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# The Impact of Sanctions Imposed by the European Union against Iran on their Bilateral Trade:

## General versus Targeted Sanctions

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# Abstract

Economic sanctions are intensively used by international institutions to enforce political objectives. Since 2006 the EU has been implementing general sanctions against the whole economy of Iran, affecting their trade relations. Since 2007, and following the imposition of sanctions by the UN Security Council, the EU has also implemented smart sanctions targeting Iranian entities and natural persons associated with its military activities. In a non-linear autoregressive distributed lag (NARDL), this paper investigates the impact of general and targeted EU sanctions against Iran on quarterly bilateral trade values between the 19 members of the euro area (EA19) and Iran between the first quarter of 1999 and the fourth quarter of 2018. The results indicate that general sanctions have strongly hampered trade flows between the two trading partners. The impact of general sanctions on the total imports of the EA19 from Iran is more than four times stronger than on the total exports of the EA19 to Iran. Moreover, the EU's general sanctions have hampered trade in almost all sectors, except for the primary sectors. Furthermore, our study finds that the impact of smart sanctions targeting Iranian entities and natural persons is much smaller than the impact of general sanctions on total trade values and the trade values of many sectors. Smart sanctions affect the exports of most sectors from the EA19 to Iran, while they are statistically insignificant for the imports of many sectors from Iran. Thus, this paper provides evidence on the motivations behind smart sanctions, which target specific individuals and entities rather than the whole economy, unlike general sanctions, which have a negative impact on ordinary people.

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# 1. Introduction

European countries have traditionally been the major trading partners of Iran, although over the past two decades Iran has diversified its trade relations with other countries, mostly in the Middle Eastern region and in Asia. The economic relations between Europe and Iran, by contrast, which were shaped mainly by their political relations (Ghodsi, 2019), have deteriorated for a number of reasons, such as allegations of violations of human rights in Iran and the country's nuclear programme.

After the Islamic Revolution in 1979 and the hostage crisis Iran's relations with the United States turned into long-term animosity, leading to the imposition of the first US economic sanctions against Iran. This was followed by strained relations between Iran and the US and its allies, including Western Europe. For the first time after the establishment of the Islamic Republic of Iran in 1979, the Council of the European Union (EU) mandated a dialogue between the EU and Iran in 2001. This was initiated by the Iranian reformist president, Mohammad Khatami (1997-2005), who reached out to the international community for a Dialogue Among Civilizations. The EU-Iran dialogue was meant to lead to comprehensive diplomatic negotiations on the Middle East Peace Process, the fight against terrorism, human rights, and the non-proliferation of weapons of mass destruction, which involved Iran's nuclear activities. However, after the 9/11 terrorist attacks and the subsequent invasions of Afghanistan and Iraq in 2001 and 2003 by the US and its allies Iran's dialogue with the West under the auspices of the EU broke down (for additional information, see Ghodsi et al., 2018).

After this the Islamic Republic steered systematically away from all the elements that were supposed to have been negotiated and finally resolved within the framework of the EU-Iran dialogue. Iran's political system became hard-line after Mahmoud Ahmadinejad was elected president in 2005 and again in 2009. During his presidency Mr Ahmadinejad stopped all cooperation with the International Atomic Energy Agency (IAEA), withdrew Iran from the Non-Proliferation Treaty (NPT) Safeguard Agreement and banned the IAEA's inspectors from visiting its nuclear sites, making it impossible for the organisation to verify that Iran's nuclear programme had no military dimension. In response the US government under the presidency of George W Bush imposed nuclear-related sanctions against Iran in 2005.

Iran's hard-line actions were met by the international community with sanctions. On 31 July 2006 the United Nations Security Council adopted Resolution 1696, which called on Iran to halt its uranium enrichment programme and abide by the provisions of the NPT. As Iran did not stop its nuclear activities, a series of other UN Security Council resolutions were adopted over the years to intensify sanctions against Iran.

The accumulated number of these sanctions is depicted by dashed lines in Figure 1. It shows that the total number of UN Security Council sanctions against Iran reached a peak of eight in the second quarter of 2012. Following the first UN Security Council Resolution, the EU Council also imposed sanctions against Iran with the adoption of EC Regulation 423/2007 of 19 April 2007.[1] From 2010 through to early 2012 the sanctions regime was greatly intensified, targeting Iran's economy with

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[1]    https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32007R0423

prohibitive measures aimed at its trade and financial sectors mandated by the UN Security Council and single countries like the US, Canada, Australia and the EU member states. As  depicted by the dotted line in Figure 1, the number of these general sanctions against Iran that were implemented by the EU also reached a peak in the first quarter of 2012, when the EU introduced an oil embargo and froze the assets of Iran's Central Bank.

In addition to the general sanctions imposed by the EU, which were mainly related to Iran's nuclear activities, in the second quarter of 2007 the EU imposed its first sanctions against seven Iranian entities and 11 natural persons with travel bans and asset freezes, which were mostly aimed at Iran's aerospace industry and its military. Assets of these individuals are frozen, and doing business with them is prohibited for any EU firm. Most of these entities and natural persons had been designated by the UN Security Council a few months earlier. As depicted in Figure 2, the number of entities and natural persons targeted by the European sanctions has been rising over the years. Data on the EU sanctions list have been published since 2017 by the Service for Foreign Policy Instruments (FPI) of the European Commission. Among the natural persons are high-ranking generals and commanders of the Islamic Revolutionary Guard Corps (IRGC), such as Qasem Soleimani and his deputies.

**Figure 1 / Accumulated sanctions imposed by the EU and the UN against Iran, general versus induvial targeting, 2006–2015**
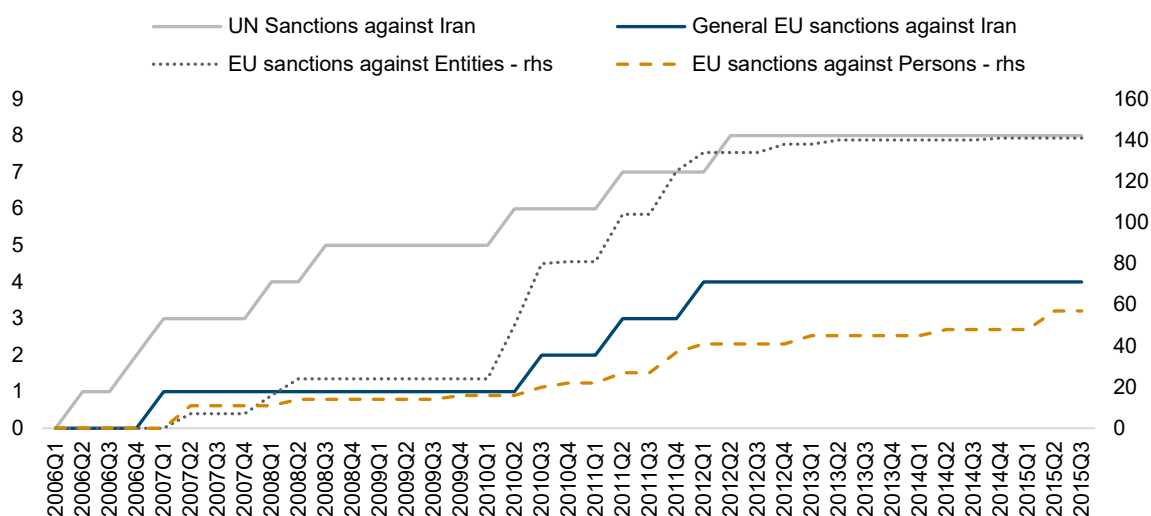


Sources: European Union Open Data Portal; Service for Foreign Policy Instrument (FPI); European Commission; United Nations Security Council Resolutions website;[2] authors' elaboration.

Furthermore, the EU joined the international alliance against nuclear Iran that was initiated by the first round of executive orders by the US president, Barak Obama, in September 2010. As illustrated in Figure 2, the share of the 19 members of the euro area (EA19)[3] in Iran's trade has been decreasing since 1996, while the level in US dollars terms reached its peak in 2011. From 2002 to 2004 the share of EA19 exports in Iran's total imports recorded a slight increase. This coincided with the first surge in foreign direct investment (FDI) to Iran (Ghodsi et al., 2019) since 1979, following the adoption in 2002 by

[2]   http://unscr.com/ and arms control website: https://www.armscontrol.org/factsheets/JCPOA-at-a-glance

[3]   The euro area members are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain.

Iran's parliament of the Foreign Investment Promotion and Protection Act (FIPPA), which was passed with a majority of reformists and aimed to increase the incentives for FDI. The large volume of imports by the EA19 from Iran during 2007-2011 is mostly attributable to the rising price of oil in that period. The share of Iran's total exports going to the EA19 during that period actually contracted.

The EA19's share in Iran's total trade dropped to a historical low in 2013, after the Council of the EU imposed stringent sanctions against Iranian individuals, companies, government entities, officials and the Central Bank of Iran in January 2012. These sanctions disconnected Iran from the international monetary system and the SWIFT international payment network, paralysing all of Iran's international trade and financial transactions. Although Iran's revenue from its exports to the EA19 dropped to a negligible figure of about USD 1 billion in 2013, its imports from the EU still hovered around a significant figure of USD 7 billion in the same year. These imports consisted mainly of primary products, such as pharmaceuticals and food, which were mostly re-exported through third-party countries such as Turkey and the United Arab Emirates.

**Figure 2 / EA19 trade of goods with Iran – 1996–2018**
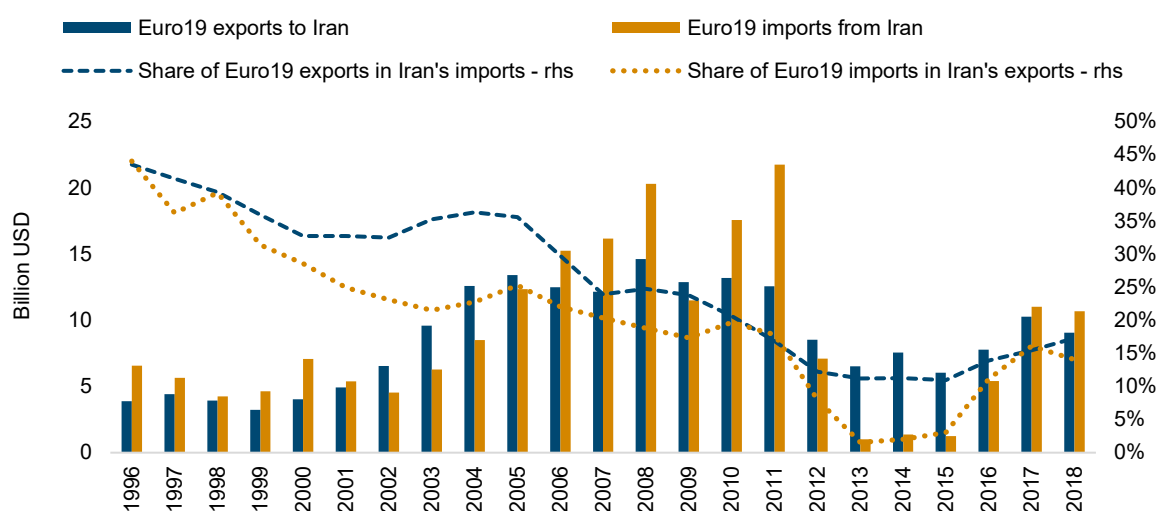


Sources: UN COMTRADE; authors' elaboration.

