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## **Sanctions and Export Deflection: Evidence from Iran**

Jamal Ibrahim Haidar  
(Kennedy School of Government, Harvard University)

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# Sanctions and Export Deflection: Evidence from Iran

Jamal Ibrahim Haidar\*<sup>†</sup>

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## Abstract

I uncover the existence, extent, and mechanism of export deflection, which followed export destruction, after the imposition of export sanctions against Iranian exporters. Using disaggregated data about Iranian exports, I show how exporter size, past export status, and pricing strategy matter in the process of export deflection. The main findings are as follows: (i) two-thirds of the value of Iranian exports thought to be destroyed by export sanctions have actually been deflected to non-sanctioning countries; (ii) exports by exporters who exported only to non-sanctioning countries increased significantly after sanctions; (iii) exporters reduced their product prices as they deflected exports to new destinations; (iv) exporters deflected more of their core and homogeneous products; (v) larger exporters deflected more of their exports than smaller exporters; (vi) the new destinations are more politically-friendly with Iran; and (vii) the probability of an exporter to deflect exports to another destination rised if the exporter already existed in that destination, suggesting that costs of exporting matter too. I conclude that export sanctions are less effective in a more globalized world as exporters can deflect exports from one destination to another.

Key words: trade policy; globalization; export deflection; sanctions; Iran

JEL codes: F13; F14; F15; F23; F5; F6

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\*Affiliation: Kennedy School of Government, Harvard University ; E-mail address: Jamal\_Haidar@hks.harvard.edu

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# 1 Introduction

Milton Friedman said “all in all, economic sanctions are not an effective weapon of political warfare.”<sup>1</sup> This statement is not necessary always true. To evaluate the effectiveness of economic (i.e., export, import, financial, and banking) sanctions, it is important to distinguish between their different types. Economic sanctions are heterogeneous by definition, so their impacts should not be stereotyped. In this paper I investigate an effect of a specific type of sanctions: export sanctions.<sup>2</sup>

Existing literature explains how export sanctions work (Crawford and Klotz (2016), Davis and Engerman (2003), Doxey (1980), Drezner (1999), Eaton and Engers (1992, 1999), Hufbauer et al. (2007), Joshi and Mahmud (2016), Kaempfer and Lowenberg (1988), Levy (1999), Martin (1993), Pape (1997), Tolley and Wilman (1977), and van Bergeijk (2009)). They seek to lower aggregate welfare of a target state by reducing its exports in order to coerce the target government to change its political behavior. This type of sanctions can coerce either directly, by persuading the target government that the issues at stake are not worth the price, or indirectly, by inducing a popular revolt that overthrows the government, resulting in the establishment of a government that will make the concessions.

However, we still lack empirical evidence about how exporting firms behave when faced with export sanctions. The existing literature does not inform whether exporters stop exporting or just reduce exports to sanctioning countries following sanctions. Also, it does not inform whether and how (some or all) exporting firms deflect their exports to new destinations following export sanctions.<sup>3</sup> The ability of firms to deflect their exports – as well as to start new export relationships – can explain partially why Iranian exports increased (Figure 1) following the imposition of sanctions. Due to an increasingly globalized economy, alternative destinations exist for exporters affected by export sanctions. In other words, export deflection can compensate export destruction and, thus, should not be ignored.<sup>4</sup>

In this paper, being able to access the universe of (more than 1.81 million) Iranian non-oil export transactions data, I study the existence, extent, and mechanism of export deflection following the

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<sup>1</sup>“Economic Sanctions,” Newsweek, 21 January 1980, p. 76.

<sup>2</sup>Export sanctions are different from embargoes: while export sanctions represent higher export costs (i.e., they raise cost of exporting at the exporter-destination level), embargoes represent a shift to autarky via a trade blockade. In section 2 below I explain in more detail the export sanctions against Iran.

<sup>3</sup>Following Bown and Crowley (2007), I define export deflection as a change in the destination of exports in response to an increase in a trade barrier in another market, as when a rise in a tariff on an export from A to B causes the exports to be sold instead to C.

<sup>4</sup>I define export destruction as a reduction in export growth due to an increase in a trade barrier. For evidence on the extent to which discriminatory trade policy eliminate trade, see Besedes and Prusa (2013).

imposition of export sanctions against Iranian exporters.<sup>5</sup> Iran serves as a suitable country for this study for several reasons. First, the export sanctions against Iran in March 2008 are similar (in terms of definition) to export sanctions that are typically imposed. Thus, understanding how Iranian exporters behaved can help us understand how exporters from other countries could perform under export sanctions. Second, the export sanctions that Iranian exporters faced are unique as they involved many (but not all) countries. The imposition of export sanctions by United States, United Kingdom, European Union, Canada, and Australia in 2008 increased export costs for Iranian exporters to these destinations but not to other destinations. Third, the ability to access highly disaggregated data of Iranian export flows makes Iran an outstanding case for identifying whether export sanctions cause export deflection. Fourth, the choice to use the export sanctions in 2008 as a quasi-natural experiment allows identifying a point in time when export costs increased at the exporter-destination level.

I focus on Iranian exports for four reasons. First, sanctions which targeted companies that buy oil from Iran were imposed in 2012, outside the (2006-2011) time-span of the dataset in hand. Second, unlike exports, oil exports happen via long-term contracts. So, the study of their impacts requires more years following the imposition of sanctions against oil exporting firms. Third, Iranian oil is exported by government (1 exporter) but there exist 35,953 non-oil exporters that were the ones mainly targeted by the 2008 export sanctions. Fourth, according to the Statistical Memorandum of the Foreign Trade Regime of Iran, the oil sector currently accounts for 80% of exports but captures only 0.7% of total employment in Iran. Meanwhile, non-oil sectors represent 20% of total Iranian exports and 38% of employment. The remaining employment is mainly in the services and non-oil public sectors.

In Figures 2-4 I provide simple empirical motivations for this paper. In Figure 2 I show total Iranian monthly exports<sup>6</sup> between January 2006 and June 2011 to two groups of destinations. I plot exports to sanctioning countries (henceforth, SCs) and to non-sanctioning countries (henceforth, NSCs). I sketch how Iranian monthly exports to SCs decreased while they increased to NSCs. I observe related trends when I look at the exporter level as well. In Figure 3 I present the entry and exit rates<sup>7</sup> of Iranian exporters to different destination types. While entry (exit) rates of exporters decreased (increased) in SCs, they increased (decreased) in NSCs after the imposition of export sanctions in March 2008.<sup>8</sup> In

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<sup>5</sup>The impact of the financial sanctions on Iranian economy in 2012 is beyond the scope of this paper, especially as the dataset, which I exploit in this paper, ends in 2011. In 2012, the sanctions moved from country specific restrictions on Iranian exports, as I explain in detail in section 2 below, to limiting Iran's access to the global financial system, such as the SWIFT.

<sup>6</sup>Starting here and onwards in the paper, exports refer to exports.

<sup>7</sup>Entry refers to the first time the exporter or product entered a given destination. Exit refers to the last time the exporter or product was seen at destination, so there should be no confusion with exporters and products that exited and then entered the same destination.

<sup>8</sup>Following export sanctions, the number of exported products per exporter to SCs also decreased but increased to

addition, in Figures 4a and 4b I show aggregate exports to selected SCs as well as to selected NSCs.

A novel feature of this paper is an investigation of export deflection following export sanctions. Exporter-level data allows me to uncover action taking place within exporters and across destinations. Precisely, I show that while export sanctions against Iranian exporters led to export destruction, they caused deflection in exports of these exporters to destinations that did not impose export sanctions.

This paper is organized into four further sections. The next section gives a brief timeline of the sanctions against Iran, with an emphasis on export sanctions, between January 2006 and June 2011. Section 3 introduces the disaggregated customs dataset that I used in this paper. Section 4 presents the empirical analysis. Section 5 concludes.

## 2 The sanctions against Iran

This section is divided into two parts. First, I give a brief timeline of the sanctions against Iran, with an emphasis on export sanctions, between January 2006 and June 2011. Second, I highlight how Iranians perceived export sanctions.

### 2.1 Timeline of sanctions against Iran

On February 4, 2006, the International Atomic Energy Agency (IAEA) voted to report Iran to the United Nations Security Council (UNSC). Russia and China also voted in favor.<sup>9</sup> On June 26, 2006, Germany said that Iran should be allowed to enrich uranium, but under close watch by the United Nations (UN) to ensure that Iran is not using uranium to build atomic weapons.<sup>10</sup> On July 31, 2006, the UNSC demanded that Iran “suspend all enrichment- and reprocessing-related activities, including research and development, to be verified by the IAEA”. On December 23, 2006 - after having called on Iran to halt its uranium enrichment program in July 2006 - the UNSC voted to strengthen sanctions on Iranian imports of nuclear-related materials and technology and froze the assets of individuals involved with nuclear activities.<sup>11</sup>

On March 24, 2007, the UNSC voted to toughen the sanctions put in place in December 2006 by extending the freeze on assets and restricting the travel of individuals engaged in the country’s

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NSCs. However, export values per exporter increased to both types of destinations. This observation is consistent with the data presented in Appendix Tables A1 and A2, suggesting that smaller exporters exited sanctioning countries.

<sup>9</sup>For details, see “Iran Reported to Security Council,” BBC News, February 4, 2006.

<sup>10</sup>For details, see “Germany could accept nuclear enrichment in Iran,” Reuters, June 26, 2006

<sup>11</sup>For details, see UNSC Resolutions 1696 and 1737.

nuclear activities.<sup>12</sup> Moreover, the EU published an expanded list of Iranian individuals deemed *persona non grata* in the union. On August 27, 2007, President Nicolas Sarkozy stated that France will not rule out the possibility of military action against Iran if it does not curtail its nuclear program. President Sarkozy praised the sanctions and diplomatic measures taken by the UN, but added that if Iran continue to be uncooperative, alternatives should be evaluated, as a nuclear Iran would be “unacceptable” to France.<sup>13</sup> Subsequently, in October 2007, the United States announced a raft of new unilateral sanctions against Iran, the toughest since it first imposed sanctions on Iran following the Islamic Revolution in 1979, for “supporting terrorists”.<sup>14</sup> The sanctions cut more than 20 organizations associated with Iran’s Islamic Revolution Guard Corps from the US financial system.

The first non-oil export sanctions against Iran happened in 2008. The UNSC passed Resolution 1803 on March 3, 2008, calling upon all member states to “exercise vigilance in entering into new commitments for financial support for trade with Iran, including the granting of credits, guarantees or insurance, to their nationals or entities involved in imports from Iran as well as tightening restrictions on cargos of Iranian origin.” It is important to highlight that the UN does not impose sanctions, it only asks member states to impose sanctions; the UN does not export and import, so its resolutions are treated as “recommendations”. Thus, knowing precisely how and which countries imposed export sanctions against is important.

The United States, European Union, Canada, and Australia imposed non-oil export sanctions against Iran in March 2008. These sanctions aimed to hinder Iranian exports and, thus, make Iranian firms and people exercise internal pressure on Iranian government. Through its Comprehensive Iran Sanctions, Accountability, and Divestment Act (CISADA, 22 U.S.C. 8501), the United States issued Iranian Transactions Regulations which increased cost of importing from Iran to United States by “requiring U.S. firms to obtain special federal authorization to import into United States.”<sup>15</sup> The Council of the European Union adopted Common Position 2008/652/CFSP. It required member states to “exercise restraint in entering into new commitments for public- and private-financial support for non-oil imports.” Australia imposed sanctions on imports from Iran as well as on the transit through Australia of products of Iranian origin.<sup>16</sup> The Canadian Foreign Affairs and International Trade Department

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<sup>12</sup>“UNSC Resolution 1747.”

<sup>13</sup>“French leader raises possibility of force in Iran,” *The New York Times*, August 28, 2007.

<sup>14</sup>The United States and Iran cut diplomatic relationships between each other in 1979, but trade continued between Iranian and U.S. firms.

<sup>15</sup>Examples of imports violating these sanctions exist. For instance, Mahdavi’s A&A Rug Company (Georgia, US) was called to have violated Iran Sanctions by importing products from Iran to U.S. without obtaining special federal authorization. In 2008, Mahdavi’s A&A Rug Company paid a penalty of USD 9240 to settle the matter.

<sup>16</sup>See the section of Australia’s autonomous sanctions on Iran, Department of Foreign Affairs and Trade.

issued sanctions under its Special Economic Measures (Iran) Regulations. Canada prohibited providing services for the operation or maintenance of vessels owned by or operating on behalf of Iranian shipping lines. Although countries imposed sanctions in different ways against Iran in 2008, these sanctions had a common goal which was to hinder Iranian exports.

It is important to distinguish between (i) sanctions imposed on Iranian imports of nuclear-related products (in 2006-2007), (ii) sanctions imposed on Iranian exports of non-oil products (in 2008), and (iii) financial (i.e. SWIFT/banking) sanctions on Iran (in 2012). Given the available data does not cover Iranian importers but only Iranian non-oil exporters and it covers only the period between January 2006 and June 2011, I investigate in this study only how Iranian non-oil exporters behaved after the imposition of the export sanctions in 2008.

