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ANALYSIS OF THE IRAN OIL EMBARGO

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Executive summary

To analyse the energy and economic consequence of an Iranian oil embargo, five different scenarios are analysed that basically reflect an increasing degree of oil scarcity from Scenario 1 to 5b below.

1. **"Baseline":** The "business-as-usual" development. Hence, no sanctions imposed.
2. **"Small Coalition"**: All individual EU27 Member States, USA, Canada, Australia, New Zealand, and Japan impose a unilateral import boycott on oil from Iran. The exports of Iran do not decrease but are redirected to countries that do not participate in the boycott. The coalition countries find their oil supply outside Iran.
3. **"Intermediate Coalition"**: Same conditions are for the "Small Coalition" above, except that the Iranian oil exports to the Small Coalition countries are not compensated by higher exports to other markets, and the Iranian production of crude oil decreases by 20%.
4. **"Grand Coalition"**: All countries in the world impose a unilateral oil import boycott from Iran, shutting down part of its production (Iran still produces for internal needs).
5. **"Hormuz"**: The Strait of Hormuz is blocked and no oil exports are let through. Two cases are being reviewed, depending on the availability of the pipeline going through the Red Sea and Israel-Lebanon (Saudi Arabia), Syria and Turkey.
    a. **"Hormuz Optimistic (High Pipeline Capacities)"**: About 60% of the Gulf oil production (excl. Iran) can be exported through the pipeline system.
    b. **"Hormuz Pessimistic (Low Pipeline Capacities)":** About 45% of the Gulf oil production (excl. Iran) can be exported through the pipeline system.

We calculate the macro-economic impacts applying the global general equilibrium model GEM-E3. This results in an estimate of the impact of the supply shock in the macroeconomic equilibrium. The international oil and energy markets are assessed with the POLES model. This provides the impacts in prices and quantities in the international energy (oil) market resulting from the different supply and demand situations for every scenario. Impacts on trade flows regarding refined oil products are estimated with the OURSE model.

- The analysis shows that a unilateral embargo by the "Small Coalition" hardly has an effect on Iran’s economy. The "Grand Coalition" and "Hormuz" scenarios, however, give an impact of 17-18% of GDP to Iran’s economy, whereas the impact of the Intermediate Scenario is lower (5.7% of GDP).
- Impacts on the international oil market are negligible in the "Small Coalition" scenario and remain limited in the "Grand Coalition" scenario. In the "Hormuz Optimistic" and "Hormuz Pessimistic" scenarios, on the contrary, the oil price increases are more than 80% and 120% compared to baseline levels, respectively, on average for a two-year period.
- The lower oil availability in the "Grand Coalition" scenario has a cost for the world economy of 0.34% compared to the baseline. Iran is the single most affected country (17% GDP contraction). With a GDP decrease of 0.49%, the EU on average suffers more than the global economy. Countries with a relatively higher reliance on oil

imports compared to their GDP are stronger affected. India (-0.83%) belongs to this group, but also some EU countries like Estonia, Portugal, Cyprus. Less affected countries are either very energy efficient such as Japan (-0.38%), or they have an important domestic production of crude oil, such as USA (-0.31%).

- In the two "Hormuz" scenarios we assume that either 45% or 60% of the Gulf oil exports can be transported through existing pipelines. Even though the difference seems of limited nature (i.e. 15 percentage points), it leads to drastically different results in terms of global GDP (0.6 percentage points). This shows that the world economy becomes increasingly sensitive to supply shocks the scarcer the oil becomes. This also underlines the possible role of spare capacity beyond the Gulf region.
- The impact on the GDP in the EU could reach -3% compared to a baseline in the "Hormuz Pessimistic" scenario, with important differences across EU Member States influenced by the importance of oil imports in their economy, and almost 2% in the USA. At global level, the GDP would be reduced by around 2%.
- The size of the economic impacts of the "Hormuz" scenarios (between 1.5 and 2% loss of the global GDP) makes them unlikely to be very 'stable' scenarios on the long-term.
- The scenarios not only have losers but also winners. In particular the major oil exporting countries as Russia and some Gulf countries (depending on the scenario) could temporarily benefit from the increase in oil prices.
- The costs of oil in the OECD and the EU economy would only be slightly affected in the "Grand Coalition" scenario, but could more than double from today's (elevated) levels for one year in the "Hormuz case". Since in the latter case the high oil prices trigger an important reduction in oil demand, oil costs would fall rapidly again to reach below-baseline levels once supply is restored.
- Refinery output in both Northern and Southern Europe remains more or less at baseline levels in the "Intermediate Coalition" and "Grand Coalition" scenarios in 2014. The larger volumes of Iranian crudes that are currently used in Southern Europe can be replaced by a blend of different other crude types without any major increase in prices and technical difficulty. In both "Hormuz" scenarios, the Southern European refinery output would decrease due to a higher dependence on oil imports from Middle East. All in all, though, the total European refinery production decreases less than demand, leading to higher exports and a larger share of own production compared to the baseline.

1. Introduction

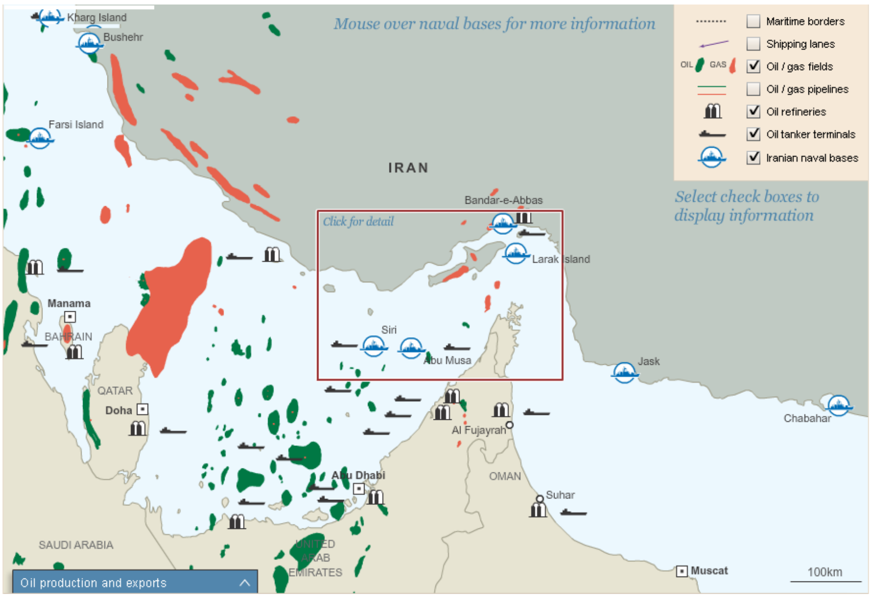
On 23 January 2012 EU foreign ministers decided to ban new contracts to import oil and petroleum products from Iran and to end existing contracts by 1 July 2012 as part of a diplomatic strategy aimed at raising the cost of Iran's defiance of the international community over its nuclear program. Other countries such as the US are also preparing to sanction Iran's crude oil exports. Iran has responded by threatening to disrupt the flow of oil through the Strait of Hormuz, the world's most important oil chokepoint; about 35 percent of seaborne traded oil moves through the Strait (EIA, 2011).

The increasing pressure on Tehran's government has already added a significant "Iran Premium", perhaps 10 to 20 US dollars per barrel (as of March 2012), to the current price of crude oil, possibly as an anticipation of future events. Any escalation may further increase the oil prices. As, historically, high oil prices have contributed to a number of economic recessions, the increase of the "Iran Premium" is particularly troubling given the current fragile state of the global economy.

In this study, we analyse four major scenarios and compare them to a baseline scenario. The "Small Coalition" scenario, the "Intermediate Coalition" and the "Grand Coalition" scenarios are dealing with an oil embargo on Iran only. They differ in the coalition size of the oil embargo. In the "Small Coalition" scenario, all EU27 Member States, USA, Canada, Australia, New Zealand, and Japan impose a unilateral embargo on oil imports from Iran. The exports of Iran do not decrease but are redirected to countries that do not participate in the boycott. The coalition countries find their oil supply outside Iran.

In the "Intermediate Coalition" the same countries impose an embargo; on top, it is assumed that the lower Iranian oil exports to these countries are not compensated by higher exports to other markets. In the "Grand Coalition" scenario the oil embargo on Iran is world wide. The two "Hormuz" scenarios (differing in assumed pipeline capacity) assume that the transport of oil through the Strait of Hormuz is completely disrupted. Here, not only oil exports from Iran are affected, but also the oil supply from major exporters such as Saudi Arabia, Kuwait, UAE, Iraq, Bahrain and Qatar is affected.

