approximated with the central government balances.

[23] The variable could therefore be endogenous and linked to the oil price. Possible problems with multicollinearity might arise in the estimation. The coefficients should therefore be interpreted with caution.

fund to channel excess liquidity from increasing oil revenues in this fund. Therefore, if funds are spent on increasing the fiscal surplus, fewer resources are used to demand imports.

3.2 Estimation Methodology

In the following analysis I will show that it is appropriate to conduct a panel cointegration analysis for our model. First, panel unit root tests are conducted to test for the stationarity of the variables. In a second step, panel cointegration tests are performed. The test results suggest that there are long run cointegration relationships between the variables of the model. The main focus of this study will, thus, be on the long run determinants of oil exporters' import demand.

Panel Unit Root Tests

This section analyses the property of the variables over time. First of all, the question whether the variables in the panel are stationary or exhibit a high degree of time persistence will be explored. When finding nonstationary variables in the panel it is analysed whether there are variables with a similar stochastic trend so that a long run cointegration relationship can be established. To this end some of the standard panel unit root and cointegration tests are discussed and results presented.

The first question when discussing unit root and cointegration tests for this panel is whether the assumption of asymptotic behaviour will hold at all due to the relatively short time and cross section dimension of the panel. Hlouskova and Wagner (2006) discuss the performance of several panel unit root and stationarity tests.[24] In their discussion on the different unit root tests Hlouskova and Wagner (2006) distinguish between two groups of tests, namely those which assume homogenous behaviour, i.e. the first order serial correlation coefficient is required to be identical in all units and those based on the heterogeneous alternative where tests are based on individual time series unit root tests which are combined in an appropriate way to form group-mean computations. For the assumption of homogeneity, both the Levin,

---

There are two reasons why the specification is still chosen in this way. First of all, the correlation between the fiscal variable and the oil price is only around 45 percent. Second, both variables prove to be significant which would not be the case if multicollinearity was a serious problem.

[24] Their main finding is that the stationarity tests proposed by Hadri (2000) and Hadri and Larsson (2005) do not exhibit a good performance. According to their analysis, the null hypothesis of stationarity is almost always (wrongly) rejected. Own estimation results for this panel not reported confirm this behaviour. The Hadri test would also reject stationarity for all variables in differences, thus, suggesting that the variables are integrated of order two.

Lin and Chu (2002) and the Breitung (2000) test show the best performances. Problems arise for short samples when the time dimension is not sufficiently large. They come to the conclusion, however, that the estimation results exhibit satisfactory behaviour when T is larger than 25 and at the same time larger than the cross section dimension. As this is the case for the present panel, results of the unit root tests should be reliable and give a good impression of the characteristics of the variables. The tests for heterogeneous unit root tests based on group-mean estimates perform equally well. For our purpose the Im, Pesaran and Shin (2003) test can be used as our panel is balanced.

Table 2: Panel Unit Root Tests

	Im, Pesaran, and Shin		Levin-Lin-Chu		Breitung		Fisher PP	
	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
Variables in levels								
imports	0.2	0.58	1.9	0.97	2.8	1.00	34.5	0.93
exdd	1.1	0.87	1.5	0.94	2.1	0.98	25.6	0.99
reer	-0.8	0.20	1.9	0.97	1.1	0.85	44.5	0.62
oil	9.1	1.00	2.4	0.99	12.7	1.00	0.5	1.00
fiscal	-1.1	0.14	0.5	0.71	0.2	0.58	96.4	0.00
Variables in differences								
imports	-4.9	0.00	-0.7	0.24	-6.2	0.00	444.1	0.00
exdd	-3.7	0.00	-1.2	0.11	-4.7	0.00	260.2	0.00
reer	-5.5	0.00	-4.7	0.00	-6.3	0.00	215.9	0.00
oil	-9.4	0.00	-4.3	0.00	-17.1	0.00	949.3	0.00
fiscal	-9.6	0.00	-3.6	0.00	-10.6	0.00	972.8	0.00

Source: Author's estimations.

Table 1 reports the results of the unit root tests. All tests cannot reject the null hypothesis of a unit root for the variables in levels, while they do reject the null of a unit root for the variables in differences.[25] Our variables should, thus, all be integrated of order 1.

Panel Cointegration Tests

To find out whether theses I (1) variables possess a common stochastic trend the tests suggested by Pedroni (1999) are performed. These are cointegration tests for which information is pooled in such a way that the short run dynamics and the fixed effects are allowed to be heterogeneous over countries while common long-run relationships are assumed in the panel. The null hypothesis is that for each member of the panel the variables of interest are not cointegrated. As can be seen from Table 2 five out of seven cointegration tests can reject the null hypothesis of no cointegration at the 1 percent significance level while the panel v and panel rho statistic fail to reject it.

[25] Only the Levin-Lin-Chu test cannot reject the null of unit roots for the differences of imports and of domestic demand and exports.

Table 2: Pedroni cointegration tests

	t-statistic
Panel v-stat	0.75934
Panel rho-stat	0.7178
Panel pp-stat	-2.61762***
Panel adf-stat	-3.14538***
Group rho-stat	2.38183***
Group pp-stat	-2.54379***
Group adf-stat	-3.79910***

The tests are divided into two subgroups. The panel statistics are based on tests where the residuals of the regression are pooled along the within dimension of the panel. The second type group statistics is based on pooling along the between dimension and are thus simply the group mean statistics of the individual time-series statistics. Pedroni (2004) finds that for small time and cross section dimensions, the panel ADF and the group ADF tests perform best.[26] There is therefore sufficiently strong evidence for cointegration in the panel.

Panel Cointegration Models

After showing that the variables in the panel exhibit unit roots and that there are long run relationships between the variables we can proceed in estimating a panel long run relationship. Given the data restrictions the choice of the methodology crucially depends on the assumption of slope homogeneity of the coefficients. Estimating the panel with fixed effects assumes slope homogeneity and puts a restriction not only on the long run coefficient but also the short run dynamics and the adjustment processes are restricted to be the same across countries. For a panel of oil exporting countries this assumption seems to be too strong as the panel includes economies as different as Norway, Oman and Venezuela. The alternative would be to run separate regressions for each country. The shortcoming of this estimation methodology is that it requires sufficient data on the time dimension. For most of the countries included in this panel it is, however, impossible to increase the time frequency from annual data to quarterly data and no data prior to 1980 exists. The time dimension is, thus, not long enough to perform country by country estimations. An alternative suggested by Pesaran et al. (1999) is the estimation of the Pooled Mean Group Estimator (PMGE). This maximum likelihood estimator allows the short run dynamics and the speed of adjustment to differ

[26] The power of the unit root tests sharply increases with a larger T dimension. For samples of this size the empirical power of the test is just below 50 percent.

across countries and only restricts the long-run coefficients to be the same across countries. It seems reasonable to assume that oil exporting countries have the same economic behaviour concerning their import behaviour in the long run and to leave the short run dynamics and the adjustment process to equilibrium unrestricted. An alternative, simpler estimation method also proposed by Pesaran et al. is the Mean Group Estimator (MGE) where the estimates are not pooled but only averages of the country by country estimations are calculated. While this estimator is always consistent it does not take advantage of the possible poolability of the data and is therefore inefficient. The PMGE is efficient when compared to the MGE. To test whether the PMGE is also consistent a Hausman (1987) test comparing MGE and PMGE and testing for slope homogeneity has to be performed.

