Sanctions and Exports Deflection: Evidence from Iran

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Abstract

I uncover the existence, extent, and mechanism of exports deflection, which followed exports destruction, after the imposition of exports sanctions against Iranian exporters. Using highly disaggregated data about Iranian non-oil exports, 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 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 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 continue to be an economic weapon deployed by countries in support of foreign policy goals. Over the last century, different countries imposed 174 international economic sanctions (Hufbauer et al. (2007)). Thus, exports sanctions against Iran are no exception. Davis and Engerman (2003), Doxey (1980), Drezner (1999), Eaton and Engers (1992, 1999), Elliot and Hufbauer (1999), Elliot and Richardson (1997), Kaempfer and Lowenberg (1988), Levy (1999), Martin (1993), and van Bergeijk (2009) provided various theoretical frameworks to explain how sanctions work. However, we still lack understanding about how exporting firms behave when faced with exports sanctions. Due to an increasingly globalized economy, many alternative destinations exist for exporters affected by sanctions. The fact that non-oil Iranian exports increased following the imposition of sanctions on Iranian non-oil exports (Figure 1) makes understanding relevant exporters dynamics even more important. Being able to access the universe of (more than 1.81 million) Iranian non-oil exports transactions data that are disaggregated at the exporter-product-destination-day level, I study empirically whether and how exports sanctions against Iranian exporters caused exports deflection.

The potential response of exporters to sanctions is not obvious. The literature does not inform whether exporters stop exporting following sanctions or whether they just reduce their exports to destinations imposing sanctions. Also, it does not tell whether and how (some or all) exporters deflect their exports to new destinations following exports sanctions. Exports deflection can compensate exports destruction and, thus, should not be ignored. In this paper, I address these questions and document the existence, extent, and mechanism, at the most dis-aggregated level, of exports deflection following exports sanctions. By doing so, I contribute to the burgeoning literature – i.e., Albornoz et al. (2012), Atkeson and Burstein (2008), Berman et al. (2012), Bernard et al. (2012), Berthou and Fontagné (2013), Cebeci et al. (2012), Das et al. (2007), Eaton et al. (2004, 2011), Freund and Pierola (forthcoming), Khandelwal and Topalova (2011), Mayer et al. (2014), and Melitz (2003) – on exporters dynamics and cost of exporting. For example, Besedes and Prusa (2011) investigated and compared countries export growth based on their performance at the extensive and intensive export margins. Moreover, Besedes and Prusa (2013) provided evidence on the extent to which discriminatory trade policy eliminate trade.[1] Precisely, I establish empirically, at the firm-level, whether and how exports deflection happened following the imposition of exports sanctions against Iran.[2]

[1] 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.

[2] The impact of the financial sanctions on Iranian economy in 2012 is beyond the scope of this paper, especially as

Iran serves as a suitable country for this study for various reasons. First, the exports sanctions against Iran in March 2008 serve as a quasi-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.

To investigate whether exports sanctions cause exports deflection at the micro-level, I exploit a rich dataset covering the universe (more than 1.81 million transactions of daily exports) of Iranian non-oil exporters between 2006 and 2011. I focus on non-oil exports for four reasons. First, sanctions which 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 that 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 sectors represent 20% of Iranian total 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 illustrations of the empirical motivation for investigating the existence of exports destruction and exports deflection following exports sanctions. Sanctions are usually not imposed as complete cessation of all trading relationships. Rather, they are imposed with regulations which make trade more expensive or cumbersome (see discussion in section 2). In Figures 2a and 2b I show total Iranian monthly exports of selected products between January 2006 and June 2011 to two groups of destinations. I plot exports to destinations imposing sanctions and to destinations not imposing sanctions. I 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.[3] The dramatic fall in exports to destinations imposing sanctions (exports destruction) is associated with a substantial increase in exports of those same (HS-6 digit level) products to destinations not imposing sanctions (exports deflection). I observe the same trends when I look at the aggregate level as well. In Figures 3a and 3b I show

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.

[3]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.

aggregate Iranian non-oil exports to selected destinations imposing sanctions as well as to selected destinations not imposing sanctions. In addition, in Figure 4a I show 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 Appendix Tables A1 and A2, suggesting that smaller exporters exited destinations imposing sanctions. In Figures 4b and 4c I look at the entry and exit rates[4] 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. To know whether exports deflection happened following sanctions, I test whether the same exporters who exited destinations imposing sanctions have then entered destinations 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 had 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".[5] A novel feature of my analysis is a deeper investigation of the mechanism of exports deflection as exporter-level data allow me to uncover a lot of action taking place within exporters and across destinations.

[4]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.

[5]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. In the literature, trade deflection is different from trade diversion (see Bown and Crowley (2007)). 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 in Viner (1950), is associated with welfare reduction for the importing country since it increases the cost of the imported good.

As an outline of the empirical analysis, I first find evidence that exports sanctions on Iranian exporters lead to destruction of Iranian exporter-level exports to the destinations that imposed exports sanctions. Second, I show evidence that exports sanctions on Iranian exporters lead to a deflection in Iranian exporter-level exports 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.[6]

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 showed 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 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 another market. The results of these

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

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. Section 4 presents the empirical anaylsis. Section 5 concludes.

2 The sanctions against Iran

In this section I give a brief historical outline of the sanctions against Iran, with an emphasis on exports sanctions,[7] 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.[8] 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.[9] 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 strenghthen sanctions on Iranian imports of nuclear-related materials and technology and froze the assets of individuals involved with nuclear activities.[10]

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.[11] Moreover, the EU published an expanded list of Iranian individuals deemed persona non grata in the union. 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 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.[12] Subsequently, in October 2007, the United States announced a raft of

[7] Export sanctions are different from embargoes: export sanctions represent higher export costs, and embargoes represent a shift to autarky via a trade blockade.

[8] For details, see "Iran Reported to Security Council," BBC News, Feb. 4, 2006.

[9] For details, see "Germany could accept nuclear enrichment in Iran," Reuters, June 26, 2006

[10] For details, see UNSC Resolutions 1696 and 1737.

[11] For details, see UNSC Resolution 1747.

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

new unilateral sanctions against Iran, the toughest since it first imposed sanctions on Iran following the Islamic Revolution in 1979, for "supporting terrorists".[13] The sanctions cut more than 20 organizations associated to Iran's Islamic Revolution Guard Corps from the US financial system.

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. I 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 mainly treated as "recommendations". Thus, knowing about how countries precisely imposed sanctions is important.

The United States, European Union, Canada, and Australia imposed exports 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.[14] 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.[15] 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.

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

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

[14]There has been recent instances of 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.

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

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.

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.[16] 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.[17] 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, between January 1, 2006 and June 30, 2011, 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,[18] 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.[19] I aggregated

[16] For details, see "Obama offers Iran a new beginning," BBC, March 20, 2009.

[17] For details, see Borger, Julian, "Iran calls for nuclear talks as further sanctions loom," The Guardian, Sept. 1, 2009.

[18] I deflated export values to their January 2006 equivalents using the monthly US consumer price index (from Global Financial Data).

[19] 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

daily customs data into exporter-product-destination-month observations.[20] To test the quality of the data, which I obtained from Iranian Customs, I compared the customs data 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 product-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-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 within exporters and across products.

I should mention three caveats related to the dataset. 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 interested mainly in studying whether and how existing exporters reallocate their exports across destinations following exports 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 exports sanctions against Iranian exporters, 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 necessary fixed effects in each estimation.

the data at the HS-6 digit level product classification.

[20]To save presentation space, I present the descriptive statistics in the appendix at the exporter-product-destination-quarter level.

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 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.[21]

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.

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

4 Empirical analysis

In this section I present the empirical analysis in four steps. First, I show the impact of exports sanctions on exports destruction. Second, I present empirical evidence on exports deflection following exports sanctions. Third, I document the extent to which exports destruction had been compensated by exports deflection following exports sanctions against Iran. Fourth, I highlight the mechanism through which exports deflection occurred following exports sanctions.