Figure 1: The Strait of Hormuz



Source: Financial Times

2. Methodology: models used

To assess the economic and energy impact of the scenarios we apply three models in an integrated manner. We calculate the macro-economic impacts applying the global General Equilibrium Model for the Economy, the Energy system and the Environment, GEM-E3. This results in an estimate of the impact on key macroeconomic variables (such as GDP, and sectoral output) at the theoretical economic equilibrium after the supply shock. The international oil and energy markets are assessed with the POLES model. This model provides the impacts on prices and quantities in the international energy markets (including the oil market) resulting from the different supply and demand situations for every scenario. In addition, it indicates the reaction of oil supply by regions and shows how the energy consumption is reduced by sector and country. Unlike GEM-E3, POLES is a dynamic simulation model – hence, impacts are not immediate but occur over time. A closer look at the refinery sector and the impacts on the refined oil products markets is then undertaken with the OURSE model, using inputs from POLES.

GEM-E3: GEM-E3 (www.gem-e3.net) is a multi-region, recursive dynamic computable general equilibrium model that covers the interactions between the economy, the energy system and the environment. GEM-E3 covers the entire economy and can be used to evaluate consistently the distributional effects of policies on the national accounts, investment, consumption, public finance, foreign trade and employment for the various economic sectors and agents across the countries. It is especially designed to evaluate environmental and energy policies. In the standard version, the model includes all 27 Member States of the European Union and all major non-European countries in a disaggregated manner, while the remaining countries are aggregated in regions. Furthermore, in this version 16 economic sectors are modelled and electricity production is depicted in a detailed manner. The geographical regions are linked through endogenous bilateral trade. The labour market is modelled following the efficiency wages approach which allows for non-voluntary unemployment and flexibility in wages. The government has nine categories of revenues. The model is able to compare the welfare effects of various environmental instruments in the context of climate and energy policies. It is also possible to consider various ways of revenue recycling.

The current version of GEM-E3 is calibrated to the GTAP7 database with 2004 as base year, and with an extrapolation of data to 2010.

The GEM-E3 model has been used to analyse climate and energy policies to support DG CLIMA, and to analyse tax reforms in the EU Member States for DG TAXUD / DG CLIMA. Ciscar et al. (2004) and Maisonnave et al. (2012) use earlier versions of the GEM-E3 model to simulate the impact of high oil prices (the latter focussing on the cross-relation with climate policies).

POLES: The POLES model (Prospective Outlook for the Long-term Energy System[1]) is a global sectoral simulation model for the development of energy markets. It operates on a yearly basis up to 2050, with a very recent data update. Main exogenous inputs are economic growth and demographic projections for each region. POLES provides comprehensive energy balances (demand, transformation, and supply) for the 57 countries / regions covering the world and detailed oil and gas productions for 80 countries. Energy demand in 15 sectors is driven by income and derived activity variables as well as energy prices through short term

[1] The model was originally developed at the Centre National de la Recherche (CNRS) – Université de Grenoble (UG2) in France and is now collaboratively maintained and further developed at EDDEN-UG2, Enerdata and JRC-IPTS.

and long-term effects. In addition POLES provides a detailed description of the transformation sectors, in particular power generation.

The endogenous calculation of international energy prices that balance supply and demand is one of the key features of the POLES model. Energy prices for the next modelling period are derived from comparing import and export capacities of each energy sub-market by using recursive simulation. This feature of the model allows for the simulation of under- or over-capacity situations, with the possibility of price shocks or counter-shocks similar to those that occurred on the oil market in the seventies and eighties. The model thus provides a consistent framework for studying the interconnected dynamics of energy development, energy policies (environment, fiscal regime) and resource availability.

The preliminary results of the study presented in this document have been produced by the February 2012 POLES version, which uses 2010 data for most energy variables: consumption, production, capacity, prices. It captures the most recently updated information on oil production from OPEC countries (2011); an estimate of production recovery in Libya from its low 2011 level (full production in 2013) is also made. Macro assumptions are from the UN World population projection (2010 revision[2], issued in 2011) and from IMF World Economic Outlook[3] (issued in September 2011, revision January 2012)[4].

Table 1. Status of data in POLES

Type of information		Most updated info in POLES	Source and date
Population		2011 (-2050)	UN (2011)
GDP growth		2011	IMF WEO (Sept 2011 - January 2012), DG ECFIN and ECP (2011)[4]
Other activity	Mobility, ..	2009-10	Sectoral databases
Energy demand	All fuels, all sectors, all countries	2010	IEA (2011), Eurostat (2011), Enerdata (2012)
Energy Supply	OPEC crude & NGLs	2011	IEA (2012)
	Other energies, other countries	2010	IEA (2011), Enerdata (2012)
Energy Prices	Oil and gasoline	2010-11	IEA (2011), Eurostat (2011), Enerdata (2012)
	Other energies	2010	IEA (2011), Eurostat (2011), Enerdata (2012)

OURSE: The OURSE (Oil is Used in Refineries to Supply Energy) model is a world-wide aggregated model for the refinery sector designed to simulate the world oil product supply for the POLES model. OURSE is able to simulate the impact of changes in the crude oil supply on the world refining industry (in costs and qualities) as well as in the oil product demand (in terms of level, structure and specifications). A major update and recoding of the OURSE model was completed in 2011 (Lantz et al., 2012). The regional disaggregation in OURSE is less detailed than in the other models. It distinguishes between the North and West European region, which comprise France, United Kingdom, Germany, Austria, Belgium, Luxembourg, Denmark, Finland, Ireland, Netherlands, Sweden, Hungary, Poland, Czech Republic, Slovak Republic, Estonia, Latvia, Lithuania, Slovenia, Bulgaria, Romania, Iceland, Norway, Switzerland and Southern Europe which contains Italy, Spain, Greece, Portugal, Malta, Cyprus, Turkey, Croatia, Bosnia-Herzegovina, Macedonia, Serbia & Montenegro, Albania. Results at the level of individual Member States or the EU-27 cannot be provided.

[2] http://esa.un.org/unpd/wpp/

[3] http://www.imf.org/external/pubs/ft/weo/2012/update/01/

[4] The resulting economic growth for Europe is consistent with figures given in "The 2012 Ageing Report" issued in 2011 by DG ECFIN of the European Commission.

3. Scenario definition and implementation

In order to assess the several potential impacts of an embargo on Iranian oil, five different scenarios are analysed, reflecting an increasing degree of oil scarcity from 1 to 5b.

1. **"Baseline":** The "business-as-usual" development. Hence, no sanctions imposed.
2. **"Small Coalition"**: All individual EU27 Member States, USA, Canada, Australia, New Zealand, and Japan impose a unilateral import boycott on oil from Iran. Exports from Iran are redirected to other non-coalition consumers. The coalition countries find their oil supply outside Iran.
3. **"Intermediate Coalition"**: Same conditions apply as for the "Small Coalition" above, except that the Iranian oil exports to the Small Coalition countries are not compensated by higher exports to other markets ,and the Iranian output of crude oil decreases with 20%.

   Both the "Small Coalition" scenario and the "Intermediate Coalition" scenario correspond closely to the situation that has been decided to be in force of 1 July 2012 (short of any further unplanned escalation). The difference between the two coalition scenarios depends on the behaviour of the countries that do not participate in the embargo, and the characteristics and flexibility of the global oil market. In the "Small Coalition" scenario the assumption is that the non-participating countries do not forego on a longer term the opportunity to have more easy access to Iran's oil, unless they are forced to by events (such as "Hormuz") or are joining the "Grand Coalition". In the "Small Coalition" scenario the global output of crude oil does not change from the business-as-usual case, and we only observe a change in oil trade relations. In the "Intermediate Coalition" scenario the non-participating countries do not trade and consume the excess oil output of Iran, the global output of crude oil decreases with the amount corresponding to 20% of Iran's production. The observed reality is likely to lie somewhere in between the "Small Coalition" and the "Intermediate Coalition", with the latter being a realistic scenario on the short-term, and the former likely to be observed on the long-term.

4. **"Grand Coalition"**: All countries in the world impose a unilateral oil import boycott from Iran, shutting down part of its production (Iran still produces for internal needs).
5. **"Hormuz"**: The Strait of Hormuz is blocked and no oil exports are let through anymore[5]. Two scenarios are being reviewed, depending on the availability of pipelines going through the Red Sea and Israel-Lebanon (Saudi Arabia), Syria and Turkey (Iraq), and the soon to be ready UAE pipeline (see Table 2).
   a. **"Hormuz Optimistic (High Pipeline Capacities)"**: It is assumed that the existing pipeline export capacity in the Gulf region is fully available and will be used. In this scenario about 60% of the oil production of the "Gulf" (excl. Iran) can be exported through the pipeline system.
   b. **"Hormuz Pessimistic (Low Pipeline Capacities)"**: Only part of the existing pipelines capacity will be available. Due to the recent turmoil in Syria, a long-standing ally of Iran, we assume that the pipelines through this country are

[5] Any "Hormuz" scenario may lead to a full-blown conflict including military action. However, we only take into account the effect of the changed oil supply (i.e. supply shock and alternative routes through pipelines), and we discard the costs and impacts of a potential conflict itself.

totally unavailable. In this scenario about 45% of the oil production of the "Gulf" (Excl. Iran) can be exported through the existing pipelines.

