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ABSTRACT

Employment Effects of Economic Sanctions in Iran*

This paper investigates the effect of economic sanctions on employment. We exploit the imposition of a series of unexpected and unprecedented international economic sanctions on Iran in 2012 and estimate the short-run effects of the change in import exposure on manufacturing employment at the industry level. Our estimates indicate that the sanctions led to an overall decline in the manufacturing employment growth rate by 16.4 percentage points. However, we uncover significant asymmetric effects across industries with different ex-ante import shares. Interestingly, the effects are mostly driven by labor-intensive industries and industries that heavily depend on imported inputs. This suggests that the overall negative impact of the sanctions on employment might be largely due to the decline in productivity experienced by industries with a high propensity to import inputs from abroad.

JEL Classification: F16, F51, J21

Keywords: economic sanctions, employment, import exposure, labor reallocation

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1. Introduction

Economic sanctions have become a popular foreign policy tool in international politics over the last decades. While sanctions are designed as a non-violent instrument to persuade governments to comply with the interests of the imposing countries (often viewed as a more humane option than military intervention), they have in fact the aim of changing the policy of the target country by inflicting severe economic damages.

The study of the effects of economic sanctions has attracted considerable attention among economists and political scientists in recent years.¹ Prior studies have mainly focused on the effects on human rights (Gutmann et al., 2020; Peksen, 2009; Wood, 2008), government and political leader stability (Allen, 2008; Marinov, 2005; McLean and Radtke, 2018), the level of democracy (Adam and Tsarsitalidou, 2019; Dizaji and van Bergeijk, 2013; Peksen and Drury, 2010), and on conflict intensity (Hultman and Peksen, 2017).

Several papers have looked at the economic effects of sanctions, documenting significant effects on GDP growth (Hufbauer et al., 2009; Neuenkirch and Neumeier, 2015), international trade (Afesorghor, 2019; Haidar, 2017), foreign direct investment (Mirkina, 2018), banking crises (Hatipoglu and Peksen, 2018), firms' performance (Ahn and Ludema, 2020; Crozet et al., 2021) as well as on income inequality and poverty (Afesorghor and Mahadevan, 2016; Neuenkirch and Neumeier, 2016), and on corruption and crime (Andreas, 2005).

Surprisingly, however, the labor market impact of economic sanctions has been so far overlooked.² This paper aims at filling this gap in the literature by providing first evidence on the impact that economic sanctions have on the labor market. More specifically, we exploit

¹ See Felbermayr et al. (2021) for a recent review of the theoretical and empirical literature on sanctions.

² To the best of our knowledge, the only study that indirectly explores the labor market impact of sanctions is Ahn and Ludema (2020), who focus on the effects of the targeted sanctions imposed against Russia in 2014 on firms' financial performance. They use the number of employees, along with operating revenues and asset values, as a proxy to measure firms' financial performance.

the imposition of a series of unexpected and unprecedented international sanctions on the Iranian economy in 2012 as a natural experiment to study the short-run effects of economic sanctions on employment.

While there were UN sanctions already in place since 2006 that mainly targeted Iran's nuclear program, the new sanctions that were imposed in 2012 aimed to bring Iran's economy towards a financial and trade autarky. As an unprecedented step, the European Union froze Iran's central bank's assets and denied Iranian financial sector's access to SWIFT messaging service in March 2012, thus cutting off Iran's access to a secure international payment system. Swift had never cut off a country prior to this incident in near 40-year history (Financial Times, 2012).³ This was in addition to the oil embargo imposed in 2012. These sanctions are some of the most comprehensive international sanctions regime ever imposed on a country.

The EU sanctions followed a number of US sanctions that were imposed in late 2011 and aimed to cut Iranian financial sector's connections to the US and the world financial system, forcing foreign banks and companies to choose between doing business with Iran or the US. The sanctions sought to reduce Iranian export earnings as well as restricting the country's access to its foreign reserves mainly to the purchase of humanitarian goods.