An alternative for the PMG estimation is the estimation with fully-modified ordinary least squares (FMOLS) as proposed by Pedroni (2004). This estimator provides superconsistent estimates for the long-run parameters. In general it is found that the FMOLS needs less restrictive assumptions and performs well even for small panels. Pedroni (2004) shows that the group mean FMOLS estimation method performs well even for small T and small N. For our panel which has a time dimension (T) of 26 years and a cross section dimension (N) of 24 countries the above mentioned estimation methods should be appropriate. Indeed, both Pedroni (2004) and Pesaran et al. (1999) use panels with similar dimensions for their estimations.[27]

3.3 Estimation Results

The long-run import function for oil exporting countries is assumed to be given by:

$$im_{it} = \theta_{0i} + \theta_{1i}\, exdd_{it} + \theta_{2i} reer_{it} + \theta_{3it} oil_{it} + \theta_{4it}\, fisc_{it} + u_{it} \qquad (1)$$

$$i = 1,2,\ldots..,24 \text{ and } t = 1,2,\ldots..26,$$

where *im* is the logarithm of real imports, *exdd* is the logarithm of the sum of real domestic demand and real exports, *reer* is the logarithm of the real effective exchange rate, *oil* is the logarithm of the US dollar price of oil and *fisc* is the government balance in percent of nominal GDP as described in the data section. As discussed above we would expect θ_{1i} and θ_{2i} to be close to unity from a theoretical point of view while previous empirical studies point to θ_{1i} higher than 1 and θ_{2i} lower than 1. The coefficient for oil θ_{3it} is expected to be positive and

[27] Pesaran, Shin and Smith (1999) use a panel with N=24 and T=32 and Pedroni simulates panel results with at the lowest N=10 and T=10. For the PMGE it is also important that the condition holds that the time dimension is larger than the cross section dimension. This is the case for this panel.

the coefficient of government balances θ_{4it} is expected to have a negative sign. From the previous tests on unit roots we conclude that our variables are I(1) and cointegrated.

The import equation can be written as an autoregressive distributed lag (ARDL) equation in general terms (with one lag short run dynamics as an example):

$$im_{it} = \mu_i + \delta_{10i}\, exdd_{it} + \delta_{11i}\, exdd_{i,t-1} + \delta_{20i} reer_{it} + \delta_{21i} reer_{i,t-1} + \delta_{30i} oil_{it} + \delta_{31i} oil_{i,t-11} + \delta_{40i}\, fisc_{it} + \delta_{41i}\, fisc_{i,t-1} + \lambda_i\, im_{i,t-1} + \varepsilon_{it} \quad (2)$$

The error correction form of the autoregressive distributed lag (ARDL) equation is given as

$$\Delta im_{it} = \Phi_i\,(im_{it-1} - \theta_{0i} - \theta_{1i}\, exdd_{it} - \theta_{2i} reer_{it} - \theta_{3i} oil_{it} - \theta_{4i}\, fisc_{it}) - \delta_{11i}\, \Delta exdd_{it} + \delta_{21i}\, \Delta reer_{it} - \delta_{31i}\, \Delta oil_{it} - \delta_{41i}\, \Delta fisc_{it} - \varepsilon_{it} \quad (3)$$

where $\theta_{0i}=\mu_i/(1-\lambda_i)$, $\theta_{1i}=(\delta_{10i}+\delta_{11i})/(1-\lambda_i)$, $\theta_{2i}=(\delta_{20i}+\delta_{21i})/(1-\lambda_i)$, $\theta_{3i}=(\delta_{30i}+\delta_{31i})/(1-\lambda_i)$, $\theta_{4i}=(\delta_{40i}+\delta_{41i})/(1-\lambda_i)$ and $\Phi_i = -(1-\lambda_i)$.

The lag structure is determined by the Akaike selection criterion. The maximum lag length is chosen to be two and then the optimum lag length for each variable for each country is chosen individually by the Akaike criterion. Table 3 shows the estimation results.

Table 3: Estimation of Import Demand in Oil Exporting Countries

Regression	FMOLS	PMGE
EXDD	1.28***	1.65***
	(56.41)	(28.68)
REER	0.18***	0.18***
	(10.8)	(7.98)
OIL	0.09***	0.25***
	(5.94)	(6.76)
FISC	-0.00***	-0.01***
	(-3.30)	(-7.22)
Phi		-0.21***
		(-4.33)
Hausman-test		3.28
		(0.51)
Number of observations	624	624

Absolute value of t statistics in parentheses (p-value for Hausman test)
* significant at 10%; ** significant at 5%; *** significant at 1%

All coefficients are significant at the 1 percent significance level and have the predicted sign. At the same time, the Hausman test cannot reject the null hypothesis that the PMG estimator is significantly different from the consistent MG estimator. The main focus of our

analysis will, thus, be on the PMGE estimation results. In addition, FMOLS results are reported as robustness because they are superconsistent and therefore a good robustness check. As can be seen in Table 3, the coefficient for the variable exdd which includes real domestic demand and real exports is 1.28 for the FMOLS and 1.65 for the PMGE. This coefficient is comparable with findings for the real activity coefficient in many other studies for industrial countries. The coefficient for real demand including real exports is higher than the coefficient only including domestic demand (1.2).[28] However, for oil exporting countries, the volume of exports needs to be included as an explanatory variable as much of their purchasing power comes from export revenues.[29] It is reassuring to see that this real activity variable has a highly significant and positive effect on real import demand.

The main focus of this study is, however, on the price effects both of the real exchange rate and of the oil price. As can be seen in Table 3, the real effective exchange rate (reer) has a significantly positive impact on imports. A 10 percent appreciation of the real exchange rate for imports leads to a 1.8 percent increase in imports in the long run. This elasticity is rather on the lower side. Theory predicts an elasticity of unity in the long run. One reason for this low elasticity might be the relatively low substitutability of imports and domestically-produced goods. Especially for oil exporting countries, a large share of imports are luxury goods produced only abroad, e.g. luxury cars. Some import goods seem to be substitutes of domestically-produced goods, however, because in the extreme case of no substitutability no expenditure switching would take place and the coefficient of the real exchange rate measure would be zero. Table A3 in the appendix summarizes the growth rates of the main variables in oil exporting countries. It can be seen that real exchange rate fluctuations have been rather small in the past. Only for the CIS countries sizeable fluctuations can be observed. The main reason for this phenomenon is that most of the oil exporting countries do not only have a fixed exchange rate regime so that nominal exchange rate fluctuations are kept small, but they also do not allow local prices to adjust freely. The latter restrictions most likely prevent more pronounced real appreciations that the Balassa-Samuelson effect would predict.[30]

The coefficient for oil has a significantly positive impact on import demand. Through higher export revenues import demand is stimulated. In addition there can be a significant

[28] This specification was estimated as an additional robustness check.
[29] It is, however, important to distinguish between quantity and price effects of export revenues. The volume of exports only reflects the quantity of oil exports. This is likely to be relatively stable comparable to domestic demand. In contrast to prices which are likely to be highly volatile and which are the source of fluctuations in export revenues in the short and medium run.
[30] The Balassa Samuelson effect states that countries in a catching up process (like countries in transition) exhibit higher inflation rates than industrial countries.

wealth effect through the higher value of existing oil reserves if the oil price change is perceived as permanent. The overall wealth effect is quite large even though the coefficient looks rather small with 0.25. In the long run a 10 percent increase in the oil price leads to 2.5 percent more imports. In the past years the oil price more than doubled. Only from 2004 to 2005 the oil price increased by more than 40 percent. This shows the dimension of the impact the oil price can have on imports.

The size of the effect of the fiscal variable on imports in the long run cannot directly be read from the coefficient as this is not reported in logarithms but as share of nominal GDP. The qualitative estimation results show, however, that the fiscal balance has a significant negative effect on import demand. This shows that some of the revenue increases due to higher oil prices are kept as a reserve for times of lower oil prices so that fiscal policy can be countercyclical to movements in the oil price. Many countries such as Russia or Norway have oil stabilization funds. These funds can indeed have a negative effect on import demand as our results show. To claim that oil exporting countries should not keep their petrodollars in funds but to use them to minimize global imbalances is, however, unjustified. This study shows that the oil price does have a significant positive effect on import demand. The nature of the oil price which is highly volatile as well as the nature of petroleum as an export product which is scarce, make it necessary for oil exporting countries to build up some reserves for times of low oil prices and for future generations.

