Understanding Multi-Layered Sanctions:
A Firm-Level Analysis

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ABSTRACT. This paper examines which types of firms are hit by multi-layered sanctions, quantifies the extent of the economic impact on the affected firms, and identifies the channels through which these effects are propagated. To this end, I use a text-based approach from computational linguistics to gauge the exposure of publicly listed Iranian firms to sanctions, validating this measure through its anticipated fluctuation over time and across industries. The findings reveal three key insights. First, Iranian firms report significant challenges due to sanctions, exceeding COVID-19 concerns by up to 20%. Second, politically-connected and non-connected firms suffer equally from sanctions; for every \$1 loss inflicted on connected firms, an externality of \$5 is imposed on non-connected firms, considering their economic scale. This contradicts the idea that sanctions only inflict harm on political decision-makers. Third, sanctions are hurtful; firms with higher exposure to sanctions endure greater losses in stock market value in the wake of unanticipated sanction events. Sanctions also lead to reduced sales, investment and hiring. Furthermore, the study reveals that sanctions impact firms via several mechanisms, the primary one being the limitation of access to export destinations.

Key words: Economic Sanctions, firms, text-as-data, computational linguistics
JEL codes: E0, E6, F0, G12, H32, F51, F14

1. INTRODUCTION

Sanctions are not just rising in popularity as a foreign policy instrument, but they are also growing in complexity. Recent sanctions on Russia and Iran have ranged from asset freezes and trade curbs to targeting key sectors, imposing banking limitations, and singling out influential individuals and businesses. Their unpredictable application, unclear interpretation, and evolving nature create an atmosphere of uncertainty and add to the complexity. In response, targeted governments often employ a suite of countermeasures, including tailored macroeconomic tactics, subsidies, governmental contracts, and loans, which further muddles the situation. As a result, corporations and individuals in target countries encounter diverse and often unforeseen challenges due to these sanctions, with the extent of impact varying according to their distinctive attributes and the nature of their operations.

The growing complexities of sanctions introduce added challenges for researchers attempting to address key policy-driven questions, such as the effectiveness of sanctions, their impact on the incentives of targeted countries, and the extent of their collateral damage. In scenarios with defined sanctions on specific entities, establishing distinct treatment and control groups is straightforward. However, as sanctions evolve to be more multifaceted and intertwined, discerning which firms are impacted becomes ambiguous. Without clear knowledge upfront about which firms are subject to sanctions, drawing a direct link between their performance and the sanctions becomes a formidable task. This obscurity also hinders assessments of whether sanctions successfully target political leaders' interests and persuade them to adjust their actions.

To account for these factors, we need a flexible model that can incorporate these numerous, potentially ex-ante unknown, channels, capturing their interactive influences at equilibrium. This effort is further hampered by the scarcity of reliable data from sanctioned countries, often attributable to their lack of transparency. Compounded by political constraints, conducting surveys in such environments might be impracticable. Intriguingly, this opacity might itself be endogenous to the imposition of sanctions, as they may not be willing to disclose the extent to which sanctions have impacted them.

In this paper, I overcome these challenges by utilizing a text-based methodology to quantitatively measure the impact of sanctions on individual Iranian firms—a nation heavily under sanctions—using stakeholder perceptions. To this end, I first use a training library of sanction-related articles and a training library of non-sanction text to find two-word combinations (bigrams) that are frequently used in sanction-related texts. I also assemble a unique dataset composed of transcripts and reports from board meetings of publicly traded Iranian firms. I then use a natural language processing method to quantify sanctions exposure by counting instances of sanctions-related bigrams in discussions between firm management and financial analysts, with each bigram assigned a weight that reflects its relative importance to sanctions.

This approach is inspired by studies that aim to measure a firm's exposure to specific shocks, such as political risk, COVID-19, Brexit, and climate change (Hassan et al., 2019, 2021, 2023; Sautner et al., 2023).[1] The premise here is that company meetings serve as a forum for management to discuss current issues and for analysts to probe the company's challenges and thus offer a wealth of valuable information. Significant sanctions exposure, due to any reason like reliance on international supply chains or competition with imported substitutes, is likely to emerge in these dialogues.

This method offers a subjective risk metric, allowing the measurement of a firm's sanctions exposure without resorting to executive surveys, which are often impractical in the context of sanctioned countries. Given the intricate and multi-layered nature of comprehensive sanctions and the associated challenge of categorizing clear treatment and control groups from sanction documents, the flexibility of this approach stands particularly useful.

Using these new measures, I present a series of novel empirical findings. First, the average Iranian firm reports significant challenges due to sanctions. My main measure of sanction exposure, averaged across firms, intuitively evolves over time, reaching its apex in 2018 following the announcement from the Trump administration regarding its departure from the JCPOA and imminent re-imposition of sanctions. It also intuitively fluctuates across industries, which further attests to its validity. Industries with deep ties to international supply chains, partnerships, and markets—such as architectural and engineering activities, technical testing and analysis, and computer electronics manufacturing—score high on this scale. In contrast, sectors like sports, amusement, and creative arts and entertainment, which are less involved in global trade, register much lower values. To provide perspective on the severity of this shock, I compare it to the concern surrounding COVID-19. At its peak, the sanctions concern was 20% more severe than that of the COVID-19 shock, underscoring the substantial risk that sanctions represent to Iranian firms.

Most sanction proponents justify their use on the basis of providing incentives for policy reform for political decision-makers in the sanctioned country, as sanctions can be lifted in exchange for policy changes. According to this idea, modern sanctions should ideally target the economic interests of elite decision-makers while sparing non-decision-makers. However, my second finding suggests that with increasingly more complex sanctions, the idea of "targeted sanctions" appears to be a misnomer. Instead, sanctions impact politically-connected and non-connected firms alike, implying that sanctions may operate as 'blunt instruments', affecting the broader economy. I find for every $1 loss inflicted on connected firms, an externality of $5 is imposed on non-connected firms, primarily because non-connected firms represent a more substantial segment of the market.

Third, I examine the extent to which sanctions adversely affect Iranian firms. Initially, I study stock market reactions to unexpected sanction-related events. To do so, I utilize search intensity data for the topic "Sanctions against Iran" on Google Trends, and identify eight major events

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[1]Hassan et al. (2019) uses computational linguistics to measure U.S. firms' political risk via earnings conference calls, revealing heightened discussions during peak political risk periods. Hassan et al. (2021) employs a text-based method to capture the global impacts of Brexit uncertainty, highlighting anticipated regulatory and trade challenges. Hassan et al. (2023) determines firms' primary concerns about COVID-19, illustrating simultaneous demand and supply shocks. Sautner et al. (2023) leverages machine learning to gauge firms' attention to climate change exposures, predicting green innovation outcomes.

related to sanctions on Iran. For each identified event, I conduct an event study to assess the abnormal return of firms with higher exposure to sanctions. The results show a robust and quantitatively large impact of unfavourable news about sanctions on the returns of firms exposed to sanctions. Furthermore, I assess firm-level performance, showing that sanctions reduce firms' sales, and investments. Notably, the impact on hiring was relatively muted, a finding consistent with the notion that employment costs are often sticky in the short term, typically treated as short-term fixed expenditures.

I next turn to investigating the potential mechanisms through which sanctions might operate. I undertake a systematic human audit with the help of two trained experts. These experts were recruited from PhD students specializing in Economics at Sharif University of Technology. These human auditors scrutinize the text fragments that underlie my sanction scores to pinpoint the specific channel through which sanctions impact the firm's associated decisions. The findings suggest that the most potent channels are the limitation of exports and the escalation of import costs.

I address two main concerns that could challenge the causal interpretation of my results. One potential challenge is that corporate executives could use the threat of sanctions as an excuse for underperformance. Moreover, politically connected firms may also refrain from openly discussing sanctions due to their already familiarity with associated risks or political considerations, resulting in fewer references to sanctions in their case. This challenge is addressed by turning to the stock market. If mentions of sanctions were merely a form of deception or cheap talk, then the stock market should not price sanction exposure during the advent of unanticipated sanction news. Reassuringly, the observed results suggest otherwise.

The second challenge is that companies subject to sanctions may have inherent differences from other businesses, such as being vulnerable to various types of risks or having a trade-focused business model. It is possible that these other factors, rather than the sanctions themselves, could be responsible for the observed results. However, I argue that this challenge is mitigated by the inclusion of industry-fixed effects and the robustness of the results to a set of controls for firm-specific characteristics.

Taking together, my findings indicate that sanctions present a substantial challenge for Iranian firms, as evident in stakeholder discussions. These sanctions are growing in their complexity and impact firms through various mechanisms, leading to diminished stock market returns and declines in sales, investments, and hiring activities. While there is a noticeable variation in exposure to sanctions among Iranian firms, this variation does not align with any indicators of political connectedness. This highlights the indiscriminate nature of sanctions imposed on Iran.

This paper aligns with and contributes to several branches of literature. The first contribution is to the economics of sanctions literature, which primarily employs cross-country analyses to estimate the cost of sanctions on an entire economy (Yang et al., 2004; Felbermayr et al., 2019; Afesorgbor, 2019; Crozet et al., 2021). A subsection of this literature leverages microdata to study sanction effects on individual firms (Crozet et al., 2016; Haidar, 2017; Stone, 2016; Ahn and Ludema, 2020; Nigmatulina et al., 2022; Draca et al., 2023). Most of these papers studies compare sanctioned entities to non-sanctioned ones. Nevertheless, the evolution towards more intricate and multi-layered

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sanctions has blurred the demarcation between treatment (those exposed to sanctions) and control groups (those unexposed), as businesses may experience impacts through various channels that are not immediately apparent. This complexity necessitates a versatile analytical framework capable of capturing the diverse degrees of a firm's exposure to sanctions. To this end, I employ a text-based approach that analyses the perceptions of firms' stakeholders. This approach can account for the intricate nature of global trade relations, interconnectedness, and spillovers. Furthermore, this approach allows for the identification and decomposition of channels through which sanctions impact firms, providing more insight into the way sanctions operate.

The second significant contribution of this study is to the literature examining the political success of sanctions. A line of empirical research investigates how sanctions might bring political change and the conditions under which sanctions are more likely to fulfil the objectives set forth by the sender, largely building upon the cross-country analysis and dataset of Hufbauer (1990). Recently, Draca et al. (2023) analyzed the success of sanctions in targeting the economic interests of political elites in Iran. This paper's findings are in line with Draca et al. (2023)'s assertion that sanctions act bluntly, but the methodology differs. Here, I separate politically connected and exposed firms ex-ante and directly test for correlation between them. I show when sanctions reach a high level of complexity, the concept of being 'smart' or 'targeted' loses its relevance. I also examine the channels through which sanctions operate, exploring if these differ between politically connected and non-connected firms.

Lastly, this work contributes to the growing field of economics literature that leverages text as data (Gentzkow et al., 2019), specifically within the subset that utilizes text to gauge firms' susceptibility to particular shocks (Hassan et al., 2019, 2021, 2023; Sautner et al., 2023). I showcase the adaptability of text-based measurements in assessing firm-level shocks in a new context. I demonstrate this approach can be applied to a developing country undergoing sanctions, thus extending the utility of text-as-data methodology to broader contexts.

The remaining sections of the paper are organized as follows. Section 2 provides the historical context of sanctions on Iran, discussing the key events and developments that have shaped the imposition and impact of sanctions. In Section 3, I introduce the datasets used in the analysis. Section 4 presents the methodology and operationalization of the measure of sanction exposure, detailing the text-based approach. The section further demonstrates the validation and usefulness of the measure. Section 5 provides evidence of the bluntness or targeted nature of sanctions. Section 6 presents the empirical results on the economic impact of sanctions, including the analysis of stock market reactions, an assessment of the investment, sales, and employment patterns of firms exposed to sanctions, and the decomposition of sanction mechanisms. Section 7 concludes.