On March 20, 2009, President Barack Obama offered Iran a “new beginning,” proposing that Iran engage in direct negotiations with the United States and discuss ending its nuclear program.<sup>17</sup> And, on April 8, 2009, the United States, United Kingdom, France, and Germany offered Iran a “freeze-for-freeze” deal, which stipulated that no additional sanctions would be imposed on Iran if the latter agrees to freeze uranium enrichment.<sup>18</sup> As reality on the ground did not change, in June 2010, the UNSC recommended further sanctions against Iran over its nuclear programme, expanding arms embargo. The measures prohibited Iran from buying heavy weapons such as attack helicopters and missiles. And, the United States Congress imposed new unilateral sanctions targeting Iran’s energy sectors. Penalties were instated for firms that supply Iran with refined petroleum products. Followingly, in May 2011, the United States blacklisted the Twenty-First Iranian state bank as well as the Bank of Industry and Mines for transactions with previously banned institutions. And, on March 17, 2012, all Iranian banks were disconnected from the SWIFT, the world’s hub of electronic financial transactions.

## 2.2 Iranian public perception of export sanctions

Iranians perceived export sanctions, which were imposed in 2008, as ones with limited effects. This perception was reflected in media and speech tones of various groups of Iranian public and private sectors.<sup>19</sup>

The rhetoric of Iranian government officials insisted that sanctions had no impact on the Iranian

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<sup>17</sup>“Obama offers Iran a new beginning,” BBC, March 20, 2009.

<sup>18</sup>“Iran calls for nuclear talks as further sanctions loom,” The Guardian, September 1, 2009.

<sup>19</sup>The Iranian public perceived SWIFT/banking sanctions (imposed in 2012) much differently from export sanctions (imposed in 2008). The export sanctions were not perceived as very harmful by the Iranian public, but the subsequent SWIFT/banking sanctions were perceived as harsher ones.

economy. For example, President Mahmoud Ahmadinejad said that international leaders who “still think sanctions are an effective means are politically retarded.”<sup>20</sup> Speaker of Parliament Ali Larijani added that “sanctions will definitely be turned into opportunities.”<sup>21</sup> Moreover, Iran’s deputy information chief Hossein Mazloumi claimed that sanctions have led to technological innovation in Iranian universities and industrial sectors by focusing efforts on domestic production.<sup>22</sup>

At the firm-level, the managing director of Iran’s SAIPA car-manufacturing company, Nematollah Poustindouz declared that sanctions have not negatively impacted SAIPA. He stated that “those who impose sanctions on Iran have in fact imposed restrictions on themselves.”<sup>23</sup> In addition, China has leapfrogged the European Union and became Iran’s top importer. Iran’s exports to China rose by nearly 35 percent to USD 5.9 billion in non-oil-related goods after the imposition of export sanctions against Iran.<sup>24</sup> Moreover, between 2008 and 2012, the United Arab Emirates (UAE) has been a back door for Iranian exporters to the destinations imposing export sanctions, thanks to 400,000 Iranians living in UAE as well as to 8000 Iranian firms and 1200 Iranian trading firms operating in UAE. Esfandiar Rashidzadeh, who set up an affiliate of Iran’s Bank Melli in Dubai, said “The pressure of sanctions will not change regime behavior but only add to the cost of doing business.”<sup>25</sup>

### 3 Data

In this study I employ a rich non-oil Iranian customs dataset that is disaggregated at the exporter-product-destination-day level. I obtained this dataset from Iranian Customs. To test the quality of the data, I compared the customs data with (i) UN-Comtrade data and (ii) mirror data (what each destination reports as imports from Iran). The customs dataset matches both the UN-Comtrade data and mirror data; the data quality checks show that the reported Iranian Customs aggregate exports represent 98.5% of reported Iranian exports at UN-Comtrade and 99.5% of reported mirror (imports) data at the product-destination level.

Each Iranian non-oil exporting firm and export transaction, between January 1, 2006 and June 30, 2011 is included in the dataset. The periodicity of the observations is daily, and data includes the following variables for each export transaction: exporter ID, product ID, destination of shipment,

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<sup>20</sup>“Ahmadinejad calls UN Security Council ‘retards’ over sanctions”, ADN Kronos Int’l, December 24, 2010.

<sup>21</sup>“Speaker: Iran turns threats into opportunities,” Fars News Agency, September 20, 2010.

<sup>22</sup>“IRGC official: Sanctions caused technological growth blossoming,” Zawya, December 9, 2010.

<sup>23</sup>“Iranian Carmaker: Sanctions Ineffective,” Fars News Agency, August 11, 2010.

<sup>24</sup>“China overtakes EU as Iran’s top trade partner,” Financial Times, February 8, 2010.

<sup>25</sup>“Dubai Helps Iran Evade Sanctions as Smugglers Ignore U.S. Laws,” Bloomberg, January 25, 2010.



value of exports,<sup>26</sup> and date of transaction. Iranian Customs also report weight - in addition to value - of each shipment. The dataset includes 1,814,146 customs daily transactions.<sup>27</sup> The universe of exporters during this period consisted of 35,953 exporters, among which not all export every month. Information on 3,865 unique products is included in the dataset. The HS-6 digit level product classification illustrates the narrowness of product definitions and the richness of micro-level information available in the dataset.<sup>28</sup>

This customs dataset has several advantages. Compared to UN-Comtrade data, given it includes daily records, this dataset allows monitoring short-term trends and dynamics at the micro-level – such as entry and exit rates, export volumes and distributions, and prices and growth at the exporter-product-destination level. Also, it allows distinguishing between the number of products that are exported by each exporter to each destination - the extensive margin, and the export value per product per exporter to each destination - the intensive margin. The use of exporter-level data enables the construction of export margins with exporter-product-destination dimension, which is not the case with product level databases (i.e. UN-Comtrade). Within country pairs, I define the extensive margin with an exporter-product dimension rather than with a simple product dimension, especially as the average exporter in the dataset exported more than one product. A further advantage of the granular data is that I can see what type of firm is most affected. For example, if the purpose of the export sanctions is to generate revolt, perhaps export sanctions are sensible if small exporters are a large share of employment. However, if the purpose is to affect aggregate exports and access to foreign reserves, then the sanctions are less likely to be successful because the large exporters, who account for the bulk of exports, may deflect exports.

This dataset has three caveats as well. First, I cannot know the probability of a firm to become an exporter. I only have data on firms that export (not on exporters and non-exporters). But, knowing this probability is beyond the scope of this study. I am mainly interested in studying whether and how existing exporters reallocate their exports across destinations following export sanctions. The second caveat concerns the time period covered by the dataset and this study. I observe three years after the imposition of non-oil export sanctions against Iranian exporters, so the empirical exercise considers only the short-term changes in behavior of exporters following sanctions. The third caveat is that

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<sup>26</sup>I deflated export values to their January 2006 equivalents using the monthly US consumer price index (from Global Financial Data).

<sup>27</sup>To save presentation space, I present the descriptive statistics in the appendix at the exporter-product-destination-quarter level.

<sup>28</sup>A small portion of transactions in the dataset includes HS-8 digit level product classification but the majority of transactions uses HS-6 digit level product classification. To ensure consistency in the analysis, I aggregated and used the data at the HS-6 digit level product classification.

the dataset does not include other characteristics of Iranian exporters. For example, I do not have information about the ownership, employment, capital, and access to finance status of the exporter. But, given the scope of this paper, this caveat is not a hurdle.

For each quarter, I report in Table A.I. the number of exporters as well as the average export value per exporter, the average number of products per exporter, and the average number of destinations per exporter. The average number of exporters per quarter decreased by 22.6%, from 7,359 before the imposition of export sanctions (2006-Q1 to 2008-Q1) to 6,001 after the imposition of export sanctions (2008-Q2 to 2011-Q2). However, quarterly average export value per exporter increased from USD 0.48 to 0.93 millions and the quarterly average number of products per exporter increased from 4.08 to 4.26 during the same period, suggesting that smaller exporters exited more than larger exporters.<sup>29</sup>

In Table A.III. I report the numbers of Iranian exporters and exported products to SCs and NSCs. While the number of Iranian exporters to SCs dropped by 30.65%, during the post-sanctions period, it increased by 12.73% in the NSCs. And, while the number of Iranian products to SCs dropped by 11.58%, during the post-sanctions period, it increased by 5.04% in the NSCs. Before imposition of sanctions in March 2008, prepared food, tobacco, and chemical products such as fertilizers accounted for more than half of Iranian exports to SCs. Meanwhile, Iran's exports to NSCs were relatively more diversified. For instance, in these destinations, metals, carpets, textiles, glass, stones, and foodstuff accounted for a 60% of Iranian exports before imposition of sanctions.

## 4 Empirical analysis

In this section I present the empirical analysis in two steps. First, I document the existence of export destruction and deflection. Second, I highlight the mechanism through which export deflection occurred as well as the extent to which export destruction had been compensated by export deflection following export sanctions against Iran.

### 4.1 Existence of export destruction and deflection

I identify the effect of export sanctions on Iranian export destruction at the exporter-destination level. Figures 2, 5, 6, and 7 show that Iranian exports to sanctioning countries were steady before sanctions but decreased afterwards. Figure 2 shows that Iranian exports to non-sanctioning countries

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<sup>29</sup>See Table A.II for more descriptive statistics at the annual-level, following the decomposition format of Eaton et al. (2007)

increased significantly after sanctions. In Figures 5-7, I distinguished between exports by exporters who exported only to (i) SCs, (ii) NSCs, and (iii) both SCs and NSCs between January 2006 and June 2011. I did so to be able to observe export deflection as exporters who exported only to SCs or NSCs, by definition, did not deflect exports. Then, I test for whether the coefficients in the time series regressions vary over the periods defined by the known break date (after sanctions were imposed in March 2008). In other words, I test for a structural break within the estimation results. I specify a break date in March 2008 ( $t = 27$ ) as sanctions were imposed in March 2008. Then, I use an autoregressive model of order 1, AR(1), as follows:

$$X_{et} = \begin{cases} \alpha_1 + \beta_1 X_{et-1} + \epsilon_{et} & \text{if } t < 27 \\ \alpha_2 + \beta_2 X_{et-1} + \epsilon_{et} & \text{if } t \geq 27 \end{cases} \quad (1)$$

where  $X_{et}$  refers to different measures in the different estimations in Table 1. In (1)  $X_{et}$  refers to the total exports at time  $t$ . In (2)  $X_{et}$  refers to the total exports by exporters who exported only to NSCs at time  $t$ . In (3)  $X_{et}$  refers to the total exports to sanctioning countries at time  $t$  by (i) exporters who exported only to SCs and (ii) exporters who exported to both SCs and NSCs between January 2006 and June 2011. In (4)  $X_{et}$  refers to the total exports to NSCs at time  $t$  by exporters who exported to both SCs and NSCs between January 2006 and June 2011. I aggregate exports at the month-level, so  $t$  goes from  $t = 1$  (January 2006) to  $t = 66$  (June 2011). And,  $\epsilon_{et}$  is the usual idiosyncratic error term.

Before investigating export destruction and deflection, it is worth noting the change in exports of all Iranian exporters and in exports of Iranian exporters who exported only to non-sanctioning countries. Row (1) of Table 3 shows the growth in overall exports before and after sanctions. Average monthly export growth rate increased after sanctions from 0.24% to 1.48%. This pattern corresponds with Figure 1 that shows that overall exports increased following sanctions. Row (2) of Table 3 shows the growth in exports of exporters who exported only to NSCs. Again, their average monthly export growth rate increased after sanctions from 0.71% to 2.64%. This pattern corresponds with the red (dotted) line in Figure 5.

Export destruction is captured in the estimations in row (3) of Table 1. To reduce bias of estimates, I exclude exporters who exported only to non-sanctioning countries. Including these exporters would bias the estimates upward. It is important to mention here that the March 2008 export sanctions were against all Iranian non-oil exporters and not differentiated between one industry and another. That is why I do the data restriction at the exporter-destination level and not also at the sector-level. The

coefficients in this row show a structural break after sanctions. Before sanctions, coefficient  $\beta_1$  shows that  $X_{et}$  equaled, on average, 100.54% of  $X_{et-1}$ . However, after sanctions, coefficient  $\beta_2$  shows that  $X_{et}$  equaled, on average, 94.81% of  $X_{et-1}$ . The coefficients are statistically significant at the 1% level. In addition, the fact that intercept  $\alpha_2$  is lower than  $\alpha_1$  strengthens the finding of the existence of a structural break. This pattern corresponds to the export destruction pattern that is seen along the blue line in Figure 7.

Row (4) of Table 1 presents empirical evidence on the existence of export deflection following export sanctions. To reduce bias of estimates, I focused here on exports to NSCs by the exporters who exported to both SCs and to NSCs between January 2006 and June 2011. Again, the coefficients in this row show a structural break after sanctions. Before sanctions, coefficient  $\beta_1$  shows that  $X_{et}$  equaled, on average, 90.23% of  $X_{et-1}$ . However, after sanctions, coefficient  $\beta_2$  shows that  $X_{et}$  was, on average, 3.11% higher than  $X_{et-1}$ . The coefficients are statistically significant at the 1% level. In addition, the fact that intercept  $\alpha_2$  is higher than  $\alpha_1$  strengthens the finding of the existence of a structural break. This pattern corresponds to the export deflection trend that is seen along the red line in Figure 7. These results highlight that Iranian exporters to both destinations experienced an increase in exports to non-sanctioning countries. Thus, when Iranian exporter-level exports to sanctioning countries declined because of export sanctions, there was an associated increase in Iranian exporter-level exports to non-sanctioning countries (Figure 7).

