Sanctions Backfire: How Exports Deflection Helped Iranian Exporters

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Abstract

Using highly dis-aggregated data about Iranian non-oil exports, I uncover the existence, extent, and mechanism of exports deflection following imposition of exports sanctions. I show how exporter size, past export status, and pricing strategy matter in the process of exports deflection. The main findings are as follows: (i) two thirds of the value of Iranian non-oil exports thought to be destroyed by exports sanctions have actually been deflected to destinations not imposing sanctions; (ii) exporters reduced their product prices as they deflected exports to new destinations; (iii) exporters deflected more of their core and homogeneous products; (iv) larger exporters deflected more of their exports than smaller exporters; (v) the new destinations, which deflecting exporters targeted, are more politically-friendly with Iran; and (vi) the probability of an exporter to deflect exports to another destination rised if the exporter already existed in that destination, suggesting that fixed cost of exporting matters too. I conclude that exports sanctions may be less effective in a globalized world as exporters can deflect their exports from one export destination to another.

Key words: sanctions; international trade; exporters dynamics; economic integration

JEL codes: F10, F13, F14, F15

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1 Introduction

Sanctions[1] continue to be an economic weapon deployed by countries in support of foreign policy goals, and exports sanctions against Iran are no exception[2]. While some studies conclude that sanctions do not always achieve their goal (i.e. Levy (1999)), others suggest that sanctions often do succeed (i.e. Smeets (1990) and Evenett (2002)). And, existing literature provides various theoretical frameworks that explain how sanctions work[3]. However, we still lack understanding about how exporters behave when faced with exports sanctions. Due to an increasingly globalized economy, many alternative destinations exist for exporters hit by sanctions. The fact that non-oil Iranian exports increased following the imposition of sanctions on Iranian non-oil exports (Figure 1) makes understanding exporters dynamics even more important. The goal of this paper is to study empirically whether and how exports sanctions against Iranian exporters caused exports deflection[4] at the exporter-product-destination level.

Do exporters deflect their exports to new destinations following exports sanctions? If yes, how? Precisely, which exporters do deflect their exports to new destinations? Where do they deflect to? Which of their products do they deflect? At what price are they able to deflect their products? And, how much of their exports destruction is compensated by exports deflection? This paper addresses these questions and documents the existence, extent, and mechanism, at the most dis-aggregated level, of exports deflection following exports sanctions. It also contributes to the burgeoning micro-econometric literature on exporters dynamics and cost of exporting[5]. While Besedes and Prusa (2011) investigates and compares countries export growth based on their performance at the extensive and intensive export margins and Besedes and Prusa (2013) provides evidence on the extent to which discriminatory trade policy [6] eliminate trade, this paper is the first to establish empirically whether and how exports deflection happens following the imposition of exports sanctions[7].

Iran serves as a suitable country for this study for various reasons. First, the exports sanctions against Iran in March 2008 serve as a natural experiment affecting cost of exporting at the exporter-destination level. Second, the exports sanctions that Iranian exporters faced are unique as they involved many countries. Third, the ability to access highly disaggregated data of Iranian export flows makes Iran an outstanding case for this research.

This paper exploits a rich dataset covering the universe (more than 1.81 million transactions of daily exports)

[1] Sanctions are different from embargos. While exports sanctions represent a higher exports cost, embargoes represent a shift to autarky via a trade blockade.

[2] Over the last century, different countries imposed 174 international economic sanctions (Hufbauer et al. (2007)).

[3] See, for instance, the works of Hufbauer et al. (2007), Elliot and Richardson (1997), Davis and Engerman (2003), Doxey (1980), Kaempfer and Lowenberg (1988), Martin (1993), Drezner (1999), Eaton and Engers (1992, 1999), and van Bergeijk (2009).

[4] I define exports 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. I follow this definition which was introduced and used by Bown and Crowley (2006, 2007). In the international trade literature, trade deflection is different from trade diversion. Trade diversion is trade that occurs between members of a preferential trading arrangement (PTA) that replaces what would have been imports from a country outside the PTA. Trade diversion, as defined by Viner (1950), is associated with welfare reduction for the importing country since it increases the cost of the imported good.

[5] See Melitz (2003), Eaton et al. (2004, 2011), and Bernard et al. (2010), among others, for more work on exporters dynamics.

[6] A "discriminatory" trade policy is one in which a country imposes different trade restrictions on imports from different exporting countries. Examples include trade agreements, sanctions, and antidumping duties. In contrast, a "non-discriminatory" trade policy is one that is applied equally to all importers.

[7] The impact on Iran's economy following the financial sanctions in 2012, the year after the data in this paper ends, is beyond the scope of this paper. In 2012, the sanctions moved from country specific restrictions on Iranian exports, as explained in detail in section 2 below, to limiting Iran's access to the global financial system, such as the SWIFT.

of Iranian non-oil exporters between 2006 and 2011. This study focuses on non-oil exports for four reasons. First, sanctions that targeted companies that buy oil from Iran were imposed in late 2012, outside the time-span of the dataset in hand. Second, unlike non-oil exports, oil exports happen via long-term contracts, so their study requires more years following the imposition of sanctions on them. Third, Iranian oil is exported by government (1 exporter) but there exist 35,953 non-oil exporters who were the ones mainly targeted by the 2008 exports 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 0.7% of total employment in Iran. Meanwhile, non-oil exports represent 20% of Iranian total exports and the non-oil exports sector captures 38% of employment. The remaining employment is mainly in the services and non-oil public sectors.

Figures 2-4 provide a simple illustration of the empirical motivation for investigating the existence of exports destruction and exports deflection. Figures 2a and 2b show total Iranian monthly exports of selected products between January 2006 and June 2011 to two groups of destinations. They plot exports to destinations imposing sanctions and to destinations not imposing sanctions. They sketch examples of how, following the imposition of sanctions, non-oil Iranian monthly exports decreased sharply to destinations imposing sanctions and increased significantly during the same period to destinations not imposing sanctions [8]. The dramatic shrinkage in exports to destinations imposing sanctions following the imposition of sanctions (exports destruction) is associated with a substantial increase in exports of those same products to destinations not imposing sanctions (exports deflection). I observe the same trends when I look at the aggregate level. Figures 3a and 3b show aggregate Iranian non-oil exports to selected destinations imposing sanctions as well as to selected destinations not imposing sanctions. And, Figure 4a shows total non-oil Iranian monthly export values per exporter and number of products per exporter between January 2006 and June 2011 to the same two groups of destinations as above. Following sanctions, the number of exported products per exporter decreased to destinations imposing sanctions but increased to destinations not imposing sanctions. However, export values per exporter increased to both groups of destinations. This observation is consistent with the data presented in Tables A1 and A2, suggesting that smaller exporters exited destinations imposing sanctions. Figures 4b and 4c look at the entry and exit rates[9] of Iranian exporters and exported products to destinations imposing sanctions and destinations not imposing sanctions. The entry and exit rates of Iranian exporters and products followed the same trends. While entry rates of exporters and products decreased in destinations imposing sanctions, they increased in destinations not imposing sanctions. Meanwhile, while exit rates of exporters and products increased in destinations imposing sanctions, they decreased in destinations not imposing sanctions. As part of the empirical investigation to know whether exports deflection existed following sanctions, I test whether the same exporters who exited destinations imposing sanctions have actually then entered destinations

[8] To save space, I present results for selected products in these two figures. Results for other non-oil products are available and show similar trends as well.

[9] Entry here refers to the first time the exporter or product enters a given destination. Exit refers to the last time the exporter or product is seen at destination, so there should be no confusion with exporters and products that exit and then enter the same destination.

not imposing sanctions. And, I also test the dynamics of adding and dropping products at the exporter-destination level.

In the econometric investigation, I take elements from Prusa (1996, 2001) and Besedes and Prusa (2006a, 2006b). I track Iranian exports deflection as one potential link through which the international externality of sanctions may be transmitted. I use exporter-product-destination-time level data to estimate the impact that sanctions have on Iranian exports deflection. I expect sanctions by a given destination on Iranian exporters to be associated with a reduction in Iranian exporter-level exports growth to that destination, I call this term "exports destruction". I also expect the sanctions by a given destination on Iranian exporters to lead to surges in Iranian exporter-level exports to destinations not imposing sanctions, I call this pattern "exports deflection" following the methodology of Bown and Crowley (2007). A novel feature of my analysis is a deeper investigation of the mechanism of exports deflection as exporter-level data allows me to uncover a lot of action taking place within exporters and across destinations.

As an outline of the empirical analysis, I first find evidence that exports sanctions lead to destruction of Iranian exporter-level exports to the destinations that imposed exports sanctions. Second, I show evidence that exports sanctions on Iran lead to a deflection in Iranian exporter-level exports of the same products to destinations that did not impose exports sanctions on Iran. Third, I document the extent and mechanism of exports deflection.

The main results are as follows. First, two thirds of the value of Iranian non-oil exports thought to be destroyed by exports sanctions have actually been deflected to destinations not imposing sanctions. Second, small exporters were more affected by sanctions. Third, larger and more experienced exporters had a higher probability to deflect more of their exports than smaller exporters. Fourth, the decision to deflect exports is not random at the exporter-level; deflecting exporters exercised product selection while deflecting exports. Precisely, exporters tended to deflect their core-competence products as well as products that are easier to find consumers for – homogeneous products compared to differentiated products. Fifth, exporters reduced product prices when they deflected exports to new markets. Sixth, exporters deflected exports to destinations that they already existed in before sanctions as well as to destinations that are "politically-friendly" to Iran[10].

Relation to recent literature: Many others have taken interest in the consequences of cost of exporting. Liu (2012) developed and estimated a dynamic model of firms' sales dynamics in an open economy with capacity constraints. She shows how firms that are capacity constrained and face increasing marginal costs in the short run face trade-off between sales in two different markets. Blum et al. (2013) showed how an increase in cost of exporting to a given market causes exports reallocation. The authors constructed a model in which exiting a given export market and entering another market is an optimal response for firms facing increasing costs. Interestingly, Lawless (2009) documented that even firms that export on an ongoing basis still enter into and exit from specific export destinations quite regularly. Similarly, Morales et al. (2014) proved that exporting firms continuously change export destinations. They developed a model of export dynamics in which firms' exports in each market may depend on

[10]I define politically-friendly countries as ones who have similar positions during votes on resolutions in the General Assembly of the United Nations. This measurement can also be used to infer "political affinity" between countries.

how similar this market is to the firm's home country and to other countries to which the firm has previously exported. Vannoorenberghe (2012) casted doubt on the standard hypothesis that firms face constant marginal costs and maximize profits on their different markets independently of each other. Using a model in which firms face market-specific shocks and short-run convex costs of production, he stressed that firms react to a shock in one market by adjusting their sales in the other market. The results of these papers are complementary to mine as they add a theoretical backbone to my empirical conclusions.

This paper is organized into four further sections. The next section gives a brief historical outline of the sanctions against Iran, with an emphasis on the exports sanctions, between January 2006 and June 2011. Section 3 introduces a rich and disaggregated customs dataset used in this exporters dynamics analysis. The empirical anaylsis in section 4 sketches the identification strategies as well as shows the aggregate impact of exports sanctions on exports destruction and exports deflection, the extent of exporter-level Iranian exports destruction that got deflected to other destinations, and the detailed mechanism through which exports deflection occurred following exports sanctions. Section 5 concludes.

2 The sanctions against Iran

This section gives a brief historical outline of the sanctions against Iran, with an emphasis on its exports effects, between January 2006 and June 2011.

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[11]. 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[12]. 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"[13]. On December 23, 2006 - after having called on Iran to halt its uranium enrichment program in July 2006 - the UNSC voted to strenghthen sanctions on Iran's imports of nuclear-related materials and technology and froze the assets of individuals involved with nuclear activities[14].

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 nuclear activities[15]. And, the EU published an expanded list of Iranian individuals deemed persona non grata in the bloc. On August 27, 2007, French 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

[11] For details, see "Iran Reported to Security Council," BBC News, Feb. 4, 2006.
[12] For details, see "Germany could accept nuclear enrichment in Iran," Reuters, June 26, 2006
[13] For details, see UNSC Resolution 1696.
[14] For details, see UNSC Resolution 1737.
[15] For details, see UNSC Resolution 1747.

