EUROPEAN CENTRAL BANK

EUROSYSTEM

WORKING PAPER SERIES

NO 1012 / FEBRUARY 2009

PETRODOLLARS AND IMPORTS OF OIL EXPORTING COUNTRIES

by Roland Beck
and Annette Kamps

EUROPEAN CENTRAL BANK

EUROSYSTEM

WORKING PAPER SERIES

NO 1012 / FEBRUARY 2009

PETRODOLLARS AND IMPORTS OF OIL EXPORTING COUNTRIES[1]

by Roland Beck and Annette Kamps[2]

In 2009 all ECB publications feature a motif taken from the €200 banknote.

1 We would like to thank seminar participants in internal ECB seminars as well as Thierry Bracke, Christophe Kamps, Michael Fidora and Adalbert Winkler for helpful comments. The authors are responsible for any remaining errors.

2 Both authors: European Central Bank, Kaiserstrasse 29, D-60311 Frankfurt am Main, Germany; e-mail: roland.beck@ecb.europa.eu and annette.kamps@ecb.europa.eu

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Website
http://www.ecb.europa.eu

Fax
+49 69 1344 6000

ISSN 1725-2806 (online)

CONTENTS

Abstract

This paper investigates the empirical determinants of import demand in oil exporting countries. Using a new dataset including a large cross section of oil exporting countries, we show with a panel cointegration analysis that import demand in these countries depends positively on domestic demand and exports, the real exchange rate and the price of oil. Fiscal surpluses, on the other hand, tend to reduce the demand for imports. More specifically, our import elasticities estimated for oil exporting countries are not far from estimates found in the literature on industrial countries. In particular, we conclude that the import elasticity with respect to domestic activity is larger than one – a finding which is in contrast to standard theoretical predictions but in line with most empirical findings for other countries. These results are robust over a wide set of alternative specifications.

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

JEL Classification: F14; F01; Q43.

Non-Technical Summary

Rising oil prices during 2002 to end-2008 have contributed to a widening of the US current account balance through a rising US oil bill. At the same time, the continued increase in crude oil prices implied that oil-exporting countries have received, between 2002 and 2007, additional export revenues of about USD 825 billion. These increased revenues, commonly designated as "petrodollars", normally return, at least partially, to oil-consuming economies either through the trade channel via higher imports or the financial channel via an increase in the net external asset position of these countries, helping to mitigate the initial negative effects of the oil price surge on oil-importing countries' external balances. Nevertheless, during 2002 – end-2008 oil exporting countries have run record current account surpluses and have replaced Asia as region with the largest current account surplus, corresponding to about half of the US external deficit. In this context oil exporting countries had been called upon to contribute to an orderly adjustment of global imbalances by increasing spending and imports and, in some cases, enhanced exchange rate flexibility.

In order to analyse the possible magnitude of oil bill recycling through the trade channel, we estimate a standard import demand function for oil exporting countries, augmented by the oil price and a fiscal stance variable. Using a new data set and dynamic panel estimation techniques, we show that important empirical findings for import behaviour can be confirmed also for the case of oil-exporting countries. In fact, import demand can be modelled using traditional empirical determinants such as an activity variable and the real exchange rate which have both a significant positive effect on real imports. What is more, our import elasticities estimated for oil exporting countries are not far from estimates found in the literature on industrial countries. In particular, we conclude that the import elasticity with respect to the activity variable is larger than one – a finding which is in contrast to standard theoretical predictions but in line with most empirical findings for other countries. We also find that these results are robust over a number of alternative econometric specifications.

1. Introduction

Oil prices have risen sharply during 2002 to end-2008. This seems to have exacerbated global imbalances as high oil prices have contributed to the widening of the current account deficit in the United States: According to figures of the US Bureau of Economic Analysis, the US trade deficit with OPEC countries has increased from USD 35.4 bn in 2002 to USD 125.7 bn in 2007. At the same time, oil exporting countries benefited from the higher oil prices and used their export revenue windfalls to some extent to buy foreign products. Nevertheless, oil exporting countries are running record current account surpluses and have replaced Asia as region with the largest current account surplus, corresponding to about half of the US external deficit. According to the IMF, the average current account surplus of oil exporters increased from less than 4% of GDP in 2002 to more than 13% of GDP in 2007 (IMF, 2008). These observations have led to increased interest in the impact of higher oil prices on global imbalances (IMF, 2006 and 2008; Reserve Bank of San Francisco, 2006; Department of the Treasury, 2006). In particular, oil exporting countries have been called upon to contribute to an orderly adjustment of global imbalances by increasing spending and imports and, in some cases, enhanced exchange rate flexibility.

There are several research questions arising from such a policy recommendation. First of all, the direct impact of oil prices on the import demand of oil exporting countries through wealth effects has not been studied extensively. A second 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, it is of interest whether oil exporting countries are peculiar as regards their import elasticity with respect to real activity.

In this paper, we set up an empirical model of 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. 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 surpluses, on the other hand, reduce the demand for imports. The estimated coefficients have plausible orders of magnitude similar to those found in the literature on industrialised countries (e.g. an import elasticity with respect to real activity slightly larger than one). We find that these results are robust over a number of alternative econometric specifications.

The paper is organised as follows: Section 2 reviews the various channels through which oil revenues may be recycled to mature economies. In section 3, we review the existing literature on the empirical determinants of import demand in general and oil exporting countries in particular. In Section 4 we set up an empirical model of import demand in oil exporting countries, present our estimation results and perform robustness checks. Section 5 concludes and sketches out some tentative policy implications.

2. Channels for the recycling of petrodollars

As shown in Table 1 oil revenues have served three main uses: the accumulation of foreign exchange reserves, the import of foreign goods and services and the reduction of government debt.[1] 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.

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 exchange reserves or to invest abroad in the form of portfolio investment, bank lending or foreign direct investment.[2] While it is difficult to track the final geographical destinations of the capital outflows of oil exporting countries, the United States appear to be the main recipient. As a result, this aspect of financial recycling of oil revenues is often studied in the context of global imbalances.[3]

[1] For a more detailed review of the economic characteristics of oil exporting countries and the channels of oil bill recycling, see ECB (2007c).

[2] In some countries such as Norway and the Gulf Co-Operation Council countries, reserve growth has been subdued due to the fact that foreign assets have been accumulated by special government agencies often referred to as "sovereign wealth funds". For further details on such funds, see Beck and Fidora (2008).