The nuclear-related sanctions were removed after the implementation of the Joint Comprehensive Plan of Action (JCPOA) on 16 January 2016. The JCPOA was the outcome of one-and-a-half decades of dialogue between the Islamic Republic and the EU and was reached following a marathon of diplomatic negotiations between Iran and the P5+1, which included the United States, the United Kingdom, France, China and Russia, plus Germany. As illustrated in Figure 2, the implementation of the deal led to an increase in imports by the EA19 from Iran, with a surge of business and investments into Iran. More than USD 200 billion investment projects[4] were pledged in Iran. Trade in machinery and capital goods would have been stimulated if these pledged investment projects had been realised, which could have changed Iran from a large market of 80 million inhabitants with a diversity of natural resources, industries, ethnicities and large human capital to a substantial hub of energy and transportation in the middle of the ancient Silk Road.

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4    See https://www.rferl.org/a/iranian-president-says-us-sanctions-have-cost-country-200-billion/30354022.html

**Figure 3 / Structure of EA19 exports to Iran, average over the period 2009-2011, USD billion**

Transport Equipment, 3.6

Metal, 3.5

Optical, Medical, Music Instruments, 2.2

Confidential, 1.8

Rubber and Plastics, 1.6

rest, 1.5

Chemical products, 5.0

Other, 2.5

Machinery, 17.0

Glass & Stone, 0.5

Vegetable Products, 0.5

Paper & Pulp, 0.7

Beverages & Tobacco, 0.7
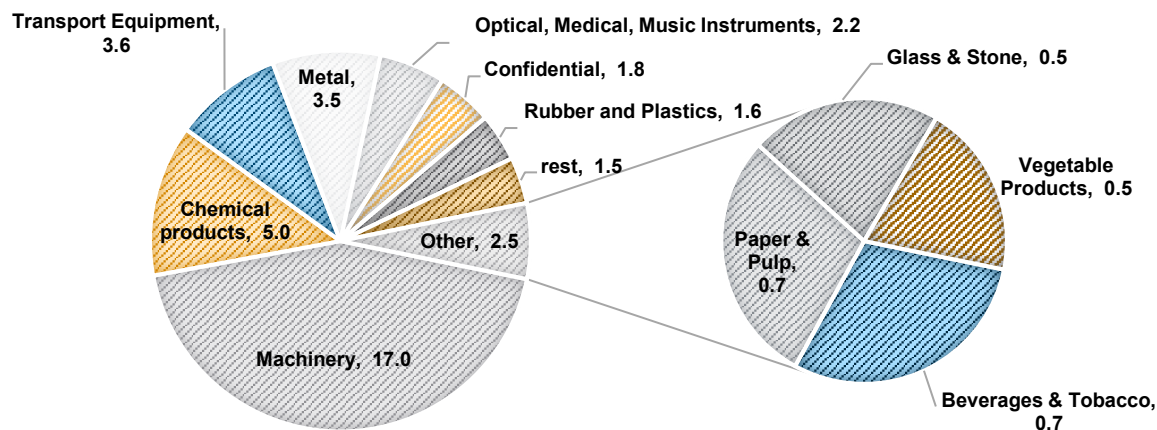
Sources: UN COMTRADE; authors' elaboration.

**Figure 4 / Structure of EA19 exports to Iran, average over the period 2013-2015, USD billion**

Vegetable Products, 2.5

Optical, Medical, Music Instruments, 1.7

rest, 0.8

Metal, 0.8

Confidential, 0.7

Transport Equipment, 0.7

Chemical products, 4.3

Other, 1.7

Machinery, 7.1

Paper & Pulp, 0.3

Glass & Stone, 0.3

Rubber and Plastics, 0.5

Beverages & Tobacco, 0.5
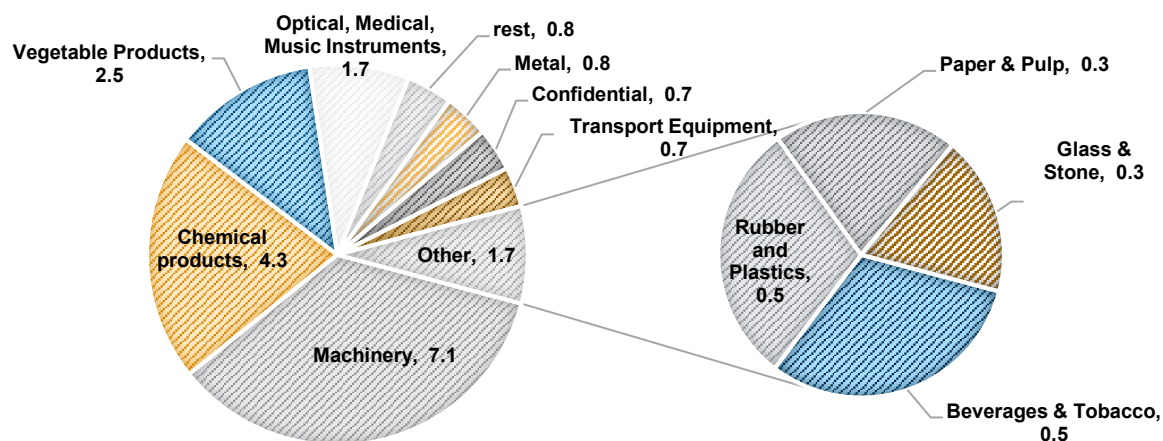
Sources: UN COMTRADE; authors' elaboration.

However, these promising prospects of attracting foreign businesses to Iran did not last long after Donald Trump took office as the 45th president of the US in January 2017. Mr Trump did not like any of the policies of his predecessor and was determined to roll back President Obama's Affordable Care Act (Obamacare) and withdraw from agreements that Mr Obama had concluded with other nations, such as the Trans-Pacific Partnership,[5] the Paris Agreement,[6] and indeed the JCPOA. On 8 May 2018 Mr Trump withdrew the US from the JCPOA and warned other countries not to trade or do business with Iran. This was regarded as secondary sanctions against third parties, and all the investment projects pledged after the deal were halted. Many European multinational enterprises withdrew from the Memorandums of Understanding they had signed with Iran for fear of losing the US market and being penalised with

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[5]    The proposed free trade agreement between the US and a number of countries in South-East Asia, Oceania and Latin America, signed on 4 February 2016: https://ustr.gov/trade-agreements/free-trade-agreements/trans-pacific-partnership/tpp-full-text

[6]    Signed on 22 April 2016 between many United Nations members to undertake efforts to combat climate change: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

enormous fines by the US Treasury. This again led to a reduction in imports by the EA19 from Iran in 2018.

As far as trade relations between Iran and the EA19 in 1999-2018 are concerned, the period can be divided between the time before the intensification of sanctions in 2011 and after that. In 2013 Iran's revenue from its exports to the EA19 dropped to their lowest value of only USD 1 billion, while its imports from these countries still accounted for USD 6 billion (Figure 2). Figure 3 shows the structure of the EA19's exports to Iran organised by Harmonised System (HS) sections averaged over three years from 2009 to 2011, before the EU sanctions intensified. Figure 4 shows the structure for the period of intensified sanctions in 2013-2015. A significant drop in the level of exports to Iran in Machinery, the largest traded sector, indicates a smaller transfer of capital goods to Iran. However, for some sectors, such as Chemical products and Optical and Medical industries, the drop in export levels to Iran as a result of sanctions was much milder. The most important reason is that medicines and medical devices are the major products in these two industries that should remain unaffected by the sanctions. This suggests that the impact of sanctions may differ depending on the sector of activity.

In this paper we study the sanctions imposed by the EU against Iran. The initial objectives of these sanctions were to keep Iran in a dialogue with the EU, while their ultimate objectives were to control Iran's nuclear programme, its role in the region, its aerospace and intercontinental missile programme, and its violation of human rights. However, the main economic aim of these sanctions was to deprive Iran of revenues derived from its exports to the EU and its imports of technology from the EU. Therefore, this paper analyses the impact of sanctions imposed by the EU against Iran on quarterly trade flows between Iran and the EA19 at the aggregate and sector level during the period 1999Q1-2018Q4. Non-linear autoregressive distributed lag (NARDL) following Shin et al. (2014) is applied to estimate the impact of sanctions on bilateral trade flows, taking the asymmetric impact of real exchange rates on bilateral trade flows into consideration. The remainder of this paper is organised as follows: Section 2 reviews the relevant literature; Section 3 presents the methodology, our econometrics model and describes the data; Section 4 presents the estimation results; and in Section 5 we summarise our findings.

# 2. Literature review and anecdotal evidence

Our paper is in line with several works on the impact of sanctions and contributes to the literature on the use of sanctions as a foreign policy tool in both political science and economics. The political science literature is abundant in studying sanctions as a foreign policy tool (Hartley and Sandler, 2007; Hufbauer et al., 2009). However, very few econometric studies have been supporting these papers in political science and international relations by showing the economic impact of sanctions (Felbermayr et al., 2019). Sanctions, like any other trade restriction on the flow of goods or factors of production between countries, must be welfare-reducing (Findlay and Wellisz, 1982; Baldwin, 1989; Anderson and Van Wincoop, 2001; Caliendo and Parro, 2015).

Since World War I, and especially in the past two decades, economic sanctions have become popular instruments for foreign policy. Wars and military confrontations have been replaced by liberal alternatives to war that take the form of economic sanctions and trade protection measures (Pape, 1997). In peace time economic integration has become a means of strengthening relations. Negotiating multilateral agreements that led to the establishment of international organisations such as the World Trade Organisation (WTO) on the one hand, and bilateral trade deals and comprehensive trade agreements on the other, have become tools of international diplomacy to influence policies abroad without resorting to military force or covert operations.

In recent years sanctions have been focused on the sources of income most valued by those responsible for the key undesired policy decisions, rather than the whole economy of the sanctioned country. Portela (2016) argues that in the 1990s the humanitarian impact of general sanctions against the whole economy of the sanctioned country led to the creation of targeted sanctions against those whose actions should be condemned. Major and McGann (2005) argue that sanctions must induce the largest costs on the interest groups whose efforts have the largest marginal effect on unfriendly policies of the target country. Portela (2010) examines the efficacy of sanctions imposed by the EU as an international actor. She finds that new targeted and smart sanctions that harm mainly individuals responsible for some wrongdoing through visa bans, financial sanctions, arms embargoes and flight bans usually achieve their objectives better than traditional general sanctions that affect the whole society.

Biersteker et al. (2016) provide a taxonomy of UN targeted sanctions, their type, and their impact, while Biersteker et al. (2018) elaborate on the dataset of UN targeted sanctions during the period 1991-2013. The general sanctions discussed in the previous section are targeting the whole economy of Iran, while sanctions against entities are targeting certain key figures in Iran's political and military system. Nevertheless, the consequences of the general sanctions discussed above indicate that they are typically found to be ineffective in changing the policies of the sanctioned country. In other words, general sanctions have rarely achieved their ultimate objectives.

Moreover, sanctions imply costs for the imposing country as well, which limits their effectiveness in achieving their main objectives. The reduction of bilateral trade as a result of sanctions is not only an obstacle for the sanctioned entities and the sanctioned country to survive and evolve, but it also affects the revenues of the companies in the sanctioning country that were engaged in trade and business relations with the sanctioned country. Morgan and Schwebach (1997) show that sanctions are unlikely to alter

significantly the expected outcome that has the highest joint probability of being accepted by both parties, essentially because the more costly the sanctions are to the target, the more costly they are to the sanctioning countries as well. They propose a theoretical framework and an empirical test which assumes that the higher the cost of economic sanctions to the target, the higher the probability that the sanctions will succeed. Crozet and Hinz (2016) find large negative impacts on trade between Russia and many EU member due to sanctions imposed against Russia. Therefore, these sanctions have contributed to losses for both the sanctioned and the sanctioning countries. A study by the World Bank (2015) shows that sanctions imposed on the Russian Federation over the conflict in Ukraine have affected investment and consumption. However, the study does not provide any specific numbers.

