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Lifting Economic Sanctions on Iran

Global Effects and Strategic Responses

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Abstract

This paper uses a global general equilibrium simulation model to quantify the effects of lifting economic sanctions on Iran with and without strategic responses. Iran benefits the most, with average per capita welfare gains ranging from close to 3 percent, in the case when Iran's crude oil exports to the European Union recover to half their pre-embargo level, to 6.5 percent, in the best case of complete recovery of oil exports to the European Union, successful domestic reforms that enable a strong supply response, and increased market access for Iranian exports in developed markets. Iran could achieve benefits close to the upper range if Gulf Cooperation Council oil exporters limit their crude oil exports to support the oil price. If they do nothing, however, the price of oil will decline by 13 percent in the case of complete recovery of oil exports to the European Union, leaving net oil importers better off and net oil exporters worse off.

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Lifting Economic Sanctions on Iran: Global Effects and Strategic Responses

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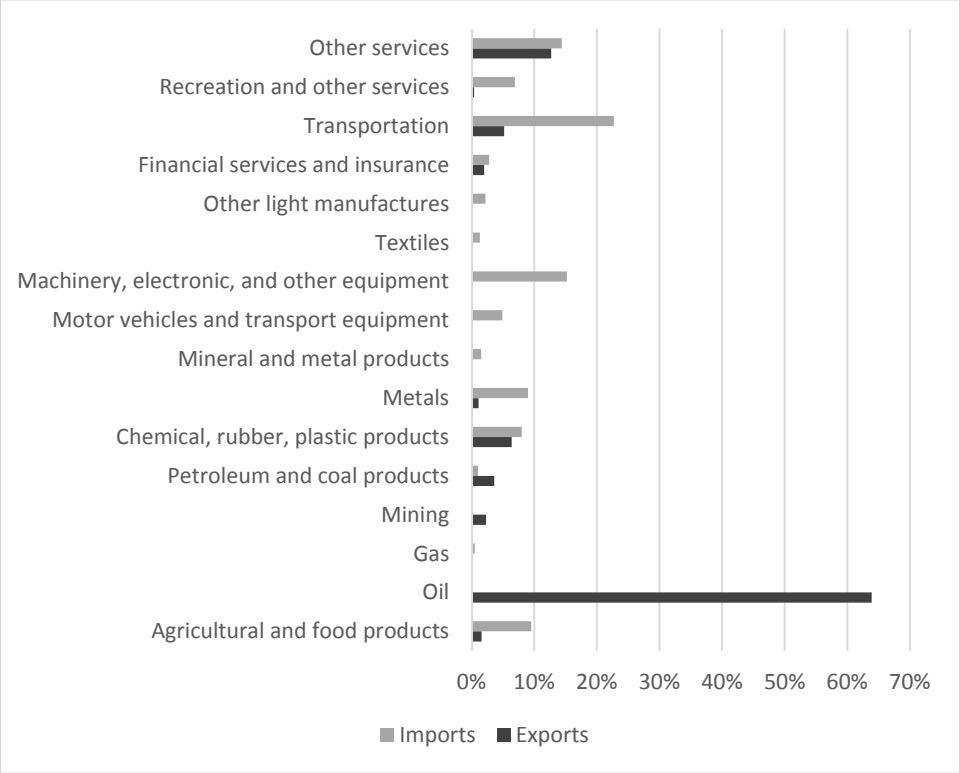
1. Introduction

The lifting of economic sanctions on Iran at the start of 2016, following the nuclear agreement with the permanent members of the UN Security Council and Germany ("P5+1") on July 14, 2015, will have consequences for the global, regional, and Iranian economies. The global effects will be felt mostly through the oil channel. The return of Iranian oil exports to pre-2012 levels could eventually add one million barrels per day on the world oil market, bidding down world prices. There will also be regional effects on Iran's major trading partners, including the United Arab Emirates and other countries in the Middle East and Central Asia, through an expansion of oil and non-oil trade, as sanctions-induced trading costs come down. Finally, there will be effects on Iran's economy as barriers to trade are relaxed and the production mix shifts in favor of goods that fetch high prices abroad and its consumption towards cheaper imports, with attendant effects on economic growth, efficiency, and household welfare.

This paper quantifies the economic effects of lifting Iran's sanctions using a modified version of the GTAP 9 database (Narayanan et al., 2015) and a global, computable general-equilibrium (CGE) model, GTAP, documented in Hertel (1997). CGE models capture the interaction between producers and consumers in the economy, mediated through the price mechanism. The global CGE model we employ in this paper also captures the trade flows between countries and solves for a set of world prices that equilibrate global supply and demand. We use the model to simulate the effect of a "shock", such as the removal of a trade embargo, on the market-clearing prices at the global and national levels. We are therefore able to isolate the consequences of the lifting of sanctions from other ongoing developments in the economy. Since the model captures the new equilibrium of an economy that has been perturbed, the time horizon of a simulation is best thought of as medium term, i.e. three to five years.

Figure 1. The structure of Iran's trade flows (pre-embargo)



Source: GTAP 9 database and COMTRADE (base year 2011).

In our simulations, the lifting of economic sanctions on Iran has three components. The first is the lifting of the EU oil embargo. The 2012 restrictions on imports of Iranian oil by the EU were the most far-reaching of the sanctions as they curtailed the volume of exports of Iran's most important export commodity. Thus, the removal of the EU oil embargo is expected to have the largest macroeconomic impact on Iran and the rest of the world, as oil accounts for about 64 percent of Iranian export revenue (Figure 1) and Iran has a relatively large share (8 percent) of total world exports. The second component is the removal or significant reduction of the cargo inspections on Iranian exports and imports that were imposed as part of the sanctions regime. Transport costs on trade with Iran are expected to decline. This in turn will have an effect on Iran's merchandise trade and boost in particular exports and imports of bulky goods and other goods with

large transport margins, such as agricultural and industrial products and machinery. The third component is associated with improvements in non-tariff barriers affecting Iran's cross-border imports of financial and transport services. As the US and other partners lift restrictions on financial transactions and transport services, Iran's imports of these services are expected to rise.

Simulations with the model show that gains from the embargo removal are the largest for Iran, resulting in a welfare gain of about $18 billion to the economy, or an increase in per capita welfare of 3.7 percent. Almost half of these gains (1.7 percent or approximately $8.2 billion) stem from the lifting of the EU oil embargo, while the reduction in trade costs and improvements in conditions for cross-border services trade result in additional gains of $2.0 billion and $7.5 billion, respectively. The gains to Iran will be 22 percent lower if Iran's oil exports to the EU do not recover completely but reach only half of their pre-sanction levels. This may be a more likely outcome since a full bounce back may not be possible in the medium term due to various impediments to oil production and exports, including a range of technical constraints on crude oil extraction and high domestic oil demand, to name a few.