[3] In 2006, the US Treasury recorded for example net inflows of around USD 60 billion into long-term securities from oil exporting countries. In addition, oil exporting countries are likely to have acquired US assets through financial centres such as London or Caribbean offshore centres. For a more detailed discussion of capital outflows of oil exporting countries, see ECB (2007c).

Table 1: Petrodollar Recycling, 2002 - 2007

Country	Exports[a] (mn bbl)	Oil export revenues[b] (bn U.S. dollar)			Foreign reserves (bn U.S. dollar)			Imports[c] (bn U.S. dollar)			Government debt to GDP[d] (percent)		
	2007	2002	2007	Δ	2002	2007[e]	Δ	2002	2007	Δ	2002	2007[e]	Δ
Algeria	1.9	11.7	49.9	38.1	23.5	110.6	87.1	12.0	33.7	21.7	53.8	12.1	-41.6
Angola	1.6	7.8	42.5	34.7	0.4	11.2	10.8	3.8	16.5	12.7	120.2	16.2	-104.0
Bahrain	0.2	1.8	5.1	3.3	1.7	4.1	2.4	5.0	10.2	5.2	32.1	19.6	-12.5
Congo, Rep. of	0.2	2.3	5.3	3.0	0.0	2.2	2.1	1.1	3.0	1.9	180.8	71.1	-109.7
Ecuador	0.3	2.2	8.4	6.2	0.8	2.9	2.1	6.4	13.7	7.2	53.7	26.1	-27.6
Equatorial Guinea	0.4	1.9	9.4	7.6	0.1	3.8	3.8	0.5	3.1	2.6	20.8	1.1	-19.7
Gabon	0.2	2.1	5.6	3.5	0.1	1.2	1.1	1.0	1.8	0.9	66.0	43.3	-22.7
Iran, I.R. of	2.5	19.5	65.8	46.3	21.4	81.7	60.3	21.2	45.0	23.8	25.4	17.2	-8.2
Kazakhstan	1.2	7.0	30.5	23.5	0.7	4.3	3.6	6.6	30.4	23.8	1.4	5.6	4.2
Kuwait	1.9	13.4	48.5	35.1	9.3	16.8	7.5	9.0	19.2	10.1	29.9	7.0	-23.0
Libya	1.6	10.3	40.8	30.5	14.5	79.7	65.1	4.4	13.3	8.9	29.6	0.0	-29.6
Nigeria	2.1	16.7	54.1	37.3	7.4	51.4	44.0	7.5	26.6	19.0	16.4	10.4	-5.9
Norway	2.3	28.4	60.0	31.6	32.1	60.8	28.8	34.9	79.8	44.9	35.8	51.9	16.1
Oman	0.6	7.5	15.9	8.4	3.2	9.5	6.4	6.0	12.4	6.4	23.3	6.3	-17.0
Qatar	1.2	7.6	31.3	23.7	1.6	9.4	7.9	4.1	19.9	15.8	47.9	8.9	-39.0
Russia	7.3	46.6	190.1	143.5	44.6	466.7	422.0	67.1	241.2	174.1	42.1	7.7	-34.4
Saudi Arabia	7.8	62.2	202.0	139.8	20.8	34.0	13.2	32.3	89.4	57.1	96.9	18.7	-78.2
Sudan	0.4	1.7	9.8	8.1	0.2	1.4	1.1	2.4	8.7	6.2	153.4	77.1	-76.3
Syrian Arab Rep.	0.2	2.8	3.9	1.1	na	na	na	21.0	56.5	35.5	119.0	44.4	-74.7
Turkmenistan	0.1	0.9	2.2	1.3	na	na	na	1.8	4.4	2.6	19.1	2.4	-16.7
Trinidad and Tobago	0.2	1.4	4.2	2.8	2.0	6.7	4.7	3.6	7.7	4.1	58.7	25.7	-33.0
United Arab Emirates	2.6	18.1	67.5	49.3	15.2	77.2	62.0	42.7	101.6	59.0	5.2	10.6	5.4
Venezuela	1.8	21.5	46.5	25.0	9.0	24.8	15.8	13.0	45.1	32.2	41.9	19.3	-22.6
Yemen	0.2	3.1	4.6	1.5	4.4	7.7	3.3	2.9	6.6	3.6	57.8	40.5	-17.4
Total	**39**	**299**	**1004**	**705**	**213**	**1068**	**855**	**310**	**889**	**579**	**na**	**na**	**na**

Notes: [a] Approximation of export volumes given as oil production minus oil consumption. [b] Approximated with export volumes and average annual oil prices [c] nominal import value. [d] Gross General 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). [e] Includes IMF staff estimates and projections for Angola, Bahrain, Congo, Ecuador, Equatorial Guinea, Gabon, Oman, Sudan, Syrian Arab Republic, Trinidad and Tobago and Yemen. Δ stands for the change in absolute numbers. na stands for not available. Some data refers to 2005.
Sources: BP (2006), Department of the Treasury (2006), IMF (2008).

The second financial channel of oil bill recycling is the debt reduction channel. In fact, as argued in ECB (2007c, p. 28), for the authorities of the countries which had a particularly high level of debt in the late 1990s, e.g. Saudi Arabia, Russia, Nigeria, Algeria and Libya, debt reduction has been a high priority.[4]

The aim of this paper is to quantify the trade channel of oil revenue recycling by identifying the empirical determinants of import demand in oil exporting countries. In the next section of the paper, we briefly discuss related literature on import demand equations in general and review existing studies on import behaviour of oil exporting countries.

[4] As noted in ECB (2007c), the debt repaid by Saudi Arabia has been domestic, whereas most other countries have repaid mainly external debt. Libya has almost completely eliminated its public debt. Norway stands out as the country that has not reduced its public debt, but accumulated foreign assets in its "Government Pension Fund" (formerly known as the Government Petroleum Fund, established in 1990). In 2005, Russia spent around U.S. dollar 3 billion on early debt repayments to the IMF and around U.S. dollar 15 billion for debt repayments to the Paris Club. In August 2006, Russia fully repaid its outstanding debt owed to the Paris Club (around USD 22 billion).

