

# Worth the pain? Firms' exporting behaviour to countries under sanctions

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## Abstract

How do exporting firms react to sanctions? Specifically, which firms are willing — or capable — to serve the market of a sanctioned country? We investigate this question for four sanctions episodes drawing on recent econometric advances in bias-corrected dynamic high-dimensional fixed effects binary choice estimators and monthly data on the universe of French exporting firms. We find that the introduction of new sanctions significantly lowers firm-level probabilities of serving the sanctioned markets, while, importantly, the lifting of sanctions is not found to yield symmetric trade recovery effects. Additionally, sanctions effects are very heterogeneous. Firms that depend more on trade finance instruments are more strongly affected, while prior experience in the sanctioned country considerably softens the blow of sanctions, and firms can be partly immune to the sanctions effect if they are specialized in serving “crisis countries”. Finally, we find suggestive evidence for sanction avoidance by exporting indirectly via neighboring countries.

**Keywords:** Sanctions, trade, foreign policy, extensive margin, firm behaviour

**JEL Classification:** F51, F14, F13, F52

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# 1 Introduction

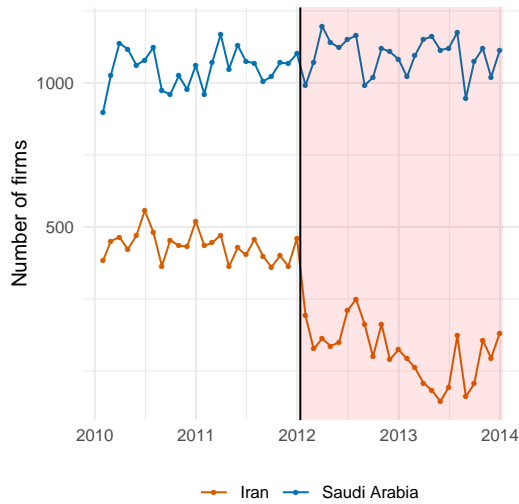
Sanctions restrict access to a market. Restrictions can be explicit — an arms embargo or the expulsion from the SWIFT system — or rather implicit — such as legal uncertainty or political instability. Yet many measures may ask companies to question their business dealings in the sanctioned country as a whole.

In this paper, we explore the impact of sanctions on this so-called *extensive* margin of trade, i.e. the firms' decision to either start or continue to serve a sanctioned market, or not to enter or withdraw. Figure 1 visually tells the story of firms under sanctions. Each panel depicts the simple comparison of the evolution of the number of French firms exporting to an affected country (red line) to a country that is comparable in geographic and economic terms (blue line). The y-axis denotes the raw number of active firms in a given month. The vertical black line signals the time of imposition or abolition of the respective sanctions regime, while the red shaded area corresponds to the sanctions period.

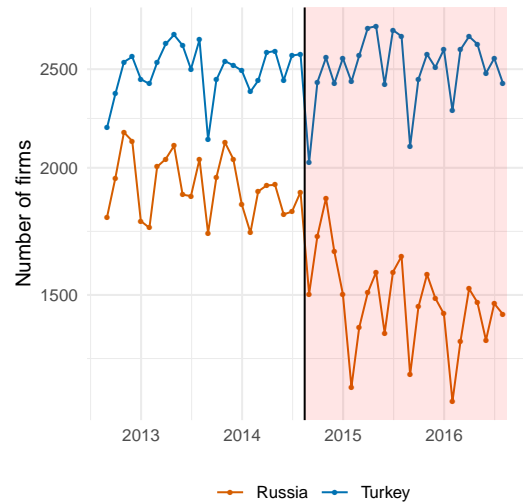
Panel 1a shows the case of Iran, where the drop in the number of active firms is particularly dramatic: Whereas in the two years prior to the sanctions imposed by the EU and other countries the number of firms in any given month hovers around an average of 457, afterwards this number decreases to 276, a minus of 40 percent. In the case of the Russia sanctions in panel 1b, the drop is a little less dramatic, but still severe: Before the sanctions a monthly average of 1922 firms were present on the Russian market, afterwards this number falls to 1480, a decrease by 23 percent.

Panel 1c shows the inverse effect for the case of Myanmar: Lifting sanctions after a prolonged period of being largely off-limits for French firms, their average monthly number increases somewhat gradually from 33 to 44 in the two years afterwards, an increase of 33 percent. Panel 1d shows the case of Cuba: While there are no sanctions by France or the EU against Cuba, there is an embargo by the United States in place that could indirectly influence French-Cuban business relations. In early 2015, under the Obama administration, political relations between the US and Cuba thawed and the former lifted a number of restrictions — until the Trump administration reversed course immediately in early 2017. French firms appear to have been largely unfazed by these political developments, with on average 59 firms present on the Cuban market in a given month before 2015, and around 60 afterwards.

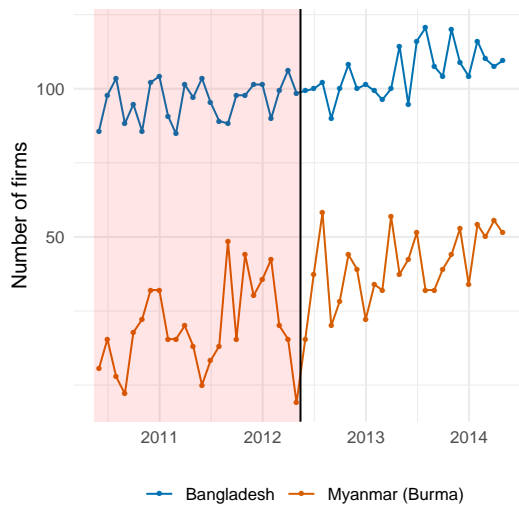
In our empirical analysis using French customs data, we investigate the firm-level trade response more thoroughly and estimate how much less likely firms are to export to a market if the destination country is sanctioned. While the specific reasons for firms' individual decisions may be manifold, we can draw on firm characteristics to describe patterns of determinants. Are firms that have experience in the sanctioned country more likely to stay? Is the extent of a firm's trade finance dependence indicative of further activity under sanctions? Are large firms differently affected? Does a focus on exporting consumer or intermediate goods make a difference? Are certain firms more robust or even specialized in serving "crisis countries"? And could firms try to circumvent sanctions by sidestepping to neighboring countries? We explore these questions by relying on highly-detailed monthly customs data on the universe of French firms



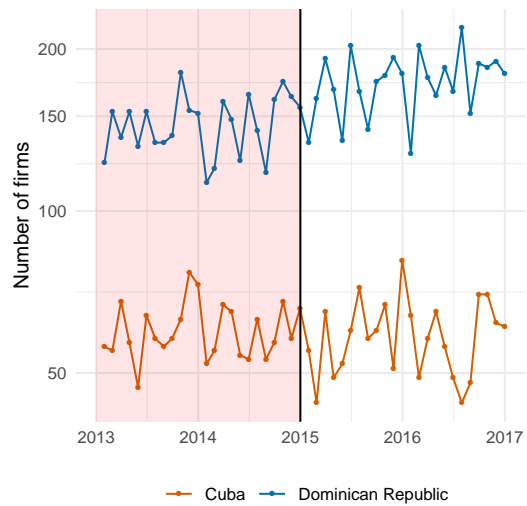
(a) Iran sanctions



(b) Russia sanctions



(c) Myanmar sanctions



(d) Cuba embargo

**Figure 1:** Evolution of number of firms in face of sanctions

and making use of recent advances in estimation techniques for fixed effects binary choice models.

The paper thus primarily contributes to the recently flourishing literature on sanctions, and as such is also related to the broader literature on firm behaviour and trade policy. There is now a vast corpus of studies assessing the consequences of international economic sanctions on international trade. Bergeijk (2009) and Hufbauer, Schott, and Elliott (2009) provide a useful overview of earlier work in this field. The case of the 1807 US embargo has been particularly well studied because it is one of the most enlightening cases of trade sanctions in the modern era and is exemplary in its simplicity and scope. Frankel (1982), Irwin (2005) and O'Rourke (2007) find that the self-inflicted blockade led to a severe reduction in international trade and a drop in US GDP of about 4 to 8%. Caruso (2003) provides an estimate of the effects of a large number of sanctions from the second half of the 20th century on global trade flows, based on a simple gravity analysis. More recently, Hinz and Monastyrenko (2019) and Cheptea and Gaigné (2019) assess the consequence of the embargo on agricultural products imposed by Russia in

2014. Hinz (2019) uses a structural gravity model to estimate international trade losses related to sanctions against Iran, Russia, and Myanmar. He estimates that these losses amounted to US\$ 50 billion in 2014, or about 0.4% of world trade.

Several studies have also examined periods of diplomatic tension which, although not leading to official sanctions, have affected trade relations. For example, Fuchs and Klann (2013) show that meetings between the Dalai Lama and Western political leaders are followed by significant decreases of bilateral trade between China and the host countries. Michaels and Zhi (2010) and Pandya and Venkatesan (2016) show that the diplomatic confrontation between France and the United States over the 2003 Iraq war significantly reduced trade between the two countries in a short period of time. In a similar vein, Heilmann (2016) studies the impact of various boycott campaigns, including the boycott of Danish products in some Muslim-majority countries in 2006. However, few studies have examined the impact of sanctions at the company level. Going down to the microeconomic level is necessary to accurately estimate, as Ahn and Ludema (2019) do, the impact of smart sanctions that explicitly target a small number of firms. It is also useful to better understand why sanctions reduce trade when this is not always the goal. It is for this purpose that Crozet and Hinz (2020) and Gullstrand (2018) use firm-level data (French and Swedish respectively) to study the case of the Russia sanctions. More generally, microeconomic trade data allow to study firms' behaviour when facing constraints resulting from diplomatic conflict. Haidar (2017), for example, shows how (some) Iranian exporters have been able to circumvent Western sanctions by diverting a part of their trade flows to non-sanctioning countries.

In this paper, we exploit French firm-level data to focus exclusively on the consequences of sanctions on the extensive margin of trade, i.e. on the propensity of firms to export at a given time to a given market. In doing so, our paper is linked with the literature studying the dynamics of firms' export decisions. A first strand of this literature focuses on the importance of sunk export costs and, as a result, on the importance of prior exporting experience on the decisions to enter foreign markets. In their seminal analysis of Colombian exporters, Roberts and Tybout (1997) find evidence of high sunk costs since the prior experience is shown to increase greatly the probability of exporting (see also Bernard and Jensen, 2004).

More recent work has examined the dynamics of new exporters. Indeed, a detailed analysis of the data suggests that companies seeking to enter a foreign market often go through an exploratory period of trial and error.<sup>1</sup> This literature also highlights the fact that the response of firms to shocks is likely to be heterogeneous. It depends on the nature of the commercial contracts, and therefore on the characteristics of the goods traded (Timoshenko, 2015; Mejean, Martin, and Parenti, 2019). It also depends on the characteristics of the firms themselves, such as firms' size and experience on foreign markets (Dickstein and Morales, 2018; Berman, Rebeyrol, and Vicard, 2019). Finally, our study is also linked to Békés, Fontagné, Muraközy, and Vicard (2017) who use monthly customs data — as we do — to study the frequency of international shipments. They show that firms send less frequent, larger shipments to more uncertain markets.

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<sup>1</sup>See e.g. Iacovone and Javorcik (2010), Albornoz, Calvo Pardo, Corcos, and Ornelas (2012), Cadot, Iacovone, Pierola, and Rauch (2013), Blum, Claro, and Horstmann (2013), Eaton, Eslava, Jinkins, Krizan, and Tybout (2015), Timoshenko (2015), Ruhl and Willis (2017), Dickstein and Morales (2018), Sager and Timoshenko (2019), or Piveteau (2019).

In our analysis, we find that French firms are significantly less likely to export to Iran and Russia after the introduction of sanctions on these countries. Importantly, we do not observe a comparable symmetric effect for the lifting of sanctions on Myanmar and Cuba. Our findings suggest that sanctions partly act via increased market entry costs, implying dynamic phase-in effects, and that the specific sanctions design drives which firms are more or less affected. This is illustrated, for example, by the much stronger sanction effect for exporters relying on trade finance instruments extensively, due to the measures imposed on the financial sector in both Iran and Russia. Furthermore, we find no systematic evidence for either larger or smaller, uni- or multi-product firms, to be generally more affected by sanctions. Firms' presence in other countries — coincidental or strategic — may allow them to better cope with sanctions. Finally, next to the specificity of the imposed measures, local factors and policy responses further shape the exporting behaviour of firms.

The remainder of this paper is as follows. In section 2 we provide a brief description of the four sanctions episodes we study quantitatively. In section 3 we sketch a model of firms' decision to enter/stay in/exit a given market subject to sanctions. The model produces an equation that characterizes this decision, which can be estimated with a *dynamic* probit estimator and appropriate fixed effects. We briefly sketch a suitable estimation procedure in section 4 and discuss the data set we use in our estimations. In section 5 we then estimate the model and test several channels — firm and market characteristics — that may influence the firms' export decision. Section 6 concludes.

## 2 Background

Sanctions are a broad basket of different types of policies, ranging from travel bans, asset freezes to all-out embargoes. In this paper we analyze four cases — sanctions against Iran, Russia and Myanmar, and the US embargo against Cuba — that are instructive in their own ways, varying in the policies applied (or lifted). We hence first review similarities and differences of the four cases to inform the empirical analysis below.

### Sanctions against Iran

Of the four cases, the measures taken against Iran were the most severe.<sup>2</sup> Sanctions against Iran were first imposed by the United States in response to the hostage crisis after the Iranian revolution in 1979 with Executive Order 12170, which froze Iranian assets in the United States and imposed a trade embargo.<sup>3</sup> These measures were lifted in 1981 as part of the negotiations to secure the hostages' release. In 1984 the US then imposed new sanctions during the height of the Iran-Iraq war, prohibiting the sale of weapons and ending US assistance in Iran. In 1995 the US then moved to essentially ban all trade with and investment in Iran, in response to its support for terrorist organizations and its nuclear program.<sup>4</sup> Multilateral sanctions by the United Nations were introduced in 2006, after Iran had failed to comply with UN Security Council Resolution

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<sup>2</sup>At the time of writing, the US has reimposed most of the sanctions detailed below, whereas multilateral and EU sanctions have been largely lifted as of January 2016.

<sup>3</sup>U.S. Executive Order 12170 - Blocking Iranian Government property, November 14, 1979.

<sup>4</sup>U.S. Executive Order 12959 - Prohibiting Certain Transactions With Respect to Iran, May 6, 1995.