In the global economy, net oil importers gain and net oil exporters lose as the world price of oil declines by about 13 percent due to the additional amount of oil sold on the global market. The gains to the EU and the US, both net oil importers, are sizable in absolute terms ($67 billion and $34 billion, respectively), but small in relative terms as per capita welfare increases by slightly less than a half of a percent in the EU and a quarter of a percent in the US. The losses are steepest for OPEC members, especially the Gulf Cooperation Council (GCC) members, which are expected to lose 3.9 percent in per capita welfare (equivalent to $55 billion in 2011 prices). Per capita welfare for other OPEC members and the Russian Federation declines by 2.9 percent ($19 billion) and 1.6 percent ($30 billion), respectively. The rest of the world is not significantly affected by

the reduction in Iran's trade costs because Iran is responsible for a negligible share of the world's non-oil exports. Overall, the removal of Iran's economic sanctions translates into a gain for the world economy of $53 billion. Iran gains the most in per capita terms, while the losses of oil exporting countries are large and of similar absolute magnitude to Iran's gains.

The paper also considers the strategic responses of different trading blocks to this trade regime change. Major oil exporters may limit their own oil output and exports in order to stabilize world oil prices. We assess the effect of such a strategic move in combination with the lifting of Iran's sanctions. Recognizing that Iran's policy responses will have a substantial effect on the country's ability to benefit from the lifting of the sanctions, we consider the effects of two policy reforms: (i) unilateral reduction of tariffs on imported capital goods and (ii) reforms intended to boost automobile production. Finally, we assess the effects of improved market access for Iranian exports in western markets in response to credible signs of successful implementation of the nuclear agreement.

We find that if major OPEC members limit the quantity of oil produced and exported in order to leave the world price of oil unchanged, the global welfare gains from the removal of the EU oil embargo would be significantly reduced. Compared to the baseline scenario, world-wide welfare gains decrease by 70 percent, from $54 billion to $16 billion. Iran's welfare gains are enhanced and the losses to oil exporting countries reduced, but not by enough to compensate for the oil importers' reduced welfare gains. The benefits to Iran will also increase if the lifting of the embargo is accompanied with national economic reforms that strengthen the supply response. With a reduction of tariffs on imports of capital goods, welfare gains are expected to be $1.8 billion larger for Iran than in the baseline scenario. Policies that encourage the expansion of automobile production to pre-sanction levels would translate into even higher gains. Given the importance of

this industry to the Iranian economy, these reforms translate into a 40 percent boost to welfare or $7 billion. Exports of automobiles are found to increase by more than two-fold, benefiting all factors of production but most significantly the returns to capital and skilled labor. Finally, improved market access to the west benefits not only Iran, but also the market-access-granting countries. The supply response will be stronger and the welfare effects larger if investment in general, and foreign direct investment in particular, picks up.

The paper is structured as follows. In section 2, we present a brief history of economic sanctions on Iran and links to the literature on the economic effects of sanctions, as background and motivation for the choice of simulations discussed in the next section. Section 3, on modeling the economic impact of sanction removal, discusses the methodology, the need for a global CGE framework, and the main mechanisms through which the lifting of the embargo will affect the economies of Iran, the main trade partners, and the rest of the world. Section 4 discusses the results of embargo removal for Iran and interprets them in light of the discussion in section 2. The strategic policy responses of key trading groups to the embargo removal are assessed in section 5. Finally, section 6 summarizes the key findings, discusses caveats, and offers concluding remarks.

2. Historical context and literature

Iran has operated under sanctions for almost 40 years. With the onset of the Iranian revolution in 1979, and following the attack on the US embassy in Teheran and the detention of US diplomats and staff, the US imposed a ban on Iranian imports to the US.[2] In the mid-1990s, the US sanctions were augmented with a ban on investing in Iran and a law imposing sanctions on

[2] Small gifts, some books, food items and carpets were exempt.

any foreign firm investing more than $20 million a year in Iran's energy sector. In the mid-2000s, when Iran restarted its uranium enrichment program, the UN Security Council outlawed trade in nuclear–related technology and materials and all types of arms, and banned the travel of certain individuals in the nuclear sector.

Throughout the second half of the 2000s, efforts were stepped up to discourage Iran from pursuing its nuclear ambitions and from providing assistance to terrorist organizations. The US banned three Iranian banks and organizations with connections to Iran's Revolutionary Guard from using the US financial system and imposed penalties on companies supplying Iran with refined petroleum products. The UN Security Council banned the trade of arms and the EU imposed sanctions on trade in natural gas technology, expanded the freeze on Iranian assets, and passed a resolution mandating meticulous cargo inspections on imports and exports from Iran. The latter resolution lengthened the time and cost of trading with Iran, effectively imposing a non-tariff barrier on trade with Iran.

In the early 2010s, the scope of the embargo continued to broaden, with the US, UK, and Canada issuing new sanctions. The UK stopped its financial institutions from doing business with Iranian banks, while the US and Canada issued sanctions on firms trading with Iran's energy industry. The US prohibited foreign financial institutions from conducting oil transactions with Iran's central bank, which handles most of the country's oil payments, and tightened the rules ensuring that sanctions are fully implemented. Perhaps the most far-reaching ban was the EU ban on imports of oil from Iran, which came into effect on July 1, 2012. As a consequence of this ban, Iran's volume of oil exports dropped by more than 30 percent.

States have been imposing sanctions on other states since at least 5th century BC, when Athens banned citizens of Megara from harbors and marketplaces throughout the Athenian empire.

The goals of sanctions may vary—from foreign policy to humanitarian purposes to preventing a military threat—but they all impose a penalty in the form of trade barriers or restrictions on financial transactions on the sanctioned country. In the most comprehensive study of sanctions, Huffbauer *et al*. (2008) found that sanctions are rarely effective in achieving their goals. The reasons have to do with the difficulties in forming a coalition of all trading partners in order to make the trade restrictions binding; and the option, in some countries, of trading in non-sanctioned goods and services. They also found that the size of the penalty, relative to global trading volumes, is generally small, although individual countries may be adversely affected.

In the case of Iran, there is some evidence that the combination of the 2012 oil embargo by the EU and the ban on oil-related financial transactions led to a significant decline in oil sales (by about 1 to 1.5 million barrels per day) as well as in foreign currency reserves. The associated macroeconomic dislocations, including import restrictions, a parallel market in foreign exchange, and high inflation, have contributed to a significant slowdown in the economy—including two years of negative GDP growth. Haidar (2015) finds some evidence of "export deflection" by Iran, namely the selling of sanctioned exports to countries that are not part of the sanction regime. While this may dampen some of the negative effects of sanctions, the quantitative magnitudes are not significant, since it was mainly non-oil exports that were deflected. Meanwhile, using a similar computable general-equilibrium model to ours, Gharibnavaz and Waschik (2015) find that the imposition of sanctions on Iran's oil exports had a serious negative effect on the Iranian government budget, but much more limited effects on the welfare of Iranian households.

In contrast to Gharibnavaz and Waschik (2015), who focus on the distributional and household impacts of the sanctions, we explore not only the economic effects of sanction removal on Iran, but the global effects of this policy change, especially the effects on the main countries

(or country groups) involved in the negotiations or those that could affect the outcome of the negotiations, the major oil exporting countries, and other developed and developing countries. The paper also highlights the effects of different policy responses by Iran and Iran's major trading partners to the lifting of the sanctions.

3. Modeling the economic impact of sanction removal

The lifting of the EU sanctions on oil imports from Iran is the major component of Iran's embargo removal. Since the market for oil is global, and Iran is a major player, modeling the effects of embargo removal with a single-country model will be inadequate. Such a framework will not be able to capture the effect of additional oil exports on world oil prices and the associated supply and demand responses of other countries and it will therefore misrepresent the effects of this change on oil-importing and oil-exporting countries. Hence, we use a global CGE model.