Harkness (1990) examines the sanctions imposed by Canada against South Africa in 1985. While the data show that South African export values to Canada were rising despite sanctions, Harkness (1990) finds that the volume of trade was reducing. He argues that this effect is caused via changes in the terms of trade and the exchange rate between the two countries. Following Marshall Lerner, he shows that the effects of such sanctions on the sanctioning country's terms of trade and trade balance depend on the elasticities of demand for its imports and exports.

Kaempfer and Lowenberg (1999) argue that multilateral sanctions are less effective in causing economic damage via negative terms-of-trade effects on the targeting country than unilateral sanctions. However, the opposite is usually expected. The intuition behind their argument is that a unilateral sanction by a country with close ties to the target country could do more harm to the interest groups in the target country. This applies, for example, to the sanctions imposed by the US against Iran since 1979, which have suffocated Iran's economy for a long time, given the US's strong role in the international economy. The US's unilateral but secondary sanctions since 2018 have led Iran's economy to its worst recession of about 9% since its eight-year war with Iraq in 1980s. Kaempfer and Lowenberg (1999) argue that with multilateral sanctions the interest groups in the target country might find ways to consolidate their power, while coalition members imposing the multilateral sanctions may not fully cooperate to tackle this strong solidarity in the target country. However, this was not the case with Iran, and the international coalition that intensified its sanctions against Iran during 2009-2012 forced Iran to come to the negotiating table.

Drezner (2003) claims that the negative impact of coercive economic measures is usually underestimated as the target country concedes to incurring the cost of sanctions. This was interestingly the case of Iran under President Ahmadinejad. To show its strength, the Islamic Republic did not admit the effectiveness of sanctions. Furthermore, Drezner (2003) argues that even before imposition of sanctions, the target country has an incentive to acquiesce. This was the case for Iran before the US's withdrawal from the JCPOA and the imposition of secondary sanctions by the Trump administration. Selden (1999) notes that, in the long run, sanctions often foster the development of domestic industries in the target country, thus reducing the target's dependence on the outside world and the ability of the sanctioning country to influence the sanctioned country's behaviour through economic coercion. Using a panel database of countries and sanctions during the period 1947-1999, Marinov (2005) finds evidence that coercive measures significantly destabilise the political system of the target country proxied by the survival of leaders in offices as the least expected outcome of the economic sanctions.

Maloney (2010), in her investigation of the sanctions against Iran, argues that crippling Iran's economy using strict economic sanctions has become drastically harder than before. One major reason is that Iran's economy and its trade relations with the international economy have become more complex and diversified. Unlike the Europeans, Russia, China, and India are reluctant to follow the US's foreign policies

in the region, which was the case when the international sanctions intensified in 2012 and following the US's withdrawal from the JCPOA in 2018. Iran's trade with these three major countries is hampered but has remained much larger than its trade with the EU. Another reason why Maloney (2010) argues that sanctions against Iran were not very effective at the time was the reluctance of regional countries to pressurise Iran. However, with the recent campaign of "maximum pressure" initiated by the Trump administration, the escalated tensions have managed to destabilise Iran's role in the region.

Torbat (2005) finds that the financial sanctions imposed by the US against Iran had a more powerful impact than trade sanctions. This is mainly because of the inability of Iran to finance its imports, leading to larger foreign debt, currency depreciations, exchange-rate volatilities, long-run instability, and welfare loss. He notes that these sanctions, while delivering a powerful economic blow to the ruling elite, have had little political success. Moreover, he advocates the use of smart sanctions designed to exert pressure directly on the ruling clerics while avoiding negative impacts on the Iranian population as side effects of general sanctions.

Felbermayr et al. (2019) apply the gravity framework to estimate the impact of sanctions on bilateral aggregate trade values during the period 1950-2016. They use the Global Sanctions Data Base and find a significant negative impact of sanctions against Iran on its bilateral trade flows. Using a general equilibrium framework of the gravity model, their counterfactual scenario suggests that Iran's real per capita income would have been larger by only 4.2% if there had been no sanctions against Iran. However, this underestimation is an oversimplification of the reality, as the real GDP per capita of Iran has never reached its peak in 1976 (see Ghodsi et al., 2018), with the long-existing US sanctions in force since 1979.

Using Iranian customs data, Haidar (2017) finds evidence of export deflection and re-exporting through third-party countries after the imposition of UN non-oil export sanctions in 2008. Ghodsi and Elhami (2015) also show that Iran's export unit values increased owing to the intensification of sanctions in 2012 and trade deflection through third countries. Thus, while exports became more expensive in the destination country, it produced lower revenues for Iranian exporters. Moreover, Iran's imports of goods became more expensive, causing prices to soar and inflation to rise during the sanction years.

Draca et al. (2017) study the relationship between sanctions relief over the course of negotiating the JCPOA and the performance of companies on the Tehran Stock Exchange. Companies owned by the IRGC and the semi-public conglomerates under the Supreme Leader of Iran are the main firms under investigation. The authors find evidence that the conglomerates linked to the main circle of power in Iran that were targeted by sanctions showed more positive returns than other firms during the diplomatic negotiations.

This paper contributes to the literature by studying the impact of sanctions imposed by the EU against Iran since 2006 on the whole economy and targeted entities and natural persons. This is the first paper to analyse the difference between the impact of general sanctions versus the impact of smart targeted sanctions on trade flows. As illustrated by the literature discussed above, it is expected that general sanctions affect the whole economy, while targeted sanctions may only deprive specific interest groups in the sanctioned country from their financial and economic benefits. Thus, by applying a NARDL econometric framework that considers the asymmetric role of exchange rates in bilateral trade flows between the EA19 and Iran, this paper analyses how general and targeted sanctions affect trade values between these two trading partners. Total trade and trade by 22 sections of the HS will be studied to indicate how humanitarian trade flows could be maintained through the application of targeted sanctions.

# 3. Methodology

We follow the recent strand of the literature to estimate the quarterly bilateral trade flows between the EA19 and Iran against the sanctions controlling for other variables during the period 1999Q1-2018Q4. Gross domestic product (GDP) of the importing country and the real exchange rate (RER) between the two trading partners are the main control variables in the model. In a famous remark, Keynes (1936, p. 314) noted that "the substitution of a downward for an upward tendency often takes place suddenly and violently, whereas there is, as a rule, no such sharp turning point when an upward is substituted for a downward tendency". Based on Shin et al. (2014), "the nonlinearity of many macroeconomic variables and processes has long been recognised and nonlinearity is endemic within the social sciences and that asymmetry is fundamental to the human condition". Following the suggestions in the literature (Kahneman and Tversky, 1979; Shiller, 1993, 2005), we use the nonlinear approach, which also corrects for the short-term changes in an error correction mechanism (ECM). This model, which has been developed by Shin et al. (2014) and is frequently used in the literature (Bahmani-Oskooee and Aftab, 2017; and Bahmani-Oskooee and Karamelikli, 2019), also considers that the relation between the RER and trade values is non-linear, meaning that the impact of an increase in the RER on trade values is different from the impact of a decrease in the RER on trade values. This asymmetric relation between the RER and trade values originates in the behaviour of consumers and importers with respect to changes in relative prices that is usually referred to as "price stickiness". Neglecting this asymmetry when it is statistically significant leads to the omitted variable bias in the estimation of trade values, which may also cause bias in the estimation of other explanatory variables. Here we describe this model briefly by showing first the long-run equation of traded value with respect to the control variables as follows:

$$X_{st}^{EZ,IR} = \alpha_0^x + \alpha_1^x REX_t + \alpha_2^x Y_t^{IR} + \alpha_3^x SANC_t^G + \alpha_4^x SANC_t^I + e_t^x \tag{1}$$

$$M_{st}^{EZ,IR} = \alpha_0^m + \alpha_1^m REX_t + \alpha_2^m Y_t^{EZ} + \alpha_3^m SANC_t^G + \alpha_4^m SANC_t^I + e_t^m \tag{2}$$

where $X_{st}^{EZ,IR}$ in equation (1) represents the log of the real export value of sector $s$ from the whole EA19 (identified with subscript $EZ$) to Iran (identified with subscript $IR$) at time t; $M_{st}^{EZ,IR}$ in equation (2) represents the log of the real import value of sector $s$ to the EA19 from Iran; $REX_t$ is the logarithmic value of the real exchange rate at time t that is defined as the relative prices of goods in the EA19 in terms of Iran's prices; $SANC_t^G$ represents the number of general sanctions imposed by the EU that are all waived after the implementation of the JCPOA; $SANC_t^I$ defines the number of smart sanctions imposed by the EU targeted either against individual entities (including companies, banks, foundations etc.) or natural persons (including military officers or judges); and $e_t^x$ and $e_t^m$ represent the error terms. As it is commonly addressed in the econometric and economic literature, the reverse causality between the dependent and independent variables, cointegration between these variables, and spurious regression, these error terms in the long-run relations should be corrected using the short-term relations. Thus, the ARDL model for both equations is defined as follows:

$$\Delta X_{st}^{EZ,IR} = \psi^x + \eta_0 X_{s,t-j}^{EZ,IR} + \eta_1 REX_{t-1} + \eta_2 Y_{t-1}^{IR} + \eta_3 SANC_{t-j}^{G} + \eta_4 SANC_{t-j}^{I} + \sum_{j=1}^{c} \beta_{1j}^{x} \Delta X_{s,t-j}^{EZ,IR}$$

$$+ \sum_{j=0}^{d} \beta_{2j}^{x} \Delta REX_{t-j} + \sum_{j=0}^{e} \beta_{3j}^{x} \Delta Y_{t-j}^{IR} + \sum_{j=0}^{f} \beta_{4j}^{x} \Delta SANC_{t-j}^{G} + \sum_{j=0}^{g} \beta_{5j}^{x} \Delta SANC_{t-j}^{I} + \epsilon_{t}^{x}$$

(3)

$$\Delta M_{st}^{EZ,IR} = \psi^m + \eta_5 X_{s,t-j}^{EZ,IR} + \eta_6 REX_{t-1} + \eta_7 Y_{t-1}^{IR} + \eta_8 SANC_{t-j}^{G} + \eta_9 SANC_{t-j}^{I} + \sum_{j=1}^{p} \beta_{1j}^{m} \Delta M_{s,t-j}^{EZ,IR}$$

$$+ \sum_{j=0}^{q} \beta_{2j}^{m} \Delta REX_{t-j} + \sum_{j=0}^{n} \beta_{3j}^{m} \Delta Y_{t-j}^{EZ} + \sum_{j=0}^{r} \beta_{4j}^{m} \Delta SANC_{t-j}^{G} + \sum_{j=0}^{s} \beta_{5j}^{m} \Delta SANC_{t-j}^{I} + \epsilon_{t}^{m}$$

(4)

where $\Delta$ indicates the time difference in the variables in logs; thus, $\Delta REX_{t-j}$ would indicate the $j$'s time difference in the RER. The ARDL model can become non-linear (NARDL) in terms of the RER by decomposing its growth into two separate variables of positive $POS_t$ and negative $NEG_t$ changes:

$$POS_t = \sum_{i=1}^{t} \Delta POS_i = \sum_{i=1}^{t} max(\Delta LRER_i , 0) \ ; \ NEG_t = \sum_{i=1}^{t} \Delta NEG_i = \sum_{i=1}^{t} min(\Delta LRER_i , 0)$$