Since the sanctions on Iran were substantially eased after 3 years - with the Joint Comprehensive Plan of Action (JCPOA) signed in July 2015 - and the Iranian economy had been open to international trade for a long time before the sanctions, this study ultimately investigates the short-run effects of moving from a trading equilibrium to near-autarky.

The main objective of this paper is to investigate the employment consequences of the sanctions for the manufacturing sector. The manufacturing sector accounted for 19% of Iran's non-oil GDP in 2011 and comprised 92% of total imports in 2011. The demand for manufacturing imports is mainly for capital and intermediate goods that are

³ This was one of the first sanctions Iran asked to be lifted (The Economist, 2014).

complementary to domestic production. Manufacturing employment represented 16% of total employment in Iran in 2011 (SCI, 2011).

Our empirical analysis builds on Acemoglu et al., 2016 and estimates the direct impact of economic sanctions on manufacturing employment at the industry level. We exploit the sanctions-induced change in the industry-level import exposure, fitting the model for stacked first differences covering the subperiods 2008–2010 and 2012–2014. We then analyze how the effect of the change in import exposure varies across industries with different share of import in the year before the sanctions.

The exposure to the trade shock varies across manufacturing industries. The impact on employment, however, depends on how each industry responds to trade restrictions. In some industries, the sanctions could have re-routed or deflected imports (exports) from (to) other markets where informal financial channels are still available and enforcing compliance with sanctions is more difficult. In industries where deflection is costly, domestic production may replace imports. In the case of imported inputs, this could lead to input autarky or ceasing production completely. We, therefore, exploit the heterogeneous responses of industries to the trade shock and estimate their relative short-run employment loss/gain.

We find that the sanctions asymmetrically affect industries with different level of exposure to international trade. Specifically, we find that an increase in import competition positively affects employment for relatively open industries (with high import share as of 2011), but this effect turns negative for relatively closed industries (with low import share as 2011). This suggests that the sanctions lead to significant reallocation effects in employment across industries with different degrees of openness to trade.

These findings are robust to a placebo test as well as to a battery of checks, such as: i) controlling for potential industry confounding factors and for a set of industry-level start-of-period controls to capture exposure to technical change; ii) accounting for the change in export exposure to capture the total effect of the sanctions; iii) using alternative pre-sanctions

years to define the import share; iv) dropping industries in the top and bottom 5% of the overall import share distribution.

We also explore whether the employment effects are heterogeneous by the extent to which industries use production labor and capital as well as by their degree of dependence on imported inputs. Our heterogeneity analysis reveals that the estimated effects are mainly driven by labor-intensive industries as opposed to capital-intensive industries.

Importantly, we also find that the effects are mainly observed in industries that heavily rely on imported inputs in the production process, therefore indicating that the manufacturing sector in Iran is characterized by a strong complementarity between imported inputs and labor. This suggests that the sanctions might have affected employment mainly through a decline in productivity within industries that use imported inputs intensively. This result is in line with (Etkes and Zimring, 2015), who show that the overall welfare loss of the Gaza blockade in 2007-2010 was largely due to the decline in productivity experienced by import-competing industries.

Finally, turning to the economic magnitude of our results, we compute the implied changes in employment in the spirit of Acemoglu et al. (2016) and Feenstra et al. (2019). Our calculations suggest that absent the sanctions Iranian manufacturing employment would have experienced almost 18,000 fewer job losses. This implies that, overall, the sanctions had a negative effect on manufacturing employment. Precisely, we estimate that the sanctions led to a reduction in the employment growth rate by 16.4 percentage points. However, we show that this effect is mostly attributable to relatively closed industries, i.e., industries with low import share in the year before the sanctions.