3. Related Literature

In order to study the question of how the real exchange rate and the oil price affect import demand of oil exporting countries, it is worth to briefly recall the general determinants of import demand as identified by the trade literature. Generally, (real) import demand is driven by a (real) activity variable 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.[5] In a comparison of import demand estimations for seven industrial countries Thursby and Thursby (1984) find 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. One of the key findings of this literature is that the import demand elasticity with respect to the income or activity variable is higher than unity. This finding runs contrary to predictions of the theory: 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) include 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 reducing income elasticities closer to unity.[6] 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 these patterns 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. For example, Senhadji (1998) estimates an import demand function for 77

[5] For an overview of this early literature see Goldstein and Kahn (1985).
[6] Estimated at 1.2, the income elasticity is still significantly different from unity but lower than without the FDI variable. Their sample comprises the 22 countries with the highest share in merchandise imports in the world. This sample does not include any of the oil exporting countries as none of these countries have such high import shares.

countries, including some oil-exporting countries. Using GDP minus exports as the activity variable, he finds that most of the coefficients have the expected sign and are significant. The elasticity with respect to this measure of income is relatively small for the oil exporting countries. In fact, this elasticity is below unity for all oil exporting countries and even below 0.1 for the case of Norway, possibly because export revenues account for a notable part of national income in these countries.

With a longer time dimension Harb (2005) studies the import demand in 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. This finding contrasts with Reinhart's finding described above. As regards oil exporting countries (Norway, Syria and Venezuela), Harb's estimation results for the impact of the relative prices on import demand are inconclusive.

The impact of oil prices on the imports of oil-producing countries has been analysed in more country-specific studies. For example, the International Monetary Fund (2006) computes the "marginal propensity to import out of oil revenues" which seems to have decreased in most oil-exporting countries since the 1970s but may have started to rise again more recently (OECD, 2008).[7] In order to formally test whether the simple propensity to import is similar to the past the authors estimate an error correction model for imports in 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. For the Gulf Co-operation Council (GCC) countries, on the other hand, the authors find that spending out of revenues has been significantly lower than past relationships would suggest. The IMF (2006) study also attempts to quantify the impact of the oil price on the current account balances of oil exporting and importing countries. For this purpose, the authors set up a global, multiregion VAR model. In this model, a permanent 10 US dollar increase in oil prices leads to 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 GDP. Using a macroeconomic balance approach a recent IMF study also examines the medium-term determinants of the current account surpluses in oil exporting countries, showing that they can be only to some extent explained by structural determinants (e.g. demographic factors) similar to that of other countries (IMF, 2008).

[7] The marginal propensity to import out of oil revenues is defined in this study 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).

To sum up, the general import demand literature has often neglected specific characteristics of oil exporting countries. In the few available studies on import demand by oil exporting countries most papers analyse the reactions of the current account to changes in the oil price or in the terms of trade. Since the current account reflects both price and volume effects, it is not possible to distinguish between the latter in these studies.

We add to the empirical literature on import demand of oil exporting countries in various ways. First, we disentangle price and volume effects by estimating a dynamic panel error-correction model for real imports. Secondly, we base our analysis on a new large panel data set of oil exporting countries. Thirdly, we perform various robustness checks of our results and present a simple calculation for the impact of a rise in oil prices on global imbalances through the trade recycling of oil revenues.

4. Dynamic panel estimation of import demand of oil exporting countries

This section contains robust dynamic panel estimates of import demand using a new panel data set of 24 oil exporting countries. Our estimation strategy takes account of the two main challenges for the estimation of import demand functions for oil exporting countries: limited data availability and possibly strong role of fiscal policy. First of all, given that macroeconomic data are only available for relatively short time spans, we employ panel estimation techniques which tend to be more efficient than country-by-country estimates. In order to rule out that such estimates are not consistent, we perform appropriate statistical tests. Secondly, oil-exporting countries face specific fiscal policy challenges as oil revenues are volatile and oil reserves exhaustible. Fiscal policy frameworks in oil-producing countries therefore often contain elements of short-term macroeconomic stabilisation (e.g. through oil stabilisation funds) and saving for future generations (e.g. through special saving funds).[8] In addition, most of the oil industry in oil exporting countries is state-owned or at least partially state-owned. Therefore, the fiscal policy stance is likely to play a central role in influencing import demand in oil exporting countries. We therefore include a measure of the government balance in our regressions.

[8] For a more detailed analysis of fiscal policy challenges in oil exporting countries, see Barnett and Ossowski (2002).

4.1 The Data

The estimations are based on newly collected annual data for a balanced panel of 24 oil exporting countries for the period from 1980 to 2005.[9] 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, i.e. 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.[10]

Real imports

The variable to be explained is real imports which we take (in 2000 constant prices) 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.

Domestic demand and exports

The first explanatory variable is an activity variable capturing real demand. In the literature, there is little theoretical guidance of how to best measure this variable. In addition to real domestic demand (including private consumption, investment, government consumption and investment, and changes in inventories), we propose to also include real exports as oil export revenues make up a big part of national income in oil exporting countries. While the price effect of export revenues will be estimated separately with the inclusion of the oil price, the volume of exports is likely to also play a separate role. We therefore use “domestic demand and exports” defined as the sum of real domestic demand and real exports as explanatory variable. We also show that the use of a different activity measures does not change the results, however. The data for domestic demand and exports is taken from the national

[9] On a quarterly basis there is no data for a large cross section of oil exporting countries available.

[10] According to the IMF, a country is considered a “fuel exporter” if its 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 the average value of exports exceeds 500 million U.S. dollar. Kazakhstan is included since we consider the country to be a major oil exporter even though it is not possible to verify whether it meets the IMF 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 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 A1 in the Appendix gives a detailed overview of the availability of data by country and states the data sources.

accounts of the respective countries.[11] 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 also more revenues to spend on foreign products.

The real effective exchange rate

The second explanatory variable is a measure of the real exchange rate. We use the real effective exchange rate, taking into account the relative weight of the trading partners of the respective countries. As real effective exchange rates are not available for all the countries in the sample we use an approximation of the real effective exchange rate (see Table A1 in the Appendix). 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. This approximation captures on average around half of the countries' import flows and should be a good approximation of the real effective exchange rate. Also, a comparison of this approximation and the real effective exchange rate of the IMF for those countries where data is available suggests that the approximation performs well.[12] 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). 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. The case of Algeria where data on the structure of currency invoicing in trade is available supports this claim.[13] 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.