1696, which demanded Iran to halt its uranium enrichment program.<sup>5</sup> Through UN Security Council Resolution 1737 trade with potentially nuclear-related technology and material to Iran was prohibited, and certain individuals' and companies' assets abroad frozen. These measures were subsequently expanded.<sup>6</sup>

Starting in 2010 the European Union started to impose own sanctions against Iran, successively banning Iranian airlines, air cargo and shipping companies from operating in the European Union. New measures also put restrictions on Iran's financial services and energy sectors, banning insurance and reinsurance by EU insurers of Iranian entities.<sup>7</sup> In January 2012, after raising concerns regarding the Iranian nuclear program, the European Union introduced, among other measures, an import embargo on Iranian oil, other petrochemicals and precious metals. Existing oil contracts were allowed to be honored until July 2012.<sup>8</sup> The next and hitherto ultimate escalation of the sanctions measures against Iran was put forward in March 2012, when banks in violation of EU sanctions were disconnected from SWIFT, thereby effectively cutting of Iran from the global financial system.<sup>9</sup> These drastic measures appear to have brought Iran to the negotiating table, resulting in a rapprochement between Iran and Western countries. On 16 January 2016 sanctions were lifted as part of the "Joint Comprehensive Plan of Action", which had been agreed upon in July 2015.<sup>10</sup> In the empirical analysis we study the behaviour of firms after the imposition of the severe sanctions measures introduced in January 2012.

## Sanctions against Russia

In late 2013, Ukraine was rocked by a massive protest movement known as the "Euromaidan". The protests were a new episode in the deep polarization of the country, which has long been torn between the hope of a closer relationship with Western Europe and the desire to forge closer ties with Russia. This division is both geographical and cultural. A majority in the Western regions and in Kiev expresses a relative mistrust of Russia, in contrast to the Russian-speaking regions in the East. On February 2014, the Euromaidan movement ousted the Ukrainian government, headed by the pro-Russian President Yanukovic.

In reaction, the situation deteriorated rapidly in parts of south-eastern Ukraine and Crimea, where pro-Russian uprisings degenerated into separatist movements and armed conflict with Russian involvement. On February 27, 2014, armed men seized key public infrastructures of the peninsula of Crimea. On March 16, 2014, a much-criticized referendum paved the way for the absorption of the Crimea by the Russian Federation (Dreyer, Luengo-Cabrera, Bazoobandi,

<sup>5</sup>See e.g. [http://news.bbc.co.uk/2/hi/middle\\_east/6205295.stm](http://news.bbc.co.uk/2/hi/middle_east/6205295.stm) (accessed on June 29th, 2020).

<sup>6</sup>Resolutions 1747 imposed an arms embargo and expanded the freeze on Iranian assets; Resolution 1803 mandated UN member states to monitor activities of Iranian financial institutions, inspect Iranian aircraft and maritime vessels, and monitor the movement of individuals in their jurisdiction; Resolution 1929 banned trade in dual-use and other military goods, introduced further travel bans and called on states to actively inspect Iranian vessels and aircraft. See <https://www.consilium.europa.eu/en/policies/sanctions/iran/> (accessed on June 29th, 2020) for reference.

<sup>7</sup>European Council Decision 2007/140/CFSP, July 26, 2010.

<sup>8</sup>Other measures further included travel bans and asset freezes. See Council conclusions on Iran 3142th, FOREIGN AFFAIRS Council meeting Brussels, 23 January 2012.

<sup>9</sup>See <https://www.swift.com/insights/press-releases/swift-instructed-to-disconnect-sanctioned-iranian-banks-following-eu-council-decision> (accessed on June 29th, 2020).

<sup>10</sup>See e.g. <https://www.swift.com/insights/press-releases/update-iran-sanctions-agreement> (accessed on June 29th, 2020).

Biersteker, Connolly, Giumelli, Portela, Secieru, Seeberg, and van Bergeijk, 2015).

To protest against Russia's involvement in this breach of Ukraine's territorial integrity, European and allied Western countries issued a first series of sanctions against the Russian Federation in mid-March 2014. This first wave of sanctions from Western countries targeted senior political and military personnel. These sanctions consisted mainly of travel bans, asset freezes, and the prohibition of financial transactions involving a range of political and military personnel and financial institutions in Russia and Ukraine.<sup>11</sup> The list of targeted individuals and entities was amended several times until the end of 2015.<sup>12</sup>

The situation further deteriorated after July 17, 2014, when a civilian aircraft (Malaysian Airlines flight MH17) was shot down over the separatist region of Donbass, with the probable involvement of pro-Russian insurgents. The EU, like most Western allies, then broadened sanctions by imposing trade restrictions and severely tightening financial restrictions.<sup>13</sup>

European entities were restricted from exporting certain goods to the Russian Federation and buying certain Russian financial assets. The trade restrictions were primarily directed at military use and dual-use products and technology.<sup>14</sup> They also covered capital goods specific to the oil and mining industry. Perhaps more importantly, the financial sanctions have targeted major Russian financial institutions, as well as a number of defense and energy companies (including Gazprom, for instance). The sanctions have essentially cut off the access to financing on European markets for these institutions. The United States, but also Japan and other European and Oceanian countries have taken similar measures. Russia retaliated on August 7, 2014, by imposing a strict embargo on imports of agricultural and food products from countries that had introduced sanctions. In the analysis below, we study the exporting behaviour of firms after August 2014.

## **Sanctions against Myanmar**

Myanmar's political history has been extremely troubled since the country's independence in 1947. After a number of years of relative stability, the 1962 coup d'état led to the establishment of a military dictatorship led by Ne Win and the Burma Socialist Programme Party. Despite an authoritarian and isolationist policy, this government was not subject to explicit international sanctions. This government was removed in 1988, in the wake of massive nationwide protests, which peaked on August 8, 1988. The crackdown of this "8888 uprising" was violent (350 dead according to official sources, but more likely several thousand casualties, cf. Hufbauer, Schott, Elliott, and Oegg, 2008). The protest ended the Ne Win regime, but not the dictatorship. On September 18, 1988, the military regained control of the situation, with a new coup that ended the protests brutally. This violent repression led to protests from India and other major democracies, but the promise to organize free elections quickly made it possible to minimize foreign

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<sup>11</sup> Council regulation No 269/2014, Official journal of the European Union, 17.3.2014.

<sup>12</sup> See, e.g., Council Implementing Regulation No 284/2014, Official Journal of the European Union 21.3.2014; Council implementing decision of 28 April 2014, Official journal of the European Union, 29.4.2014; etc.

<sup>13</sup> Council regulation No. 833/2014, Official journal of the European Union, 31.7.2014.

<sup>14</sup> Dual-use goods are those products which, although not arms, are essential inputs in the manufacture of weapons. Cf. Council Regulation No 428/2009.

concern. Elections were indeed held in 1990 which gave a landslide victory to the National League for Democracy, led by Aung San Suu Kyi. It is the military junta's refusal to accept the results of the 1990 elections that finally triggered the first significant international sanctions. The US and most Western European countries downgraded diplomatic relations, imposed an embargo on arms, munitions and military equipment, and suspended defense cooperation and all non-humanitarian foreign aid. They also imposed a visa ban on members of the Burmese political leadership, senior military, and their family members. Furthermore, they suspended high-level governmental visits to Myanmar. In 1991, the US refused to renew the bilateral US/Myanmar textile agreement. In 1996, the EU Common Position on Myanmar confirmed the EU sanctions imposed in 1990.<sup>15</sup>

From then, the pressure on Myanmar increased progressively. NGOs, buoyed up by the Nobel Prize awarded to Aung San Suu Kyi in 1991, redoubled their calls for tougher sanctions and boycotts. This led a large number of Western companies to stop their investments and withdraw from the country. The United States banned new investment in Myanmar by US citizens and firms in 1997. In the same year, the EU imposed trade sanctions in the form of an exclusion of Myanmar from the General System of Preferences and the "Everything But Arms" trade and development initiative. In 1998, a resolution extended the visa bans.<sup>16</sup> The EU embargo on arms and munitions was reinforced significantly in 2000.<sup>17</sup> The 2000 resolution imposed an asset freeze and a ban on the financing of state-owned enterprises and those owned by senior members of the Myanmar government and security forces. These measures were extended again in 2006.<sup>18</sup>

An important step was taken in 2008. After severely repressing a new protest movement in the summer of 2007, the government proposed a new constitution and called for elections in 2010. Western diplomats, doubting the sincerity of the Burmese authorities, decided to step up their pressure. In 2008, the EU banned the imports of a large number of products corresponding to Myanmar's comparative advantages (metals and stones, coal, wood, etc) and exports of key equipment for these industries.<sup>19</sup> In 2011, after a few uncertain years, the Myanmar government started a genuine democratization process. This included measures in favor of freedom of speech, the legalization of political parties and the release of political prisoners. The 2012 elections offered a clear victory to the main opposition party and the 2015 elections were the first truly free general elections.

In response to these positive developments, the EU, like the US, progressively dismantled its sanctions. The EU council regulation, published in late April 2012, suspended all sanctions against Myanmar with the exception of the arms embargo.<sup>20</sup> In May 2013, this suspension was confirmed and sanctions were definitively lifted.<sup>21</sup> The embargo on arms and munitions remained in force, but financial and trade restrictions were removed and Myanmar was reintegrated into

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<sup>15</sup>Official Journal of the European Union, 8.11.96.

<sup>16</sup>Official Journal of the European Union, 30.10.98.

<sup>17</sup>Official Journal of the European Union, 24.5.2000.

<sup>18</sup>Official Journal of the European Union, 2.6.2006.

<sup>19</sup>Official Journal of the European Union, 10.3.2008.

<sup>20</sup>European Council regulation 2012/0101, April 27, 2012.

<sup>21</sup>Official Journal of the European Union, 15.5.2012.



the Generalized System of Preferences and obtained the most favorable "Everything But Arms" regime. The analysis below studies the behaviour of firms after sanctions were lifted at the end of April 2012.

## **US embargo against Cuba**

The US embargo against Cuba is one of the oldest international sanctions packages still in force. The first measures came in the form of an embargo on exports of arms and ammunition introduced by the Eisenhower administration in 1958, during the civil conflict between Castro's rebel forces and Batista's regular army. In 1960, trade restrictions increased in response to Fidel Castro's seizure of power and the nationalizations of US companies operating in Cuba. In 1961, after the Bay of Pigs invasion, Congress passed the Foreign Assistance Act<sup>22</sup> allowing the US to cut off aid to Cuba. This law was amended the following year to prohibit any assistance to foreign countries that would send aid to Cuba, and to establish a general trade embargo, with the exception of medical products and food. Following the 1962 missile crisis, travel to Cuba was banned and Cuban assets in the United States were frozen. The sanctions regime evolved marginally over the following decades, but most of it remained unchanged until the end of the Cold War. After the collapse of the USSR, Cuba lost its most important trading partner. This loss magnified mechanically the economic consequences of the US sanctions and triggered a severe economic crisis in the early 1990s. By losing the support of the USSR, Cuba also lost a valuable political ally, which led the United States to further tighten its sanctions against the island. Laws passed during the 1990s strengthened the embargo and codified previous regulations.

The Cuban Democracy Act (also known as the Torricelli Act),<sup>23</sup> adopted by the US Congress in 1992, banned subsidiaries of US companies based abroad from trading with the island. It also prevented merchant ships that had called in Cuba in the last 180 days from docking in the United States. In 1996, the Cuban Liberty and Democratic Solidarity (LIBERTAD) Act (also known as the Helms-Burton Act)<sup>24</sup> paved the way for legal action against non-US companies operating in Cuba that use property owned by American citizens (including former Cuban citizens) and confiscated after the Cuban revolution. With these successive laws, US sanctions have clearly taken on a new dimension since they are explicitly extra-territorial in nature, and are able to penalize companies or individuals based abroad if they also have an activity linked to the United States. It is noteworthy that the European Union reacted to the Helms-Burton Act with an explicit Council Regulation.<sup>25</sup> The aim of this regulation was to denounce the extra-territorial aspects of the provisions of the Helms-Burton Act, to require the European companies affected to report the situation to the European Commission and to propose various support measures. Obviously, this has not prevented US restrictions from entering into force and affecting third countries' exports to Cuba. For example, the Torricelli Act forced the Swedish company Pharmacia to stop exporting to Cuba after its merger with the US company Upjohn.<sup>26</sup> Similarly, the Helms-Burton Act led the Mexican cement manufacturer Cemex to stop its activities in Cuba under threat of a lawsuit by its American competitor Lone Star Industries (see Gordon, 2016, for details and

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<sup>22</sup>Public Law 87-194 - Sept 1, 1961.

<sup>23</sup> H.R.5323 - 102nd Congress (1991-1992).

<sup>24</sup>.H.R.927 — 104th Congress (1995-1996).

<sup>25</sup>Council Regulation No 2271/96.

<sup>26</sup>Compare <https://www.medicc.org/resources/documents/embargo/Chapter%20Three.pdf>.

additional examples).

More recently, the extraterritoriality of US sanctions has been reinforced by more aggressive enforcement of financial transaction regulations. The scope of regulations prohibiting dollar transactions involving Cuban nationals is indeed very broad. Between 2009 and 2012, the Treasury Department imposed fines ranging from \$375 million to over \$600 million on several European banks (Credit Suisse, ING, HSBC) for violating US sanctions. In these cases, the main litigations involved transactions with Iran, but violations of the embargo with Cuba were also alleged.

A process of de-escalation began with the Obama administration. In April 2009, the US presidency used its statutory power to modulate certain provisions of the Torricelli and Helms-Burton acts in order to ease the sanctions. More travels were allowed, some constraints on remittances were lifted and the government issued licences authorising US telecommunications companies to operate in Cuba (see LeoGrande, 2016). In December 2014, the US administration announced its commitment to normalizing relations with Cuba and ending the embargo, seen as a policy “that was long past its expiration date”. In January 2015, an important step was taken. The United States significantly eased the constraints on travels to Cuba. Above all, US companies were allowed to export goods and services to the Cuban private sector. This was a significant breach of the embargo, although these export authorizations were limited to contracts with the private sector, which remains relatively marginal in Cuba. This last important constraint was lifted in January 2016. A new set of regulations allowed US companies to sell their goods and services to Cuban state-owned enterprises if these sales “meet the needs of the Cuban people” — a criterion sufficiently vague to cover a wide range of situations. The ban on offering trade credits to Cuba has also been partially lifted.

Starting immediately in 2017, and continuing up until 2019, the Trump administration reversed the loosening of sanctions against Cuba. In April 2019, the United States reactivated Title III of the Helms-Burton Act, allowing the prosecution of foreign companies that benefited from properties nationalized after the 1957. In October 2019, a revision of the Cuban Assets Control Regulations (CACR) reversed certain travel authorizations, imposed the closure of airlines to Cuba, limited remittances, etc. In the empirical analysis below, we will focus on the (brief) time of loosened sanctions, which started in January 2015. The period characterized by the return of sanctions is not covered in our econometric analysis.