This study contributes to two other strands of wider research. First, we add to the vast literature on the effects of trade shocks. Previous studies focus on the “China Shock” (Autor et al., 2013; Acemoglu et al., 2016; Autor et al., 2016; Pierce and Schott, 2016) - mainly

looking at the US labor market⁴ - and show that rising import penetration have detrimental effects on employment, especially in the manufacturing sector. Our contribution to this strand of research is twofold. On the one hand, Iran is a net (non-oil) importer country in manufacturing. Thus, differently from most of previous studies, who focused on the effects of surging import penetration, we can instead address labor market dynamics following a reduction in import competition.

On the other hand, the case of Iran provides a unique setting to revisit the impact of trade shocks on employment through the lens of a developing economy. While there is evidence that employment adjustment to trade shocks is mainly between import-competing industries and exporting ones (Feenstra et al., 2019), this margin of adjustment, however, is likely to be less effective when the country largely depends on imported inputs, as it is the case of less developed economies such as Iran.⁵ Furthermore, focusing on the effect of sanctions is interesting because reallocation effects from import-competing to exporting industries is even more restrained as both have limited access to world markets.

Second, our analysis complements the literature on the impact of autarky (Bernhofen and Brown, 2004; Irwin, 2005; Coulibaly, 2009; Etkes and Zimring, 2015; Esposito, 2020) along two dimensions. First, by providing evidence from one of the rare cases of near-autarky in modern history. Previous episode of autarky that have been investigated in the literature refers to the Jeffersonian trade embargo in 1807 (Irwin, 2005; Esposito, 2020) or the case of Japan in 1860 (Bernhofen and Brown, 2004). Thus, in the spirit of Etkes and Zimring (2015), we advance the literature on the effects of autarky by looking at how such an event affects the economy in the age of globalization. Second, while the extant research mainly focused on the

⁴ A few exceptions are Balsvik et al. (2015) and Dauth et al. (2014), who focused on Norway and Germany, respectively.

⁵ McCaig and Pavcnik (2018), for instance, examine the labor reallocation effects of a positive export shock in Vietnam and find that the reallocation of labor from the informal to the formal sector provides an important margin of adjustment to exporting.

welfare effects of autarky, this paper investigates its employment consequences.

The remainder of the paper is organized as follows. Section 2 presents some theoretical considerations on why and how the imposition of sanctions could affect employment and outlines the main research questions. Section 3 provides an institutional background for Iran and a timeline of the sanctions. Section 4 introduces our estimation strategy, describes the data used in the empirical analysis and presents some descriptive statistics. Section 5 discusses our main results. Section 6 provides some concluding remarks.

2. Theoretical Arguments and Hypotheses

The existing empirical evidence shows that economic sanctions have significant adverse effects on the target states' economic development (Hufbauer et al., 2009; Neuenkirch and Neumeier, 2015).

From a theoretical viewpoint, there are different mechanisms through which the imposition of economic sanctions can negatively impact the economy of the target country and consequently its labor market. First, economic sanctions can lead to a sharp contraction in imports and exports. Hufbauer et al. (2009) show that the volume of bilateral trade between the imposing countries and the target state drops dramatically. The contraction in both import and export can negatively impact on the labor market of the sanctioned economy by causing not only a drop in employment in import - competing and exporting industries, but also a reallocation of labor across different industries. (Etkes and Zimring, 2015), for instance, document that the adjustment of production in Gaza during the blockade occurred mainly through a large reallocation of workers away from manufacturing and into services.

Second, sanctions can cause a slump in international capital flows due to the withdrawal of foreign direct investments (Mirkina, 2018). This can happen even in the absence of explicit imposition of trade embargoes or suspensions of international aid and capital flows.

According to Whang (2011), as economic sanctions are often used symbolically to stigmatize political regimes, the isolation of the sanctioned economy within the international community is a result of the loss of reputation that discourages foreign firms from providing investments. The reduction in foreign direct investments may spill over into the labor market. Kosova (2010), for instance, find that while the presence of foreign firms might crowd out domestic production in the short run, this seems to be associated with an increase in the growth and survival of domestic firms in the long run (technology spillover).