**Which exporters were affected most?** While the above results show that the imposition of sanctions had a significant negative impact on the average Iranian exporter to SCs, they possibly hide some heterogeneity among exporters. One can expect larger and more experienced exporters to be affected differently as they are typically more productive and can afford higher export costs. On this basis, I repeated estimations (3) and (4) in Table 1 to see the impacts on small and large exporters. I defined large exporters as the exporters whose monthly export value was above the export value per average exporter before March 2008 at sanctioning countries and small exporters as the exporters whose monthly export value was below the export value per average exporter before March 2008 at sanctioning countries. Small exporters suffered from more export destruction than large exporters (rows 3a and 3b of Table 1). For small exporters, in (3a), before sanctions, coefficient  $\beta_1$  shows that  $X_{et}$  equaled, on average, 99.16% of  $X_{et-1}$ . After sanctions, coefficient  $\beta_2$  shows that  $X_{et}$  equaled, on average, 54.31% of  $X_{et-1}$ . However, for large exporters, in (3b) before sanctions, coefficient  $\beta_1$  shows that  $X_{et}$  was, on average, 17.18% more than  $X_{et-1}$ . After sanctions, coefficient  $\beta_2$  shows that  $X_{et}$  equaled, on average,

96.32% of  $X_{et-1}$ . Thus, the reduction in exports was clearly less for large exporters. And, large exporters achieved higher levels of export deflection than small deflecting exporters (rows 4a and 4b in Table 1). For small exporters, in (4a), before sanctions, coefficient  $\beta_1$  shows that  $X_{et}$  equaled, on average, 87.12% of  $X_{et-1}$ . After sanctions, coefficient  $\beta_2$  shows that  $X_{et}$  equaled, on average, 101.41% of  $X_{et-1}$ . However, for large exporters, in (4b) before sanctions, coefficient  $\beta_1$  shows that  $X_{et}$  was, on average, just 1.21% more than  $X_{et-1}$ . After sanctions, coefficient  $\beta_2$  shows that  $X_{et}$  equaled, on average, 124.08% of  $X_{et-1}$ .

The above findings are also supported by an assessment of the impact of sanctions on the rates of entry and exit of exporters at the destination level, using the following estimation:

$$EAD_{dt} = \delta_1 + \eta_0 S_d + \eta_1 PS_t + \delta_2 S_d \cdot PS_t + \gamma_d + \kappa_t + \epsilon_{dt} \quad (2)$$

where  $EAD_{dt}$  represent, in different estimations, the  $Entry_{dt}$  and  $Exit_{dt}$  (0-100) rates of exporters as well as the  $ADD_{dt}$  and  $Drop_{dt}$  at the destination-quarter level.  $ADD_{dt}$  is the (0-100) share of exporters that introduced a new product to destination  $d$  at time  $t$ .  $Drop_{dt}$  is the (0-100) share of exporters that dropped an existing product from destination  $d$  at time  $t$ . To ensure the estimates are not driven by small-size destinations, I weighted entry and exit rates as well as the  $ADD_{dt}$  and  $Drop_{dt}$  shares by aggregate destination-level exports of Iranian exporters before March 2008. I used aggregate exports to a given destination before March 2008 to measure the size of that destination. And,  $S_d$  is a dummy variable that equals to 1 for sanctioning countries (SCs), and zero otherwise and  $PS_t$  is a dummy variable for the post-sanctions period. The coefficient of interest,  $\delta_2$ , multiplies the interaction term,  $S_d \cdot PS_t$ , which is the same as a dummy variable equal to one for sanctioning countries after the imposition of sanctions. And, to reduce bias of estimates, I exclude exporters who exported only to destinations not imposing sanctions. Including these exporters would bias the estimates upward.  $\gamma_d$  and  $\kappa_t$  are destination and time fixed effects that control for destination- and time invariant factors that determine firm selection into an export market.  $\epsilon_{dt}$  is the usual idiosyncratic error term.

It is important to mention that I cannot determine whether an exporter with a positive export value in January 2006 (in 2006-Q1) started exporting in 2006 or before (i.e. if it is a new exporter or not). Thus, to be more accurate, I only considered exporters that started exporting strictly after 2006-Q1 when I estimated the effect of export sanctions on entry rates. Similarly, I cannot determine whether exporters reporting a positive export value in June 2011 (in 2011-Q2) exited the next quarter or not. So, I only consider the exits that took place before 2011-Q2 when I estimate the effect of export

sanctions on exit rates. Column 1 of Table 2 shows that export sanctions reduced exporter entry rate by an average of 22.8 percentage points to sanctioning countries compared to non-sanctioning countries. And, column 3 of Table 2 shows that export sanctions increased exporter exit rate by an average of 8.6 percentage points from sanctioning countries compared with non-sanctioning countries.

While  $Entry_{dt}$  and  $Exit_{dt}$  allow focusing on the extensive margin,  $ADD_{dt}$  and  $Drop_{dt}$  allow looking at the intensive margin. Precisely, I looked at whether exporters introduce more new products to non-sanctioning countries and drop more of the existing products from sanctioning countries. Column 5 of Table 2 shows that export sanctions reduced the share of exporters that introduced a new product to sanctioning countries by an average of 15.1 percentage points compared to non-sanctioning countries. And, column 7 of Table 2 shows that export sanctions increased the share of exporters that dropped an existing product from sanctioning countries by an average of 24.2 percentage compared to non-sanctioning countries.

That said, it is important to reflect on whether exports to sanctioning countries were going to fall regardless of sanctions due to other reasons such as the trade collapse that followed the global recession in 2008. Export sanctions came along just few months before the global economic crisis broke in fall of 2008. The economic crisis may have obscured the effects of export sanctions on Iranian export deflection given the countries that imposed sanctions were actually hit by the crisis more than other countries. Given traded-goods sectors are procyclical, one explanation is that Iranian exports to sanctioning countries fell due to the recession in these economies. Another explanation is that increasing trade frictions at the international borders, broadly defined, might be the culprit. In other words, if export destruction was caused by the recession and not by export sanctions, then I should expect a similar pattern of imports of SCs and NSCs from Iran. However, it is not the case. Figure 8 shows the growth rates of China's imports from Iran as well as China's and U.S.'s total imports, and economic growth over time. Clearly, the crisis affected Iranian exports to both U.S. and China.<sup>30</sup> However, following the crisis, Iranian exports to China rose again, unlike in the case of U.S. although its imports from other countries rose again. This pattern suggest that the bulk of the decline in Iranian exports to specific destinations is attributable to the imposition of sanctions.

Also, it is worth mentioning a note about export transshipments.<sup>31</sup> The absence of rules of origin within export sanctions resolutions created a "loophole" that may have helped Iranian exporters. For instance, it may be the case that Iranian exporters transshipped their products through United Arab

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<sup>30</sup>I present graphs only for US and China but I observe similar trends for other destinations.

<sup>31</sup>I define export transshipment as shipment of product to an intermediate destination, then to yet another destination.

Emirates (UAE) to sanctioning countries.<sup>32</sup> And, it may be the case that new businesses (not necessarily of Iranian origin) captured new business opportunity and started importing from Iran to UAE and re-exporting to destinations that imposed export sanctions on Iranian exporters. While I can track Iranian exporters to UAE and other destinations, I cannot identify which firms are exactly exporting from UAE. That is why I cannot establish whether export transshipments by same exporters followed export sanctions. And, that is why I include this part in the appendix. In Table A.IV I present descriptive statistics about potential Iranian export transshipment that happened through UAE following the imposition of export sanctions on Iranian exporters. First, I look at the percentage change in exports of exporters that exited or reduced their exports to the US, UK, Canada, and France, following the imposition of export sanctions, between the pre- and post-export sanctions periods. Second, I track the exports of the same exporters, at the product-level, to UAE following their exit from or reduction of exports to the 4 mentioned destinations. Third, I get an aggregate measure of product-level re-exports from UAE to the 4 mentioned destinations. While I conduct the first two steps using Iranian Customs data as the interest is primarily in the exporter-level export transshipment, I used UN-Comtrade data for the third step as I do not have access to UAE customs importer-exporter level data.<sup>33</sup> The results in Table A.IV allow observing a trend (but not a causal relationship) of export transshipment, at the product-level, of Iranian exporters through UAE ports.

## 4.2 Mechanism of export deflection

**The price of export deflection:** If Iranian exporters reduced prices of products that they deflected, the change in product prices should be reflected in the unit values of the products exported to NSCs after March 2008. I focus mainly on the products that exporters deflected from SCs to NSCs as no price change is expected in new products which were introduced following export deflection to serve the needs of new customers in NSCs. A change in the unit value of a given product in the data can be consistent with a combination of (i) a change of the product quality, (ii) other changes in product characteristics that make the product more desirable or affordable to consumers in lower income countries, or (iii) a change in the demand characteristics at the new market (Schott (2004) and Hallak (2006)).

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<sup>32</sup>One can also think about other countries that Iranian exporters may have depended on for the same purpose. I use the case of UAE and selected sanctioning countries solely for illustrative purposes.

<sup>33</sup>On a related note, Edwards and Lawrence (2016) and Frazer and Biesebroeck (2010) showed theoretically and empirically how US quotas on Chinese exports served as an implicit subsidy for African apparel exporters led Chinese exporters to transship their trade, following the imposition of US quotas on them, to US through African countries who actually benefited from the “African Growth and Opportunity Act”.

To check for evidence of changes in product prices following export deflection, I compared product prices of deflecting exporters in the first shipment to a NSC following March 2008 with (i) the prices of same products by same exporters in their last shipment to a SC before March 2008 and (ii) the average prices of the same products sold by other Iranian existing exporters in the NSCs before March 2008 and at the time of the first shipment following export deflection. Given my dataset does not have product prices in each shipment transaction but only total export value and weight of each exporter-product-destination shipment, I obtained unit values by dividing the total value of shipment of exports of product  $p$  by the weight of shipment at the exporter-time level.

The results presented in Figure 9 indicate that deflecting exporters reduced their product prices by, on average, 7.4% in the first shipment following export deflection compared to prices of same products in their last shipment before export deflection. Also, the right bar in Figure 9 shows a 1.8% drop in the average price in the same products sold by other Iranian exporters that were already existing in the new destination at the time of first shipment by deflecting exporters, after export deflection took place.<sup>34</sup> One potential explanation for this price reduction is that deflecting exporters reduced their prices in an attempt to enter the new markets and scramble for new consumers.<sup>35</sup>

To check for evidence on changes in product prices following export deflection, I compared product prices of deflecting exporters in the first shipment to a non-sanctioning country following March 2008 with (i) the prices of same products by same exporters in their last shipment to a sanctioning country as follows:

$$P_{ept} = \begin{cases} \alpha_3 + \beta_3 P_{ept-1} + \epsilon_{et} & \text{if } t < 27 \\ \alpha_4 + \beta_4 P_{ept-1} + \epsilon_{et} & \text{if } t \geq 27 \end{cases} \quad (3)$$

where  $P_{ept}$  is the price of product  $p$  exported by exporter  $e$  at time  $t$  and  $P_{ept-1}$  is the price of product  $p$  exported by exporter  $e$  at time  $t - 1$ . I focus here on exporters who reduced their product exports to zero in sanctioning countries after March 2008 and existed in non-sanctioning countries after March 2008. Thus, this estimation allows me to capture the product price differences over time by the same exporter at sanctioning countries before sanctions ( $t < 27$ ) as well as between sanctioning countries and non-sanctioning countries ( $t \geq 27$ ). The results presented in Table 3 support

<sup>34</sup>The new product prices of deflecting exporters were, on average, 1.1% lower than the average prices of the same products sold by other Iranian existing exporters in the new destination at the time of the first shipment following export deflection.

<sup>35</sup>I have also checked the product prices of deflecting exporters over time. Product prices did not change the longer (i.e., the second year) deflecting exporters remain in new markets.



the observed pattern that we see in Figure 9. The coefficient  $\beta_4$  shows that after export deflection, deflecting exporters reduced their product prices by 8.1%.

**The role of exporter size:** Exporters are not equal in their ability to deflect exports from one destination to another. When trying to understand the dynamics of export deflection, one must ask whether all or which exporters deflected exports from sanctioning countries to non-sanctioning countries. The size and experience of exporters are expected to affect their ability, willingness, and decision to deflect exports. To test whether this prediction is true, I estimate the following model:

$$Deflect_{e|t>26} = \alpha_0 + \alpha_5 \ln X_{e|pre-sanctions} + \alpha_6 \ln Experience_{e|pre-sanctions} + \gamma_e + \kappa_t + \epsilon_{et} \quad (4)$$

where the dependent variable,  $Deflect_{e|t>26}$ , equal to 1 if the exporter exited a sanctioning country and, afterward, entered a non-sanctioning country after March 2008, and zero otherwise. And,  $\ln X_{e|pre-sanctions}$  and  $\ln Experience_{e|pre-sanctions}$  represent the size and experience of the exporter before March 2008. I measure the size and experience of the exporter by, respectively, the log of export value and number of months of presence in export market between entry and March 2008.