### **3 Model**

In this section, we present a partial equilibrium heterogeneous firms model of international trade for which we derive an expression for the firm-level decision of serving specific markets. We lean on Hinz, Stammann, and Wanner (2020), who focus on the aggregate extensive margin of trade between two countries. Our firm-level consideration will allow us to rely on a somewhat more general set of assumptions.

### 3.1 Theory

Consumers in  $N$  countries (denoted by a  $j$  subscript) obtain utility from consumption of different varieties  $\omega$  in period  $t$  via the following CES function:

$$u_{jt} = \left( \int_{\omega \in \Omega_{jt}} (\xi_{\omega jt})^{\frac{1}{\sigma}} q_{\omega jt}^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}},$$

where  $\Omega_{jt}$  denotes the set of available varieties,  $\xi_{\omega jt}$  is a log-standard-normally-distributed demand shock,  $q_{\omega jt}$  represents the consumed quantity, and  $\sigma > 1$  denotes the elasticity of substitution across varieties. One period corresponds to one month in our empirical setup. Each variety is produced by a distinct firm. Hence, the  $\omega$  subscript can equivalently index a variety or a firm.

In each origin country  $i$ , there is a set of firms  $\Omega_i$ .<sup>27</sup> In our empirical application, we will consider firms from one specific origin, namely French firms only. Firms differ in their unit production costs  $c_{\omega t}$ , e.g. due to different draws in a Melitz (2003)-type productivity lottery or due to firm-specific wages, as for instance in Helpman and Itskhoki (2010). Due to iceberg trade costs, firms have to produce  $\tau_{\omega jt}$  units in order to deliver one unit to market  $j$ . The consumers' love of variety allows firms to charge a constant markup  $\sigma/(\sigma - 1)$  over marginal costs  $\tau_{\omega jt}c_{\omega t}/\varphi_{\omega t}$ . The demand for  $\omega$  in market  $j$  depends on the variety price relative to the overall price level in the respective market, the idiosyncratic demand shock, and the market size:

$$q_{\omega jt} = \frac{p_{\omega jt}^{-\sigma}}{P_{jt}^{1-\sigma}} \xi_{\omega jt} E_{jt},$$

where  $p_{\omega jt} = \frac{\sigma}{\sigma-1} \tau_{\omega jt} c_{\omega t}$  is the variety price discussed above,  $P_{jt} = \left( \int_{\omega \in \Omega_{jt}} \xi_{\omega jt} p_{\omega jt}^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}$  denotes the ideal price index, and  $E_{jt}$  is total expenditure in market  $j$  in period  $t$ .

Due to its monopolistic competition markup, a firm can earn an operating profit  $\pi_{\omega jt} = (1/\sigma)p_{\omega jt}q_{\omega jt}$  by serving the respective market. However, it has to pay a fixed exporting cost  $f_{\omega jt}^{exp}$ . If the firm has not been active in the previous year, it additionally incurs a market entry cost which scales up the fixed cost of exporting, i.e. it has to pay  $f_{\omega jt}^{entry} f_{\omega jt}^{exp}$  rather than only  $f_{\omega jt}^{exp}$ . A firm hence only decides to export to a market at all, if the profits to be earned are high enough to overcome the associated fixed (and entry) costs. For simplicity, we let firms base their export decision only on the current and past period and abstract from “investments” into specific markets, where a firm is willing to incur a loss due to entry costs in order to earn future profits in the market.<sup>28</sup> Then, we can derive the following expression for the indicator variable  $y_{\omega jt}$  for the firm-level extensive margin:

$$y_{\omega jt} = \begin{cases} 1 & \text{if } \frac{\left( \frac{1}{\sigma} \left( \frac{\sigma}{\sigma-1} \tau_{\omega jt} c_{\omega t} \right)^{1-\sigma} P_{jt}^{\sigma-1} \xi_{\omega jt} E_{jt} \right)}{f_{\omega jt}^{exp} (f_{\omega jt}^{entry})^{(1-\max_{s \in \{1, \dots, 12\}} \{y_{\omega j(t-s)\})}})} \geq 1, \\ 0 & \text{else.} \end{cases} \quad (1)$$

<sup>27</sup>We abstract from firm creation and firm death and hence consider a constant set of firms here.

<sup>28</sup>See Hinz, Stammann, and Wanner (2020) for a very similar formulation of the extensive margin that allows for this investment motive.

Note that entry cost expression includes twelve lags (captured by superscript  $s$ ), because one period in our data set will correspond to one *month*, while entry costs only have to be paid if the firm has not been active in the market in the previous *year*.

As Equation (1) shows, a firm is likely to export if it is very competitive (due to low production costs), the destination market is attractive (due to low competitive pressure and/or large size), if it was already active in the market in the previous year, and if it faces low barriers of exporting (due to low variable, fixed, and/or entry costs). The latter part is where trade sanctions come into play: they make trading with the sanctioned country more costly. This can happen via increased transaction costs that make every unit sold to the sanctioned country more expensive. Or it could mean additional administrative costs for the firm to make sure that it acts in line with the imposed sanctions, implying higher fixed costs of selling to the sanctioned country at all.

## 3.2 Empirical Specifications

### 3.2.1 Baseline

As a baseline, we choose the following flexible specifications for fixed and variable trade costs:

$$\tau_{\omega jt} = \exp \left( \lambda_{\omega t}^{\tau} + \psi_{jt}^{\tau} + \mu_{\omega j}^{\tau} + \beta_{\tau} SANCT_{jt} \right), \quad (2)$$

$$f_{\omega jt}^{exp} = \exp \left( \lambda_{\omega t}^f + \psi_{jt}^f + \mu_{\omega j}^f + \beta_f SANCT_{jt} \right), \quad (3)$$

where the  $\lambda$ 's,  $\psi$ 's, and  $\mu$ 's are (potentially unobservable) firm-time, destination-time, and firm-destination trade cost components, and  $SANCT_{jt}$  is the treatment variable, i.e. an indicator variable that is equal to one if country  $j$  is sanctioned in period  $t$ . We will consider the four different sanctions episodes in separate regressions and drop the three other sanctioned countries from the sample in each case.

With trade cost specifications (2) and (3), the theoretical expression (1) translates into the following empirical specification:

$$y_{\omega jt} = \mathbf{1} \left[ \kappa + \lambda_{\omega t} + \psi_{jt} + \mu_{\omega j} + \gamma \max_{s \in \{1, \dots, 12\}} \{y_{\omega j(t-s)}\} \geq \zeta_{\omega jt} \right], \quad (4)$$

where

$$\begin{aligned} \kappa &\equiv -\sigma \log(\sigma) - (1 - \sigma) \log(\sigma - 1) - \gamma, \\ \lambda_{\omega t} &\equiv (1 - \sigma)(\log(c_{\omega t}) + (1 - \sigma)\lambda_{\omega t}^{\tau} - \lambda_{\omega t}^f), \\ \psi_{jt} &\equiv (\sigma - 1) \log(P_{jt}) + \log(E_{jt}) + (1 - \sigma)\psi_{jt}^{\tau} - \psi_{jt}^f \\ &\quad + SANCT_{jt} ((1 - \sigma)\alpha_{1\tau} - \alpha_{1f}), \\ \mu_{\omega j} &\equiv (1 - \sigma)\mu_{\omega j}^{\tau} - \mu_{\omega j}^f, \\ \gamma &\equiv \log(f^{entry}) \quad , \text{ and} \\ \zeta_{\omega jt} &\equiv -\log(\xi_{\omega jt}) \sim \mathcal{N}(0, 1). \end{aligned}$$

$\lambda_{\omega t}$ ,  $\psi_{jt}$ , and  $\mu_{\omega j}$  are three high-dimensional sets of firm-time, destination-time, and firm-destination fixed effects. These fixed effects flexibly control for the unobserved components of

the theoretical expression (1) (such as firm-level production costs or the competitive environment in the destination market), as well as for many, partly unobserved, trade cost determinants. However, besides posing some computational and econometric challenges discussed in the next section, they have an additional drawback: the  $jt$  fixed effects not only successfully control for a number of important unobservables, they also capture the overall sanction effect on fixed and variable trade costs. As we will discuss below, if the sanctions affect firms' trade costs differently depending on characteristics of the firms or their products, this heterogeneous impact can be identified — yet only jointly for fixed and variable trade costs.

However, we also want to estimate an overall sanctions effect. To do so, we follow the strategy by Crozet, Head, and Mayer (2011) and include *estimated values* for the destination-time fixed effects, obtained from a standard gravity estimation of the *intensive* margin of aggregate trade flows, as a regressor. The additional regressor controls for the importing countries' overall market potential, while leaving identifying variation at the destination-time level for the sanction effect. This approach leads to the second type of specification that we will consider (here and in the following we shorten notation by suppressing the constant and defining  $y_{\omega j(t-12)}^{max} \equiv \max_{s \in \{1, \dots, 12\}} \{y_{\omega j(t-s)}\}$ ):

$$y_{\omega jt} = \mathbf{1} \left[ \lambda_{\omega t} + \alpha \hat{\psi}_{jt} + \mu_{\omega j} + \gamma y_{\omega j(t-12)}^{max} + \beta SANCT_{jt} \geq \zeta_{\omega jt} \right] \quad (5)$$

Importantly, this specification features  $\beta \equiv (1 - \sigma)\alpha_{1\tau} - \alpha_{1f}$  and therefore allows identification of the sanction effect.

### 3.2.2 Entry Cost Sanction Effect

Besides fixed and variable trade costs, sanctions can also affect market entry costs. Coping with the sanctions may be easier (and cheaper) if the firm has already a business network in the partner country, implying that the relative costs of *starting* to export to the sanctioned country compared to continuing to serve it may also increase. We incorporate this possibility by allowing the entry cost factor to be variable:

$$f_{jt}^{entry} = \exp \left( \gamma_0 + \gamma_1 SC_j + \gamma_2 SP_t + \gamma_3 SANCT_{jt} \right), \quad (6)$$

where  $SC_j$  and  $SP_t$  are dummy variables for the sanction country (Iran, Russia, Myanmar, and Cuba in the different estimations) and the corresponding sanctions periods, respectively. They are included in addition to the  $SANCT_{jt}$  variable to ensure that the sanction effect does not pick up general differences in trade costs for the countries that *at some point* get sanctioned or general time trends.

Incorporating the more general entry cost specification given in (6), the three-way fixed effects specification (4) becomes:

$$y_{\omega jt} = \mathbf{1} \left[ \lambda_{\omega t} + \psi_{jt} + \mu_{\omega j} + y_{\omega j(t-12)}^{max} (\gamma_0 + \gamma_1 SC_j + \gamma_2 SP_t + \gamma_3 SANCT_{jt}) \geq \zeta_{\omega jt} \right]. \quad (7)$$

While the overall sanction effect is not identified in the three-way fixed effects specification, a different picture emerges for the differential impact on firms that are previously active in

the sanctioned market. Entry costs are only relevant for firms that are not yet active in the destination market. Therefore, the (firm-destination-time varying) lagged dependent variable features in the estimation of all entry cost components and hence the effect of all variables of interest on the entry costs can be identified.

For comparability and to be able to identify overall sanction treatment effects, we again complement the three-way specification with a two-way fixed effects model that additionally incorporates estimated destination-time fixed effects as a regressor:

$$y_{\omega jt} = \mathbf{1} \left[ \lambda_{\omega t} + \alpha \widehat{\psi}_{jt} + \mu_{\omega j} + y_{\omega j(t-12)}^{max} (\gamma_0 + \gamma_1 SC_j + \gamma_2 SP_t) + SANCT_{jt} (\beta + \gamma_3 y_{\omega j(t-12)}^{max}) \geq \zeta_{\omega jt} \right] \quad (8)$$

A comparison of the estimates for  $\beta$  and  $\gamma_3$  in this specification can inform us which part of the sanction effect can be avoided by firms that are already active in the sanctioned market.

### 3.2.3 Heterogeneous Sanction Effects Along Firm Characteristics

Previous export activity in the sanctioned country is not the only potential source of heterogeneous treatment effects. Firms could for example be differently affected if they rely more or less strongly on trade finance, if they are specialized in consumer or intermediate goods, or if they have gathered experience by exporting to other “crisis countries” (see Section 5 for a discussion of all sources of heterogeneity that we consider). We test whether sanction effects differ along these firm characteristics by introducing the following more general trade cost specifications:

$$\tau_{\omega jt} = \exp \left( \lambda_{\omega t}^{\tau} + \psi_{jt}^{\tau} + \mu_{\omega j}^{\tau} + SANCT_{jt} (\alpha_{1\tau} + \alpha_{2\tau} x_{\omega}) \right), \quad (9)$$

$$f_{\omega jt}^{exp} = \exp \left( \lambda_{\omega t}^f + \psi_{jt}^f + \mu_{\omega j}^f + SANCT_{jt} (\alpha_{1f} + \alpha_{2f} x_{\omega}) \right), \quad (10)$$

where  $x_{\omega}$  refers to the observable firm characteristic under investigation. With these variable and fixed trade costs, our three- and two-way fixed effects specifications become

$$y_{\omega jt} = \mathbf{1} \left[ \lambda_{\omega t} + \psi_{jt} + \mu_{\omega j} + \gamma y_{\omega j(t-12)}^{max} + SANCT_{jt} (\beta_2 x_{\omega}) \geq \zeta_{\omega jt} \right] \quad (11)$$

and

$$y_{\omega jt} = \mathbf{1} \left[ \lambda_{\omega t} + \alpha \widehat{\psi}_{jt} + \mu_{\omega j} + \gamma y_{\omega j(t-12)}^{max} + SANCT_{jt} (\beta_1 + \beta_2 x_{\omega}) \geq \zeta_{\omega jt} \right]. \quad (12)$$

Similar to the lagged dependent variable in (7),  $x_{\omega}$  introduces firm-level variation that allows identification of the heterogeneity coefficient in the three-way specification. The results can be compared to the ones from the two-way fixed effects framework, in which we can again additionally identify the overall sanction effect.

## 4 Data and Estimation Methodology

We now turn to the estimation of the model. Our empirical specifications (4), (5), (7), (8), (11), and (12) are equivalent to probit models with two or three sets of fixed effects and a lagged dependent variable. This poses econometric as well as computational challenges. In this section we first briefly describe the firm-level data that is used in all estimations, and then discuss how we overcome these challenges.