Third, as economic sanctions often have the objective to overthrow the target's political regime, by increasing political instability, they can generate uncertainty on the future of the political system, thus producing harmful effects on the country's trade and financial relations, on its domestic and foreign direct investments and therefore on its labor market. The existing empirical evidence suggests that economic sanctions are indeed associated with increased political instability and societal conflicts (Adam and Tsarsitalidou, 2019; Allen, 2008; Hultman and Peksen, 2017; Marinov, 2005; McLean and Radtke, 2018; Peksen and Drury, 2010), which in turn are estimated to have adverse effects on both investment and economic growth (Alesina et al., 1996; Alesina and Perotti, 1996; Ray and Esteban, 2017). By the same token, sanctions may adversely affect the access to the international credit markets and the relative credit costs as investors might perceive the higher political instability as a signal of the increased risk of insolvency.

Fourth, sanctions are also followed by an increase in the shadow economy as both individuals and governments may promote illegal economic activities. As Andreas (2005) put it: "sanctions can unintentionally contribute to the criminalization of the state, economy, and civil society of both the targeted country and its immediate neighbors, fostering a symbiosis between political leaders, organized crime, and transnational smuggling networks. This symbiosis, in turn, can persist beyond the lifting of sanctions, contributing to corruption and crime and undermining the rule of law". The criminalizing consequences of sanctions

cause an increase in transaction costs and lead to a more unproductive use of the available resources. This is especially true in the labor market as workers can switch from formal to informal sectors based on their expected employment prospects. Previous studies show that trade shocks are associated with changes in informal employment (Goldberg and Pavcnik, 2003; Dix-Carneiro and Kovak, 2017; McCaig and Pavcnik, 2018).

The size of the impact of economic sanctions on the target's economy and labor market may depend on a variety of factors. On the one hand, it may depend on the severity of the sanctions. UN sanctions, for example, can differ for their level of severity, ranging from restrictions on arms and other military hardware to restrictions on trade in primary commodities and the freezing of public and/or private assets to embargoes on all or most economic activity between UN member states and the target.⁶ Similarly, previous US sanctions vary from retracting foreign aid and banning loans, grants or credits to restricting trade, finance and investment to imposing embargoes on all economic activities between the US and the sanctioned country.

On the other hand, the size of the effect changes whether it relates to unilateral sanctions versus multilateral ones. The former should, in principle, have smaller effects than the latter as the target country can potentially circumvent the sanctions by switching to alternative trading partners. On the contrary, when sanctions are multilateral - as in the case on UN sanctions - the target country cannot avoid losing access to goods or markets by increasing its trade with other partners. Neuenkirch and Neumeier (2015), indeed, find that UN sanctions are associated with a decrease in the sanctioned country's GDP per capita growth rate by more than 2 percentage points, while US sanctions are associated with a drop by nearly 1 percentage point.

How should we expect the sanctions to impact on Iran's manufacturing employment? As

⁶ We refer to Neuenkirch and Neumeier (2015) for an overview of sanction categories.

Iran is a net importer in the manufacturing sector, the sanctions might be expected to mitigate the negative effects of import competition (Autor et al., 2013; Acemoglu et al., 2016; Autor et al., 2016; Pierce and Schott, 2016; Feenstra et al., 2019). It follows that a reduction in import competition - as the one caused by the sanctions - should be expected to exert a positive impact on employment at least in import-competing industries. As import deflection might be costly under the imposition of sanctions, domestic production could replace imports. Thus, our *first hypothesis* is that the sanctions would lead to the reallocation of labor from relatively closed industries into industries with high degree of exposure to import competition.