4.1 Exports destruction

In this subsection I identify 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 March 2008 as an increase in exports costs. As discussed in section 2, non-oil exports sanctions against Iran were imposed in March 2008. The choice to use the exports sanctions in 2008 as a quasi-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 by United States, United Kingdom, European Union, Canada, and Australia in 2008 increased exports costs for Iranian exporters to these destinations but not to other destinations. Using the exports sanctions experiment allows identifying a clear point in time when exports costs increased at the exporter-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 against Iran. 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 exports sanctions on Iran.

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

$$X_{edt} = \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \alpha_1 S_d.PS_t + \gamma_{ed} + \kappa_t + \epsilon_{edt} \quad (1)$$

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_d is a dummy variable that equals to 1 for destinations imposing exports sanctions against Iran after March 2008 and zero otherwise. PS_t is a dummy variable for the period $t = 27 - 66$, starting in March 2008. The coefficient of interest, α_1, multiplies the interaction term, $S_d.PS_t$, 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 a fixed effect $exporter \times destination$. κ_t is a 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.

I report the results in Table 1. 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 1, 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 (1) of Table 1. Columns (2) and (3) 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 and not also at the sectoral 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 against Iran, 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 $S_d.PS_t$ 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 (1-3) 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 percentage decrease in exports to destinations imposing sanctions compared to destinations not imposing sanctions.

4.2 Exports deflection

In this subsection I present empirical evidence on the 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 economic 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 by exports 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 U.S. and China's imports from Iran, total imports, and economic growth. Clearly, the crisis affected Iranian exports to both U.S. and China.[22] 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, suggesting that the bulk of the decline in Iranian exports to specific destinations is attributable to the imposition of sanctions.

To capture whether sanctions caused exports deflection at the exporter-level, I estimate the follow-

[22]I present graphs only for US and China but I observe similar trends for other destinations.

ing specification:

$$Deflect_{ed|t>26} = \alpha_0 + \alpha_2 Exit_{S_d=1|t>26} + \alpha_3 Enter_{S_d=0|t>26} + \gamma_{ed} + \kappa_t + \epsilon_{edt} \quad (2)$$

where the dependent variable, $Deflect_{ed|t>26}$, equal to 1 if the exporter exited a destination imposing sanctions and, afterward, entered another destination that did not impose sanctions after March 2008, and zero otherwise. As above, S_d equals to 1 for destinations imposing exports sanctions against Iranian exporters after March 2008, and zero otherwise. $Exit_{S_d=1|t>26}$ equals to 1 if the exporter exited a destination that imposed sanctions, and zero otherwise. $Enter_{S_d=0|t>26}$ equals to 1 if the exporter entered a destination that did not impose sanctions, and zero otherwise. Column 1 of Table 3 shows that the movement of $Exit_{S_d=1|t>26}$ from 0 to 1 produce a 51.2 percentage point increase in the probability that the given exporter deflected its exports from a destination imposing sanctions to a destination not imposing sanctions. It also shows that the movement of $Enter_{S_d=0|t>26}$ from 0 to 1 produce a 36 percentage point increase in the probability that the given exporter deflected its exports from a destination imposing sanctions to a destination not imposing sanctions.

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

$$E_{dt} = \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \alpha_4 S_d.PS_t + \gamma_d + \kappa_t + \epsilon_{dt} \quad (3)$$

where E_{dt} represent, in different estimations, the entry and exit rates of exporters at the destination level. 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, 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, 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. Column 1 of Table 4 shows that sanctions reduced exporters' entry rate by an average of 24.6% to destinations imposing sanctions compared to destinations not imposing sanctions. And, column 4 of Table 4 shows that sanctions increased exporters' exit rate by an average of 9.4% from destinations imposing sanctions compared with destinations not imposing sanctions.

While I focused above on the extensive margin, I now turn to look at the intensive margin. Precisely,

I 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:

$$AD_{dt} = \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \alpha_5 S_d.PS_t + \gamma_d + \kappa_t + \epsilon_{dt} \tag{4}$$

where AD_{dt} represent, in different estimations, ADD_{dt} and $Drop_{dt}$. ADD_{dt} is the share of exporters that introduced a new product to destination d at time t. $Drop_{dt}$ is the share of exporters that dropped an existing product from destination d at time t. Column 1 of Table 5 shows that sanctions reduced the share of exporters that introduced a new product to destinations imposing sanctions by an average of 17.3% compared to destinations not imposing sanctions. And, column 4 of Table 5 shows that sanctions increased the share of exporters that dropped an existing product from destinations imposing sanctions by an average of 27.1% compared to destinations not imposing sanctions.

Before studying the extent and mechanism of exports deflection, it is worth mentioning a note about exports transshipments. The absence of rules of origin within exports 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 Emirates (UAE) to destinations imposing sanctions.[23] 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 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 UAE. 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. In Table A.IV I present descriptive statistics about potential Iranian exports transshipment that happened through UAE following the imposition of exports 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 exports sanctions, between the pre- and post-exports 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

[23] 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.

as the interest is primarily in the exporter-level exports transshipment, I used UN-Comtrade data for the third step as I do not have access to UAE customs importer-exporter level data.[24] The results in Table A.IV allow observing a trend (but not a causal relationship) of exports transshipment, at the product-level, of Iranian exporters through UAE ports.

4.3 Extent of exports deflection

In this subsection I provide "back-of-the-envelope" estimates about how much of the Iranian non-oil exports to the destinations imposing sanctions that are thought to be destroyed because of exports sanctions have actually been deflected to destinations not imposing exports sanctions. To derive these estimates, I divided the exports of Iranian non-oil 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 non-oil 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 6 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. However, 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 econometric results presented in Table 6 below.

[24] 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".

4.4 Mechanism of exports deflection

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

$$lnX_{epdt} = \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \alpha_6 S_d.PS_t + \alpha_7 lnX_{epd,t-1} + \alpha_8 lnX_{et} + \gamma_{td} + \epsilon_{epdt} \tag{5}$$

Fixed effects (FE) estimator is one way of estimating equation (5) because it eliminates time invariant error component. However, a key econometric concern in FE estimation of equation (5) 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 (5) 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.[25]

I should emphasize that there are also two potential problems with the IV estimator used in estimating equation (5): 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 $(lnX_{epd,t-1})$.[26]

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. Also, the growth in exports can 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 (5). The $S_d.PS_t$ variable has the

[25]Note that direct estimation of the first difference of equation (5) by OLS also provides biased estimates because lagged difference of exports is correlated with the error term.

[26]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.

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:

$$lnX_{epdt} = \begin{array}{c} \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \alpha_9 S_d.PS_t + \alpha_{10} lnX_{epd,t-1} + \alpha_{11} ExporterC \\ +\alpha_{12} S_d.PS_t * ExporterC + \alpha_{13} lnX_{et} + \gamma_{td} + \epsilon_{epdt} \end{array} \tag{6}$$

$$P(EXP)_{epdt} = \begin{array}{c} \alpha_0 + \eta_0 S_d + \eta_1 PS_t + \alpha_{14} S_d.PS_t + \alpha_{15} lnX_{epd,t-1} + \alpha_{16} ExporterA + \alpha_{17} ExporterB \\ \alpha_{18} S_d.PS_t * ExporterA + \alpha_{19} S_d.PS_t * ExporterB + \alpha_{20} lnX_{et} + \gamma_{td} + \epsilon_{epdt} \end{array} \tag{7}$$

where $ExporterC$ is a dummy and unity if the exporter in the unit observation was exporting a product to destination d_1 and destination d_3 before the imposition of sanctions.[27] Equation (7) 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. $ExporterB$ equals 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 (6), $ExporterC$ equals 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, $ExporterA$, which did not export to destination d_3 before, has to incur specific market entry costs. These costs include efforts to learn the bureaucratic procedures of exporting to country d_3 as well as product-specific entry costs such as adapting the particular product to preferences of consumers in country d_3. However, $ExporterB$ does not have to incur the destination specific entry cost in a similar scenario, given the fact that it has already served destination d_3 before, but it has to incur the product-specific entry costs. When it comes to $ExporterC$, which has an ongoing export relationship for product p in both destinations, there is no need to pay any entry cost. Intuitively, deflecting exports to its trading partner for $ExporterC$ is as easy as a couple of more phone calls compared to the $ExporterA$ 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, $ExporterB$ has a comparative advantage over $ExporterA$ in terms of market specific entry costs such as learning the bureaucratic procedures to export to country d_3.