The main focus of the analysis is on the estimation results of the PMGE estimations. For this long run cointegration estimation the adjustment coefficient Φ is crucial because it describes the speed of adjustment with which the system reacts to shocks to come back to the steady state relationship between the variables. This coefficient is significant and negative as it should be for the overall panel. It is estimated for each country individually. For the majority of countries this adjustment coefficient is significantly negative.[31] It is not surprising that there are some insignificant adjustment coefficients given the small sample size. The size of the average coefficient of adjustment can be interpreted in such a way that the estimated speed of convergence is about 20 percent per year and that the system is close to equilibrium in around five years. Most of the countries have an adjustment coefficient close to 0.2. The highest speed of adjustment to equilibrium can be found for Russia. The coefficient of 0.78 is

[31] For Saudi Arabia the optimum lag length criterion selects a lag length of 0 so that a static model is estimated. In 19 countries the coefficient is negative, only in 4 countries is the coefficient positive (and not significant). In 10 countries the coefficient is highly significant. 8 countries show t-statistics between 1 and 2.

similar to the error correction coefficient in the country analysis of Russia (0.65).[32] Russian imports seem to adjust quickly to shocks. The contrary is true for imports of Iran and Oman. Here, adjustment takes around 10 years. Reasons for these different speeds in adjustment could be found in the respective trade openness of the countries.

Table A4 shows some tests on the functional form of the group specific estimates. It is important to see how well specified the model is on a country-by-country basis before the more efficient PMGE procedure should be implemented. The results presented are reassuring. Only three countries exhibit signs of serial correlation, three countries show signs of functional form misspecification, in one country signs of non-normality and in one country signs of heteroscedasticity of the residuals can be found. On average almost 90 percent of the change in the logarithm of imports is explained. Some long run elasticities estimated on this country-by-country basis are found to be insignificant. When judging these diagnostic results it should, however, always be kept in mind that the estimation over such a short horizon is likely to render some estimates insignificant or unstable. This is precisely, why the analysis is not based on a country-by-country study but on the PMG estimation. In addition, when comparing these results with an analysis of OECD countries it should be noted that it is not unsurprising that the data quality and diversity of oil exporting countries does not allow for even more robust results. On the contrary, as the next section will show, the estimation results are surprisingly robust over different specifications.

3.4 Robustness of the Estimation Results

The panel of oil exporting countries is extremely diverse; therefore it is important to check the estimation results for robustness. The first check of robustness was the estimation of FMOLS parallel to the estimation of PMGE. As a next step I check whether the stepwise exclusion of a country (group) has a significant effect on the size and significance of the coefficient. Figure A 1 in the appendix shows the coefficients of exdd, reer and the price of oil respectively. On the x axis the country groups which are excluded are listed.

The coefficient for domestic demand and exports is very robust. It is almost the same for all the specifications. Only for the specification without the Middle East the coefficient is a little bit lower. This has to be read in such a way that the coefficient for the countries of the Middle

[32] See chapter 4 for details. Even though this coefficient is estimated for quarterly data, the slightly lower coefficient for the quarterly estimation leads to a similar adjustment process within one year.

East is higher than for the overall panel.[33] The intuition behind this result is straightforward. These economies are highly dependent on oil and often hardly have any domestic industry outside the oil production process. With increased domestic demand most of the demand is therefore channelled to foreign products because the domestic industry is slow to adjust to the additional demand.

The coefficient of the real exchange rate seems to be less robust when compared to the coefficient of exdd. It should be kept in mind, however, that the reaction to the real exchange rate is more likely to differ across countries already because of the different exchange rate regimes which have been in place over the sample period. Yet, it is reassuring to note that even with reduced degrees of freedom due to the smaller sample when excluding country regions the coefficient is highly significant for all specifications. It also hardly fluctuates with all the country regions. Only when excluding the countries of the CIS the coefficient increases somewhat. It is important to keep in mind that for the countries of the CIS the data quality before 1995 is very poor. Especially the approximation of the real exchange rate is extremely poor for the beginning of the sample period.[34] The reason to include the countries of the CIS nevertheless is not only that Russia is one of the major economies in the sample, but also that the CIS countries are almost the only countries with a relatively flexible exchange rate regime.[35] Fluctuations of the real exchange rate in the other economies have been more subdued in the past due to nominal exchange rate restrictions. Especially when discussing a possible step to let the currencies of the oil exporting countries float freely it is crucial to compare the effect this could have on their import demand to the countries that have had flexible exchange rate regimes already over the current sample period.

The coefficient for the panel without the CIS countries is higher, i.e. the coefficient for the CIS countries would be lower if it could be estimated individually.[36] The CIS countries have such a large effect on the size of the coefficient because their real exchange rates are the main ones to fluctuate. The discussion on the real exchange rate coefficient can show two things. First, there is an even higher potential for the impact of the real exchange rate on oil exporting countries for all the countries that are currently in a fixed peg. Second, this effect should not

[33] It would not be efficient to estimate the panel for each country group individually because of the limited time dimension and degrees of freedom of the panel.
[34] It can be argued indeed that there should be no approximation of the real exchange rate for these countries during this time period as they were extremely closed economies and capital was not allowed to fluctuate freely.
[35] For a list of exchange rate regimes in oil exporting countries see Table A3 of the appendix.
[36] When comparing the coefficient for the overall panel with the coefficient for the long run elasticity of the real exchange rate for Russia in the section on Russia's dependence on oil, it can be seen that the two do not differ considerably. This is an additional proof of robustness.

be overestimated, however, as the experience of the CIS countries shows that the effect might become smaller when exchange rate fluctuations become larger. The next section will show that neither interpretation of the coefficient leads to fundamentally different interpretations of the impact of the real exchange rate of oil exporting countries for global imbalances in the long run.

The coefficient of the oil price is robust over countries. The relatively higher impact of the oil price in the Middle East can be explained by the big share of oil exports in overall GDP. These countries are therefore especially dependent on their oil revenues and more likely to show more pronounced reactions to the oil price. Also, as argued above, the domestic industry mostly cannot absorb additional demand created by the increased wealth due to higher oil prices so that the additional demand is channelled to foreign products. The contrary is true for a country like Russia which is such a big economy that even though it is highly dependent on the price of oil, it still has a sizeable industry outside the oil sector which can also absorb additional demand created by higher oil revenues.

The next robustness check is to see whether the estimation results are robust to changes in the lag length. The lag length is chosen with the optimum lag selection criterion of the Augmented Dickey Fuller test. The results do not change when instead of the ADF test, the Schwartz or the Hannan Quinn lag selection criterion is chosen. The maximum lag length is chosen to be two for the standard specification. Figure A2 of the appendix shows that the estimation results are robust to different maximum lag lengths. A maximum lag length higher than 3 is not chosen because of the reduced degrees of freedom and also because a higher lag length seems rather implausible economically as the data is on an annual basis.

As another robustness test different versions of the explanatory variables are included. Different concepts of the activity variable as explained above, as well as different concepts of the real exchange rate are included and estimations where also performed with a real oil price. For an overview of the results of the different estimation specifications see Table 4. Estimations for both the real oil price deflated with the U.S CPI and the real oil price converted to local currency using the nominal exchange rate and deflated with each country's CPI are shown. The reason to include the nominal oil price in the main specification is simply a matter of better interpretability as stated above. Including the real oil price does not change the estimation results. The coefficient of the oil price is 0.18 for the U.S. real oil price and 0.20 for the country specific real oil price. The coefficient is, thus, only marginally smaller than in the estimation with nominal oil prices.