Given the large share of oil in Iran's exports and the large share of Iran's oil exports going to the EU before the sanctions, we expect this action to have the strongest effect on Iran. However, there will be effects on other countries, as the supply of oil in global markets increases, driving down the world price of oil. Oil-exporting countries will lose mainly due to the deterioration in their terms of trade. To the extent that these countries subsidize domestic oil consumption, the fall in the world oil price will reduce the distortion, providing a small, compensating efficiency gain. Oil-importing countries will gain mostly because of improvements in their terms of trade, but also because cheaper oil enables expansion of their oil-based production sectors, such as petrochemicals. Furthermore, in most of these countries, oil use is taxed, so the lower price leads to efficiency gains. This effect is most pronounced for the EU where taxes on oil use are highest.

The increase in Iranian oil production will involve a shift of resources from other sectors to the oil sector. This shift is likely to be an efficiency gain to the economy, as oil is one of the most profitable sectors in Iran, but was hitherto constrained by the sanctions. To capture these gains and losses, we present the results in terms of welfare changes. The dollar estimates can be thought of as windfall gains to the economy—the increase in welfare from the removal of sanctions and the shift towards more efficient production and consumption.

3.1 The model

The GTAP model is a global, multi-region CGE model which is designed for simulation analysis of trade reform. It takes into account the role of overall resource constraints (land, labor, and capital) in determining sectoral output supply, and has an explicit treatment of international trade and transport margins, a "global" bank mediating between world savings and investment, and a consumer demand system designed to capture differential price and income responsiveness across countries. The model captures the linkages discussed above through the accounting relationships and behavioral linkages that constrain outcomes. In particular, each country's exports of a particular good equal total imports of this good in other countries, net of shipping costs; global supply equals global demand for individual goods; and global investment equals global savings. In each country, aggregate output determines aggregate income; for each factor, demand equals supply; and increases in total factor productivity not only raise competitiveness but also factor prices.

Firms are assumed to produce for domestic and export markets using constant-returns-to-scale technology and a mix of primary and intermediate inputs. Intermediate products are either produced domestically or imported and substitute imperfectly, following an Armington (1969) structure. Product differentiation between imported and domestic goods and among imports from

different regions allows for two-way trade in each product category, depending on the ease of substitution between products from different regions. Land, physical capital, skilled, and unskilled labor, and in the resource sectors, a natural resource, are used as primary factor inputs into production.[3] As all factor inputs other than the natural resource factor are perfectly mobile across sectors and returns adjust to changes in economic conditions, the results from this model are indicative of medium-term outcomes.

The government sector is represented in a stylized fashion. An index of current government expenditure proxies the welfare derived from the government's provision of public goods and services to private households in a country.[4] A Cobb-Douglas utility function is used to allocate government spending across composite goods and demand for composite goods is allocated between imports and domestically produced goods in a way completely analogous to that of firms and households.

3.2 The data

We use the GTAP 9 database, aggregated into 13 countries/regions and 16 sectors/industries (Appendix Table A.1 and A.2), modified to ensure consistency between Iran's bilateral trade flows and UN Comtrade data. The aggregation presents individually the countries and groups of countries that (i) play an important role or could affect the outcome of the nuclear negotiations (Iran, the US, the EU, Russia, Israel); and (ii) are major oil exporting countries or country groupings, most of them located in the Middle East and North Africa. The first criterion

[3] For example, oil fields are inputs into the process of crude oil extraction.
[4] The assumptions behind this approach are that the level of public goods provided in the initial equilibrium is optimal, preferences for public goods are separable from preferences for private goods, and the utility function for public goods is identical across households within the regional economy (Keller, 1980).

enables us to look at the implications of embargo removal on the main negotiating partners and study their potential responses under alternative policy scenarios. The second criterion allows us to investigate the magnitude of the economic impact and the response of major oil exporters to the lifting of the EU oil embargo. This policy reform is expected to have the strongest global general equilibrium effects. The rest of the developing and developed economies are aggregated into regional blocks, which also happen to be net oil importing regions.

The sectoral aggregation highlights the sectors with greatest importance in Iran's production and exports, and those that are likely to be most affected by the lifting of the sanctions. These include oil extraction, petro-chemical and other processing activities, machinery and equipment, agriculture and food, textiles, and the main commercial sectors affected by the embargo – finance and insurance, transport, and tourism.

3.3 Simulation design

The paper investigates the economic effects of the removal of international sanctions on trade with Iran. Given the comprehensive nature of the sanctions, it is difficult to capture them in a detailed way. Instead, we reflect the main features of the sanctions – the fact that they restrict trade in Iran's major export (oil) and increase the trade costs of doing business. Since the benchmark year for the GTAP 9 database is 2011, the data record nonzero oil trade between Iran and the EU. In a pre-simulation, we implemented mid-2012 EU oil embargo by reducing Iran's volume of exports to the EU to zero and Iran's oil production by 25 percent.

The updated database is the initial point for our policy simulations. The first one lifts the EU oil embargo and assumes that Iran's oil exports to the EU and Iran's oil production recover to their pre-embargo levels. The other two simulations capture the positive impact on trade costs of

relaxing border patrol inspections and restrictions on cross-border trade in services. According to the most recent Doing Business ranking of countries, Iran takes 148th place (of 189 countries) in terms of ease of trading across borders. It is conceivable that as trade inspections are simplified, the removal of sanctions will allow Iran to improve its rank and move closer to the median rank of 100, a 32 percent improvement in the ranking. If we assume that there is a direct correspondence between the ranking on ease of trading across borders and the cost of exporting and importing standard container units, then there will be a reduction of 30% in the transport costs to and from Iran.

Liberalization of cross-border trade in services under Mode 1 is also a part of the trade regime change. According to the World Bank's Services Trade Restrictions (STR) database, which contains values of the STR index (STRI) for Iran and other MENA countries, the restrictions in Iran under Mode 1 affect mostly imports of financial and transport services. As these restrictions are much higher in Iran than elsewhere in MENA, in the medium term the liberalization is expected to push Iran's STRI closer to the average for the MENA region. This, in turn, is expected to generate an efficiency boost,[5] which we implement as productivity shocks that would lower the effective prices of imported financial and transport services and that corresponds in size to the reduction in the STRI. We follow Ianchovichina and Ivanic (2014), who assume that the import-augmenting productivity P is a function of the trade restrictiveness policies affecting these sectors, S, and other factors, denoted as R. This way the percentage change in productivity is given by $\hat{P} = \varepsilon\hat{S}$, where ε is the elasticity of the productivity P to a change in the services trade restrictiveness

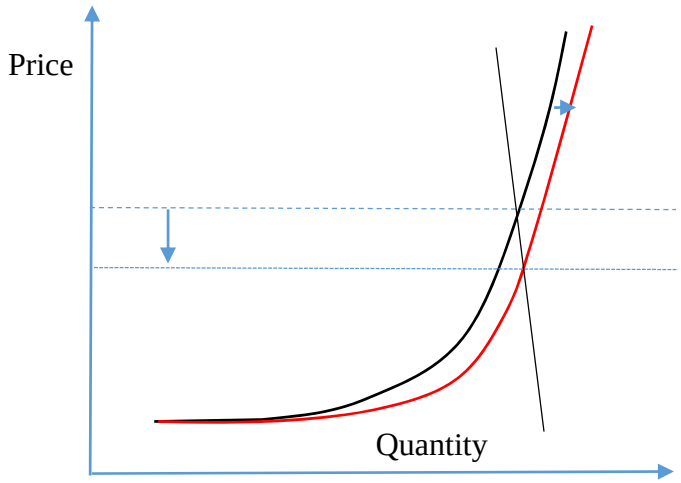
[5] Since the model does not differentiate between firms based on their ownership structure, we follow Walmsley *et al.* (2006) who represent the opening of the services sectors to foreign competition as efficiency improvements.

index *S*. When $\varepsilon=1$, $\Delta P=\Delta S$ or the import-augmenting productivity change is equal to the change in the STR index required to reach the average for MENA, or productivity *P* improves by 34 percent.