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[16]. 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"[17]. The sanctions cut more than 20 organizations associated to Iran's Islamic Revolution Guard Corps from the US financial system and three state-owned banks.

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 the period between January 2006 and June 2011, this study investigates how Iranian non-oil exporters behaved after the imposition of the 2008 sanctions. The impacts of import sanctions and financial sanctions are beyond the scope of this paper.

The non-oil exports sanctions against Iran happened in March 2008. The UNSC passed Resolution 1803 on March 3, 2008, calling upon all 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 note 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 mainly treated as "recommendations". So, learning about how countries precisely imposed sanctions is important.

The United States, United Kingdom, European Union, Canada, and Australia imposed trade sanctions against Iran. These sanctions commonly aimed to hinder Iranian non-oil 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, requiring firms to obtain special federal authorization to import into United States[18]. 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[19]. The Canadian Foreign Affairs and International Trade Department issued sanctions under its Special Economic Measures (Iran) Regulations in March 2008. 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, the imposed sanctions had a common goal which was to hinder Iranian exports.

[16] Sciolino, Elaine, "French leader raises possibility of force in Iran," The New York Times, August 28, 2007.

[17] The Unites States and Iran cut diplomatic relationships between each other in 1979.

[18] There has been recent stories about imports violating sanctions against Iran. For instance, Mahdavi's A&A Rug Company (Georgia, US) was called to have violated Iran Sanctions by importing products from Iran to US. In 2008, Mahdavi paid a penalty of USD 9240 to settle the matter.

[19] See the section of Australia's autonomous sanctions on Iran, Department of Foreign Affairs and Trade.

On March 20, 2009, President Obama offered Iran a "new beginning," proposing that Iran engage in direct negotiations with the United States and discuss ending its nuclear program[20]. 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 the Iran if it agrees to freeze uranium enrichment[21]. 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, the Bank of Industry and Mines, for transactions with previously banned institutions. And, on 17 March 2012, all Iranian banks were disconnected from the SWIFT, the world's hub of electronic financial transactions.

3 Data

This study employs a rich non-oil Iranian customs dataset that is disaggregated at the exporter-product-destination-day level. Each Iranian non-oil exporting firm and export transaction are 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, value of exports[22], and date of transaction. Iranian Customs data also reports weight - in addition to value - of each exporter-product-destination shipment. The dataset includes 1,814,146 customs daily transactions. 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[23]. I aggregated daily customs data into exporter-product-destination-month observations[24].

To test the quality of the data, which I obtained from Iranian Customs, I compared it with (i) UN-Comtrade data and (ii) mirror data (what each other destination reports as imports from Iran). The customs dataset matches both UN-Comtrade data and mirror data. The data quality check shows that the reported Iranian Customs aggregate exports represent 98.5% of UN-Comtrade data and overlap with mirror (imports) data at the destination level.

This customs dataset has advantages over the UN-Comtrade data. Given it includes all exporters daily records for the period January 2006 to June 2011, it 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-

[20] For details, see "Obama offers Iran a new beginning," BBC, March 20, 2009.
[21] For details, see Borger, Julian, "Iran calls for nuclear talks as further sanctions loom," The Guardian, Sept. 1, 2009.
[22] I deflated export values to their January 2006 equivalents using the monthly US consumer price index (from Global Financial Data).
[23] 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.
[24] To save presentation space, I present the descriptive statistics in the appendix at the exporter-product-destination-quarter level.

destination level. It also 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, since each exporter is likely to export more than one product. The dataset is extensive enough to study the impact of exports sanctions against Iran on exporters dynamics and exports deflection.

I should mention three caveats related to the dataset. First the observations in the dataset are likely to be subject to left and right censoring. In the case of left censoring, 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, for accuracy purposes, I only consider exporters that started exporting strictly after 2006-Q1 when I estimate the effect of exports sanctions on entry rates. Similarly, for right censored observations, 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 exports sanctions on exit rates[25].

The second caveat concerns the period covered by the dataset and this study. I observe three years after the imposition of non-oil exports sanctions, so the empirical exercise considers only the short-term exporters adjustments following the sanctions. Moreover, this period coincides with the global economic crisis that broke in 2008-Q3, which may have amplified the effects of the exports sanctions on Iranian non-oil exports. I handle this caveat in the below empirical analysis section by employing the necessary fixed effects in each model estimation.

A third caveat is that the dataset does not include any other characteristic of the Iranian exporters. For example, I do not know the ownership, employment, capital, and access to finance of the exporter. But, given the scope of and the question asked in this paper, this caveat is not a hurdle.

For each quarter, Table A.I. reports 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 top Iranian non-oil exported products include prepared food, vinegar, tobacco, chemical products, aluminium, carpets, cement, fertilizers, glass, nuts, silk, zink, copper, and fibers. For the 9 quarters before the imposition of non-oil exports sanctions and for the 13 quarters after the imposition of non-oil exports sanctions, the dataset provides exhaustive information on the universe of Iranian non-oil exporters. The average number of exporters per quarter decreased by 22.6%, from 7,359 before the imposition of non-oil exports sanctions (2006-Q1 to 2008-Q1) to 6,001 after the imposition of non-oil exports sanctions (2008-Q2 to 2011-Q2). While the number of exporters during the period under analysis declined, quarterly average export value per exporter increased from USD 0.48 to 0.93 millions

[25] Along the same line, I also can not 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 interested mainly in studying whether and how existing exporters reallocate their exports across destinations following exports sanctions.

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[26].

Table A.III. reports the number of exporters and number of products to destinations imposing non-oil exports sanctions and to destinations not imposing non-oil exports sanctions. While the number of Iranian exporters to destinations imposing sanctions dropped by 30.65%, during the post-sanctions period, it increased by 12.73% in the destinations not imposing sanctions. A similar trend exists for exported products. While the number of Iranian products to destinations imposing sanctions dropped by 11.58%, during the post-sanctions period, it increased by 5.04% in the destinations not imposing sanctions. Before imposition of sanctions in March 2008, prepared food, tobacco, and chemical products such as fertilizers accounted for more than half of Iranian non-oil exports to destinations imposing sanctions. Meanwhile, Iran's non-oil exports to destinations not imposing sanctions were relatively more diversified. For instance, metals, carpets, and textiles accounted for a third of total Iranian non-oil exports. And, glass, stones, and foodstuff accounted for a quarter of Iranian non-oil exports before imposition of sanctions. Plastics and rubbers is another key component of exports to destinations not imposing sanctions.

4 Empirical analysis

4.1 Exports destruction

This subsection identifies the impact of exports sanctions on Iranian non-oil exports destruction at the exporter-destination level. I treat the imposition of exports sanctions by 31 countries in 2008 as an increase in exports costs, as discussed in section 2 above. The choice to use the exports sanctions in 2008 as a natural experiment is motivated by this being the largest shock for Iranian exporters during the time period covered by available exporter-level data for Iran. The imposition of exports sanctions in 2008 increased exports costs for Iranian exporters to various - US, UK, EU, Canadian, and Australian - destinations but not to other destinations. Using the exports sanctions experiment allows identifying a clear point in time when exports costs increased at the destination-level.

I apply a difference-in-difference approach to compare the evolution of exports to two different types of destination groups. The first group is composed of 31 treated destinations that imposed exports sanctions in March 2008 on Iranian exporters. The control group is composed of all other destinations that did not impose sanctions on Iranian exporters. The above figures show that the treated and controlled groups had similar trends before imposition of exports sanctions but different trends following imposition of exports sanctions. In the above tables, I also compare the average growth rates of different measures of exporter performance for the treated and control groups, before and after the imposition of sanctions.

I estimate the effect of sanctions on exports destruction at the exporter-destination level, using a within fixed-effect estimator for positive trade flows only, as follows:

[26] See Table A.II for more descriptive statistics at the annual-level, following the decomposition format of Eaton et al. (2007)

$$X_{edt} = \eta_0 S_{dt} + \eta_1 PS + \alpha_1 S_{dt}.PS + \gamma_{ed} + \kappa_t + \epsilon_{edt} \quad (1)$$

where X_{edt} is the log of Iranian non-oil exports per exporter to destination d at time t (I aggregate exports at the month level, so t goes from $t = 1$ (January 2006) to $t = 66$ (June 2011). S_{dt} is a dummy variable that equals to 1 for destinations imposing exports sanctions after March 2008 and zero otherwise. PS is a dummy variable for the period $t = 27 - 66$, starting in March 2008. The coefficient of interest, α_1, multiplies the interaction term, $S_{dt}.PS$, which is the same as a dummy variable equal to one for those observations in the treatment group in the period $t = 27 - 66$, following the imposition of exports sanctions. γ_{ed} is the fixed effect *exporter* $\times$ *destination*. κ_t is the set of month dummy variables. By their inclusion, I control for any market and month specifics that could affect the results, such as the difficult business environment of 2008 and 2009. Also, these fixed effects allow isolating the effects of sanctions from other macroeconomic shocks related to business cycle and competition from the rest of the world. ϵ_{edt} is the usual idiosyncratic error term.

In the above and below estimations, I account for possible correlation between disturbances within groups (Moulton, 1990). This correlation would bias the standard errors downward and increase the economic significance of the regressors. Traditional clustering methods apply only in the presence of large numbers of groups (Wooldridge, 2003). Here, following similar clustering methods applied in Iacovone and Javorcik (2010), I cluster standard errors by time as well as by destination and exporter. I obtain a large number of clusters since I have large numbers of destinations, exporters, and time periods. Using destination-exporter groups allows me to account for the fact that the size of groups changes monthly based on entries and exits of exporters in each market.

The results are reported in Table 1. They show that the imposition of sanctions had statistically significant negative effect on exports at the exporter-destination level. The exporter-level exports, following sanctions, to destinations that imposed sanctions on Iranian exporters were lower by 33% compared to exporter-level exports to destinations that did not impose sanctions on Iranian exporters (column 3, Table 1). All coefficients in Table 1 are statistically significant at the 1% level. Two points are worth mentioning here. First, equation (1) refers to column (3) of Table 1. Columns (1) and (2) of Table 1 include different fixed effects to ensure robustness. Second, unlike what is commonly believed, the March 2008 exports sanctions were against all Iranian non-oil exporters and not differentiated between one industry and another. That is why I treat the variation at the destination level only and not also at the exporter level.

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 destinations imposing exports sanctions, 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 a higher exports cost. On this basis, I introduced interaction variables between the $S_{dt}.PS$ variable and the five dummy variables that identify exporters by groups

according to their size before March 2008. I identify exporter size by its total exports. The Size quintile dummies are fixed over time and rank exporters from the smallest size group ($Size_{Q1}$) to the highest size group ($Size_{Q5}$). Columns (1), (2), and (3) of Table 2 report the estimation results corresponding to the decomposition of exporter-level exports, showing that the imposition of sanctions affected most severely the small exporters. Exporters in the highest quintile were least affected in terms of decrease in exports to destinations imposing sanctions compared to destinations not imposing sanctions. In addition, the results in Table 2 shows that the bulk of the decline in the exporter-level exports to destinations imposing sanctions was due more to the decline of the exporters' average exports per product than to the reduction of number of products.

4.2 Exports deflection

This subsection tests the hypothesis about exports deflection. The increase in exports following sanctions triggers the question about whether Iranian non-oil exporters deflected their exports following exports sanctions and if exports sanctions actually caused exports deflection. I proceed in three steps to (i) document the existence, (ii) show the mechanism, and (iii) sketch the extent of exports deflection following the imposition of exports sanctions.