Table 4: Overview of different estimation specifications

Dependent variable: Imports Regression		**basis**	1a	1b	1c	2a	2b	3a	3b
Activity variable	Domestic Demand plus Exports	**1.65*** (28.69)**				1.41*** (26.18)	1.68*** (36.24)	1.60*** (34.48)	1.44*** (34.22)
	GDP		1.10*** (22.18)						
	Domestic Demand			1.22*** (44.9)					
	only exports				0.72*** (26.91)				
Real exchange rate	reera (all US Euro Area)	**0.18*** (7.98)**	0.32*** (11.29)	0.22*** (10.83)	0.17*** (5.81)			0.16*** (6.82)	0.33*** (13.34)
	reer (incl. WEO)					0.30*** (11.33)			
	reera (no other fluct.)						0.23*** (7.76)		
Oil price	nominal	**0.25*** (6.76)**	0.24*** (6.16)	0.14*** (5.57)	0.38*** (8.67)	0.21*** (6.13)	0.21*** (6.84)		
	real US							0.18*** (7.68)	
	real country specific								0.20*** (9.32)
Government balance		**-0.01*** (-7.22)**	0.00 (1.61)	0.00*** (3.87)	-0.01** (-2.19)	-0.01*** (-4.45)	-0.01*** (-8.33)	-0.01*** (-5.59)	-0.01*** (-0.74)
Phi		**-0.23*** (-4.33)**	-0.42*** (-5.32)	-0.36*** (-4.62)	-0.44*** (-5.14)	-0.23*** (-4.55)	-0.28*** (-4.63)	-0.27*** (-5.27)	-0.25*** (-3.75)
Hausman-test		**3.28 (0.51)**	3.00 (0.56)	4.07 0.40	4.69 (0.32)	3.18 (0.53)	14.35 (0.01)	5.82 (0.21)	5.84 (0.21)

Absolute value of t statistics in parentheses (p-value for Hausman test)
* significant at 10%; ** significant at 5%; *** significant at 1%

Including different approximations of the real exchange rate does not change the results either. One concept includes the IMF WEO real effective exchange rate where available (*reer (incl. WEO)*) and only fills the non available data with the approximation of the real exchange rate for imports. The other specification is the approximation of the real exchange rate which assumes that all exchange rates other than the bilateral real exchange rates vis-à-vis the U.S. dollar and the euro stay constant (*reera (no other fluct)*). This way the real exchange rate fluctuates much less on average than with the assumption used for the standard estimation that all fluctuation comes from the real exchange rate vis-à-vis the U.S. dollar and the euro, i.e. that all other bilateral exchange rates fluctuate in the same way on average (*reera (all US Euro Area)*). From a theoretical point of view it is not clear which approximation is more appropriate. When comparing the two different concepts of approximation with the IMF WEO real effective exchange rate for those countries where data exists led me to choose the second concept over the first as it follows the data from the IMF more closely. However, even the estimation with other approximations of the real exchange rate led to almost identical results.

Another robustness test is to extend the dataset which is in full only available until 2005 with preliminary and forecasted data of the WEO database for the year 2006.[37] Estimations with this extended dataset also provide almost identical coefficients.[38] This exercise was performed to judge whether recent developments would change the estimation results. This is not the case. Another issue is whether the estimation suffers from an omitted variable bias. The overall power of the estimation equation and the good fit and good robustness of the model do not point to such a bias. It is not possible to include all variables that come to mind into the estimation because this would reduce the degrees of freedom in such a way that the estimation is no longer possible. One channel for petrodollar recycling should, however, not be left unmentioned. While the focus of this study is the recycling of petrodollars through trade other studies focus on the financial channel. It is very difficult to measure the financial flows and the foreign assets of oil exporting countries as many of these are acquired through financial centres in London or similar. One specification to check the robustness of our results was to include the net foreign asset position as an explanatory variable.[39] Net foreign assets have a significantly negative effect on imports. All resources taken for financial assets are not free

[37] IMF World Economic Outlook, September 2006.
[38] Detailed results are available on request.
[39] The data is taken from the dataset by Lane and Milesi-Ferretti (2006). The variable was included as share of nominal GDP. In this specification the fiscal balance could not be included at the same time due to reduced number of degrees of freedom.

for use to buy imports. This coefficient should, however, be interpreted with caution due to the data problems mentioned above. The main reason why this estimation was performed was to show that the results for the other coefficients do not change. This is the case as the coefficients are almost the same as with the specification without the financial variable.

4. Impact on Global Imbalances

The group of oil exporting countries considered in this panel makes up only 5.6 percent of world GDP.[40] Nevertheless, theses countries are increasingly given a role as players in the global imbalances debate. In April 2006 at the G8 meeting in St. Petersburg it was argued that oil exporting countries should let their exchange rates float so as to appreciate and have increased demand for foreign products help reduce global imbalances.[41] The idea behind this is that with increasing oil prices and increasing oil revenues in theses countries some of the extra gain should be spent abroad especially as higher oil prices increase the current account deficit of oil importing countries already through the price effect.[42] It is often argued that oil exporting countries have replaced other advanced countries excluding the United States as countries with the highest current account surplus. In the following exercise I want to show that even though both oil prices and the real exchange rate have a considerable effect on imports of oil exporting countries, the overall effect on global imbalances is bound to be almost negligible. To get an intuition on the exact amount of trade flows the next section performs a simulation exercise on the impact of a 10 US dollar increase in the oil price and a 10 percent appreciation of the real effective exchange rate.

A 10 dollar increase in the price of oil is often discussed as a benchmark scenario. From the approximate level of 50 US dollars in 2005, a 10 dollar increase is a 20 percent increase in the price of oil. According to our long run elasticity of 0.25 a 20 percent increase in the price of oil would lead to a 5 percent increase in real imports. A 10 percent appreciation of the real exchange rate given the long run elasticity of approximately 0.2 would result in a 2 percent increase in real imports. While this has a considerable impact for each oil exporting country,

[40] In nominal GDP numbers for the year 2005.

[41] For example Krueger (2006): "The oil exporters' large surpluses—and their increase in wealth—provide a rare opportunity to tackle some long-standing domestic problems, and at the same time—as an important by-product—make a major contribution to the reduction of global imbalances. […] Oil-importers, too, need flexibility both in their exchange rate regimes and elsewhere in the economy if they are to minimize the impact of oil price rises on their economies."

[42] Nsouli, Saleh M., Director Offices in Europe, IMF (2006): "Indeed, oil exporters' imports may come partly to offset the initial oil price-driven revenue inflow in their current account. If those imports come from oil-importing countries, they also help reduce the pressure on oil importers' current accounts."

to find out how this increase in real imports affects global imbalances a number of assumptions have to be set.

As discussed in the introduction the focus of this study is on real effects rather than on price effects. This is why the impact of the real exchange rate and the oil price on real imports has been analysed. In the worldwide discussion on global imbalances, the current account balances, in particular the current account deficit of the United States is the main focus of attention, however. Therefore I will transform the effect on real imports into changes in the current account balances of the trading partners. For this exercise a set of simplifying assumptions can transform real import changes into value changes in the trade balance. First of all, it is assumed that oil demand is completely inelastic.[43] Second, there are no changes in the nominal exchange rate.[44] That is, the real appreciation comes only through relative price differences or higher price increases in the oil exporting countries than in their trading partners. This assumption is not binding for the analysis of the US current account deficit as the US dollar value of exports of the US to oil exporting countries shows only volume effects and not value effects (as their exports are priced in US dollar). The same is true when the assumption holds that all exporters to the oil exporting countries invoice in producer currency, i.e. no nominal exchange rate movements influence the value of the exports going to the region of oil exporting countries. Another assumption is that export prices of the trading partners are not subject to inflation, i.e. real changes equal nominal changes. These assumptions might seem very restrictive but they are not at all crucial for the overall qualitative result of the analysis, rather they serve to make the analysis as simple and straightforward - leaving out all effects outside the direct transmission mechanism - as possible.

4.1 Simulation of a 10 U.S. dollar increase in the price of oil

First of all, the impact of a 10 US dollar increase in the oil price is analysed. A simple oil bill calculation is based on the assumption of an oil price increase from 50 US dollar to 60 US dollar (20 percent increase). Current account and trade balance data are taken from the World Economic Outlook of the IMF for the year 2005.

[43] This assumption is quite plausible as the demand for oil is very price inelastic.
[44] The assumptions should hold both for the oil price increase and the real exchange rate increase simulation.