## 4.1 Data

To estimate the effect of sanctions on the extensive margin of trade at the firm-level, i.e. a firm's decision to export or not to a given market, we rely on French customs data. The data set encompasses the universe of French exporting firms from 2009 until 2016 with monthly frequency. It comprises the date, i.e. year-month, an identifier of the firm (the so-called SIREN), the importing or exporting partner, the products, with an 8 digit HS-code, as well as the value in Euros and quantity traded. We restrict our analysis to information on the firm and exporting destination and hence trace firms' participation in exporting markets over time.

For each of the four cases discussed above — sanctions against Iran, Russia, Myanmar and a US-imposed embargo on Cuba — we restrict the sample to two years before and after the imposition or lifting of sanctions, respectively. The specific points in time we consider as the starting and end points of the sanctions are January 2012, August 2014, May 2012, and January 2015 for Iran, Russia, Myanmar, and Cuba, respectively. As the data set records positive trade flows, we need to construct the absence thereof. We do so by assigning zeros to those combinations of date  $\times$  firm  $\times$  destination, where the firm has been active on a given market at least once and only if the firm exports at all on a given date.<sup>29</sup> For each regression we omit all observations of the three other sanctioned countries. All in all, the case subsets of the data each comprise around 35 million observations and cover more than 150,000 firms potentially exporting to up to 223 destinations in 48 months.<sup>30</sup>

Furthermore we construct a number of firm-level variables for use in the estimation of equations (11) and (12). When constructing shares and means, these are computed using trade weights from the 12 months prior to the first year in the sample.<sup>31</sup>

## 4.2 Estimation Methodology

The standard approach to estimate fixed effects probit models is a maximum likelihood estimator (MLE) that estimates the parameters of interest and the fixed effects simultaneously. Due to the network structure of our data and the two- or three-way fixed effects specifications of our model, a large number of parameters has to be estimated. Thanks to recent advances in the field of computational econometrics, however, such high-dimensional specifications are no longer an obstacle.<sup>32</sup>

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<sup>29</sup>With the employed three sets of fixed effects this covers exactly all possible combinations that are not trivially perfectly classified. E.g. if a firm does not export at all on a given date, the firm  $\times$  date fixed effect will consume these observations; if a firm never exports to a given market, the firm  $\times$  destination effect will consume these.

<sup>30</sup>See Table 11 in Appendix A for case-specific summary statistics. Note that in the estimations we report the sample size as the number of those observations actually used in the estimation, i.e. net of those observations perfectly classified with one, or a combination of multiple, fixed effects.

<sup>31</sup>As an example, the sample for Iran starts in January 2010 and hence the 4 digit-product trade weights are taken as the sum of export values by the specific firm to all destinations observed in the months January – December 2009. Information on the trade finance intensity is sourced from Crozet et al. (2020), on external financial dependence from Kroszner et al. (2007), the classification for consumer and intermediate goods by broad economic categories (BEC) is provided by the United Nations Statistics Division.

<sup>32</sup>Stammann (2018) proposed a pseudo-demeaning approach which is a generalization of the within-transformation known from the linear fixed effects estimator and pursues the same objective: to avoid the necessity of explicitly estimating the nuisance parameters.

Another issue that needs to be addressed is the so-called incidental parameter problem (IPP), which leads to asymptotically biased estimates of the structural parameters and average partial effects (see Neyman and Scott, 1948). More precisely, the inclusion of each set of fixed effects,  $\lambda_{\omega t}$ ,  $\psi_{jt}$  and  $\mu_{\omega j}$ , creates a separate bias, each of a different order.<sup>33</sup> Fernández-Val and Weidner (2018) formulate a simple heuristic helping to assess the order of the incidental parameter bias:  $bias \sim p/n$ , where  $p$  denotes the number of parameters and  $n$  the number of observations. Hence, the composite bias in our two-way fixed effects specification is of order  $(\Omega T + \Omega J)/(\Omega J T)$  and in our three-way fixed effects specification it is of order  $(\Omega T + J T + \Omega J)/(\Omega J T)$ , where  $\Omega$ ,  $J$ , and  $T$  are the number of firms, destination markets, and periods, respectively. Thus, the bias term induced by  $\lambda_{\omega t}$  decreases with increasing  $J$ , the one induced by  $\psi_{jt}$  shrinks with growing  $\Omega$ , and the one induced by  $\mu_{\omega j}$  gets smaller with larger  $T$ . Since in our applications  $\Omega$  and  $J$  will be large (around 150,000 exporters and more than 200 destinations), the biases induced by  $\lambda_{\omega t}$  and  $\psi_{jt}$  are expected to be relatively small. The main driver of the bias in our application will come from the inclusion of the  $\mu_{\omega j}$  fixed effect, because  $T$  is only moderately large (48 months). Further, the combination of pair fixed effects and lagged dependent variables as regressors leads to a violation of the strict exogeneity assumption, which further amplifies the bias (see Fernández-Val and Weidner, 2018; Hinz, Stammann, and Wanner, 2020).<sup>34</sup> Recently, Hinz, Stammann, and Wanner (2020) developed appropriate bias corrections for coefficients and average partial effects of dynamic binary choice models with the same fixed effects structure we are considering. In our econometric analysis we follow their recommendation and use an analytical bias correction.

We compute the bias-corrected coefficients according to

$$\tilde{\beta}^a = \hat{\beta}_{\Omega, J, T} - \frac{\hat{\mathbf{B}}_2^\beta}{J} - \frac{\hat{\mathbf{B}}_3^\beta}{T}$$

in the case of two-way fixed effects specifications and according to

$$\tilde{\beta}^a = \hat{\beta}_{\Omega, J, T} - \frac{\hat{\mathbf{B}}_1^\beta}{\Omega} - \frac{\hat{\mathbf{B}}_2^\beta}{J} - \frac{\hat{\mathbf{B}}_3^\beta}{T}$$

in the case of three-way fixed effects specifications, where  $\hat{\beta}_{\Omega, J, T}$  denotes the uncorrected coefficients and the expressions for the bias terms  $\hat{\mathbf{B}}_1^\beta$ ,  $\hat{\mathbf{B}}_2^\beta$ , and  $\hat{\mathbf{B}}_3^\beta$  are further specified in Hinz, Stammann, and Wanner (2020).

As coefficients are not directly interpretable beyond their signs and relative sizes in a binary choice context, we will also obtain average partial effects. Specifically, we will report average

<sup>33</sup>The intuition is as follows. Due to the nonlinearity of the probit model, the MLE cannot estimate the structural parameters separately from the fixed effects. More precisely, the IPP arises because the fixed effects are replaced by sample analogues, which are estimated only with a limited number of observations. For example, there are only  $T$  observations contributing to the identification of a firm-destination fixed effect  $\mu_{\omega j}$ , leading to noisy estimates. Due to the dependence of the estimates of the structural parameters on the estimates of the fixed effects, they will be affected by this estimation noise.

<sup>34</sup>This also includes various functional forms of the lagged dependent variable. For example, interactions between an exogenous regressor with a lagged dependent variable or lags aggregated on a different time dimension than the dependent variable (e.g. if the dependent variable is on a monthly basis, but the lag is based on years).



treatment effects on the treated (ATT) which we obtain as follows:

$$\widehat{ATT} = \frac{\sum_{\omega} \sum_j \sum_t SC_j \times SP_t \times \widehat{\Delta}_{\omega jt}}{\sum_{\omega} \sum_j \sum_t SC_j \times SP_t}, \quad (13)$$

where  $\widehat{\Delta}_{\omega jt}$  takes slightly different forms for the three types of specifications discussed in Sections 3.2.1 to 3.2.3 . Specifically, it is given by

$$\widehat{\Delta}_{\omega jt} = \Phi(\hat{\lambda}_{\omega t} + \hat{\alpha}\hat{\psi}_{jt} + \hat{\mu}_{\omega j} + \hat{\gamma}y_{\omega j(t-12)}^{max} + \hat{\beta}) - \Phi(\hat{\lambda}_{\omega t} + \hat{\alpha}\hat{\psi}_{jt} + \hat{\mu}_{\omega j} + \hat{\gamma}y_{\omega j(t-12)}^{max}) \quad (14)$$

in the baseline specification, by

$$\begin{aligned} \widehat{\Delta}_{\omega jt} = & \Phi(\hat{\lambda}_{\omega t} + \hat{\alpha}\hat{\psi}_{jt} + \hat{\mu}_{\omega j} + (\hat{\gamma}_0 + \hat{\gamma}_1 SC_j + \hat{\gamma}_2 SP_t + \hat{\gamma}_3) y_{\omega j(t-12)}^{max} + \hat{\beta}) \\ & - \Phi(\hat{\lambda}_{\omega t} + \hat{\alpha}\hat{\psi}_{jt} + \hat{\mu}_{\omega j} + (\hat{\gamma}_0 + \hat{\gamma}_1 SC_j + \hat{\gamma}_2 SP_t) y_{\omega j(t-12)}^{max}) \end{aligned} \quad (15)$$

if sanction entry cost effects are considered, and by

$$\widehat{\Delta}_{\omega jt} = \Phi(\hat{\lambda}_{\omega t} + \hat{\alpha}\hat{\psi}_{jt} + \hat{\mu}_{\omega j} + \hat{\gamma}y_{\omega j(t-12)}^{max} + \hat{\beta}_1 + \hat{\beta}_2 x'_{\omega}) - \Phi(\hat{\lambda}_{\omega t} + \hat{\alpha}\hat{\psi}_{jt} + \hat{\mu}_{\omega j} + \hat{\gamma}y_{\omega j(t-12)}^{max}) \quad (16)$$

if the sanction effect varies with firm characteristics.

Note that we focus on the specification with firm-destination and firm-time fixed effects and *estimated* destination-time fixed effects for the ATTs, as it allows the separate identification of all coefficients featuring in the partial effect expression. Similar as for the coefficients, we apply a bias correction for the ATTs following Fernández-Val (2009) and Hinz, Stammann, and Wanner (2020). More precisely, we bias-correct the ATT according to

$$\widetilde{ATT}^a = \widehat{ATT} - \frac{\widehat{\mathbf{B}}_2^{\delta}}{J} - \frac{\widehat{\mathbf{B}}_3^{\delta}}{T}$$

where the expressions  $\widehat{\mathbf{B}}_2^{\delta}$  and  $\widehat{\mathbf{B}}_3^{\delta}$  are further specified in Hinz, Stammann, and Wanner (2020). We allow the sanction effect to be heterogeneous along different dimensions. To infer the effect of drivers of heterogeneity, it is not sufficient to split the treatment group along this dimension and obtain separate ATTs for the “high  $x_{\omega}$ ” and “low  $x_{\omega}$ ” groups. This is because the groups potentially have different fitted probabilities and therefore have different average partial effects irrespective of whether the source of heterogeneity actually has an additional impact on the sanction effect or not. We therefore calculate group ATTs *with and without* taking the respective source of heterogeneity into account in the specifications and then look at how the incorporation of the heterogeneity *changes* the different group ATTs. For the heterogeneous sanction effects, we hence calculate five bias-corrected ATTs altogether:  $\widetilde{ATT}_{high}^{baseline}$ ,  $\widetilde{ATT}_{low}^{baseline}$ ,  $\widetilde{ATT}_{high}^{heterogeneous}$ ,  $\widetilde{ATT}_{low}^{heterogeneous}$ , and an  $\widetilde{ATT}_{highvs.low}^{change}$  which captures the change discussed above and is defined as

$$\widetilde{ATT}_{highvs.low}^{change} = \left( \widetilde{ATT}_{high}^{heterogeneous} - \widetilde{ATT}_{low}^{heterogeneous} \right) - \left( \widetilde{ATT}_{high}^{baseline} - \widetilde{ATT}_{low}^{baseline} \right). \quad (17)$$

**Table 1: Baseline specification**

| <b>(a) Coefficients from three-way fixed effects model</b> |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                       | 0.209***<br>(0.001)                 | 0.172***<br>(0.001)      | 0.206***<br>(0.001)      | 0.169***<br>(0.001)      |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 27,396,537                          | 27,785,280               | 27,640,157               | 27,499,973               |

| <b>(b) Coefficients from two-way fixed effects model</b> |                                     |                      |                     |                     |
|--|-------------------------------------|----------------------|---------------------|---------------------|
|  | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|  | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year                                     | 0.302***<br>(0.001)                 | 0.246***<br>(0.001)  | 0.296***<br>(0.001) | 0.242***<br>(0.001) |
| Sanctions $_{jt}$  | -0.260***<br>(0.012)                | -0.222***<br>(0.007) | 0.004<br>(0.033)    | 0.015<br>(0.03)     |
| Estimated Date-Partner FE $_{jt}$                        | 0.222***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.201***<br>(0.002) | 0.191***<br>(0.002) |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size  | 27,410,538                          | 27,851,032           | 27,671,986          | 27,555,391          |

| <b>(c) ATTs of Sanctions from two-way fixed effects model</b> |                      |                      |                  |                  |
|---|----------------------|----------------------|------------------|------------------|
|   | Iran                 | Russia               | Myanmar          | Cuba             |
| Overall ATTs of Sanctions                                     | -0.043***<br>(0.002) | -0.041***<br>(0.001) | 0.000<br>(0.002) | 0.002<br>(0.003) |

*Notes:* Sanctions $_{jt}$  = Sanctions Period $_t$   $\times$  Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

## 5 Estimation results

### 5.1 Baseline

We now turn to the estimation of the model. We first estimate the baseline specifications (4) and (5), to get an overall picture of the respective impact of the four different sanctions episodes.

We report the results in Table 1.<sup>35</sup> Panel (a) displays the three-way fixed effects results. As discussed in Section 3, the sanction effect is not identified in this case and there is hence only the coefficient of the (extended) lagged dependent variable to report. As expected, it is highly statistically significant, indicating strong true state dependence, or — in terms of the model — the existence of considerable entry costs.

Panel (b) shows the results of the two-way fixed effects specification. Again, previous export activity significantly increases the probability to serve a market. The corresponding coefficients

<sup>35</sup>Note that we show only bias-corrected coefficients in the main body of the text. The bias correction uses a bandwidth parameter  $L = 2$  (see Hinz, Stammann, and Wanner, 2020, for details). Uncorrected estimates for the baseline specifications (4) and (5), as well as for the lag-interaction specifications (7) and (8), can be found in Tables 13 and 14 in Appendix B. Uncorrected estimates for all other specifications are available in the Online Appendix ([https://julianhi.nz/worth\\_the\\_pain\\_online\\_appendix.pdf](https://julianhi.nz/worth_the_pain_online_appendix.pdf)).

actually are somewhat larger than in the three-way specification. Unsurprisingly, the *estimated jt* fixed effects also turn out to be a highly significant determinant of the firm-level extensive margin as they capture the overall market potential of the destination country. Importantly, the two-way specification now also allows the identification of the sanction effect. We find that the introduction of sanctions on Iran and Russia significantly lowered the probability of French firms to export to these destinations. No such effect is found for the lifting of the Myanmar sanctions and the US embargo on Cuba. The absence of an effect in the Cuban case may not come as a surprise, given the fact that France (or the EU) did not have in place the embargo, but rather the United States. For Myanmar, however, it is remarkable that the abolition of the rigorous sanctions does not have a perceptible effect on exporting behaviour.