2. HISTORICAL CONTEXT

Sanctions on Iran have been imposed by various countries and international organizations since the Iranian Revolution of 1979. These sanctions have been put in place for various stated reasons, including support of terrorist groups, human rights records, nuclear programs and other perceived threats to international security. Over the years, the scope and severity of these sanctions

have evolved, targeting different aspects of Iran's economy, political structure, and military capabilities. The strongest sanctions on Iran are imposed by the US, and the strongest sanctions the US has imposed are on Iran. Figure 1 Panel A shows sanctions have emerged as an increasingly prominent foreign policy tool in recent years, and Panel B indicates that Iran is by far the most targeted country for US sanctions.

The history of sanctions against Iran can be traced back to 1979, when the United States imposed economic sanctions following the Iranian Revolution and the US embassy hostage crisis. These sanctions, based on the International Emergency Economic Powers Act (IEEPA), included freezing approximately 12 billion worth of Iranian assets held in US banks and a comprehensive ban on US exports to Iran, except for essential goods such as food and medicine.

In 1995, President Clinton issued Executive Orders 12957 and 12959, which expanded sanctions on Iran on the grounds of its support for terrorist groups, human rights abuses, and pursuit of weapons of mass destruction (WMD). The Iran and Libya Sanctions Act (ILSA) of 1996 further expanded these sanctions by penalizing foreign companies that invested in Iran's energy sector, thus extending the reach of US sanctions extraterritorially.

The UN Security Council adopted Resolution 1737 in 2006, imposing sanctions on Iran for its non-compliance with the International Atomic Energy Agency (IAEA) and its refusal to suspend uranium enrichment activities. These measures included asset freezes and travel bans for individuals involved in Iran's nuclear and missile programs, as well as restrictions on the trade of sensitive nuclear-related materials and technologies. In subsequent years, the UN Security Council passed additional resolutions, further targeting Iran's financial, transportation, and energy sectors.

In 2010, the United States and the European Union intensified the pressure on Iran by adopting the Comprehensive Iran Sanctions, Accountability, and Divestment Act (CISADA) and the EU Regulation 961/2010, respectively. These measures targeted Iran's energy and financial sectors, aiming to reduce its oil exports and access to the international banking system. The EU imposed a full oil embargo on Iran in 2012, while the United States tightened restrictions on the Iranian financial sector, including the Central Bank of Iran (CBI). These sanctions also severely limited Iran's international financial access; for example, in early 2012, the Belgium-based Society for Worldwide Interbank Financial Telecommunication (SWIFT) removed several Iranian banks from its system. It is important for my identification to highlight that sanctions placed on Iran were a mix of both targeted "smart sanctions" and broader comprehensive measures. These sanctions were arguably intentionally ambiguous, making it difficult for businesses and traders to understand the risks of conducting transactions with Iran. Diplomatic efforts to reach an agreement were shrouded in uncertainty.

In April 2012, the P5+1 nations (five permanent members of the UN Security Council and Germany) resumed negotiations on Iran's nuclear program with a meeting in Istanbul, which was deemed successful by both sides. Through a series of meetings in the following months, the first significant diplomatic breakthrough was achieved in November 2013, when the parties reached a framework agreement in Geneva. Subsequently, extensive negotiations took place to finalize

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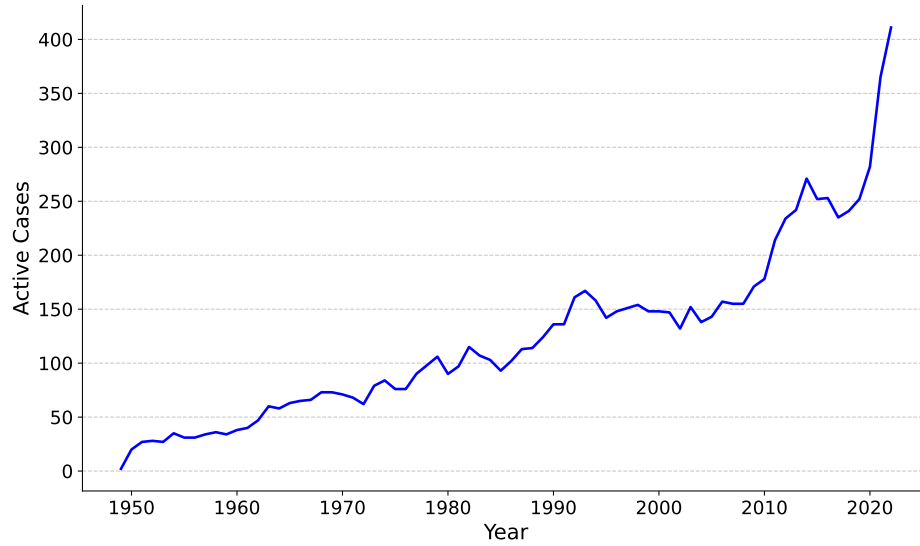
(a) Number of active sanction cases over time
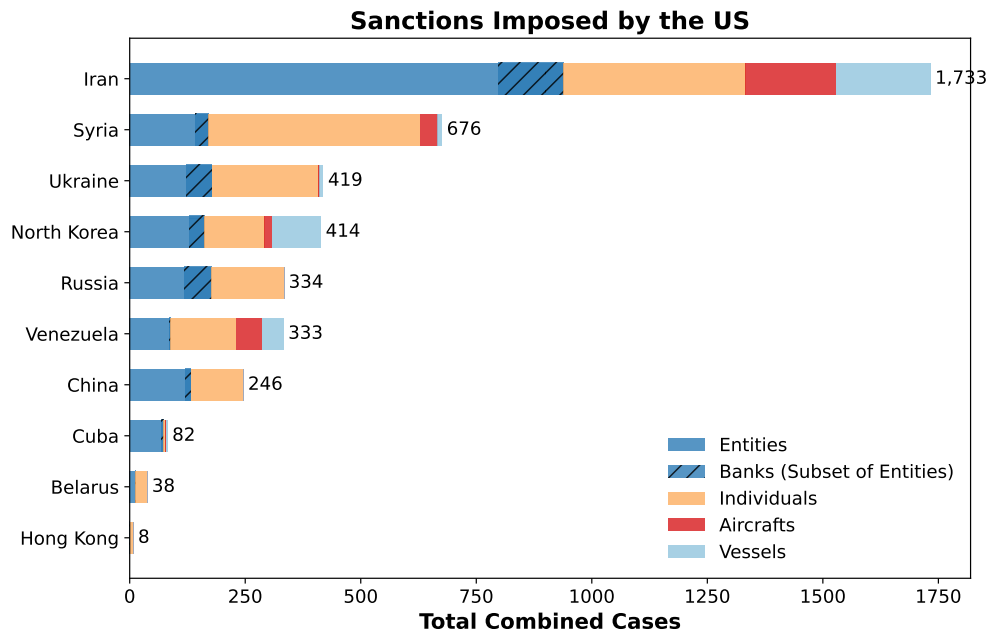
(b) Sanctions imposed by the US as of 2022

Figure 1. *Notes:* Panel A displays the number of active sanction cases from various sanctioning bodies over time. Each 'case' denotes a distinct imposition of sanctions, which might target an individual, firm, distinct entity, or even an entire sector within a nation. The data is from the third release of the Global Sanctions Data Base (Felbermayr et al., 2020; Kirikakha et al., 2021). Panel B illustrates selected countries on the Specially Designated Nationals and Blocked Persons list. The data is from Peterson Institute for International Economic; Office of Foreign Assets Control.
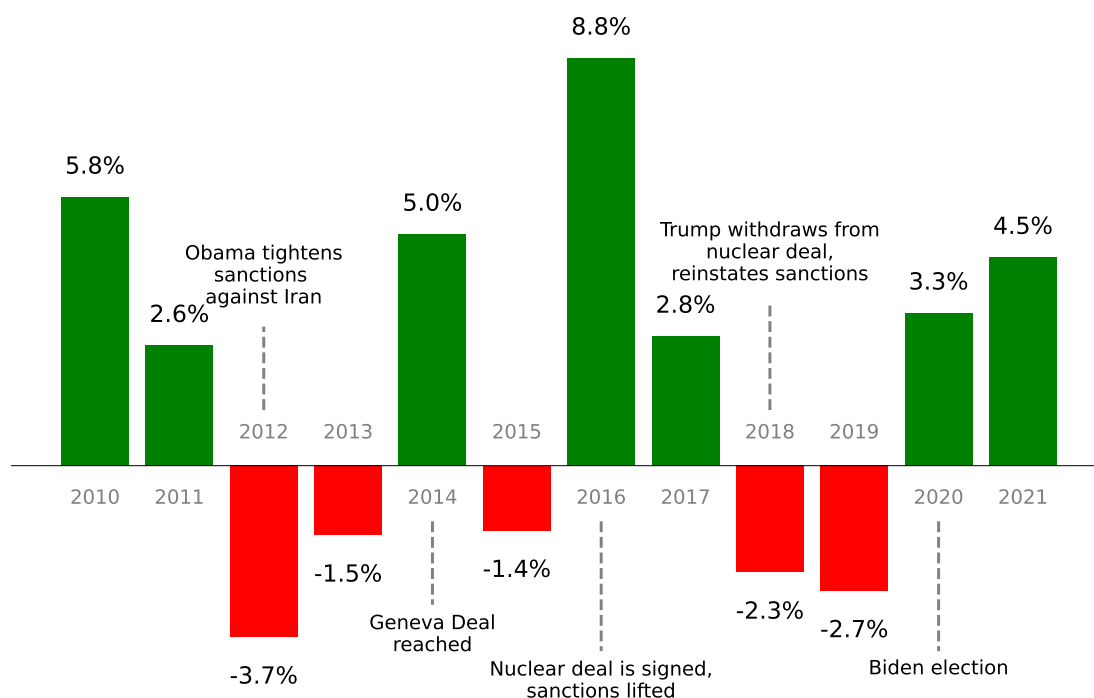
Figure 2. *Notes:* The figure displayed shows the GDP growth rate of Iran over time, expressed as a percentage. The data has been sourced from the World Bank.

an agreement in which sanctions would be lifted in exchange for concessions on Iran's nuclear program.

Finally, in 2015, the US, EU and UN lifted many of their sanctions on Iran as part of the Joint Comprehensive Plan of Action (JCPOA), commonly known as the Iran Nuclear Deal, which aimed to limit Iran's nuclear program in exchange for lifting of sanctions. However, despite certifying Iran's compliance to Congress twice since taking office, President Trump announced in May 2018 that the US would be withdrawing from the JCPOA. This decision led to the re-imposition of US sanctions on Iran, including the "snapback" of secondary sanctions targeting non-US companies conducting business with Iran.

Several decades of sanctions have negatively impacted Iran's economy. The annual GDP growth rate of Iran, along with big events regarding sanctions on Iran in the last two decades are depicted in Figure 2. This figure suggests that sanctions are taking a toll on the Iranian economy, as depicted by the lower growth rate during epochs of sanctions.

Sanctions on Iran are complex and have a multifaceted nature, as they are imposed by various entities and have varying levels of reach. I have conducted several interviews with business representatives inside and outside of Iran, and they both have reported that sanctions can impact businesses in various ways and that complying with sanctions requires navigating a complex web of regulations and guidelines, often with varying levels of enforcement and differing interpretations of the rules. Their insights revealed these difficulties exist for both Iranian firms and non-Iranian firms considering business endeavours in Iran.