4. Simulation results

Iran's gains from the lifting of the economic restrictions are largest in per capita terms, resulting in an increase in per capita welfare of 3.7 percent or slightly more than $17.7 billion in total (in 2011 US$). The gain stems mainly from the lifting of the EU oil embargo and the liberalization of cross-border trade in financial and transport services, each of which contributes 1.6-1.7 percent to per capita welfare or about $8 billion, while the reduction in trade costs adds less than a half of a percent to per capita welfare or $2 billion.

Figure 2. The effect of Iran's EU oil embargo removal on global oil supply & demand



Note: In the model, the supply function has the curvature associated with the underlying CES function.

Net oil importers gain while net oil exporters lose as the world price of oil declines by about 13 percent due to the additional amount of oil sold on the global market. The relatively sizable price decline in response to a fairly small change in the oil supplied can mainly be attributed to the inelastic oil demand and supply. The addition of Iranian oil will shift the global oil supply outwards, lowering the global oil price in the absence of a demand shift (Figure 2).

The gains to the EU and the US from this price drop are large in absolute terms ($67 billion and $34 billion, respectively), but small in relative terms, as per capita welfare increases by slightly less than a half of a percent in the EU and a quarter of a percent in the US (Table 1). In per capita terms, Israel is the second largest beneficiary of the lifting of Iran's economic sanctions, gaining almost a half of a percent in per capita welfare or close to $1.1 billion. The losses are steepest for OPEC members, especially the GCC group, which is expected to lose 3.9 percent in per capita welfare (equivalent to $55 billion in 2011 prices). Per capita welfare for other OPEC members and Russia declines by 2.9 percent ($19 billion) and 1.6 percent ($30 billion), respectively. The world is not significantly affected by the improvement in Iran's trade costs and the liberalization in financial and transport services, as Iran accounts for a negligible share of the world's non-oil trade. Consequently, the world benefits the most from the lifting of the EU oil embargo (a gain assessed at almost $41 billion), and less so from improvements affecting trade with Iran (a gain of $13 billion). Overall, the world economy is expected to gain close to $54 billion.

Net oil exporting countries lose mainly due to the deterioration in their terms of trade. To the extent that they subsidize oil, the lower oil price will have a compensating efficiency gain, but not enough to reverse the welfare loss. Net oil importing countries gain mostly because of improvements in their terms of trade, but also because cheaper oil enables expansion of their petrochemical production and because in most of these countries oil use is taxed, so the interaction of existing distortions and structural change leads to efficiency gains. This effect is most pronounced for the EU where taxes on oil use are highest.

The lifting of sanctions will have the strongest effect on oil production in Iran, and petroleum and coal products in Israel, the EU, and the US (Table 2). The supply response in non-oil industries will be by design negligible in Iran (Table 2), but the effect on Iran's trade will be

significant (Table 3). Increases in export volumes will be significant, especially for cross-border exports of financial and transport services. However, increases of merchandise exports are also substantial: 17 percent for agricultural and food products, 3 percent for metals and mineral products, 10 percent for machinery, 17 percent for textiles, and 25 percent for light manufactures.

Table 1. Welfare effects of lifting Iran's sanctions

	EU oil embargo		**Merchandise trade costs**		**Liberalization in cross-border trade in services**		**Total**	
	US$ million	per capita (percent)	US$ million	per capita (percent)	US$ million	per capita (percent)	US$ million	per capita (percent)
Iran	8,174	1.72	1,968	0.41	7,571	1.60	17,713	3.73
USA	33,073	0.24	486	0.00	483	0.00	34,043	0.24
EU28	65,891	0.41	654	0.00	783	0.00	67,330	0.42
Russia	-29,873	-1.61	-320	-0.02	-101	-0.01	-30,295	-1.63
Israel	1,107	0.45	14	0.01	16	0.01	1,138	0.46
Non-OPEC oil exporters	-23,659	-0.67	-271	-0.01	-19	0.00	-23,949	-0.67
Rest of OECD	34,006	0.36	315	0.00	345	0.00	34,666	0.37
GCC OPEC	-54,321	-3.88	-553	-0.04	-135	-0.01	-55,009	-3.93
Developing MENA OPEC	-4,991	-2.15	-58	-0.02	-6	0.00	-5,055	-2.17
Other OPEC	-19,051	-2.84	-227	-0.03	-30	0.00	-19,308	-2.88
MENA Oil Importers	1,187	0.31	17	0.00	36	0.01	1,241	0.32
Other Developing MENA	-9,529	-2.71	-103	-0.03	-1	0.00	-9,634	-2.74
Rest of developing world	38,737	0.22	1,081	0.01	854	0.00	40,674	0.24
World	40,751	0.06	3,003	0.00	9,796	0.01	53,555	0.08

Table 2. Sectoral output effects of lifting Iran's sanctions (percent change)

	Iran	USA	EU	Russia	Israel	Non-OPEC Oil Exporters	Rest of OECD	GCC OPEC Oil Exporters	Developing MENA OPEC	Other OPEC Oil Exporters	MENA Oil Importers	Other Developing MENA	Rest of developing world
Agricultural products	-0.05	0.00	0.00	0.02	-0.01	0.02	0.00	0.04	0.04	0.03	0.00	0.03	0.00
Oil	25.00	-0.17	-0.18	-0.14	-0.31	-0.15	-0.21	-0.10	-0.11	-0.08	-0.13	-0.16	-0.20
Gas	0.22	0.05	0.02	0.13	0.02	0.06	0.01	0.09	0.07	0.09	0.04	0.13	0.04
Mining	0.04	0.01	-0.01	0.06	-0.03	0.02	-0.02	0.05	0.03	0.06	-0.01	0.05	0.00
Petroleum and coal products	-0.17	1.49	1.78	0.41	5.74	-0.09	0.75	-0.07	-0.13	0.08	0.42	1.16	0.27
Chemical products	-0.05	0.01	0.01	0.37	0.00	0.04	0.04	0.07	0.08	0.07	0.01	0.05	0.01
Metals	-0.06	-0.04	-0.04	0.02	-0.04	0.00	-0.03	0.03	0.03	0.06	-0.03	0.05	-0.02
Mineral and metal products	-0.07	-0.01	-0.01	0.03	-0.02	0.02	-0.01	0.04	0.11	0.06	0.00	0.05	0.00
Motor vehicles & transp. equipment	-0.06	-0.01	-0.01	0.03	0.00	0.02	-0.01	0.04	0.08	0.05	0.01	0.08	0.00
Machinery, elect. & other equipment	-0.06	-0.01	-0.01	0.03	-0.01	0.02	-0.01	0.05	0.10	0.06	0.00	0.06	0.00
Textiles	-0.05	-0.01	-0.01	0.04	-0.01	0.02	-0.01	0.05	0.05	0.05	0.00	0.04	0.00
Other light manufactures	-0.08	0.00	-0.01	0.05	-0.01	0.02	-0.01	0.05	0.05	0.05	0.00	0.04	0.00
Financial services and insurance	-0.25	0.00	-0.01	0.02	-0.02	0.01	-0.01	0.03	0.02	0.01	-0.01	0.02	-0.01
Transport	-0.17	0.19	0.15	0.06	0.06	0.07	0.03	0.11	0.29	0.12	0.06	0.09	0.03
Recreation and other services	-0.06	0.01	0.00	0.04	0.01	0.01	0.00	0.05	-0.13	0.01	0.01	0.03	0.00
Other services	-0.04	0.00	-0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.02	0.00
Total	5.41	0.01	0.11	-0.10	0.09	-0.04	0.05	-0.05	-0.07	-0.28	0.01	-0.17	0.03