Column 1 of Table 4 shows that larger and more experienced exporters have higher probabilities of deflecting exports following sanctions. This observation is consistent with the exporter-heterogeneity assumption which suggests that exporters have specific productivities and behave differently in export markets. Figure 10 complements this result by showing how much of export volumes deflecting exporters were actually able to deflect. In Figure 10 I divided the exporters into two groups: small exporters whose monthly export value was below the export value per average exporter before sanctions and large exporters whose monthly export value was above the export value per average exporter in the sanctioning country (that they deflected from) during the month of their last shipment. Large deflecting exporters achieved higher level of export deflection, on average, than small deflecting exporters. While large exporters deflected on average 86% of their exports, small exporters deflected on average 16% of their exports from SC to NSCs.<sup>36</sup>

**The role of past export status:** Exporting to a destination requires incurring sunk and variable

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<sup>36</sup>Exports of large exporters dropped by 0.29 USD billions in SC but increased by 0.25 USD billions in NSCs per month following sanctions. And, exports of small exporters dropped by 0.12 USD billions in SC but increased by 0.02 USD billions in NSCs per month following sanctions.

costs. If an exporter has already been in a particular market, then her current export costs depend on past exporting status. To examine if past export status at NSC affected export deflection, I estimate the following equations:

$$\begin{aligned} \ln X_{epNSCt} = & \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \eta_2 S_d \cdot PS_t + \alpha_7 \ln X_{e|pre-sanctions} \\ & + \alpha_8 \text{Exporter}C + \alpha_9 S_d \cdot PS_t * \text{Exporter}C + \gamma_{ed} + \epsilon_{epdt} \end{aligned} \quad (5)$$

$$\begin{aligned} P(EXP)_{epNSC|post-sanctions} = & \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \eta_2 S_d \cdot PS_t + \alpha_{10} \ln X_{e|pre-sanctions} + \alpha_{11} \text{Exporter}A \\ & + \alpha_{12} \text{Exporter}B + \alpha_{13} S_d \cdot PS_t * \text{Exporter}A + \alpha_{14} S_d \cdot PS_t * \text{Exporter}B + \gamma_{ed} + \epsilon_{epdt} \end{aligned} \quad (6)$$

where *ExporterA* is a dummy variable that equals to 1 if the exporter had exported product *p* to a SC but had not exported at all to a NSC before March 2008. *ExporterB* is a dummy variable that equals to 1 if the exporter had exported product *p* to a SC but exported another product to a NSC before March 2008. *ExporterC* is a dummy variable that equals to 1 if the exporter had exported a product to a SC as well as to a NSC before March 2008. Both equations (5) and (6) include an exporter-size control,  $\ln X_{e|pre-sanctions}$ , as larger firms are typically more productive and have better performance in export markets (Bernard and Jensen (2004)) which improve exporting activity and, by definition, firm size is a proxy for past success. Equation (6) models the probability of exporting to a given destination when sanctions are imposed in a different destination (extensive margin).  $P(EXP)_{epControl|post-sanctions}$  is a binary variable that equals to 1 if the exporter had exported product *p* to NSC after sanctions were imposed, and zero otherwise.

Column (1) of Table 5 shows the estimation results of equation (5). The imposition of export sanctions resulted in a 65% [ $100 * (\exp(0.501) - 1)$ ] increase in Iranian exporter-product level exports to NSC that these same exporters had previously exported the same product to. This result shows that exporters increase their export values to alternative destinations that they are already existing in – i.e., along their intensive margin – when they face export sanctions by a particular export destination. In addition, this result suggests that it would be easier for an exporter to deflect part or all of its exports from a SC to a NSC if she already exists in the latter destination. The reason is that, in addition to sunk entry costs that have an effect on the extensive margin, exporters incur variable costs after entry. These variable costs at a given destination can be lower for exporters who already exist in that destination.

Column (2) of Table 5 shows the estimation results of equation (6). The interaction of export sanc-

tions with export status variables has a higher economic significance for *ExporterB* than *ExporterA*. This result suggests that the exporter’s probability of deflecting product exports to a NSC is higher if the exporter had already served that destination before. And, it shows that export deflection probability is lower for exporters that did not serve a NSC before March 2008. In terms of economic interpretation: the imposition of export sanctions against certain exporters by a particular destination increases their export probability to a NSC by 9.2% if they had already exported another product to that destination but only by 5.3% if they had not exported at all to that destination before. The lower economic significance level of the coefficient of *ExporterA* interaction demonstrates that past export status matter in determining an exporter’s decision to deflect exports when faced with export sanctions by a particular destination.

The above results are also supported by Figure 11. Figure 11 shows the extent to which Iranian exporters were able to deflect exports following the imposition of export sanctions in March 2008. It differentiate between (i) exporters who exported only to sanctioning countries before March 2008 and (ii) exporters who exported to both sanctioning countries and to non-sanctioning countries before March 2008. The average monthly export value by both types of exporters to sanctioning countries decreased from 0.58 (blue bars) before March 2008 to 0.17 (red bars) after March 2008. The average monthly export value by both types of exporters to non-sanctioning countries increased from 0.05 (green bars) before March 2008 to 0.32 (orange bars) after March 2008. Thus, two-thirds of the value of Iranian exports thought to be destroyed by export sanctions have actually been deflected to non-sanctioning countries.

**Product selection during export deflection:** The literature emphasizing heterogeneity at the product level predicts that “core competence” products are the most responsive to new export environments (Eckel and Neary (2010)). For that, I examined whether Iranian exporters, who succeed to deflect their exports following export sanctions tend to deflect more of their “core-competence” products. In addition, products have different export trends and characteristics. For example, some products are homogeneous while others are differentiated (Rauch (1999)).<sup>37</sup> So, I also examined whether homogeneous products are more likely to be deflected – by deflecting exporters following sanctions – from sanctioning countries to non-sanctioning countries. The hypothesis is that it is easier for exporters to

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<sup>37</sup>An example of a homogeneous products is copper, and an example of a differentiated product is carpets. Rauch (1999) offers more details about the motivation of this product classification. The basic idea is that differentiated products require more marketing.

deflect homogeneous products as the cost of searching for consumers of these products is lower given these products are typically standard in terms of content and quality (i.e. copper) compared to other products (i.e. carpets), and thus require less marketing.

I examine the above hypotheses using this estimation:

$$Deflect_{ep|t>26} = \alpha_0 + \alpha_{15}X_{pre-deflection} + \alpha_{16}X_{share_{pre-deflection}} + \alpha_{17}Diff + \gamma_e + \kappa_d + \epsilon_{ept} \quad (7)$$

where  $Deflect_{ep|t>26}$  equals to one if the exporter dropped a given product from a SC and, then, introduced it in a NSC after March 2008, and zero otherwise.  $X_{pre-deflection}$  is the log of export value of the product at the exporter-destination level before export deflection from a treated destination.  $X_{share}$  represent the weight of the product in the portfolio of the exporter before export deflection from a SC. “ $Diff$ ” is a dummy variable which equals to 1 if the product is differentiated, and zero otherwise. Following Eckel and Neary (2010), I define “core competence” products at the exporter-destination level as the most successful products, products of highest sales volume.

The results in column 1 of Table 6 show that higher export value and share of exports of a given product by a given exporter to a treated destination are associated with higher probability that the product gets deflected by the exporter. Also, the movement of  $Diff$  from 0 to 1 decreases the probability that the given product gets deflected by its exporter from a SC to a NSC. In other words, homogeneous products have higher export deflection probability. The results are statistically significant at less than 5% level. These observations support the assumption of product differentiation made by Eckel and Neary (2010) and the work of Rauch (1999).

**Destination selection during export deflection:** While deflecting exports, do exporters target destinations randomly? To know which destinations deflecting exporters targeted, I estimate the following equation:

$$N_{dt} = \alpha_0 + \alpha_{18}Z_{dt} + \gamma_t + \kappa_d + \epsilon_{dt} \quad (8)$$

where the dependent variable is the log of total number of deflecting exporters to a given destination at a given month. And,  $Z_{dt}$  is a vector of controls capturing economic size, distance, price competitiveness, ease of imports, foreign direct investment net inflows, tariff rate, import growth, the

correlation of positions during votes on resolutions in the General Assembly of the United Nations<sup>38</sup> as well as the number of Iranian immigrants<sup>39</sup> and existing Iranian exporters at the new destination that deflecting exporters deflected to. I control for UN vote correlation because it is a good measure of ideological, cultural, and historical affinity between countries that may affect bilateral trade. The coefficients in Table 7 show that larger and closer markets; markets with higher import, income, and FDI growth rates; as well as destinations that have fewer import restrictions, lower tariff rates, more Iranian immigrants, higher number of Iranian existing exporters, and are more “politically-friendly” with Iran (in terms of voting similarities at UN) attracted more of the deflecting exporters. All results are statistically significant at conventional levels. These results are independent of consumer price index at destination. As expected, the inflation variable has a positive coefficient: an increase in prices at destination creates more demand for imported products. Moreover, time fixed effects control for real exchange rate fluctuations in the Iranian currency vis-a-vis currencies of all destinations.

## 5 Conclusion

How firms behave when faced with export sanctions is of interest to trade economists and policy-makers. In this paper I investigate an international implication of export sanctions. Using a rich customs dataset that includes Iranian non-oil exports over the 2006-2011 period, I show that export sanctions against Iran in 2008 triggered Iranian exporters to deflect exports to non-sanctioning countries. Precisely, I uncover that (a proportion of) exporters are able to redirect (part of) their exports towards politically-friendly destinations, at the cost of lowering the export price. This effect of export sanctions is heterogeneous and depends on characteristics of the exporter (larger exporters are better able to deflect their exports), of the product (core and homogeneous products are more easily deflected), and of the destination country (countries in which the exporter is already present at are more likely to become destinations of deflected exports). In aggregate, two-thirds of the value of Iranian exports thought to be destroyed by export sanctions have actually been deflected to non-sanctioning countries. On the policy front, these results highlight that the idea that one country can impose export sanctions on another country may not necessarily prove effective unless the exporters of the targeted country do not have or can not find compensating market destinations and new trading partners.

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<sup>38</sup>I use the voting similarity index of Strezhnev and Voeten (2013) dataset on the correlation between positions of countries during UN General Assembly votes.

<sup>39</sup>The data on immigration stocks come from the Global Migrant Origin Database (GMOD) of the University of Sussex’s Development Research Centre on Migration, Globalization and Poverty.

While this paper is the first to use firm-level disaggregated data to understand the impact of export sanctions on Iranian exporters between 2006 and 2011, further research can go in at least three directions. First, there is need for further theoretical and empirical investigations of the mechanisms by which sanctions achieve success or failure in the presence or absence of international consensus and cooperation. Second, one can study the impact of sanctions on welfare of people in Iran at the aggregate and disaggregate levels (using household income and expenditure survey data) as sanctions may be affecting different social, income, and regional groups differently. Third, Iran has been affected lately (in 2012 and 2013) by SWIFT/banking sanctions, so one can study the impact of financial sanctions as well.

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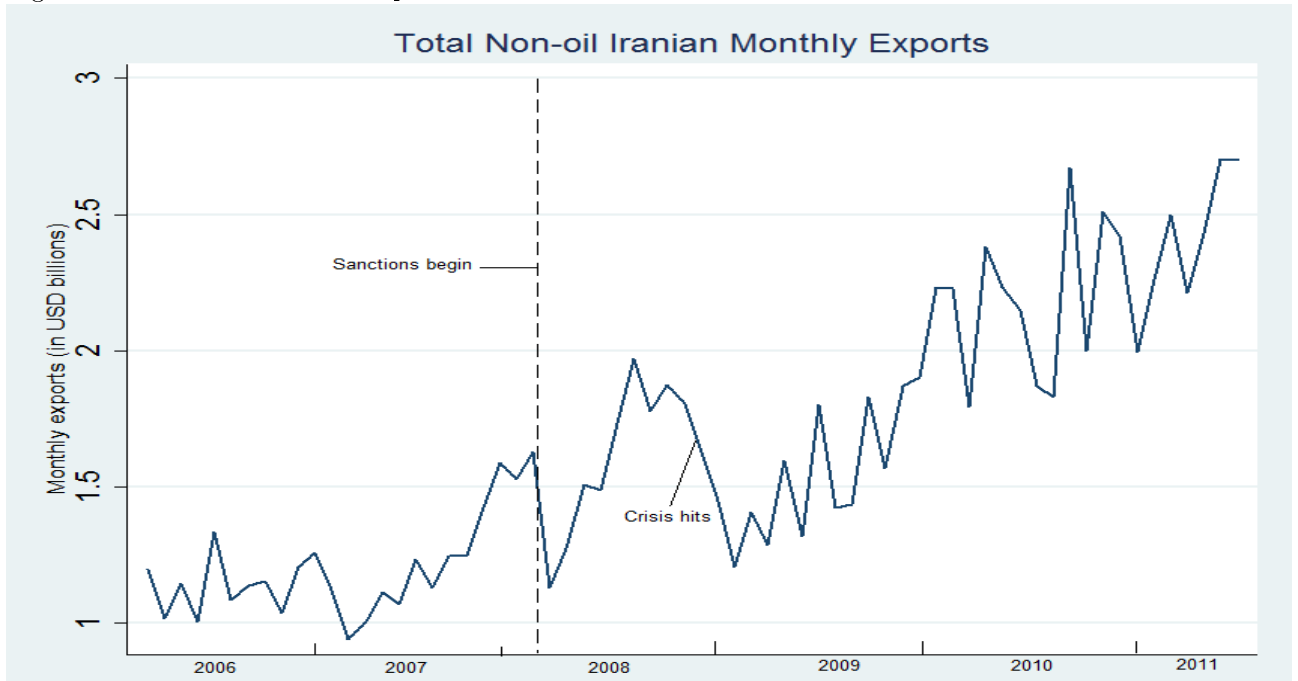
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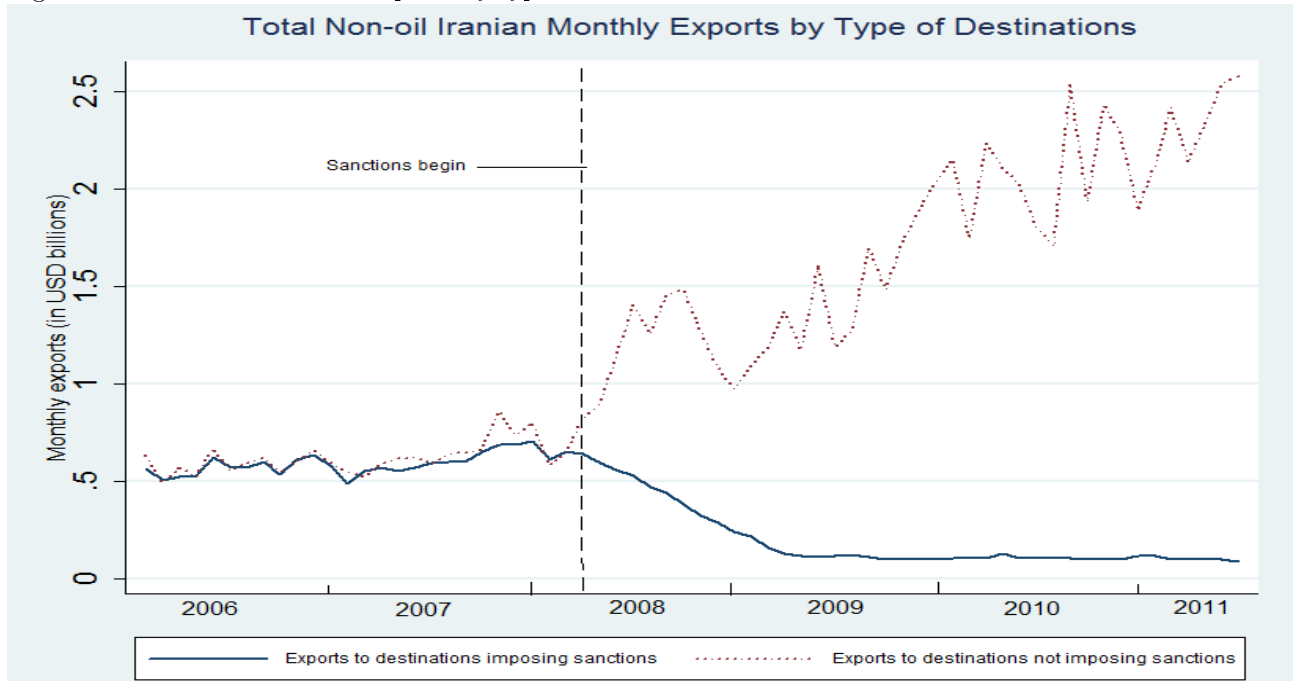
Figure 1: Evolution of Iranian exports