[11] As can be seen in detail in Table A1 in the Appendix we rely on approximations for some countries due to a lack of data.
[12] The correlation between the approximation and the IMF real effective exchange rate is 92 percent on average.
[13] As reported in Kamps (2006), Algeria's exports are almost exclusively invoiced in U.S. dollar as crude oil exports account for more than 98% of total exports (see ECB 2007c). As regards imports, around 50% are invoiced in euro which is not much lower than Algeria's relative import share with the euro area.

Oil prices

The third explanatory variable is the price of oil in U.S. dollar. We use data from the IMF's WEO database. 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 in the public debate on oil price fluctuations. As discussed below in the section on robustness, we 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, more oil-related projects become profitable, stimulating import demand as well.

Government balance

The fourth explanatory variable is the share of government balances in nominal GDP. Where available, we use the general government balance, otherwise we refer to the central government balance (see Table A1 in the Appendix). As this variable is reported as share of GDP and not in logarithmic terms like all other variables the coefficient of this variable cannot 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 which has been the case in most oil exporting countries over the past few years (ECB 2007c).[14]

4.2 Estimation Methodology

In the following analysis, we show that it is appropriate to conduct a panel cointegration estimation of our model. First, we carry out panel unit root tests to test for the stationarity of

[14] Due to special fiscal arrangements such as oil stabilisation funds which channel government revenues into special savings accounts if oil prices reach a certain threshold, the variable could 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. However, the correlation between the fiscal variable and the oil price is only around 45 percent. In addition, both variables prove to be significant which would not be the case if multicollinearity was a serious problem.

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.

Panel Unit Root Tests

First of all, we examine whether the variables in the panel are stationary. Table 2 reports the results of standard 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 first differences.[15] We conclude that our variables are all integrated of order 1.

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.

Panel Cointegration Tests

To find out whether theses I (1) variables have a common stochastic trend, we perform a wide array of tests as suggested by Pedroni (1999). These are cointegration tests for which the information is pooled in such a way that the short run dynamics and the fixed effects are allowed to be heterogeneous over cross sections (countries) while the long-run relationships are restriced to be the same. The null hypothesis is that for each member of the panel the variables of interest are not cointegrated. As can be seen from Table 3, 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.

[15] Only the Levin-Lin-Chu test cannot reject the null of unit roots for the first difference of imports and that of domestic demand and exports.

Table 3: 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.[16] We conclude that there is therefore sufficiently strong evidence for cointegration in our panel data set.

Panel Cointegration Models

After having shown 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. Estimating the panel with dynamic fixed effects would assume slope homogeneity and puts a restriction not only on the long run coefficient but also the short run dynamics and the adjustment processes would be 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. In addition, this estimation method can lead to inconsistent estimates. The first alternative would be to run separate regressions for each country. The shortcoming of this estimation methodology is that it requires the estimation of lots of coefficients and hence sufficient data on the time dimension. For most of the countries included in this panel, however, no data prior to 1980 exist. The second 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 across countries and only restricts the long-run

[16] 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.

coefficients to be the same across countries. In our data set, it seems reasonable to assume that oil exporting countries have the same import behaviour in the long run and to allow the short run dynamics and the adjustment process to the long-run equilibrium as being country-specific. 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 more 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 to the PMG estimation is the method of 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.[17]

4.3 Estimation Results

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

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

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

where *im* is the logarithm of real imports, *exdd* is the logarithm of domestic demand and 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 the coefficient of

[17] 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 time dimension is larger than the cross section dimension. This is the case for our panel data set.

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.

Illustrating the case of one lag in the short-term dynamics, the import equation can be written as an autoregressive distributed lag (ARDL) equation as follows:

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

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 $\Phi_i = -(1-\lambda_i)$.[18]

We determine the optimal lag structure using the Akaike selection criterion, starting with a maximum lag length of two. Table 4 shows the PMGE and the FMOLS estimation results for the long-term cointegration relationship between real imports and our independent variables.

Table 4: Estimation of Import Demand in Oil Exporting Countries

Regression	PMGE	FMOLS
EXDD	1.65*** (28.68)	1.28*** (56.41)
REER	0.18*** (7.98)	0.18*** (10.8)
OIL	0.25*** (6.76)	0.09*** (5.94)
FISC	-0.01*** (-7.22)	-0.00*** (-3.30)
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%

[18] It is convenient to parameterize the error correction model using current rather than lagged values of the exogenous regressors, since it allows an ARDL (1,0,0) as a special case (see Pesaran 1999, p.627).

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. In what follows, we will therefore focus on the PMGE estimation results. FMOLS results are reported as robustness check because they are superconsistent. As can be seen in Table 4, 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 real effective exchange rate (reer) also has a significantly positive impact on imports (Table 4). A 10 percent appreciation of the real exchange rate leads to a 1.8 percent increase in imports in the long run. This elasticity appears somewhat low as theory would predict 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 due to the lack of economic diversification in oil-exporting countries. For example, oil exporting countries tend to import mostly investment goods (such as machinery equipment for oil production and transport facilities) or luxury goods which are not produced domestically.

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 wealth effect through the higher value of existing oil reserves if the oil price change is perceived as permanent. According to our PMG estimates, a 10 percent increase in the oil price leads in the long run to 2.5 percent more imports.

The coefficient of the fiscal balance has a significant negative effect on import demand (Table 4). This finding suggests that, controlling for the impact of oil prices, a higher fiscal surplus would lower imports since, for example, lower government consumption cannot be spent on imports.

The adjustment coefficient Φ in the PMG estimation is significant and negative as it should be for the overall panel to confirm the existence of a long-term cointegration relationship. It is estimated for each country individually. For the majority of countries this adjustment coefficient is significantly negative.[19] The size of the average coefficient of adjustment

[19] 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. Given the small sample size, it is not surprising that some countries exhibit insignificant adjustment coefficients.

suggests that the estimated speed of adjustment to the long-term relationship is about 20 percent per year so that the system is close to equilibrium in around five years.

Finally, standard tests for mis-specification suggest that overall, the model is well specified. In the next section, we show that it is also robust to a large range of alternative specifications.

4.4 Robustness of the Estimation Results

Robustness to country-by-country estimations

In the Appendix, we report standard tests on the functional form of the group-specific estimates (Table A4) as it is important to see how well specified the model is on a country-by-country basis before the more efficient PMGE procedure is implemented. 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. However, it should be kept in mind that a country-specific estimate over such a short horizon is likely to suffer from small sample biases. Therefore, the analysis is not based on country-by-country study but on the more efficient PMG estimation.