Table 4 shows the implications of a 10 US dollar increase in the price of oil for the United States. First of all, it should be noted that the increase in the oil price has a direct (and considerable) negative impact on the U.S. current account balance through the higher oil bill.[45]

Table 4: Implications for the United States

	Hypothetical Oil Price (in $ per barrel)	Oil Bill (in billion $)	Exports to Oil Exporting Countries (in billion $)	% point compensation in Current Account	Share of Bill Increase compensated for by export increase
Starting point	**50.0**	**224.1**	**62.6**		
Increase	**60.0**	**268.9**	**65.8**		
in dollar	**10.0**	**44.8**	**3.1**		
in percent	**20**	**20**	**5.0**	**0.03**	**7.0**

Source: IMF WEO, IMF DTS, BP (2006), own calculations.

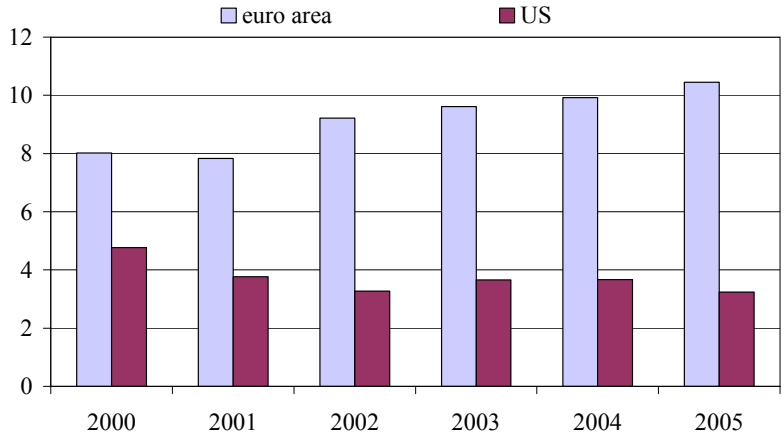
Assuming that the geographic import structure of the oil exporting countries does not change, the 20 percent increase in the oil price translates into a 5 percent increase of oil exporting countries' imports from the U.S. or a 5 percent increase of U.S. exports to the oil exporting countries. Calculated as a percentage point change from the 2005 level of the current account deficit, this translates into a 0.03 percentage point compensation for the otherwise worsening current account balance. Or transformed into a the share of the bill increase due to the oil price increase that is compensated for by the higher exports to oil exporting countries, this is a 7 percent compensation. This calculation illustrates that higher oil prices cannot be compensated for by higher exports to the region benefiting from the oil price increase, at least not for the United States.

Figure 1 shows the geographical distribution of exports of the United States and the euro area.[46] The figure shows that not only is the share of euro area exports almost three times as high in 2005 as the share of U.S. exports to the region of oil exporting countries, but the euro area gradually increased their trade share with the region while the United States does not seem to participate in this increased demand from the region of oil exporting countries. This is the case even though the oil exporting countries depreciated on average in real terms by

[45] It is assumed that there is no quantity adjustment in the demand of oil. This assumption is quite plausible as the demand for oil is very price inelastic.
[46] For the euro area the share is the share of exports relative to extra euro area trade. All euro area data is for the composition of the European Monetary Union as of 2006, i.e. excluding Slovenia.

around 7 percent against the euro while they appreciated against the U.S. dollar by around 23 percent.[47]

Figure 1: Share of exports to oil exporting countries



Source: IMF Direction of Trade Statistics (DTS). Author's Calculations.

How does the oil bill calculation of the euro area compare to that of the United States? When comparing the euro area oil bill to the oil bill of the United States it should first of all be noted that – although the United States is an oil producer – the oil bill of the U.S. is still slightly higher than for the euro area, i.e. the U.S. is likely to suffer more from increasing oil prices. It can also be seen that the euro area exports almost five times more in absolute terms to the region of oil exporting countries. With similar oil bill increases due to a 10 U.S. dollar increase of the oil price, the compensation of higher exports to the region is, thus, five times as high as for the United States.

Table 5: Implications for the Euro Area

	Hypothetical Oil Price (in $ per barrel)	Oil Bill (in billion $)	Exports to Oil Exporting Countries (in billion $)	% point compensation in Current Account	Share of Bill Increase compensated for by export increase
Starting point	**50.0**	**202.8**	**294.6**		
Increase	**60.0**	**243.4**	**309.3**		
in dollar	**10.0**	**40.6**	**14.7**		
in percent	**20**	**20**	**5.0**	**0.15**	**36.32**

Source: IMF WEO, IMF DTS, BP (2006), own calculations.

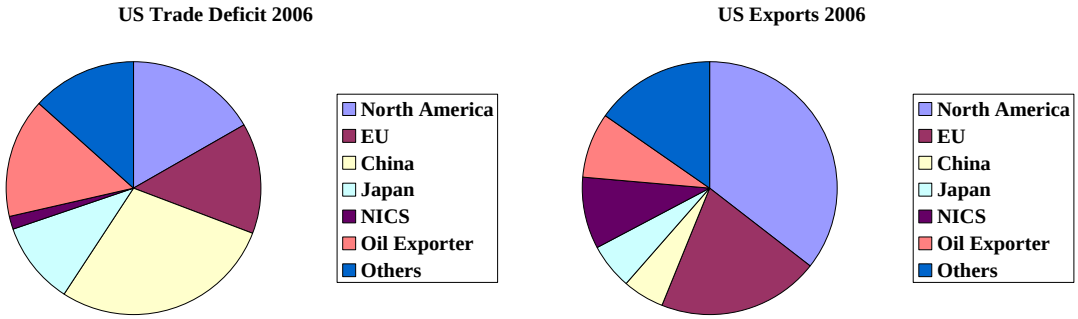
As can be seen from Table 5, for the euro area almost 40 percent of the oil bill increase is compensated for by higher exports to the region of oil exporting countries.

[47] These numbers are calculated for the period from 2000 to 2005 from a weighted average of oil exporting countries. In nominal terms oil exporting countries depreciated by around 30 percent against the euro and by around 8 percent against the USD.

4.1 Simulation of a 10 percent real appreciation

A 10 percent real appreciation leads to a 2 percent increase in real imports in the long run. As discussed above, this effect could also be slightly higher when abstracting from the CIS countries or when using different estimation specifications. This exercise shows that the overall impact on global imbalances would be almost negligible. The improvement of the U.S current account deficit would amount to 0.01 percentage points[48] while the improvement of the euro area current account would amount to 0.06 percentage points. Even if the elasticity was four times as large the improvement in the current account balances would still be minimal, especially for the United States.

Figure 2: Oil Exporters' Share in the U.S. Trade Deficit and U.S. Exports 2006



Source: U.S. Bureau of Economic Analysis (2007), own calculations.
Note: Oil Exporter includes OPEC countries without Indonesia and in addition of Russia and Algeria. North America consists of Canada and Mexico; NICS are the Newly Industrialised Countries (Hong Kong, Korea, Singapore, Taiwan). The data includes data up to November 2006.

In Figure 2 it can be seen that the bilateral U.S. trade deficit with the oil exporting countries is approximately of the same size than the bilateral trade deficit with North America[49] and the EU. However, the share of exports going to the oil exporting countries is not very high when compared to other regions. Given that imports form the region consist almost exclusively of oil which is invoiced in U.S. dollar, the adjustment mechanism of the exchange rate and the expenditure switching mechanism can work only for exports going to oil exporting countries. The effect is, thus, bound to be very low.

Therefore, the role of the oil exporting countries in global imbalances seems to be rather limited so far. This is not to say that the impact of considerable real appreciations that could well be higher than 10 percent per year would not be felt in the world economy. But given the geographical trade structure of the United States and the euro area, considerable real

[48] Using a current account deficit of -6.35 of GDP as a starting point.
[49] In the definition of the Bureau of Economic Analysis, North America includes Canada and Mexico.

appreciations of oil exporting countries are more likely to benefit the euro area rather than the U.S leaving global imbalances unresolved.