For non-Iranian firms, entering into business ventures with Iranian counterparts necessitates meticulous due diligence to ensure compliance with sanctions regulations. This is partly due to fear generated due to the records of hundreds of millions of dollars of fines that have been levied against institutions like Credit Suisse AG in 2009, ING Bank N. V. in 2012, and BNP Paribas SA in 2014 by OFAC for allegedly violating US Sanctions. Even for transactions that are stated to be exempt from sanctions, such as those involving humanitarian aid, medical supplies, and certain agricultural products, businesses need to stay vigilant and seek expert advice to ensure compliance with the applicable regulations as these exemptions can be complex and subject to change.

On the other hand, sanctions also affect Iranian firms directly. Their experience, however, varies significantly based on factors such as industry sector, operational scale, and integration level with the global economy. Some Iranian firms may find workarounds or alternative sources of financing and trade, while others may struggle to survive under the weight of international sanctions. This feature of sanctions necessitates a more flexible approach to measuring a firm's exposure to sanctions.

3. DATA

I assemble a novel dataset to analyze the conversations between financial analysts and other market participants with firms' managers. The dataset comes from three sources. First, I use the text from information conferences that firms hold periodically. When a firm plans to hold one of these conferences, it is announced in advance, and market participants, such as financial analysts, investors, and other stakeholders, have a few days to post their questions and concerns on a platform provided by the firm. The firm then answers all questions. I have obtained, through data scraping, all of these answers and questions in information conferences from the official outlet for stock market-related documents, the Codal website.

The second and third sources are related to annual meetings. Unfortunately, the full transcripts of these meetings are not accessible. Instead, I utilize summaries of the annual conferences from two major market analyst firms. These summaries are usually compiled by specialized market reporters who attend the conference and summarize the key takeaways and highlights of the meeting. This data is useful as it allows me to analyze the sentiments and concerns of analysts and market participants towards a firm and its performance, even if the full transcript of the conference is not available.

The period under consideration in my study spans from September 2016 to 2022, and my data consists of 5,500 meeting reports from 700 firms listed on the Tehran Stock Exchange. The average number of reports for each firm is 8.9 and the standard deviation is 4.6. Unfortunately, I could not obtain information on any meetings held before September 2016 since no records were available. Since the number of meetings a firm holds depends on several factors, there is variation in the number of meetings per firm in my sample.

To collect data on the stock returns of the full universe of domestic publicly traded companies, I scrape daily information from the website of the Tehran Stock Exchange (TSE). The TSE is recognized for its financial access, depth, and efficiency among developing countries, according to the World Bank's Global Financial Development database (Čihák et al., 2012). The TSE operates from 9:00 AM to 12:00 PM for three hours daily, five days a week (Saturday to Wednesday).

I collected firm-level data, such as employment, investment, and sales, by scraping statements, cash flow statements and balance sheets, which were released on the official outlet Codal, and extracting the relevant information. I exclude non-annual financial documents as my firm-level analysis will be conducted annually. To ensure the reliability and accuracy of the collected data, a manual auditing process was conducted by human reviewers. Non-annual financial documents were excluded from the dataset to maintain consistency. As a result, I obtained an unbalanced panel dataset comprising data from 600 companies, covering fiscal years that concluded between June 2010 and July 2020.

I use GDELT (Global Database of Events, Language, and Tone), a large, real-time database of news, social media, and other publicly available data sources, to create a measure of sanction intensity over time. GDELT captures a wide range of events and information from all over the world, allowing me to analyze the volume and tone of news and social media mentions related to sanctions. I can then use this information to create a measure of sanction intensity, which can be used to track the evolution of the importance of sanctions over time.

The data on connected firms for this study is sourced from Draca et al. (2023), who focused on two principal actors targeted by sanctions due to their significant roles in Iran's nuclear program decision-making: the Islamic Revolutionary Guard Corps (IRGC) and Iran's Supreme Leader. Both are reported to control sizable conglomerates. The target group of firms is defined using sanction documents from the UN, EU, or US that state entities are owned or controlled by the IRGC or Setad. Specific identifiers from the Department of the Treasury's Specially Designated Nationals and Blocked Persons list (SDN list) help identify entities linked with the IRGC. Conversely, entities sanctioned due to links with Setad are identified through a detailed US Treasury press release. All TSE-listed assets of the IRGC and Setad entities defined in this process are then identified, resulting in a target portfolio of 50 firms, representing about 10% of the TSE's total market capitalization. These firms include ones that are fully owned by IRGC or Setad, as well as ones where these entities hold stakes.

4. SANCTION EXPOSURE

As argued previously, when sanctions evolve to become intricate and multi-faceted, the true nature of the exposure of firms to them is far more complicated than can be understood from accounting statements or sanction documents alone. This might partly be due to the deliberate policy of ambiguity from the sanctioning countries. In order to more accurately assess a firm's exposure to sanctions, I follow Hassan et al. (2019) and measure exposure to sanctions based on transcripts of firms' meetings. This can flexibly capture the exposure to sanctions through channels that are not measured using conventional methods and can best think of capturing the concerns

of firms and investors by directly asking them. In particular, I measure the share of conversation between the meeting participants and firm managers that centres around sanctions.

These conversations are conducted in Persian. The decision at hand is whether to translate the dialogues into English for analysis or to analyze them in native Persian. Both approaches have their merits and limitations. Utilizing English text analysis tools allows for access to a larger pool of resources, tools, and libraries that have been extensively tested and optimized for text analysis. Conversely, the tools and resources available for processing Persian text are not as extensive as those available for English. Nevertheless, I decided to conduct the analysis in Persian. This decision was primarily due to the fact that translating Persian text to English can result in the loss of information, meaning and nuances in the original text, potentially impacting the accuracy and reliability of the analysis. As such, utilizing Persian text analysis enables a more accurate and reliable analysis of the data, even though it requires more extensive adaptation and utilization of existing resources.

I create a measure of overall sanction exposure by looking at announcement conference texts as well as reports on the annual meetings and measuring how much of it is related to sanction. Initially, to validate that sanctions-related discussions mirror real-world sanction shocks, I examined the frequency of sanction mentions, adjusted by the total word count in these documents, over a timeline. More precisely, I decompose each meeting document into a list of words and then count the number of occurrences of "sanction" or "JCOPA" and divide it by the total word count for that quarter's documents. I investigate if the evolution of mentions of "sanction" in firms' meetings over time aligns with the timeline of sanctions.

Figure 3 presents the frequency of sanction mentions, adjusted by the total word count in these documents, across firms listed on the Tehran stock exchange market. The media sanction intensity measure is also displayed, calculated as the percentage of global online news coverage monitored by GDELT mentioning sanctions and Iran. The two series display a highly positive correlation. Consistent with the timeline of sanctions, discussions about sanctions remained relatively low before 2018. However, a sudden increase was observed after President Trump's announcement to withdraw from the Iran deal on May 8, 2018, with a second peak on June 24, 2019, when further sanctions were imposed, including a sanction on the supreme leader. These results align with our prior expectations and lend support to the validity of our measure of sanction exposure, indicating that discussions on sanctions in these corporate meetings offer a reliable reflection of the actual impact of sanctions on the firm. The occasional lag observed in this measure compared to the GDELT measure can likely be attributed to the time needed for recent news events to be addressed in subsequent meetings.

The fact that the timing of "sanction" mentions in meetings that are intended to address the pressing issues faced by firms lines up with the timeline of sanctions is significant not only because it validates the measure as an accurate indicator of sanctions exposure, but in its own right. These meetings are supposed to focus on the real risks and challenges the firm is facing, devoting more time to events of greater importance to the firm. This comovement suggests that sanctions do pose a real risk to the economy and are not just symbolic moves.
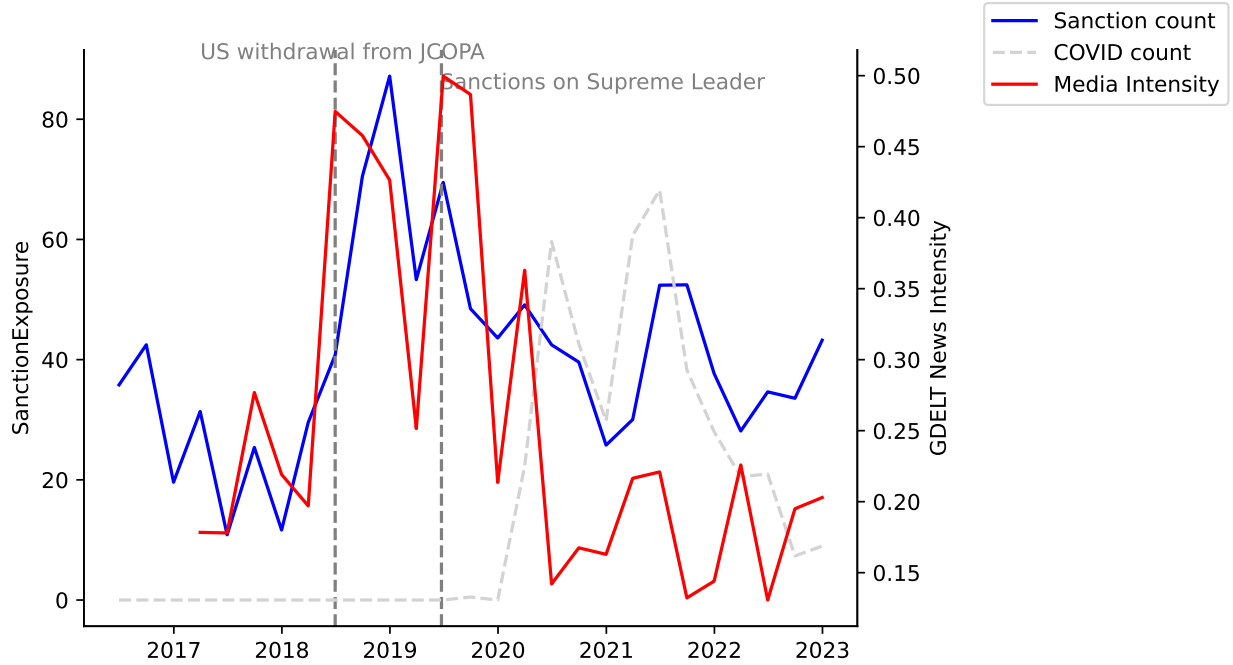
Figure 3. *Notes:* This figure illustrates the quarterly count of "sanction" (left axis) and the measure of news media sanction intensity (right axis). The measure of news media sanction intensity is built using GDELT and calculates the percentage of global online news monitored by GDELT that includes "Iran" and either "sanction" or JCPOA. The vertical line marks the quarter in which the Trump administration made the decision to withdraw from the JCPOA deal and reinstate sanctions.

To contextualize the scale of these shocks, I draw a comparative benchmark using a similarly constructed shock for COVID-19[2], illustrated as a grey dashed line in Figure 3, panel (a). The figure shows a swift surge in COVID-19 concerns immediately following 2020. Intriguingly, even at its zenith, the concern level regarding COVID-19 was 20 percent lower than the peak concern level about sanctions. This comparison underscores the considerable magnitude of Iranian firms' concerns about sanctions. The direct analysis of the impact of sanctions on firm valuation and performance will be discussed in the next section.