(5)

Decomposition of the real exchange rate into two separate variables, the asymmetric model, can be defined as follows:

$$\Delta X_{st}^{EZ,IR} = \psi^x + \eta_0 X_{s,t-j}^{EZ,IR} + \eta_1^{+} POS_{t-1} + \eta_1^{-} NEG_{t-1} + \eta_2 Y_{t-1}^{IR} + \eta_3 SANC_{t-j}^{G} + \eta_4 SANC_{t-j}^{I}$$

$$+ \sum_{j=1}^{c} \beta^x{}_{1j} \Delta X_{s,t-j}^{EZ,IR} + \sum_{j=0}^{d} (\beta_{2j}^{x+} \Delta POS_{t-j} + \beta_{2j}^{x-} \Delta NEG_{t-j}) + \sum_{j=0}^{e} \beta^x{}_{3j} \Delta Y_{t-j}^{IR}$$

$$+ \sum_{j=0}^{f} \beta^x{}_{4j} \Delta SANC_{t-j}^{G} + \sum_{j=0}^{g} \beta^x{}_{5j} \Delta SANC_{t-j}^{I} + \epsilon_{t}^{x}$$

(6)

$$\Delta M_{st}^{EZ,IR} = \psi^m + \eta_5 X_{s,t-j}^{EZ,IR} + \eta_6^{+} POS_{t-1} + \eta_6^{-} NEG_{t-1} + \eta_7 Y_{t-1}^{IR} + \eta_8 SANC_{t-j}^{G} + \eta_9 SANC_{t-j}^{I}$$

$$+ \sum_{j=1}^{p} \beta^m{}_{1j} \Delta M_{s,t-j}^{EZ,IR} + \sum_{j=0}^{q} (\beta_{2j}^{m+} \Delta POS_{t-j} + \beta_{2j}^{m-} \Delta NEG_{t-j}) + \sum_{j=0}^{n} \beta^m{}_{3j} \Delta Y_{t-j}^{EZ}$$

$$+ \sum_{j=0}^{r} \beta^m{}_{4j} \Delta SANC_{t-j}^{G} + \sum_{j=0}^{s} \beta^m{}_{5j} \Delta SANC_{t-j}^{I} + \epsilon_{t}^{m}$$

(7)

While equations (6) and (7) included asymmetric RER in both the long term and the short term, following Shin et al. (2014) we introduce asymmetry only in the short run, which can be displayed in the equations as follows:

$$
\Delta X_{st}^{EZ,IR} = \psi^x + \eta_0 X_{s,t-j}^{EZ,IR} + \eta_1 \text{REX}_{t-1} + \eta_2 Y_{t-1}^{IR} + \eta_3 SANC_{t-j}^{G} + \eta_4 SANC_{t-j}^{I} + \sum_{j=1}^{c} \beta^x_{1j} \Delta X_{s,t-j}^{EZ,IR}
$$
$$
+ \sum_{j=0}^{d} \left( \beta_{2j}^{x,+} \Delta POS_{t-j} + \beta_{2j}^{x,-} \Delta NEG_{t-j} \right) + \sum_{j=0}^{e} \beta^x_{3j} \Delta Y_{t-j}^{IR} + \sum_{j=0}^{f} \beta^x_{4j} \Delta SANC_{t-j}^{G} \qquad (8)
$$
$$
+ \sum_{j=0}^{g} \beta^x_{5j} \Delta SANC_{t-j}^{I} + \epsilon_t^x
$$

$$
\Delta M_{st}^{EZ,IR} = \psi^m + \eta_5 X_{s,t-j}^{EZ,IR} + \eta_6 \text{REX}_{t-1} + \eta_7 Y_{t-1}^{IR} + \eta_8 SANC_{t-j}^{G} + \eta_9 SANC_{t-j}^{I} + \sum_{j=1}^{p} \beta^m_{1j} \Delta M_{s,t-j}^{EZ,IR}
$$
$$
+ \sum_{j=0}^{q} \left( \beta_{2j}^{m,+} \Delta POS_{t-j} + \beta_{2j}^{m,-} \Delta NEG_{t-j} \right) + \sum_{j=0}^{n} \beta^m_{3j} \Delta Y_{t-j}^{EZ} + \sum_{j=0}^{r} \beta^m_{4j} \Delta SANC_{t-j}^{G} \qquad (9)
$$
$$
+ \sum_{j=0}^{s} \beta^m_{5j} \Delta SANC_{t-j}^{I} + \epsilon_t^m
$$

Besides, if the asymmetry is valid only in the long run and symmetry exists in the short run, the model of estimation could be as follows:

$$
\Delta X_{st}^{EZ,IR} = \psi^x + \eta_0 X_{s,t-j}^{EZ,IR} + \eta_1^+ POS_{t-1} + \eta_1^- NEG_{t-1} + \eta_2 Y_{t-1}^{IR} + \eta_3 SANC_{t-j}^{G} + \eta_4 SANC_{t-j}^{I}
$$
$$
+ \sum_{j=1}^{c} \beta^x_{1j} \Delta X_{s,t-j}^{EZ,IR} + \sum_{j=0}^{d} \beta^x_{2j} \Delta \text{REX}_{t-j} + \sum_{j=0}^{e} \beta^x_{3j} \Delta Y_{t-j}^{IR} + \sum_{j=0}^{f} \beta^x_{4j} \Delta SANC_{t-j}^{G} \qquad (10)
$$
$$
+ \sum_{j=0}^{g} \beta^x_{5j} \Delta SANC_{t-j}^{I} + \epsilon_t^x
$$

$$
\Delta M_{st}^{EZ,IR} = \psi^m + \eta_5 X_{s,t-j}^{EZ,IR} + \eta_6^+ POS_{t-1} + \eta_6^- NEG_{t-1} + \eta_7 Y_{t-1}^{IR} + \eta_8 SANC_{t-j}^{G} + \eta_9 SANC_{t-j}^{I}
$$
$$
+ \sum_{j=1}^{p} \beta^m_{1j} \Delta M_{s,t-j}^{EZ,IR} + \sum_{j=0}^{d} \beta^m_{2j} \Delta \text{REX}_{t-j} + \sum_{j=0}^{n} \beta^m_{3j} \Delta Y_{t-j}^{EZ} + \sum_{j=0}^{r} \beta^m_{4j} \Delta SANC_{t-j}^{G} \qquad (11)
$$
$$
+ \sum_{j=0}^{s} \beta^m_{5j} \Delta SANC_{t-j}^{I} + \epsilon_t^m
$$

Here we have four types of ARDL models. The main presumption is the non-linearity unless it is rejected. Therefore, the model with asymmetry in both the long-run and the short-run equations (6) and (7)) is considered to be the most comprehensive model, and it is. It would be valid until the null hypotheses of having equal coefficients for $POS_t$ and $NEG_t$ are rejected in both the long-run and the short-run equations. By not rejecting the linearity hypothesis in the long-run equation and rejecting the null hypothesis of linearity in the short-run equation, equations (8) and (9) have to be seen as the valid models. By rejecting the linearity hypothesis in the long-run and not rejecting the null hypothesis of linearity in the short-run equation, equations (10) and (11) would be the most fitted models. If the symmetry hypothesis both in the long run and the short run is not rejected, the linear models in equations (3) and (4) should be the most fitted models.

## 3.1.  DATA

Quarterly real export and import values are calculated by dividing nominal export (import) values by export (import) price indices. Import and export price indices are downloaded from the Statistical Data Warehouse of the European Central Bank. Nominal values for bilateral exports or imports by HS sections are collected from the Eurostat Comext. Because of the existence of seasonality in the real values of imports and exports, the variables are adjusted.

The real exchange rate is calculated using the nominal exchange rate of the euro in terms of Iranian rials, multiplied by the price index in the EA19 and divided by the Iranian price index. Price indices are consumer price indices (CPIs) for both Iran and the EA19. The official exchange rates are obtained from the Central Bank of Iran (CBI). The CPI for the EA19 is retrieved from Eurostat and the CPI for Iran is downloaded from the Statistical Centre of Iran. Real income for the EA19 as a whole is downloaded from Eurostat, and the real income for Iran is downloaded from the Statistical Centre of Iran.

# 4. Results

Quarterly data over the period 1999QI-2018QIV are used to carry out the estimations. Since the data are quarterly, a maximum of four lags is imposed on each first-differenced variable, and Akaike's Information Criterion (AIC) is used to select the optimum number of lags. There are two models with different sets of targeted smart sanctions which are estimated: Model I uses both general sanctions $SANC_t^G$ and smart sanctions $SANC_t^I$ targeting entities, while Model II uses both general sanctions and smart sanctions $SANC_t^I$ targeting natural persons.

## 4.1.  FITNESS OF MODELS

At the first step, the short-run and long-run symmetry hypothesis with regard to the RER should be examined using the Wald test. Table A1 in the appendix can display Wald test results for both export and import models using equations referring to short-run asymmetries in equations (8) and (9), long-run asymmetries in equations (10) and (11), asymmetries in both the long run and the short run represented in equations (6) and (7), or symmetries in both represented in equations (3) and (4).

Wald-S tests the null hypothesis of the symmetric effect of the exchange rate in the short run, while Wald-L tests the null hypothesis of the symmetric effect of the exchange rate in the long run. Then, using these for instance for total exports, the symmetry hypothesis of equation (6) in the long run and the short run cannot be rejected. Therefore, both Wald-S and Wald-L test are not rejected and the linear model, which claims symmetry in both the long run and the short run, is the most fitted model for total exports in Model I. As another example for the sector on confidential (XXII), the situation is different. Wald-S for equation (6) reveals the rejection of the null hypothesis of symmetry, and Wald-L cannot reject the null hypothesis. Hence, equation (8), which claims symmetry in the short run and asymmetry in the long run, should be the most fitted model. In the second step Wald-S for equation (8) rejects the symmetry hypothesis, so this model can be considered to be the most fitted model.

For ensuring the robustness of our estimations, some diagnostic statistics are reported in Table A2 in the Appendix. *Pesaran F* statistics can test cointegration in the models. Exports from the EU to Iran in Model I using sanctioned entities reveal that cointegration exits for all industries except for Leather and Skins, Wood, and Optical, Medical and Music Instruments. Exports in Model II using sanctioned persons reveal that variables in the sectors Vegetable products, Beverages & Tobacco, Chemical products, Footwear, Furniture, Toys, Misc., Confidential, and Optical, Medical and Music Instruments are not cointegrated. However, for the Beverages & Tobacco and Footwear industries *Pesaran F* tests are inconclusive; then, *Pesaran t* statistics can show the existence of cointegration. While variables in import Model I, which is using sanctioned entities for the Live Animals and Products, Mineral Products, Rubber and Plastics, Leather and Skins and Footwear industries, are not cointegrated, for the remaining industries the variables are cointegrated. In import Model II using sanctioned persons, variables for the Live Animals and Products, Beverages & Tobacco, Mineral Products, Rubber and Plastics, Footwear, Glass & Stone, Furniture, Toys, Misc., and Art & Antiques sectors are not integrated. Residuals of all

most fitted models are free of autocorrelation. The Ramsey Regression Equation Specification Error Test (RESET) rejects the functional misspecification of the models for almost all industries.