Robustness to the stepwise exclusion of countries and regions

As our panel of oil exporting countries is including countries with considerably different characteristics it is important to check our estimation results for robustness. Therefore, we check whether the stepwise exclusion of a geographic region has a significant effect on the size and significance of the coefficients. Figure A1 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 marginally smaller, suggesting that the coefficient for the countries of the Middle East is higher than for the overall panel. We tentatively interpret this finding as reflecting the fact that these countries are more oil-dependent than other economies (e.g. Russia) in our sample.

Therefore, most of the increase of domestic demand in Middle Eastern countries appears to be channelled into foreign products because the domestic industry is too slow to adjust.

The coefficient of the real exchange rate seems to be less robust when compared to the coefficient of domestic demand and exports. It should be kept in mind, however, that the reaction to the real exchange rate is more likely to differ across countries because of the different exchange rate regimes which have been in place over the sample period. However, the coefficient fluctuates mainly when excluding the countries of the CIS which exhibit poor data quality before 1995.

The coefficient of the oil price is relatively robust across regions, with some signs of a higher than average coefficient in the Middle East compared with a lower-than average coefficient in the CIS. As in the case of the coefficient of domestic demand and exports, we interpret this finding as tentatively suggesting that the CIS economies in our sample, most notably Russia, have a more diversified economic structure than the Middle Eastern countries. In the latter, higher revenues arising from a rise of oil prices are mostly spent on imports.

To sum up, our coefficient estimates remain highly significant and have the correct sign when certain geographic regions are excluded from the regressions. However, we do observe some variation of the size of the coefficients when performing such robustness tests.

Robustness to changes in the lag length

Next, we test whether our findings are robust to changes in the lag structure and the maximum lag length. In our benchmark regressions reported in Table 4, we chose the optimal lag structure using the Akaike optimum lag selection criterion. The results do not change when instead of the ADF test, the Schwartz or the Hannan Quinn lag selection criterion is chosen. Figure A2 in the Appendix shows that the estimation results are also robust to different maximum lag lengths which is set to two in the benchmark regressions reported in Table 4.[20]

Robustness to changes in the explanatory variables

As a final robustness test, we include alternative measures of the explanatory variables in the model. Table 5, provides an overview of such alternative specifications of the PMG model.

As regards alternative specifications of the "activity variable", using GDP (specification 1a), only domestic demand (specification 1b) or only real exports (specification 1c) also leads

[20] We do not consider a maximum lag length larger than three because of too much loss in terms of reduced degrees of freedom and because a larger lag length seems economically implausible for annual data.

to long-term coefficients which are statistically significant, have the expected positive sign and a plausible order of magnitude. In fact, it appears intuitive that our benchmark specification using domestic demand and exports yields a coefficient which is larger than that of specification 1a (in which the coefficient is likely to suffer from a simultaneity bias), 1b (which neglects real exports) and 1c (which neglects domestic demand).

Including alternative measures of the real exchange rate does not change the results either. Specification 2a includes the IMF WEO real effective exchange rate where available (*reer* (*incl. WEO)*) and uses the approximation of the real exchange rate for imports only for countries for which IMF data on the real effective exchange is not available. Specification 2b uses an 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)*). In both alternative specifications, the significance, the sign and the order of magnitude of the estimated long-term coefficient are unchanged compared to our benchmark regression.

Including the real oil price instead of the nominal oil prices does not materially change the estimation results, i.e. the respective coefficient remains significant and positive. As regards the size of the coefficient, only marginal changes occur. In fact, if we use the US real oil price (specification 3a), the long-term coefficient of the oil price is 0.18 instead of 0.25 in the benchmark regression. If we use country-specific real oil prices (specification 3b), the long-term coefficient becomes 0.20.[21]

Another robustness test is to complement the dataset which, at the time of writing was only available until 2005, with preliminary and forecasted data of the WEO database for the year 2006.[22] Estimations with this extended dataset provide almost identical coefficients.[23]

One final issue in the context of robustness is whether the estimation suffers from an omitted variable bias. The overall power of the estimation equation, its good fit as well as the robustness of the model does not point to such a bias. In addition, more variables would tend to reduce the degrees of freedom considerably. We do, however, consider one additional channel for petrodollar recycling: While the focus of this study is the recycling of petrodollars through trade, other studies focus on the financial channel. But it is very difficult to precisely measure the financial flows and the foreign assets of oil exporting countries as many of these

[21] The US real oil price is computed by deflating the nominal oil price with the U.S CPI. The country-specific real oil price is calculated by converting the nominal oil price into local currency using the nominal exchange rate and deflating it subsequently with each country's domestic CPI.
[22] IMF World Economic Outlook, September 2006.
[23] Detailed results are available on request.

are acquired through financial centres such as London or offshore. Nevertheless, we check the robustness of our results by including the net foreign asset position as an explanatory variable.[24] In this specification, net foreign assets have a significantly negative effect on imports, while all other coefficients are almost the same as in our baseline specification. This result mirrors the saving decision of oil exporting countries: Resources accumulated as foreign assets are capital outflows which cannot be spent on imports. The coefficient of the net foreign asset position should, however, be interpreted with caution since the data on the net foreign asset position may not be reliable for oil exporting countries, in particular in view of inadequate coverage of sovereign wealth funds.

[24] 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.

Table 5: 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%

5. Conclusion

During the rise in oil prices (2002 - end-2008), the oil bill of the United States has risen considerably. At the same time, it is often argued that oil exporting countries have used higher export revenues only to some extent for imports, thereby exacerbating global imbalances.

Using a new data set and dynamic panel estimation techniques, we show that important empirical findings for import behaviour can be confirmed also for the case of oil-exporting countries. In fact, import demand can be modelled using standard empirical determinants such as an activity variable and the real exchange rate which have both a significant positive effect on real imports. What is more, our import elasticities estimated for oil exporting countries are not far from estimates found in the literature on industrial countries. In particular, we conclude that the import elasticity with respect to domestic activity is larger than one – a finding which is in contrast to standard theoretical predictions but in line with most empirical findings for other countries. However, we also show that an import equation for oil exporting countries should also include two other non-standard determinants. First, the oil price has a significant positive effect on real imports, most likely through wealth effects. Secondly, government balances negatively impact real imports as oil exporting countries save to some extent the windfall gain stemming from higher oil prices. Our estimates are robust over a wide range of alternative specifications and the stepwise exclusion of certain regions in the sample.