5. Conclusion

The aim of this paper was to analyse the determinants of oil exporting countries' import behaviour and to put the results of the analysis into a global perspective. The estimation results show that real imports are driven by real domestic demand and real exports, by the real effective exchange rate, by the oil price and by fiscal balances in the long run. Higher domestic demands and higher real exports lead to additional demand for foreign products. The elasticity for oil exporting countries is higher than for industrialised countries as most of the oil exporting countries heavily rely on the oil industry in all production fields and can therefore not satisfy increased demand with domestic products. The fiscal balances have a negative effect on imports in the long run. This is the case because most of the oil exporting countries have oil stabilisation funds to safeguard against too high volatility in the oil price and to accumulate some funds for future generations which cannot profit from the oil revenues to such an extent as resources are limited.

Real appreciations also lead to an increase in imports in the long run. The elasticity of 0.2 seems to be on the lower side when compared to estimates for other countries. When excluding the countries of the CIS from the panel or using alternative approximations of the real exchange rate this elasticity could also be somewhat higher. Most of the oil exporting countries have fixed exchange rate arrangements so that the fluctuations of the real exchange rate have been subdued in the past years. However, even the considerable real appreciations that could be expected if all currencies in oil exporting countries were free to float and if prices were no longer regulated in these economies are not likely to trigger an improvement of global imbalances. Also, the impact of the increased import demand would on the contrary rather benefit the euro area and not the United States due to their respective geographical structure of trade.

An increase in the oil price is accompanied by increased demand for foreign products in oil exporting countries in the long run. This direct wealth effect through higher oil export revenues increases imports of oil exporting countries considerably following oil price increases. However, the negative effect the higher oil price has on the current account balances of oil importing countries like the United States and the euro area cannot be

compensated. For the United States only 7 percent of the higher oil bill is compensated by increased exports to oil exporting countries while almost 40 percent of the increase is compensated for the euro area.

Overall this study sheds some light on the import behaviour of oil exporting countries. Even though these countries are quite heterogeneous in their economies they still seem to exhibit some common behaviour in the long run adjustments to movements of the real exchange rate and the oil price. Their reaction to domestic demand and real export increases and to fluctuations in the exchange rate are even comparable to those of industrialised countries. The overall impact of oil exporting countries import demand on global imbalances is almost negligible, however. Even though their imports are likely to stay very dynamic in the medium term future, the size of their economies is just too small for them to play a leading role in the resolution of global imbalances. In addition, increases in demand for foreign products mainly benefit the euro area rather than the United States due to the geographical structure of trade. Future research could benefit from better data quality and longer time series.

References

Backus, David K., Patrick J. Kehoe, and Finn E. Kydland (1994). Dynamics of the Trade Balance and the Terms of Trade: The J-Curve? *The American Economic Review*, Vol. 84 (1), pp. 84-103.

Barrell, Ray and Dirk Willem te Velde (2002) European Integration and Manufactures Import Demand: An Empirical Investigation of ten European Countries. *German Economic Review* Vol. 3(3), pp 263-293.

Barrell, Ray and Stephane Dées. (2005). World Trade and Global Integration in Production Processes: a Re-assessment of Import Demand Equations. ECB Working Paper No. 503.

BP (2006). Statistical Review of World Energy 2006. Online available: http://www.bp.com/home.do?categoryId=1

Breitung, Jörg (2002). Nonparametric Tests for Unit Roots and Cointegration, *Journal of Econometrics*, Vol. 108, pp. 343-363

Cashin, Paul, Luis Felipe Céspedes, and Ratna Sahay (2004). Commodity Currencies and the Real Exchange Rate. *Journal of Development Economics* Vol. 75, pp. 239-268.

Chari, V.V., Patrick J. Kehoe, and Ellen R. McGrattan (2002). Can Sticky Price Models Generate Volatile and Persistent Real Exchange Rates? Review of Economic Studies Vol. 69, pp. 533-563.

Clarida, Richard H. (1994). Cointegration, Aggregate Consumption, and the Demand for Imports: A Structural Econometric Investigation. *American Economic Review*, Vol. 84 (1), pp 298-308.

Department of the Treasury and of International Affairs (2006). Petrodollars and Global Imbalances. Office of International Affairs Occasional Paper No. 1, Washington DC.

Federal Reserve Bank of San Francisco (2006). Oil Prices and the U.S. Trade Deficit. FRBSF Economic Letter No. 2006/24, 22 September 2006, San Francisco.

Goldstein, Morris and Mohsin S. Kahn (1985). Income and Price Effects in Foreign Trade. *Handbook of International Economics* Vol. II edited by R.W. Jones and P.B. Kenen.

Hadri, Kaddour (2000). Testing for Stationarity in Heterogeneous Panel Data. *Econometrics Journal* 3, pp. 148-161.

Hadri, Kaddour and Rolf Larsson (2005). Testing for stationarity in heterogeneous panel data where the time dimension is finite. *The Econometrics Journal* 8, pp. 55-69

Hlouskova, Jaroslava and Martin Wagner (2006). The Performance of Panel Unit Root and Stationarity Tests: Results from a Large Scale Simulation Study. *Econometric Review* 25 (1), pp. 85-116.

Harb, Nasri (2005). Import demand in heterogeneous panel setting. *Applied Economics*, No. 37, pp 2407-2415.

Hausman, Jerry (1978). Specification Tests in Econometrics. *Econometrica* Vol. 46, pp. 1251-1271.

Im, K.S., Hashem Pesaran, and Yongcheol Shin (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics* 115(1): 53-74.

IMF (2004) De facto classification of Exchange Rate Regimes. Online available on: http://www.imf.org/external/np/mfd/er/2004/eng/0604.htm.

IMF (2006). World Economic Outlook September 2006. Washington DC.

Kee, Hiau Looi, Alessandro Nicita and Marcelo Olarreaga (2004). Import Demand Elasticities and Trade Distortions. World Bank Policy Research Paper WPS3452, Washington DC.

Krueger, Anne (2006). Remarks at the G8-B-MENA Meeting. 21 May 2006, Sharm El-Sheikh, Egypt. Online available: http://www.imf.org/external/np/speeches/2006/052106.htm.

Lane, Philip and Gian-Maria Milesi-Ferretti (2006). The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004. IMF Working Paper No. 06/69. Washington DC.

Levin, Andrew, C. Lin, and C. Chu (2002). Unit Roots in Panel Data: Asymptotic and Finite-Sample Properties. Journal of Econometrics Vol. 108, pp.1-24.

Nsouli, Saleh M., Director Offices in Europe, IMF (2006). Petrodollar Recycling and Global Imbalances. Speech at the CESifo's Summer Conference in Berlin, March 23-24 2006.

Pedroni, Peter (1999). Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors. *Oxford Bulletin of Economics and Statistics*, Special Issue.

Pedroni, Peter (2000). Fully-Modified OLS for Heterogeneous Cointegrated Panels. *Advances in Econometrics,* Vol. 15, pp. 93-130.

Pedroni, Peter (2004). Panel Cointegration; Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the Purchasing Power Parity Hypothesis. *Econometric Theory* 20, pp. 597-325.

Pesaran, Hashem M., Yongcheol Shin, and Ron P. Smith (1999). Pooled Mean Group Estimates of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association* Vol. 94 (446), pp. 621-634.

Rebucci, Alessandro and Nikola Spatafora. (2006). Oil Prices and Global Imbalances. In *IMF World Economic Outlook* (April 2006), pp. 71-96. Washington, DC: International Monetary Fund.

Reinhart, Carmen (1995). Devaluation, Relative Prices, and International Trade. *IMF Staff Papers* Vol. 42 (2).

Senhadji, Abdelhak (1998). Time-series estimation of structural import demand equations: a cross-country analysis. *IMF Staff Papers* Vol. 45(2), pp. 236-68.

Thursby, Jerry and Marie Thursby (1984). How Reliable are Simple, Single Equation Specifications of Import Demand? *The Review of Economics and Statistics*, Vol. 66 (1), pp. 120-128.