In panel (c), average treatment effects on the treated are given. They are of comparable magnitude for the Iran and Russia sanctions, implying that French firms were 4.3 and 4.1 percentage points less likely to export to these destination markets. Given the stronger sanctions enacted vis-à-vis Iran, one might have expected the Iranian ATT to be more clearly the strongest. The fact that the effect for Russia is almost as strong may partly be explained by the Russian counter-measures and Russian consumers deliberately moving away from Western products in response to the sanctions. As already indicated by the coefficient estimates, Burmese and Cuban ATTs are close to zero. One distinct feature between the two groups of countries with and without significant effects is that we are considering the *introduction* of sanctions in one case and the *lifting* of sanctions in the other case. Therefore, asymmetries in how (fast) sanctions start or stop to be effective could be an explanatory factor here.

We now explore different sources of heterogeneity along which we suspect the exporting behaviour of firms to be impacted.

## 5.2 Previous Experience

As a first source of heterogeneity in the sanction effect, the model lays out a mechanism through which firms may be affected along their fixed cost of entry. We therefore estimate specifications (7) and (8). The results are displayed in Table 2.

Panel (a) again reports the results from the three-way fixed effects specification. All drivers of heterogeneity in the state dependence (i.e. in entry costs) can be identified even with this strongest set of fixed effects. The estimated coefficients for sanctions period and sanction country make clear that there is considerable heterogeneity in entry costs across countries and time. For example, the combination of negative sanctions period coefficients for the two sanctions that are introduced during the sample and the positive coefficients for the ones abolished suggest that there is an overall falling trend in entry costs. The interaction of the sanction variable with previous export activity clearly indicates in the case of Iran that already serving the Iranian market softens the blow of the sanction introduction. In terms of our empirical framework, this implies that sanctions partly act via increased entry costs.<sup>36</sup> The corresponding coefficient in

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<sup>36</sup>An alternative explanation also in line with the empirical evidence, but not captured in our theoretical consideration, is that previously active firms face systematically different demand shocks after the introduction of sanctions than previously non-active firms.

**Table 2: Previous experience**

| <b>(a) Coefficients from three-way fixed effects model</b>   |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year   | 0.338***<br>(0.002)                 | 0.312***<br>(0.002)      | 0.080***<br>(0.002)      | 0.029***<br>(0.002)      |
| — × Sanctions Period <sub>t</sub>  | -0.254***<br>(0.002)                | -0.282***<br>(0.002)     | 0.256***<br>(0.002)      | 0.281***<br>(0.002)      |
| — × Sanctioned Country <sub>j</sub>  | -0.081***<br>(0.023)                | 0.065***<br>(0.014)      | -0.300***<br>(0.053)     | -0.150***<br>(0.056)     |
| — × Sanctions <sub>jt</sub>  | 0.125***<br>(0.032)                 | 0.035*<br>(0.018)        | 0.296***<br>(0.075)      | 0.009<br>(0.07)          |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 27,396,537                          | 27,785,280               | 27,640,157               | 27,499,973               |
| <b>(b) Coefficients from two-way fixed effects model</b>   |                                     |                          |                          |                          |
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year   | 0.431***<br>(0.002)                 | 0.372***<br>(0.002)      | 0.169***<br>(0.002)      | 0.115***<br>(0.002)      |
| — × Sanctions Period <sub>t</sub>  | -0.257***<br>(0.002)                | -0.254***<br>(0.002)     | 0.254***<br>(0.002)      | 0.253***<br>(0.002)      |
| — × Sanctioned Country <sub>j</sub>  | -0.102***<br>(0.023)                | 0.061***<br>(0.014)      | -0.311***<br>(0.053)     | -0.168***<br>(0.055)     |
| — × Sanctions <sub>jt</sub>  | 0.106***<br>(0.031)                 | 0.019<br>(0.018)         | 0.255***<br>(0.073)      | 0.033<br>(0.07)          |
| Sanctions <sub>jt</sub>  | -0.362***<br>(0.027)                | -0.242***<br>(0.016)     | -0.116**<br>(0.055)      | 0.020<br>(0.056)         |
| Estimated Date-Partner FE <sub>jt</sub>  | 0.216***<br>(0.002)                 | 0.188***<br>(0.002)      | 0.196***<br>(0.002)      | 0.195***<br>(0.002)      |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$           | $\omega t, jt$           | $\omega t, jt$           |
| Sample size  | 27,410,538                          | 27,851,032               | 27,671,986               | 27,555,391               |
| <i>Notes: Sanctions<sub>jt</sub> = Sanctions Period<sub>t</sub> × Sanctioned Country<sub>j</sub>. Sample includes two years pre and post treatment periods, respectively. ***<math>p &lt; 0.01</math>, **<math>p &lt; 0.05</math>, *<math>p &lt; 0.1</math>.</i> |                                     |                          |                          |                          |

the Russian case is only marginally significant. For Cuba, it is not significantly different from zero, which is in line with the absence of an overall sanction effect in the baseline specification. For Myanmar, however, there is a significant interaction effect even though we did not find a significant overall effect previously.

Panel (b) shows the results for the entry cost interaction in a two-way fixed effects setting. Reassuringly, most of the interaction coefficients that can be identified in both the two- and three-way specification are very similar. However, the Russian sanction interaction term with previous export experience is not significant. For Iran, the relative magnitude of the coefficients indicates that about a third of the sanction effect is offset for a firm that already served the market, giving us an impression of the relative importance of the entry cost effect. Translating this into an effect on the ATT, we find that previous activity in the Iranian market lowers the average sanction

impact by about 2.4 percentage points.<sup>37</sup> For Myanmar, we now find — different than with the baseline specification — a significantly negative overall sanction effect. Note, however, that this effect is weaker than the positive interaction effect. Taking the results at face value, this would imply that firms not currently active in Myanmar were negatively affected by the sanctions, while firms already in the market actually gained from them. Given the absence of a significant overall finding for Myanmar and Cuba in the baseline specification, however, we do not want to put too much weight on the heterogeneity results for these countries.

The fact that companies already active in the sanctioned market resist better is not in itself surprising. However, it has significant implications for the assessment of the long-term consequences of sanctions. Indeed, it suggests that the consequences of diplomatic measures on international business phase-in progressively, first by reducing the numbers of new entries on the sanctioned countries, then by eroding slowly the number of incumbent exporters. But it also means that the return to normal may be slow once sanctions are lifted. This hysteresis revealed in Table 2 may partly explain the lack of average effect of lifting sanctions observed in Table 1 in the case of Cuba and Myanmar.

### 5.3 Firm characteristics

Exporting behaviour could also be heterogeneous along other characteristics. Large firms and multi-product firms may be more (or less) affected than the average firm, depending on the sanctions regime. As most sanctions schemes incorporate financial measures, firms predominantly exporting products relying on trade finance instruments may be more severely affected than others. In terms of the exported products, other characteristics may also play an important role. As Western sanctions against the Russian Federation were met with an import embargo on food and agricultural products and, as reported in the media, an at least moderate boycott of Western products by Russian consumers, firms exporting consumer products were likely more adversely affected than others. Finally, some firms may — by coincidence or strategy — export to *other* markets that make them more or less resilient in the face of sanctions. Exporting to a country in the neighborhood of the sanctioned country, e.g., may allow them a relatively easy path to circumvent sanctions.<sup>38</sup> Still other firms may actually specialize in “tough” markets, allowing them to stay in the sanctioned market when otherwise comparable firms decide not to.

We investigate these potential sources of heterogeneity by estimating equations (11) and (12), interacting the sanctions indicator with the variable in question. The variables are generated using data from the year prior to the first year of the sample used in the estimation.<sup>39</sup>

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<sup>37</sup>ATTs and the ATT differences across specifications for all heterogeneous sanction effects are reported in Tables 15ff.

<sup>38</sup>Note that the sanctions regimes against Russia were not UN mandated, and out of its neighbours only the EU members Finland, Estonia, Latvia, Lithuania, Poland, and Ukraine implemented sanctions. In the case of Iran, the measures were UN mandated, however trade with generally friendly neighboring countries such as Azerbaijan and Turkey continued to thrive (compare e.g. <https://www.theatlantic.com/international/archive/2013/05/how-iran-benefits-from-an-illicit-gold-trade-with-turkey/275948/>, accessed on June 29th, 2020).

<sup>39</sup>E.g., for the case of Iran, the sample spans January 2010 to January 2014, hence we take firm-level trade data from 2009 to construct the mean and shares used in the analysis below. We report summary statistics and display histograms of the interacted variables in Appendix A.

**Table 3: Total exports**

| <b>(a) Coefficients from three-way fixed effects model</b> |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                       | 0.284***<br>(0.001)                 | 0.251***<br>(0.001)      | 0.283***<br>(0.001)      | 0.248***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>log total exports $_{\omega}$       | -0.068***<br>(0.006)                | 0.003<br>(0.003)         | -0.005<br>(0.014)        | 0.012<br>(0.012)         |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 26,826,432                          | 26,304,830               | 26,618,756               | 24,423,850               |

| <b>(b) Coefficients from two-way fixed effects model</b> |                                     |                     |                     |                     |
|--|-------------------------------------|---------------------|---------------------|---------------------|
|  | Dependent variable: $y_{\omega jt}$ |                     |                     |                     |
|  | Iran                                | Russia              | Myanmar             | Cuba                |
| Active previous year                                     | 0.309***<br>(0.001)                 | 0.257***<br>(0.001) | 0.303***<br>(0.001) | 0.253***<br>(0.001) |
| Sanctions $_{jt}$  | 0.845***<br>(0.093)                 | -0.252***<br>(0.05) | 0.060<br>(0.234)    | -0.199<br>(0.2)     |
| Sanctions $_{jt}$ ×<br>log total exports $_{\omega}$     | -0.070***<br>(0.006)                | 0.002<br>(0.003)    | -0.003<br>(0.014)   | 0.013<br>(0.012)    |
| Estimated Date-Partner FE $_{jt}$                        | 0.224***<br>(0.002)                 | 0.185***<br>(0.002) | 0.202***<br>(0.002) | 0.193***<br>(0.002) |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$      | $\omega t, jt$      | $\omega t, jt$      |
| Sample size  | 26,840,138                          | 26,367,920          | 26,649,461          | 24,474,601          |

*Notes:* Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

### 5.3.1 Firm size and multi-product firms

We first explore how firm size and the number of product a firm exports affect the impact of sanctions. It is difficult to predict whether large exporters are likely to be hit harder than smaller ones. On the one hand, large firms may find it easier to pay the fixed costs of exporting and have the resources to adapt to the new legal environment. On the other hand, larger firms are more visible, need to preserve their reputation and are more likely to come under political pressure. We estimate specifications (11) and (12) interacting the sanctions indicator with the logarithm of the respective firms' annual total exports, as a proxy for firm size, and with the number of unique products at the HS6-level the firm has exported in the reference year.

The regression results displayed in Tables 3 and 4 paint similar pictures. In the case of the Iran sanctions, larger firms were much more affected than smaller firms. The coefficient of interest, on the interaction of Sanctions $_{jt}$  × log total exports $_{\omega}$ , is very similar in the three-way fixed effects model (panel a) and two-way fixed effects model (panel b), controlling with an estimated fixed effects from an intensive margin regression. The implied difference in the average treatment effect between those firms that export more than the mean and those that do so less is a marked 5 percentage points. Hence, larger firms were much more likely to leave and/or not to enter the Iranian market due to the imposition of the sanctions than smaller firms. Interestingly, in the case of the Russia sanctions there is no significant difference in the firms' behaviour. The

**Table 4: Number of products**

| (a) Coefficients from three-way fixed effects model    |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                   | 0.284***<br>(0.001)                 | 0.251***<br>(0.001)      | 0.283***<br>(0.001)      | 0.248***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>log number products $_{\omega}$ | -0.092***<br>(0.012)                | 0.008<br>(0.006)         | 0.015<br>(0.027)         | -0.072***<br>(0.025)     |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 26,826,432                          | 26,305,187               | 26,618,756               | 24,423,850               |

| (b) Coefficients from two-way fixed effects model      |                                     |                      |                     |                      |
|--|-------------------------------------|----------------------|---------------------|----------------------|
|  | Dependent variable: $y_{\omega jt}$ |                      |                     |                      |
|  | Iran                                | Russia               | Myanmar             | Cuba                 |
| Active previous year                                   | 0.309***<br>(0.001)                 | 0.257***<br>(0.001)  | 0.303***<br>(0.001) | 0.253***<br>(0.001)  |
| Sanctions $_{jt}$                                      | -0.010<br>(0.032)                   | -0.240***<br>(0.017) | -0.057<br>(0.085)   | 0.222***<br>(0.078)  |
| Sanctions $_{jt}$ ×<br>log number products $_{\omega}$ | -0.097***<br>(0.012)                | 0.007<br>(0.006)     | 0.021<br>(0.027)    | -0.077***<br>(0.025) |
| Estimated Date-Partner FE $_{jt}$                      | 0.224***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.202***<br>(0.002) | 0.193***<br>(0.002)  |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$       |
| Sample size  | 26,840,138                          | 26,368,277           | 26,649,461          | 24,474,601           |

Notes: Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

coefficients in both regressions are insignificant. Large and small firms exhibited a very similar behaviour with respect to leaving or staying, or entering the Russian market after the sanctions were imposed in mid 2014. For Myanmar and Cuba no significant difference is observable in the behaviour of small and large firms.

The message is reinforced by results from the specification interacting Sanctions $_{jt}$  × log number of products $_{\omega}$ . Firms with a larger number of unique products in their export portfolio were less likely to export to Iran after January 2012. The estimated effect is again remarkably similar in the two-way and three-way fixed effects regressions, implying an average treatment effect 2.7 percentage points stronger for firms exporting more than the average number of products. As in the previous regression, the results in Table 4 show that the cases of Russia, Myanmar and Cuba, larger firms did not behave any differently.