## 4.2. IMPACT OF SANCTIONS

Table 1 presents the estimation results of the impact of sanctions imposed by the EU on the export of the EA19 to Iran in both the short run ($\Delta SANC_t$) and the long run ($SANC_t$). The estimated long-run coefficients are normalised. As explained above, in Model I the number of sanctions targeting entities are included in $SANC_t^I$, while in Model II the number of sanctions targeting natural persons are included in $SANC_t^I$. In both models the number of general sanctions that were lifted after the implementation of the JCPOA are also included as $SANC_t^G$. With the exception of the Vegetable Products, Animal or Vegetable Fats & Oils, and Art & Antiques industries, exports of all other industries from the EA19 to Iran are negatively affected by the general sanctions in the long run. It is interesting to note that general sanctions have stimulated exports of food to Iran from the EA19. This suggests that when international sanctions became an obstacle for Iran to import food products from other countries in the world, the exports of food products from the EA19 to Iran increased. Arms & Ammunition, Transport Equipment, Machinery, Metal, Rubber and Plastics, Glass & Stone are among the sectors that show statistically significant negative coefficients of the long-run general sanctions in Model I. Exports from many other sectors are also negatively affected by general EU sanctions in Model II. The statistically significant coefficient for total exports in Model II suggests that an additional sanction imposed by the EU led to a reduction in total exports from the EA19 to Iran of about 13% in the long run.

While general sanctions in the majority of models have statistically insignificant coefficients in the short run, targeted sanctions have statistically significant coefficients in both the long and the short run. Controlling for general sanctions, smart sanctions targeting entities and natural persons have a statistically significant negative impact on total exports from the EA19 to Iran. However, the impact of targeted sanctions is much smaller than the impact of general sanctions. Moreover, sanctions against persons have a stronger impact than sanctions against entities. This is also the case for many sectors. For instance, an additional sanction targeting natural persons decreases total exports of from the EA19 to Iran by 0.7% in the short run and by 0.8% in the long run. However, an additional sanction targeting entities decreases total exports from the EA19 to Iran by 0.4% only in the long run, because these sanctions are specifically targeted at those individuals and do not necessarily target general trade.

Table 2 displays the estimation results of the impact of EU sanctions on the import values of the EA19 from Iran. Some positive signs can be spotted for sanctions in the long and short run. Except for the Leather and Skins and Animal or Vegetable Fats & Oils industries, the impact of general EU sanctions on the imports from Iran is statistically significantly negative for almost all sectors. Considering Model II including sanctions targeting natural persons, an additional general EU sanction reduces imports by the EA19 from Iran by 58%, which is more than four times higher than the impact on the EA19's exports to Iran. This is in line with the description presented in the introduction regarding Figure 2, namely that the EU's general sanctions have hampered imports from Iran more than exports to Iran. Furthermore, for some sectors, such as Vegetable Products, the long-run impact of general EU sanctions on imports from Iran is statistically insignificant, while they have a short-run negative impact on imports from Iran.

For the smart sanctions targeting entities and natural persons, coefficients for many of sectors are statistically insignificant. Comparing this with the results in Table 1 on exports to Iran indicates that smart EU sanctions have a stronger impact on exports to Iran rather than imports from Iran. However, the coefficient for sanctions targeting natural persons is stronger on imports from Iran than exports to Iran. An additional sanction targeting natural persons reduces total imports from Iran by 3%, which is statistically only significant at a level of 5%. Interestingly, sanctions targeting entities have resulted in positive and statistically significant coefficients for the Live Animals and Products, Vegetable Products, Animal or Vegetable Fats & Oils, and Beverages & Tobacco industries. Again, this may indicate that while general sanctions were controlled for in the econometrics model of imports from Iran, smart sanctions have facilitated imports of these primary and food products from Iran.

## 4.3.  INCOME AND EXCHANGE RATES AS CONTROL VARIABLES

Table 3 displays the effect of real GDP on exports and imports in the long run as well as the short run. As noted in equations (1) and (2), the GDP of the importer in each model is included. Long-run estimated coefficients are again normalised.  It is observed that statistically the total exports of the EA19 to Iran are significantly affected by Iran's income in both the long and the short run, and it is valid for both Model I and Model II. This is also valid in most of the sectors. However, the income of the EA19 has a significant and positive effect on the bloc's imports from Iran only in the long run, and its coefficient in the short run is statistically insignificant. The real GDP of the EA19 has statistically significant and negative coefficients for imports of some sectors from Iran. It could be interpreted in a way that when the income of the EA19 increases, there could be a substitution of products from those import sectors by a surge in domestic production. This could be mainly because the imports of EA19 from Iran in those sectors are very negligible.

Table 4 presents the normalised values of the estimated RER in the long run. The results suggest that the elasticity of exports and imports to the RER is not homogenous across sectors. For instance, the impact of the RER on exports of Chemical products, Textiles, Footwear, Metal, Machinery, Optical, Medical, Music Instruments in Model I is asymmetric. While the impact of the RER on total exports to Iran is symmetric, the impact on total imports from Iran in Model I is shown to be asymmetric. A 1% real depreciation of the euro against the Iranian rial increases total imports from Iran to the EA19 by 1.27%, while the real appreciation has no statistically significant impact on imports from Iran.

## Table 1 / The impact of the sanctions on the exports of the EA19 to Iran (most fitted models)

| Sector | Model I: sanctioned entities | | | | | | | | | | Model II: sanctioned persons | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SANC_t^I$ | Lags on $\Delta SANC_t^I$ | | | | $SANC_t^G$ | Lags on $\Delta SANC_t^G$ | | | | $SANC_t^I$ | Lags on $\Delta SANC_t^I$ | | | | $SANC_t^G$ | Lags on $\Delta SANC_t^G$ | | | |
| | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 |
| I Live Animals and Products | -0.003 | 0.02 *** | -0.002 | 0.02 *** | | -0.01 | -0.04 | | | | -0.02 * | 0.003 | | | | -0.08 *** | -0.13 | | | |
| II Vegetable Products | 0.002 | -0.04 ** | | | | 0.53 * | 0.15 | -0.25 | | | 0.02 | -0.03 | | | | 0.46 * | 0.08 | | | |
| III Animal or Vegetable Fats & Oils | -0.004 *** | -0.003 | | | | 0.26 * | 0.15 | -0.15 | -0.18 *** | -0.14 | 0.0005 | -0.03 ** | -0.03 *** | -0.02 | -0.04 *** | 0.19 * | 0.21 *** | | | |
| IV Beverages & Tobacco | 0.001 | 0.009 | | | | -0.05 | -0.05 | | | | -0.004 | -0.007 | | | | -0.06 *** | -0.05 | | | |
| V Mineral Products | -0.01 ** | -0.006 | | | | -0.15 | 0.009 | | | | -0.04 ** | -0.03 *** | | | | -0.40 * | -0.08 | | | |
| VI Chemical products | -0.002 ** | 0.004 *** | -0.002 | 0.004 ** | 0.003 | -0.02 *** | -0.02 | 0.06 * | -0.03 | | -0.006 ** | -0.006 ** | | | | -0.06 * | -0.02 | 0.06 * | -0.02 | |
| VII Rubber and Plastics | -0.008 * | 0.001 | 0.00005 | 0.006 ** | | -0.10 * | -0.004 | | | | -0.02 * | -0.010 * | | | | -0.22 * | -0.02 | | | |
| VIII Leather and Skins | -0.009 ** | 0.009 | | | | 0.07 | -0.04 | -0.11 | -0.05 | -0.15 ** | -0.10 * | 0.007 | 0.01 | 0.03 *** | 0.03 ** | -0.28 * | -0.07 | | | |
| IX Wood | -0.01 *** | 0.003 | | | | 0.11 | -0.01 | | | | -0.04 * | -0.02 ** | | | | -0.09 ** | -0.02 | | | |
| X Paper & Pulp | -0.005 * | 0.002 | -0.003 | 0.008 ** | 0.006 *** | -0.04 | -0.01 | | | | -0.02 * | -0.005 | | | | -0.12 * | -0.05 | | | |
| XI Textiles | -0.001 | 0.009 ** | 0.0009 | 0.009 ** | | -0.009 | 0.02 | -0.04 | 0.05 | | -0.01 * | 0.002 | 0.01 ** | 0.01 ** | | -0.04 * | 0.03 | -0.01 | 0.08 *** | |
| XII Footwear | -0.007 *** | -0.002 | 0.02 ** | -0.0002 | 0.02 ** | -0.04 | -0.01 | | | | -0.02 ** | -0.01 | -0.006 | 0.02 | 0.03 ** | -0.11 ** | -0.01 | | | |
| XIII Glass & Stone | -0.004 * | 0.006 ** | 0.001 | 0.006 ** | | -0.05 * | -0.07 ** | | | | -0.01 * | 0.001 | | | | -0.10 * | -0.07 ** | | | |
| XIV Precious Metal & Stones | -0.01 * | -0.004 | | | | -0.01 | 0.13 | | | | -0.03 * | -0.005 | 0.05 *** | 0.10 * | 0.09 * | -0.14 * | 0.09 | | | |
| XV Metal | 0.004 | -0.005 | -0.008 | | | -0.15 * | -0.07 | | | | -0.005 | -0.02 ** | | | | -0.17 * | -0.06 | 0.08 | | |
| XVI Machinery | -0.008 * | 0.002 | | | | -0.17 * | -0.01 | | | | -0.01 ** | -0.004 | 0.006 *** | | | -0.22 * | -0.03 *** | | | |
| XVII Transport Equipment | -0.007 *** | 0.009 | | | | -0.28 * | -0.05 | | | | -0.01 | -0.005 | -0.009 | -0.02 *** | -0.02 *** | -0.43 * | -0.06 | | | |
| XVIII Optical, Medical, Music Instruments | -0.008 * | 0.001 | -0.0003 | 0.004 *** | | -0.02 | -0.005 | | | | -0.01 *** | -0.003 | | | | -0.08 *** | -0.007 | | | |
| XIX Arms & Ammunition | -0.006 | 0.02 | 0.04 | 0.05 | | -0.88 * | -0.14 | | | | -0.13 * | -0.01 | 0.12 *** | | | -1.19 * | -0.31 | | | |
| XX Furniture, Toys, Misc. | -0.002 | -0.0006 | | | | 0.03 | -0.06 | -0.06 *** | -0.07 *** | -0.10 * | -0.004 | -0.01 ** | | | | -0.01 | -0.06 | -0.05 | -0.06 | -0.09 ** |
| XXI Art & Antiques | -0.008 ** | -0.004 | | | | 0.33 * | 0.005 | | | | -0.07 * | -0.05 | 0.06 | | | 0.03 | -0.05 | | | |
| XXII Confidential | -0.007 | 0.02 | | | | -0.03 | -0.18 | 0.16 | -0.21 | -0.30 ** | -0.009 | -0.01 | -0.04 *** | -0.02 | -0.11 * | -0.13 | -0.1 | | | |
| Total | -0.004 ** | 0.00007 | | | | -0.07 ** | -0.02 | | | | -0.008 ** | -0.007 * | | | | -0.13 * | -0.02 | | | |

Notes: *, **, and *** show the significance at the 1%, 5% and 10% respectively. The critical values of standard t-distribution, i.e., 2.63, 1.99, and 1.66 are used to arrive at *, **, and ***, respectively. The long-run coefficients were normalised.