U.S. Bureau of Economic Analysis (2007). News, Wednesday, January 10, 2007. U.S. International Trade in Goods and Services November 2006. Online available: http://www.bea.gov/bea/newsrelarchive/2007/trad1106.pdf

Appendix

Table A1: Data Availability

Variable	Source	Type	Start date	End date	Countries	Notes
imports	IMF WEO	national accounts data	1980	2005	All countries except listed below	real imports in constant 2000 prices.
	IMF WEO	national accounts/ BoP data	1990	2005	Congo, Ecuador, Libya, Oman, Qatar, Yemen.	approximation for missing national accounts data with BoP data
			1997	2005	Turkmenistan	approximation for missing data with BoP data
BoP imports	IMF WEO	BoP data	1980	2005	Kazakhstan and Sudan	
domestic demand and exports	IMF WEO	national accounts/ BoP data	1980	2005	All countries except listed above	approximation for missing data with BoP data
reer	IMF WEO	real effective exchange rate	1980	2005	Algeria, Bahrain, Congo, Ecuador, Equatorial Guinea, Gabon, Iran, Nigeria, Russia, Saudi Arabia, Trinidad and Tobago, Venezuela and Norway	Data for Equatorial Guinea only available from 1985, for Russia only from 1994
reer approximation	author's calculation with IMF WEO and DTS data	CPI, nominal exchange rates and Direction of Trade (DTS)	1980	2005	All countries	approximation with relative exchange rates to USD and euro deflated with relative prices and weighted by import trade shares
oil	IMF WEO	average of three sorts (in USD)	1980	2005	All countries	
real U.S. oil	IMF WEO	author's calculations	1980	2005	All countries	nominal oil price deflated with U.S. CPI
real country spedific oil	IMF WEO	author's calculations	1980	2005	All countries	nominal oil price deflated with each country's CPI and nominal exchange rate towards the USD
fiscal	IMF WEO	general government balances	1980	2005	All countries except listed below	As share of nominal GDP. For Nigeria, Trinidad and Tobago and Venezuela approximation with central government balances for early 1980s.
	IMF WEO	central government balances			Algeria, Bahrain, Gabon,Saudi Arabia	

Table A2: Development of major economic variables

	gdp	im	exdd	reera	oil	fisc
All countries						
(1980 - 2006)	3.8	7.1	4.0	2.9	5.4	-1.9
(1980 - 1995)	2.0	4.2	1.8	3.8	-2.8	-4.4
(1996 - 2006)	6.3	11.0	7.1	1.5	16.5	1.7
(1980 - 2006)						
African Countries	4.5	8.2	4.9	1.0	5.4	-2.7
Middle East	4.2	5.8	4.3	1.6	5.4	-1.9
CIS	2.4	4.2	2.3	15.5	5.4	-2.6
Latin America/Caribean	2.6	11.8	3.0	0.0	5.4	-1.8
Europe (Norway)	2.9	3.9	3.1	0.2	5.4	6.2

Note: All variables except for fisc are averages of growth rates. Fisc is the average share of the general government balance to nominal GDP.
Source: IMF World Economic Outlook (2006) and IFS (2006), authour's calculations.

Table A3: De facto exchange rate arrangements

Country	Exchange rate arrangement	Reference Currency/Anchor
Algeria	managed float	no explicitly stated nominal anchor
Angola	managed float	no explicitly stated nominal anchor
Bahrain	conventional fixed peg	U.S. dollar
Congo, Rep. of	exchange rate with no separate legal tender	Franc zone CAEMC[a]
Ecuador	exchange rate with no separate legal tender	U.S. dollar
Equatorial Guinea	exchange rate with no separate legal tender	Franc zone CAEMC[a]
Gabon	exchange rate with no separate legal tender	Franc zone CAEMC[a]
Iran, I.R. of	managed float	monetary aggregate target
Kazakhstan	managed float	no explicitly stated nominal anchor
Kuwait	conventional fixed peg	U.S. dollar[b]
Libya	conventional fixed peg	SDR basket
Nigeria	managed float	no explicitly stated nominal anchor
Norway	independently floating	inflation targeting
Oman	conventional fixed peg	U.S. dollar
Qatar	conventional fixed peg	U.S. dollar
Russia	managed float	no explicitly stated nominal anchor
Saudi Arabia	conventional fixed peg	U.S. dollar
Sudan	managed float	monetary aggregate target
Syrian Arab Rep.	conventional fixed peg	U.S. dollar
Turkmenistan	conventional fixed peg	U.S. dollar
Trinidad and Tobago	managed float	no explicitly stated nominal anchor
United Arab Emirates	conventional fixed peg	U.S. dollar
Venezuela	conventional fixed peg	U.S. dollar[c]
Yemen	independently floating	monetary aggregate target

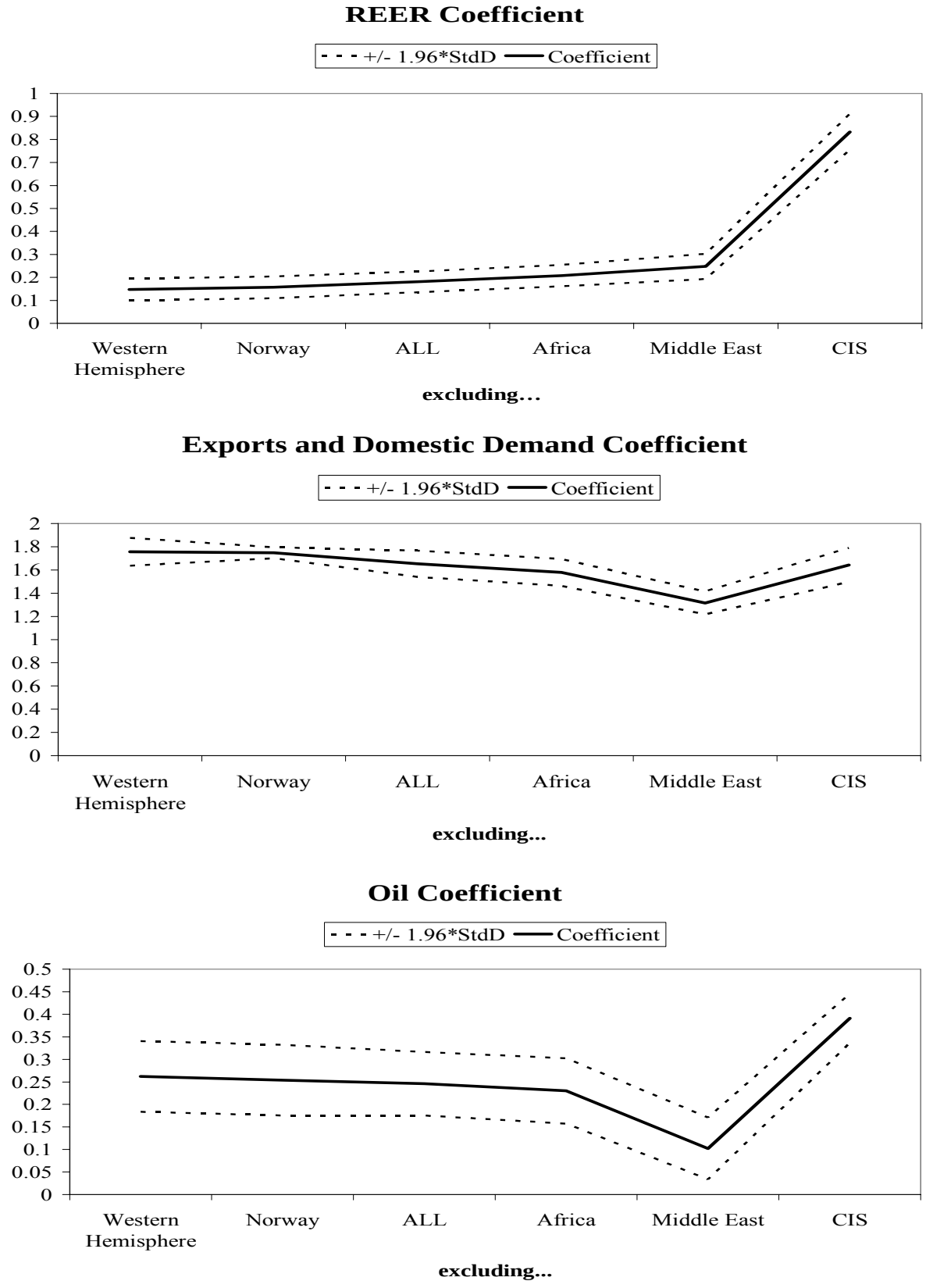
Notes: [a] African Economic and Monetary Community [b] Peg with a 3.5 percent margin. Before 2003 the Kuwaiti Dinar was pegged against a basket of currencies. [c] bevor 2004 crawling peg, since 2005 the euro is also included in foreign exchange interventions.
Source: IMF (2004) De facto classification of Exchange Rate Regimes.