However, given the severity and multilateral nature of the sanctions and the fact that Iran's manufacturing sector largely depends on imported inputs (as it is often the case in the context of developing countries), it is very unlikely that domestic production could entirely replace imports in the short run. As a result, our prediction - in line with the evidence provided by Etkes and Zimring (2015) for the case of the Gaza blockade in 2007–2010 - is that the sanctions would necessarily entail a decline in productivity. As a matter of fact, this could even lead to the interruption of the production process in industries that intensively rely on imported inputs.

Therefore, based on all the arguments above, our *second hypothesis* is that the sanctions should have detrimental effects on Iran's overall manufacturing employment.

3. Institutional Background

The history of the current episode of sanctions against Iran which are of interest in this study, goes back to the referral of Iran to the UN Security Council over Iran's disputed nuclear energy program in 2006 by International Atomic Energy Agency (see Samore, 2015).⁷ During

⁷ U.S. unilateral sanctions against Iran, however, began in 1979 after Iran revolution and following the hostage crisis.

2006 to 2010 the UN Security Council passed several resolutions against Iran's nuclear and military program which were consequently followed by the European Union and the United States in late 2011 and 2012.

The disputes over Iran's nuclear program continued to escalate. A new regime of sanctions that were imposed on Iran in 2012, however, were unprecedented in terms of its tools, severity, and its scope and non-discriminatory nature. While the previous sanctions were limited in scope and often targeted designated individual or companies involved in the nuclear or military program, the new sanctions targeted Iran's economy.

The European Union imposed oil embargo in January 2012 which banned import, purchase or transport of Iranian crude oil, natural gas and petrochemical products, and prohibited provision of related financing, insurance or reinsurance.⁸ In addition, the EU froze Iran's central bank's assets and denied Iranian financial sector's access to SWIFT messaging service, as an unprecedented step, in March 2012.⁹ This was to cripple Iranian financial sector's ability, including Iran's central bank, to conduct international business. This was the first time that the Society for Worldwide Interbank Telecommunication (SWIFT), a consortium based in Belgium, denied the entire financial system of a country's access to its vital service (Gladstone and Castlel, 2012).

The EU sanctions followed a set of U.S. unilateral sanctions in November 2011 that designated Iranian financial sector as jurisdiction of "primary money laundering concern" under Section 311 of the USA PATRIOT Act for the first time in the history. In December 2011 President Obama signed the National Defense Authorization Act for fiscal year 2012 which imposed severe unilateral sanctions against the Central Bank of Iran. The act prohibited any activity of foreign financial institutions that conduct or facilitate any significant financial transaction with the Central Bank of Iran or any other Iranian financial institutions. The same

⁸ Council Decision 2012/35/CFSP and 2012/635/CFSP.

⁹ Council Decision 2012/635/CFSP.

restriction applies to the foreign central banks if they engage “in financial transactions for the sale or purchase of petroleum or petroleum products to or from Iran”, effectively blocking Iran’s oil exports (OFAC, 2012).

These measures (especially in reaction to its scale and severity) were completely unexpected. The governor of Iran’s Central Bank, in fact, rejected the possibility of any sanctions against the Central Bank by the United States and the EU in August and October 2011, and on several other occasions, arguing that such an act would be illegal and against all the principles and that the sanctioning countries “will be ridiculed by the world” (IRNA, 2011a, b).

As a response to the sanctions imposed on its oil exports, Iran threatened to block the Strait of Hormuz in Persian Gulf. The unexpected decision to cut Iran’s oil exports was made at the time when the oil price stayed above \$100 dollars per barrel for the entire 2011.¹⁰ The Iranian Rial depreciated by around 40% in January against the dollar. The national currency depreciated again in October 2012 as the sanctions intensified and the European Union boycott of Iranian oil exports came into effect.