[27] 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.

One concern in equation (7) 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 exports 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. Because the unobserved heterogeneity is correlated with exporter specific controls, random effect estimation is not appropriate for this specification. Thus, to model the unobserved heterogeneity as fixed, I chose to work with linear probability model.[28] 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.

Column (2) of Table 6 shows the results of equation (6). The effect of exports sanctions remains holds 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 exports sanctions by 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 exports sanctions variable. The interaction of sanctions variable has a higher economic significance for $ExporterB$ than $ExporterA$. This result suggests that imposition of exports sanctions by a particular destination increases the exporters' probability of exporting their product to 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

[28] see Avsar (2013) for similar framework

effect, imposition of exports sanctions by a particular destination increases the probability of exporting to a different destination by 9% for the destinations that the exporter exported another product to before and by only 5% for the destinations that the exporter did not export another product before. The lower economic significance level of the coefficient of $ExporterA$ interaction demonstrates that market specific start-up costs of exporting and past export status play 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. 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. 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 deflecting 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 value of shipment of exports of product p by exporter e at time t by the weight of shipment.

The results presented in Figure 7 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. Also, 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. 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.[29]

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 exports from one destination to another. To test whether this prediction is true, I estimate the following equation:

$$Deflect_{ed|t>26} = \alpha_0 + \alpha_{21} lnX_{edt} + \alpha_{22} lnExperience_{edt} + \gamma_{ed} + \kappa_t + \epsilon_{edt} \quad (8)$$

where 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 1 of Table 7 shows that doubling the size or experience of exporter in a destination imposing sanctions generates, respectively, a 19 and 11 percentage point 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 exporter heterogeneity assumption which suggests that exporters have specific productivities and thus behave in export market in different ways. Figure 8 complements 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 deflecting

[29] I have also checked the product prices of deflecting exporters over time. After they start deflecting their exports at lower prices, those prices did not change the longer (i.e. the second year) they remain in new markets.

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: I now turn to look 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 differentiated.[30] 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 and (ii) homogeneous products more than differentiated products. When modelling exports deflection at the exporter-product level, I first check whether there is heterogeneity among deflected products. One can model heterogeneous deflecting exporters as being equally good in deflecting any 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 deflect 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 differentiated products. While homogeneous products (i.e. copper) are traded on organized exchanges, differentiated products (i.e. carpets) are not.[31] The idea is that there is a cost of 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

[30] Using Rauch (1999) methodology, I split the products in the dataset into two groups: homogeneous and differentiated.
[31] Rauch (1999) offers more details about the motivation of this product classification.

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 homogeneous products as the 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 an export barrier for differentiated products. I examine the above hypotheses using this estimation:

$$Deflect_{ep|t>26} = \alpha_0 + \alpha_{23} X_{pre-deflection} + \alpha_{24} Xshare_{pre-deflection} + \alpha_{25} Diff + \gamma_{ed} + \kappa_t + \epsilon_{ept} \tag{9}$$

where $Deflect_{ep|t>26}$ equals to one if the exporter dropped a given productfrom a destination imposing sanctions and, then, introduced it to a destination not imposing sanctionsafter 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 given destination. $Xshare$ represent the weight of the product in the portfolio of the exporter before export deflection from a given destination. "$Diff$" 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 8 show that higher export value and share of exports of a given product by a given exporter to a destination imposing sanctions are associated with higher probability that the product gets deflected by its exporter. And, the movement of $Diff$ from 0 to 1 generate a 51 percentage point increase in the probability that the given product gets deflected by its exporter from a destination imposing sanctions to a destination not imposing sanctions. 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). The existence of product differentiation 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:

$$N_{dt} = \alpha_0 + \alpha_{26} Z_{dt} + \gamma_t + \kappa_d + \epsilon_{dt} \tag{10}$$

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 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[32] of as well as the number of Iranian immigrants[33] 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 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.

5 Conclusion

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

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

[33] 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.

I document 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. Also, I highlight 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 more of their core and of 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 redirect 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 firm-level dis-aggregated data to understand the impact of exports sanctions on Iranian exporters between 2006 and 2011, 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 dis-aggregate 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 one can study the impact of financial sanctions as well.

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Figure 1: Evolution of Iranian Non-oil Exports