Table A4: Country Specific Diagnostic Results

Country	Ch-SC[1]	CH-FF[2]	CH-NO[3]	CH-HE[4]	RBARSQ[5]
Algeria	0.01	0.00	0.92	0.30	0.87
Angola	0.31	2.78	0.04	0.17	0.85
Bahrain	7.37	1.28	0.69	0.80	0.91
Congo, Rep. of	0.11	4.85	1.18	0.32	0.74
Ecuador	0.91	2.13	1.03	0.44	0.91
Equatorial Guinea	0.22	0.48	0.71	0.09	0.92
Gabon	5.80	0.01	0.64	0.92	0.89
Iran, I.R. of	0.98	0.12	1.70	0.84	0.91
Kazakhstan	0.31	8.53	1.31	0.02	0.97
Kuwait	1.65	0.96	1.03	0.81	0.97
Libya	2.14	3.26	3.28	0.00	0.87
Nigeria	0.00	6.26	0.19	0.13	0.94
Norway	2.38	0.80	0.21	2.00	0.78
Oman	1.96	2.88	0.12	1.02	0.98
Qatar	0.06	2.07	1.48	0.01	0.84
Russia	0.17	0.30	4.26	0.07	0.89
Saudi Arabia	1.81	0.20	2.51	0.35	0.97
Sudan	1.50	2.64	1.26	0.00	0.74
Syrian Arab Rep.	9.53	0.03	0.53	0.95	0.82
Turkmenistan	3.22	19.76	4.24	8.11	0.90
Trinidad and Tobago	0.00	3.27	5.57	0.00	0.88
United Arab Emirates	0.44	0.07	0.36	1.05	0.88
Venezuela	0.85	2.45	0.58	2.21	0.91
Yemen	0.43	4.20	0.75	0.05	0.95

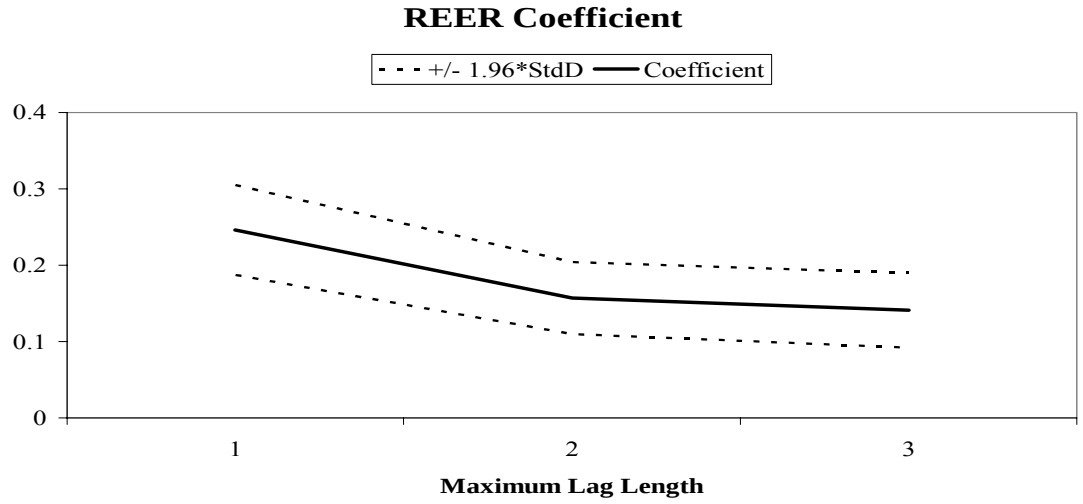
Note: 1. Godfrey's test of residual correlation
2. Ramsey's RESET test of functional form
3. Jarque-Bera test of normality of residuals.
4. Lagrange multiplier test of homoscedasticity.
5. Adjusted R^2.

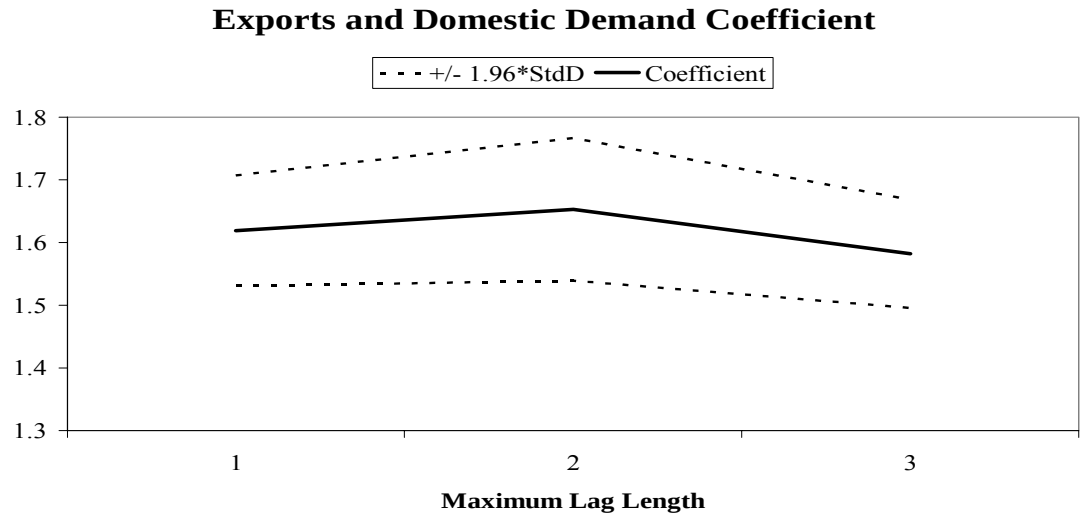
Figure A1: Robustness over Countries

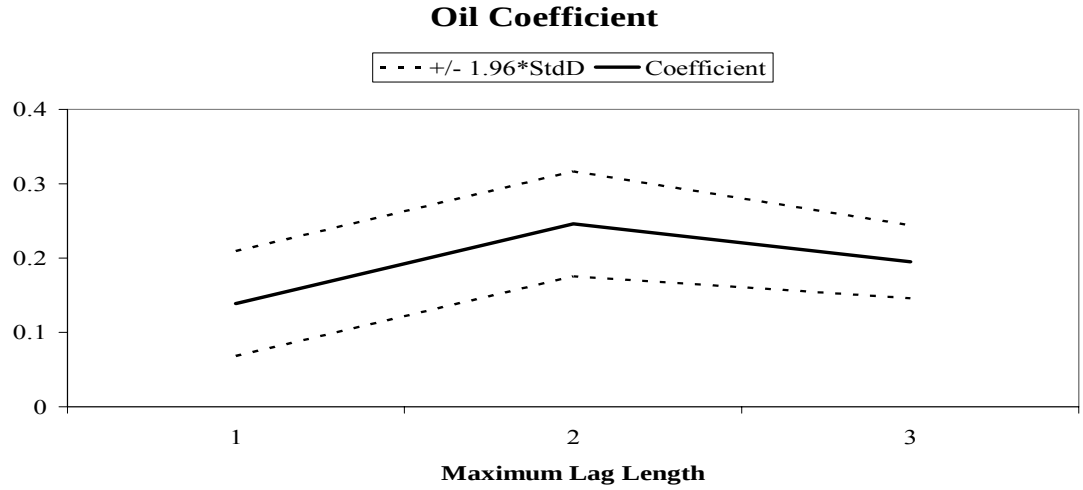


Source: Author's estimations.

Figure A2: Robustness over Maximum Lag Length







Source: Author's estimations