4.2.1 Existence of exports deflection following exports sanctions

Before testing whether sanctions caused exports deflection, it is worth reflecting on whether exports to destinations imposing sanctions were going to fall regardless of the imposition of sanctions due to other reasons such as the trade collapse that followed the global recession in 2008. Exports sanctions came along just few months before the global economic crisis broke in fall of 2008 (Figure 1). The crisis may have obscured the effects of exports sanctions on Iranian exports deflection given the countries that imposed sanctions were actually hit more by the crisis than other countries. Given traded-goods sectors are procyclical, one explanation is that Iranian exports to destinations that imposed sanctions fell due to the recession in those economies. Another explanation is that increasing trade frictions at the international borders, broadly defined, might be the culprit. In other words, if exports reduction and deflection were caused by the recession and not due to sanctions, then I should expect a similar pattern of imports of destinations imposing sanctions from Iran and of other countries. However, it is not the case. Figure 5 shows the growth rates of US and China's imports from Iran, total imports, and economic growth. Clearly, the crisis affected Iranian exports to both US and China[27]. However, following the crisis, Iranian exports to China rose again, unlike in the case of US although its imports from other countries rose again, suggesting that the bulk of the decline in Iranian exports to specific destinations is attributable to the imposition of sanctions.

To capture whether sanctions actually caused trade deflection, I estimate the following specification:

[27] I show graphs only for US and China but I observe that similar trends hold for other destinations.

$$Deflect = \begin{array}{c} \alpha_2 Exit_{S_{dt}=1|t>26} + \alpha_3 Enter_{S_{dt}=0|t>26} \\ +\gamma_{ed} + \kappa_t + \epsilon_{edt} \end{array} \quad (2)$$

where the dependent variable is an index variable equal to 1 if the exporter exited any destination and, afterward, entered any other destination after the imposition of exports sanctions, and zero otherwise. As above, S_{dt} is a dummy variable that equals to 1 for destinations imposing exports sanctions after March 2008 and zero otherwise. $Exit_{S_{dt}=1}$ is an index variable equal to 1 if the exited destination imposed sanctions, and zero otherwise. $Enter_{S_{dt}=0}$ is an index variable equal to 1 if the entered destination did not impose sanctions and zero otherwise. And, while I focus here on the extensive margin, I look in the following subsections at whether the decrease in the volume of exports of a particular product by a particular exporter to a destination imposing sanctions happened at the same time as it increased towards destinations not imposing sanctions. In other words, I also look at the intensive margins by using a measure of volumes. Column 3 of Table 3 shows that the probability that the diverting exporter exited a destination imposing sanctions is higher by 51% and that it, subsequently, entered a destination not imposing sanctions is higher by 36%. In other words, following sanctions, Iranian exporters exited destinations imposing sanctions and entered destinations not imposing sanctions.

The above observation is confirmed when I assess the impact of sanctions on the dynamics of entry and exit at the exporter-destination and exporter-product-destination levels, using the following two equations:

$$Entry_{dt} = \eta_1 S_{dt} + \eta_2 PS + \alpha_4 S_{dt}.PS + \gamma_{td} + \epsilon_{dt} \quad (3)$$

$$Exit_{dt} = \eta_3 S_{dt} + \eta_4 PS + \alpha_5 S_{dt}.PS + \gamma_{td} + \epsilon_{dt} \quad (4)$$

where $Entry_{dt}$ and $Exit_{dt}$ represent the exporters' entry and exit rates at destination d at time t. Columns 3 and 6 of Table 4 show that exporters' entry rate was 25% lower and exporters' exit rate was 9% higher in destinations imposing sanctions compared to destinations not imposing sanctions.

I also look at whether exporters introduce more new products to destinations not imposing sanctions and drop more of the existing products from destinations imposing sanctions. To do so, I estimate:

$$Add_{epdt} = \eta_5 S_{dt} + \eta_6 PS + \alpha_6 S_{dt}.PS + \gamma_{td} + \epsilon_{dt} \quad (5)$$

$$Drop_{epdt} = \eta_7 S_{dt} + \eta_8 PS + \alpha_7 S_{dt}.PS + \gamma_{td} + \epsilon_{dt} \quad (6)$$

where Add_{epdt} is an index variable equal to 1 if the exporter introduced a new product to destination d at time t, and zero otherwise; $Drop_{epdt}$ is an index variable equal to 1 if the exporter dropped an existing product from

destination d at time t, and zero otherwise. Column 3 of Table 5 shows that the probability that an exporter introduced a new product to a destination imposing sanctions is 17% lower when compared to the probability that an exporter introduced a new product to a destination not imposing sanctions. And, column 6 of Table 5 shows that the probability that an exporter dropped an existing product from a destination imposing sanctions is 27% higher when compared to the probability that an exporter dropped an existing product from a destination not imposing sanctions.

Before moving to study the mechanism of exports deflection, it is worth mentioning a note about exports transshipments. The absence of rules of origin created a "loophole" that may have helped Iranian exporters. It may be the case that same Iranian exporters transshipped their products through UAE[28] to destinations imposing sanctions. And, it may be the case that new businesses (not necessarily of Iranian origin) captured a new business opportunity and started importing from Iran and re-exporting to destinations that imposed exports sanctions on Iranian exporters. While I can track Iranian exporters to UAE and other destinations, I cannot identify which firms are exactly exporting from Iran. That is why I cannot establish whether exports transshipments by same exporters followed exports sanctions. And, that is why I include this part in the appendix. Table A.IV presents descriptive statistics about the potential Iranian exports transshipment that happened through United Arab Emirates (UAE) following the imposition sanctions. Mainly, First, I look at the percentage change in exports of exporters that exited or reduced their exports to the US, UK, Canadian, and French destinations, following imposition of sanctions, between the pre- and post- sanctions periods. Second, I track the exports of the same exporters, at the product-level, to United Arab Emirates (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 exports transshipment, I used UN-Comtrade data for the third step as, unfortunately, I do not have access to UAE customs importer-exporter level data[29]. The results in Table A.III allow observing a trend (but not a causal relationship) of exports transshipment, at the product-level, of Iranian exporters through UAE ports.

4.2.2 Mechanism of exports deflection following exports sanctions

The role of past export status: Exporter's entry to a new destination requires fixed start-up costs related to establishing networks, acquiring information about the official procedures, and adapting products (Bernard and Jensen (2004)). Thus, if exporters already exported to a particular destination before, then the current-period

[28] 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 destinations imposing sanctions solely for illustrative purposes.

[29] On a related note, Edwards and Lawrence (2010) 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".

export supply depends on past exporting status as they continue exporting without burdening the start-up costs. So, I estimate the following equation:

$$lnX_{epdt} = \eta_9 S_{dt} + \eta_{10} PS + \alpha_8 S_{dt}.PS + \alpha_9 lnX_{epd,t-1} + \alpha_{10} lnX_{et} + \gamma_{td} + \epsilon_{epdt} \tag{7}$$

Fixed effects (FE) estimator is one way of estimating equation (7) because it eliminates time invariant error component. However, the greatest econometric concern in FE estimation of equation (7) is that it results in biased and inconsistent estimates associated with the serial correlation of $lnX_{epd,t-1}$ with FE transformed residuals. In order to remedy this autocorrelation, I first difference equation (7) and estimate it using the two stage least squares/instrumental variables (IV) approach in which I instrument for using the multiple lags of the levels of this variable[30].

It should be emphasized that there are also two potential problems with the IV estimator used in estimating equation (7); bias due to the measurement error and bias associated with the use of a weak instrument. If there is measurement error in (lnX_{epdt}), then the measurement error in the variable, $(lnX_{epd,t-1})$, will be correlated with the measurement error in the instrument, $(lnX_{epd,t-2})$. Therefore, I employ an alternative instrument, $(lnX_{epd,t-3})$ in consideration that its measurement error is not correlated with the measurement error in $(lnX_{epd,t-1})$[31].

In addition, I control for exporter size given, as discussed in Bernard and Jensen (2004), it may control for several factors; larger firms have lower costs which improve exporting activity and also size is a proxy for past success by definition. The growth in exports can also partially be explained by macroeconomic factors in the destination market. For instance, trade openness, GDP growth and exchange rate appreciation in a potential export market can work as an import demand shifter which would help exporters deflect their shipments to that destination. In this regard, I use destination-quarter dummies to control for macroeconomic aggregates.

Column (1) of Table 6 documents the estimates for equation (7). The $S_{dt}.PS$ variable has the expected sign and is statistically significant. To examine if past export relationships of the exporters to the destinations imposing sanctions provide a different outcome in terms of exports deflection, I estimate the following equations:

$$\begin{aligned} lnX_{epdt} = \; & \eta_{11} S_{dt} + \eta_{12} PS + \alpha_{11} S_{dt}.PS + \alpha_{12} lnX_{epd,t-1} + \alpha_{13} ExporterC + \\ & + \alpha_{14} S_{dt}.PS * ExporterC + \alpha_{15} lnX_{et} + \gamma_{td} + \epsilon_{epdt} \end{aligned} \tag{8}$$

$$\begin{aligned} P(EXP)_{epdt} = \; & \eta_{13} S_{dt} + \eta_{14} PS + \alpha_{16} S_{dt}.PS + \alpha_{17} lnX_{epd,t-1} + \alpha_{18} ExporterA + \alpha_{19} ExporterB \\ & \alpha_{20} S_{dt}.PS * ExporterA + \alpha_{21} S_{dt}.PS * ExporterB + \alpha_{22} lnX_{et} + \gamma_{td} + \epsilon_{epdt} \end{aligned} \tag{9}$$

where $ExporterC$ is a dummy and unity if the exporter in the unit observation was exporting a product to

[30] Note that direct estimation of the first difference of equation (7) by OLS also provides biased estimates because lagged difference of exports is correlated with the error term.

[31] I estimate the first-stage model using my instrument to test the quality of the instrument. I find that my instruments are strong and conclude that IV approach is appropriate for the above estimation.

destination d_1 and destination d_3 before the imposition of sanctions[32]. Equation (9) models the probability of exporting to a destination when sanctions are imposed in a different destination (extensive margin). $(EXP)_{epdt}$ is a binary variable that equals 1 if the exporter exports product p to destination d in time t and zero otherwise. $ExporterA$ takes on a value of 1 if the exporter was exporting product p to country d_1 and non-exporter in country d_3, $ExporterB$ is equal to 1 if the exporter was exporting product p to country d_1 but exporting another product to country d_3 before the imposition of sanctions. And, as in equation (8), $ExporterC$ is equal to 1 if the exporter was exporting product p both to d_1 and d_3 before the imposition of sanctions.

In order to deflect its exports from destination d_1 to destination d_3, exporter A, which did not export to destination d_3 before, has to incur the destination specific start-up costs such as learning the bureaucratic procedures of exporting to country d_3 and product-market specific start-up costs such as adapting the particular product in country d_3. However, exporter B does not have to incur the destination specific start-up cost in a similar scenario, given the fact that it has already served destination d_3 before. When it comes to exporter C, which has an ongoing export relationship for product p in both destinations, there is no need to pay any start-up cost. Intuitively, deflecting exports to its trading partner for exporter C is as easy as a couple of more phone calls compared to the exporter A which has to undertake the cost of entering to a new country, contacting potential customers and establishing necessary distribution channels to sell its product. On the other hand, exporter B has a comparative advantage over exporter A in terms of market specific start-up costs such as learning the bureaucratic procedures to export to country d_3.

One concern in equation (9) is the influence of unobserved heterogeneity given the existence of potential permanent exporter characteristics, product attributes, or managerial skills which can affect the decision to start exporting a particular product as a result of imposition of sanctions. Given these variations are not observed in the dataset, the estimation can overestimate the effect of the sanctions interactions. There are different alternatives to estimate the binary choice model of starting to export a product with unobserved elements including maximum likelihood techniques such as probit or conditional logit, or linear probability model with random or fixed effects. For the reason that unobserved heterogeneity is correlated with exporter specific controls, random effect estimation is not appropriate for this specification. As a result, to model the unobserved heterogeneity as fixed, I chose to work with linear probability model[33].

In addition, it is likely that unobserved characteristics in my model are serially correlated with $(lnX_{epd,t-1})$. Therefore, I follow a methodology similar to the above estimation to correct for autocorrelation and instrument for $(lnX_{epd,t-1})$ using its second lag. Given the potential correlation of fixed effects transformed residuals with the lagged export value, I estimate the model using IV first differences in order to avoid the problem of inconsistent estimates found in the fixed effects model.