While focusing only on mentions of "sanction" or "JCPOA", echoing Hassan et al. (2021), is transparent, minimizes noise, and allows for comparative studies with other impactful events, such as the COVID-19 shock, it is arguably information-restrictive as it only looks at 'sanction' and may overlook other relevant terms associated with sanctions. Thus, in my principal approach, instead of a pre-determined selection of words associated with sanctions, I use a computational linguistics-based sequence-classification method to assign to each bigram a weight that indicates how strongly it is associated with discussions of the sanction. This is essentially utilizing tf-idf vectorization and follows Hassan et al. (2019). In appendix B, I explain the alternative approach of

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[2]When determining exposure to COVID-19, I took into account all Persian spelling variations of 'COVID', 'Corona', and 'Coronavirus'.

only looking at mentions of "sanction" and underscore the strong correlation between these two methodologies, yielding qualitatively comparable results.

The first step in constructing my measure is to identify those two-word combinations that are archetype of discussions around sanction. For this end, I define two training libraries: S, composed of texts primarily focused on sanctions, and NS, containing typical non-sanction related text. While the process of constructing the measure is automatic, the library choice requires human discretion. I draw from the leading Iranian economic publications for my training libraries: Donay-e Eghtesad, Tejart Farda, and Eghtesad Online, 90Eghtesadi, and Farsnews. This is partly because each source doesn't provide enough size and partly to minimise the role of human judgment by using training libraries from outlets with different political leaning. I selectively target articles tagged with 'sanction' or featuring the term in their title to constitute the sanction library. A randomized selection of non-sanction articles from these publications forms the non-sanction library. I then extract all adjacent two-word combinations (bigrams) from the texts of these two libraries, with all punctuation removed.[3] The resulting weighting term would be $1[b \in S/NS] \times \frac{f_{b,P}}{B_p}$.

$f_{b,P}$ is the frequency of bigram b in the sanction training library, and B_p is the total number of bigrams in the sanction training library. When more than two training libraries exist, the first term generalizes to the more familiar form: log(# of training libraries / # of libraries in which the bigram occurs). The first component, known as "inverse document frequency" (idf), eliminates bigrams that also appear in non-sanction training libraries. The second component, known as "term frequency" (tf), gives more importance to bigrams that are commonly used in the training library for sanctions. These two terms combined are known as tf-idf, determining the weight of each bigram.

Table 1 displays the most frequent bigrams in S/NS, based on their term frequency ($f_{b,P}/B_P$), that are strongly associated with discussions of sanctions and have the highest weight in our measure. These bigrams are exclusively related to sanctions, such as "from JCPOA", and "Lifting Sanctions". Figure 4 illustrates a histogram of the term frequency of these bigrams, which shows a highly skewed distribution with a median term frequency of 6.186×10^{-2}.

I create a measure of overall sanction exposure by looking at announcement conference text as well as reports on the annual meetings and measuring how much of it is related to sanction. I compose each document into a list of bigrams. Specifically, I decompose each meeting document for firm i in time t into a list of bigrams. I then count the number of occurrences of bigrams indicating discussion of sanctions, multiplied by the corresponding weight, and divide by the total number of bigrams in the transcript:

$$SanctionExposure_{i,t} = \frac{1}{B_{i,t}} \sum_{b=1}^{B_{i,t}} 1[b \in S/NS] \times \frac{f_{b,P}}{B_p}$$

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[3]I eliminate all words that contain pronouns, shortened pronouns, or two adverbs. I further eradicate all half-spaces, typically seen in two-part words in the Persian language. Despite experimenting with additional text preprocessing techniques, such as removing stop words and lemmatization, I did not find them to have a meaningful impact on our results. Thus, I choose not to implement these methods in order to stay consistent with the methodology outlined by Hassan et al. (2019).

Table 1. Top 50 Bigrams and their Translation

Rank	Translated Bigram	Weight	Frequency	Rank	Translated Bigram	Weight	Frequency
0	From JCPOA	75.46	50	25	That sanctions	11.28	14
1	To JCPOA	46.90	5	26	Exit JCPOA	11.24	2
2	Revival of JCPOA	46.26	3	27	Revival negotiations	11.07	0
3	JCPOA is	40.77	2	28	Sanction and	10.77	62
4	JCPOA and	36.00	23	29	Economic sanctions	10.56	29
5	JCPOA in	30.80	5	30	Sanctions on Iran	10.35	6
6	JCPOA to	29.91	6	31	Action JCPOA	10.22	0
7	In JCPOA	28.01	1	32	Implementation of JCPOA	9.97	0
8	American sanctions	25.48	17	33	JCPOA from	9.63	2
9	Sanctions are	25.39	18	34	That JCPOA	9.63	1
10	Lifting sanctions	22.35	46	35	JCPOA commitments	9.46	0
11	These sanctions	21.93	4	36	Applying sanctions	9.17	22
12	Sanctions and	18.63	128	37	JCPOA agreement	8.70	6
13	Some sanctions	17.58	2	38	Preserve JCPOA	8.45	0
14	Nullify sanctions	17.58	0	39	Canceling the sanctions	8.45	0
15	Sanctions against	16.60	6	40	JCPOA negotiations	8.11	3
16	Sanctions in	16.56	34	41	With JCPOA	8.03	1
17	From the sanction	14.87	37	42	Comprehensive action	7.99	2
18	From sanctions	14.79	58	43	Sanction is	7.99	10
19	Sanctions to	14.15	26	44	Lifting the sanctions	7.90	13
20	New sanctions	13.39	14	45	That the sanctions	7.60	4
21	From the sanctions	13.01	37	46	And the sanctions	7.01	34
22	About JCPOA	12.97	0	47	And sanction	7.01	8
23	JCPOA is	12.63	0	48	That sanction	6.97	6
24	Sanction it	11.75	1	49	And JCPOA	6.93	1
25	That sanctions	11.28	14	50	Negotiations to lift	6.76	1

Notes: This table shows the translation of top 100 bigrams with the highest term frequency $f_{b,P}/B_P$ and receiving the highest weight in the construction of sanction exposure. The frequency column lists the frequency count of each bigram in all transcripts.

In the above equation, b is a word in a document from firm i at time t, and $B_{i,t}$ is the total number of words in that document. Ideally, this measure could be delineated for every firm and quarter. However, due to the limited sample size for individual firms, the majority of my analysis averages the data across all timeframes for each firm. Consequently, I omit the t subscript and predominantly work with $SanctionExposure_i$.

Hassan et al. (2019) suggests differentiating between a shock's first and second moment effects on a firm and introduces a method to do so. While I incorporate this distinction, my primary analysis relies on $SanctionExposure$. This decision is based on two main reasons. Firstly, my Persian sentiment and risk dictionary, compared to the one utilized in Hassan et al. (2019), might not be as comprehensive, possibly leading to information loss. Secondly, and most crucially, the study period witnessed various sanction-related events, some involving the "imposition" of sanctions, and others related to "lifting" sanctions. Hence, when firms discuss sanctions, they could be referring to either imposition, lifting, or a blend of both. If this variability is not considered, the results may become confounded. One potential solution involves examining each instance of the term
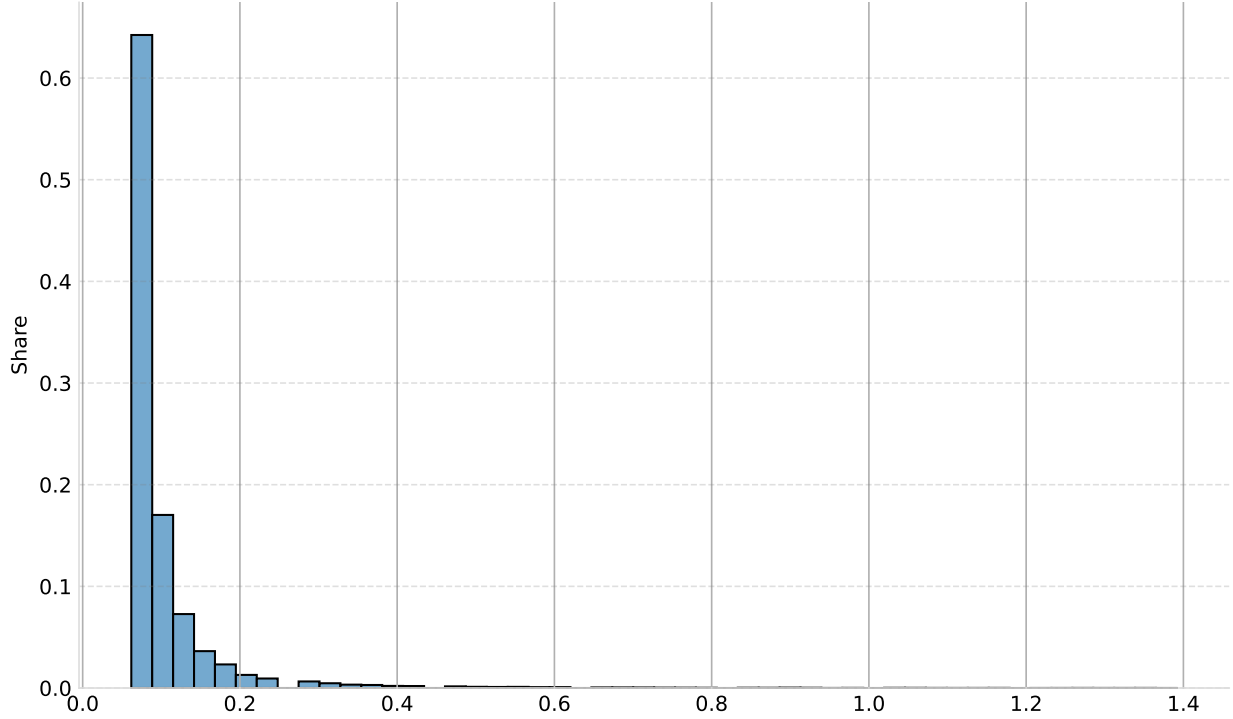
Figure 4. *Notes:* This figure displays a histogram of the weights associated with bigrams derived from our textual analysis.

"sanction", and applying a multiplier of -1 if the context is about "lifting" sanctions. Though this approach could alleviate the issue, it does not fully resolve it since it necessitates subjective judgment. Furthermore, it might not always be clear if the reference to sanctions pertains to their "lifting" or "imposing" or a discussion of both. For the sake of simplicity in notation, I have not explicitly detailed this adjustment, but it is applied in the following analysis.

With these caveats in mind, to differentiate between these first- and second-moment impacts, I employ the method outlined in Hassan et al. (2019) by creating measures of sanctions risk and sentiment by analyzing word counts in relation to synonyms for risk or uncertainty and positive and negative tone words, respectively. More precisely, I count the number of mentions of "sanction" within the set of 10 words surrounding a synonym for "risk" or "uncertainty" on either side, and divide by the total number of words in the transcript:

$$SanctionRisk_{i,t} = \frac{1}{B_{i,t}} \sum_{b=1}^{B_{i,t}} \{1[b \in S/NS] \times \frac{f_{b,P}}{B_p} \times 1[|b - r| < 10]\}$$

r here is the position of the nearest synonym of risk or uncertainty.

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Table 2. Summary Statistics

	Firm-level outcomes			Firm-year outcomes		
	$\overline{SExposure_i}$	$\overline{SRisk_i}$	$\overline{SSentiment_i}$	$SExposure_{it}$	$SRisk_{it}$	$SSentiment_{it}$
	(1)	(2)	(3)	(4)	(5)	(6)
Mean	-100.85	40.88	16.41	-106.82	44.84	17.77
Median	-28.29	17.39	0.0	0.0	0.0	0.0
SD	171.15	63.36	32.57	286.89	109.45	58.84
N	678	678	678	3133	3133	3133

Notes: The table presents descriptive statistics for the variables included in the subsequent analysis. It provides information on the mean, median, standard deviation, and the number of observations for each variable. $\overline{SExposure_i}$, $\overline{SRisk_i}$, and $\overline{SSentiment_i}$ are averages for each firm in the sample.