Note: This figure shows the total exports between January 2006 and June 2011. Non-oil export sanctions against Iranian exporters were imposed in March 2008.

Source: Author's calculations using Iranian Customs data

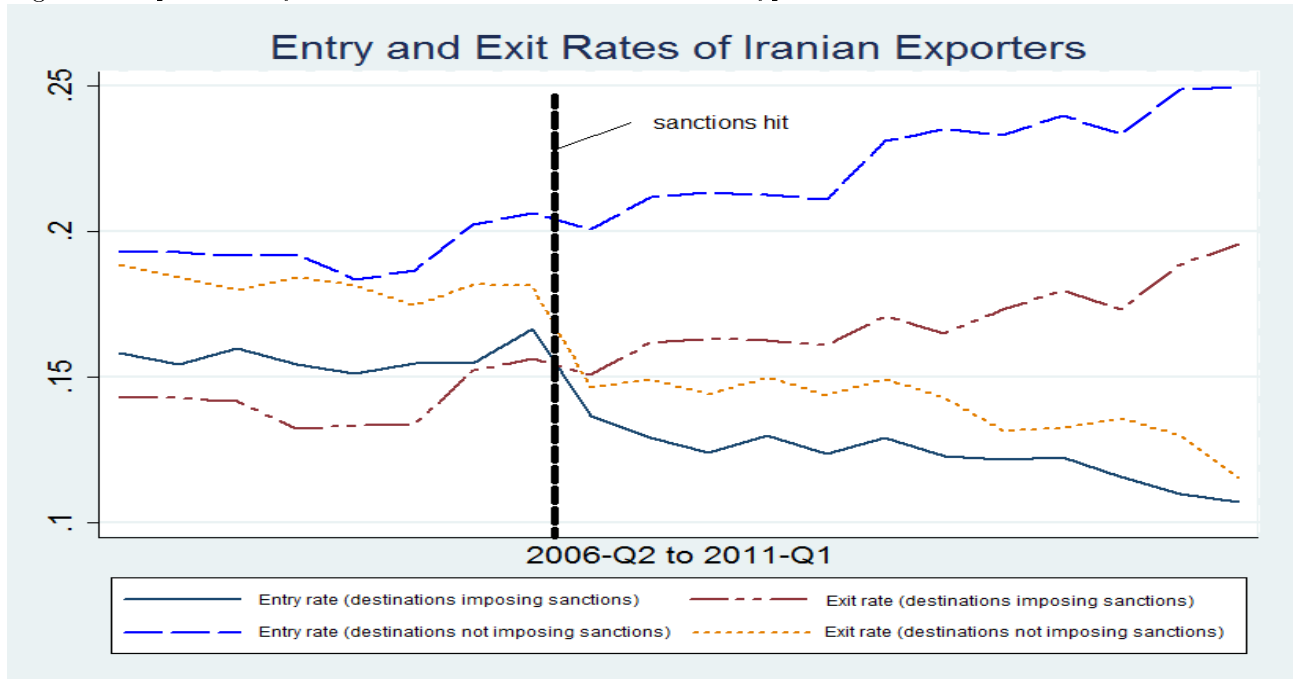
Figure 2: Evolution of Iranian exports by type of destinations



Note: This figure shows the total exports to different types of destinations between January 2006 and June 2011. Non-oil export sanctions against Iranian exporters were imposed in March 2008. The blue line represent monthly exports to sanctioning countries. The red (dotted) line represent monthly exports to non-sanctioning countries.

Source: Author's calculations using Iranian Customs data

Figure 3: Exporter entry to and exit from different destination types



Note: This figure shows the entry and exit rates of Iranian exporters to different destinations at the quarterly level between April 2006 and March 2011. Non-oil export sanctions against Iranian exporters were imposed in March 2008. Entry refers to the first time the exporter entered a given destination. Exit rates refer to the last time the exporter was seen at destination, so there should be no confusion with exporters that exited and then entered the same destination.

Source: Author's calculations using Iranian Customs data

Figure 4a: Evolution of Iranian exports to (selected) sanctioning countries (SCs)

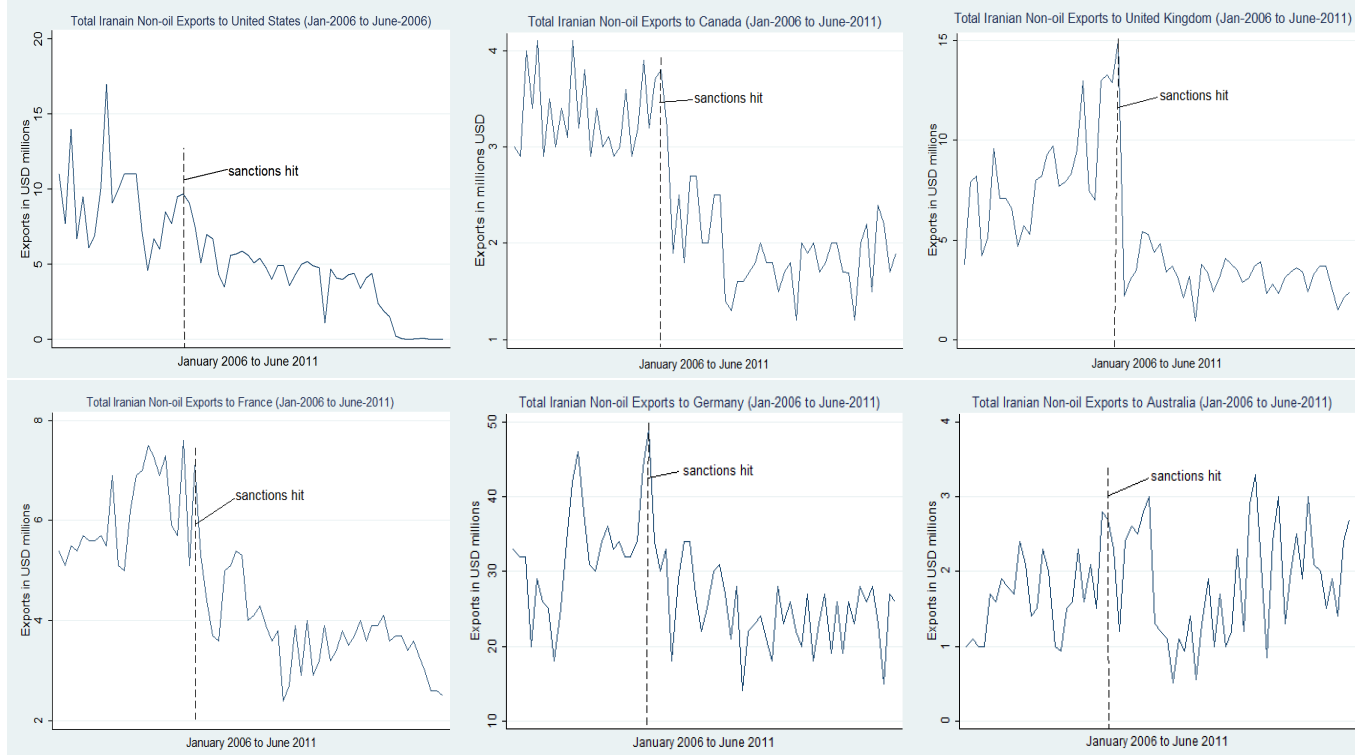
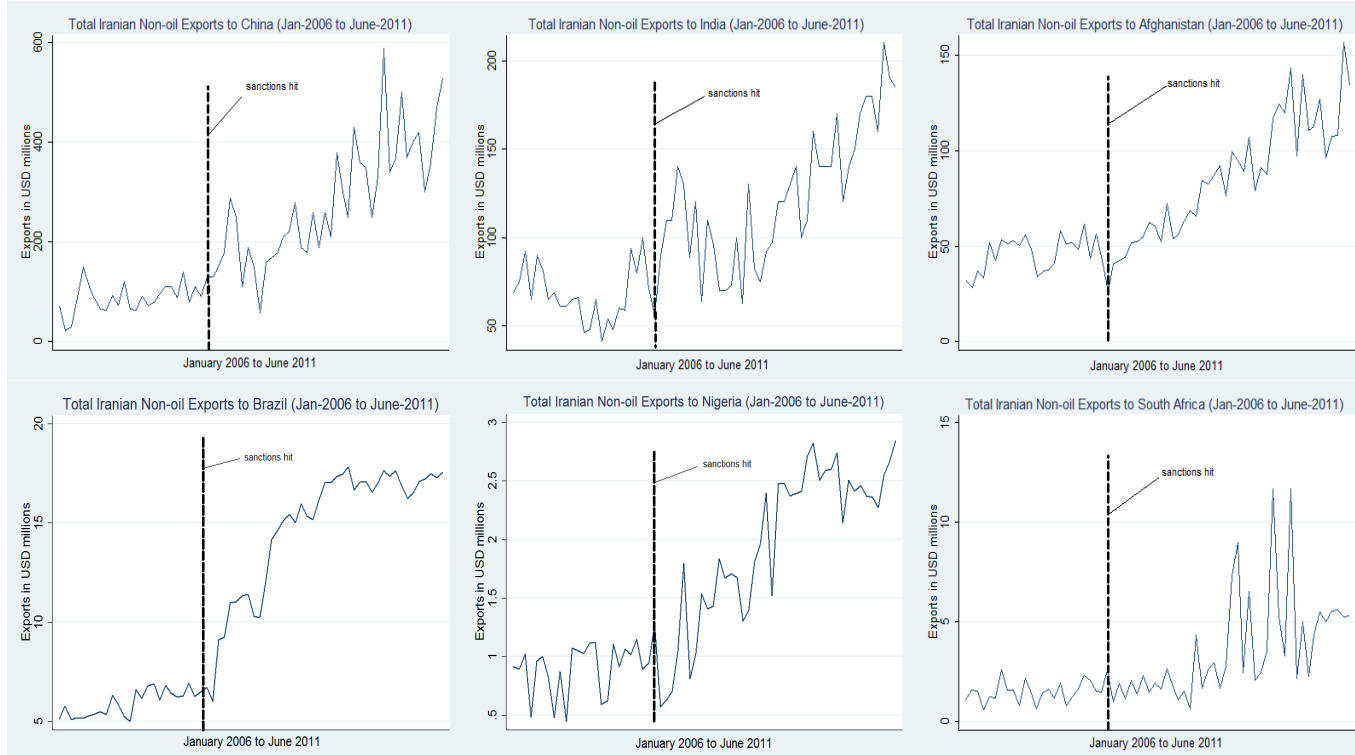
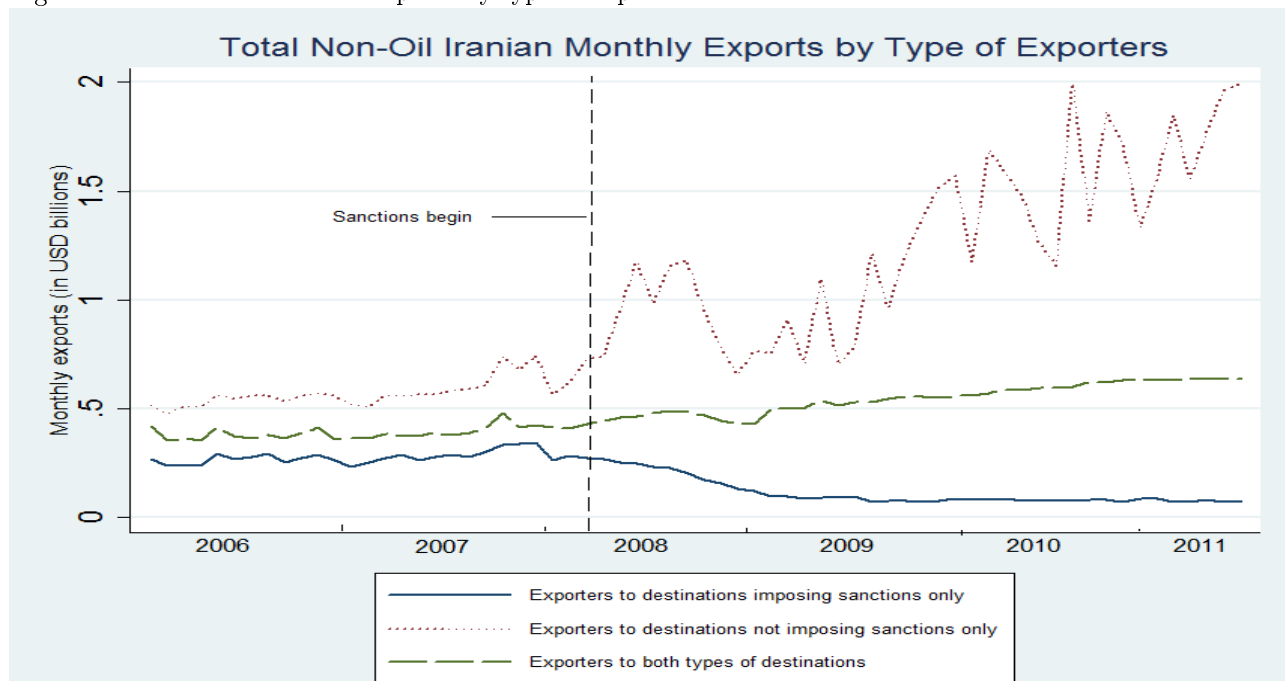