Table 3. Change in Iran's trade volumes in response to lifting of sanctions (% change)

	Exports				Imports			
	EU oil embargo	Merchan-dise trade costs	Services trade NTBs	Total	EU oil embargo	Merchan-dise trade costs	Services trade NTBs	Total
Agricultural and food products	-1.4	18.9	-0.6	16.8	8.1	9.2	4.6	23.3
Oil	25.8	0.0	0.0	25.8	-75.6	34.8	0.2	45.0
Gas	0.3	1.0	0.0	1.3	12.9	0.0	0.0	12.9
Mining	0.0	0.8	0.0	0.8	0.0	9.8	0.1	9.9
Petroleum and coal products	-4.6	5.2	-0.3	0.0	6.5	19.0	3.0	31.0
Chemical, rubber, plastic products	0.0	1.6	0.0	1.6	1.6	1.9	0.7	4.5
Metals	-0.1	3.3	0.0	3.3	-0.1	0.4	0.0	0.4
Mineral and metal products	-4.9	33.1	-1.0	27.1	17.3	6.2	4.9	29.0
Motor vehicles & transport equipment	-3.6	8.6	-1.0	3.8	11.6	1.8	3.7	17.7
Machinery, electr. & other equipment	-2.3	13	-0.5	10.3	6.0	0.5	1.5	8.2
Textiles	-0.4	17.5	-0.4	16.6	3.0	3.5	1.8	8.9
Other light manufactures	0.9	23.6	0.1	24.6	1.9	1.9	1.2	5.4
Financial services and insurance	-1.7	-0.1	66.6	64.5	2.9	0.4	37.3	40.7
Transportation	-0.3	0.0	22.9	22.5	2.4	0.3	-8.9	-6.0
Recreation and other services	-0.4	-0.1	-0.4	-0.9	3.5	0.4	1.2	5.5
Other services	-12.7	-0.6	-2.2	-17.2	32.4	3.8	14	53.3
Total	14.6	0.7	2.3	17.4	8.1	2.4	2.2	13.5

The expansion of Iran's oil sector raises the real price of capital by 7.8 percent, as the oil sector is intensive in capital use, and to a lesser extent the wages of skilled and unskilled Iranian workers (1.0 and 0.5 percent, respectively). The wage increase comes from the spillover effects of the oil sector and not from the direct effect of the oil sector's expansion, as the oil sector employs a negligible share of the Iranian workforce. The boost in overall trade on account of lower trade costs translates into additional increases in wages, especially for skilled labor. Overall, wages of skilled and unskilled labor are expected to go up by 3.6 and 2.0 percent, respectively, as sanctions on Iran are removed (Table 4). Importantly, the lifting of the EU oil embargo will have a non-negligible effect on wages in the rest of the world; it will be negative for oil exporting countries and positive for oil importing ones. As returns to oil extraction fall, the rental price of oil fields

drops too in oil exporting countries and has a negative effect on the rental price of the natural resource, which is most pronounced in oil exporting countries (Table 4).

Table 4. The effect of lifting Iran's sanction on real factor returns (percent change)

	Land	Unskilled labor	Skilled labor	Capital	Natural resources
Iran	0.76	2.00	3.61	10.42	-26.70
USA	0.25	0.64	0.32	0.28	-11.27
EU28	0.62	0.87	0.85	0.89	-6.43
Russia	1.18	0.63	-0.18	-1.60	-13.83
Israel	0.13	0.66	0.69	0.78	-1.46
Non-OPEC oil exporters	1.13	0.36	0.14	-0.62	-11.38
Rest of OECD	0.35	0.60	0.70	0.66	-3.05
GCC OPEC	1.26	-0.83	-2.15	-3.59	-12.65
Developing MENA OPEC	1.63	-0.37	-0.97	-3.14	-8.21
Other OPEC	0.70	-0.03	-0.91	-4.44	-11.91
MENA Oil Importers	0.57	0.95	1.04	0.22	-8.10
Other Developing MENA	1.61	0.00	-2.47	-1.32	-18.55
Rest of developing world	0.38	0.69	0.75	0.47	-7.82

The analysis above assumes that Iran's exports to the EU will fully return to pre-2012 levels. While this is certainly plausible in the long run, it may be too optimistic as a medium term scenario. Despite partial sanctions relief and efforts by some Asian countries to issue sovereign guarantees for vessels carrying Iranian oil in 2014, Iranian exports recovered slightly but failed to reach pre-sanction levels (Devarajan and Mottaghi, 2015). We explore the robustness of our results, by considering the case in which Iran's oil exports to the EU reach only half of their pre-sanction level. Results show that in this case Iran's welfare gains will be reduced by about 22 percent or $3.7 billion, because although the quantity exported by Iran is less, so is the reduction in the world oil price, which declines by 6.8 percent.

5. Responses to the removal of Iran's economic sanctions

The lifting of Iran's economic sanctions could prompt responses around the world. This section investigates the effects of several scenarios that capture the likely responses of different trading blocs. First, we consider the economic impact of a strategic response from major oil exporters who limit their own oil output and exports in order to stabilize world oil prices. Second, we explore the effects of two policy alternatives that would help Iran improve its supply response and boost the benefits from the sanctions removal. More specifically, we assess the effects of reducing Iran's import tariffs on capital goods and promoting policies that will allow the recovery of the automobile sector to pre-sanction levels. Finally, as part of normalizing relations further and preparation for Iran's WTO accession, the US and the EU may increase market access for Iran beyond the reforms considered in the baseline scenario. We therefore explore the effects of reducing existing non-tariff barriers on Iranian exports of goods and services in American and European markets.

5.1. GCC oil exporters cut back oil production to keep oil prices stable

In the baseline scenario discussed in section 4, major oil exporters such as GCC countries do not adjust their oil production and exports in response to the removal of the embargo on Iran. Given the current context of historically low oil prices, it is plausible to envisage a situation in which major oil exporting countries intervene in the market in order to stabilize the world price of oil. In this section, we discuss the economic impacts of the removal of sanctions on Iran leading to full recovery of Iran's oil exports to the EU but no change in the global price of oil as GCC countries cut back their oil production and exports.