To assess the impact of sanctions on a firm's profitability (i.e., its first-moment impact), I use the same procedure, but this time I use the translation of Loughran and McDonald (2011)'s sentiment dictionary[4] to differentiate between positive and negative words.

$$SanctionSentiment_{i,t} = \frac{1}{B_{i,t}} \sum_{b=1}^{B_{i,t}} \{1[b \in S/NS] \times \frac{f_{b,P}}{B_p} \times \sum_{c=b-10}^{b+10} S(c)\}$$

In the above equation, S assigns a sentiment to each word c based on the following function, where S^+ is the set of positive-tone words and S^- is the set of negative-tone words.

$$S(c) = \begin{cases} +1, & \text{if } c \in S^+ \\ -1, & \text{if } c \in S^- \\ 0, & \text{otherwise} \end{cases}$$

Table 2 presents the mean, median, and standard deviation of the variables used in my study. The key variables of interest are my Sanction exposure, risk, and sentiment measures. For the purpose of this analysis, I also consider the firm-level averages (denoted by an overline) of the Sanction Exposure, Risk, and Sentiment variables. This group of variables is computed by averaging all available Sanction variable scores for all years for each firm.

The average $SanctionExposure_{it}$ by industry is presented in Figure 5. This metric was obtained by calculating the mean value of $SanctionExposure_{it}$ for all firms in each industry. The results reveal that the ""Architectural and engineering activities", "Water transport", and "Mining of coal

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[4]The English words were translated using Google Translate and then reviewed and edited by a certified English-to-Persian business translator. Some words were excluded from the translation as they did not have a one-to-one equivalent in Persian, while for some others, more than one Persian translation was considered. Despite these adjustments, the overall number of positive and negative words remained largely the same.
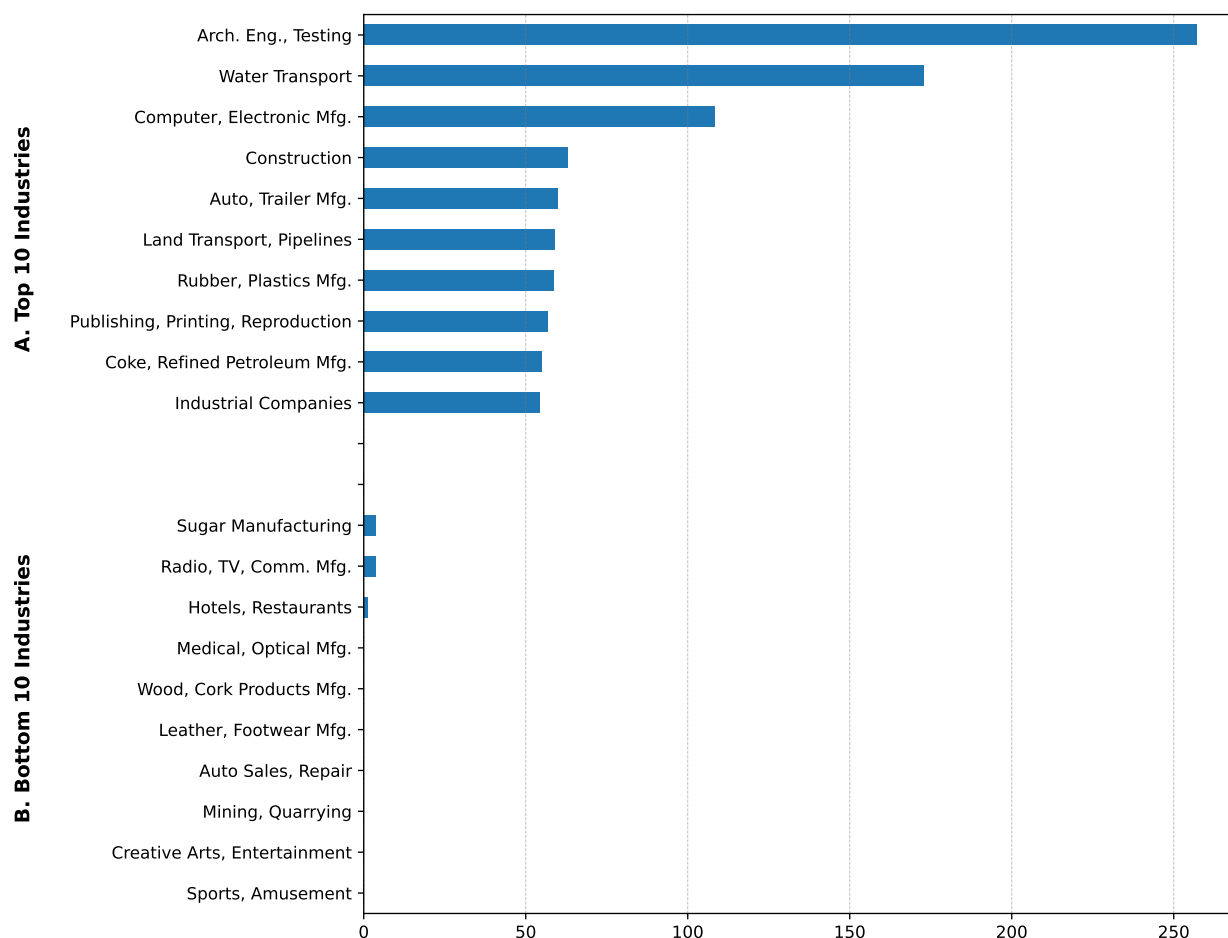
Figure 5. *Notes:* This figure displays the mean value of $SanctionExposure_{i,t}$ calculated across all firms in industry i. Higher mean values indicate that firms in industry i operating in Iran are potentially more exposed to the impact of sanctions, and may face greater challenges as a result.

and lignite" industries have, on average, the highest proportion of time spent discussing political risk topics during conference calls. Conversely, the "Sport and amusement" and "Creative art and entertainment" industries exhibit the lowest exposure to sanctions. These findings are consistent with the expectation that industries that are more dependent on international trade and connectedness to the outside world may be more sensitive to political risks.

5. EVALUATING THE PRECISION OF SANCTIONS: ON TARGET OR OFF?

Sanctions can exert pressure on a target government to modify its political behavior in at least two ways. The first is through direct means by inflicting harm on the interests of political decision-makers, thereby persuading them to alter their behaviour. This is usually the rationale offered by those imposing sanctions. Alternatively, sanctions can work indirectly by inciting a popular

revolt that overthrows the government, or by creating public frustration that places pressure on the government to change its behavior.

In this section, I test these two ideas by investigating if the companies targeted by sanctions are indeed those that are more exposed to them. If we find that this is the case, it will support the first rationale for using sanctions, which involves directly inflicting harm on the interests of political decision-makers to persuade them to change their behavior. To this end, I estimate the following specification:

$$SanctionExposure_i = \alpha_{j(i)} + \beta Target_i + u_i$$

In the above equation, $Target_i$ is a binary indicator that takes the value 1 if firm i is the target of the sanctions, and 0 otherwise. This equation thus assesses the correlation between being a primary target of sanctions and exposure to these sanctions. Target firms are identified as companies that are owned or controlled by political decision-makers and are the focus of sanctions with the aim of changing the behavior of their owners.

To identify these firms, I follow the definition from Draca et al. (2023). According to this paper, target firms as companies that are either owned or controlled by the IRGC (Iran's Revolutionary Guard Corps) or Setad (a conglomerate in Iran). These two key actors had very important roles in decisions about Iran's nuclear program. The authors first exclude companies directly related to Iran's nuclear program. To identify the target firms, the authors use official documents from the UN, EU, and US to identify entities that are explicitly stated to be owned or controlled by the IRGC or Setad. The authors also use shareholder information from the TSE (Tehran Stock Exchange) to identify additional companies in which the IRGC or Setad have ownership stakes. The final target portfolio includes 50 firms, representing 10% of the TSE's total market capitalization.

The findings are detailed in Table 3. These results emphasize the lack of correlation between different measures of political connection and exposure to sanctions in a significant way. This indicates that sanctions, in their current form, may not accurately pinpoint their intended targets. Instead, they seem to cast a wide net, affecting the economy of the targeted country in a more comprehensive way than initially intended or openly acknowledged. In particular, the study reveals that the economic interests of Iran's political elite were not exposed to sanctions any more than other publicly traded firms.

These findings suggest that complex, multi-layered sanctions may not be as effective as sometimes argued in exclusively impacting specific firms or individuals. Selectively 'activating or de-activating' their impact across various entities within the recipient nation appears not to be possible. As sanctions grow more complex, the notion of 'targeted' sanctions becomes less applicable. The subsequent chapter's findings reinforce this by illustrating that, in equilibrium, sanctions impact through various pathways that are somewhat indiscriminate. These channels, like financial limitations or restricted access to intermediary goods, affect a wide range of firms, not only the politically affiliated ones.

Table 3. Exposure and Target

| | Sanction Exposure | | |
	(1)	(2)	(3)
Target	8.954		
	(7.028)		
Direct		21.505	
		(19.884)	
Indirect		7.308	
		(7.442)	
IRGC			31.886
			(22.922)
Setad			6.770
			(7.329)
Observations	840	840	840

Notes: Sanction Exposure is constructed as explained in the previous section. Standard errors are shown in parentheses. Different definitions of 'target' are borrowed from Draca et al. (2023) and are explained in the text.

6. Economic Impact

I now turn to the real economic impact of sanctions and ask if firms that frequently report concerns about sanctions actually experience economic ramifications. Initially, I explore whether firms with high sanction exposure experience an excessive negative return following news about the imposition of sanctions. The underlying premise is that to the extent that news about sanctions is unanticipated, firms with greater exposure should display a more negative excess return, signalling a diminished future revenue stream. I then delve into firm-level performance and see if sanction leads into lower sales, investments, and hiring. Lastly, I probe the mechanisms underlying these effects.

6.1. **Stock Market Reaction.** This section analyzes how stock markets responded to the events related to sanctions on Iran. The idea is that when investors were informed of this development, they recalibrate their expectations about the future of publicly-listed firms, leading to changes in stock prices during the event period. These stock price shifts mirror changes in investors' perceptions of both direct and indirect sanctions effects on Iranian firms, which can affirm that my measure transcends mere distraction or trivial rhetoric and contains substantive information.