Applying the import elasticities from our model to bilateral trade between the US and the oil exporting countries would suggest the negative effect of a rise in oil prices on the US trade balance would be only marginally offset by increased US exports to oil exporting countries. In addition, the impact of an appreciation of the real exchange rate of oil exporting countries on the US current account deficit would be marginal. Policy conclusions in this context should be based, however, on a richer general equilibrium framework which also takes into account the nature of the oil price shock.

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.

Barnett, S. and R. Ossowski (2002) "Operational aspects of fiscal policy in oil-producing countries", IMF Working Paper No 02/177, 2002.

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.

Beck, Roland and Michael Fidora (2008). "The Impact of Sovereign Wealth Funds on Global Financial Markets", ECB Occasional Paper No. 91, July 2008.

BP (2006). Statistical Review of World Energy 2006.

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.

European Central Bank (2007a) "Oil-Bill Recycling and Extra-Euro Area Exports" published as box in: Monthly Bulletin, April 2007.

European Central Bank (2007b) "Review of the International Role of the Euro".

European Central Bank (2007c) "Oil-Exporting Countries: Key Structural Features, Economic Developments and Oil Revenue Recycling" in: Monthly Bulletin, July 2007.

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.

IMF (2008). World Economic Outlook October 2008. Washington DC.

Kamps, A. (2006) "The euro as invoicing currency in international trade", ECB Working Paper No, 665, August 2006.

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

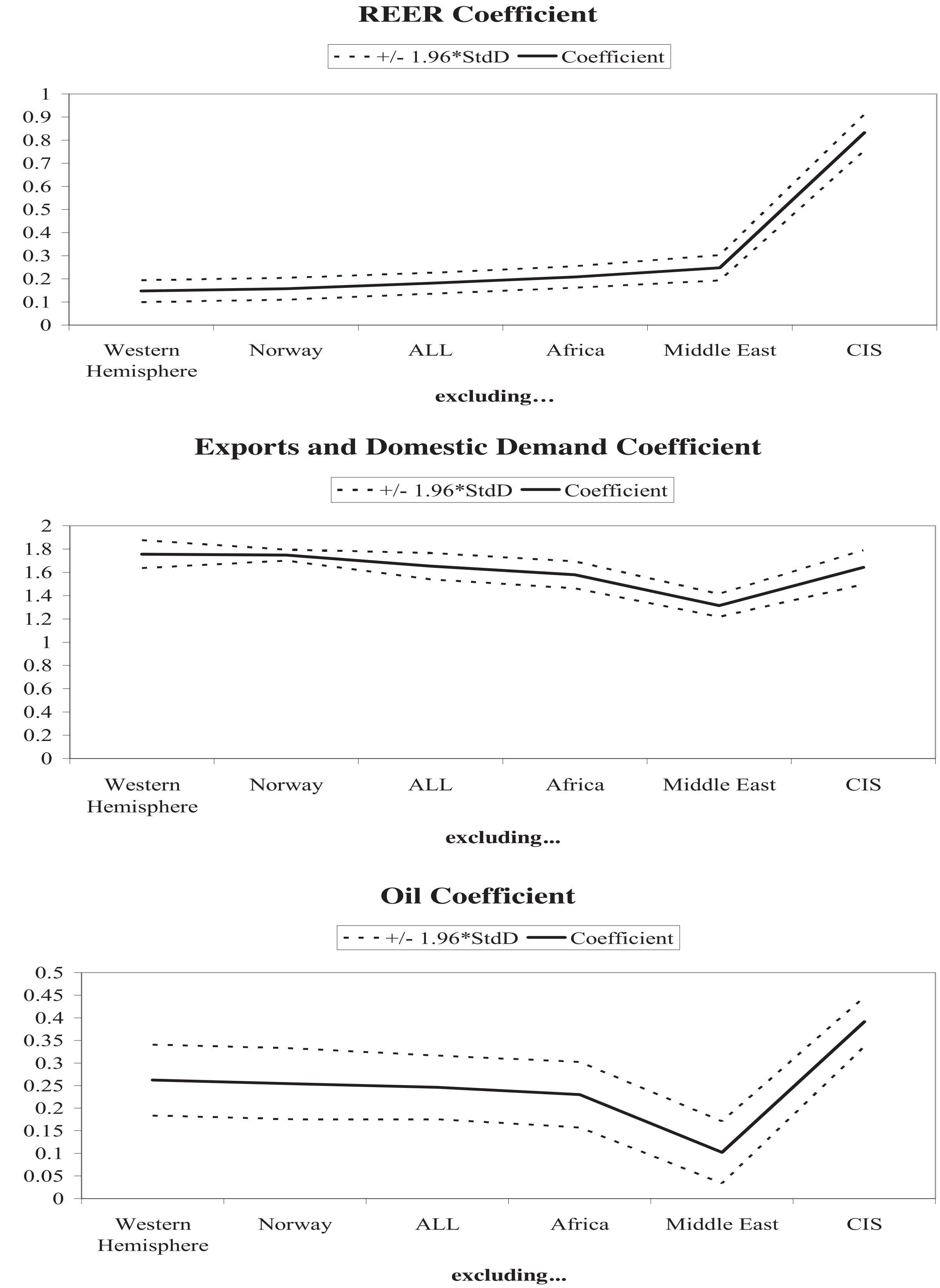
Notes: [a] African Economic and Monetary Community [b] Peg with a 3.5 percent margin. Before 2003 the Kuwaiti Dinar was pegged against a basket of currencies. [c] bevor 2004 crawling peg, since 2005 the euro is also included in foreign exchange interventions.
Source: IMF (2004) De facto classification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