[32] I assume that d_1 is a destination that imposed exports sanctions on exporters from d_2 and d_3 is a destination that did not impose exports sanctions on exporters from d_2; Iran is d_2 in this case.

[33] see Avsar (2013) for similar framework

Column (2) of Table 6 shows the results of equation (8). The effect of sanctions remains statistically significant when it is interacted with the past exporting status ($ExporterC$). This result suggests that exporters begin to increase their export values to alternative destinations that they were already exporting the same product to when they face sanctions in a particular export destination (intensive margin). Following Kennedy (1981), I convert the coefficient of the dummy variable to its true marginal effect to better quantify the magnitude of exports deflection. So, in terms of the economic interpretation, imposition of exports sanctions resulted in a 65% increase in the Iranian exporters' exports to alternative destinations where the exporters previously exported the same product.

Column (3) of Table 6 documents the results for the extensive margin estimation. Similarly, the past exporting statuses of exporters are interacted with the sanctions variable. The interaction of sanctions variable has a higher statistical and economic significance for $ExporterB$ than $ExporterA$. This result suggests that imposition of sanctions in a particular destination increases the exporters' probability of exporting their product in a different destination if the exporter already served the destination before. And, it shows that such probability also increases - but at a lower rate - to the export destinations that exporters did not export before. In terms of the magnitude of the effect, imposition of sanctions in a particular destination increases the probability of exporting in a different destination by 9% for the destinations that the exporter exported another product before and by only 5% for the destinations that the exporter exported another product before. The lower statistical and economic significance levels of the coefficient of $ExporterA$ interaction demonstrate that market specific start-up costs of exporting plays a crucial role in determining an exporter's decision to deflect exports when faced with exports sanctions in a particular destination.

The price of exports 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 product exported to destinations not imposing exports sanctions[34]. A change in the unit value of a given product in the data can be consistent with a combination of (i) 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)).

To check for evidence of changes in product prices following exports deflection, I compared deflected product prices of diverting exporters in the first shipment following exports deflection with (i) the prices of same products by same exporters in their last shipment before exports deflection and (ii) 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 exports 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 (per kg) by dividing the total

[34]In this subsection, I focus mainly on the products that exporters deflected from destinations imposing sanctions to destinations not imposing sanctions. If a new product is introduced following exports deflection just to serve the needs of new customers in the new destination, then no change will be observed.

value of shipment of exports of product p by exporter e at time t by the weight of shipment.

The results presented in Figure 6 indicate that deflecting exporters reduced their product prices by, on average, 6.3% in the first shipment following exports deflection compared with their prices of same products in their last shipment before exports deflection and their new product prices are just, on average, 0.7% 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 exports deflection.

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 exports deflection, one must ask whether all or which exporters deflected exports from destinations imposing sanctions to destinations not imposing sanctions. The size and experience of exporters are expected to affect their ability, willingness, and decision to deflect trade from one destination to another. To test whether this prediction is true, I estimate the following equation:

$$Deflect_{edt} = \alpha_{23} X_{edt} + \alpha_{24} Experience_{edt} + \gamma_{ed} + \kappa_t + \epsilon_{edt} \tag{10}$$

where $Deflect_{edt}$ is an indicator variable equal to one if an exporter exited a destination imposing sanctions and, then, entered a destination not imposing sanctions following the imposition of sanctions, and zero otherwise. X_{edt} and $Experience_{edt}$ represent the size and experience of the exporter in the destination imposing sanctions before March 2008. I measure the size and experience of the exporter at destination by, respectively, the log of value of its exports and log of number of months of its export experience in that destination since entry.

Column 3 of Table 7 shows that a 1% increase in the size or age of exporter in a destination imposing sanctions is associated with, respectively, a 19% and 11% increase in the probability that this exporter actually deflected exports following sanctions to a destination not imposing sanctions. In other words, small exporters tend not to deflect exports to new destinations following sanctions as they have lower ability to cover the cost of entering a new market. In all specifications, I find that larger exporters are more likely to deflect exports to new export markets following sanctions. As a robustness check (not reported to save space), I also test a linear probability model with exporter-destinations fixed effects and confirm that smaller exporters are more likely to stop exporting to (exit) a destination after it imposes exports sanctions on them. These observations are consistent with the assumption of exporter heterogeneity, which suggests that exporters have specific productivities and thus behave in export market in different ways. Figure 7 complement this result. It shows how much of export volumes deflecting exporters were actually able to deflect. I divide the exporters into two groups: small exporters whose monthly export value was below the export value per average exporter and large exporters whose monthly export value was above the export value per average exporter in the destination imposing sanctions (that they deflected from) during the month of their last shipment. Large deflecting exporters achieved higher level of exports deflection, on average, than small

diverting exporters. While large exporters deflected on average 75% of their exports, small exporters deflected on average 40% of their exports from destinations imposing sanctions to destinations not imposing sanctions.

Product selection during exports deflection: This subsection looks at the characteristics of products that deflecting exporters deflected from destinations imposing sanctions to destinations not imposing sanctions. It is well known that products of a given exporter have different export volumes in a given destination. And, by no means different products have similar exporting trends and characteristics. For example, while some products are homogeneous, other products are heterogeneous[35]. The heterogeneity of exporters along the dimensions of both characteristics and quality of their products affect the differentiation level of products. Precisely, I examine whether exporters tend to deflect (i) more of their "core competence" products[36] and (ii) their homogeneous products more than their differentiated products.

When modelling exports deflection at the exporter-product level, I first check whether there is heterogeneity among deflected products within the same exporter. One can model heterogeneous deflecting exporters producing multiple products as being equally good in deflecting each of their products. Or one can assume that exporters have product-specific competencies and deflect some products more efficiently than others – or that some products are easier to redirect than others.

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 succeeded to deflect their exports following exports sanctions tend to deflect more of their "core-competence" products. I also examined whether homogeneous products are more likely to be deflected – by deflecting exporters following sanctions – from destinations imposing sanctions to destinations not imposing sanctions. For this reason, following Rauch (1999), I split all exported products in the dataset into two groups: homogeneous products and heterogeneous products. While homogeneous products (i.e. copper) are traded on organized exchanges, heterogeneous products (i.e. carpets) are not[37]. The idea is that there is a cost to setting up "markets" (organized exchanges) that is independent of the volume of transactions, and that this non-convexity will not allow a market to open if the expected volume of transactions at the price expected to prevail in equilibrium is too small.

For the purpose of empirical work, following Rauch (1999) product classification scheme, I consider the existence of a reference price distinguishes homogeneous from differentiated products. Homogeneous commodities can be further divided into those whose reference prices are quoted on organized exchanges and those whose reference prices are quoted only in trade publications. It is easier for exporters to deflect their homogeneous products as the

[35] Using Rauch (1999) methodology, I split the products in the dataset into two groups: homogeneous and heterogeneous.

[36] 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.

[37] Rauch (1999) offers more details about the motivation of this product classification.

cost of searching for consumers for 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). Thus, exports deflection is expected to apply most strongly to homogeneous products and most weakly to products not traded on organized exchanges; higher export costs act as a barrier to trade for differentiated products.

I examine the above hypotheses using this estimation:

$$Deflect_{ept} = \begin{array}{c} \alpha_{25} X_{pre-diversion} + \alpha_{26} Xshare_{pre-diversion} \\ +\alpha_{27} Diff + \gamma_{ed} + \kappa_t + \epsilon_{edt} \end{array} \tag{11}$$

where $Deflect_{ept}$ is a dummy variable equal to one if the exporter dropped a given product from a destination imposing sanctions and, then, introduced it in a destination not imposing sanctions at a given time, and zero otherwise. $X_{pre-diversion}$ is the log of export value of the product at the exporter-destination level before export deflection from a given destination; $Xshare$ represent the weight of the product in the portfolio of the exporter before export deflection from a given destination; and "$Diff$" is an dummy variable equal to 1 if the product is differentiated, and zero if the product is homogeneous.

The results in Table 8 show that higher export value and share of exports of a given product before export deflection are associated with higher probability of product export deflection. And, the probability that differentiated products tend to get diverted is 51% lower compared to homogeneous products (column 3, Table 8). I proxy the importance of a product by the value of the product exports and the share of the product in the exporter total exports at the exporter-destination level. The results hold at less than 5% significance levels. These observations are consistent with the assumption of product heterogeneity made by Eckel and Neary (2010) theoretical model. The existence of product heterogeneity informs about which products are more likely to be deflected from destinations imposing sanctions to destinations not imposing sanctions.

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

$$N_{dt} = \alpha_8 Z_{dt} + \gamma_t + \kappa_d + \epsilon_{dt} \tag{12}$$

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 control variable capturing economic size, distance, price competitivenesss, ease of imports, foreign direct investment net inflows, tariff rate, imports growth, the correlation of positions during votes on resolutions in the General Assembly of the United Nations[38] of as well as the number of Iranian immigrants[39]

[38] I use the voting similarity index of Strezhnev and Voeten (2013) dataset on the correlation between positions of countries during UN Gereral Assembly votes.

[39] 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.

and existing Iranian exporters at the new controlled 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 both the probability of sanctions and bilateral trade. The coefficients in Table 9 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.

4.3 Extent of exports deflection

As a final exercise I provide "back-of-the-envelope" estimates to calculate how much of the Iranian non-oil exports to the destinations imposing sanctions that are thought to be destroyed because of exports sanctions were actually deflected to destinations not imposing exports sanctions. To derive these estimates, I divided the exports of Iranian products to destinations imposing sanctions into two groups: (i) product exports by exporters exporting the same products to destinations imposing sanctions as well as to destinations not imposing sanctions before March 2008; and (ii) product exports by exporters existing only in destinations imposing sanctions before March 2008. Exporters existing in destinations imposing sanctions as well as destinations not imposing sanctions accounted for 70 % of Iranian exports to destinations imposing sanctions before March 2008. And, exporters existing only in destinations imposing sanctions accounted for 30 % of Iranian exports to destinations imposing sanctions before March 2008.

Figure 8 sketches the extent to which exporters were able to deflect exports following the imposition of exports sanctions. It shows that deflecting exporters deflected two-thirds of their pre-sanctions exports. Precisely, exporters to both treated and controlled destinations diverted 88% of their exported product values to destinations not imposing sanctions that they were already exporting the same products to. This value is equivalent to 61.6% (88% of 70%) of Iranian exports to destinations imposing sanctions before March 2008. And, the exporters that only exported to the destinations imposing sanctions before March 2008 were able to deflect only 14% to destinations not imposing sanctions that they did not exist in already. This value is equivalent to 4.2% (14% of 30%) of Iranian exports to destinations imposing sanctions before imposition of sanctions. These results are consistent with the results presented in Table 6.

5 Conclusion

How exporters behave when faced with exports sanctions is of interest to economists and policy-makers. This paper investigates one of the potential international implications of exports sanctions. Using a rich Customs dissaggreted dataset, it studies whether and how exports sanctions triggered Iranian exporters to deflect exports to destinations not imposing sanctions. It uncovers the mechanism through which Iranian exports deflection happened, at the micro-level, following sanctions as well as the extent to which Iranian exporters were able to deflect exports.

This paper documents that two-thirds of the value of Iranian non-oil exports thought to be destroyed by non-oil exports sanctions have actually been deflected to destinations not imposing sanctions. The paper also highlights that: larger and more experienced exporters were less affected by sanctions and more able to deflect their exports than smaller and less experienced exporters; exporters deflected firstly their core and homogeneous products; exporters reduced their product prices as they deflected exports to new destinations; past exporter's status in a given destination matter for exports deflection at the exporter-level; and deflecting exporters targeted more the destinations that are more politically-friendly with Iran. These findings provide evidence that sanctions may be less effective in a globalized world as exporters can deflect their exports from one export destination to another. The idea that one country can impose trade sanctions on another may not necessarily prove effective unless the exporters of the targeted country do not have or can not find compensating alternatives and new trading partners. The empirical analysis in this paper also provides support to recent theories suggesting the existence of trade reallocation following changes in trade costs.