There are numerous events related to sanctions and negotiations to lift sanctions between Iran and the West that could be examined through an event study approach. To avoid biases associated with arbitrary event selection, I adopt a systematic methodology as proposed by Amiti et al.
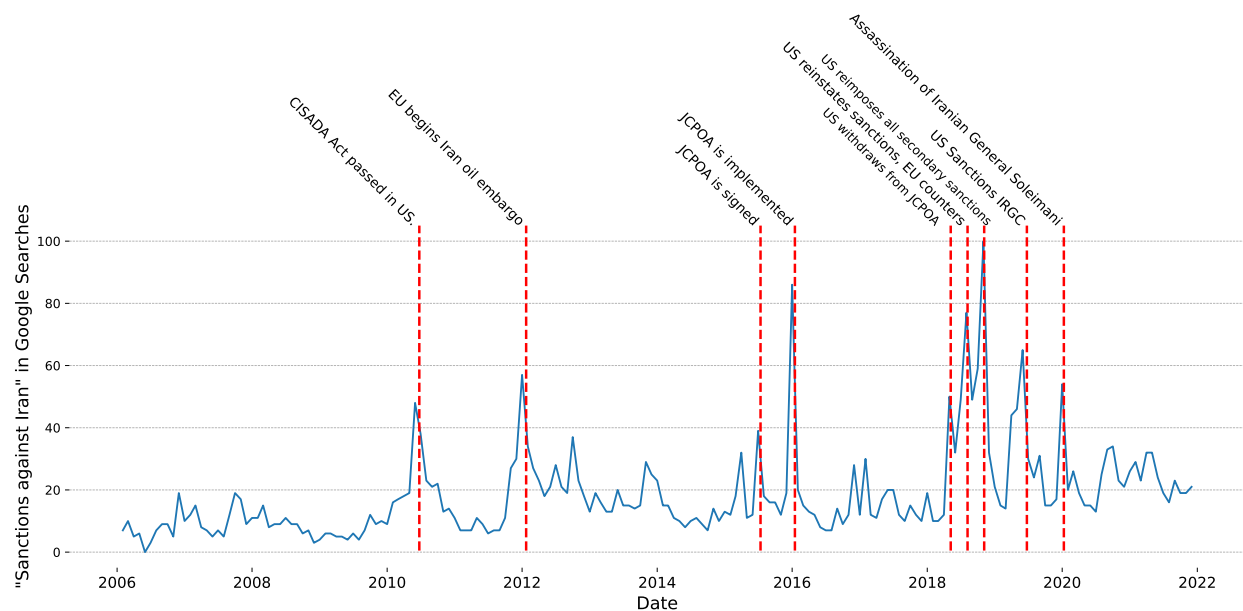
Figure 6. *Notes:* This figure displays the frequency of Google searches for "Sanctions against Iran," marked with significant related events: June 24, 2010: The Comprehensive Iran Sanctions, Accountability, and Divestment Act (CISADA) was passed under President Obama. January 23, 2012: The EU imposed an oil embargo on Iran and froze the assets of Iran's central bank. July 14, 2015: JCPOA Signed. January 16, 2016: Most UN sanctions on Iran were lifted following the JCPOA. May 8, 2018: The US withdrew from the JCPOA. August 7, 2018: The EU nullified US sanctions on countries trading with Iran, and the US reinstated non-oil sanctions. November 5, 2018: The US reimposed all secondary sanctions on Iran. June 24, 2019: The US sanctioned eight senior commanders of the IRGC. January 10, 2020: Sanctions were authorized on Iran's key sectors by President Trump. Each vertical line on the figure corresponds to these key events, providing a visual timeline of political events and public interest.

(2020) to identify key events. Specifically, I pinpoint days with a peak in the number of Google searches for the term "Sanctions Against Iran," as depicted in Figure 6. I then cross-reference these dates with media reports to identify significant sanction-related events around these periods. Two events are excluded from this analysis. Initially, the aftermath of the assassination of Iranian general Soleimani is omitted because it is not directly linked to the implementation or removal of sanctions. Furthermore, the event dated November 2018 is excluded due to its ambiguous nature regarding its positive or negative implications for sanctions. While the US ushered in the second wave of renewed sanctions in November 2018, the other signatories of the Iran nuclear agreement—France, Britain, Germany, Russia, and China—announced their plans to launch a "Special Purpose Vehicle" (SPV). This mechanism aimed to ease transactions with Iran, bypassing US sanctions, and was designed to "assist and reassure economic operators pursuing legitimate business with Iran." Given the ex-ante unknown nature of whether this event is positive or negative, it is not considered in the analysis.

Abusing notation and omitting time subscript t for each event, I run the following specification:

$$R_i = \alpha + \theta Sanction_i + \gamma X_i + u_i$$

Here, R_i refers to the four-trading-day return of firm i following the event, while X_i is a vector that includes industry fixed effects, firm-specific characteristics such as the size of the asset, and the firm's market betas, which is calculated by regressing monthly returns of the firms on the monthly Tehran Stock Market index (TEDPIX). The variable $Sanction_i$ represents either the firm-level averages of Sanction Exposure ($\overline{SExposure_i}$), Sanction Risk ($\overline{SRisk_i}$), or Sanction Sentiment ($\overline{SSentiment_i}$) for firm i. This strategy is valid if, absent the sanction events taking place during this window, no systematic differences would exist between the returns of the exposed versus non-exposed firms. In other words, we require the standard identification assumption $Cov(Sanction_i, u_i | X_i) = 0$.

The result is tabulated in Table 4. While coefficients are noisy, the signs of coefficients generally align with expectations. Firms exposed to sanctions tend to exhibit a lower return when there is news about the imposition of sanctions and a higher return when news is about the lifting of sanctions. Specifically, columns 3 and 4, which indicate events leaning towards the lifting of sanctions, positively influenced the excess return of firms more exposed to sanctions. It's noteworthy that the evolution of the JCPOA was filled with uncertainties at every phase, so each major event conveyed fresh insights into the probability of sanctions being removed. Other columns demonstrate events associated with the imposition of sanctions led those sanction-exposed firms to experience a negative excess return.

The last column provides a parsimonious summary of former results by estimating the average impact of all sanction-related events on firms that are more susceptible to sanctions. To accomplish this, I introduce a variable, denoted as E_t, which assumes a value of zero on days without any events. On event days, depending on whether the event conveyed a positive, neutral, or negative outlook regarding the possibility of sanctions being imposed, the variable takes on the values -1, 0, or +1, respectively. I then proceed to interact this variable with my measure of sanction exposure. The resulting negative coefficient confirms that firms with higher exposure to sanctions are likely to experience a decline in market value upon receiving news that hints at a potential escalation in the severity of sanctions.

The computation of the full in-sample distribution of point estimates, as inferred from the last column and each firm's market cap, indicates that an average Iranian firm loses around 800B rial in response to unfavourable news about sanctions. Although this figure may not convey a direct interpretation on its own, comparing the total impact on politically connected versus non-connected firms is very insightful. Based on the estimation presented in the final column, the total effect on all politically connected firms amounts to 32000B Rial, whereas non-connected firms face a more substantial impact of 161000B Rial. This substantial difference underscores the externality associated with the enactment of sanctions aimed predominantly at connected firms. This externality signifies that for every \$1 of intended damage on politically connected firms, an unintended loss of \$5 is incurred by non-targeted firms. This considerable externality stems from the fact that sanctions impact politically connected and non-connected firms roughly in the same way, but there's a significantly larger number of non-connected firms. The externality multiplier

Table 4. Stock Market

	(1)	(2)	(3)	(4)	Stock Returns (5)	(6)	(7)	(8)
	24-06-2010 CISADA Act Passed	22-01-2012 EU Oil Embargo	14-07-2015 JCPOA Signed	16-01-2016 JCPOA Implemented	09-05-2018 US Exits JCPOA	07-08-2018 US Part1 Sanctions	24-06-2019 US Sanctions IRGC	2010-2020 Pooled Results
$\overline{SanctionExposure}_i$	-3.756	-1.705	8.069	4.056	-4.103	-7.993	-6.041	
	(4.425)	(3.658)	(4.329)	(4.037)	(2.912)	(4.664)	(4.741)	
$E_t \times \overline{SanctionExposure}_i$								-2.849
								(1.328)
Observations	219	263	398	436	501	510	542	868100
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the OLS estimation results for cross-sectional regressions of $StockReturns_i$ on $\overline{SanctionExposure}_i$. The stock returns are calculated as $\Sigma_{t=0}^{t=N} LogP_{i,t}/P_{i,t-1}$, where t is at a daily frequency, and $[0, N]$ represents the period of four trading days (including weekend days) following the event. The controls incorporate market cap and ISIC 2-digit dummies, and the standard errors are robust.

remains the same when considering General Equilibrium effects and spillovers, provided these effects don't systematically differ between connected and non-connected firms.

The observed correlation between sanction-related events and the fluctuating stock market valuations of firms discussing sanctions in their meetings supports the notion that sanctions inflict damage on firms with a higher degree of exposure, subsequently affecting the entire economy. I discuss two other potential interpretations of these results, but the evidence at hand largely supports the original explanation.

Firstly, one could argue that this correlation merely illustrates how firms with distinct characteristics respond differently to macroeconomic shocks, rather than reflecting the specific impacts of sanctions. However, considering that my analysis accounts for various firm-level characteristics and industry-specific factors, this correlation is more likely to be indicative of sanctions' effects. Furthermore, the analysis takes into account a range of different events, making it highly improbable that certain macroeconomic shocks consistently coincide with sanction-related events.

An alternative interpretation suggests that sanctions, while impacting the values of firms exposed in the targeted country, primarily result in a resource reallocation among firms with different sanction exposures, without having a substantial effect on the overall economy. While some resource reallocation is plausible and perhaps even probable - for example, firms producing similar goods may gain an inadvertent advantage from sanctions due to decreased foreign competition, or the government may bolster support for certain firms to help it circumvent sanctions - it cannot completely counteract the effects of sanctions. The preceding chapter's evidence demonstrates that certain sanction-induced mechanisms -for example, no access to intermediary inputs- can more or less universally affect all firms, indicating that resource reallocation cannot comprehensively mitigate these impacts. Moreover, the aggregate effect of sanctions on the entire economy, as illustrated in Figure 2, suggests that resource reallocation cannot offset the net effect.

6.2. **Impact on Firm-level Investment and Sales.** Previous sections showed that sanctions pose a challenge for firms, at least to the extent that they are likely to be discussed by stakeholders and that equity markets may price these shocks accordingly. This section will delve into the specific impacts of sanctions exposure at the firm level, focusing on investment and sales, while also acknowledging several limitations and challenges that arise in this context.

The first limitation is that due to data availability, our $SanctionExposure$ measure does not cover a broad enough time period and does not extend far enough into the past. This means that for t prior to the re-imposition of sanctions in 2018, $SanctionExposure_{it}$ data is absent. This results in a constrained range in the imposition and lifting of sanctions over the timeframe for which $SanctionExposure_{it}$ data is accessible.

Secondly, the sanctions levied against Iran cover a period of more than four decades, during which the intensity of sanctions has fluctuated significantly. This extensive and variable period lacks clear "sanctions on" and "sanctions off" phases, complicating the application of a difference-in-difference approach.

Acknowledging these constraints, I adopt the following specification to estimate the effect of sanctions:

$$y_{i,t} = \delta_i + \delta_t + \beta SanctionExposure_i \times SanctionEpoch_t + \gamma X_{it} + u_{it}$$

This regression employs data from the decade spanning the Persian calendar years 1390-1400. $SanctionEpoch_t$ is an indicator variable assigned a value of one during the years 1393, 1394, 1397, and 1398, corresponding to periods of maximum sanction intensity. $SanctionExposure_i$ represents the average sanction exposure for each firm over time.

Table 5 displays the results of this analysis. The sales growth rate, represented as $\frac{\Delta Sales_{i,t}}{\Delta Sales_{i,t-1}}$, indicates the annual change in sales relative to the previous year's sales. The capital investment rate, denoted as $\frac{I_{i,t}}{K_{i,t-1}}$, is calculated annually using the perpetual inventory method, the details of which are provided in appendix A.