Figure 4b: Evolution of Iranian exports to (selected) non-sanctioning countries (NSCs)



Note: Non-oil export sanctions against Iranian exporters were imposed in March 2008.

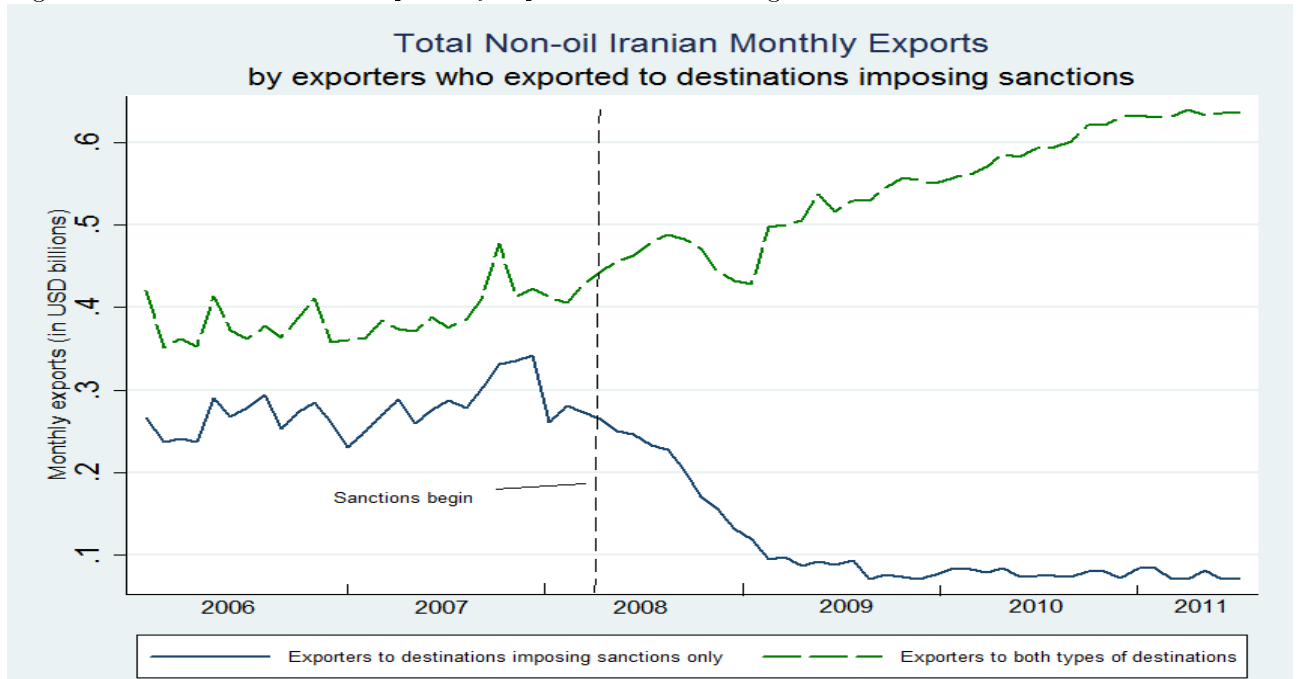
Figure 5: Evolution of Iranian exports by type of exporters



Note: This figure shows the total exports by different types of exporters between January 2006 and June 2011. Non-oil export sanctions against Iranian exporters were imposed in March 2008. The blue line represent monthly exports by exporters who exported only to sanctioning countries. The red (dotted) line represent monthly exports by exporters who exported only to non-sanctioning countries. The green (dashed) line represent monthly exports by exporters who exported to both sanctioning countries and non-sanctioning countries.

Source: Author's calculations using Iranian Customs data

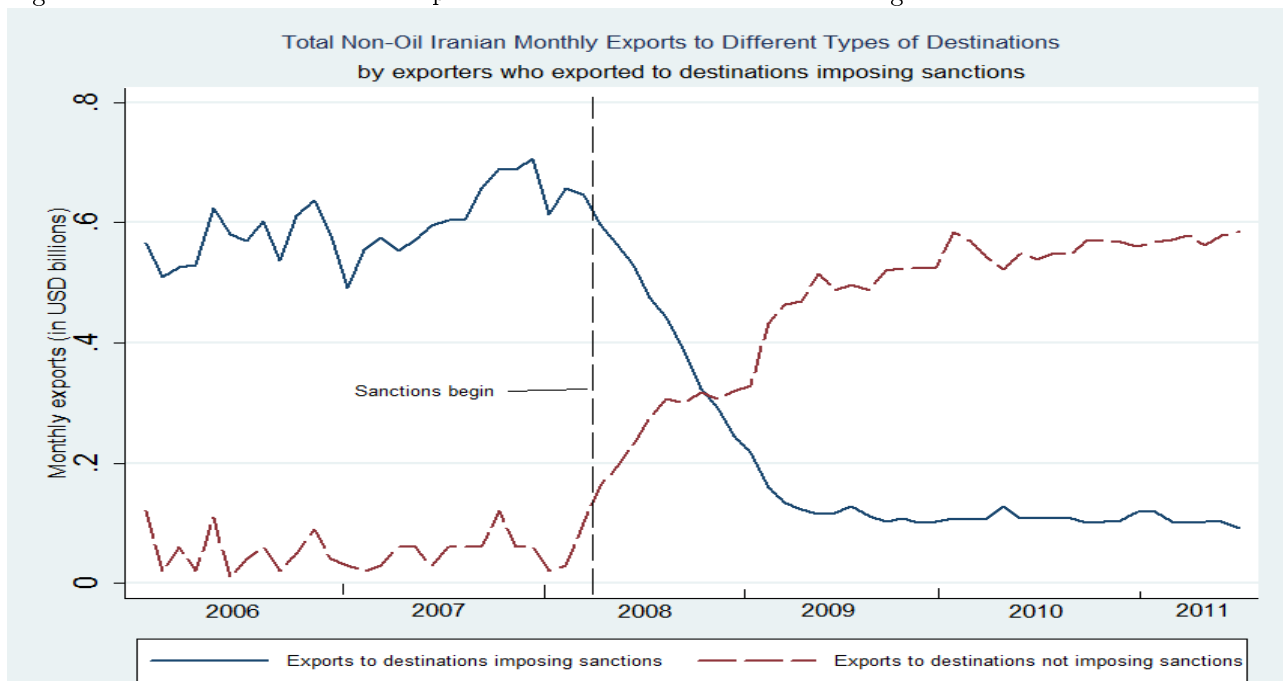
Figure 6: Evolution of Iranian exports by exporters to sanctioning countries



Note: This figure shows the total exports by exporters who exported to destinations imposing export sanctions between January 2006 and June 2011. Non-oil export sanctions against Iranian exporters were imposed in March 2008. The blue line represent the monthly exports by exporters who exported only to sanctioning countries between January 2006 and June 2011. The green (dashed) line represent the monthly exports by exporters who exported to both sanctioning countries and non-sanctioning countries between January 2006 and June 2011.

Source: Author's calculations using Iranian Customs data

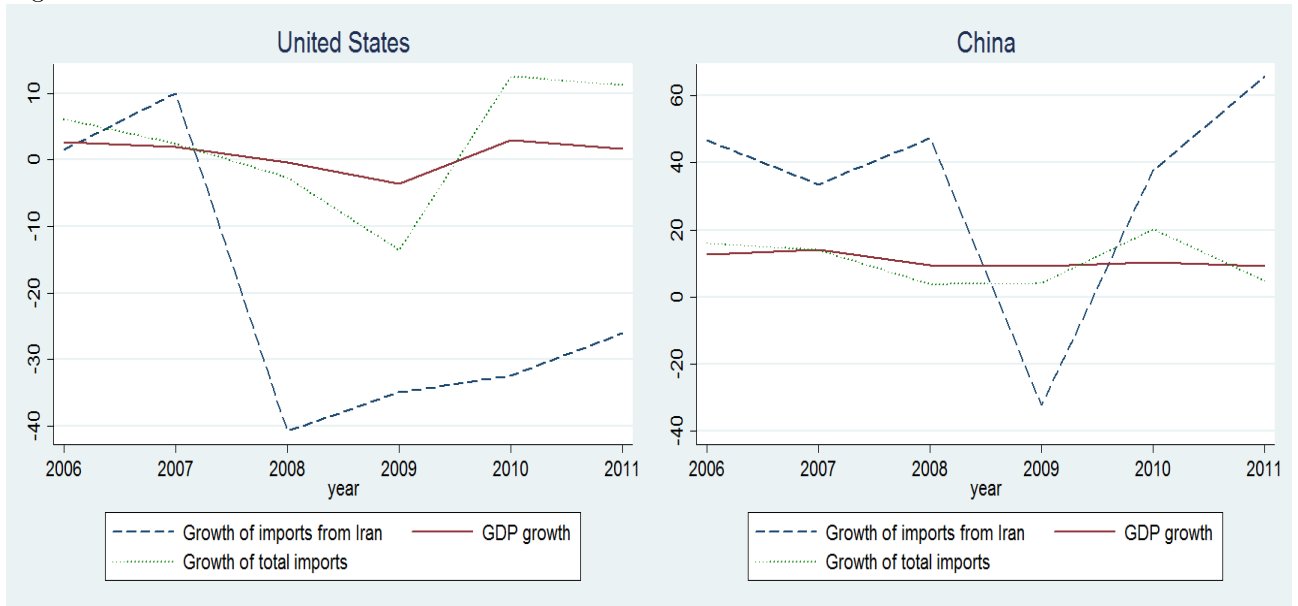
Figure 7: Existence and extent of export destruction and deflection following sanctions



Note: This figure shows the sum of exports to sanctioning countries (SCs) and to non-sanctioning countries (NSCs) by (i) exporters who exported only to SCs and (ii) exporters who exported to both SCs and to NSCs between January 2006 and June 2011. Non-oil export sanctions against Iranian exporters were imposed in March 2008. The blue line represent the sum of Iranian monthly exports to SCs by the above-mentioned exporters. The red (dashed) line represent the sum of Iranian monthly exports to NSCs by the exporters who exported to both SCs and to NSCs between January 2006 and June 2011.

Source: Author's calculations using Iranian Customs data

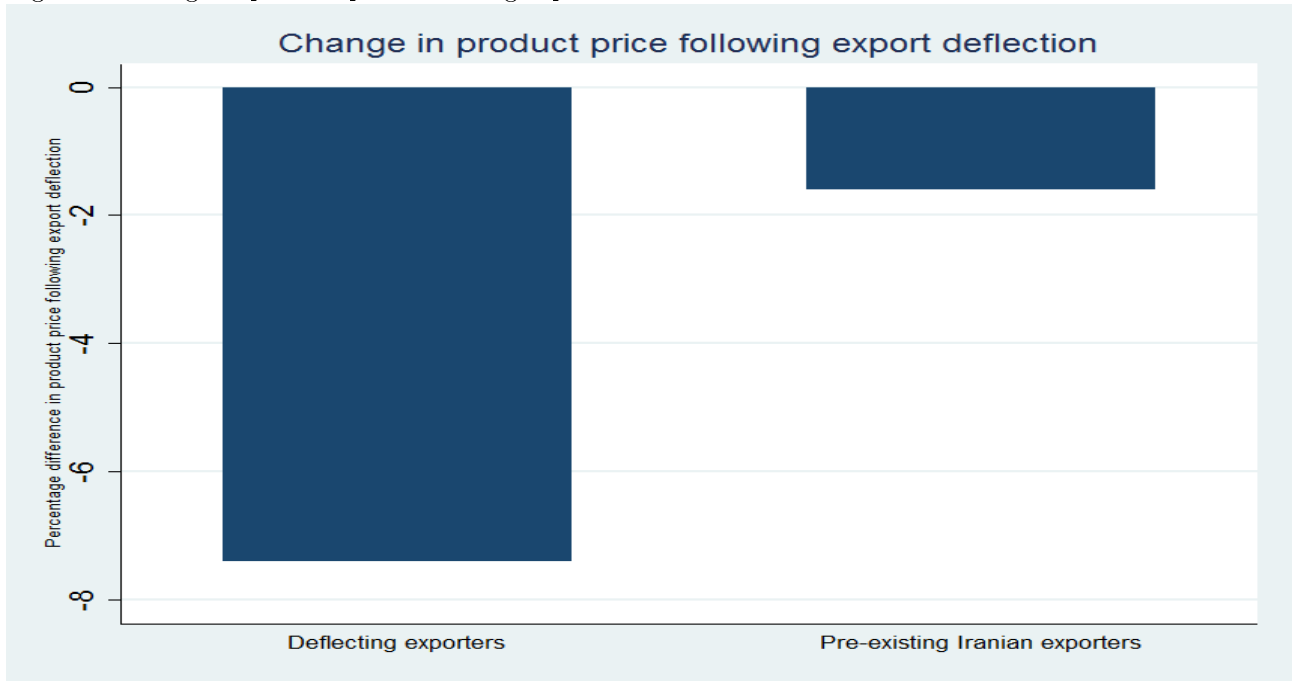
Figure 8: Is it about recession or sanctions?