## Table 2 / The impact of the sanctions on the imports of the EA19 from Iran (most fitted models)

| Sector | Model I: sanctioned entities | | | | | | | | | | Model II: sanctioned persons | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SANC_t^I$ | Lags on $\Delta SANC_t^I$ | | | | $SANC_t^G$ | Lags on $\Delta SANC_t^G$ | | | | $SANC_t^I$ | Lags on $\Delta SANC_t^I$ | | | | $SANC_t^G$ | Lags on $\Delta SANC_t^G$ | | | |
| | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 |
| I Live Animals and Products | 0.007 ** | 0.004 | | | | -0.08 | -0.005 | | | | 0.01 | -0.0002 | | | | 0.007 | 0.02 | | | |
| II Vegetable Products | 0.002 *** | 0.001 | | | | -0.0004 | -0.04 | -0.05 ** | -0.05 ** | -0.05 ** | 0.004 *** | -0.0003 | | | | 0.03 | -0.02 | -0.05 ** | -0.05 ** | -0.05 ** |
| III Animal or Vegetable Fats & Oils | 0.02 * | 0.05 *** | -0.05 *** | -0.03 | -0.08 * | -0.01 | 0.16 | 0.53 | 0.70 ** | 0.47 | 0.06 * | 0.12 * | -0.06 | | | 0.29 * | 0.13 | | | |
| IV Beverages & Tobacco | 0.009 *** | -0.01 | | | | -0.1 | -0.1 | | | | 0.002 | 0.000004 | | | | -0.08 | -0.12 | | | |
| V Mineral Products | 0.002 | 0.04 *** | 0.03 | 0.02 | 0.05 ** | -1.11 * | 0.37 | 0.43 | -0.46 | | -0.07 *** | 0.08 *** | 0.06 | -0.03 | 0.07 | -0.72 | 0.43 *** | -0.14 | -1.05 * | -0.45 |
| VI Chemical products | -0.02 * | 0.02 *** | | | | 0.18 ** | -0.01 | | | | -0.02 | 0.004 | | | | 0.05 | -0.03 | | | |
| VII Rubber and Plastics | -0.01 | 0.02 | | | | -0.03 | -0.005 | | | | -0.05 | 0.01 | | | | -0.21 | 0.01 | | | |
| VIII Leather and Skins | -0.002 | 0.005 | | | | 0.10 *** | 0.003 | -0.07 ** | | | -0.03 * | 0.01 ** | 0.01 ** | 0.01 ** | 0.02 ** | 0.08 ** | 0.004 | -0.09 * | -0.05 | -0.05 |
| IX Wood | -0.006 | 0.04 | | | | -0.02 | -0.08 | 0.46 *** | | | -0.02 | -0.01 | | | | -0.08 | -0.003 | 0.47 *** | | |
| X Paper & Pulp | 0.002 | -0.01 | | | | -0.44 ** | 0.04 | | | | 0.01 | 0.04 | 0.03 | 0.04 | 0.09 ** | -0.42 ** | -0.06 | | | |
| XI Textiles | -0.0006 | -0.002 | 0.0009 | -0.0001 | -0.005 ** | -0.10 * | 0.02 | -0.01 | 0.04 | 0.04 *** | 0.006 | 0.006 ** | | | | -0.13 * | 0.003 | | | |
| XII Footwear | -0.0001 | 0.03 | | | | -0.23 | -0.05 | 0.86 ** | | | 0.02 | -0.009 | | | | -0.24 | 0.06 | 0.89 ** | | |
| XIII Glass & Stone | -0.009 ** | -0.0006 | | | | -0.20 * | 0.004 | 0.1 | | | 0.006 | 0.005 | | | | -0.18 * | 0.0002 | 0.05 | 0.03 | -0.11 |
| XIV Precious Metal & Stones | -0.02 ** | -0.002 | | | | -0.13 | 0.2 | | | | -0.04 *** | 0.02 | 0.12 ** | | | -0.33 ** | 0.002 | | | |
| XV Metal | -0.006 | -0.02 | | | | 0.11 | 0.02 | | | | -0.007 | 0.01 | | | | 0.06 | -0.04 | | | |
| XVI Machinery | -0.006 * | 0.003 | | | | -0.07 *** | 0.02 | | | | -0.02 * | -0.001 | | | | -0.14 * | 0.00005 | | | |
| XVII Transport Equipment | -0.008 * | -0.01 | | | | 0.02 | 0.08 | | | | -0.008 | -0.02 | | | | -0.09 | 0.03 | | | |
| XVIII Optical, Medical, Music Instruments | -0.01 * | -0.02 ** | | | | -0.17 * | 0.007 | 0.06 | 0.29 * | 0.18 *** | -0.008 | -0.003 | 0.02 | | | -0.20 * | -0.11 | -0.04 | 0.20 *** | |
| XIX Arms & Ammunition | -0.04 *** | -0.03 | 0.06 | -0.06 | -0.09 | -1.01 * | -0.8 | 1.20 *** | 1.26 *** | 1.32 *** | 0.03 | 0.08 | -0.33 * | -0.08 | -0.28 ** | -1.37 * | -1.27 *** | 1.05 | 0.98 | 1.61 ** |
| XX Furniture, Toys, Misc. | 0.004 | -0.002 | -0.009 | -0.01 *** | | -0.14 * | 0.11 | | | | 0.008 | 0.01 | | | | -0.1 | 0.09 | -0.07 | -0.19 ** | |
| XXI Art & Antiques | -0.010 *** | 0.01 | -0.01 | 0.009 | 0.04 ** | 0.06 | -0.25 | | | | -0.02 | -0.006 | 0.03 | 0.01 | 0.16 * | -0.11 | -0.29 | 0.37 *** | | |
| XXII Confidential | -0.002 | -0.0005 | | | | -0.18 * | 0.06 | | | | 0.0006 | -0.003 | | | | -0.22 * | 0.06 | | | |
| Total | -0.001 | 0.02 * | 0.01 | | | -0.47 * | -0.03 | 0.16 | -0.15 | | -0.03 ** | 0.002 | | | | -0.58 * | 0.03 | 0.13 | -0.17 *** | |

Notes: *, **, and *** show the significance at the 1%, 5% and 10% respectively. The critical values of standard t-distribution, i.e., 2.63, 1.99, and 1.66 are used to arrive at *, **, and ***, respectively. The long-run coefficients were normalised.

**Table 3 / The impact of income on real bilateral trade values between the EA19 and Iran (most fitted models)**

| Sector | Effect of Iranian Income on EU Export | | | | | | | | | | Effect of EU Income on EU Import | | | | | | | | | |
| | Model I: sanctioned entities | | | | | Model II: sanctioned persons | | | | | Model I: sanctioned entities | | | | | Model II: sanctioned persons | | | | |
| | Ln Y | Lags on ΔLn Y | | | | Ln Y | Lags on ΔLn Y | | | | Ln Y | Lags on ΔLn Y | | | | Ln Y | Lags on ΔLn Y | | | |
| | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 | | 0 | 1 | 2 | 3 |
| **I Live Animals and Products** | 2.92* | -0.44 | | | | 4.84* | 0.7 | -1.64 | | | -7.38** | -1.13 | | | | -5.91 | -0.72 | | | |
| **II Vegetable Products** | 1.17 | 1.3 | | | | -0.31 | 1.05 | | | | -0.13 | 1.63** | 1.64** | 1.76** | 1.57** | -0.16 | 1.66** | 1.65** | 1.86** | 1.62** |
| **III Animal or Vegetable Fats & Oils** | 3.88* | 0.67 | | | | 3.75* | 1.28 | | | | -7.15 | -12.83*** | | | | -13.20* | -14.01** | | | |
| **IV Beverages & Tobacco** | 2.55* | 0.91 | | | | 2.90* | 0.01 | -1.06 | -1.64** | | 1.54 | 2.85 | 3.92 | | | -5.87 | 2.08 | 5.20*** | | |
| **V Mineral Products** | 4.56** | 1.32 | | | | 2.13* | 0.74 | | | | 7.38 | 1.97 | -10.37 | -1.06 | 15.89*** | 21.46 | 8.93 | -8.98 | 1.82 | 22.46** |
| **VI Chemical products** | 0.74** | 0.49** | | | | 0.39*** | 0.27 | | | | 21.74* | 5.49** | | | | 28.17* | 5.68** | | | |
| **VII Rubber and Plastics** | 2.07* | 0.56* | -0.48** | | | 0.68* | 0.45** | -0.46** | | | 1.86 | -1.82 | 0.17 | 6.46 | | 29.88*** | 4.61 | | | |
| **VIII Leather and Skins** | 4.90** | 0.74 | | | | 0.52 | 0.24 | | | | -1.18 | 0.04 | | | | -2.57 | 1.3 | 1.54 | | |
| **IX Wood** | 4.09 | 1.07 | | | | 4.54* | -1.02 | -4.99* | -3.74* | -2.78** | -3.38 | -8.4 | | | | -1.5 | -5.8 | | | |
| **X Paper & Pulp** | 1.17** | 0.73** | | | | 1.08* | 0.66** | -0.45 | | | 4.61 | 7.03*** | | | | -6.77 | 5.54 | | | |
| **XI Textiles** | 2.34* | 0.90*** | -1.38* | -1.07** | | 3.26* | 0.35 | -1.58* | -1.34** | | -8.56 | 0.03 | 1.94*** | 2.36** | 1.73*** | -11.92* | -0.92 | 1.57*** | 1.19*** | |
| **XII Footwear** | 1.43 | 0.53 | | | | 2.23** | 1.56*** | -1.08 | | | -6.31 | 20.34 | 17.72 | | | -8.45 | 20.73*** | 16.76 | | |
| **XIII Glass & Stone** | 1.34* | 0.39 | -0.4 | | | 1.14* | 0.29 | | | | 6.69* | 1.42 | | | | 11.56* | 2.95*** | | | |
| **XIV Precious Metal & Stones** | 2.34** | 0.21 | | | | 2.18** | 1.06 | | | | 29.46* | 12.69 | | | | 26.07* | 12.48 | | | |
| **XV Metal** | 5.35* | -0.58 | -2.97* | -1.96** | -1.21 | 3.11* | -1.78*** | -3.75* | -2.93* | -2.10*** | 7.52*** | 16.49* | 14.11* | 15.40* | 13.79* | 4.48 | 12.96** | 13.99* | 13.11* | 10.67** |
| **XVI Machinery** | -0.52 | 0.12 | | | | 0.29** | 0.18 | -0.34*** | | | 4.46 | -3.85* | -5.13* | -3.65*** | -4.26** | 6.07* | -3.53** | -5.85* | -4.44** | -4.53** |
| **XVII Transport Equipment** | 0.4 | 0.5 | | | | 0.33 | 0.32 | | | | 1.09 | 0.55 | | | | -1.58 | 0.44 | | | |
| **XVIII Optical, Medical, Music Instruments** | -0.72 | 0.08 | | | | 0.08 | 0.14 | | | | -8.43* | -1.36 | | | | -4.82** | 0.89 | | | |
| **XIX Arms & Ammunition** | 1.84 | 3.25 | | | | 2.26 | -2.06 | | | | -28.60** | -16.4 | 33.02 | 54.13** | | -7.23 | -0.22 | | | |
| **XX Furniture, Toys, Misc.** | 2.17** | 1.66* | 1.03*** | 1.02** | 1.49** | 0.87** | 1.59* | 1.01*** | 0.87*** | 1.68* | 0.75 | 6.38** | 3.78 | | | -0.97 | 5.73** | 4.76*** | | |
| **XXI Art & Antiques** | 5.94* | 1.07 | | | | 9.23* | -15.70* | -12.58** | -17.50* | -8.75*** | 10.55** | 4.77 | | | | 7.52 | 6.25 | | | |
| **XXII Confidential** | 1.22 | 0.24 | | | | 0.96 | 0.47 | | | | 2.84 | 1.93 | | | | 1.52 | 1.42 | | | |
| **Total** | 1.09** | 0.34** | | | | 0.31** | 0.30*** | | | | 11.65** | 1.97 | | | | 12.71** | 2.4 | | | |

Notes: *, **, and *** show the significance at the 1%, 5% and 10% respectively. The critical values of standard t-distribution is 1.99.