Column 1 shows the base specification of the relationship between sales and $SanctionExposure$, and, as control, the year and firm fixed effects. As anticipated, we find a significant negative association between $SanctionExposure$ and the sales growth rate, implying that firms most exposed to sanctions tend to experience lower sales during periods of intensified sanctions. Column 3 highlights firms exposed to sanctions retrench investment when faced with sanctions. Column 2 and 4 include $SanctionRisk$ and $SanctionSentiment$. Aside from $SanctionRisk$ in the final column, all other variables display anticipated signs. However, their correlations are notably weaker and lack statistical significance, which is in alignment with the discussions outlined in Section Three. The last two columns look at the effect of sanctions on employment. It shows a negative impact on employment, although the effect is small. The fact that headcount employment is less responsive to an external shock compared to other firm-level outcome variables is consistent with the idea that some firms may have been able to maintain employment levels by reducing hours or wages. Employment costs are costly and sticky in the short term and thus are typically viewed as short-term fixed costs, making adjustments like layoffs costly and disruptive. Additionally, firms may prioritize workforce continuity and skill retention, anticipating a recovery after the shock, whereas investment decisions can be more easily deferred or adjusted in response to changing conditions.

6.3. **Decoding Sanction Channels.** The current findings prompt an inquiry into the specific risks and impacts that firms attribute to sanctions. In this section, I try to identify major channels through which sanctions will affect firms in as systematic a manner as possible. I achieve this through a structured human reading of texts utilized to construct SanctionSentiment and SanctionRisk. The method involves scrutinizing the paragraphs encapsulating each instance of the term "Sanction".

In accordance with the methodology established by Hassan et al. (2021) and Baker et al. (2016), a structured approach was developed to undertake the human reading of these text fragments. The first step involved conducting interviews with business professionals, both domestic and international, who engage in importing to and exporting from Iran, as well as executives and market experts in the Tehran Stock Exchange to identify the various channels through which sanctions could affect Iranian firms. The discussions uncovered that businesses could face impacts from sanctions on both the supply and demand fronts.

Table 5. Firm-level Effects of Sanctions

	$\frac{\Delta Sales_{i,t}}{\Delta Sales_{i,t-1}} * 1000$		$\frac{I_{i,t}}{K_{i,t-1}} * 1000$		$\frac{\Delta Emp_{i,t}}{\Delta Emp_{i,t-1}} * 1000$	
	(1)	(2)	(3)	(4)	(5)	(6)
$\overline{SanctionExposure}_i$	-0.768		-1.625		-0.182	
	(0.236)		(1.382)		(0.170)	
$\overline{SanctionRisk}_i$		-0.213		1.351		0.262
		(0.452)		(3.382)		(0.493)
$\overline{SanctionSentiment}_i$		0.205		1.017		0.093
		(0.100)		(0.750)		(0.116)
Observations	4195	4195	3697	3697	1174	1174
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Sales, $\frac{\Delta Sales_{i,t}}{\Delta Sales_{i,t-1}} * 1000$ is the change in year-to-year sales over last year's value. Capital investment, $\frac{I_{i,t}}{K_{i,t-1}} * 1000$, is calculated recursively using a perpetual-inventory method. Details are in the appendix A. All regressions include firm and year-fixed effects. Standard errors are clustered at the firm level.

On the supply side, firms may struggle to acquire the necessary inputs and intermediaries that were previously supplied from abroad. Even if they manage to find a foreign supplier, they may encounter obstacles when trying to obtain the required foreign exchange or make payments to the supplier. Additionally, finding a shipment company willing to transport their inputs and an insurance company willing to insure the cargo could be a challenge.

On the demand side, firms may struggle to find customers for their products or services, as many export destinations and foreign customers may no longer be accessible to them. Even if they find foreign customers, issues with money transfer and shipment could persist. Domestic consumers, including both the government and private sector, may also be affected by the sanctions.

After considering all these channels, the potential categories of impact were streamlined to:

(1) Restrictions on Money Transfers and Access to Financial Markets: Economic sanctions can hinder a company's ability to transfer money to and from Iran and limit its access to global financial markets. This can affect both their ability to pay their suppliers and receive payments from their consumers, as Iranian banks may be unable to make or receive payments to foreign banks where suppliers or consumers are located.

(2) Increased Logistics and Transportation Costs: Economic sanctions can raise the cost of logistics and transportation, as shipping companies and airlines may be hesitant to do business with Iran and shipping to and from Iranian ports, and insurance companies may not provide coverage for transportation to and from the country, leading to higher costs

and potential delays in delivery. This also affects both the supply and demand sides for business.

(3) Other Export Limitations and Restrictions: Sanctions may hinder Iranian firms' ability to export goods through other means, e.g., by discouraging potential business partners from conducting transactions with them. This can manifest in traditional buyers halting purchases from Iranian businesses either due to government instructions or their own assessment of risks and compliance costs.

(4) Import Costs, Supply Chain Disruption, and Lower Foreign Investment: Economic sanctions can elevate the expenses associated with importing both goods and capital into Iran, while simultaneously creating disruptions in supply chains. This makes it difficult for companies to obtain the essential capital and inputs they need for their operations.

(5) Foreign Exchange and Currency Volatility: Economic sanctions can increase the exchange rate and currency volatility, making it difficult for Iranian companies to conduct international business and manage financial risk. The foreign exchange market in Iran is multi-layered, and firms planning to buy intermediaries might face obstacles in acquiring the required foreign currency due to market disruptions or government-imposed restrictions. Similar challenges happen for exporter firms trying to exchange their foreign currency for domestic currency.

(6) Reduced Government Support: Economic sanctions can limit the resources available to the Iranian government to support businesses and invest in infrastructure and public projects. As one of the largest customers in the economy, a reduction in government demand can limit a company's access to government services and resources, potentially hindering its ability to operate and grow. This can be particularly problematic for businesses that rely on government contracts or subsidies, as reduced government spending can lead to a contraction in these markets.

(7) Lowered Demand and Market Contraction: Sanctions can impact the entire Iranian economy, leading to reduced demand for goods and services, whether for consumer-focused companies or those selling to other businesses. This can lead to a decrease in a business's revenue and profitability.

(8) Other channels: There could be other specific ways in which sanctions can affect businesses operating in Iran, depending on the type of business, industry, and partners involved.

Subsequently, an instruction manual was composed for two independent human auditors, who were recruited from the Ph.D. program of an Iranian economics department (Sharif University of Technology). The manual comprised elaborate step-by-step directives for classifying fragments into each of the eight topic categories. In addition, the study requested the auditors to flag fragments in which the meeting participants mentioned that sanctions had limited or no impact on the firm or fragments that the auditors found challenging to classify. Each auditor was asked to classify all fragments. The study found that the auditors agreed on the classifications most of the time, and in cases of disagreement, a third auditor was invited to provide judgment.

Table 6. Firms' Meetings Excerpts by Category

Company	Time	Translations of Excerpts

Challenge: Restrictions on Money Transfers and Access to Financial Markets

| IASCO | 2018-08 | Although the sanctions make transferring currency from exports challenging, past experience with sanctions has led to the development of new channels for money transfer- alternative foreign currency transfer methods have mitigated the impact... |

Challenge: Increased Logistics and Transportation Costs

| Farsnov Cement Co | 2018-09 | The company is in talks with the Government Shipping Company to continue exporting at a similar rate as last year despite the harsh US sanctions. Additionally, our export product buyers have suggested alternative transportation methods... |

Challenge: Other Export Limitations and Restrictions

| Pars Oil Co | 2018-10 | Question: Has the company experienced any issues with export sales due to the upcoming sanctions? Answer: It's uncertain how the upcoming sanctions will affect the company's exports as it depends on the specific mechanism of the sanctions, making it impossible to make a specific prediction... |

Challenge: Higher Import Costs and Supply Chain Disruption

| Iran Tire Co | 2018-10 | Question: Has acquiring raw materials from overseas become problematic for the company since the sanctions? While half of the intermediate goods are sourced from foreign suppliers, the company aims to secure its raw materials on time despite the obstacles... |

Challenge: Foreign Exchange and Currency Volatility

| Zagros Pharmed Pars Co | 2018-08 | Question: If sanctions are imposed, what exchange rate does the company use to import raw materials, and have there been any obstacles in obtaining them at this rate? Moreover, if the company utilizes the discounted central bank rate, what is the likelihood of this rate being liberalized? |

Challenge: Reduced Government Support

| Persian Railway Transportation | 2018-09 | How has the estimated decrease in government oil production and export due to the sanctions affected the company's operations? Is there any alteration in the rate received from the National Iranian Oil Products Distribution Company per kilometer/ton transported? |

Challenge: Lowered Demand and Market Contraction

| Persian Railway Transportation | 2018-09 | Will the decrease in fuel oil exports due to the oil sanctions lead to a reduction in the demand for transporting these materials to export terminals? |

Challenge: Other channels

| IKCO | 2018-10 | Question: Is there a possibility that the production of Peugeot and Suzuki products will cease due to the current and future sanctions and the departure of foreign companies from Iran? |

Notes: The table displays sample excerpts from firms' meetings related to a specific topic category of discussion that mentions sanctions

The transcripts presented in Table 6 provide sample excerpts on each topic related to sanctions. Upon reading the text, it becomes clear that the discussions primarily focus on specific channels through which the firm in question could potentially be impacted by sanctions. To illustrate the distribution of these topics, Figure 7 shows the proportion of each pre-defined category in the discussions of sanction risks. The horizontal axis represents the topic categories, while the vertical axis displays the proportion of each topic relative to all other specific topics mentioned by the firm. The figure shows, in equilibrium, the most prevalent channels through which sanctions are hitting Iranian firms are Export limitation, followed by increased import costs and increased logistics costs.

Additionally, the plot reveals that concerns over sanctions extend beyond politically connected firms. This is illustrated by the hashed area within each bar, which represents the proportion of concerns over sanctions originating from politically connected firms (data from Draca et al. (2023)). It becomes evident that, in equilibrium, the majority of concerns over sanctions arise from non-politically connected firms to some extent because most of the firms are not politically connected. This result lines up with the findings of chapter 5 that politically connected firms do not exhibit higher levels of sanctions exposure,

Figure 8 illustrates the progression of concerns related to sanctions over time. For each quarter, the figure displays the percentage of sanction-focused discourse dedicated to each channel. The graph suggests the relative share of each mechanism has remained remarkably consistent over time. The steadfastness of these thematic proportions suggests that businesses have settled into a rhythm of expectation and response regarding sanctions, possibly reflecting a market that has, to some extent, adapted to the persistent state of economic containment.

7. CONCLUSION

This research, set within the context of sanctions imposed on Iran, looks into the challenges that firms face in an economy subject to different layers of sanctions. I use text-based method to explore the economic effects of comprehensive sanctions at the firm level and to offer unique insights into the channels through which these effects permeate and the magnitude of the economic impact on the targeted firms.

The study underscores that Iranian firms face considerable challenges due to sanctions. At its peak, the concern over sanctions surpassed even the anxiety provoked by the COVID-19 pandemic by 20%. The sanctions have predominantly impacted firms by limiting access to export destinations and escalating import costs. This affirms that sanctions can create significant economic disruptions even when the political objectives may not be entirely realized.