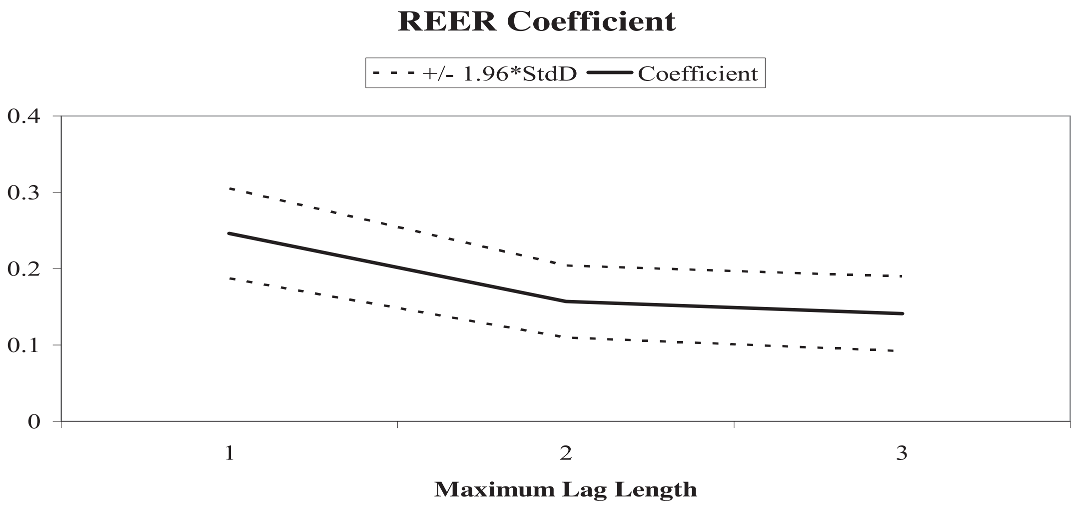
Note: 1. Godfrey's test of residual correlation
2. Ramsey's RESET test of functional form
3. Jarque-Bera test of normality of residuals.
4. Lagrange multiplier test of homoscedasticity.
5. Adjusted R^2.

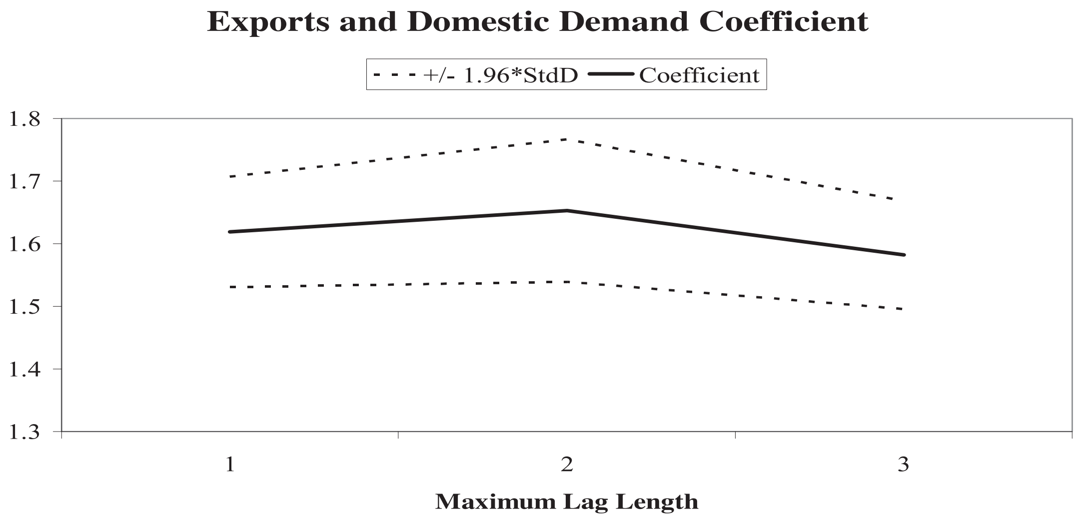
Figure A1: Robustness over Countries

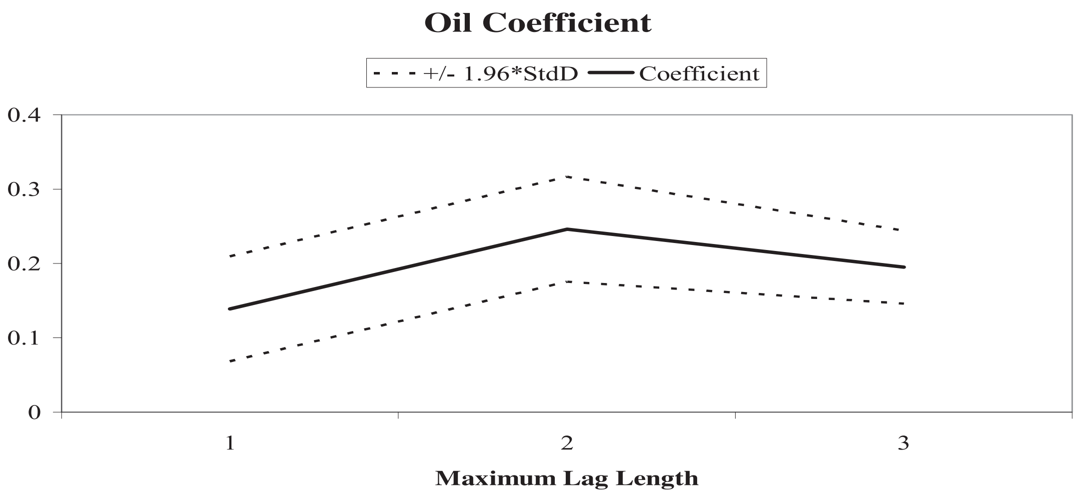


Source: Author's estimations.

Figure A2: Robustness over Maximum Lag Length







Source: Author's estimations

European Central Bank Working Paper Series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (http://www.ecb.europa.eu).

956 "The political economy under monetary union: has the euro made a difference?" by M. Fratzscher and L. Stracca, November 2008.

957 "Modeling autoregressive conditional skewness and kurtosis with multi-quantile CAViaR" by H. White, T.-H. Kim, and S. Manganelli, November 2008.

958 "Oil exporters: in search of an external anchor" by M. M. Habib and J. Stráský, November 2008.

959 "What drives U.S. current account fluctuations?" by A. Barnett and R. Straub, November 2008.

960 "On implications of micro price data for macro models" by B. Maćkowiak and F. Smets, November 2008.

961 "Budgetary and external imbalances relationship: a panel data diagnostic" by A. Afonso and C. Rault, November 2008.

962 "Optimal monetary policy and the transmission of oil-supply shocks to the euro area under rational expectations" by S. Adjemian and M. Darracq Pariès, November 2008.