Table 2. Alternative oil export pipelines (mb/d)[6]

	Capacity max	Currently used	**Low pipeline**	**High pipeline**
East-West Pipeline (Petroline)	5	2	5	5
Trans-Arabian Pipeline (Tapline)	0.5			0.5
Abu Dhabi Crude Oil Pipeline (ADCOP)	1.5			1.5
Iraqi Pipeline through Saudi Arabia (IPSA)	1.65			
Strategic Pipeline	0.7			
Iraq-Turkey	1.6	0.3	0.3	1.6
Iraq-Syria-Lebanon (ISLP)	0.7	0.5		0.7
		Total	**5.3**	**9.3**

For the scenarios 1-5 above, a further differentiation regarding the availability of spare capacity for oil production in Gulf countries (labelled "high spare" and "low spare") is explored with the POLES model. The macro-economic analysis with the GEM-E3 model assumes fixed oil supply (i.e. none of the crude oil producers has any spare capacity). As a default, the results presented in this report bear on the "low spare capacity" estimate.

Table 3 summarizes the assumptions on production/export capacities elaborated on the basis of the scenarios described above.

Table 3. POLES assumptions on production/export capacities for Gulf countries (mb/d)

		2010	*2011*	*2012*	*2013*	*2014*	*2015*
1a. Baseline - high spare	Gulf countries	26.70	27.43				
1b. Baseline - low spare	Gulf countries	22.91	24.55				
2a. Small Coalition - high spare	Gulf countries	26.70	27.43				
2b. Small Coalition - low spare	Gulf countries	22.91	24.55				
3a. Intermediate Coalition - high spare	Iran	4.41	4.25	3.98	3.43	3.98	4.25
	Other Gulf countries	22.29	23.18				
3b. Intermediate Coalition - low spare	Iran	4.27	4.15	3.91	3.43	3.91	4.15
	Other Gulf countries	18.64	20.40				
4a. Grand Coalition - high spare	Iran	4.41	4.25	3.50	2.02	3.50	4.25
	Other Gulf countries	22.29	23.18				
4b. Grand Coalition - low spare	Iran	4.27	4.15	3.44	2.02	3.44	4.15
	Other Gulf countries	18.64	20.40				
5a. Hormuz Blockade - high pipe	Gulf countries	22.91	24.55	23.84	14.84	23.84	24.55
	of which export cap.	17.70	19.17	18.30	9.30	18.21	18.75
5b. Hormuz Blockade - low pipe	Gulf countries	22.91	24.55	23.84	10.84	23.84	24.55
	of which export cap.	17.70	19.17	18.30	5.30	18.21	18.75

Depending on the nature of the model used, the scenarios are implemented in different ways. In GEM-E3, we assess a situation in which oil supply is affected for one year; and related oil prices would also increase accordingly. Note that, unlike for POLES − in which the high oil prices trigger a demand (and supply) reaction with some delay − in GEM-E3 the markets and prices adjustment is immediate. Therefore, the GEM-E3 oil prices cannot be directly compared with the POLES oil prices for one year. Nevertheless, the relative increase in oil prices across the scenarios are in line with the increase in POLES oil prices for the average of the two consecutive years 2012 and 2013: oil prices rise by more than 80% in the "Hormuz optimistic" scenario, and more than 120% in the "Hormuz pessimistic" case compared to a

[6] mb/d = million barrels per day

baseline (low spare) scenario. The output describes the response emerging under this assumption.

In POLES, under the “Grand Coalition” and "Hormuz" scenarios it is assumed that the embargo results in a partial reduction of the Iranian oil export volumes in 2012, and that the consequences of the embargo come to full impact in 2013, which is gradually relaxed during 2014. Therefore, by 2013 Iranian oil exports are blocked fully and Iran continues to produce oil for domestic supply only. On top of this, under the "Hormuz" scenarios the oil export levels Gulf countries exports are limited by the available pipeline capacities. The optimistic scenario refers to 100% of existing and on-going pipeline capacities (9.30 mb/d) while the pessimistic one only considers existing and operational pipelines (5.30 mb/d), excluding the option via Syria[7].

In the OURSE model, the POLES assumptions are replicated, taking in consideration that the regional disaggregation of OURSE is significantly less detailed than those of GEM-E3 and POLES. In particular, in OURSE, Iran forms part of a much larger region, the Middle East region.

Interpretation of Model Results

As we work with three different model families, each model result should be interpreted in a distinct way:

- The GEM-E3 results are of comparative static nature, and reflect the annual impact of imposing the constraint during a full year in the year 2010.

- For the POLES model the full constraint lasts 1 year (2013) with an additional year of transition to the normal situation (2014). The impacts last longer than the duration of the constraints, due to long-lasting changes in consumption and investment. Depending on the severity of the constraint this can be felt up to 2020.

- The full effect on demand for oil products is felt in 2014: this is why that year was chosen to conduct the analysis of the refining sector with the OURSE model.

[7] Due to the on-going unrest in that country and its long-term strategic alliance with Iran.

4. Results

In the following, the oil supply and price effects will be discussed first, followed by the macro-economic impacts calculated for the different scenarios.

4.1. Oil supply

Table 4 below displays the evolution of the oil production by country group in the baseline scenario. It shows a slow growth of the liquid fossil fuel production, coming from OPEC, non-conventional oil and biofuels.

Table 4. World liquid fuel production in the Baseline (low spare), 2000-2020

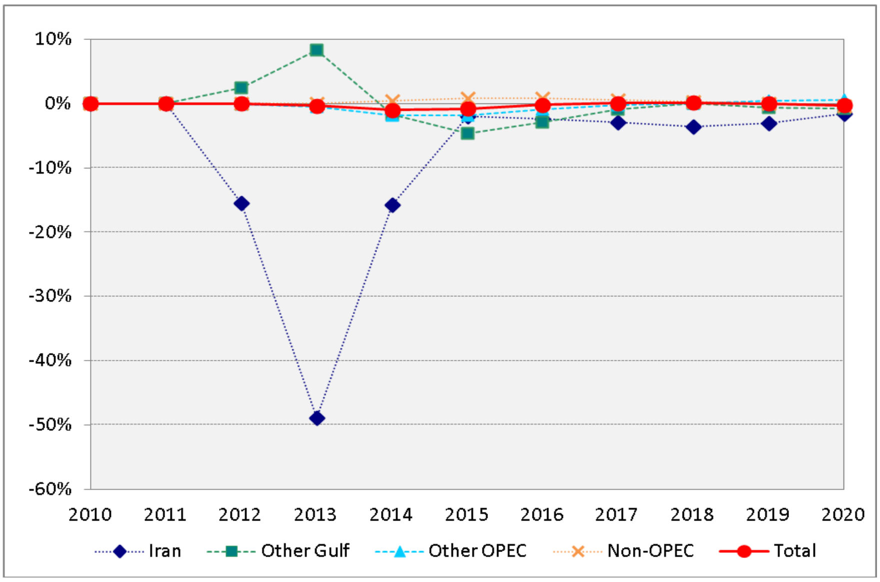
Production (mb/d)	*2000*	*2005*	*2010*	*2015*	*2020*
Crude production					
Gulf, of which	20.4	22.4	22.0	24.6	27.2
Iran	3.8	4.2	4.2	4.0	4.2
Other OPEC	9.7	11.4	11.7	12.6	13.4
Non-OPEC	43.5	46.3	46.9	46.3	45.0
Other liquids					
Heavy, tar sands, shale oil	0.6	1.2	1.6	2.5	3.5
Coal- and Gas-To-Liquid	0.02	0.02	0.03	0.09	0.17
Biomass-To-Liquid	0.04	0.06	0.26	0.46	0.72
Total oil	74.3	81.3	82.2	86.1	89.1
Total liquids from fossil	74.3	81.3	82.3	86.2	89.3
Total liquids	**74.3**	**81.4**	**82.5**	**86.6**	**90.0**

Source: 2000-2010: IEA; 2015-2020: POLES model results

Figure 2 and Figure 3 below provide the change in production levels compared to the baseline for the "Grand Coalition (low spare)" and the "Hormuz Optimistic" scenarios. In the "Grand Coalition" scenario the temporary sharp decrease in oil output from Iran is compensated by the other Gulf countries. The resulting oil price increase (see below Table 6) leads to a small contraction of oil demand compared to the Baseline.