An important finding from this research challenges the claim by some proponents of sanctions that they only, or at least disproportionally, target political decision-makers. The analysis reveals that politically-connected and non-connected firms are equally affected, underscoring that sanctions often act as blunt instruments inflicting harm broadly. Such outcomes suggest that the multi-layered nature of sanctions hinders their precision, resulting in a widespread adverse effect. This
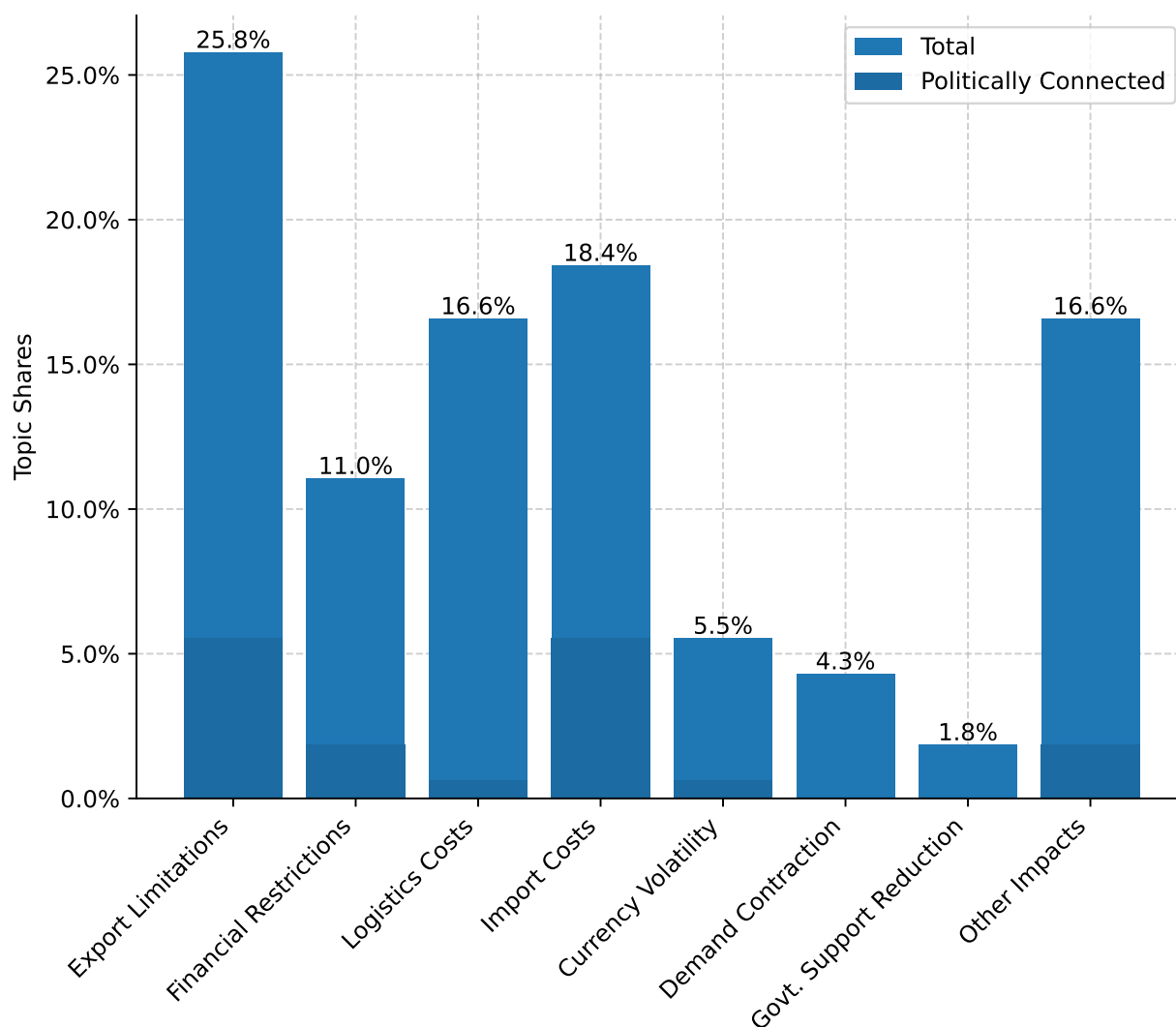
Figure 7. *Notes:* This figure illustrates the proportion of each topic category discussed during firms' meetings when the topic of "sanctions" was raised. The hashed area shows the share of mentions of "sanctions" that are from politically connected firms. The definition of connected firms is taken as the most extensive definition from Draca et al. (2023).

study's evidence shows that for every $1 of loss inflicted on connected firms, a considerable externality of $5 is imposed on non-connected firms.

Further, firms with higher sanctions exposure experienced a pronounced reduction in stock market value in response to unexpected sanction events. This investigation extends to explore the effects of sanctions on firms' investments and sales, establishing that sanctions can induce a considerable negative impact on the overall economic performance of firms.

There are a few important points to consider regarding this analysis. Firstly, it's worth noting that the data only pertains to listed firms. This means that the overall impact on a national level may be more negative if unlisted firms, such as farmers, were also negatively affected on average.
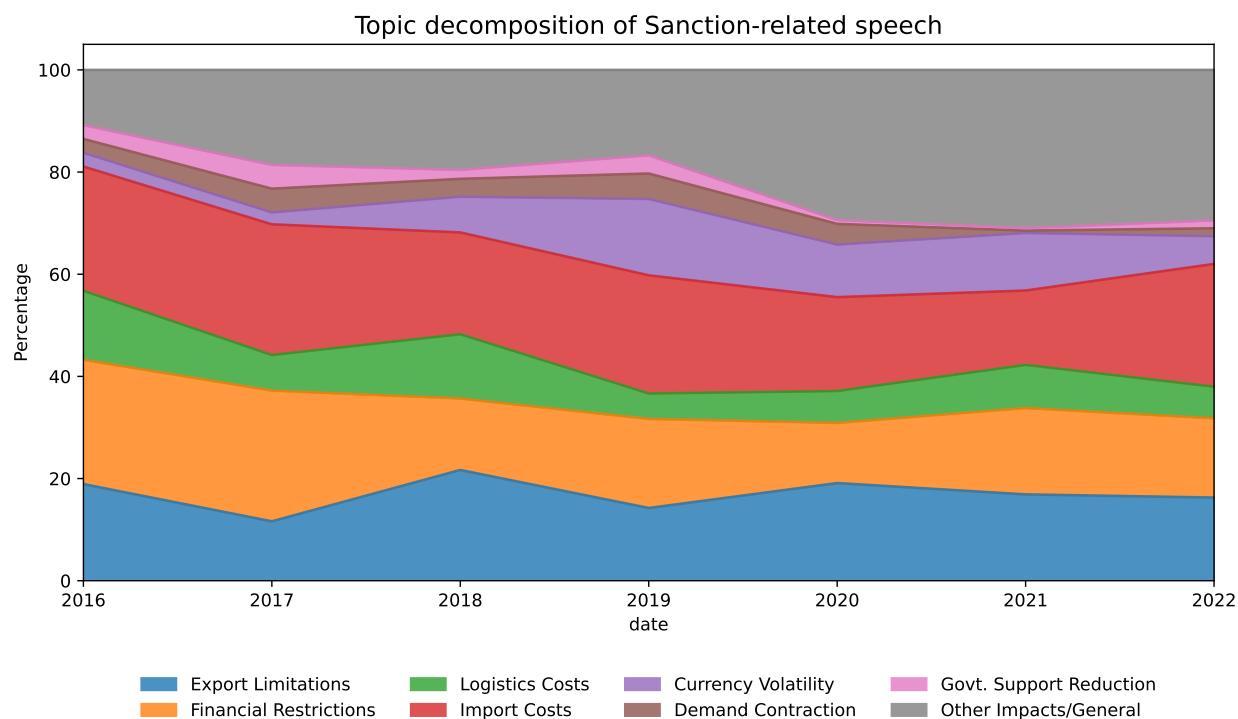
Figure 8. *Notes:* This figure displays the proportion of each of the eight topics within the discussions surrounding sanctions during meetings of Iranian firms over time.

Alternatively, the impact may be less negative if the sanctions led to new businesses entering more exposed sectors.

Second, this paper employs a comparative analysis between firms more exposed to sanctions versus those less exposed within the Iranian economy. However, it's crucial to acknowledge that sanctions will likely exert substantial influence across the entire economy, not just on the firms directly exposed. Consequently, while the differential impact on more and less exposed firms can be discerned through this analysis, the total effect of sanctions on Iranian firms and the broader economy, taking into account these spillover and GE effects, is not quantified in this study.

Third, it is worth mentioning that this study does not directly delve into the effect of sanctions on households. While the focus is primarily on firms, the downstream effects on households may be substantial and warrant further exploration. The consequences of sanctions on household income, consumption patterns, and living standards constitute an important area for future research.

In conclusion, this paper contributes to the literature on the economics of sanctions, their political effectiveness, and the emerging field of text-as-data in economics. The findings underscore that while sanctions do impair firms in the recipient nation, they inadequately target politically connected entities. This research, hence, underscores the pressing need for more focused and careful considerations in the application of sanctions as a foreign policy tool, given the extensive,

severe, but indiscriminate economic consequences they can impose on firms and, by extension, economies of the target countries.

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APPENDIX A. VARIABLE CONSTRUCTION

The firm-level data and sales information used in this analysis are obtained from the income statement, cash flow statement, and balance sheet published on the official Codal outlet. I calculate the change in sales, represented as $\Delta Sales_{i,t}/Sales_{i,t-1}$, by determining the difference in sales between two periods and dividing the result by the sales from the previous year. Subsequently, I perform winsorization on this variable at the 1st and 99th percentile.

The capital expenditure measure utilized in this study, denoted as $I_{i,t}/K_{i,t-1}$, is recursively determined using a perpetual inventory approach. This is necessitated due to the financial statements presenting capital values at book value rather than replacement value. This method draws upon established methodologies, such as the one demonstrated by Stein and Stone (2013). The computation begins with the initial observation for each company spell available within the dataset. More specifically, the capital expenditure measure for $t = 2$ is calculated as $\frac{I_{i,2}}{PPE_{i,1}}$. For instances where $t > 2$, the measure is computed as $\frac{I_{i,t}}{K_{i,t-1}}$. The denominator for $t > 2$ is calculated recursively as $K_{i,t} = \frac{\pi_t^K}{\pi_{t-1}^K}(1-\delta)K_{i,t-1} + I_{i,t}$ where $I_{i,t}$ is capital expenditure (CapEx), PPE is the net value of property, plant and equipment, and $\frac{\pi_t^K}{\pi_{t-1}^K}$ is the ratio of this period's to last period's Producer Price Index, and δ is depreciation (set at 10%). I winsorize the variable at the first and last percentile.

APPENDIX B. AN ALTERNATIVE APPROACH

In this section, instead of utilizing tf-idf vectorization, I solely focus on the occurrences of the term "sanction". More precisely, I decompose each meeting document for firm i in time t into a list of words, and then count the number of occurrences of "sanction" and divide by the total number of words in the transcript:

$$SanctionExposure_{i,t} = \frac{1}{B_{i,t}} \sum_{b=1}^{B_{i,t}} 1[b = Sanction]$$

In the above equation, b is a word in a document from firm i at time t, and $B_{i,t}$ is the total number of words in that document.

To differentiate between these first- and second-moment impacts, I employ the same method outlined in Hassan et al. (2019) by creating measures of sanctions risk and sentiment by analyzing word counts in relation to synonyms for risk or uncertainty and positive and negative tone words, respectively.

$$SanctionRisk_{i,t} = \frac{1}{B_{i,t}} \sum_{b=1}^{B_{i,t}} \{1[b = Sanction] \times 1[|b - r| < 10]\}$$

$$SanctionSentiment_{i,t} = \frac{1}{B_{i,t}} \sum_{b=1}^{B_{i,t}} \{1[b = Sanction] \times \sum_{c=b-10}^{b+10} S(c)\}$$

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Both approaches produce similar results, despite utilizing different bigrams as a key component for analyzing texts related to sanctions.

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