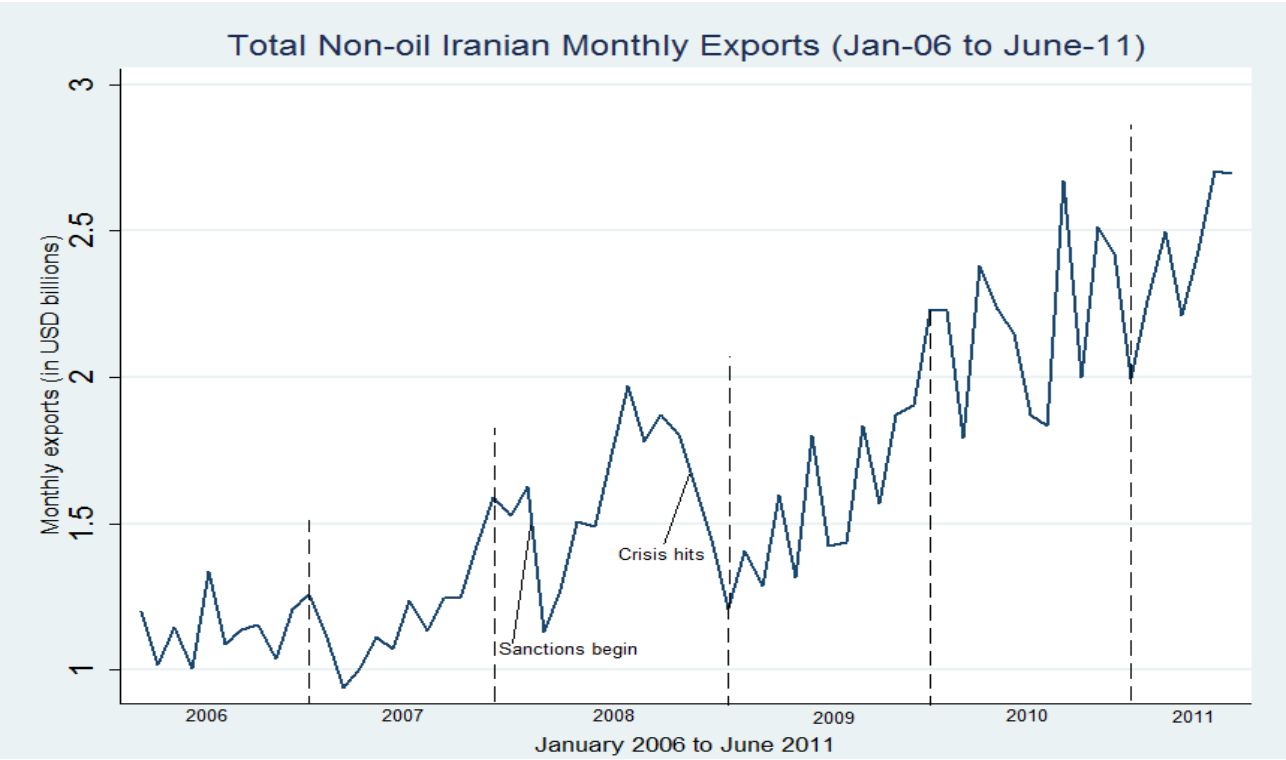

Figure 2a: Evolution of Iranian Non-oil Exports

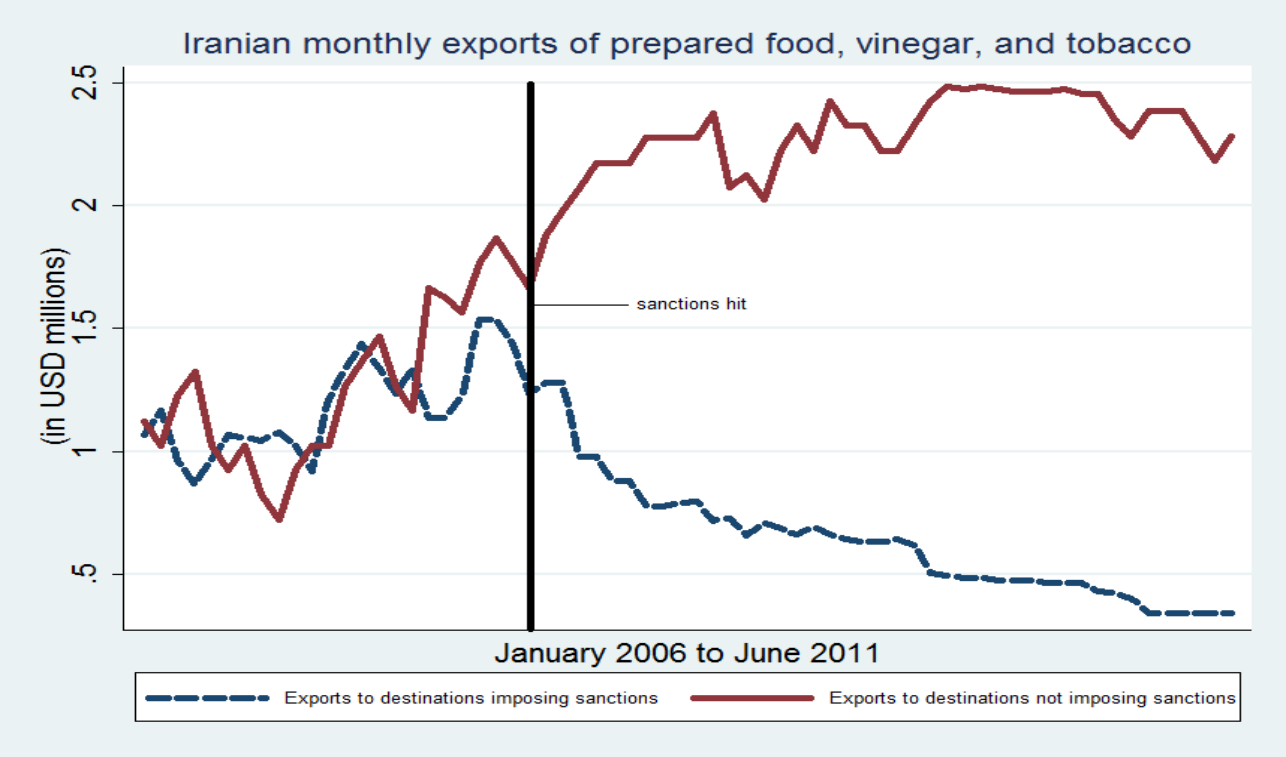

Figure 2b: Evolution of Iranian Non-oil Exports

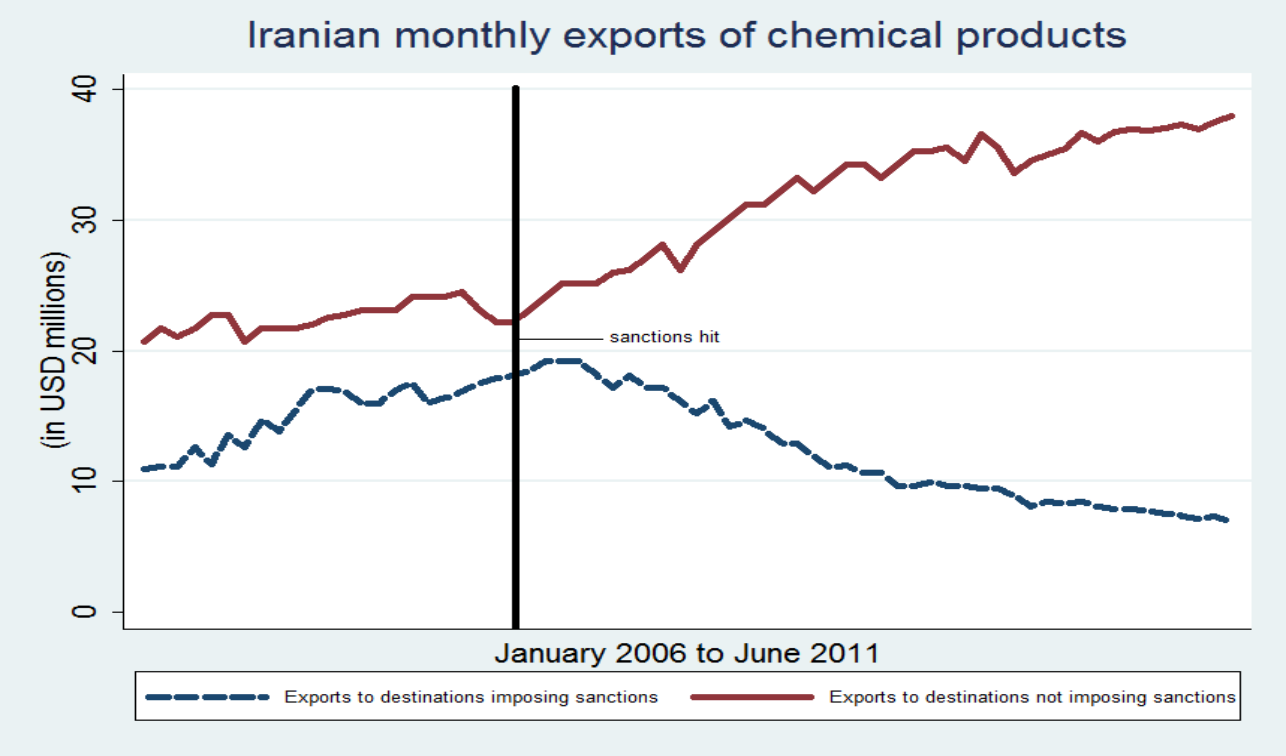