963 "Public and private sector wages: co-movement and causality" by A. Lamo, J. J. Pérez and L. Schuknecht, November 2008.

964 "Do firms provide wage insurance against shocks? Evidence from Hungary" by G. Kátay, November 2008.

965 "IMF lending and geopolitics" by J. Reynaud and J. Vauday, November 2008.

966 "Large Bayesian VARs" by M. Bańbura, D. Giannone and L. Reichlin, November 2008.

967 "Central bank misperceptions and the role of money in interest rate rules" by V. Wieland and G. W. Beck, November 2008.

968 "A value at risk analysis of credit default swaps" by B. Raunig and M. Scheicher, November 2008.

969 "Comparing and evaluating Bayesian predictive distributions of asset returns" by J. Geweke and G. Amisano, November 2008.

970 "Responses to monetary policy shocks in the east and the west of Europe: a comparison" by M. Jarociński, November 2008.

971 "Interactions between private and public sector wages" by A. Afonso and P. Gomes, November 2008.

972 "Monetary policy and housing prices in an estimated DSGE for the US and the euro area" by M. Darracq Pariès and A. Notarpietro, November 2008.

973 "Do China and oil exporters influence major currency configurations?" by M. Fratzscher and A. Mehl, December 2008.

974 "Institutional features of wage bargaining in 23 European countries, the US and Japan" by P. Du Caju, E. Gautier, D. Momferatou and M. Ward-Warmedinger, December 2008.

975 "Early estimates of euro area real GDP growth: a bottom up approach from the production side" by E. Hahn and F. Skudelny, December 2008.

976 “The term structure of interest rates across frequencies” by K. Assenmacher-Wesche and S. Gerlach, December 2008.

977 “Predictions of short-term rates and the expectations hypothesis of the term structure of interest rates” by M. Guidolin and D. L. Thornton, December 2008.

978 “Measuring monetary policy expectations from financial market instruments” by M. Joyce, J. Relleen and S. Sorensen, December 2008.

979 “Futures contract rates as monetary policy forecasts” by G. Ferrero and A. Nobili, December 2008.

980 “Extracting market expectations from yield curves augmented by money market interest rates: the case of Japan” by T. Nagano and N. Baba, December 2008.

981 “Why the effective price for money exceeds the policy rate in the ECB tenders?” by T. Välimäki, December 2008.

982 “Modelling short-term interest rate spreads in the euro money market” by N. Cassola and C. Morana, December 2008.

983 “What explains the spread between the euro overnight rate and the ECB’s policy rate?” by T. Linzert and S. Schmidt, December 2008.

984 “The daily and policy-relevant liquidity effects” by D. L. Thornton, December 2008.

985 “Portuguese banks in the euro area market for daily funds” by L. Farinha and V. Gaspar, December 2008.

986 “The topology of the federal funds market” by M. L. Bech and E. Atalay, December 2008.

987 “Probability of informed trading on the euro overnight market rate: an update” by J. Idier and S. Nardelli, December 2008.

988 “The interday and intraday patterns of the overnight market: evidence from an electronic platform” by R. Beaupain and A. Durré, December 2008.

989 “Modelling loans to non-financial corporations in the euro area” by C. Kok Sørensen, D. Marqués Ibáñez and C. Rossi, January 2009

990 “Fiscal policy, housing and stock prices” by A. Afonso and R. M. Sousa, January 2009.

991 “The macroeconomic effects of fiscal policy” by A. Afonso and R. M. Sousa, January 2009.

992 “FDI and productivity convergence in central and eastern Europe: an industry-level investigation” by M. Bijsterbosch and M. Kolasa, January 2009.

993 “Has emerging Asia decoupled? An analysis of production and trade linkages using the Asian international input-output table” by G. Pula and T. A. Peltonen, January 2009.

994 “Fiscal sustainability and policy implications for the euro area” by F. Balassone, J. Cunha, G. Langenus, B. Manzke, J. Pavot, D. Prammer and P. Tommasino, January 2009.

995 “Current account benchmarks for central and eastern Europe: a desperate search?” by M. Ca’ Zorzi, A. Chudik and A. Dieppe, January 2009.

996 “What drives euro area break-even inflation rates?” by M. Ciccarelli and J. A. García, January 2009.

997 "Financing obstacles and growth: an analysis for euro area non-financial corporations" by C. Coluzzi, A. Ferrando and C. Martinez-Carrascal, January 2009.

998 "Infinite-dimensional VARs and factor models" by A. Chudik and M. H. Pesaran, January 2009.

999 "Risk-adjusted forecasts of oil prices" by P. Pagano and M. Pisani, January 2009.

1000 "Wealth effects in emerging market economies" by T. A. Peltonen, R. M. Sousa and I. S. Vansteenkiste, January 2009.

1001 "Identifying the elasticity of substitution with biased technical change" by M. A. León-Ledesma, P. McAdam and A. Willman, January 2009.

1002 "Assessing portfolio credit risk changes in a sample of EU large and complex banking groups in reaction to macroeconomic shocks" by O. Castrén, T. Fitzpatrick and M. Sydow, February 2009.

1003 "Real wages over the business cycle: OECD evidence from the time and frequency domains" by J. Messina, C. Strozzi and J. Turunen, February 2009.

1004 "Characterising the inflation targeting regime in South Korea" by M. Sánchez, February 2009.

1005 "Labor market institutions and macroeconomic volatility in a panel of OECD countries" by F. Rumler and J. Scharler, February 2009.

1006 "Understanding sectoral differences in downward real wage rigidity: workforce composition, institutions, technology and competition" by P. Du Caju, C. Fuss and L. Wintr, February 2009.

1007 "Sequential bargaining in a new-Keynesian model with frictional unemployment and staggered wage negotiation" by G. de Walque, O. Pierrard, H. Sneessens and R. Wouters, February 2009.

1008 "Liquidity (risk) concepts: definitions and interactions" by K. Nikolaou, February 2009.

1009 "Optimal sticky prices under rational inattention" by B. Maćkowiak and M. Wiederholt, February 2009.

1010 "Business cycles in the euro area" by D. Giannone, M. Lenza and L. Reichlin, February 2009.

1011 "The global dimension of inflation – evidence from factor-augmented Phillips curves" by S. Eickmeier and K. Moll, February 2009.

1012 "Petrodollars and imports of oil exporting countries" by R. Beck and A. Kamps, February 2009.