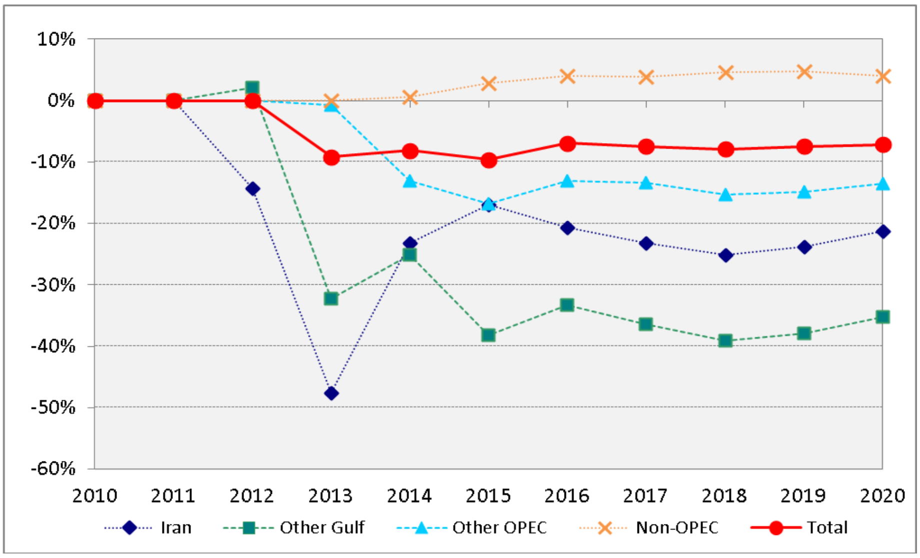
The situation is highly contrasted in the "Hormuz Optimistic" scenario. Here, the disappearance of Gulf output in 2013 profoundly perturbs for a long time the oil market; total global output is reduced by about 10%. The resulting high oil price and the volatility triggers investment in non-OPEC regions, that see their oil production increasing substantially, by about 5% over 2015-2020. As a consequence, the swing production (OPEC, and most notably Gulf) is depressed up to 2020 compared to the Baseline situation. This situation is close to what happened in the early 80s after the second oil price shock.

Figure 2. Oil production – Grand Coalition (low spare) vs. Baseline (low spare)



Source: POLES model results

Figure 3. Oil production – Hormuz Optimistic vs. Baseline (low spare)



Source: POLES model results

Potential of strategic oil stocks

Simulating the five scenarios considered does not take into account the possible utilisation of strategic oil stocks but it is assumed that stocks could be used in order to fill the temporary gap between demand and supply in the case of a major oil shortage. According to the latest information available from the International Energy Agency, 37% of the total stocks in IEA countries (4142 Mb) are government-controlled and the remaining 67% are industry stocks which include commercial[8] stocks as well as strategic stock obligations imposed by the respective governments.

The EU has implemented its own oil stockholding system which has been revised (Council Directive 2009/119 /EC). This revision concerns enhancing the system, bringing it into line with the existing rules of the IEA and optimising administrative obligations in Member States. Many countries are also bolstering their own stockpiles and several, such as China and India, have major storage projects at various stages of development.

In assessing the necessity to initiate a co-ordinated action, the IEA considers multiple factors beyond the gross peak supply loss caused by the event. The decision depends on the expected duration and severity of the oil supply disruption, and also takes into account any additional oil which may be put on the market by producer countries.

Table 5. Stock levels and drawdown rates for one year's oil disruption.

	Stock Level (Mb)	Drawdown rate - 12 months (mb/d)
IEA Members	4142	11.3
of which government-controlled	1531	4.2
Other*	749	2.1
Total	**4891**	**13.4**

* excluding Gulf countries

Table 5 establishes stock levels and drawdown rates in order to have an idea of the theoretical potential of oil stocks based on a 100% utilisation of stocks (industry and government-controlled) for a period of 12 months. It is necessary to keep in mind that the growth in stocks by emerging countries (like China and India) or the fact of building up again stocks by main consumers after an oil disruption would cause a rise in demand and would contribute to higher oil prices.

4.2. Oil price

Figure 4 shows the recent evolution of oil prices for Brent and WTI (West Texas Intermediate) in constant US $2005[9], taken from the US EIA[10]. This document reports the Brent spot price. The chart clearly shows the increase in prices (in particular Brent) in the first months of the year 2012. This is in line with the IEA Oil Monthly Report, which reported that in January 2012, spot crude oil prices increased due to rising tensions between Iran and the West.

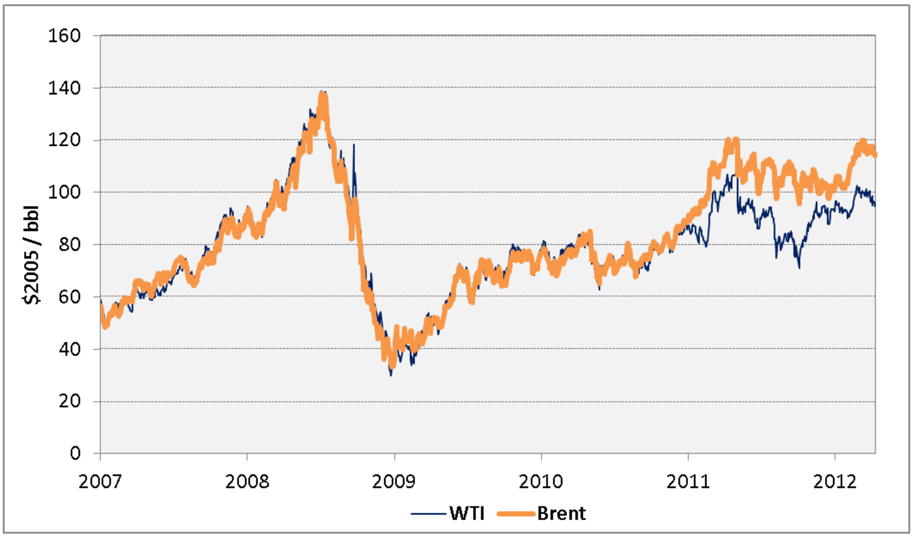
[8] Commercial stocks are held by private companies or final consumers to guarantee the smooth functioning of their plants or vehicles between the discrete re-fills of tanks, or in the expectation of financial gain in case the future price might be higher than the current one. Strategic stocks, on the other hand, are meant to deal with extraordinary situations, which constitute a security threat to the nation.

[9] We applied the deflator provided by the US BEA to convert current prices in constant $.

[10] The EIA provides the latest data on oil price at http://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm

The "Iran premium" of perhaps 10-20$ in the oil price that may be observed since last autumn to some extent reflects the hedging behaviour of some major players, anticipating a possible escalation of events (up to important disruption in the Hormuz Strait).

Figure 4. Recent evolution of oil price, January 2007 - April 2012



This on-going evolution in 2012 is better reflected in the POLES results obtained with the assumption on "low spare capacity". We therefore keep the assumption of low spare capacities for the years 2011-2012 as the default setting for the analysis for the scenarios "Intermediate Coalition", "Grand Coalition" and "Hormuz". From 2013 the model simulates endogenously how the capacity evolves thereafter unless explicitly stated.

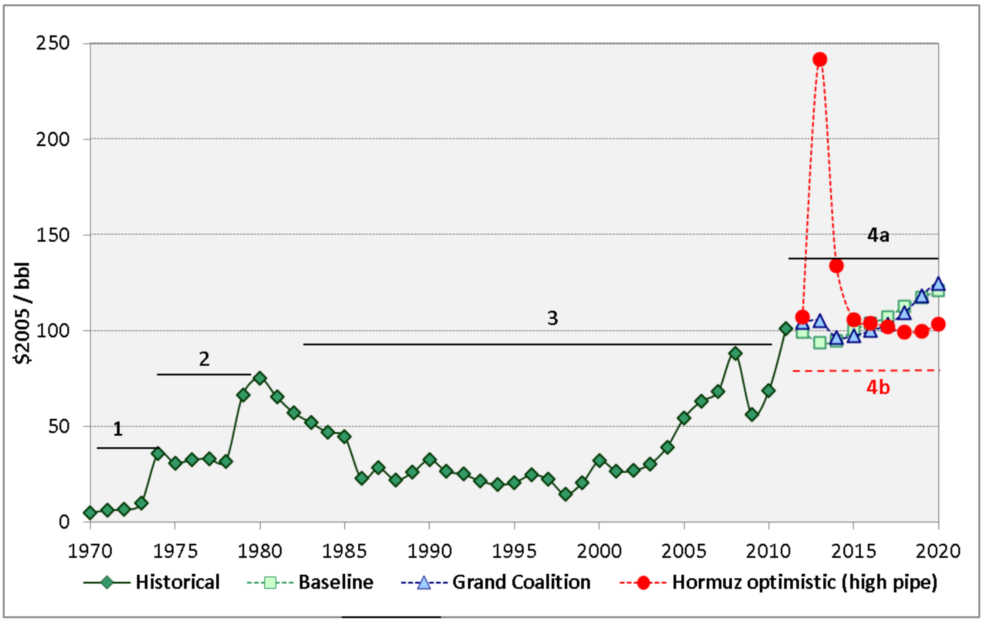
As explained earlier, the "Small Coalition" is considered as being neutral in terms of crude oil price evolution in the POLES model, since it results only in a shift of the crude trade flows. The "Intermediate Coalition" results in a slight increase of the oil price in 2012-2013 compared to the Baseline. The "Grand Coalition" has a more severe impact on the oil price in 2013, up to levels that are actually pretty close to the situation observed in January – April 2012.