Figure 3a: Exports destruction

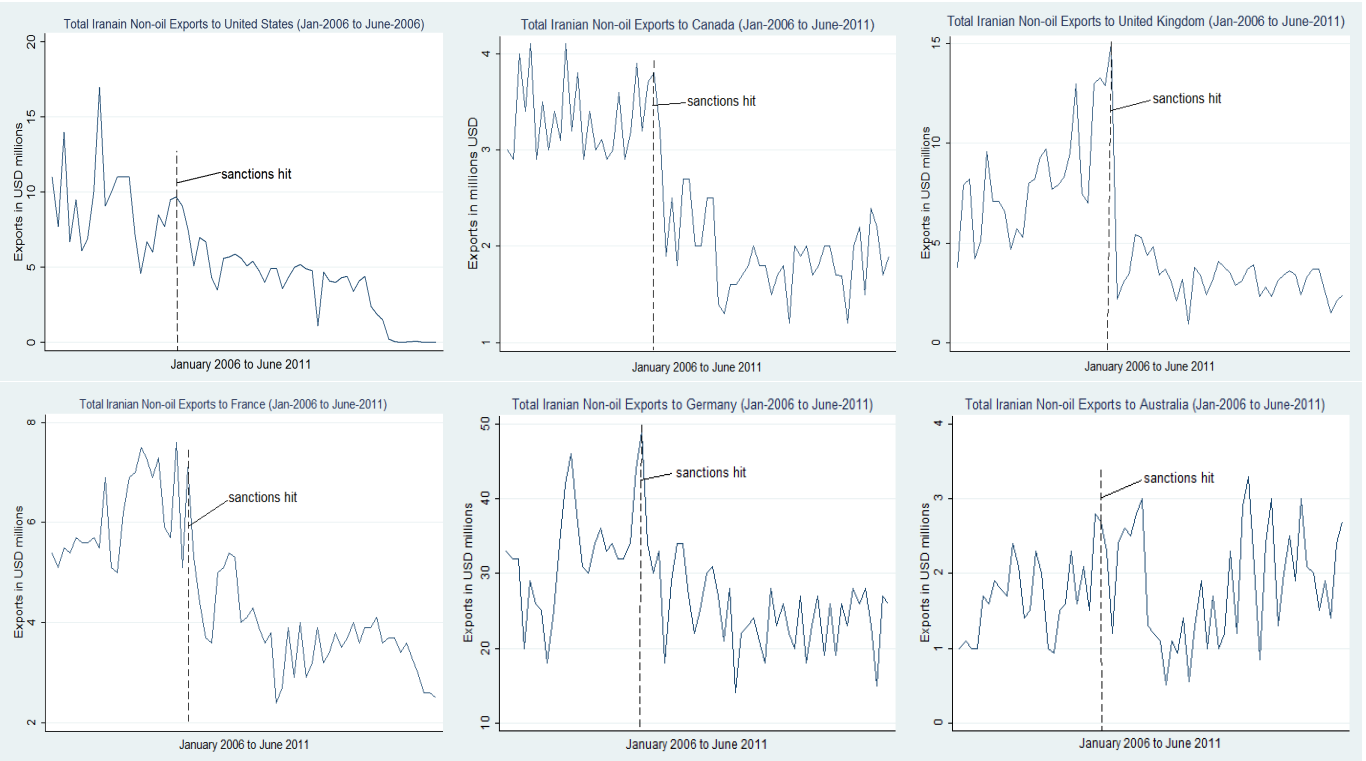

Figure 3b: Exports deflection

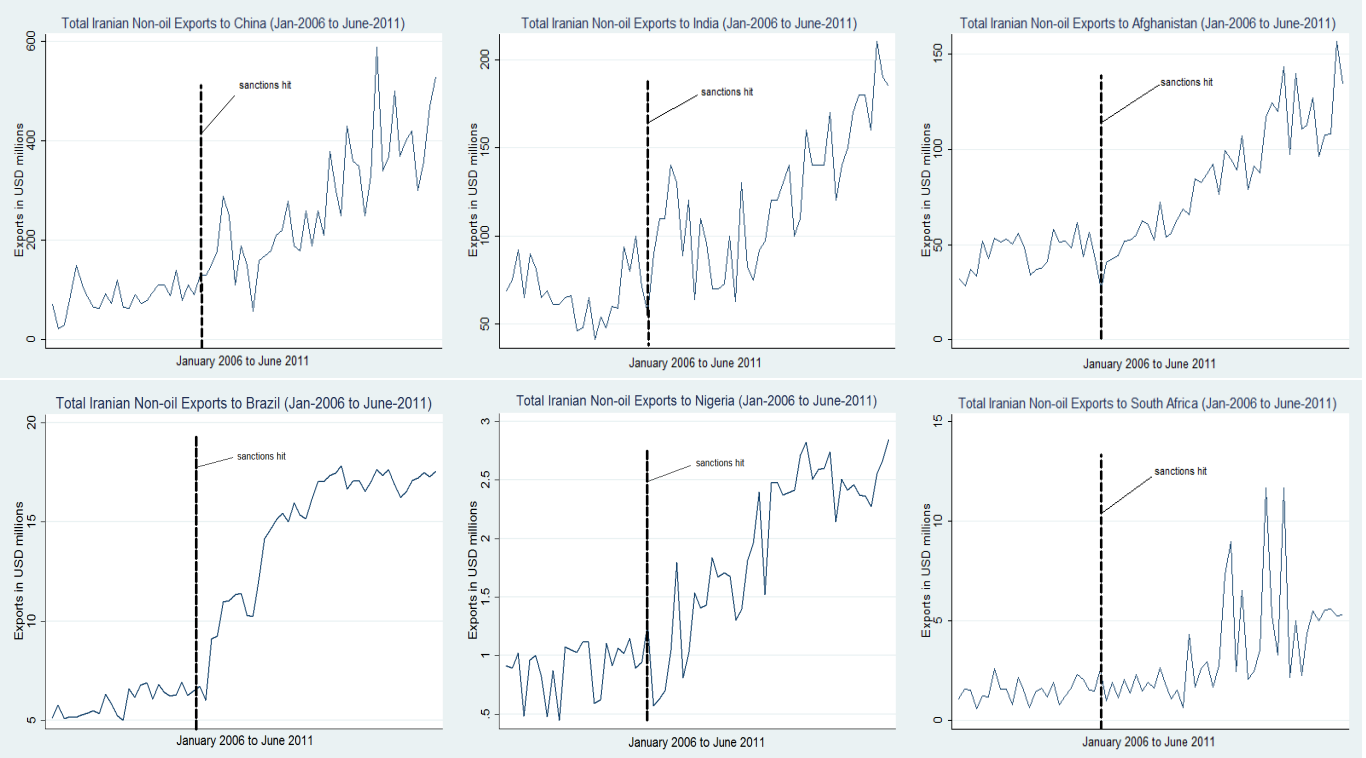

Figure 4a: Export Trends

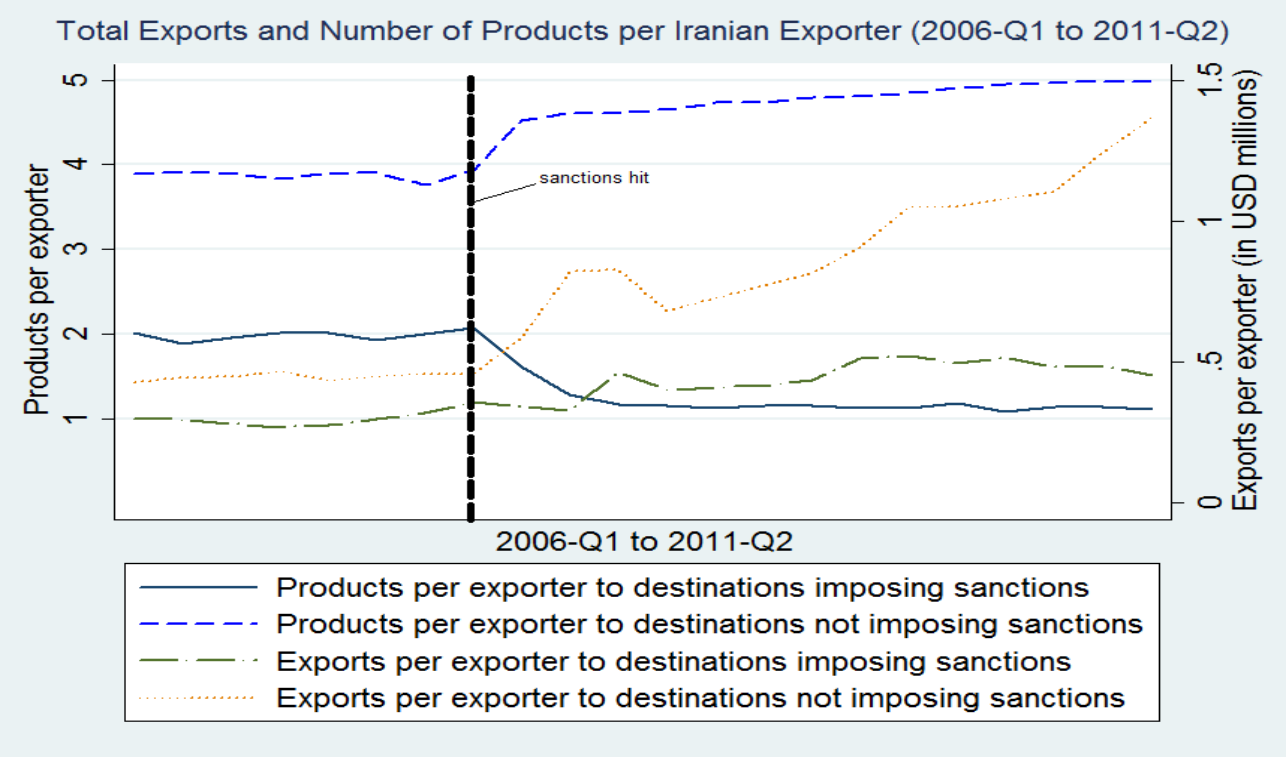