**Table 4 / Long-run impact of exchange rate on real bilateral trade values between the EA19 and Iran (most fitted models)**

| Sectors | EXPORT | | | | | | IMPORT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model I: sanctioned entities | | | Model II: sanctioned persons | | | Model I: sanctioned entities | | | Model II: sanctioned persons | | |
| | RER | NEG | POS | RER | NEG | POS | RER | NEG | POS | RER | NEG | POS |
| I Live Animals and Products | 0.68 ** | | | 0.53* | | | 0.13 | | | 0.01 | | |
| II Vegetable Products | 0.31 | | | 0.36 | | | 0.09 | | | 0.08 | | |
| III Animal or Vegetable Fats & Oils | -0.09 | | | -0.04 | | | 0.25 | | | 0.46 | | |
| IV Beverages & Tobacco | 0.16 | | | -0.05 | | | | 1.14 *** | -0.19 | -0.19 | | |
| V Mineral Products | 0.35 | | | 0.34 | | | 0.15 | | | -0.01 | | |
| VI Chemical products | | -0.31 * | -0.02 | | -0.42** | -0.06 | -0.32 | | | | 1.82* | -0.27 |
| VII Rubber and Plastics | -0.03 | | | -0.09 | | | 0.29 | | | 0.44 | | |
| VIII Leather and Skins | -0.53 *** | | | | -4.46* | -0.21 | | 0.31 | -0.42 *** | -0.45** | | |
| IX Wood | 0.27 | | | | -0.33 | 0.24*** | 0.48 | | | 0.43 | | |
| X Paper & Pulp | -0.32 ** | | | -0.63* | | | 1.08 *** | | | 1.46** | | |
| XI Textiles | | 0.28 ** | -0.03 | -0.05 | | | 0.09 | | | 0.24*** | | |
| XII Footwear | | -1.13 ** | -0.2 | | -1.15** | -0.39** | -2.44 | | | -2.30 | | |
| XIII Glass & Stone | -0.07 | | | -0.10 | | | -0.44 *** | | | | 1.22** | -0.31 |
| XIV Precious Metal & Stones | -0.42 | | | -0.30 | | | -2.10 * | | | -1.86** | | |
| XV Metal | | 2.56 * | 0.06 | | 1.73* | 0.08 | 0.35 | | | 0.65** | | |
| XVI Machinery | | -0.55 ** | 0.18 | -0.01 | | | 0.13 | | | 0.09 | | |
| XVII Transport Equipment | 0.50 *** | | | 0.32 | | | -0.15 | | | -0.14 | | |
| XVIII Optical, Medical, Music Instruments | | -1.25 * | -0.01 | | -0.81** | 0.01 | | -0.62 | 0.45 ** | 0.55* | | |
| XIX Arms & Ammunition | -0.13 | | | | -4.92** | -0.54 | | -5.22 ** | -0.23 | -0.16 | | |
| XX Furniture, Toys, Misc. | 0.18 | | | 0.14 | | | | 1.18 * | 0.13 | | 1.09** | 0.16 |
| XXI Art & Antiques | 0.91 ** | | | | -1.51** | 0.80* | -0.73 *** | | | -0.68 | | |
| XXII Confidential | 0.007 | | | -0.12 | | | 0.49 ** | | | 0.58** | | |
| Total | 0.19 *** | | | 0.20*** | | | 1.27 *** | | 0.14 | -0.05 | | |

Notes: *, **, and *** show the significance at the 1%, 5% and 10% respectively. The critical values of standard t-distribution, i.e., 2.64, 1.66 and 1.99 are used to arrive at *, ** and ***, respectively.

# 5. Summary and concluding remarks

Economic sanctions are intensively used by international institutions to enforce political objectives. Since 2006 the EU has been implementing general sanctions against the whole economy of Iran, affecting the bloc's trade relations with the country. These general sanctions were implemented to stop Iran from violating the Safeguard Agreement of the nuclear Non-Proliferation Treaty. After years of diplomacy and dialogue the signing of the Joint Comprehensive Plan of Action (JCPOA) between Iran and the P5+1 removed all general EU sanctions against Iran. Moreover, since 2007, and following the designations by the UN Security Council, the EU has also implemented smart sanctions targeting Iranian entities and natural persons associated with its military activities and aerospace industry. These targeted sanctions were introduced to avoid the humanitarian impact of general sanctions on ordinary people, whose lives are affected by the wide-ranging impact of these measures.

In a non-linear autoregressive distributed lag (NARDL), this paper investigates the impact of general and targeted EU sanctions against Iran on quarterly bilateral trade values between the EA19 and Iran during the period 1999Q1-2018Q4. Following Shin et al. (2014), the asymmetric impact of the real exchange rate on traded values is considered to provide robust and unbiased estimations of the impact of sanctions on trade. The results indicate that general sanctions have strongly hampered trade flows between the two trading partners. The impact of general sanctions on the EA19's total imports from Iran is more than four times stronger than on its total exports to Iran. Moreover, the EU's general sanctions have hampered trade in almost all sectors, except for the primary sectors. For instance, exports and imports of Vegetable Products and Animal or Vegetable Fats & Oils, as well as Live Animals and Products and Beverages & Tobacco, have been positively affected by the EU's general sanctions. This is mostly attributable to Iran's strong diaspora network in the EU and the numerous Iranian grocery stores across the EA19 countries.

Furthermore, our analysis finds that the impact of smart sanctions targeting Iranian entities and natural persons is much smaller than the impact of general sanctions on total trade values and the trade values of many sectors. Smart sanctions affect the exports of most sectors from the EA19 to Iran, while they are statistically insignificant for the imports of many sectors from Iran. Since the 1990s sanctions have been designed to reduce the negative humanitarian impact on the whole economy. Thus, targeted sanctions have the smart motivation not to harm the normal citizens of a country, but only those who are unfriendly to the sanctioning country. This paper provides strong evidence of the smart motivation behind the imposition of targeted sanctions compared with general sanctions, which deprive the whole economy of export revenues.

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# Appendix

**Figure A1 / EA19 trade of goods with Iran in total EA19 trade – 1996–2018**
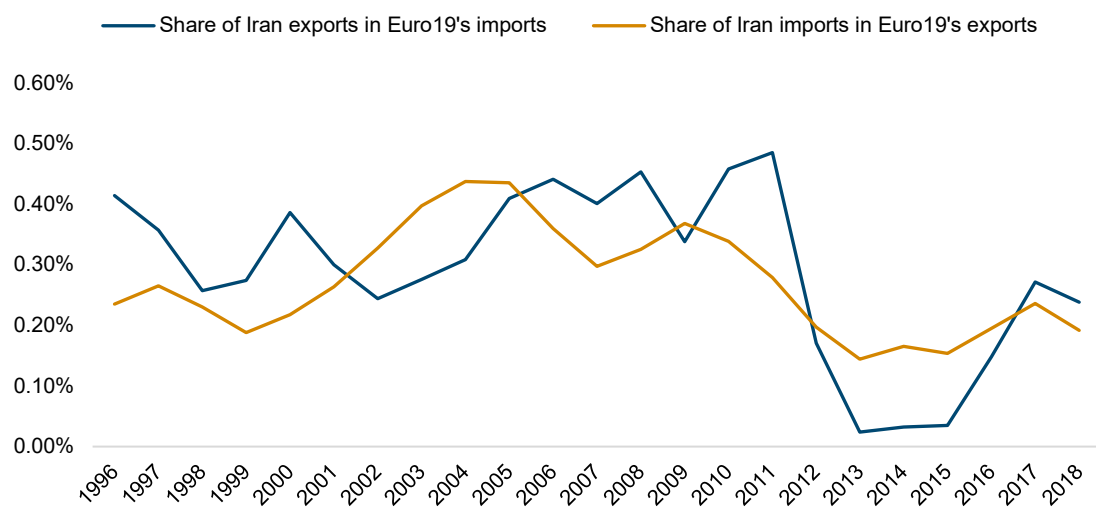


Source: UN COMTRADE.