While this paper is the first to use micro-level data to understand the real impact of exports sanctions, further research can go in at least three directions. First, the empirical evidence presented in this paper calls 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 financial sanctions, so in couple years one can study the impact of financial sanctions as well.

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Figure 1: Evolution of Iranian Non-oil Exports

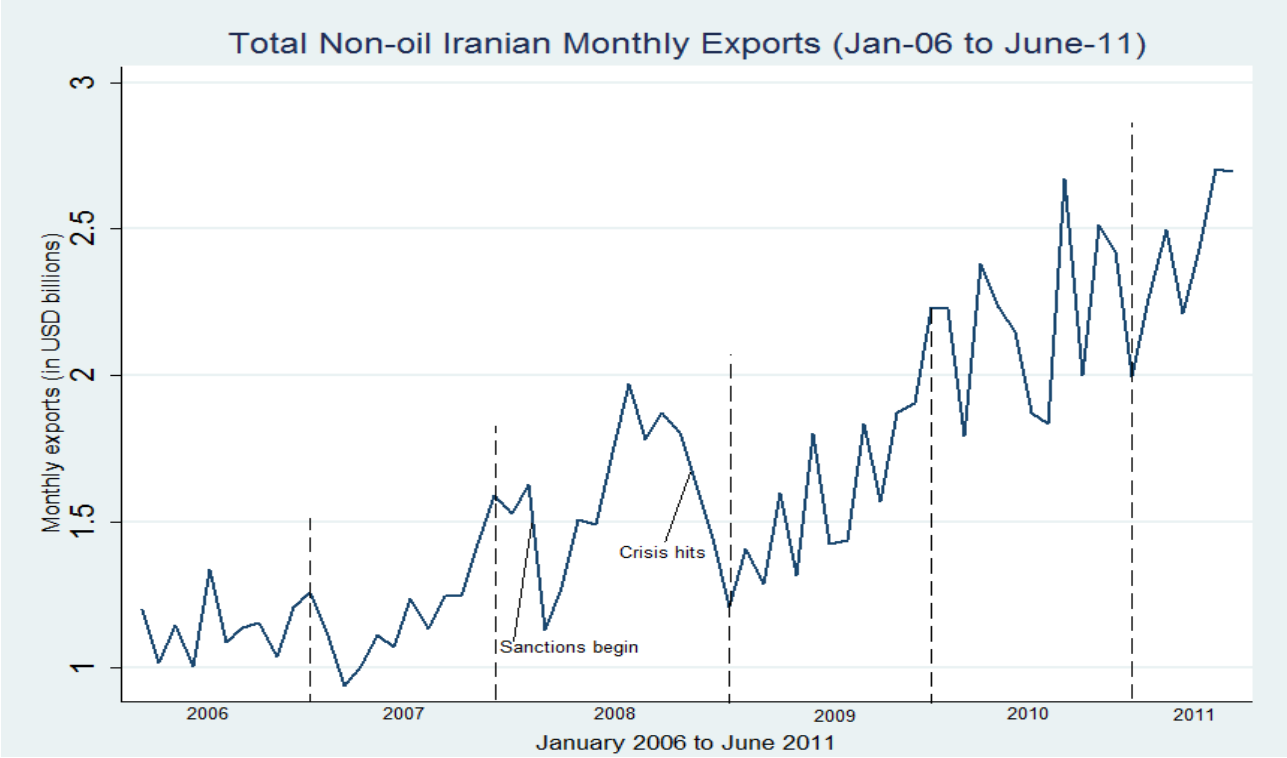

Figure 2a: Evolution of Iranian Non-oil Exports

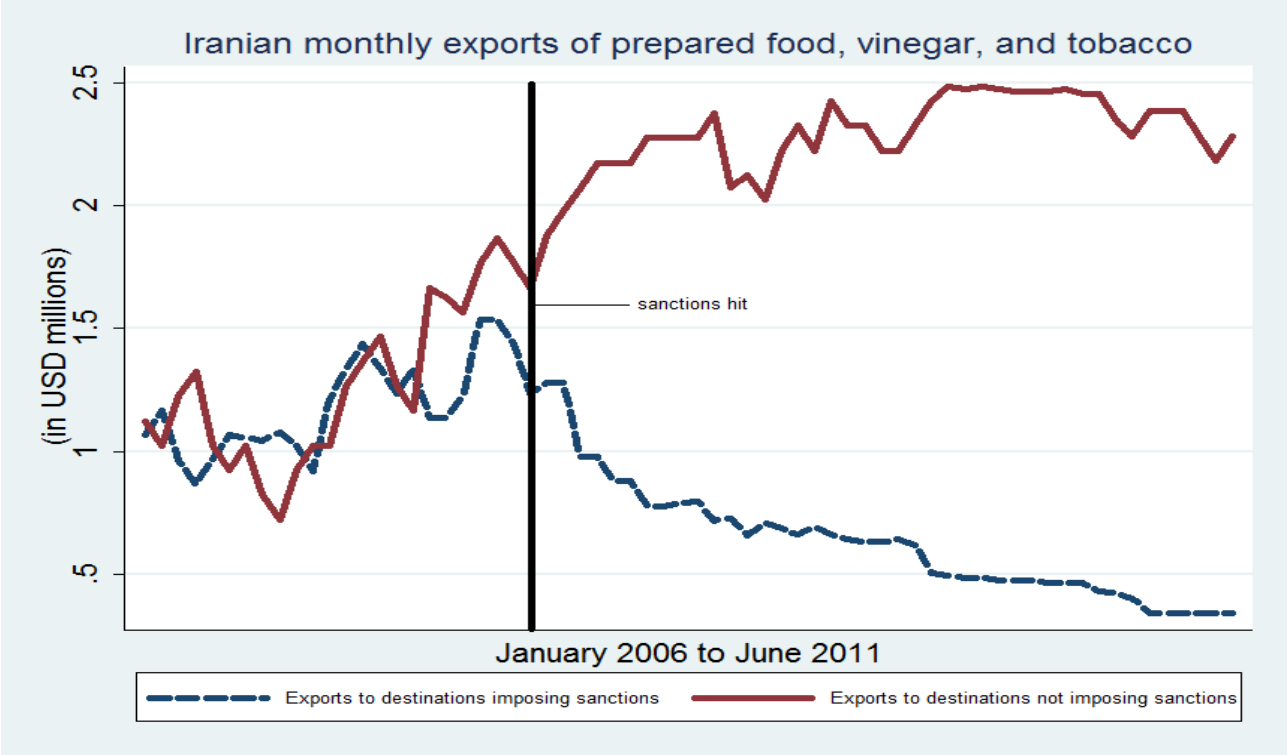

Figure 2b: Evolution of Iranian Non-oil Exports

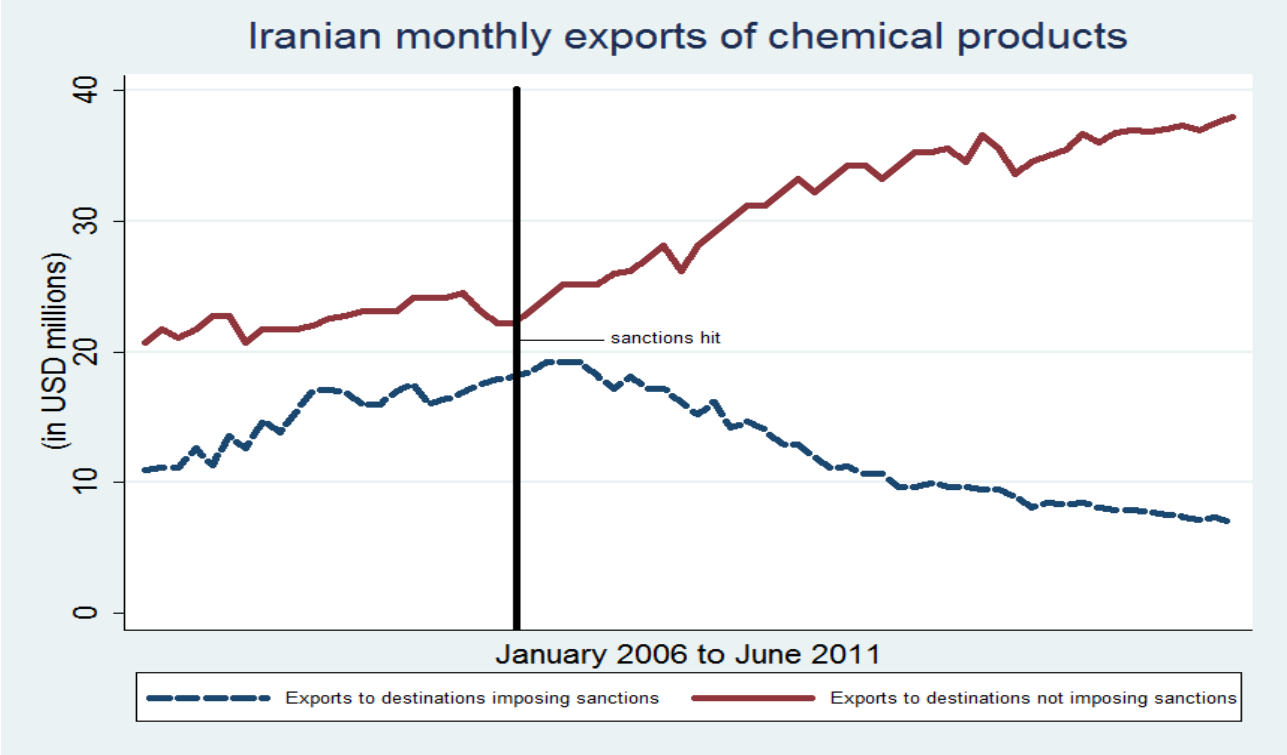

Figure 3a: Exports destruction

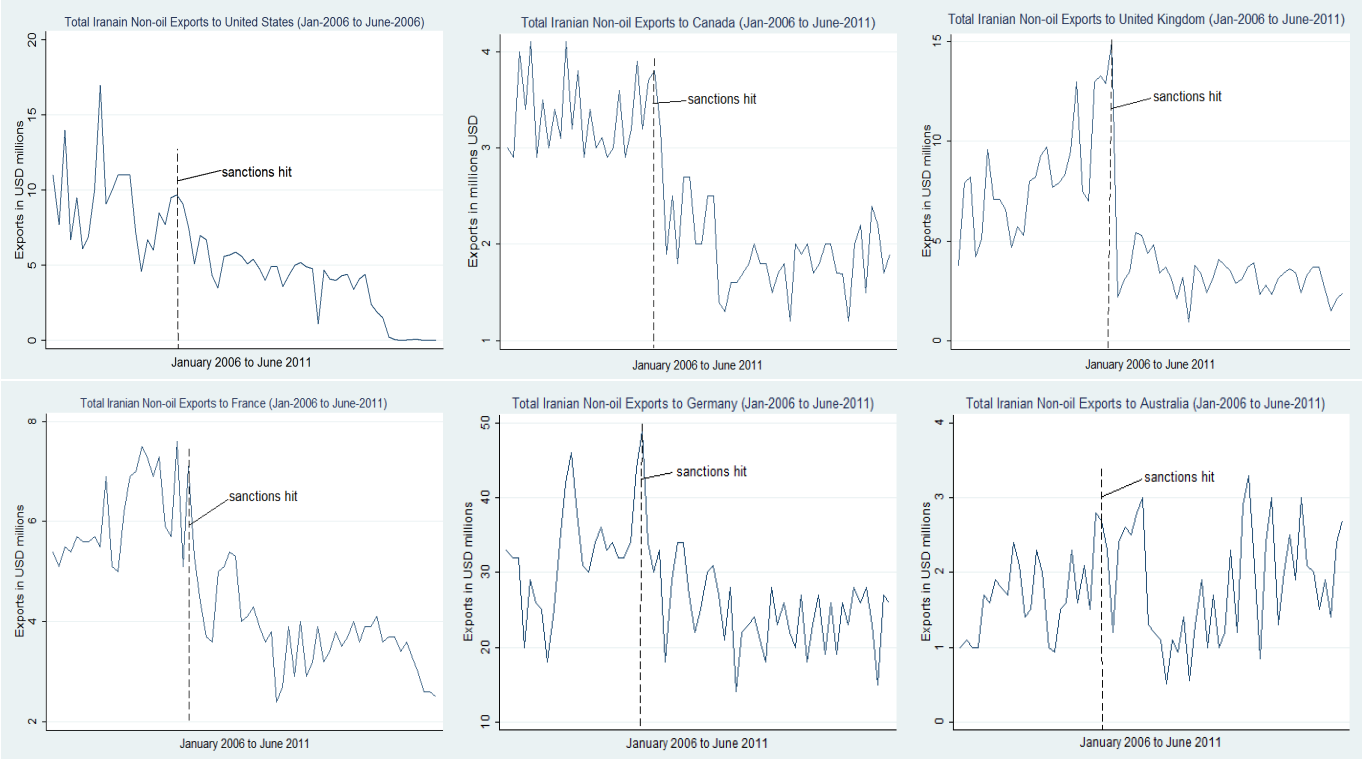

Figure 3b: Exports deflection

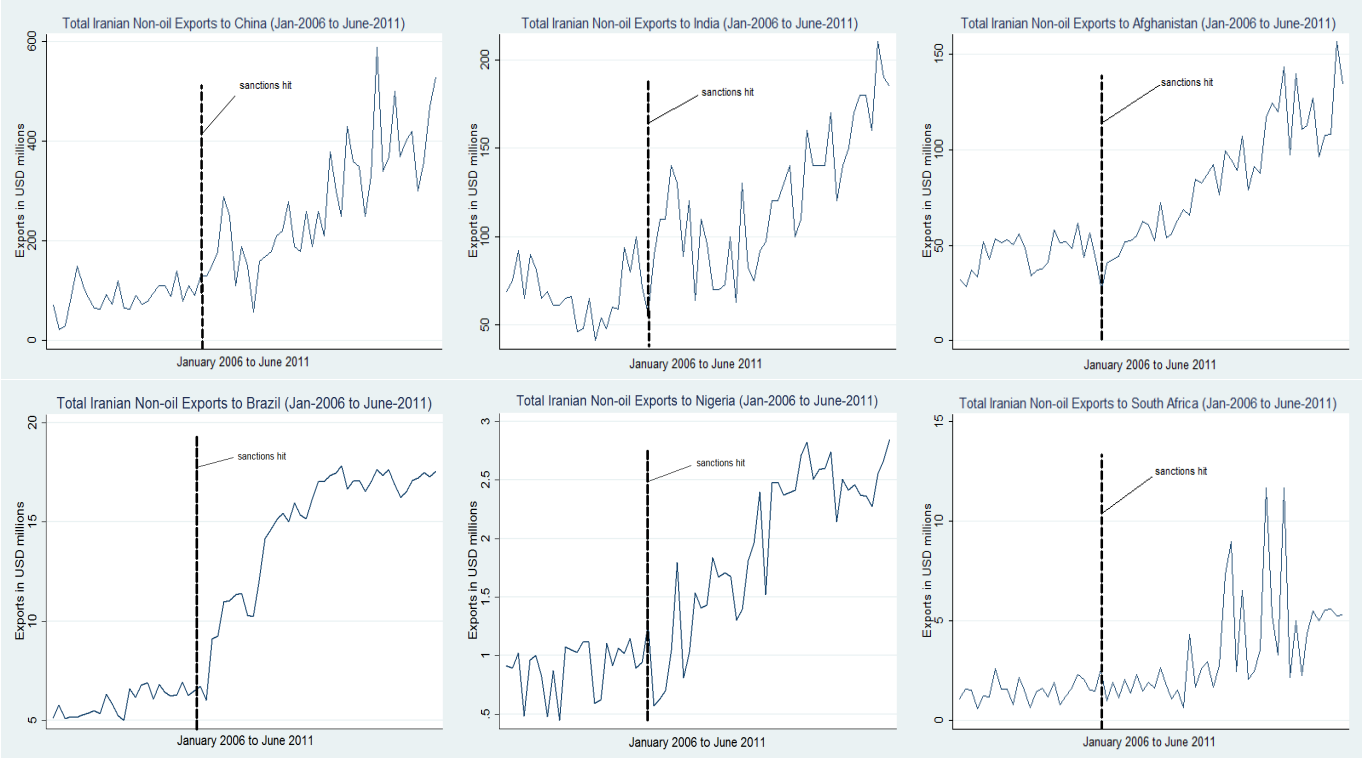

Figure 4a: Export Trends

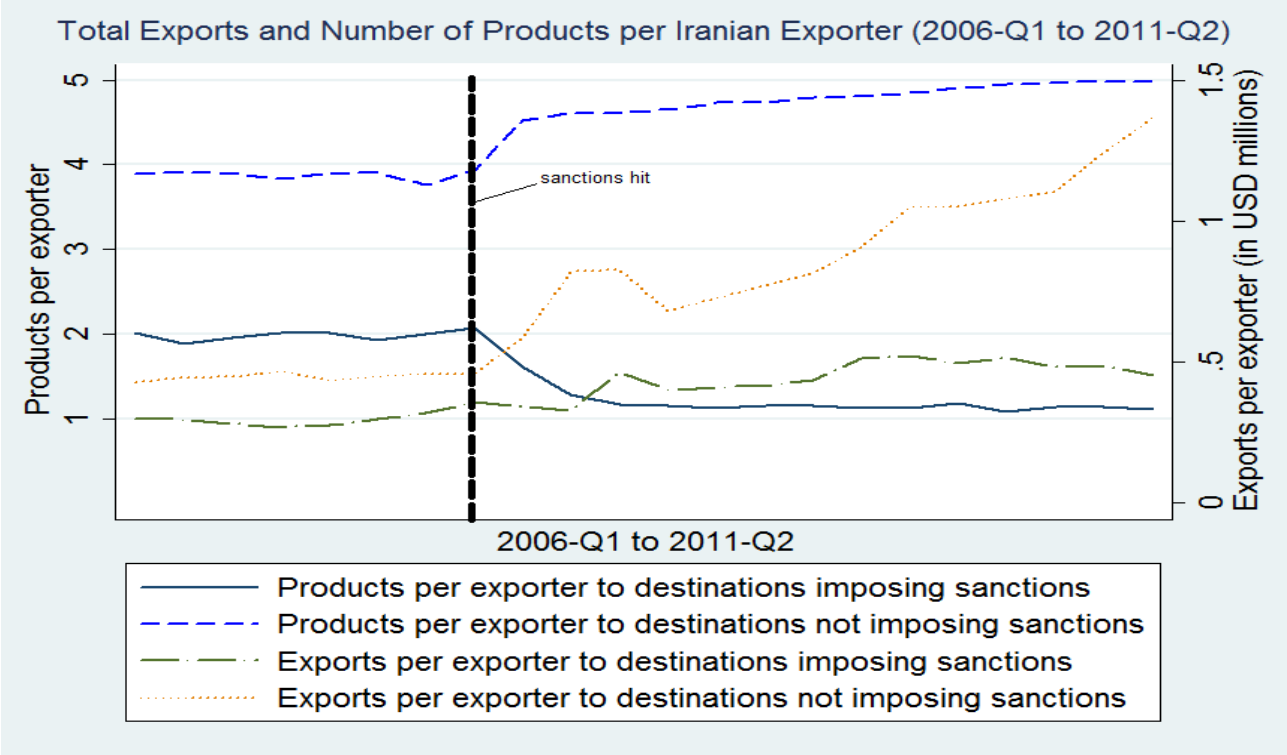