Figure 4b: Export trends - entry and exit

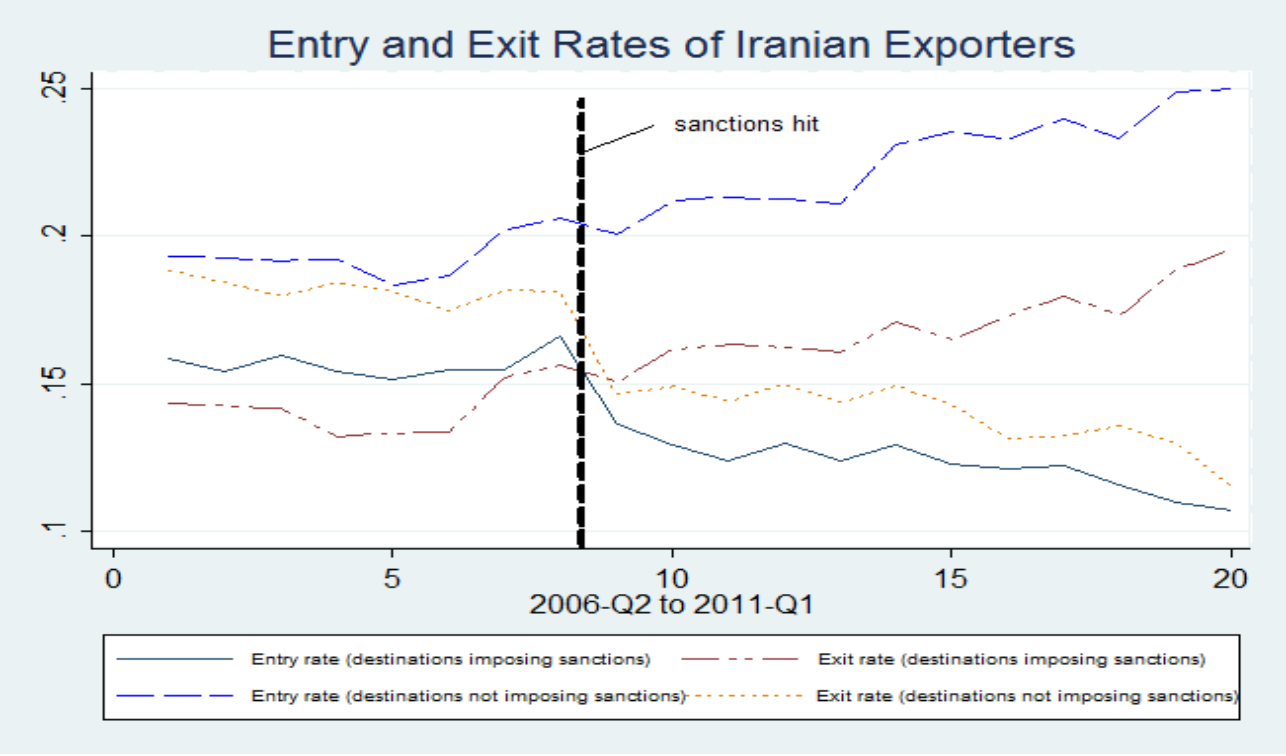

Figure 4c: Export trends - entry and exit

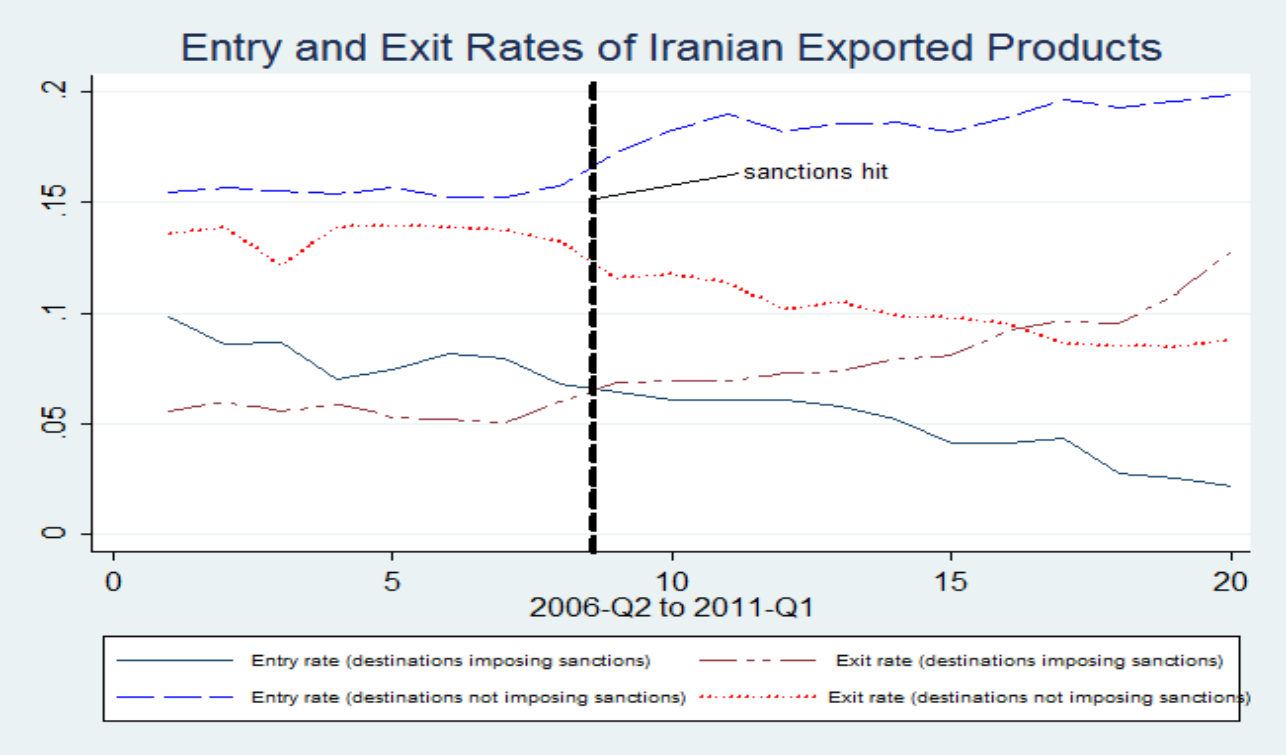

Figure 5: Is it about recession or sanctions?