## Table A1 / Short-run and Long-run the symmetry test results

| | EXPORT | | | | | | | | IMPORT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model I: sanctioned entities | | | | Model II: sanctioned persons | | | | Model I: sanctioned entities | | | | Model II: sanctioned persons | | | |
| | Wald-S | | Wald-L | | Wald-S | | Wald-L | | Wald-S | | Wald-L | | Wald-S | | Wald-L | |
| | Eq (6) | Eq (8) | Eq (6) | Eq (10) | Eq (6) | Eq (8) | Eq (6) | Eq (10) | Eq (7) | Eq (9) | Eq (7) | Eq (11) | Eq (7) | Eq (9) | Eq (7) | Eq (11) |
| I Live Animals and Products | 2.71 | 4.18 ** | 0.22 | 3.49 *** | 7.03 ** | 8.93 * | 0.08 | 0.9 | 0.002 | 1.18 | 4.94 ** | 0.27 | 0.13 | 0.72 | 0.95 | 0.33 |
| II Vegetable Products | 2.05 | 0.44 | 1.31 | 1.15 | 3.17 *** | 1.34 | 2.21 | 1.13 | 0.96 | 0.23 | 1.53 | 0.8 | 0.74 | 0.06 | 2.15 | 1.37 |
| III Animal or Vegetable Fats & Oils | 3.97 *** | 4.25 ** | 0.01 | 2 | 1.92 | 4.44 ** | 1.52 | 2.61 | 1.73 | 1.86 | 0.001 | 0.00001 | 0.0006 | 0.05 | 0.37 | 0.01 |
| IV Beverages & Tobacco | 2.06 | 4.33 ** | 4.70 ** | 0.18 | 0.01 | 5.37 ** | 15.19 * | 2.11 | 2.12 | 0.93 | 18.28 * | 4.47 ** | 0.04 | 1.14 | 1 | 2.03 |
| V Mineral Products | 1.65 | 1.93 | 0.00003 | 0.02 | 3.53 *** | 4.08 ** | 0.0002 | 0.93 | 0.34 | 0.01 | 1.29 | 0.89 | 0.07 | 0.04 | 0.04 | 0.008 |
| VI Chemical products | 0.78 | 3.50 *** | 8.27 * | 6.77 ** | 0.35 | 0.09 | 4.23 ** | 3.95 *** | 5.86 ** | 6.58 ** | 0.03 | 7.80 * | 0.57 | 6.38 ** | 5.58 ** | 10.84 * |
| VII Rubber and Plastics | 0.63 | 1.18 | 0.08 | 0.74 | 0.48 | 0.17 | 0.44 | 0.21 | 0.16 | 2.58 | 6.24 ** | 1.74 | 1.97 | 2.43 | 0.05 | 0.76 |
| VIII Leather and Skins | 3.49 *** | 2.22 | 1.15 | 0.61 | 12.76 * | 3.18 *** | 4.11 ** | 2.12 | 0.93 | 0.45 | 3.99 *** | 2.81 *** | 3.04 *** | 5.07 ** | 2.7 | 0.73 |
| IX Wood | 0.21 | 1.73 | 1.06 | 2.25 | 1.12 | 2.65 | 3.27 *** | 3.99 *** | 0.32 | 0.68 | 0.01 | 0.36 | 0.33 | 0.98 | 0.12 | 0.76 |
| X Paper & Pulp | 10.99 * | 17.15 * | 0.86 | 1.38 | 11.72 * | 12.89 * | 0.01 | 0.21 | 0.02 | 0.14 | 0.05 | 0.16 | 0.13 | 0.02 | 0.52 | 0.4 |
| XI Textiles | 9.76 * | 2.93 *** | 6.93 ** | 4.13 ** | 2.44 | 1.61 | 4.43 ** | 2.53 | 0.1 | 0.0002 | 0.13 | 0.06 | 0.29 | 0.21 | 0.08 | 0.01 |
| XII Footwear | 0.73 | 0.0001 | 3.83 *** | 3.59 *** | 1.92 | 0.08 | 6.67 ** | 3.30 *** | 0.35 | 0.00006 | 0.62 | 0.41 | 0.0008 | 0.02 | 0.04 | 0.06 |
| XIII Glass & Stone | 3.17 *** | 5.47 ** | 0.47 | 2.73 | 3.18 *** | 1.84 | 0.76 | 0.35 | 0.02 | 1.44 | 1.92 | 3.63 *** | 1.11 | 0.6 | 13.54 * | 9.99 * |
| XIV Precious Metal & Stones | 0.55 | 0.16 | 1.21 | 0.36 | 1.22 | 0.14 | 2.55 | 1.57 | 0.58 | 0.28 | 0.83 | 0.9 | 1.16 | 0.7 | 1.9 | 1.39 |
| XV Metal | 7.04 ** | 0.92 | 39.30 * | 4.38 ** | 5.15 ** | 1.23 | 26.42 * | 0.16 | 0.27 | 0.55 | 0.1 | 0.38 | 0.1 | 0.18 | 0.02 | 0.1 |
| XVI Machinery | 0.02 | 2.79 *** | 5.20 ** | 7.34 * | 0.77 | 1.11 | 0.01 | 6.26 ** | 0.0006 | 0.004 | 0.005 | 0.01 | 0.42 | 0.52 | 0.0006 | 0.1 |
| XVII Transport Equipment | 0.15 | 0.01 | 0.95 | 0.0004 | 0.002 | 0.53 | 1.44 | 2.23 | 5.11 ** | 5.61 ** | 0.18 | 0.19 | 12.38 * | 10.94 * | 1.56 | 0.48 |
| XVIII Optical, Medical, Music Instruments | 7.24 * | 4.55 ** | 10.29 * | 6.70 ** | 7.64 * | 3.95 *** | 5.13 ** | 6.35 ** | 0.001 | 1.1 | 4.66 ** | 5.77 ** | 0.04 | 0.91 | 1.67 | 2.49 |
| XIX Arms & Ammunition | 2.03 | 0.01 | 2.90 *** | 2 | 4.92 ** | 1.87 | 3.25 *** | 2.52 | 0.35 | 0.002 | 4.55 ** | 4.39 ** | 0.004 | 0.004 | 0.0007 | 0.00008 |
| XX Furniture, Toys, Misc. | 0.4 | 0.74 | 0.28 | 0.66 | 0.31 | 0.96 | 0.38 | 0.86 | 0.74 | 0.74 | 17.16 * | 7.50 * | 0.51 | 0.0008 | 4.07 ** | 5.37 ** |
| XXI Art & Antiques | 0.35 | 0.47 | 1.11 | 13.47 * | 0.07 | 0.12 | 3.97 *** | 15.85 * | 0.0007 | 0.05 | 0.15 | 0.2 | 0.55 | 0.004 | 1.41 | 1.28 |
| XXII Confidential | 3.38 *** | 4.78 ** | 0.31 | 1.1 | 4.49 ** | 5.03 ** | 0.17 | 0.67 | 1.29 | 0.05 | 2.56 | 1.16 | 0.11 | 0.005 | 0.22 | 0.12 |
| Total | 1.12 | 2.19 | 0.75 | 1.64 | 1.36 | 2.3 | 0.22 | 3.04 *** | 0.04 | 0.06 | 2.97 *** | 3.15 *** | 0.04 | 0.26 | 0.77 | 1.05 |

Notes: *, **, and *** show the significance at the 1%, 5% and 10% respectively. Both Wald tests are also distributed as χ2 with one degree of freedom. Its critical value at 1%, 5% and 10% level is 6.63, 3.84 and 2.71, respectively.

## Table A2 / Diagnostic Statistics Associated with the optimum models

| | Bound F | | | | Breusch-Godfrey Serial Correlation LM | | | | RESET | | | | ARCH | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EXPORT | | IMPORT | | EXPORT | | IMPORT | | EXPORT | | IMPORT | | EXPORT | | IMPORT | |
| | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons | Model I: sanctioned entities | Model II: sanctioned persons |
| I Live Animals and Products | 7.34 * | 8.88 * | 1.66 | 1.44 | 0.05 | 1.52 | 0.38 | 0.06 | 1.17 | 1.05 | 0.97 | 1.13 | 5.73 ** | 1.85 | 1.92 | 0.3 |
| II Vegetable Products | 5.14 * | 3.46 | 5.34 * | 4.94 ** | 0.03 | 2.95 *** | 0.003 | 0.12 | 4.97 ** | 13.72 * | 0.57 | 0.23 | 25.11 * | 20.26 * | 7.43 * | 8.26 * |
| III Animal or Vegetable Fats & Oils | 7.77 * | 8.33 * | 4.16 ** | 4.16 ** | 0.001 | 0.11 | 0.00005 | 2.27 | 2.01 | 0.14 | 3.47 *** | 3.58 *** | 12.40 * | 10.27 * | 2.92 *** | 2.74 |
| IV Beverages & Tobacco | 5.67 * | 3.38 | 3.1 | 2.13 | 0.02 | 0.11 | 0.05 | 0.08 | 8.28 * | 18.36 * | 0.65 | 0.004 | 0.57 | 17.45 * | 0.06 | 0.0001 |
| V Mineral Products | 4.05 ** | 3.62 *** | 4.09 ** | 1.53 | 0.09 | 0.00009 | 0.19 | 0.03 | 2.41 | 6.60 ** | 1.74 | 1.52 | 0.46 | 1.08 | 0.06 | 3.83 *** |
| VI Chemical products | 3.56 *** | 2.8 | 7.75 * | 4.41 ** | 1.76 | 0.03 | 0.08 | 0.7 | 0.46 | 0.03 | 0.31 | 0.18 | 1.18 | 0.29 | 0.02 | 0.21 |
| VII Rubber and Plastics | 5.23 * | 6.22 * | 3.32 | 2.63 | 1.32 | 1.21 | 0.13 | 0.003 | 0.58 | 0.17 | 0.06 | 2.06 | 0.07 | 3.68 *** | 0.02 | 0.008 |
| VIII Leather and Skins | 3.47 | 4.02 ** | 2.94 | 5.75 * | 0.33 | 0.38 | 0.13 | 0.002 | 0.91 | 0.74 | 1.07 | 0.06 | 0.07 | 1.14 | 1.77 | 0.76 |
| IX Wood | 3.14 | 6.58 * | 8.95 * | 7.74 * | 0.12 | 1.18 | 1.21 | 0.02 | 0.22 | 0.34 | 1.46 | 1.78 | 3.09 *** | 1.13 | 6.31 ** | 0.18 |
| X Paper & Pulp | 6.50 * | 8.74 * | 3.17 | 3.77 *** | 0.79 | 0.02 | 0.15 | 2.45 | 0.0002 | 0.12 | 2.62 | 2.82 *** | 0.18 | 0.33 | 1.19 | 2.27 |
| XI Textiles | 10.71 * | 11.41 * | 5.61 * | 5.92 * | 0.14 | 0.59 | 1.26 | 2.16 | 0.01 | 0.37 | 0.08 | 1.78 | 0.0004 | 0.55 | 5.53 ** | 1.44 |
| XII Footwear | 3.39 *** | 3.2 | 1.58 | 1.47 | 0.2 | 0.63 | 0.92 | 0.08 | 0.99 | 0.04 | 0.07 | 0.19 | 3.45 *** | 0.1 | 0.5 | 0.94 |
| XIII Glass & Stone | 8.73 * | 9.57 * | 4.46 ** | 3.23 | 0.19 | 0.09 | 1.03 | 1.32 | 0.33 | 1.21 | 0.45 | 0.34 | 3.43 *** | 2.83 *** | 0.21 | 7.57 * |
| XIV Precious Metal & Stones | 5.54 * | 9.44 * | 7.43 * | 7.67 * | 0.44 | 0.31 | 0.005 | 1.96 | 2.11 | 1.75 | 0.01 | 0.04 | 0.14 | 0.08 | 0.7 | 1.07 |
| XV Metal | 6.04 * | 6.48 * | 6.35 * | 5.78 * | 0.02 | 0.44 | 4.02 ** | 0.22 | 0.17 | 0.59 | 0.38 | 1.11 | 0.005 | 0.27 | 18.39 * | 0.31 |
| XVI Machinery | 6.68 * | 7.39 * | 4.95 ** | 6.61 * | 0.03 | 1.02 | 0.002 | 0.04 | 0.94 | 0.93 | 0.1 | 0.61 | 7.50 * | 0.65 | 0.69 | 0.42 |
| XVII Transport Equipment | 6.03 * | 4.08 ** | 5.23 * | 4.71 ** | 0.005 | 0.1 | 0.02 | 0.49 | 2.29 | 3.34 *** | 2.77 | 2.58 | 0.03 | 0.17 | 3.47 *** | 24.28 * |
| XVIII Optical, Medical, Music Instruments | 2.85 | 2.01 | 5.32 * | 4.97 ** | 0.002 | 1.13 | 1.03 | 1.02 | 0.0004 | 0.56 | 0.34 | 0.04 | 0.34 | 0.79 | 0.66 | 0.94 |
| XIX Arms & Ammunition | 8.56 * | 4.83 * | 4.31 ** | 4.20 ** | 0.01 | 0.06 | 0.17 | 0.0009 | 1.05 | 4.53 ** | 0.5 | 0.17 | 2.5 | 4.02 ** | 0.13 | 1.12 |
| XX Furniture, Toys, Misc. | 4.23 ** | 3.43 | 4.46 ** | 2.66 | 0.19 | 0.35 | 0.93 | 0.05 | 0.0002 | 0.002 | 11.20 * | 6.80 ** | 0.12 | 0.03 | 1.25 | 0.85 |
| XXI Art & Antiques | 8.65 * | 11.33 * | 3.56 *** | 2.74 | 1.85 | 1.12 | 1.72 | 0.51 | 0.21 | 0.48 | 0.04 | 2.04 | 0.02 | 0.01 | 0.03 | 0.08 |
| XXII Confidential | 4.78 ** | 2.49 | 5.11 * | 5.12 * | 0.003 | 1.63 | 0.8 | 1.68 | 2.94 *** | 9.86 * | 0.82 | 0.8 | 0.01 | 0.33 | 0.0004 | 0.03 |
| Total | 4.44 ** | 4.21 ** | 5.20 * | 4.04 ** | 0.17 | 0.77 | 0.6 | 0.008 | 0.58 | 1 | 1.86 | 0.84 | 0.39 | 0.32 | 5.56 ** | 5.49 ** |

Notes:

*, **, and *** show the significance at the 1%, 5% and 10% respectively.

LM is Lagrange Multiplier test of residual serial correlation. It is distributed as χ2 with one degree of freedom (first order). Its critical value at 1%, 5% and 10% level is 6.63, 3.84 and 2.71, respectively.

The F test due to Pesaran et al. (2001) is denoted by FPSS. At the 1%, 5% and 10% significance level when there are three exogenous variables (asymmetry in the long-run), its critical value is 4.68, 3.79 and 3.35. And for symmetric models aforementioned critical vales are 5.06, 4.01 and 3.52 respectively. This comes from Pesaran et al. (2001, Table CI-Case III, page 300).