Table 5. Welfare, trade and investment effects of lifting Iran's sanctions and reducing GCC oil exports

	EV		Exports	Imports	Investment
	$ mil	percent	percent change		
Iran	30,982	6.52	16.44	22.19	6.34
USA	159	0.00	0.09	0.05	-0.02
EU28	5,192	0.03	0.09	0.11	0.03
Russia	-1,292	-0.07	0.26	0.03	-0.04
Israel	30	0.01	0.10	0.12	0.00
Non-OPEC oil exporters	-600	-0.02	0.10	0.02	-0.05
Rest of OECD	-1,156	-0.01	0.26	0.18	-0.05
GCC OPEC	-17,877	-1.28	-2.61	-2.03	-0.56
Developing MENA OPEC	-167	-0.07	0.30	-0.01	-0.11
Other OPEC	-94	-0.01	0.20	0.11	-0.07
MENA Oil Importers	78	0.02	0.00	0.01	-0.04
Other Developing MENA	44	0.01	0.35	0.33	0.01
Rest of developing world	1,083	0.01	0.25	0.24	-0.03
World	16,382	0.02	0.18	0.19	0.02

The worldwide efficiency gains from the removal of Iran's embargo are significantly reduced in this case. Compared to the baseline scenario, the worldwide welfare gain decreases by 70 percent, from $54 billion (Table 1) to $16.4 billion (Table 5). This result is attributed to the smaller decreases in oil exporters' welfare losses relative to steep declines in oil importers' welfare gains. However, the benefits accruing to Iran almost double due to stronger terms of trade effects. In this case Iran is able to sell pre-embargo quantities of oil to the EU at world oil prices that are 13 percent higher than in the baseline scenario. In absolute welfare terms, the biggest losers relative to the main scenario are net oil importers such as the EU, the US, rest of developed and developing countries. In Iran, the significant expansion of the oil sector draws resources away from other sectors where output remains the same or slightly declines. Increased domestic consumption stimulated by increases in per capita income are resulting in excess demand that is satisfied by a greater increase in imported goods and services compared to the baseline scenario (22.2 percent in Table 5 relative to 13.5 percent in Table 3).

5.2 Iran's policy responses

5.2.1 Iran reduces its tariffs on imports of capital goods

The lifting of the sanctions provides an opportunity for Iran to upgrade its technology through imports of capital goods from developed countries. Iran will be able to do this more efficiently if it reduces its own tariffs on imported capital goods and related parts and components. As highlighted in Table 6**,** existing tariff barriers to imports of motor vehicles and equipment from the EU, US, and the rest of OECD countries are quite significant and range between 16 - 44 percent for motor vehicles and transport equipment and 14 - 20 percent for machinery and other equipment. We therefore consider the case of zero tariffs on these two groups of products and their associated parts and components.

While the liberalization of imports of capital goods has moderate impacts on Iran's welfare, resulting in an additional gain of $1.8 billion compared to the main scenario (see Table 7 and Table 1), it boosts investment by 6.9 percent or nearly 2 percentage points more than in the absence of tariff cuts. In addition, as the liberalized sectors are intensive in the use of skilled labor and capital, most gains accrue to these two factors, with wages of skilled workers increasing by 2.8 percent compared to only 1.2 percent in the baseline scenario in section 4. Imports of motor vehicles and transport equipment increase by 52.3 percent, compared to 17.7 percent in the baseline (Table 3), while imports of machinery and other equipment increase by 16.7 percent, compared to 8.2 percent in the baseline. Finally, the liberalization of capital goods imports not only increases the imports of these products and related components but, as Iran upgrades its production base, enables it to stimulate Iran's exports. Compared to an increase of 3.8 percent and 10.3 percent in the baseline (Table 3), in this case exports of motor vehicles and machinery are expected to increase five-fold and three-fold, respectively.

Table 6. Iran's import tariffs by product and source country (weighted averages, percent)

	USA	EU28	Russia	Non-OPEC oil exporters	Rest of OECD	GCC OPEC	Developing MENA OPEC	Other OPEC	MENA Oil Importers	Other Developing MENA	Rest of developing world
Agricultural and food products	19.1	21.1	17.2	10.1	12.2	27.4	34.7	1.3	29.4	28.5	17.7
Oil	0.0	0.0	0.0	3.9	6.1	0.0	7.0	0.0	0.0	0.0	0.5
Gas	0.0	18.1	0.0	0.0	19.5	19.5	19.5	0.0	0.0	0.0	5.7
Mining	0.0	5.0	4.4	6.7	6.4	5.9	4.0	6.8	6.0	8.3	5.9
Petroleum and coal products	18.0	15.4	6.1	16.2	15.7	6.0	10.6	0.0	0.0	10.7	7.1
Chemical, rubber, plastic products	17.4	14.8	5.3	18.0	13.7	11.5	12.6	0.0	11.4	13.6	14.6
Metals	16.2	14.5	5.8	5.6	8.8	7.1	7.9	6.1	13.1	4.3	12.7
Mineral and metal products	19.2	25.5	6.7	18.5	23.9	33.0	26.5	0.0	30.4	24.3	35.4
Motor vehicles & transp. equipment	16.5	17.0	16.6	61.4	44.3	39.7	33.2	0.4	1.8	17.8	31.7
Machinery &other equipment	14.0	13.9	15.2	20.8	20.2	19.2	16.4	10.2	29.3	12.6	18.9
Textiles	0.0	19.2	13.4	57.5	42.4	48.2	49.5	0.0	18.9	49.3	42.8
Other light manufactures	5.7	24.6	5.3	29.3	24.4	29.9	62.0	0.9	19.0	36.2	54.0
Average	14.4	15.9	6.1	14.9	18.6	19.1	39.2	0.0	22.6	13.8	21.5

Source: GTAP 9 database (trade weighted averages). Note: Tariffs on imports from Israel are not shown as Iran does not trade with Israel.

Table 7. Welfare, trade, and investment effects of lifting Iran's sanctions and liberalizing Iran's imports of capital goods

	EV		Exports	Imports	Investment
	$ mil	percent	percent change		
Iran	19,516	4.11	16.88	13.26	6.93
USA	33,979	0.24	-0.73	0.64	-0.08
EU28	67,200	0.41	-0.22	0.62	0.38
Russia	-30,435	-1.64	0.10	-6.56	-1.16
Israel	1,130	0.46	-0.34	0.66	0.17
Non-OPEC oil exporters	-24,080	-0.68	0.36	-2.18	-1.04
Rest of OECD	34,794	0.37	-0.14	1.16	0.20
GCC OPEC	-55,143	-3.94	0.61	-7.85	-1.90
Developing MENA OPEC	-5,077	-2.18	-0.28	-7.53	-2.18
Other OPEC	-19,357	-2.89	-0.11	-10.96	-3.73
MENA Oil Importers	1,232	0.32	-0.42	0.20	-0.37
Other Developing MENA	-9,665	-2.75	0.27	-6.89	-1.61
Rest of developing world	40,160	0.23	-0.01	0.43	-0.10
World	54,254	0.08	-0.02	-0.01	0.02

5.2.2 Iran increases domestic auto production

The sanctions not only slowed down the pace of growth of the Iranian economy, but also affected the structural transformation of the economy, harming particularly sectors such as oil, automobiles, construction, and financial services. Automobile production contracted from an estimated 1.6 million cars per year prior to the sanctions to 700,000 in 2012 (Devarajan and Mottaghi, 2015). In this simulation, we explore the effect of reforms intended to boost Iran's automobile production by 50 percent. Given the importance of this industry for the Iranian economy, it is not surprising that its expansion results in a significant welfare gain for Iran - about $7.1 billion higher than in the baseline scenario (Table 8 and Table 1). As output expands, exports of automobiles are found to increase by more than two-fold, benefiting all factors of production but most significantly capital and skilled labor. The increase in per capita welfare rises to 5.2 percent (Table 8), compared to 3.7 percent in the baseline (Table 1). Furthermore, as returns to

capital increase by more than 2 percentage points than in the baseline, overall investment is also found to increase by more than 1.5 percentage points relative to the baseline.