Note: Author's calculations using Iranian Customs data



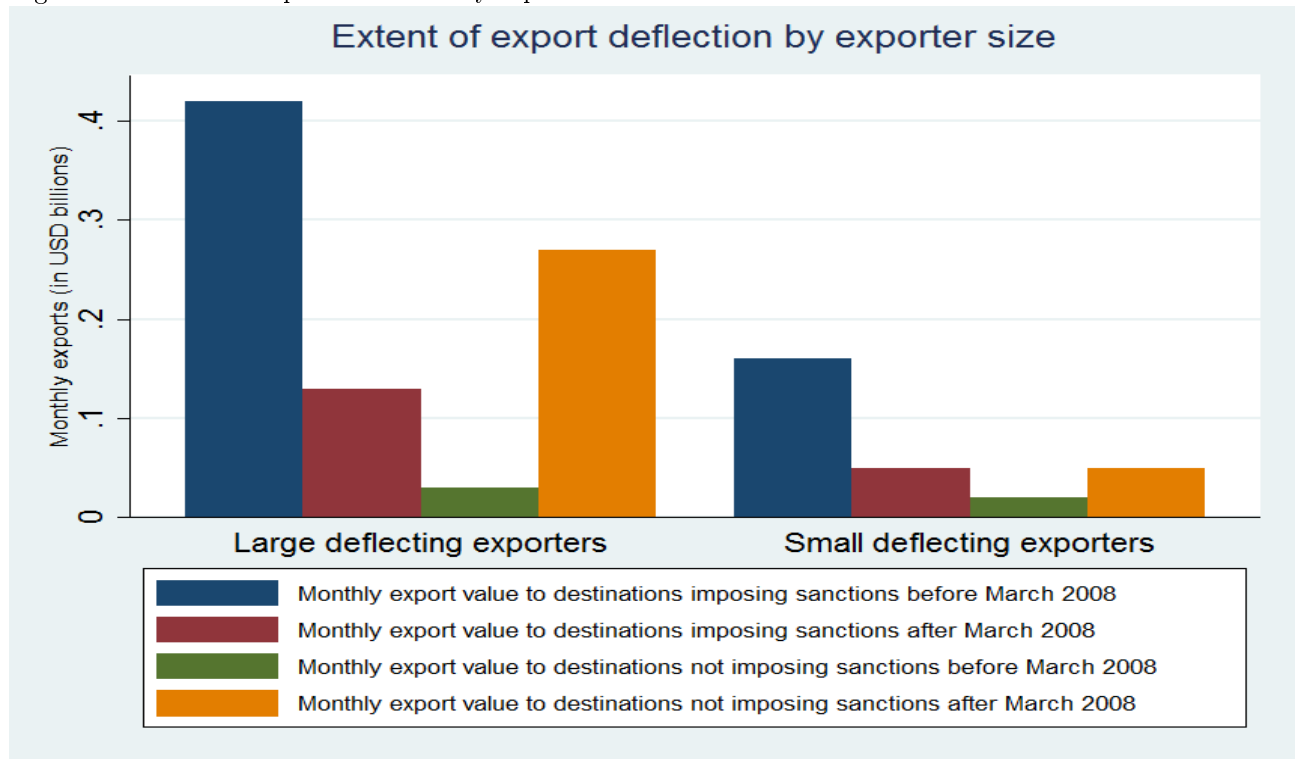
Figure 9: Change in product price following export deflection



Note: This figure shows the percentage difference in product price after export deflection. Non-oil export sanctions against Iranian exporters were imposed in March 2008. The left-hand side bar shows the average price drop in the first product shipment of deflecting exporters to non-sanctioning countries following export deflection relative to price of same product by same exporters in their last shipment to sanctioning countries before export deflection. The right-hand side bar shows the average price drop in the same products sold by other Iranian exporters that were already existing in the new destination at the time of first shipment by deflecting exporters, after export deflection took place.

Source: Author's calculations using Iranian Customs data

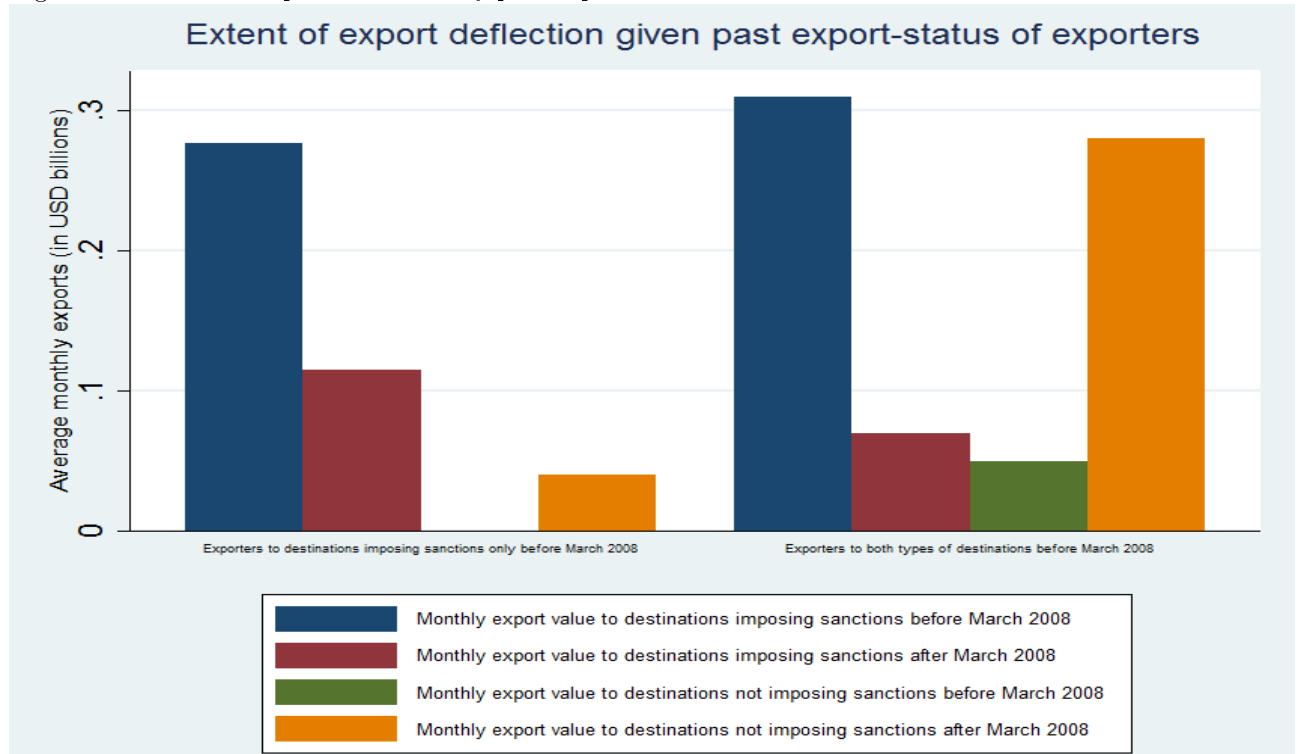
Figure 10: Extent of export deflection by exporter size



Note: This figure shows the extent of export deflection by exporter size. Non-oil export sanctions against Iranian exporters were imposed in March 2008. It looks at exporters who exported to both sanctioning countries and to non-sanctioning countries between January 2006 and June 2011. It differentiates between large exporters (whose monthly export value was above the export value per average exporter before March 2008 at sanctioning countries) and small exporters (whose monthly export value was below the export value per average exporter before March 2008 at sanctioning countries). Large deflecting exporters achieved higher level of export deflection than small deflecting exporters.

Source: Author's calculations using Iranian Customs data

Figure 11: Extent of export deflection by past export-status



Note: This figure shows the extent to which Iranian exporters were able to deflect exports following the imposition of export sanctions in March 2008. Non-oil export sanctions against Iranian exporters were imposed in March 2008. It differentiates between (i) exporters who exported only to sanctioning countries before March 2008 and (ii) exporters who exported to both sanctioning countries and to non-sanctioning countries before March 2008. The average monthly export value by both types of exporters to sanctioning countries decreased from 0.58 (blue bars) before March 2008 to 0.11 (red bars) after March 2008. The average monthly export value by both types of exporters to non-sanctioning countries increased from 0.05 (green bars) before March 2008 to 0.32 (orange bars) after March 2008.

Source: Author's calculations using Iranian Customs data

Table 1: Export destruction and deflection

		$\alpha_1$	$\beta_1$	$\alpha_2$	$\beta_2$	Statistics
(1)	$t < 27$	0.0570 (0.018)	1.0024 (0.217)			$N_{t < 27} = 110820$ $N_{t \geq 27} = 150305$
	$t \geq 27$			0.0691 (0.024)	1.0148 (0.340)	F(2, 262121)=35.67 Prob > F=0.000
(2)	$t < 27$	0.0213 (0.009)	1.0071 (0.311)			$N_{t < 27} = 67851$ $N_{t \geq 27} = 92867$
	$t \geq 27$			0.0106 (0.032)	1.0264 (0.285)	F(2, 160714)=48.37 Prob > F=0.000
(3)	$t < 27$	0.0215 (0.006)	1.0054 (0.253)			$N_{t < 27} = 19700$ $N_{t \geq 27} = 22958$
	$t \geq 27$			0.0122 (0.004)	0.9481 (0.165)	F(2, 42654)=82.7 Prob > F=0.000
(3-a)	$t < 27$	0.0102 (0.003)	0.9916 (0.327)			$N_{t < 27} = 17527$ $N_{t \geq 27} = 19903$
	$t \geq 27$			0.0071 (0.002)	0.5431 (0.183)	F(2, 37426)=73.4 Prob > F=0.000
(3-b)	$t < 27$	0.0326 (0.008)	1.1718 (0.308)			$N_{t < 27} = 2173$ $N_{t \geq 27} = 3055$
	$t \geq 27$			0.0247 (0.006)	0.9632 (0.247)	F(2, 5224)=45.7 Prob > F=0.000
(4)	$t < 27$	0.0289 (0.010)	0.9023 (0.219)			$N_{t < 27} = 32152$ $N_{t \geq 27} = 46164$
	$t \geq 27$			0.0594 (0.154)	1.0311 (0.326)	F(2, 78312)=27.75 Prob > F=0.000
(4-a)	$t < 27$	0.0205 (0.008)	0.8712 (0.307)			$N_{t < 27} = 28740$ $N_{t \geq 27} = 41858$
	$t \geq 27$			0.0411 (0.150)	1.0141 (0.283)	F(2, 70594)=29.24 Prob > F=0.000
(4-b)	$t < 27$	0.0317 (0.137)	1.0121 (0.350)			$N_{t < 27} = 3412$ $N_{t \geq 27} = 4306$
	$t \geq 27$			0.0628 (0.204)	1.2408 (0.326)	F(2, 7714)=31.48 Prob > F=0.000

Note: In (1)  $X_{et}$  refers to total exports at time  $t$ . In (2)  $X_{et}$  refers to total exports by exporters who exported only to non-sanctioning countries (NSCs). In (3)  $X_{et}$  refers to total exports to sanctioning countries (SCs) by (i) exporters who exported only to SCs and (ii) exporters who exported to both SCs and NSCs between January 2006 and June 2011. Estimations (3a) and (3b) repeat estimation (3) for small and large exporters, respectively. I defined small exporters as those whose monthly export value was below the export value per average exporter before March 2008. And, I defined large exporters as those whose monthly export value was below the export value per average exporter before March 2008. In (4)  $X_{et}$  refers to total exports to NSCs by exporters who exported to both SCs and to NSCs between January 2006 and June 2011. Estimations (4a) and (4b) repeat estimation (4) for small and large exporters, respectively. Standard errors are in parantheses. All coefficients are statistically significant at the 1% level. Sanctions were imposed in March 2008.

Source: Author's estimations using Iranian Customs data.