Table 6. Impact on oil price, 2010-2020 ($2005/bbl)

Scenario	#	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Baseline - high spare	1a	101	89	87	89	93	96	99	105	112	117
Baseline - low spare	1b	101	99	94	95	100	104	107	113	117	121
Intermediate Coalition - high spare	3a	101	89	88	89	92	95	98	105	112	115
Intermediate Coalition - low spare	3b	101	101	97	95	99	103	107	113	118	123
Grand Coalition - high spare	4a	101	91	93	89	91	94	97	104	111	117
Grand Coalition - low spare	4b	101	104	105	97	98	100	103	110	118	125
Hormuz - high pipe	5a	101	107	242	134	106	104	102	99	100	103
Hormuz - low pipe	5b	101	107	321	130	97	97	92	87	86	88

The "Hormuz" scenarios lead to a price peak in 2013. From 2015 onwards, the oil price remains lower than in the "Baseline" due to the demand reduction triggered by the oil price peak. This reaction can be compared to the counter-shock that followed the price shocks in the mid 70s and early 80s, as shown in Figure 5 and Figure 6. The 4 periods refer to changes in the oil demand profile, as shown in the Figure 6 below.

Figure 5. Oil price evolution, 1970 – 2020



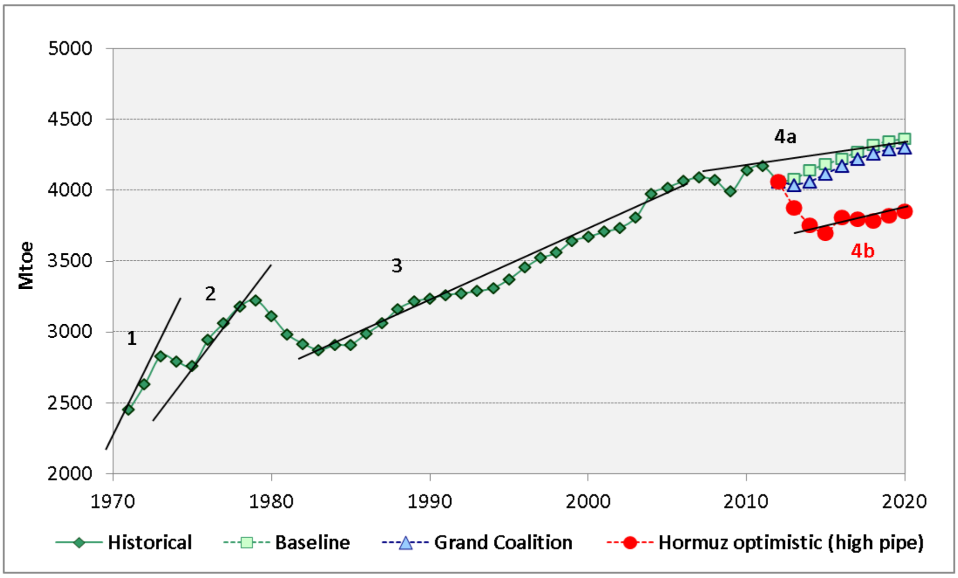
Source: POLES model results; historic data: EIA

4.3. Impact on oil demand

The evolution of world oil demand since 1970 is given in Figure 6. We identify 4 historical trajectories:

- 1970-1973 (phase 1): before the 1st oil shock (1975) oil demand was growing fast.
- 1974-1978 (phase 2), between the 1st and the 2nd oil shocks: the price first stabilises oil demand, which then resumes its growth at a slightly lower rate than in phase 1.
- 1979-2005 (phase 3): after the 2nd oil shock the oil demand decreases during 5 years, then restarts growing with a flatter slope than in phase 2. It takes 10 years to recover the pre-1980 level.
- 2005-2010 (phase 4): oil demand grows slowly, the oil price remains high. The baseline trajectory (4a) displays a consistent trajectory with these recent developments. Here the adjustment between demand and supply goes through a price increase, the demand being driven by the sustained economic growth in many developing regions while supply remains fairly stable. Indeed, it appears that the room for new discoveries is much smaller compared to those that took place in the late 80s and early 90s, thus limiting the scope for more production and lower oil price.
- "Hormuz" scenarios – oil price shock (phase 4b): as in the early 1980s the oil demand declines substantially compared to baseline. In 2014, global oil demand decreases by more than 9% and more than 11% for the "Hormuz optimistic" and "Hormuz pessimistic" scenarios, respectively. Even though demand growth picks up again from 2015 on, it takes more than 10 years to recover the 2010 level and to converge towards the Baseline situation (4a).

Figure 6. Global oil demand, 1970 – 2020

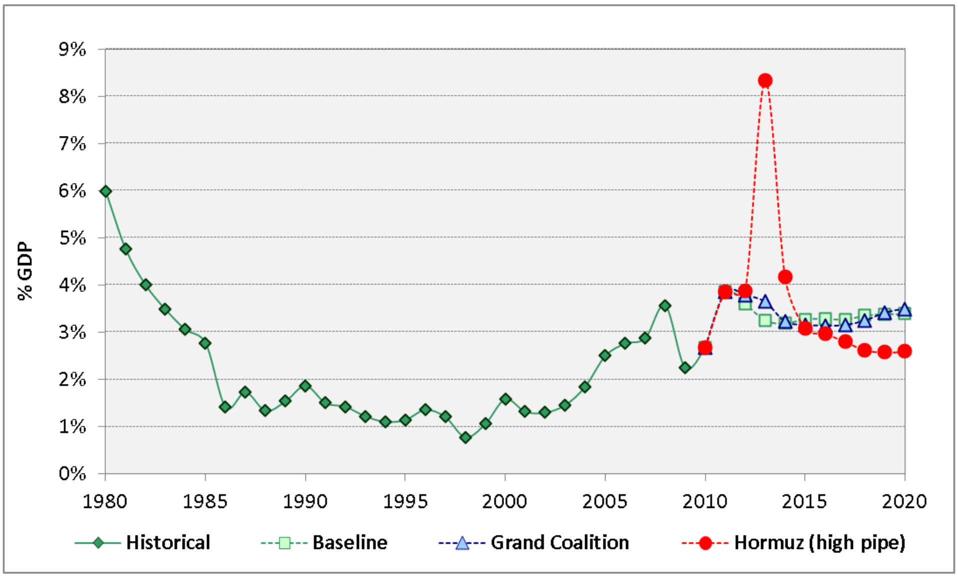


Source: POLES model results; historic data: IEA/Enerdata

4.4. The oil bill in the world economy

Since the 1980s, the cost of oil (in terms of GDP expressed in PPP) has been declining in the OECD to remain at relatively low levels in the order of 1-2% for about two decades. With the rise in oil prices in the years 2007/8 and more recently in 2010/11 combined with the effects of the economic downturn, the oil bill has exceeded 3% of the GDP of OECD countries in recent times. Under the baseline, the oil costs would slightly decrease from today's levels and remain more or less stable thereafter. This trend is altered only to a limited extent in the Grand Coalition scenario. On the contrary, in the Hormuz cases oil costs would rise to much above baseline levels for a few years before they would then fall below the baseline levels and remain there for some years. This is largely due to the comparably low oil demand in the Hormuz case combined with the lower oil prices in the long run.

Figure 7. Oil cost for the OECD, 1980-2020 (% GDP)



Source: POLES model results; historic data: IEA/Enerdata

Revenues from oil exports

Since the early 2000s the Gulf countries experienced an increase of oil export revenues[11] with a sharp rise in 2008, which was counterbalanced in 2009 due to the combined effect of the oil price decrease and the economic crisis. Under the “Grand Coalition” and the “Hormuz optimistic” cases, the oil export revenues of Gulf countries would increase compared to the baseline for a short period of time due to the higher oil price, and in the Grand coalition case also due to the higher export levels in order to compensate for the disruption in Iranian oil. However, their revenues decrease after a few years and reach values below the baseline levels, particularly pronounced in the "Hormuz" scenarios. This is due to both lower prices and lower oil exports compared to the baseline that are the consequence of an overall lower demand and an increase in the non-Gulf oil supply in the Hormuz case. The increase in the oil price and the growing importance of non-Gulf oil suppliers also imply a temporary rise in the oil revenues of non-Gulf producers.

4.5. Impact on GDP

Changes in the oil price have a direct effect on the GDP of all economies. In general, for oil importing countries, factors affecting the GDP impact are influenced by the dependency of the economy on (imported) oil, which in return is largely dependant on the structure of the economy and the available domestic resources. For oil exporting countries, the oil export revenues – due to price and quantity effects - are key to the overall economy.

Table 7 reports the GDP effect under the five main scenarios[12] compared to the baseline scenario for the 27 EU Member States as well as for Major Economies such as USA, China, India, Russia, Japan, and Canada. The table also lists the GDP effects for Iran and the Gulf region[13]. Table 7 is discussed more in detail in Section 5.