Table 8. Welfare, trade and investment effects of lifting Iran's sanctions and boosting Iran's auto production

	EV		Exports	Imports	Investment
	$ mil	percent	percent change		
Iran	24,844	5.23	15.43	10.80	6.50
USA	34,091	0.24	-0.76	0.66	-0.04
EU28	66,800	0.41	-0.24	0.60	0.39
Russia	-30,132	-1.62	0.16	-6.45	-1.14
Israel	1,132	0.46	-0.32	0.68	0.20
Non-OPEC oil exporters	-23,901	-0.67	0.33	-2.20	-1.03
Rest of OECD	34,185	0.37	-0.19	1.08	0.22
GCC OPEC	-54,807	-3.91	0.35	-8.11	-1.90
Developing MENA OPEC	-5,036	-2.17	-0.31	-7.52	-2.16
Other OPEC	-19,252	-2.87	-0.07	-10.89	-3.71
MENA Oil Importers	1,275	0.33	-0.42	0.22	-0.36
Other Developing MENA	-9,599	-2.73	0.35	-6.77	-1.58
Rest of developing world	40,766	0.24	-0.03	0.40	-0.10
World	60,366	0.09	-0.06	-0.05	0.04

5.3 Improved market access for Iranian exports in the West

If the nuclear agreement with Iran is successfully implemented, the US, the EU and other countries in the West may further strengthen their economic ties with Iran and grant improved market access for Iranian exports in their markets. This simulation evaluates the effects of reducing non-tariff measures (NTMs) on Iranian exports of goods and services to the US, the EU, and other OECD countries. Since NTMs add friction to trading relations, the reduction in the trade restrictive power of NTMs is modeled as an import-augmenting efficiency improvement. The implemented efficiency improvements associated with NTMs imposed on services are calculated using data from the Services Trade Restrictions Database of the World Bank. The calculations assume that after the US and the EU open their markets for financial and transport services, Iran will face the

average STRI of the EU and the US for cross-border services trade (Mode 1) in finance and transportation.[6] In addition, we assume a 50 percent import-augmenting efficiency improvement associated with the elimination of some NTMs imposed on Iranian merchandise exports to EU and US markets. Improved access to these markets for Iranian goods (except oil) and services boosts Iran's competitiveness and welfare; the latter increases by more than $4.9 billion compared to the baseline. Furthermore, these reforms are beneficial not only for Iran but for the welfare of market access granting counties, each of which gains, respectively, 12 percent and 10 percent more in terms of welfare than in the baseline scenario. Such measures are expected to allow Iran to diversify its production and export portfolio and further improve its export competitiveness for goods and services that were previously only accounting for small shares of the Iranian economy.

Table 9. Welfare, trade, and investment effects of lifting Iran's sanctions and granting Iran greater market access in Western markets

	EV		**Exports**	**Imports**	**Investment**
	$ mil	percent	percent change		
Iran	22,593	4.76	23.31	23.73	5.51
USA	38,197	0.27	-0.80	0.77	-0.04
EU28	74,992	0.46	-0.04	0.86	0.42
Russia	-33,453	-1.80	0.19	-7.16	-1.26
Israel	1,269	0.52	-0.31	0.82	0.23
Non-OPEC oil exporters	-26,429	-0.74	0.36	-2.44	-1.13
Rest of OECD	40,202	0.43	0.15	1.49	0.25
GCC OPEC	-60,749	-4.34	0.78	-8.55	-2.10
Developing MENA OPEC	-5,559	-2.39	-0.11	-8.11	-2.39
Other OPEC	-21,304	-3.18	-0.02	-11.99	-4.11
MENA Oil Importers	1,475	0.38	-0.46	0.28	-0.38
Other Developing MENA	-10,579	-3.01	0.45	-7.41	-1.73
Rest of developing world	45,432	0.26	-0.08	0.41	-0.10
World	66,087	0.10	0.11	0.12	0.03

[6] Currently, the STRI for Iran in the US and the EU is 100, i.e. these markets are closed to Iranian firms.

6. Summary and concluding remarks

We use a global general-equilibrium simulation model to quantify the global effects of lifting Iran's economic sanctions and the effect of strategic responses to this trade regime change. The analysis highlights individually the countries and groups of countries that play an important role or could affect the outcome of the nuclear negotiations and the major oil exporting countries or country groups. It represents the lifting of Iran's economic sanctions in a stylized fashion, emphasizing three components that are likely to have effects in the near to medium term: (i) the lifting of the EU oil embargo, (ii) the reduction in Iran's trade costs, and (iii) the liberalization of cross-border imports of financial and transport services.

The lifting of Iran's economic sanctions is most beneficial to Iran's economy. Its per capita welfare is expected to rise by 3.7 percent mainly because of the lifting of the oil embargo imposed by the EU and the liberalization of cross-border trade in financial and transport services. Net oil importers gain while net oil exporters lose as the world price of oil declines by about 13 percent due to the additional amount of oil sold on the global market in response to the recovery of Iranian oil exports to the EU. In per capita terms, Israel is the second largest beneficiary of the lifting of Iran's economic sanctions, gaining almost 0.5 percent in per capita welfare, while the EU and the US gain 0.5 percent and 0.3 percent, respectively. The losses are steepest for OPEC members, especially the GCC countries which as a group are expected to lose 3.9 percent in per capita welfare. Per capita welfare for other OPEC members and Russia declines by 2.8 percent and 1.6 percent, respectively. Overall, the world benefits most from the lifting of the EU oil embargo and less so from other aspects of the sanction removal as Iran accounts for a negligible share of the world's non-oil trade.

Net oil exporting countries lose mainly due to the deterioration in their terms of trade. As many of them subsidize oil, the lower oil price will have a compensating efficiency gain, but not enough to reverse the welfare loss. Net oil importing countries gain mostly because of improvements in their terms of trade, but also because cheaper oil enables expansion of their petrochemical production and because in most of these countries oil use is taxed, so the interaction of existing distortions and structural change leads to efficiency gains.

If major OPEC members limit the quantity of oil produced and exported to support the world oil price, they will enhance Iran's gains, limit oil exporters' losses, and reduce the gains to oil importers (see Summary Table 10). The world would be worse off as the reduction in oil exporters' losses would be insufficient to compensate the reduction in oil importers' gains.