Figure 4b: Export trends - entry and exit

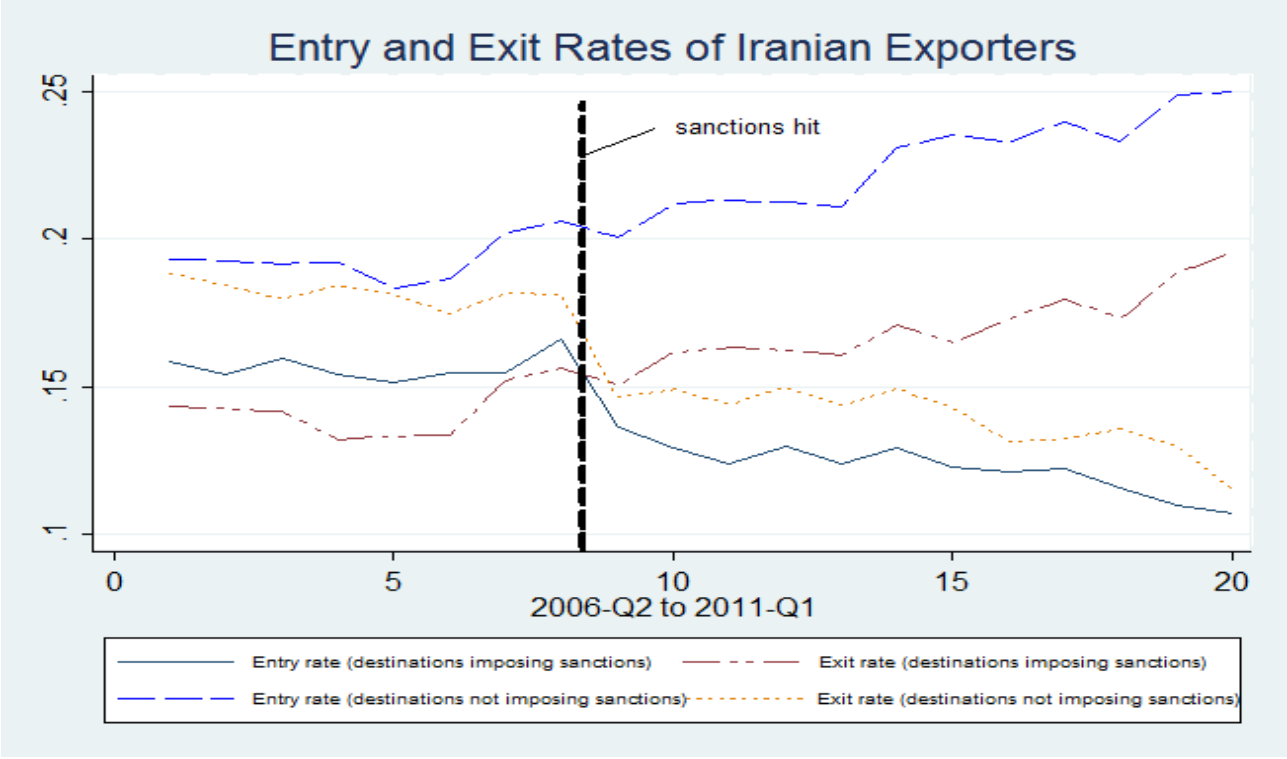

Figure 4c: Export trends - entry and exit

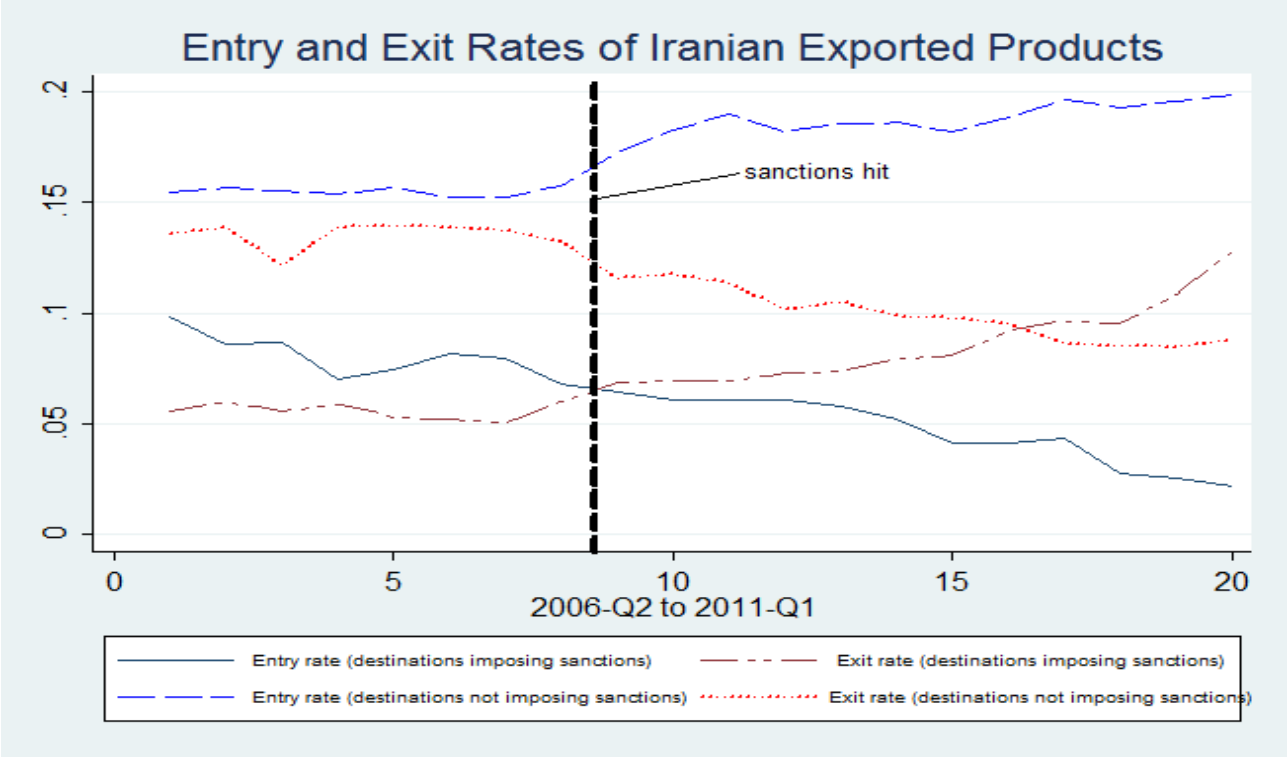

Figure 5: Is it about recession or sanctions?

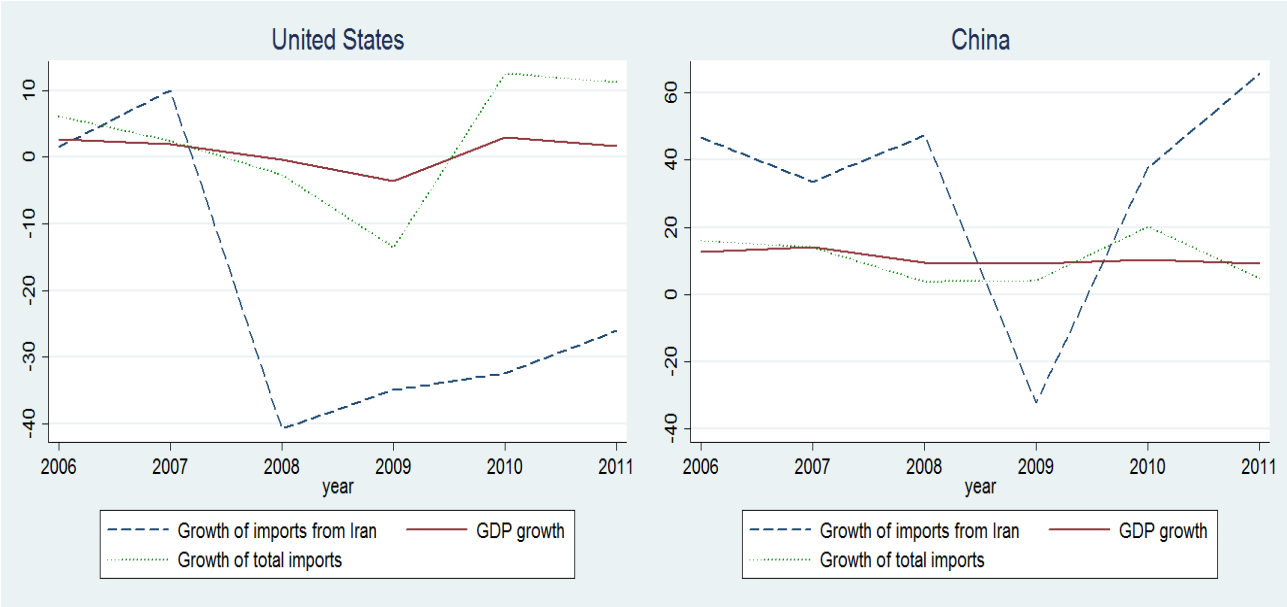

Figure 6: Deflecting exporters reduced their prices following exports deflection

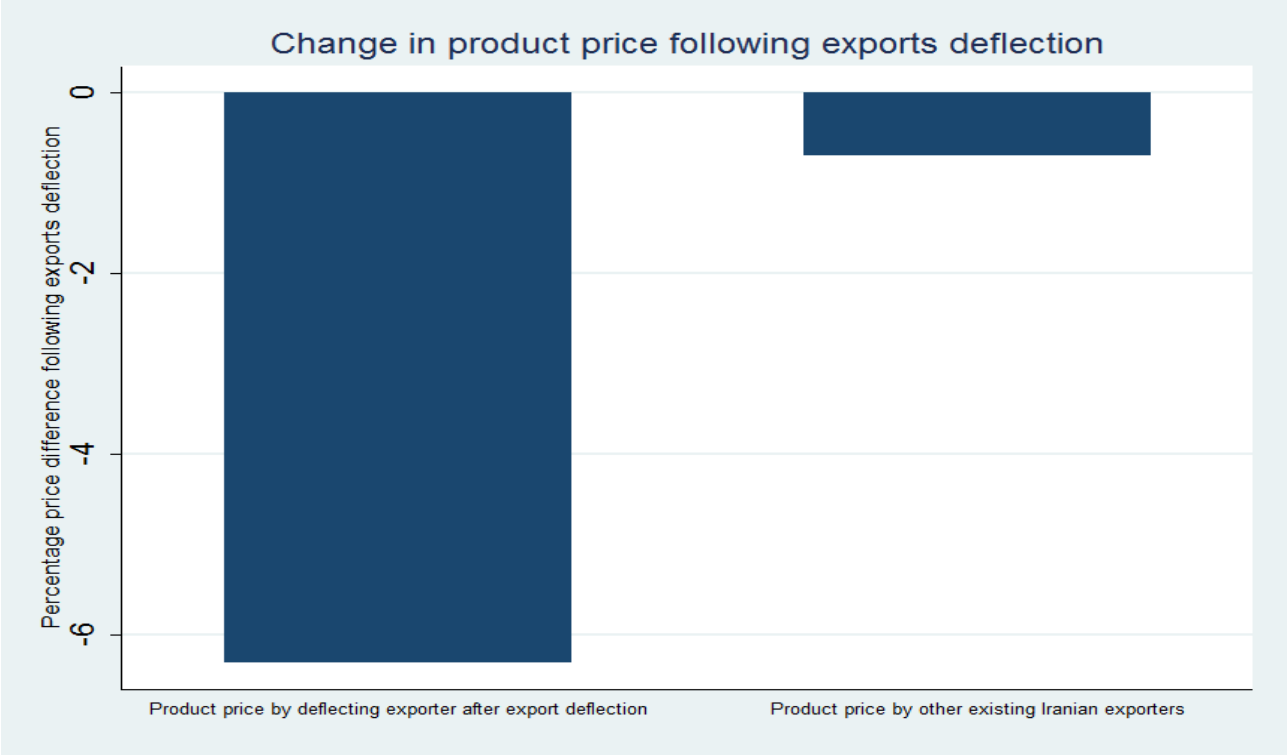

Figure 7: Large exporters deflect relatively more of their exports than small exporters