The macro-economic impacts are calculated using GEM-E3. As an equilibrium model the results reflect the situation when all parts of the economy, i.e. industrial sectors, government and consumers have fully adapted to the shocks in oil supply. In other words, the calculation does not take into account any transaction costs. Similarly, the oil sector is modelled as a single, flexible global market. Countries that substitute oil from Iran do no face any search costs for finalizing existing contracts and looking for new providers.

Table 8 shows the impacts of the oil shock supplies on the various sectors of the economy (aggregated on a global level). The fossil oil sector (incl. oil products and refineries) is the sector that is affected most severely and their output decreases up to -17% for the Hormuz Pessimistic scenario. This is a direct effect of the shock in oil supply. Road, air and water transport are all oil-intensive and this sector shows a strong impact due to the oil scarcity (up to -5% of their activity). The impact on other sectors (electricity, industry and construction, agriculture, and services and government) is smaller but still significant for the 'Hormuz' scenarios. The other sector that feels almost no impact is the other energy carriers (in particular gas). Here, the lower activity levels of the global economy are compensated by a higher demand due to substitution away from the expensive oil.

[11] Export revenues are defined as the as net crude exports multiplied with the Brent price in constant $US\$_{2005.}$

[12] In GEM-E3, we assess situations in which the different scenarios are in force for one full year. Oil price increases for the different scenarios GEM-E3 are 0% for the "Small Coalition", 5% for the "Intermediate Coalition", 16% for the "Grand Coalition", 85% for the "Hormuz" scenario, and 122% for the "Hormuz Pessimistic" scenario. These price changes are consistent with POLES.

[13] Following the GTAP 7 categories the 'Gulf' includes Bahrain, Iraq, Israel, Jordan, Kuwait, Lebanon, Palestinian Territories, Oman, Qatar, Saudi Arabia, Syria, UAE, and Yemen.

Table 7. GDP effects across the various scenarios

Vs. Baseline (%)	Small Coalition	Intermediate Coalition	Grand Coalition	Hormuz	Hormuz Pessimistic
Austria	-0.01	-0.12	-0.43	-1.90	-2.62
Belgium	-0.01	-0.16	-0.57	-2.48	-3.42
Bulgaria	-0.01	-0.16	-0.56	-2.56	-3.52
Cyprus	-0.02	-0.24	-0.86	-3.80	-5.30
Czech Republic	-0.01	-0.19	-0.69	-3.07	-4.23
Germany	-0.01	-0.15	-0.54	-2.41	-3.34
Denmark	0.00	-0.03	-0.10	-0.33	-0.39
Spain	-0.01	-0.15	-0.55	-2.44	-3.37
Estonia	-0.01	-0.24	-0.87	-3.74	-5.07
Finland	-0.01	-0.14	-0.49	-2.13	-2.92
France	-0.01	-0.15	-0.54	-2.46	-3.42
United Kingdom	0.00	-0.09	-0.30	-1.32	-1.80
Greece	-0.05	-0.20	-0.63	-2.70	-3.73
Hungary	-0.01	-0.11	-0.41	-1.79	-2.48
Ireland	-0.01	-0.11	-0.39	-1.67	-2.25
Italy	-0.01	-0.13	-0.46	-2.03	-2.80
Lithuania	-0.02	-0.24	-0.89	-3.85	-5.30
Luxembourg	-0.01	-0.13	-0.48	-2.14	-2.94
Latvia	-0.01	-0.24	-0.90	-3.89	-5.36
Malta	-0.02	-0.28	-1.00	-4.38	-6.03
Netherlands	-0.01	-0.14	-0.50	-2.22	-3.06
Poland	-0.01	-0.17	-0.62	-2.77	-3.83
Portugal	-0.01	-0.22	-0.80	-3.58	-4.95
Slovakia	-0.01	-0.20	-0.71	-3.13	-4.33
Slovenia	-0.01	-0.13	-0.48	-2.11	-2.92
Sweden	-0.01	-0.17	-0.59	-2.61	-3.62
Romania	-0.01	-0.25	-0.92	-4.12	-5.71
EU27	-0.01	-0.14	-0.49	-2.18	-3.01
Rest of Europe	0.00	0.02	0.07	0.51	0.85
USA	0.00	-0.09	-0.31	-1.40	-1.93
Japan	-0.02	-0.12	-0.38	-1.70	-2.38
Canada	0.00	0.01	0.04	0.28	0.46
Oceania	0.00	-0.15	-0.29	-1.32	-1.82
Brazil	0.00	-0.12	-0.57	-2.32	-3.07
China	0.00	-0.20	-0.46	-2.01	-2.78
India	0.01	-0.08	-0.83	-3.72	-5.31
Russian federation	0.03	0.45	1.66	7.82	11.05
Iran	-0.38	-5.68	-16.80	-17.64	-17.97
Gulf	0.05	1.03	3.81	2.11	-2.04
Rest of the World	0.01	-0.06	-0.25	-0.79	-0.89
World	0.00	-0.10	-0.34	-1.46	-2.05

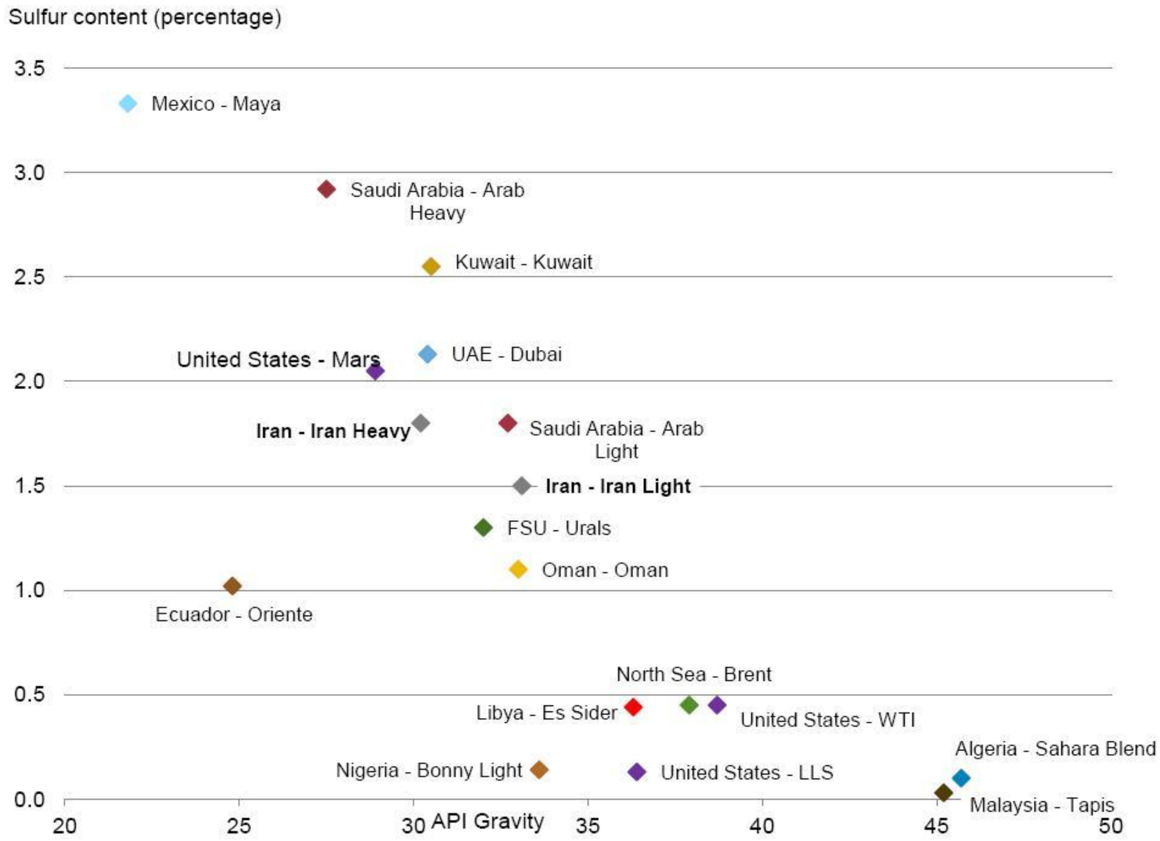
Source: GEM-E3 - own calculations

Table 8. Global sectoral impacts on output

World Vs. Baseline (%)	Small Coalition	IntermediateCoalition	Grand Coalition	Hormuz	Hormuz Pessimistic
Fossil Oil Sector	0.00%	-1.12%	-3.09%	-13.31%	-17.23%
Coal, gas, biofuels	0.01%	-0.03%	-0.07%	-0.06%	0.00%
Electricity	0.00%	-0.06%	-0.21%	-0.96%	-1.32%
Industry and Construction	0.00%	-0.07%	-0.24%	-1.06%	-1.48%
Transport	-0.01%	-0.75%	-0.75%	-3.65%	-4.99%
Agriculture	0.00%	-0.03%	-0.12%	-0.61%	-0.89%
Services and Government	0.00%	-0.03%	-0.12%	-0.51%	-0.71%