Overall, the results give the impression that sanctions have a similar effect on small and large companies, except in cases where countries are labelled an international pariah hit with multilateral UN-mandated sanctions, as in the case of Iran. Interestingly, these results from the extensive margin mirror those found for the intensive margin, as reported in Crozet and Hinz (2020). In the case of French firms exporting to Russia, large firms are reported to perform no differently than small firms in terms of the *value* exported, given they do export. At the same time the results stand somewhat in contrast to Haidar (2017)'s findings for Iranian firms, who, essentially

**Table 5: Trade finance intensity**

| <b>(a) Coefficients from three-way fixed effects model</b>             |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year   | 0.284***<br>(0.001)                 | 0.251***<br>(0.001)      | 0.283***<br>(0.001)      | 0.248***<br>(0.001)      |
| Sanctions $_{jt}$ $\times$<br>mean trade finance intensity $_{\omega}$ | -0.370**<br>(0.177)                 | -0.177*<br>(0.102)       | 0.830<br>(0.531)         | 0.125<br>(0.37)          |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 26,826,432                          | 26,305,187               | 26,618,756               | 24,423,850               |

| <b>(b) Coefficients from two-way fixed effects model</b>               |                                     |                      |                     |                     |
|--|-------------------------------------|----------------------|---------------------|---------------------|
|  | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|  | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year   | 0.309***<br>(0.001)                 | 0.257***<br>(0.001)  | 0.303***<br>(0.001) | 0.253***<br>(0.001) |
| Sanctions $_{jt}$  | -0.288***<br>(0.021)                | -0.238***<br>(0.011) | 0.079<br>(0.06)     | 0.017<br>(0.044)    |
| Sanctions $_{jt}$ $\times$<br>mean trade finance intensity $_{\omega}$ | -0.354**<br>(0.177)                 | -0.173*<br>(0.102)   | 0.819<br>(0.528)    | 0.120<br>(0.369)    |
| Estimated Date-Partner FE $_{jt}$                                      | 0.224***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.202***<br>(0.002) | 0.193***<br>(0.002) |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size  | 26,840,138                          | 26,368,277           | 26,649,461          | 24,474,601          |

*Notes:* Sanctions $_{jt}$  = Sanctions Period $_t$   $\times$  Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

looking at the issue from the other side, reports that smaller exporting firms were harder hit than larger firms. Importantly, however, this dissonance may be due to firms either being from the target or the sender country. Big Iranian firms may have the resources to circumvent the sanctions and nothing to lose in terms of reputation or political support. This is likely not true for Western firms.

### 5.3.2 Trade finance intensity

One sanctions instrument that is styled as surgical yet severe are financial sanctions (compare e.g. Drezner, 2015; Ahn and Ludema, 2019). In the past decade, their use has proliferated, with the sanctions regimes against Russia and Iran being the most prominent cases. In the case of Iran, as described above, measures were particularly severe, largely cutting the country off from existing financial links, and effectively branding the country a no-go area. In the case of Russia, financial sanctions were designed *not* to directly impede trade flows, yet recent research has shown that the observed adverse trade effects on intensive margin of trade were particularly driven by trade finance intensive goods, as Western banks refrained from interacting with Russian counterparts. We hence now investigate whether those firms exporting products relying heavily on trade finance instruments are any different in their exporting behaviour than those that do not.

As in Crozet and Hinz (2020), we rely on an indicator that describes the *product*-level intensity



**Table 6: Financial dependence**

| <b>(a) Coefficients from three-way fixed effects model</b>          |                                     |                          |                          |                          |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
|   | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|   | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year  | 0.284***<br>(0.001)                 | 0.251***<br>(0.001)      | 0.283***<br>(0.001)      | 0.248***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>mean external finance dependence $_{\omega}$ | 0.074*<br>(0.039)                   | 0.066***<br>(0.025)      | -0.014<br>(0.12)         | -0.126<br>(0.117)        |
| Fixed effects   | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size   | 26,826,432                          | 26,305,187               | 26,618,756               | 24,423,850               |

| <b>(b) Coefficients from two-way fixed effects model</b>            |                                     |                      |                     |                     |
|---|-------------------------------------|----------------------|---------------------|---------------------|
|   | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|   | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year  | 0.309***<br>(0.001)                 | 0.257***<br>(0.001)  | 0.303***<br>(0.001) | 0.253***<br>(0.001) |
| Sanctions $_{jt}$   | -0.259***<br>(0.013)                | -0.222***<br>(0.007) | 0.004<br>(0.034)    | 0.012<br>(0.032)    |
| Sanctions $_{jt}$ ×<br>mean external finance dependence $_{\omega}$ | 0.074*<br>(0.039)                   | 0.064***<br>(0.025)  | -0.020<br>(0.119)   | -0.128<br>(0.116)   |
| Estimated Date-Partner FE $_{jt}$                                   | 0.224***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.202***<br>(0.002) | 0.193***<br>(0.002) |
| Fixed effects   | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size   | 26,840,138                          | 26,368,277           | 26,649,461          | 24,474,601          |

*Notes:* Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

of the use of trade finance instruments, letters-of-credit in particular.<sup>40</sup> We therefore estimate equations (11) and (12) interacting the sanctions indicator with the respective firms' mean trade insurance intensity.

The results in Table 5 paint a clear picture: In both sanctions regimes in which significant financial sanctions are imposed, Russia and Iran, firms that rely on trade finance instruments more heavily than otherwise comparable firms are much more affected. As before, the coefficient on the interaction term is very similar in magnitude (and standard errors) in both specifications. The implied difference between the two groups relying either more or less on trade insurance than the average is 0.5 percentage points in the case of Iran, and 0.3 percentage points in the case of Russia. As one would expect, the impact is hence stronger for the former case, where sanctions effectively cut off the country from the international monetary system, and therefore likely strongly disincentivized banks to involve themselves in transactions with the targeted country.

It could be, however, that these results merely reflect product characteristics associated with generally higher financial dependence (compare e.g. Manova, 2008; Chan and Manova, 2015), rather than explicit trade finance intensity. We therefore repeat the exercise, now interacting

<sup>40</sup>We use the indicator constructed by Crozet, Demir, and Javorcik (2020).

the sanctions indicator with the measure of external financial dependence from Kroszner et al. (2007). The results are displayed in Table 6. It turns out the worry was not warranted, as in fact the coefficient of interest in both sanctions cases in question are both *positive* and significant. This may reflect two possible explanations: Financial sanctions on Iran and Russia should in fact have no impact on how French companies finance their production of goods, as long as these are not specifically designed for use tangential to sanctions, as e.g. certain oil drilling equipment for Arctic conditions that currently requires a special export license for transactions to Russia.<sup>41</sup> The positive coefficient, on the other hand, may reflect that certain industries that continued to be in demand from Russia and to a lesser extent Iran, as e.g. machinery and heavy industry products, are products with particularly low need for external financing. Hence, results from Table 6 do not run counter to those presented in Table 5.

Overall it appears that financial sanctions are an important driver of the heterogeneity in the impact of sanctions on the extensive margin. Mirroring results for the intensive margin of trade, firms relying on trade finance instruments more adjust their exporting behaviour much more than those that do not.

### 5.3.3 Product mix

As we describe above, each sanctions case is to some degree unique. In the case of the Russia sanctions, e.g., the country reacted against Western sanctions by imposing an embargo on food and agricultural products. At the same time, the media reported that at least some Russian consumers were staging a general boycott against Western consumer products.

Such idiosyncracies may therefore also matter in the ways certain types of *products* are more affected than others. As we study the exporting behaviour of firms, we now construct two indicators that reflect the product mix of firms, denoting the share of consumer products and intermediate products in the respective firms' export portfolio. We then re-estimate equations (11) and (12) interacting the sanctions indicator with these variables.

Table 7 shows the results for the interaction of the sanctions indicator with the variable denoting the share of consumer goods in a firm's export portfolio. The coefficient on the interaction with the variable of interest,  $\text{Sanctions}_{jt} \times \text{share intermediate goods}_{\omega}$ , is significantly negative for Russia in both specifications. The implied difference between the average treatment effect for groups with above and below mean share of consumer products is 3.7 percentage points (-2.7 for low share of consumer product vs. -6.4 for high share of consumer products), and hence a sizeable driver of the overall effect.<sup>42</sup> Interestingly, the coefficient is positive and significant for the case of Iran. While this may look counter-intuitive at first sight, two possible explanations come to mind: First, consumer products really may have been much less affected due to ongoing

<sup>41</sup>See the EU's Council Regulation No 833/2014 from 31 July 2014 that specifies certain 6 and 8 digit HS codes for which an export licence is "required to export, sell, supply or transfer goods suited to certain oil exploration and production projects to Russia or to other destinations where they are ultimately for use in Russia. A licence will not be granted if the items are intended for use in deep water oil exploration and production, arctic oil exploration and production, or shale oil projects in Russia." (<https://www.gov.uk/guidance/trade-sanctions-on-russia>, accessed on June 29th, 2020).

<sup>42</sup>Compare Table 20 in Appendix C. As the baseline ATTs are statistically indistinguishable for both groups, we can in this case directly compare the absolute ATTs, as the last term from equation 17 drops out.

**Table 7: Consumer goods**

| (a) Coefficients from three-way fixed effects model     |                                     |                          |                          |                          |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
|   | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|   | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                    | 0.284***<br>(0.001)                 | 0.251***<br>(0.001)      | 0.283***<br>(0.001)      | 0.248***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>share consumer goods $_{\omega}$ | 0.216***<br>(0.032)                 | -0.249***<br>(0.016)     | -0.166*<br>(0.09)        | -0.005<br>(0.072)        |
| Fixed effects   | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size   | 26,826,432                          | 26,305,187               | 26,618,756               | 24,423,850               |

| (b) Coefficients from two-way fixed effects model       |                                     |                      |                     |                     |
|---|-------------------------------------|----------------------|---------------------|---------------------|
|   | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|   | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year                                    | 0.309***<br>(0.001)                 | 0.257***<br>(0.001)  | 0.303***<br>(0.001) | 0.253***<br>(0.001) |
| Sanctions $_{jt}$                                       | -0.305***<br>(0.015)                | -0.133***<br>(0.009) | 0.042<br>(0.04)     | 0.008<br>(0.039)    |
| Sanctions $_{jt}$ ×<br>share consumer goods $_{\omega}$ | 0.210***<br>(0.032)                 | -0.245***<br>(0.016) | -0.167*<br>(0.09)   | 0.000<br>(0.072)    |
| Estimated Date-Partner FE $_{jt}$                       | 0.224***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.202***<br>(0.002) | 0.193***<br>(0.002) |
| Fixed effects   | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size   | 26,840,138                          | 26,368,277           | 26,649,461          | 24,474,601          |

Notes: Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

strong demand for these goods from Iranian consumers. There is a plethora of anecdotal evidence about Western consumer products finding their way to Iranian consumers, even in the form of knock-off stores and so-called front men selling legitimate products.<sup>43</sup> Second, as the interacted variable denotes a share in the firms' product portfolio, other types of exported goods may just be even more severely affected by the sanctions. One type of product that is likely to have suffered more severely are intermediate products. French companies are historically comparatively active in Iran, with prominent car makers Renault and Peugeot, food producer Danone, and energy company Total operating own plants and joint ventures in the country, likely requiring inputs from abroad.<sup>44</sup>

Table 8 shows the results for estimating equations (11) and (12) with an interaction of the sanctions indicator with the firms' share of intermediate goods in their product portfolio. As hypothesized, firms exporting intermediate goods to Iran adjusted their behaviour more than otherwise comparable firms. The estimated coefficients are again very similar in the two

<sup>43</sup>Compare e.g. <https://www.economist.com/middle-east-and-africa/2015/03/05/fading-hope>, <https://www.nytimes.com/2016/04/05/fashion/iran-fashion-retail.html>, <https://www.lensculture.com/articles/thomas-cristofolletti-iran-s-booming-consumer-culture> and [https://ec.europa.eu/chafea/agri/sites/chafea/files/market-entry-handbook-iran\\_en.pdf](https://ec.europa.eu/chafea/agri/sites/chafea/files/market-entry-handbook-iran_en.pdf) (all accessed on June 29th, 2020).

<sup>44</sup>Compare e.g. <https://www.bbc.com/news/business-40850181>, <https://www.wsj.com/articles/western-companies-see-potential-in-reaching-irans-consumers-after-nuclear-deal-1428313107?cb=logged0.5079263212005186> and <https://www.gao.gov/new.items/d10515r.pdf> (all accessed on June 29th, 2020).

**Table 8: Intermediate goods**

| <b>(a) Coefficients from three-way fixed effects model</b>  |                                     |                          |                          |                          |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
|   | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|   | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year  | 0.284***<br>(0.001)                 | 0.251***<br>(0.001)      | 0.283***<br>(0.001)      | 0.248***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>share intermediate goods $_{\omega}$ | -0.085***<br>(0.029)                | 0.201***<br>(0.017)      | -0.019<br>(0.083)        | -0.036<br>(0.08)         |
| Fixed effects   | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size   | 26,826,432                          | 26,305,187               | 26,618,756               | 24,423,850               |

| <b>(b) Coefficients from two-way fixed effects model</b>    |                                     |                      |                     |                     |
|---|-------------------------------------|----------------------|---------------------|---------------------|
|   | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|   | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year  | 0.309***<br>(0.001)                 | 0.257***<br>(0.001)  | 0.303***<br>(0.001) | 0.253***<br>(0.001) |
| Sanctions $_{jt}$   | -0.223***<br>(0.017)                | -0.287***<br>(0.009) | 0.010<br>(0.044)    | 0.018<br>(0.039)    |
| Sanctions $_{jt}$ ×<br>share intermediate goods $_{\omega}$ | -0.083***<br>(0.029)                | 0.196***<br>(0.017)  | -0.020<br>(0.083)   | -0.033<br>(0.079)   |
| Estimated Date-Partner FE $_{jt}$                           | 0.224***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.202***<br>(0.002) | 0.193***<br>(0.002) |
| Fixed effects   | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size   | 26,840,138                          | 26,368,277           | 26,649,461          | 24,474,601          |

Notes: Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

specifications. The difference in the average treatment effect reflects the negative coefficient: firms with a higher than average share of intermediate products in their product mix have a 1 percentage point stronger reaction to the the sanctions than those below. The results for Russia indicate a similar mechanism described above, only in reverse. As firms predominantly exporting consumer products were more severely hit by the sanctions than others, those with a higher share of intermediate products are less severely hit by sanctions. For Cuba and Myanmar, as above and as expected, there is little of significance to report. Only for Myanmar the estimation featuring the interaction with the share of consumer products yields a significant negative coefficient, translating into a 1.2 percentage points stronger average treatment effect for firms exporting a higher share of consumer products than the average firm. As we study the situation in which sanctions are lifted in the country, this points to a stronger *recovery* of those firms after sanctions are lifted.