Reforms to enhance the supply response in Iran could greatly enhance Iran's welfare benefits from the trade regime change. Unilateral reduction of import tariffs on capital goods could add an additional 0.4 percentage points to the baseline per capita welfare gain, while reforms in support of the automobile sector recovery could enhance per capita welfare by an additional 1.5 percentage points (Table 10). Improved market access is important not only to Iran, which is expected to gain an additional 1 percentage point in per capita welfare, but also to market access granting countries although their per capita benefits are small.

Admittedly, there is uncertainty about the welfare gains of the trade regime change discussed in this paper. We address some of this uncertainty by presenting a range of possibilities. We find that Iran's welfare gains range from just under 3 percent, in the case when Iran's oil exports to the EU recover to half of their pre-embargo level, to 6.5 percent if Iran's oil exports not only recover to their pre-embargo levels, but Iran implements reforms that enhance the economy's competitiveness and strengthen its supply response and Iran's partners in the West open up their

markets to Iranian exports (Table 10). Iran could benefit as much (6.5 percent) also in the case when GCC oil exporters limit their oil production and exports in order to support the oil price.

Table 10: Range of welfare effects (percent) under alternative scenarios

	Base-line	Half-way	Baseline + Cutting GCC Oil Output	Baseline + Liberalizing Capital Goods	Baseline + Boosting Auto Output	Baseline + Market access to the West	Baseline + All reforms
Iran	3.7	2.9	6.5	4.1	5.2	4.8	6.5
USA	0.2	0.1	0.0	0.2	0.2	0.3	0.3
EU28	0.4	0.2	0.0	0.4	0.4	0.5	0.5
Russia	-1.6	-0.8	-0.1	-1.6	-1.6	-1.8	-1.8
Israel	0.5	0.2	0.0	0.5	0.5	0.5	0.5
Non-OPEC oil exporters	-0.7	-0.3	0.0	-0.7	-0.7	-0.7	-0.7
Rest of OECD	0.4	0.2	0.0	0.4	0.4	0.4	0.4
GCC OPEC	-3.9	-2.0	-1.3	-3.9	-3.9	-4.3	-4.3
Developing MENA OPEC	-2.2	-1.1	-0.1	-2.2	-2.2	-2.4	-2.4
Other OPEC	-2.9	-1.5	0.0	-2.9	-2.9	-3.2	-3.2
MENA Oil Importers	0.3	0.2	0.0	0.3	0.3	0.4	0.4
Other Developing MENA	-2.7	-1.4	0.0	-2.7	-2.7	-3.0	-3.0
Rest of developing world	0.2	0.1	0.0	0.2	0.2	0.3	0.3
World	0.1	0.1	0.0	0.1	0.1	0.1	0.1

At the same time, there are a number of caveats that the reader should keep in mind when using these results. There is little knowledge of the true extent to which sanctions were binding Iran's trade and production. Iran may have found ways to effectively minimize the damage of the restrictions through various means (e.g. barter trade). Likewise, we do not have a perfect picture of what trade with Iran would look like in the absence of sanctions. Without such knowledge, it is hard to estimate the potential of trade to pick up following the removal of restrictions. With the oil price so much below its 2011 level, the estimated per capita gain to Iran will be smaller than the numbers presented in the baseline scenario. Finally, in our static model, we ignore important

investment-growth effects that would enhance Iran's output but may have different welfare effects depending on the composition of domestic and foreign investment.

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Appendix

Table A.1 Regional aggregation

Economies/regions	GTAP region
1. Iran	Iran
2. USA	United States
3. EU	European Union (28)
4. Russia	Russian Federation
5. Israel	Israel
6. Non-OPEC oil exporters	Norway, Canada, Kazakhstan, Mexico, Oman, Bahrain
7. Rest of OECD	Australia, New Zealand, Japan, Republic of Korea, Chile, Switzerland, Rest of EFTA, Turkey
8. GCC OPEC	Saudi Arabia, Kuwait, Qatar, United Arab Emirates
9. Developing MENA OPEC	Libya, Algeria
10. Other OPEC	Ecuador, Nigeria, Venezuela
11. MENA Oil Importers	Egypt, Tunisia, Morocco, Jordan
12. Other Developing MENA	Yemen, Syria, Lebanon, Iraq, Djibouti
13. Rest of developing world	Albania, Argentina, Armenia, Azerbaijan, Benin, Burkina Faso, Bangladesh, Belarus, Bolivia, Brazil, Brunei Darussalam, Botswana, China, Cote d'Ivoire, Cameroon, Colombia, Costa Rica, Dominican Republic, Ethiopia, Georgia, Ghana, Guinea, Guatemala, Hong Kong SAR, China, Honduras, Indonesia, India, Jamaica, Kenya, Kyrgyzstan, Cambodia, Lao, Sri Lanka, Madagascar, Mongolia, Mozambique, Mauritius, Malawi, Malaysia, Namibia, Nicaragua, Nepal, Pakistan, Panama, Peru, Philippines, Puerto Rico, Paraguay, Rwanda, Senegal, Singapore, El Salvador, Togo, Thailand, Trinidad and Tobago, Taiwan, China, Tanzania, Uganda, Ukraine, Uruguay, Viet Nam, South Central Africa, Rest of Central America, Caribbean, Central Africa, Rest of East Asia, Rest of Eastern Africa, Rest of Eastern Europe, Rest of Europe, Rest of North America, Rest of Oceania, Rest of South Asia, Rest of South African Customs, Rest of Southeast Asia, Rest of South America, Rest of Former Soviet Union, Rest of the World, Rest of Western Africa, South Africa, Zambia, Zimbabwe

Table A.2 Regional aggregation

Industry/sector	GTAP commodity
1. Agricultural commodities & food	Paddy rice, Wheat, Cereal grains nec, Vegetables, fruit, nuts, Oil seeds, Sugar cane, sugar beet, Plant-based fibers, Crops nec, Cattle, sheep, goats, horses, Animal products nec, Raw milk, Wool, silk-worm cocoons, Forestry, Fishing, Meat: cattle, sheep, goats, horse, Meat products nec, Vegetable oils and fats, Dairy products, Processed rice, Sugar, Food products nec, Beverages and tobacco products
2. Oil	Oil
3. Gas	Gas
4. Coal & other minerals	Coal, Mineral nec
5. Petroleum & coal products	Petroleum and coal products
6. Chemical, rubber, plastic products	Chemical, rubber, plastic products
7. Metals	Ferrous metals, Metals nec
8. Mineral & metal products	Mineral products nec, Metal products
9. Motor vehicles & transport equipment	Motor vehicles and parts, Transport equipment nec, Manufactures nec,
10. Machinery, electronic, and other equipment	Electronic equipment, Machinery and equipment nec
11. Textiles	Textiles
12. Light manufactures	Wearing apparel, Leather products, Wood products, Paper products, publishing
13. Finance and insurance	Financial services nec, Insurance
14. Transport	Sea transport, Air transport, Other transport
15. Recreation and other services	Recreation and other services
16. Other services	Electricity, Gas manufacture, distribution, Water, Construction, Trade, Communication, Business services nec, Public Administration, Defense, Health, Education, Dwellings