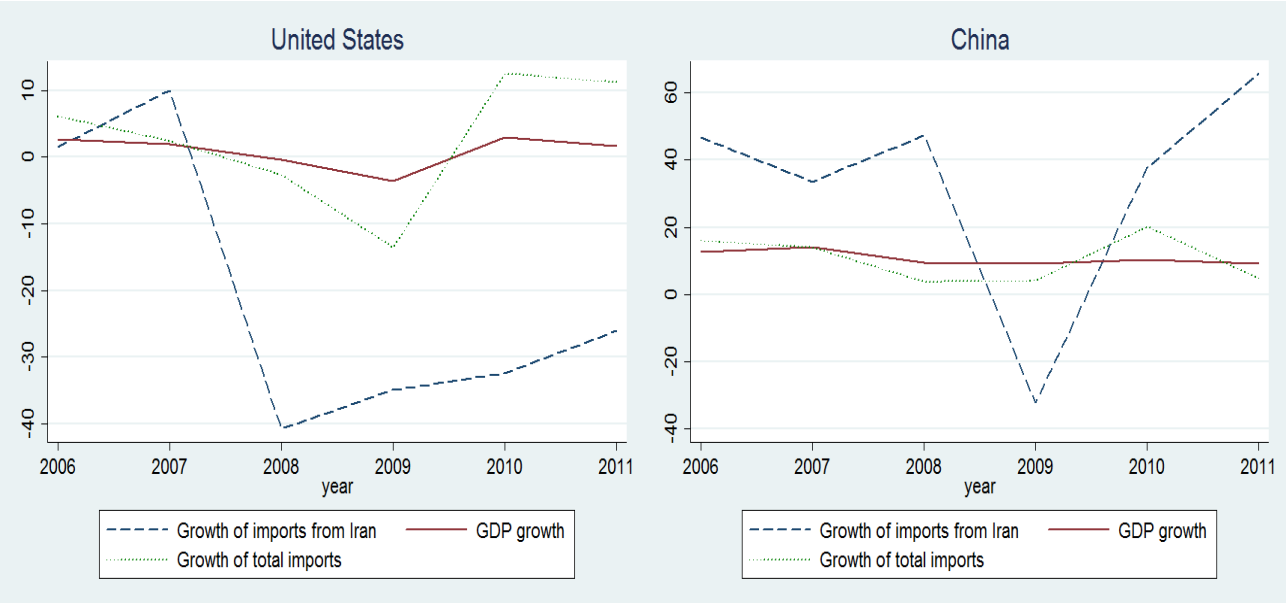

Figure 6: Iranian exporters diverted two-thirds of their pre-sanctions exports

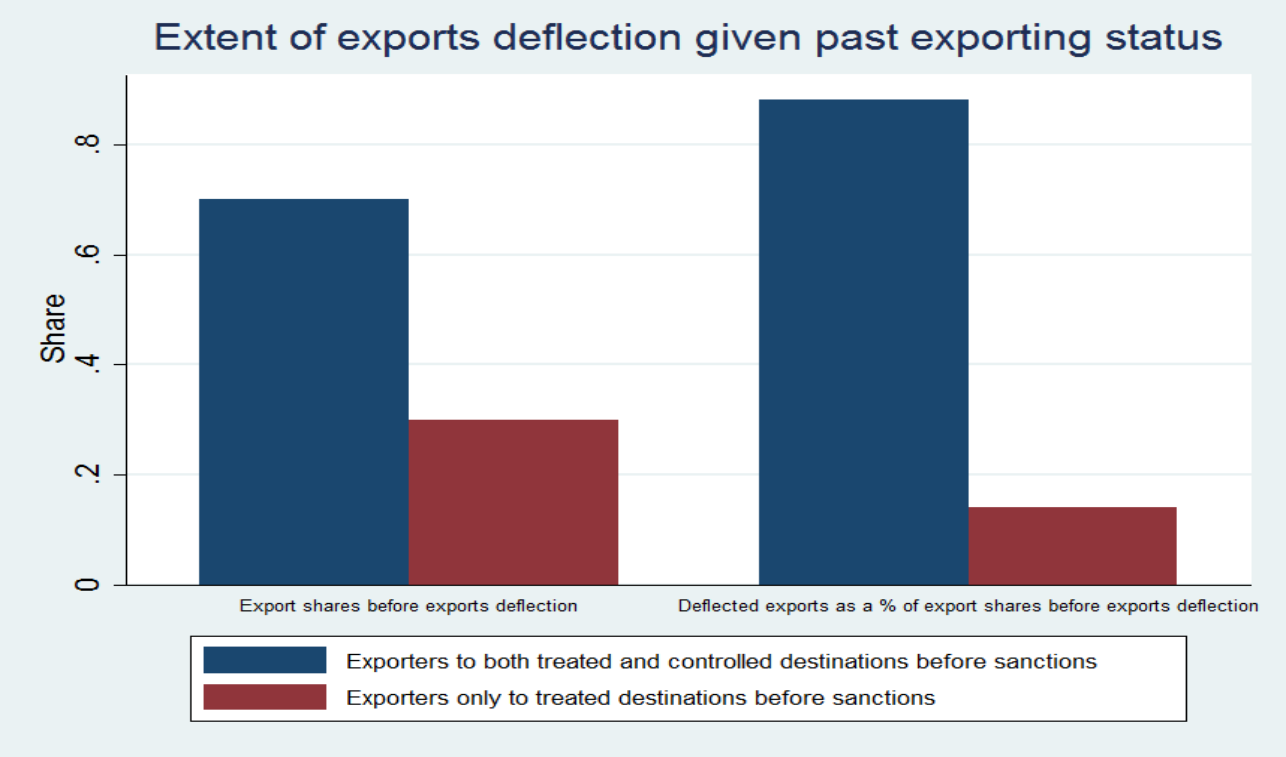

Figure 7: Deflecting exporters reduced their prices following exports deflection

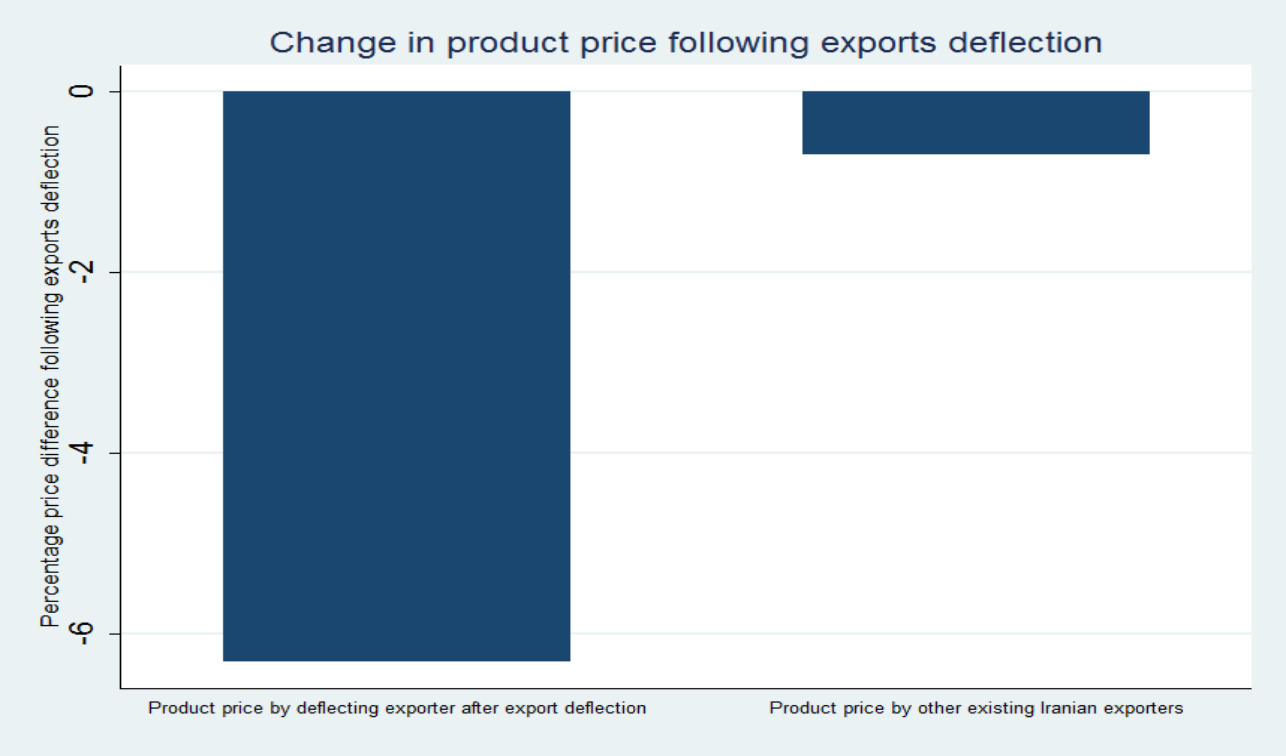

Figure 8: Large exporters deflect relatively more of their exports than small exporters