### 5.3.4 Specialized firms

Finally, as hypothesized above, certain firms may be — by strategy or coincidence — in a better situation to weather sanctions than others. Some firms may be specialized in “tough” markets, in terms of political stability and legal uncertainty. As an indicator for such countries we turn to the official advice by the French foreign ministry as to which countries have been given a “travel

**Table 9: Exposure crisis countries**

| <b>(a) Coefficients from three-way fixed effects model</b> |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                       | 0.278***<br>(0.001)                 | 0.245***<br>(0.001)      | 0.275***<br>(0.001)      | 0.242***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>exposure crisis country $_{\omega}$ | -0.029<br>(0.03)                    | 0.044***<br>(0.014)      | 0.171<br>(0.127)         | -0.121<br>(0.103)        |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 27,396,537                          | 27,078,704               | 27,350,724               | 26,828,490               |

| <b>(b) Coefficients from two-way fixed effects model</b>   |                                     |                     |                     |                     |
|--|-------------------------------------|---------------------|---------------------|---------------------|
|  | Dependent variable: $y_{\omega jt}$ |                     |                     |                     |
|  | Iran                                | Russia              | Myanmar             | Cuba                |
| Active previous year                                       | 0.302***<br>(0.001)                 | 0.251***<br>(0.001) | 0.295***<br>(0.001) | 0.247***<br>(0.001) |
| Sanctions $_{jt}$  | -0.228***<br>(0.026)                | -0.244***<br>(0.01) | -0.171<br>(0.121)   | 0.134<br>(0.097)    |
| Sanctions $_{jt}$ ×<br>exposure crisis country $_{\omega}$ | -0.041<br>(0.03)                    | 0.047***<br>(0.014) | 0.192<br>(0.126)    | -0.132<br>(0.102)   |
| Estimated Date-Partner FE $_{jt}$                          | 0.222***<br>(0.002)                 | 0.185***<br>(0.002) | 0.200***<br>(0.002) | 0.191***<br>(0.002) |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$      | $\omega t, jt$      | $\omega t, jt$      |
| Sample size  | 27,410,538                          | 27,142,141          | 27,382,481          | 26,881,506          |

*Notes:* Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

warning”.<sup>45</sup> Firms with experience in these countries may be more used to operating in difficult environments and hence be able to handle the sanctions with lower additional costs than other firms.

Table 9 displays the results for estimating equations (11) and (12) with an interaction with an indicator variable for whether the firm exported to any of the “crisis countries”. For Russia, we find indeed significant evidence that firms with experience in such tough markets are less affected by the sanctions. The corresponding difference in the average treatment effect between those firms that are present in another crisis country and those that are not is 0.8 percentage point. The coefficients are insignificant for all other cases.

However, firms operating in these countries may be able to circumvent the sanctions by exporting via a third country rather than directly to the sanctioned country itself. This sanction avoidance channel should be easier to use for firms that are also active in neighboring countries of the sanctioned country through which they can enter the final destination market.

<sup>45</sup>See <https://www.diplomatie.gouv.fr/fr/conseils-aux-voyageurs/> (accessed on October 7th, 2019). The countries where in whole travels are advised against — “formellement déconseillé” or “déconseillé sauf raison impérative” — are Haiti, Guatemala, Venezuela, Honduras, Mali, Libya, Chad, Niger, Central African Republic, Sudan, Democratic Republic of the Congo, Somalia, Yemen, Syria, Iraq, Afghanistan, Pakistan, Bangladesh, and North Korea.

**Table 10: Exposure neighboring country**

| (a) Coefficients from three-way fixed effects model  |                                     |                          |                          |                          |
|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
|  | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|  | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                 | 0.278***<br>(0.001)                 | 0.245***<br>(0.001)      | 0.275***<br>(0.001)      | 0.242***<br>(0.001)      |
| Sanctions $_{jt}$ ×<br>exposure neighbor $_{\omega}$ | -0.076*<br>(0.043)                  | -0.075***<br>(0.017)     | -0.180<br>(0.111)        | -0.155**<br>(0.073)      |
| Fixed effects  | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size  | 27,396,537                          | 27,078,704               | 27,350,724               | 26,828,490               |

| (b) Coefficients from two-way fixed effects model    |                                     |                      |                     |                     |
|--|-------------------------------------|----------------------|---------------------|---------------------|
|  | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|  | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year                                 | 0.302***<br>(0.001)                 | 0.251***<br>(0.001)  | 0.295***<br>(0.001) | 0.247***<br>(0.001) |
| Sanctions $_{jt}$                                    | -0.175***<br>(0.041)                | -0.161***<br>(0.015) | 0.154<br>(0.104)    | 0.136**<br>(0.064)  |
| Sanctions $_{jt}$ ×<br>exposure neighbor $_{\omega}$ | -0.094**<br>(0.043)                 | -0.077***<br>(0.017) | -0.167<br>(0.11)    | -0.158**<br>(0.073) |
| Estimated Date-Partner FE $_{jt}$                    | 0.222***<br>(0.002)                 | 0.185***<br>(0.002)  | 0.200***<br>(0.002) | 0.191***<br>(0.002) |
| Fixed effects  | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size  | 27,410,538                          | 27,142,141           | 27,382,481          | 26,881,506          |

Notes: Sanctions $_{jt}$  = Sanctions Period $_t$  × Sanctioned Country $_j$ . Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

In Table 10, we test this channel by including an interaction term between our sanctions variable and an indicator variable that is equal to one if firms have also been active in at least one neighboring country, or those that are historically or geographically closely-related to the sanctioned countries.<sup>46</sup> Indeed, for Iran, Russia and Cuba, we find significantly stronger sanction effects for firms that also serve neighbouring countries. As there is no reason, why these firms should actually be hit more severely, we interpret this as evidence that they are less likely to export to the sanctioned country not because they actually are less likely to serve the market, but because they do so indirectly.

<sup>46</sup>In the case of Iran we take Armenia, Azerbaijan, Turkmenistan, Afghanistan, Pakistan, Iraq and Turkey. For Russia, we take former countries of the Soviet Union, i.e. Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. For Myanmar, we take India, Bangladesh, Thailand and Laos. And for Cuba, we take other Caribbean countries, namely Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Curacao, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saint Barthelemy, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sint Maarten, Trinidad and Tobago, Turks and Caicos Islands, and the United States Virgin Islands. In the cases of Iran and Russia, some neighboring countries are presumably not an ideal conduit country, because of bilateral hostilities. However, in both cases some other neighbouring countries are either neutral or allies.

## 6 Conclusion

Studying the cases of the Iran and Russia sanctions, we find that the introduction of sanctions significantly lowers the probability of French firms to export to these countries. The lifting of sanctions on Myanmar and Cuba, however, did not show symmetric significant effects. This suggests that sanctions may have persistent effects beyond their time actually being in force.

A comparison of firms previously active or non-active in the sanctioned market unveils a second interesting finding concerning the dynamics of sanctions: They appear to first decrease entry, before gradually pushing incumbents out. These findings are important because they are informative about the long term consequences of the sanctions: Their impact is delayed when they are imposed (firms do not all exit immediately, but progressively) and removing the sanctions does not lead to a rapid back-to-normal.

Our third take-away is that financial sanctions, as imposed in both the Iran and Russia cases, impact trade through the firm-level extensive margin. Firms that rely on trade finance instruments reduce their activity on these markets significantly stronger than otherwise comparable ones.

Fourth, there is some evidence for trade deflection or sanctions avoidance. Firms that were previously active in neighbouring countries of the sanctioned country are less likely to serve the sanctioned country when the sanctions hit, suggesting that they take an indirect route instead.

We find heterogeneity in the impact of sanctions on firms' exporting behaviour for other variables of interest, along the lines of idiosyncracies and particularities of the respective sanctions case. This is interesting in its own regard, since while certain sanctions measures are styled as surgical and precise, it suggests that it is hard to have reliable regularities allowing to predict who will be hit the most. The design of the sanctions, pre-existing trade relationships, the counter party's policy response and the public's reaction in fact matter a lot. Therefore, we can conclude that sanctions are policy tools that should be used cautiously: They have strong effects on trade, on its intensive and extensive margin, and it is generally hard to know who will be hit, how and for how long.

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## A Summary statistics

**Table 11:** Summary statistics for case-specific sample of the customs data set

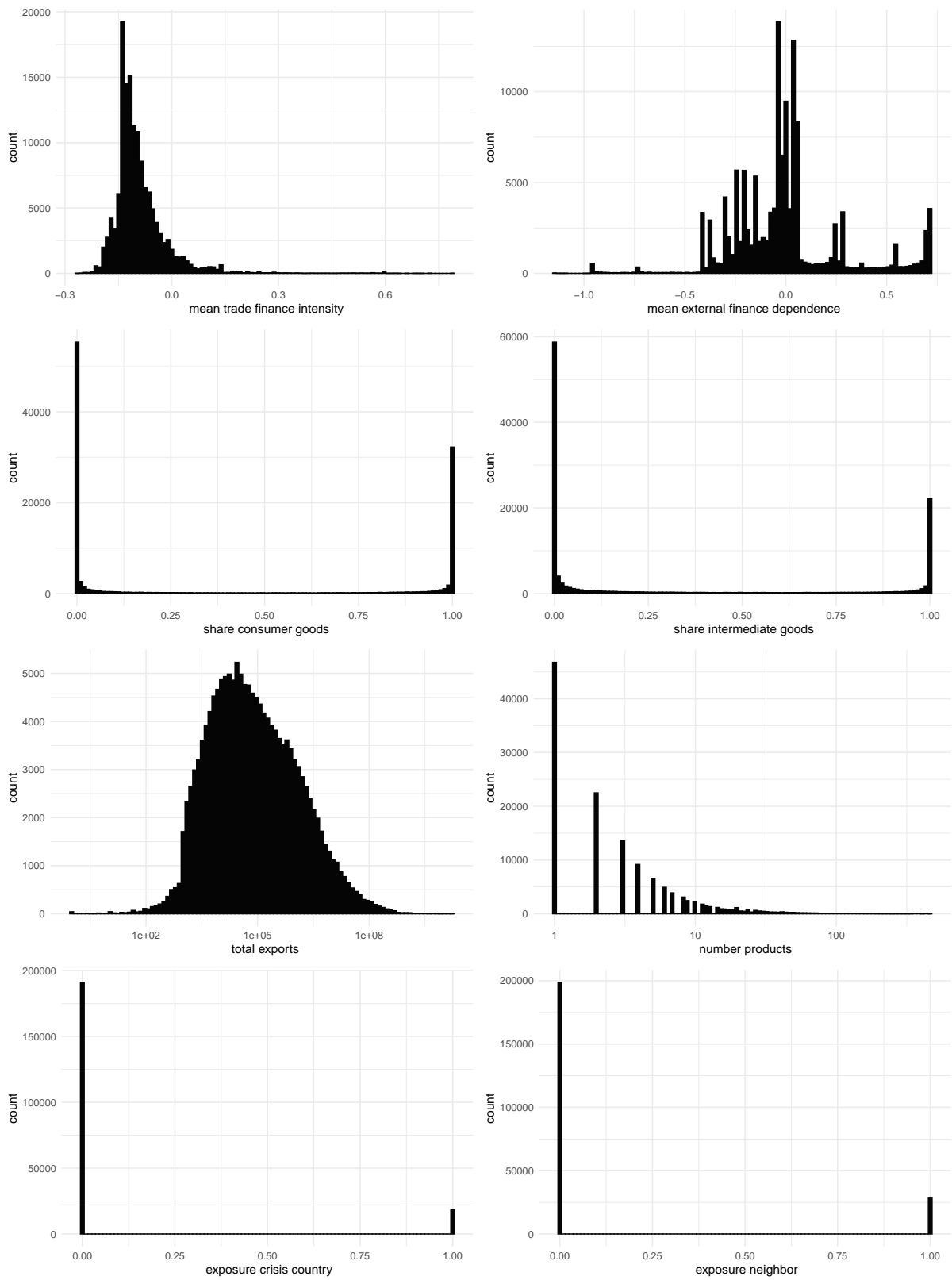
|  | Cuba       | Iran       | Myanmar    | Russia     |
|--|------------|------------|------------|------------|
| Number of observations                 | 34,664,323 | 35,070,266 | 35,041,843 | 34,941,967 |
| Number of destinations                 | 223        | 222        | 222        | 222        |
| Number of firms in sample              | 156,992    | 153,035    | 151,881    | 157,400    |
| Number of firms active in case country | 528        | 2,877      | 438        | 9,912      |
| — during sanctions                     | 344        | 1,628      | 219        | 6,235      |

**Table 12:** Summary statistics for variables of interest

| Variable                         | Mean  | Std. dev. | Median | Max   | Min   |
|----------------------------------|-------|-----------|--------|-------|-------|
| log total exports                | 11.38 | 2.71      | 11.18  | 23.56 | 0.00  |
| log number products              | 1.02  | 1.07      | 0.69   | 6.14  | 0.00  |
| mean trade finance intensity     | -0.09 | 0.08      | -0.11  | 0.79  | -0.26 |
| mean external finance dependence | -0.01 | 0.27      | -0.02  | 0.72  | -1.14 |
| share consumer goods             | 0.38  | 0.46      | 0.00   | 1.00  | 0.00  |
| share intermediate goods         | 0.31  | 0.42      | 0.00   | 1.00  | 0.00  |
| exposure crisis country          | 0.09  | 0.28      | 0.00   | 1.00  | 0.00  |
| exposure neighbor                | 0.08  | 0.27      | 0.00   | 1.00  | 0.00  |

*Note:* Figures for all firms present in dataset in 2013.