Table 2: Sanctions and exporter entry and exit at the destination level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>Entry<sub>dt</sub></i>		<i>Exit<sub>dt</sub></i>		<i>Add<sub>dt</sub></i>		<i>Drop<sub>dt</sub></i>	
$S_d \cdot PS_t$	-22.827 <sup>b</sup> (11.501)	-29.514 <sup>b</sup> (13.659)	8.621 <sup>b</sup> (4.021)	7.173 <sup>c</sup> (4.262)	-15.182 <sup>b</sup> (8.304)	-17.332 <sup>a</sup> (5.241)	24.225 <sup>c</sup> (13.242)	28.416 <sup>a</sup> (9.258)
$S_d$ dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$PS_t$ dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination Controls		Yes		Yes		Yes		Yes
Destination FEs	Yes		Yes		Yes		Yes	
Observations	8421	8421	8421	8421	8421	8421	8421	8421

Note:  $Entry_{dt}$  and  $Exit_{dt}$  are entry and exit rates (0-100) of exporters at the destination-quarter level.  $Add_{dt}$  is the (0-100) share of exporters that added a new product to a destination  $d$  at time  $t$ .  $Drop_{dt}$  is the (0-100) share of exporters that dropped an existing product from destination  $d$  at time  $t$ . Standard errors in parantheses are clustered at the destination level. <sup>b</sup> and <sup>c</sup> denote statistical significance at the 5% and 10% levels, respectively.

$S_d$  is a dummy variable that equals to 1 for sanctioning countries, and zero otherwise.  $PS_t$  is a dummy variable for the post-sanctions period, starting in March 2008. Destination controls include logs of GDP, distance, number of immigrants, number of exporters, as well as inflation rate, ease of imports, FDI (net flows), tariff rate, and imports growth at the destination level.

Source: Author's estimations using Iranian Customs data.

Table 3: Product prices after export deflection

	$\alpha_3$	$\beta_3$	$\alpha_4$	$\beta_4$	Statistics
$t < 27$	0.0124 (0.152)	0.0041 (0.019)			$N_{t < 27} = 52726$ $N_{t \geq 27} = 83401$
$t \geq 27$			0.0214 (0.011)	-0.0813 <sup>a</sup> (0.023)	$F(2, 136123) = 37.18$ Prob > F = 0.002

Note: This tables focuses only on exporters who reduced their product exports to zero in sanctioning countries after March 2008 and existed in non-sanctioning countries after March 2008. The dependent variable is  $P_{ept}$ , which is the price of product  $p$  exported by exporter  $e$  at time  $t$ . The independent variable is  $P_{ept-1}$  which is the price of product  $p$  exported by exporter  $e$  at time  $t-1$ . Standard errors are in parantheses. <sup>a</sup> denotes statistical significance at the 1% level. Sanctions were imposed in March 2008, at  $t = 27$ .

Source: Author's estimations using Iranian Customs data.

Table 4: Which exporters did deflect?

	$Deflect_{e t > 26}$		
	(1)	(2)	(3)
$\ln X_{e pre-sanctions}$	0.171 <sup>b</sup> (0.082)	0.304 <sup>a</sup> (0.103)	
$\ln Experience_{e pre-sanctions}$	0.125 <sup>b</sup> (0.061)		0.148 <sup>c</sup> (0.084)
Exporter FEs	Yes	Yes	Yes
Month FEs	Yes	Yes	Yes
Observations	237182	237182	237182

Note: The dependent variable,  $Deflect_{e|t > 26}$ , equal to 1 if the exporter exited a sanctioning country and, afterward, entered a non-sanctioning country after March 2008, and zero otherwise. And,

$\ln X_{e|pre-sanctions}$  and  $Experience_{e|pre-sanctions}$  represent the size and experience of the exporter before March 2008. I measure the size and experience of the exporter by, respectively, the log of export value and log of number of months of presence in export experience between entry and March 2008. Standard errors in parentheses are clustered at the destination level. <sup>a</sup>, <sup>b</sup>, and <sup>c</sup> denote statistical significance at the 1, 5, and 10 % levels, respectively.

Source: Author's estimations using Iranian Customs data.

Table 5: Did past export status matter?

	Intensive margin	Extensive margin
	$\ln X_{epNSCt}$	$P(EXP)_{epNSC post-sanctions}$
	(1)	(2)
$S_d.PS_t$	0.048 <sup>b</sup> (0.021)	0.037 <sup>c</sup> (0.021)
$S_d.PS_t*ExporterA$		0.053 <sup>b</sup> (0.024)
$S_d.PS_t*ExporterB$		0.092 <sup>a</sup> (0.031)
$S_d.PS_t*ExporterC$	0.501 <sup>a</sup> (0.125)	
ExporterA		0.017 (0.121)
ExporterB		0.092 <sup>c</sup> (0.053)
ExporterC	0.016 <sup>a</sup> (0.042)	
$\ln X_{e pre-sanctions}$	0.051 <sup>a</sup> (0.019)	0.045 <sup>a</sup> (0.013)
$S_d$	Yes	Yes
$PS_t$	Yes	Yes
Exporter*Destination FEs	Yes	Yes
R-squared	0.27	0.39
Observations	211341	211341

Note: Standard errors in parentheses are clustered at the destination level. . <sup>a</sup>, <sup>b</sup>, and <sup>c</sup> denote statistical significance at the 1, 5, and 10 % levels, respectively. All specifications include a constant term.  $S_d$  is a dummy variable that equals to 1 if the destination imposed export sanctions against Iran in and after March 2008, and zero otherwise.  $PS_t$  is a dummy variable for the period t=27-66, starting in March 2008.  $ExporterA$  is a dummy variable that equals to 1 if the exporter had exported product  $p$  to a sanctioning country but had not exported at all to a NSC before March 2008.  $ExporterB$  is a dummy variable that equals to 1 if the exporter had exported product  $p$  to a SC but exported another product to a NSC before March 2008.  $ExporterC$  is a dummy variable that equals to 1 if the exporter had exported a product to a SC as well as to a NSC before March 2008.  $\ln X_{e|pre-sanctions}$  denote exporter-size.  $P(EXP)_{epNSC|post-sanctions}$  is a binary variable that equals to 1 if the exporter had exported product  $p$  to destination  $d$  after sanctions were imposed, and zero otherwise.

Source: Author's estimations using Iranian Customs data.

Table 6: Which products did deflecting exporters deflect?

	$Deflect_{ep t>26}$	
	(1)	(2)
Export value	0.743 <sup>b</sup> (0.320)	0.411 <sup>b</sup> (0.209)
Share of products in total exports	0.482 <sup>b</sup> (0.228)	
Differentiated	-0.514 <sup>a</sup> (0.208)	-0.633 <sup>a</sup> (0.214)
Exporter FEs	Yes	
Exporter*Destination FEs		Yes
Observations	237182	237182

Note: Standard errors in parentheses are clustered at the destination level.  $Deflect_{ep|t>26}$  equals to one if the exporter dropped a given product from a sanctioning country and, then, introduced it in a NSC after March 2008, and zero otherwise.  $X_{pre-deflection}$  is the log of export value of the product at the exporter-destination level before export deflection from a sanctioning country.  $X_{share}$  represent the weight of the product in the portfolio of the exporter before export deflection from a sanctioning country. “ $Diff$ ” is a dummy variable which equals to 1 if the product is differentiated, and zero otherwise. <sup>a</sup> denotes statistical significance at the 1% level. <sup>b</sup> denotes statistical significance at the 5% level.

Source: Author's estimations using Iranian Customs data.

Table 7: Characteristics of destinations that deflecting exporters targeted

	$N_{dt}$	
	(1)	(2)
UN vote correlation		0.615 <sup>a</sup> (0.214)
log of GDP	0.079 <sup>c</sup> (0.041)	0.062 <sup>c</sup> (0.035)
log of Distance	-0.056 <sup>c</sup> (0.032)	
Inflation		0.037 <sup>c</sup> (0.022)
Ease of importing		0.007 (0.041)
FDI (net inflows)		0.148 <sup>b</sup> (0.062)
Tariff rate		-1.142 <sup>b</sup> (0.461)
Import growth		0.068 <sup>c</sup> (0.040)
log(Immigrants)		0.321 <sup>c</sup> (0.183)
log(Exporters)		0.569 <sup>a</sup> (0.222)
Month FEs	Yes	Yes
Destination FEs		Yes
Observations	984	984

Note: The dependent variable is the log of total number of deflecting exporters to a given destination at a given month. The independent variables are related to the new destination that deflecting exporters deflected to. The total number of new destinations throughout the post-sanctions period/months is 984. Standard errors in parantheses are clustered at the destination level. <sup>a</sup>, <sup>b</sup>, and <sup>c</sup> denote statistical significance at the 1, 5, and 10% levels, respectively.

Source: Author's estimations using Iranian Customs data.



## Appendix

Table A.I.: Descriptive statistics for Iranian exporters

Quarter	Number of exporters	Export value per exporter (USD M.)	Number of products per exporter	Number of destinations per exporter
2006-Q1	7599	0.44	3.77	1.93
2006-Q2	7487	0.46	3.94	1.99
2006-Q3	9234	0.46	4.10	1.98
2006-Q4	7575	0.47	4.13	1.95
2007-Q1	6848	0.45	3.84	1.99
2007-Q2	6753	0.51	4.22	2.04
2007-Q3	6943	0.56	4.35	2.08
2007-Q4	7280	0.65	4.33	2.08
2008-Q1	6513	0.60	4.20	2.10
2008-Q2	6403	0.81	4.38	2.14
2008-Q3	6463	0.84	4.27	2.13
2008-Q4	6154	0.69	4.42	2.11
2009-Q1	5929	0.72	4.21	2.06
2009-Q2	5870	0.77	4.21	2.08
2009-Q3	5809	0.83	4.40	2.07
2009-Q4	6440	0.93	4.35	2.05
2010-Q1	6008	1.07	4.32	2.10
2010-Q2	5877	1.06	4.27	2.08
2010-Q3	5968	1.09	4.11	2.11
2010-Q4	6216	1.16	4.44	2.07
2011-Q1	5614	1.24	4.00	2.09
2011-Q2	5273	1.48	4.06	2.10
Pre-Sanctions	7359	0.48	4.08	2.028
Post Sanctions	6001	0.93	4.26	2.087

Note: Author's calculations based on Iranian exporter daily-level transactions data after aggregating it to the quarter-level. A product is defined as a HS 6-digit category. Sanctions hit in March 2008. Pre-sanctions period includes 2006Q1 to 2008Q1. Post-sanctions period includes 2008Q2 to 2011Q2.

Table A.II.: Additional descriptive statistics

	2006	2007	2008	2009	2010
Number of Exporters	15050	13538	12721	11373	10929
Number of Entrants		6341	6051	5186	4581
Number of Exiters		7853	6868	6534	5025
Export Value per Exporter	744583	896995	1178605	1412918	1918004
Export Value per Entrant		329768	391489	434135	514745
Export Value per Exiter		207088	215958	395504	223334
Export Value per Survivor		532114	674982	822935	1138257
Share of top 1% Exporters in Total Exports	0.504	0.518	0.576	0.508	0.529
Share of top 5% Exporters in Total Exports	0.707	0.717	0.747	0.719	0.725
Share of top 25% Exporters in Total Exports	0.927	0.932	0.938	0.937	0.939

Quarter	Number of exporters to		Number of products to	
	SCs	NSCs	SCs	NSCs
2006-Q1	1641	4937	637	2141
2006-Q2	1567	5256	655	2156
2006-Q3	1624	5332	713	2216
2006-Q4	1846	5393	776	2133
2007-Q1	1687	5385	736	2109
2007-Q2	1484	5452	646	2189
2007-Q3	1564	5578	657	2171
2007-Q4	1658	5524	746	2116
2008-Q1	1452	5781	642	2132
2008-Q2	1379	5812	643	2222
2008-Q3	1405	6010	641	2185
2008-Q4	1289	5558	681	2160
2009-Q1	1102	6116	579	2181
2009-Q2	1080	6666	574	2199
2009-Q3	1127	6419	630	2159
2009-Q4	1191	6628	629	2232
2010-Q1	1063	6725	603	2306
2010-Q2	1059	6487	631	2251
2010-Q3	1051	5824	602	2317
2010-Q4	1029	5822	587	2421
2011-Q1	904	5959	577	2447
2011-Q2	870	5942	552	2298
Pre-Sanctions	1613.67	5417.43	689.78	2151.44
Post Sanctions	1119.15	6084.86	609.92	2259.84
% change	-30.65	12.73	-11.58	5.04

Note: Author's calculations based on Iranian exporter daily-level transaction data after aggregating it to the quarter level. A product is defined as a HS 6-digit category. The exporters who exported to sanctioning countries (SCs) as well as to non-sanctioning countries (NSCs) are included in both groups in this table. Non-oil export sanctions hit in March 2008. Pre-sanctions period includes 2006Q1 to 2008Q1. Post-sanctions period includes 2008Q2 to 2011Q2.

Product	% $\Delta$ in Iranian exports to				% $\Delta$ in Iranian exports to United Arab Emirates	% $\Delta$ in UAE re-exports to			
	US	Canada	UK	France		US	Canada	UK	France
Plants Seeds	-51	-97	-81	-29	+154	+20	+90	+70	+18
Sugars	-49	-137	-15	-98	+69	+29	+83	+14	+53
Plastics	-73	-95	-92	-70	+146	+29	+62	+51	+21
Carpets	-99	-12	-34	-23	+151	+40	+15	+28	+19
Ceramics	-51	-74	-73	-22	+20	+29	+72	+29	+21
Copper	-91	-58	-81	-37	+184	+84	+21	+70	+90
Furniture	-87	-95	-89	-98	+60	+34	+29	+37	+44

Note: Author's calculations based on Iranian Customs transactions and UN-Comtrade data. All figures represent % changes between pre- and post- sanctions periods. A product is defined as an HS 6-digit category.