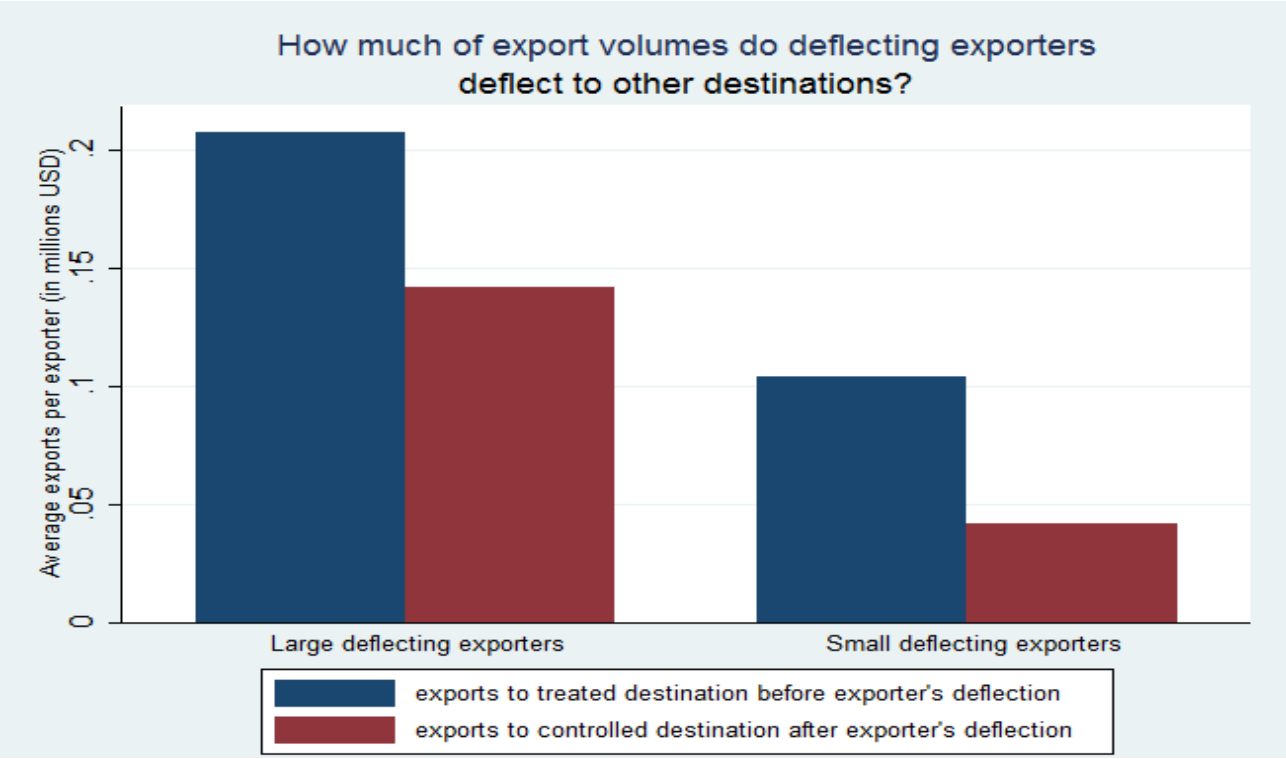

Table 1: Sanctions and exports destruction at the exporter-destination level

	(1)	(2)	(3)
$S_d.PS_t$	-0.328^a	-0.294^a	-0.411^a
	(0.000)	(0.000)	(0.000)
$S_d dummy$	Yes	Yes	Yes
$PS_t dummy$	Yes	Yes	Yes
Month, Exporter*Destination FEs	Yes		
Exporter, Destination FEs		Yes	
Month, Exporter FEs			Yes
R-squared	0.556	0.524	0.562
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: Exporter size and exports destruction following sanctions

	X_{edt}	N_{pedt}	$\bar{x}_{pedt}$
	(1)	(2)	(3)
$S_d.PS_t \times Size_{Q1}$	-0.752^a	-0.307^a	-0.445^a
	(0.000)	(0.000)	(0.000)
$S_d.PS_t \times Size_{Q2}$	-0.622^a	-0.225^a	-0.397^a
	(0.004)	(0.007)	(0.003)
$S_d.PS_t \times Size_{Q3}$	-0.446^b	-0.121^c	-0.325^c
	(0.043)	(0.061)	(0.082)
$S_d.PS_t \times Size_{Q4}$	-0.124^a	-0.094^a	-0.030^a
	(0.000)	(0.000)	(0.00)
$S_d.PS_t \times Size_{Q5}$	-0.083^a	-0.006^a	-0.073^a
	(0.000)	(0.000)	(0.000)
$S_d dummy$	Yes	Yes	Yes
$PS_t dummy$	Yes	Yes	Yes
Month, Exporter*Destination FEs	Yes	Yes	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: Sanctions and exports deflection at the exporter-destination level

	$Deflect_{ed\|t>26}$		
	(1)	(2)	(3)
$Exit_{S_d=1\|t>26}$	0.512^a	0.536^a	0.502^a
	(0.000)	(0.000)	(0.000)
$Enter_{S_d=0\|t>26}$	0.360^a	0.376^a	0.264^a
	(0.000)	(0.000)	(0.000)
Month, Exporter*Destination FEs	Yes		
Month, Exporter FEs		Yes	
Exporter, Destination FEs			Yes
Observations	398034	398034	398034

The dependent variable equals to 1 if an exporter exits a treated destination and then entered a controlled destination after sanctions. A treated (controlled) destination is one that did (did not) impose sanctions. The independent variables represent whether the exporter exited a destination that imposed sanctions whether the exporter entered a destination that did not impose sanctions. P-values are in brackets. ^{a} denotes statistical significance at the 1% level.

Table 4: Sanctions and exporters entry and exit at the destination level

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

The dependent variables are entry and exit rates of exporters at the destination-month level. P-values are in brackets.^{b} and ^{c} denote statistical significance at the 5% and 10% levels, respectively.

Table 5: Sanctions and products addition and dropout at the destination level

	(1)	(2)	(3)	(4)	(5)	(6)
	Add_{dt}			$Drop_{dt}$		
$S_d.PS_t$	-0.173^b	-0.191^a	-0.166^a	0.271^c	0.296^a	0.263^b
	(0.013)	(0.000)	(0.000)	(0.061)	(0.000)	(0.042)
$S_d dummy$	Yes	Yes	Yes	Yes	Yes	Yes
$PS_t dummy$	Yes	Yes	Yes	Yes	Yes	Yes
Month FEs	Yes	Yes		Yes	Yes	
Destination FEs	Yes		Yes	Yes		Yes
Observations	8421	8421	8421	8421	8421	8421

Add_{dt} is the share of exporters that added a new product to a destination d at time t. $Drop_{dt}$ is the share of exporters that dropped an existing product from destination d at time t. P-values are in brackets. ^{a},^{b} and ^{c} denote statistical significance at the 1%, 5%, and 10% levels respectively.

Table 6: Did past export status matter?

	Intensive margin		Extensive margin
	(1)	(2)	(3)
$S_d.PS_t$	0.052^b	0.048^b	0.037^c
	(0.026)	(0.039)	(0.072)
$S_d.PS_t$*ExporterA			0.053^b
			(0.042)
$S_d.PS_t$*ExporterB			0.092^a
			(0.000)
$S_d.PS_t$*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_d	Yes	Yes	Yes
PS_t	Yes	Yes	Yes
Quarter-Destination FEs	Yes	Yes	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?

	$Deflect_{ed\|t>26}$		
	(1)	(2)	(3)
lnX_{edt}	0.19^b	0.32^b	
	(0.021)	(0.043)	
$lnExperience_{edt}$	0.11^b		0.14^b
	(0.026)		(0.029)
Month, Exporter*Destination FEs	Yes		
Month, Exporter FEs		Yes	
Exporter, Destination FEs			Yes
Observations	398034	398034	398034

The dependent variable equals 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?

	$Deflect_{ep\|t>26}$		
	(1)	(2)	(3)
Export value	0.74[b]	0.41[b]	
	(0.014)	(0.031)	
Share of products	0.48[b]		0.59[b]
in total exports	(0.021)		(0.026)
Differentiated	-0.51[a]	-0.63[a]	-0.68[a]
	(0.002)	(0.000)	(0.000)
Month, Exporter*Destination FEs	Yes		Yes
Month FEs		Yes	
Exporter FEs		Yes	
Observations	398034	398034	398034

P-values are in brackets. The dependent variable equals to one if the exporter dropped a given product from a destination imposing sanctions and, then, introduced it to a destination not imposing sanctions after March 2008 , and zero otherwise. The independent variable "Differentiated" equals to 1 if the product is differentiated, and zero otherwise. 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 new destination that deflecting exporters deflected to. The total number of new destinations throughout the post-sanctions period/months 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.