**Figure 2: Histograms of variables of interest**



## B Uncorrected coefficients

**Table 13: Uncorrected baseline specification**

| (a) Coefficients from three-way fixed effects model |                                     |                          |                          |                          |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
|   | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|   | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                | 0.239***<br>(0.001)                 | 0.196***<br>(0.001)      | 0.237***<br>(0.001)      | 0.193***<br>(0.001)      |
| Fixed effects                                       | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size   | 27,396,537                          | 27,785,280               | 27,640,157               | 27,499,973               |

| (b) Coefficients from two-way fixed effects model |                                     |                      |                     |                     |
|---|-------------------------------------|----------------------|---------------------|---------------------|
|   | Dependent variable: $y_{\omega jt}$ |                      |                     |                     |
|   | Iran                                | Russia               | Myanmar             | Cuba                |
| Active previous year                              | 0.266***<br>(0.001)                 | 0.203***<br>(0.001)  | 0.260***<br>(0.001) | 0.199***<br>(0.001) |
| Sanctions <sub>jt</sub>                           | -0.280***<br>(0.012)                | -0.247***<br>(0.007) | 0.001<br>(0.033)    | 0.014<br>(0.03)     |
| Estimated Date-Partner FE <sub>jt</sub>           | 0.248***<br>(0.002)                 | 0.207***<br>(0.002)  | 0.224***<br>(0.002) | 0.214***<br>(0.002) |
| Fixed effects                                     | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$      | $\omega t, jt$      |
| Sample size                                       | 27,410,538                          | 27,851,032           | 27,671,986          | 27,555,391          |

Notes: Sanctions<sub>jt</sub> = Sanctions Period<sub>t</sub> × Sanctioned Country<sub>j</sub>. Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

**Table 14: Uncorrected lag specification**

| (a) Coefficients from three-way fixed effects model |                                     |                          |                          |                          |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|
|   | Dependent variable: $y_{\omega jt}$ |                          |                          |                          |
|   | Iran                                | Russia                   | Myanmar                  | Cuba                     |
| Active previous year                                | 0.387***<br>(0.002)                 | 0.360***<br>(0.002)      | 0.090***<br>(0.002)      | 0.029***<br>(0.002)      |
| — × Sanctions Period <sub>t</sub>                   | -0.291***<br>(0.002)                | -0.329***<br>(0.002)     | 0.296***<br>(0.002)      | 0.328***<br>(0.002)      |
| — × Sanctioned Country <sub>j</sub>                 | -0.110***<br>(0.023)                | 0.062***<br>(0.014)      | -0.336***<br>(0.053)     | -0.165***<br>(0.056)     |
| — × Sanctions <sub>jt</sub>                         | 0.161***<br>(0.032)                 | 0.060***<br>(0.018)      | 0.321***<br>(0.075)      | -0.004<br>(0.07)         |
| Fixed effects                                       | $\omega t, jt, \omega j$            | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ | $\omega t, jt, \omega j$ |
| Sample size   | 27,396,537                          | 27,785,280               | 27,640,157               | 27,499,973               |

| (b) Coefficients from two-way fixed effects model |                                     |                      |                      |                      |
|---|-------------------------------------|----------------------|----------------------|----------------------|
|   | Dependent variable: $y_{\omega jt}$ |                      |                      |                      |
|   | Iran                                | Russia               | Myanmar              | Cuba                 |
| Active previous year                              | 0.416***<br>(0.002)                 | 0.355***<br>(0.002)  | 0.110***<br>(0.002)  | 0.046***<br>(0.002)  |
| — × Sanctions Period <sub>t</sub>                 | -0.300***<br>(0.002)                | -0.306***<br>(0.002) | 0.298***<br>(0.002)  | 0.305***<br>(0.002)  |
| — × Sanctioned Country <sub>j</sub>               | -0.132***<br>(0.023)                | 0.053***<br>(0.014)  | -0.353***<br>(0.053) | -0.184***<br>(0.055) |
| — × Sanctions <sub>jt</sub>                       | 0.165***<br>(0.031)                 | 0.061***<br>(0.018)  | 0.281***<br>(0.073)  | 0.017<br>(0.07)      |
| Sanctions <sub>jt</sub>                           | -0.430***<br>(0.027)                | -0.300***<br>(0.016) | -0.132**<br>(0.055)  | 0.035<br>(0.056)     |
| Estimated Date-Partner FE <sub>jt</sub>           | 0.242***<br>(0.002)                 | 0.210***<br>(0.002)  | 0.219***<br>(0.002)  | 0.219***<br>(0.002)  |
| Fixed effects                                     | $\omega t, jt$                      | $\omega t, jt$       | $\omega t, jt$       | $\omega t, jt$       |
| Sample size                                       | 27,410,538                          | 27,851,032           | 27,671,986           | 27,555,391           |

Notes: Sanctions<sub>jt</sub> = Sanctions Period<sub>t</sub> × Sanctioned Country<sub>j</sub>. Sample includes two years pre and post treatment periods, respectively. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

## C ATTs

**Table 15: Previous experience**

| ATTs of Sanctions from two-way fixed effects model                       |                      |                      |                     |                    |
|--|----------------------|----------------------|---------------------|--------------------|
|  | Iran                 | Russia               | Myanmar             | Cuba               |
| Not active previous year<br>( <i>baseline</i> )                          | -0.042***<br>(0.001) | -0.041***<br>(0.001) | 0.000<br>(0.002)    | 0.002<br>(0.002)   |
| Active previous year<br>( <i>baseline</i> )                              | -0.043***<br>(0.001) | -0.042***<br>(0.001) | 0.000<br>(0.002)    | 0.002<br>(0.002)   |
| Not active previous year<br>( <i>with heterogeneity</i> )                | -0.059***<br>(0.002) | -0.054***<br>(0.001) | 0.028***<br>(0.006) | 0.012**<br>(0.005) |
| Active previous year<br>( <i>with heterogeneity</i> )                    | -0.033***<br>(0.002) | -0.025***<br>(0.001) | -0.005<br>(0.003)   | 0.002<br>(0.003)   |
| Implied ATT difference between<br>active and non-active in previous year | 2.4 p.p.             | 2.8 p.p.             | -3.2 p.p.           | -0.9 p.p.          |

**Table 16: Total exports**

| ATTs of Sanctions from two-way fixed effects model                      |                      |                      |                  |                   |
|---|----------------------|----------------------|------------------|-------------------|
|   | Iran                 | Russia               | Myanmar          | Cuba              |
| Low log total exports<br>( <i>baseline</i> )                            | -0.043***<br>(0.002) | -0.035***<br>(0.001) | 0.000<br>(0)     | 0.002***<br>(0)   |
| High log total exports<br>( <i>baseline</i> )                           | -0.042***<br>(0.002) | -0.042***<br>(0.001) | 0.000<br>(0.002) | 0.002<br>(0.003)  |
| Low log total exports<br>( <i>with heterogeneity</i> )                  | 0.005***<br>(0.001)  | -0.036***<br>(0.001) | 0.002<br>(0.003) | -0.008<br>(0.005) |
| High log total exports<br>( <i>with heterogeneity</i> )                 | -0.044***<br>(0.002) | -0.043***<br>(0.001) | 0.000<br>(0.002) | 0.002<br>(0.003)  |
| Implied ATT difference between<br>high and low log total exports groups | -5 p.p.              | 0 p.p.               | -0.2 p.p.        | 0.9 p.p.          |

**Table 17: Number of products**

| ATTs of Sanctions from two-way fixed effects model                        |                      |                      |                   |                     |
|---|----------------------|----------------------|-------------------|---------------------|
|   | Iran                 | Russia               | Myanmar           | Cuba                |
| Low log number products<br>( <i>baseline</i> )                            | -0.040***<br>(0.001) | -0.037***<br>(0.001) | 0.000<br>(0.001)  | 0.002***<br>(0.001) |
| High log number products<br>( <i>baseline</i> )                           | -0.042***<br>(0.002) | -0.042***<br>(0.001) | 0.000<br>(0.002)  | 0.002<br>(0.003)    |
| Low log number products<br>( <i>with heterogeneity</i> )                  | -0.016***<br>(0.002) | -0.041***<br>(0.001) | -0.004<br>(0.003) | 0.022***<br>(0.003) |
| High log number products<br>( <i>with heterogeneity</i> )                 | -0.046***<br>(0.002) | -0.042***<br>(0.001) | 0.001<br>(0.003)  | -0.002<br>(0.003)   |
| Implied ATT difference between<br>high and low log number products groups | -2.7 p.p.            | 0.3 p.p.             | 0.4 p.p.          | -2.5 p.p.           |

**Table 18: Trade finance intensity**

| ATTs of Sanctions from two-way fixed effects model                                 |                      |                      |                   |                  |
|--|----------------------|----------------------|-------------------|------------------|
|  | Iran                 | Russia               | Myanmar           | Cuba             |
| Low mean trade finance intensity<br>( <i>baseline</i> )                            | -0.045***<br>(0.002) | -0.041***<br>(0.001) | 0.000<br>(0.002)  | 0.002<br>(0.002) |
| High mean trade finance intensity<br>( <i>baseline</i> )                           | -0.038***<br>(0.001) | -0.042***<br>(0.001) | 0.000<br>(0.002)  | 0.002<br>(0.002) |
| Low mean trade finance intensity<br>( <i>with heterogeneity</i> )                  | -0.042***<br>(0.002) | -0.040***<br>(0.001) | -0.003<br>(0.003) | 0.000<br>(0.003) |
| High mean trade finance intensity<br>( <i>with heterogeneity</i> )                 | -0.040***<br>(0.002) | -0.044***<br>(0.001) | 0.005*<br>(0.003) | 0.002<br>(0.004) |
| Implied ATT difference between<br>high and low mean trade finance intensity groups | -0.5 p.p.            | -0.3 p.p.            | 0.8 p.p.          | 0.2 p.p.         |

**Table 19: Financial dependence**

| ATTs of Sanctions from two-way fixed effects model                                     |                      |                      |                  |                   |
|--|----------------------|----------------------|------------------|-------------------|
|  | Iran                 | Russia               | Myanmar          | Cuba              |
| Low mean external finance dependence<br>( <i>baseline</i> )                            | -0.042***<br>(0.001) | -0.042***<br>(0.001) | 0.000<br>(0.002) | 0.002<br>(0.002)  |
| High mean external finance dependence<br>( <i>baseline</i> )                           | -0.043***<br>(0.001) | -0.041***<br>(0.001) | 0.000<br>(0.001) | 0.002<br>(0.002)  |
| Low mean external finance dependence<br>( <i>with heterogeneity</i> )                  | -0.043***<br>(0.002) | -0.044***<br>(0.001) | 0.001<br>(0.003) | 0.005<br>(0.003)  |
| High mean external finance dependence<br>( <i>with heterogeneity</i> )                 | -0.039***<br>(0.002) | -0.038***<br>(0.001) | 0.000<br>(0.003) | -0.002<br>(0.003) |
| Implied ATT difference between<br>high and low mean external finance dependence groups | 0.5 p.p.             | 0.4 p.p.             | -0.1 p.p.        | -0.7 p.p.         |

**Table 20: Consumer goods**

| ATTs of Sanctions from two-way fixed effects model                         |                      |                      |                     |                  |
|--|----------------------|----------------------|---------------------|------------------|
|  | Iran                 | Russia               | Myanmar             | Cuba             |
| Low share consumer goods<br>( <i>baseline</i> )                            | -0.043***<br>(0.001) | -0.041***<br>(0.001) | 0.000<br>(0.002)    | 0.002<br>(0.002) |
| High share consumer goods<br>( <i>baseline</i> )                           | -0.041***<br>(0.001) | -0.041***<br>(0.001) | 0.000<br>(0.001)    | 0.002<br>(0.002) |
| Low share consumer goods<br>( <i>with heterogeneity</i> )                  | -0.048***<br>(0.002) | -0.027***<br>(0.001) | 0.004<br>(0.003)    | 0.001<br>(0.004) |
| High share consumer goods<br>( <i>with heterogeneity</i> )                 | -0.021***<br>(0.003) | -0.064***<br>(0.002) | -0.009**<br>(0.004) | 0.001<br>(0.005) |
| Implied ATT difference between<br>high and low share consumer goods groups | 2.5 p.p.             | -3.7 p.p.            | -1.2 p.p.           | 0 p.p.           |

**Table 21: Intermediate goods**

ATTs of Sanctions from two-way fixed effects model

|  | Iran                 | Russia               | Myanmar           | Cuba              |
|--|----------------------|----------------------|-------------------|-------------------|
| Low share intermediate goods<br>( <i>baseline</i> )                            | -0.041***<br>(0.001) | -0.041***<br>(0.001) | 0.000<br>(0.002)  | 0.002<br>(0.002)  |
| High share intermediate goods<br>( <i>baseline</i> )                           | -0.044***<br>(0.001) | -0.042***<br>(0.001) | 0.000<br>(0.002)  | 0.003<br>(0.002)  |
| Low share intermediate goods<br>( <i>with heterogeneity</i> )                  | -0.036***<br>(0.002) | -0.050***<br>(0.001) | 0.001<br>(0.003)  | 0.002<br>(0.003)  |
| High share intermediate goods<br>( <i>with heterogeneity</i> )                 | -0.049***<br>(0.003) | -0.024***<br>(0.001) | -0.001<br>(0.004) | -0.001<br>(0.006) |
| Implied ATT difference between<br>high and low share intermediate goods groups | -1 p.p.              | 2.8 p.p.             | -0.2 p.p.         | -0.4 p.p.         |

**Table 22: Exposure crisis countries**

ATTs of Sanctions from two-way fixed effects model

|   | Iran                 | Russia               | Myanmar            | Cuba                |
|---|----------------------|----------------------|--------------------|---------------------|
| Low exposure crisis country<br>( <i>baseline</i> )                            | -0.038***<br>(0.001) | -0.039***<br>(0.001) | 0.000<br>(0)       | 0.002***<br>(0.001) |
| High exposure crisis country<br>( <i>baseline</i> )                           | -0.044***<br>(0.002) | -0.045***<br>(0.001) | 0.000<br>(0.002)   | 0.002<br>(0.003)    |
| Low exposure crisis country<br>( <i>with heterogeneity</i> )                  | -0.034***<br>(0.003) | -0.043***<br>(0.001) | -0.013*<br>(0.007) | 0.016***<br>(0.006) |
| High exposure crisis country<br>( <i>with heterogeneity</i> )                 | -0.045***<br>(0.002) | -0.040***<br>(0.001) | 0.000<br>(0.003)   | 0.002<br>(0.003)    |
| Implied ATT difference between<br>high and low exposure crisis country groups | -0.5 p.p.            | 0.8 p.p.             | 1.4 p.p.           | -1.5 p.p.           |

**Table 23: Exposure neighboring country**

ATTs of Sanctions from two-way fixed effects model

|   | Iran                 | Russia               | Myanmar             | Cuba                |
|---|----------------------|----------------------|---------------------|---------------------|
| Low exposure neighbor<br>( <i>baseline</i> )                            | -0.035***<br>(0.001) | -0.035***<br>(0.001) | 0.000<br>(0.001)    | 0.002*<br>(0.001)   |
| High exposure neighbor<br>( <i>baseline</i> )                           | -0.044***<br>(0.002) | -0.045***<br>(0.001) | 0.000<br>(0.002)    | 0.002<br>(0.003)    |
| Low exposure neighbor<br>( <i>with heterogeneity</i> )                  | -0.024***<br>(0.004) | -0.026***<br>(0.002) | 0.019***<br>(0.006) | 0.018***<br>(0.004) |
| High exposure neighbor<br>( <i>with heterogeneity</i> )                 | -0.044***<br>(0.002) | -0.047***<br>(0.001) | 0.001<br>(0.003)    | -0.001<br>(0.004)   |
| Implied ATT difference between<br>high and low exposure neighbor groups | -1.1 p.p.            | -1.1 p.p.            | -1.8 p.p.           | -1.9 p.p.           |