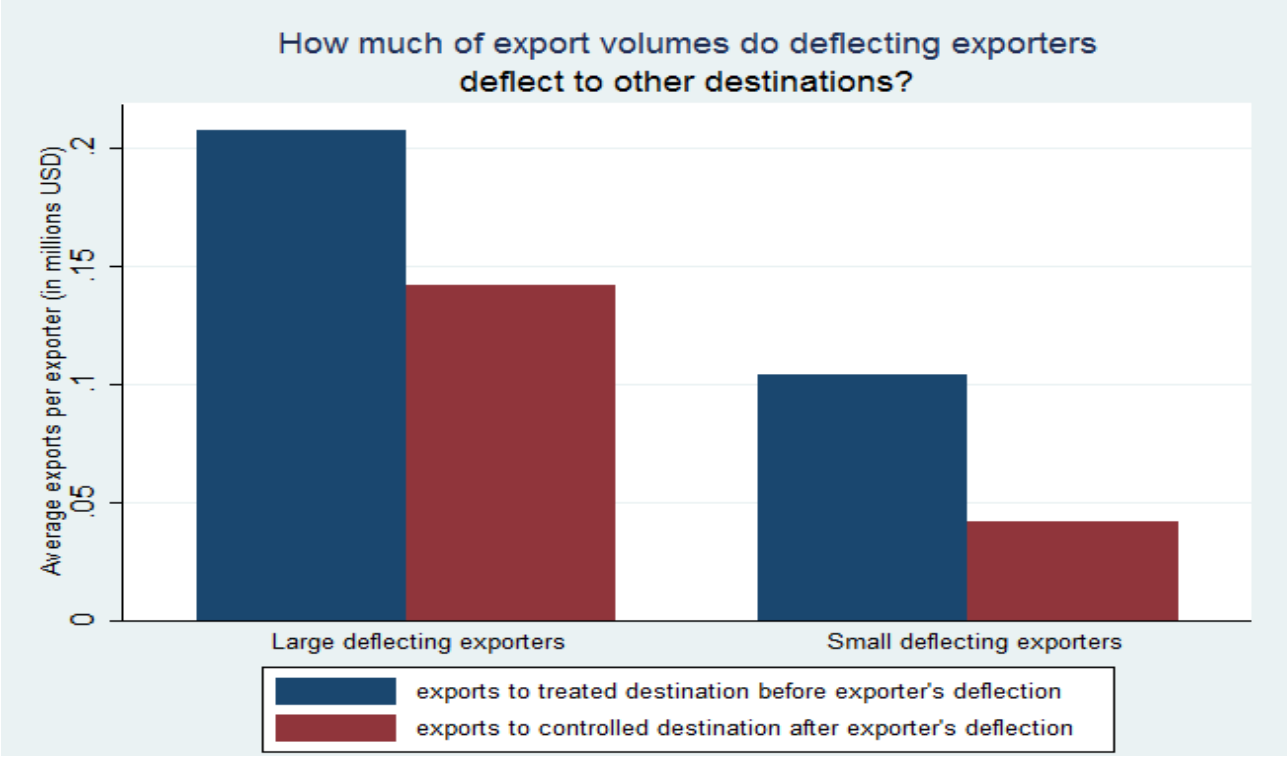

Figure 8: Iranian exporters diverted two-thirds of their pre-sanctions exports

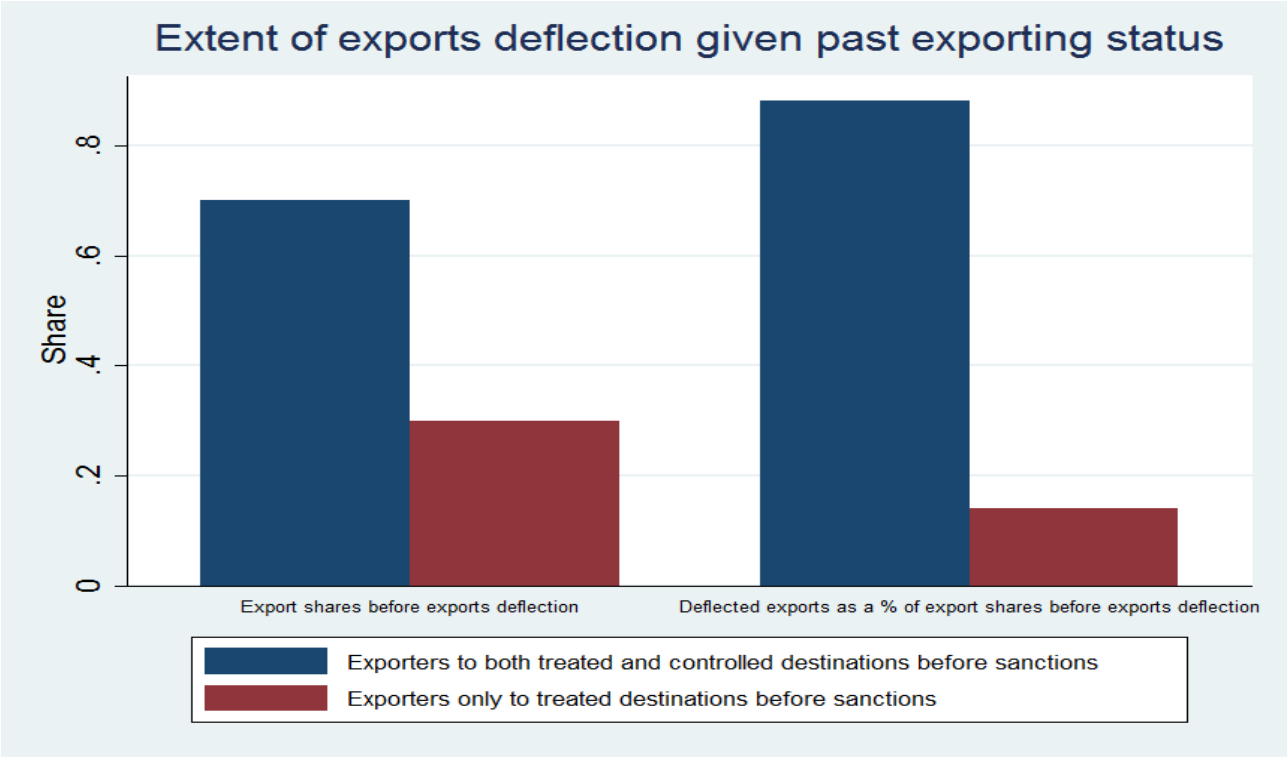

Table 1: Impact of sanctions on exports at the exporter-destination level

	(1)	(2)	(3)
$S_{dt}.PS$	-0.411^a	-0.294^a	-0.328^a
	(0.000)	(0.000)	(0.000)
$S_{dt}dummy$		Yes	
$PSdummy$		Yes	
Month, Exporter FEs	Yes		
Exporter, Destination FEs		Yes	
Month, Exporter*Destination FEs			Yes
R-squared	0.562	0.524	0.556
Observations	398034	398034	398034

The dependent variable is the log of Iranian exports at the exporter-destination-month level. P-values are in brackets. ^{a} denotes statistical significance at the 1% level. I also repeated this and the below estimations and controlled for other variables – namely distance, market size, total imports and inflation at destination – individually and jointly, and the results hold.

Table 2: Sanction impacts interacted with size before March 2008

	X_{edt}	N_{pedt}	$\bar{x}_{pedt}$
	(1)	(2)	(3)
$S_{dt}.PS\times Size_{Q1}$	-0.752^a	-0.307^a	-0.445^a
	(0.000)	(0.000)	(0.000)
$S_{dt}.PS\times Size_{Q2}$	-0.622^a	-0.225^a	-0.397^a
	(0.004)	(0.007)	(0.003)
$S_{dt}.PS\times Size_{Q3}$	-0.446^b	-0.121^c	-0.325^c
	(0.043)	(0.061)	(0.082)
$S_{dt}.PS\times Size_{Q4}$	-0.124^a	-0.094^a	-0.030^a
	(0.000)	(0.000)	(0.00)
$S_{dt}.PS\times Size_{Q5}$	-0.083^a	-0.006^a	-0.073^a
	(0.000)	(0.000)	(0.000)
$S_{dt}dummy$		Yes	
$PSdummy$		Yes	
Month, Exporter*Destination FEs		Yes	
R-squared	0.531	0.546	0.518
Observations	398034	398034	398034

X_{edt} , N_{pedt} , and $\bar{x}_{pedt}$ denote, repectively, log of Iranian non-oil exports , number of products exported, and average export value per product per exporter to destination d at time t. P-values are in brackets. ^{a}, ^{b}, ^{c} denote statistical significance at the 1, 5, and 10 % levels, respectively. I also repeated this and the below estimations and controlled for other variables – namely distance, market size, namely distance, market size, total imports and inflation at destination – individually and jointly, and the results hold.

Table 3: Impact of sanctions on exports deflection at the exporter-destination level

	(1)	(2)	(3)
Exit treated	0.536[a]	0.502[a]	0.512[a]
	(0.000)	(0.000)	(0.000)
Enter controlled	0.376[a]	0.264[a]	0.360[a]
	(0.000)	(0.000)	(0.000)
Month, Exporter FEs	Yes		
Exporter, Destination FEs		Yes	
Month, Exporter*Destination FEs			Yes
Observations	26823	26823	26823

The dependent variable is an index variable representing whether an exporter exits a treated destination and enters a controlled destination after sanctions. A treated (controlled) destination is one that did (did not) impose sanctions. The independent variables are index variables representing whether the exited destination is treated and the entered destination is controlled. P-values are in brackets. [a] denotes statistical significance at the 1% level.

Table 4: Impact of sanctions on entry and exit rates of exporters at the destination level

	(1)	(2)	(3)	(4)	(5)	(6)
		$Entry_{dt}$			$Exit_{dt}$	
$S_{dt}.PS$	-0.324[c]	-0.195[b]	-0.246[b]	0.0792[c]	0.127[b]	0.094[b]
	(0.054)	(0.035)	(0.041)	(0.097)	(0.028)	(0.012)
$S_{dt}dummy$		Yes			Yes	
$PSdummy$		Yes			Yes	
Month FEs	Yes			Yes		
Destination FEs		Yes			Yes	
Month*Destination FEs			Yes			Yes
Observations	8421	8421	8421	8421	8421	8421

The dependent variables are entry and exit rates at the exporter-destination-month level. P-values are in brackets. [b] and [c] denote statistical significance at the 5% and 10% levels, respectively.

Table 5: Impact of sanctions on entry and exit at the exporter-product-destination level

	(1)	(2)	(3)	(4)	(5)	(6)
		Add_{epdt}			$Drop_{epdt}$	
$S_{dt}.PS$	-0.191[a]	-0.166[a]	-0.173[b]	0.296[a]	0.263[b]	0.271[c]
	(0.000)	(0.000)	(0.013)	(0.000)	(0.042)	(0.061)
$S_{dt}dummy$		Yes			Yes	
$PSdummy$		Yes			Yes	
Month FEs	Yes			Yes		
Destination FEs		Yes			Yes	
Month*Destination FEs			Yes			Yes
Observations	8421	8421	8421	8421	8421	8421

Add_{epdt} is an index variable equal to 1 if the exporter added a new product to a destination d at time t, and zero otherwise. $Drop_{epdt}$ is an index variable equal to 1 if the exporter added a new product to a destination d at time t, and zero otherwise. P-values are in brackets. [a], [b] and [c] denote statistical significance at the 1%, 5%, and 10% levels respectively.

Table 6: Does past export status matter?

	Intensive margin		Extensive margin
	(1)	(2)	(3)
$S_{dt}.PS$	0.052^{b}	0.048^{b}	0.037^{c}
	(0.026)	(0.039)	(0.072)
$S_{dt}.PS$*ExporterA			0.053^{b}
			(0.042)
$S_{dt}.PS$*ExporterB			0.092^{a}
			(0.000)
$S_{dt}.PS$*ExporterC		0.648^{a}	
		(0.000)	
ExporterA			0.017
			(0.134)
ExporterB			0.092^{c}
			(0.081)
ExporterC		0.0163^{a}	
		(0.001)	
$lnX_{epd,t-1}$	0.205^{b}	0.222^{a}	
	(0.015)	(0.000)	
lnX_{et}	0.063^{a}	0.051^{a}	0.045^{a}
	(0.005)	(0.000)	(0.000)
S_{dt}		Yes	
PS		Yes	
Quarter-Destination dummies		Yes	
R-squared	0.21	0.27	0.39
Observations	211341	211341	211341

P-values are in brackets. ^{a}, ^{b}, and ^{c} denote statistical significance at the 1, 5, and 10 % levels, respectively. All specifications include a constant term.

Table 7: Which exporters did deflect?

	(1)	(2)	(3)
Log of total exports	0.32^{b}		0.19^{b}
	(0.043)		(0.021)
Log of months of		0.14^{b}	0.11^{b}
export experience		(0.029)	(0.026)
Month, Exporter FEs	Yes		
Exporter, Destination FEs		Yes	
Month, Exporter*Destination FEs			Yes
Observations	35953	35953	35953

The dependent variable is equal to one if the exporter exited a destination imposing sanctions and, then, entered a destination not imposing sanctions following the imposition of sanctions, and zero otherwise. P-values are in brackets. ^{b} denotes statistical significance at the 5% level.

Table 8: Which products did deflecting exporters deflect?

	(1)	(2)	(3)
Export value	0.41[b]		0.74[b]
	(0.031)		(0.014)
Share of products		0.59[b]	0.48[b]
in total exports		(0.026)	(0.021)
Differentiated	-0.63[a]	-0.68[a]	-0.51[a]
	(0.000)	(0.000)	(0.002)
Month FEs	Yes		
Exporter FEs	Yes		
Month, Exporter*Destination FEs		Yes	Yes
Observations	108024	108024	108024

P-values are in brackets. The dependent variable is equal to one if the exporter dropped a given product from a destination imposing sanctions and, then, introduced it to a destination not imposing sanctions at a given time, and zero otherwise. The independent variable "Differentiated" equal to 1 if the product is differentiated, and zero if homogeneous. p-values in brackets.[a] denotes statistical significance at the 1% level.[b] denotes statistical significance at the 5% level.

Table 9: Characteristics of destinations that deflecting exporters targeted

	N_{dt}	
	(1)	(2)
UN vote correlation		0.615[a]
		(0.001)
ln GDP	0.079[c]	0.062[c]
	(0.088)	(0.084)
ln Distance	-0.056[c]	
	(0.081)	
Inflation		0.037[c]
		(0.061)
Ease of import		0.007
		(0.228)
FDI (net inflows)		0.148[b]
		(0.037)
Tariff rate		-1.142[b]
		(0.037)
Imports growth		0.068[c]
		(0.055)
ln Immigrants		0.321[c]
		(0.074)
ln Exporters		0.569[a]
		(0.000)
Month FEs	Yes	Yes
Destination FEs		Yes
Observations	984	984

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 controlled destination that deflecting exporters deflected to. The total number of controlled destinations throughout the post-sanctions period/month is 984. P-values are in brackets. [a], [b], and [c] denote statistical significance at the 1, 5, and 10% levels, respectively.

Appendix

Table A.I.: Descriptive statistics for Iranian Non-Oil Exporters (2006Q1 - 2011Q2)

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 exporters transactions data after aggregating daily transactions data at 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
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

Table A.III.: Number of exporters and products across destinations before and after non-oil exports sanctions

	Total number of exporters to destinations		Total number of products to destinations	
Quarter	imposing sanctions	not imposing sanctions	imposing sanctions	not imposing sanctions
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 exporters transactions data after aggregating daily transactions data at the quarter level. A product is defined as a HS 6-digit category. The exporters who export to destinations imposing sanctions as well as to destinations not imposing sanctions are included in both groups in this table. Non-oil exports sanctions hit in March 2008. Pre-sanctions period includes 2006Q1 to 2008Q1. Post-sanctions period includes 2008Q2 to 2011Q2.

Table A.IV: Exports transshipment

Product	% Δ in Iranian exports to				% Δ in Iranian exports to	%Δ in UAE re-exports to			
	US	Canada	UK	France	United Arab Emirates	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 exporters transactions data. All figures represent % changes between pre- and post-sanctions periods. A product is defined as an HS 6-digit category.