Source: GEM-E3 - own calculations

Figure 8: Density and Sulfur Content of Selected Crude Oils



Source: EIA (2012)

4.6. Impact on the oil product market

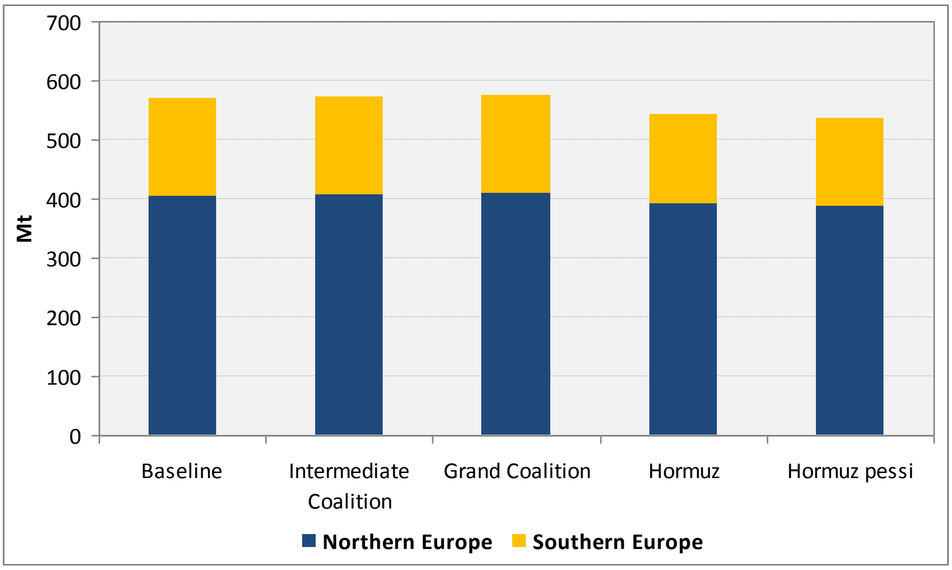
The impacts on the oil product markets have been analysed with the OURSE model. All major assumptions on demand trends, oil prices etc. were harmonised with the POLES results (and therefore also GEM-E3). Note that the regional disaggregation in OURSE does not allow differentiating between Member States, nor does it allow an aggregation on the EU-27-level. Instead, OURSE provides results for Southern Europe and Northern Europe (representing the refining markets Mediterranean and North-West Europe), which are aggregated here, and contain additional countries than the EU Member States (see section 2). In particular the inclusion of the oil-producer Norway in Northern Europe and also of Turkey in Southern Europe implies that results are different from what might be expected for the EU-27 only.

The OURSE model results show hardly any impact on the oil refining sector in the 'Small Coalition', 'Intermediate Coalition' or 'Grand Coalition' scenarios. This is due to the substitutability of Iranian crudes by other crude or blends of crude which offer similar properties and refining behaviour (Figure 8). Therefore, under these conditions, the production of Arabian light and Arabian Heavy as well as that of Forcados would be increased so as to replace the lower export levels from Iran. The results indicate that the quantities needed to fully substitute Iranian crudes are technically available in these scenarios. Given that the long term price equilibrium between the Iranian crude oil and their substitute corresponds to the equilibrium in quantity terms between these crude oils, no major change in the long term prices spread should occur even if some movements could appear in the short term

Moreover, the difference in the prices between Iranian light and heavy and their substitutes is negligible according to an estimation of the long term equilibrium between crude oil prices.

Hence, both for Northern and for Southern Europe, no significant reduction in refinery output can be observed in the 'Intermediate Coalition' or 'Grand Coalition' scenarios (see Figure 9).

Figure 9. Change in European refinery production levels across scenarios in 2014



Source: OURSE model results

This situation changes significantly in the "Hormuz" scenarios with its more severe oil supply constraints. Here, two effects can be observed that influence the European refining sector in opposite directions.

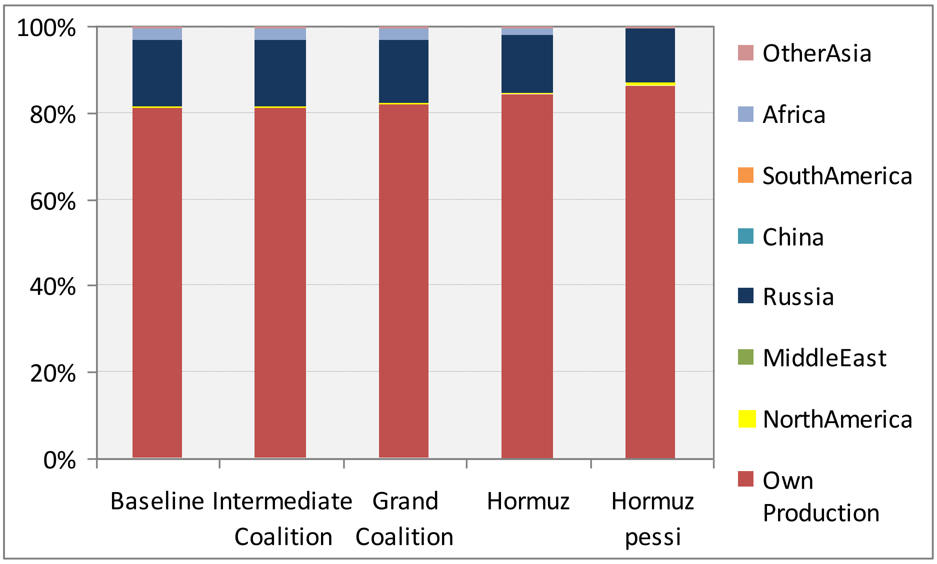
- Firstly, the high oil price drastically reduces the global and European demand for oil products (see also section 4.3). As a consequence of this, refinery output would be reduced.
- Secondly, the oil supply disruptions from Middle East would result in a change in global trade patterns of both crude and oil products. In particular Asia, which currently imports a large share of their oil from Middle East, would face shortfalls in their oil supply. Hence, it would increase its imports of refined oil products in particular from

North and South America and Russia. This in return leads to less Russian exports to Europe and to Africa. Increasing European oil product export levels would compensate for some of the missing Russian exports to Africa. This development acts to increase European refining output.

In total, these counteracting trends mean that European refining sector output would decrease less than the European demand for oil products. As a consequence, the share of own production in the overall consumption rises and net imports decrease (see Figure 10). European net export levels of oil products in the "Hormuz" scenarios would remain more or less at baseline levels, but the destination of exports would change with more exports being directed towards Africa, and less to North America.

Within Europe, the Southern European refining sector would be more strongly affected than that of Northern Europe, which keeps its production almost constant throughout all scenarios. This is due to a higher degree of dependence from crude oil imports from Middle East in Southern Europe, with some Member States such as Greece and Italy importing a relevant share of their crude oil supplies from Iran (around 12-13%) whereas the imports of Iranian crude is very limited in Northern European countries.

Figure 10. Origin of oil products imports to Europe in 2014



Source: OURSE model results

5. Discussion

Already in the **"Baseline"** scenario a slightly decreasing oil demand in 2012 can be expected. This is the consequence of the slowdown of world economic growth in 2012[14] combined with the high level reached by the oil price in 2011. On the production side, the situation in Libya is assumed to get back to normal in 2013, by when it would reach its 2010 production levels, while Iraq's production keeps increasing steadily. The oil price then tends to decrease compared to 2011 for a couple of years. However, oil demand increases in emerging economies combined with limited capacity to expand oil production capacities worldwide will finally drive the price up in the mid-term.

[14] According to GDP assumptions from IMF.

The **"Small Coalition"**[15] scenario has no effect on the global and EU economies compared to the Baseline. Also the impact on Iran's economy is very modest (-0.38% of GDP). The international oil market adjusts itself to the unilateral embargo of the 'Small Coalition' where the participating industrialised countries replace the supply from Iran by supply from the other countries. Iranian crudes would be substituted by a blend of other crudes that offer similar properties. In turn, Iran sells higher volumes to the non-participating countries such as China and India.

In the **"Intermediate Coalition"** scenario the international crude oil supply shrinks with the amount corresponding to 20% of Iran's output of crude oil in the baseline. With a GDP cost of 0.06% and 0.14%, respectively, the effect on the global and EU economies is limited. However, the impact on Iran's economy is more significant (-5.68% of GDP).

In the **"Grand coalition"**[16]scenario, all countries participate in the embargo of Iranian oil, and it is assumed that the world no longer has access to the Iranian oil. The Gulf countries increase their production to compensate, to some extent, the production in Iran that cannot reach the international market. That is close to the 2011 situation when Saudi Arabia and the United Arab Emirates compensated for the Libyan production losses induced by the conflict (yearly production of Libya declined by 70% in 2011 compared to 2010). In the "Grand Coalition" scenario, these two countries act again as swing producers in 2013. However, the total global oil supply is slightly reduced assuming that the global spare production capacity is very low. Hence, the oil price lies above its baseline levels in 2012 and 2013 by some 5$/bbl and 11 $/bbl, respectively.

The lower availability of crude oil for the world economy has a cost of 0.34% of GDP compared to the baseline. However, the costs of this embargo are not evenly distributed across the participating countries. As expected, Iran is the single country that is most heavily affected. This global embargo reduces its economy by about 17%. With a GDP decrease of 0.49%, the EU on average suffers more than the global economy. Countries with a heavy reliance on oil imports compared to their GDP are also relatively strongly affected. India (-0.83%) belongs to this group, but also EU countries like Malta (-1.00%), Romania (-0.92%), the Baltic States (-0.87% to -0.90%), Cyprus (-0.86%) and Portugal (-0.80%). Countries with relatively lower oil imports compared to GDP can contain the negative impact. They limit their oil imports either because they are very energy efficient such as Japan (-0.38%), or because they have an important domestic production of crude oil, such as USA (-0.31%) and UK (-0.30%). Major oil exporting countries such as 'Gulf' (+3.81%) and Russia (1.66%), and to a lesser extent Canada (+0.04%) and 'Rest of Europe' with Norway (+0.07) benefit from the Iran oil embargo as they can sell their oil exports at higher prices, and would also increase their production levels.

In the **"Hormuz"** scenarios, the world economy not only is cut off from the Iranian crude oil exports but also from a significant share of the Gulf oil production (either 40% in the optimistic scenario or 60% in the pessimistic scenario). The disappearance of a large share of the international market supply results in a more than doubling oil price. This oil price increase leads to substantial demand reduction that eventually balances the market. In the longer term, alternative oil supply would also play a role, but short term capacities are extremely low.

[15] Note that this scenario has not been assessed with POLES since the model's representation of the oil market ("one great pool") does not allow capturing its effect.
[16] As mentioned before, this scenario refers to Grand Coalition with low spare capacities available.

The negative impact on the world economy is quite strong with a cost of 1.45% in the optimistic scenario and 2.05% in the pessimistic scenario. In other words, lower availability of the Gulf oil production of 15 percentage points causes an additional 0.60 percentage points reduction of the global economy. This also underlines the role of any potential spare capacity that may be available beyond the Gulf region in order to keep the impacts on the global economy limited. The Iranian economy contracts with about 18%. Also under this scenario the EU economy is more negatively affected (between -2.18% and -3.01%) than the global average.

The group of countries with a heavy reliance on oil imports compared to their GDP again have the highest impact. In the pessimistic scenario, their GDP may suffer a negative impact of 5-6%. The USA and UK, which have an important domestic production of crude oil, show slightly lower negative GDP effects than the global average, whereas Japan is a bit more affected than the world economy. The even higher oil prices in the Hormuz scenario increase the revenues of the major oil exporting countries. Russia, in particular, benefits with an increase of GDP by 7.82% and 11.05%. As the production capacity of the 'Gulf' is directly affected, its GDP effect oscillates between -2.04% and 2.11%, depending on the availability of oil pipelines through which exports can be re-directed.

6. Conclusions

The combined analysis of five main scenarios with three different modelling tools that complement each other allow to draw some conclusions on possible impacts of the Iranian oil embargo on the economy, the energy sector and the refinery market, despite the caveats and limitations explained further below:

- The analysis shows that a unilateral embargo by the "Small Coalition" – countries hardly has an effect on Iran’s economy. The "Grand Coalition" and "Hormuz" scenarios, however, have an impact of 17-18% of GDP on Iran’s economy.
- Impacts on the international oil market are negligible in the "Small Coalition" scenario. They are limited in the "Intermediate Coalition" and "Grand Coalition" scenarios, whereas they are significant for the "Hormuz" scenario, in particular under the assumption of low pipeline export capacities.
- The impact on the EU GDP in the worst scenario "Hormuz pessimistic" scenario could reach -3% compared to a baseline, with important differences across EU Member States influenced by the importance of oil in their economy, and almost 2% in the USA. At global level, the GDP could be reduced by around 2%.
- The size of the economic impacts of the "Hormuz" scenarios (between 1.5 and 2% loss of global GDP) makes them unlikely to be very ‘stable’ scenarios on the long-term.
- In the two "Hormuz" scenarios we assume that either 45% or 60% of the Gulf oil exports can be transported through existing pipelines. Even though the difference seems of limited nature (i.e. 15 percentage points), it leads to drastically different results in terms of global GDP (0.6 percentage points). This shows that the world economy becomes increasingly sensitive to supply shocks the scarcer the oil becomes. This also underlines the possible role of spare capacity beyond the Gulf region.
- The scenarios not only have losers but also winners. In particular the major oil exporting countries as Russia and some Gulf countries (depending on the scenario) could benefit from the increase in oil prices. To a lesser extent Canada and Norway could also gain temporarily from oil scarcity. However, under the Hormuz scenarios almost all oil producing countries would loose out in the mid-longer term due to the persistent demand destruction induced.
- The costs of oil in the OECD and the EU economy would only be slightly affected in the 'Grand Coalition' scenario, but could more than double from today's (elevated) levels for one year in the "Hormuz" scenarios. Thereafter, however, it would fall rapidly again to reach below-baseline levels due to the lower oil demand.
- Refinery output in both Northern and Southern Europe remains more or less at baseline levels in the 'Intermediate Coalition' and 'Grand Coalition' scenarios in 2014. The larger volumes of Iranian crudes that are currently used in Southern Europe can be replaced by a blend of different other crude types without any major increase in prices. In both 'Hormuz' scenarios, the Southern European refinery output would decrease due to a higher dependence on oil imports from Middle East. All in all, though, the total European refinery production decreases less than demand, leading to higher exports and a larger share of own production compared to the baseline.

7. Caveats and limitations

The different nature of the models needs to be taken into consideration when interpreting the results. GEM-E3 (and also OURSE) are models that calculate an equilibrium under given circumstances; their results are thus of static nature. POLES, on the contrary, is a simulation model that represents explicitly the evolution over time of the markets, and, hence requires more time to reach a new equilibrium between oil supply and demand. Despite the different nature of the modelling approaches, the reading of the model results provide a coherent picture on (a) the relative price changes for each scenario; (b) the evolution of the bill of the imported oil and export revenues determined with the sector model POLES which is in line with the macro-economic results of the global multi-sectoral model GEM-E3, and (3) the evolution of trade of different oil products, refinery use and oil varieties, as reported by OURSE.

However, a scenario analyses is not a stochastic approach in which probabilities are given for each potential input variable, and as a consequence of this an expected magnitude of the impacts can be derived. This report, however, presents a quantitative analysis of the potential implications of the Iranian oil embargo under a coherent set of framework assumptions and illustrates the transmission mechanisms of those effects.

The results discussed here raise a number of important questions that will need to be further analysed in order to provide a comprehensive assessment of the impacts of an oil supply disruption following an embargo on Iranian oil.

- The role of gas in the Iran crisis remains an open question. Qatar, the 5th producer of natural gas in 2010 (120 bcm) and by far the main LNG exporter (77 bcm in 2010), will be cut off from its costumers under the Hormuz scenarios.
- One could wonder whether the weak status of the economy in some countries of the EU, Japan or USA may affect the economic impacts of Iran oil embargo. In the last year, some countries have relatively reduced their oil imports (e.g. in order to adjust their current balance), whereas other countries saw their oil/GDP intensity worsened (e.g. due to a deterioration of their financial sector). These recent evolutions may slightly influence the results of this analysis in opposite directions.
- A more detailed assessment may be done on the role that can be played by the swing producers who have sufficient spare production capacity that is not normally used but can be brought on the market quickly. Oil market analysts believe that the oil producing countries need to hold at least 5 percent of global oil demand in order to maintain stable prices (McNally, 2012). The 5 percent spare capacity rule needs stable and calm geopolitical conditions, as was the scenario during most of the 1990s. Since 2003, however, OPEC’s spare capacity has been low and geopolitical disruption risks have multiplied (e.g. Arab Spring, Iraq, Nigeria, Venezuela, and Georgia). Consequently, oil prices have been high and volatile. Given the current threats, the spare production capacity may need to be higher than 5 percent to reassure the markets. Moreover, Saudi Arabia may become unavailable as swing producers under the more extreme scenarios of this study (i.e. 'Hormuz'). Therefore it is equally important to look for available capacity beyond the OPEC, i.e. in Russia (1^{st} on the oil producers ranking), USA (3^{rd}), China (5^{th}), Canada (6^{th}), Brazil (9^{th}) and EU and Norway (both 13^{th}).

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Abstract

This report analyses the macro-economic, sectoral, and energy effects of an Iranian oil embargo. Five scenarios are analysed reflecting various degrees of oil scarcity on the global market and different sizes of embargo coalitions. The report estimates the macro-economic impacts using the global general equilibrium model GEM-E3. The international oil and energy markets are assessed with the POLES model. This provides the impacts in prices and quantities in the international energy (oil) market. Impacts on trade flows regarding refined oil products are estimated with the OURSE model.

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