These sanctions coupled with “secondary sanctions” and other extraterritorial measures that the sanctioning countries undertook in order to discourage companies and individuals of third countries to do business with Iran (Stoll et al., 2020). Therefore, the effect of enforcement went beyond the sanctioning countries. The combination of sanctions and extraterritorial enforcement practice created a major hurdle in processing international payments and curbed other bilateral economic flows (van Bergeijk, 2015). For instance, BNP Paribas, France’s largest bank, agreed to an \$8.9 billion settlement with US prosecutors over allegations of processing financial transactions for countries subject to U.S. economic

¹⁰ We refer to Samore (2015) for a detailed description and timeline of the sanctions imposed on Iran by different entities over the course of the period considered here.

sanctions, including Iran (Department of Justice, 2014).

The international sanctions caused a large drop in economic activity in Iran. The non-oil real GDP contracted by 3.1% and 1.1% in 2012 and 2013, respectively, compared to a 3.2% expansion in 2011 (IMF, 2014). Iran's oil exports declined drastically as the result of the EU and the U.S oil embargo from around 2.1 million barrels per day in 2011 to 1.4 and 1.1 million barrels per day in 2012 and 2013, respectively. Despite the fall in Iran's oil exports, the current account stayed positive over the post-sanctions period. The current account declined from 10.4% of GDP in 2011 to an average of 4.7% of GDP over the post-sanctions period. Iran built up massive foreign reserves, which amounted to \$104 billion in 2012, due to the high crude oil price. However, the access to the foreign reserves were limited during the post-sanctions period because of the financial sanctions that were in place.¹¹

Figure 1 illustrates aggregate import and export for Iran between 2008 and 2014. The figure also shows trade flows between Iran and two groups of destinations, sanctioning and non-sanctioning countries.¹² The left panel (a) shows that aggregate import remained steady before 2011 and then decreased after the imposition of new regime of sanctions, imposed in 2012, by 18% between 2011 and 2013.

[Figure 1 here]

There are stark differences in how imports from sanctioning countries and non-sanctioning countries respond to the sanctions. While import from sanctioning countries declined sharply after the sanctions (a 31% decline in import from sanctioning countries between 2011 and 2013), import form non-sanctioning countries increased after an initial fall in 2012.

A similar pattern is observed for non-oil export. The right panel (b) in Figure 1 shows that

¹¹ Data from the IMF regional economic outlook: Middle East and central Asia dataset.

¹² Sanctioning countries include the European Union, United States, and countries that are deemed to enforce sanctions against Iran more aggressively, namely Canada, Japan, South Korea, Australia, Mexico, and Singapore.

total export initially tumbled by around 7% between 2011 and 2013. This was due to a sharp decline in export to sanctioning countries. While export to non-sanctioning countries increased by 3.8%, partly because of a substantial depreciation in the value of Iranian Rials, export to sanctioning countries contracted by 71%. It is evident from the figure that the export to sanctioning economies constitutes a small share of total export. Therefore, such a large drop in export to these countries did not reflect on total export. That is the reason why in this study we mainly focus on the impact of import exposure.

The observed trade patterns led to a reduction in the current account surplus from 11% of GDP in 2011 to 4% of GDP in 2014 (IMF, 2014). Although our empirical strategy does not directly exploit this dichotomy, the observed changes in the pattern of trade flows to/from the two groups of sanctioning and non-sanctioning countries confirm the effectiveness of sanctions in restraining trade flows.

Figure 2 shows the trend in total manufacturing employment and the evolution of employment by the industry import share in Iran between 2008 and 2014. The high (low) import share industries are defined as those above (below) the median in the distribution of import share in 2011, i.e., the year before the sanctions.¹³ As the figure suggests, the low import share industries employ a larger share of manufacturing workers in Iran.

[Figure 2 here]

The figure reveals an initial drop in manufacturing employment at the outset of sanctions in 2012, followed by an increase during the post-sanctions period.

4. Empirical Approach

We build on empirical strategy used in Acemoglu et al. (2016) and estimate the direct impact of import competition on manufacturing employment using the following specification:

¹³ We refer to Section 4 for details on the data source.

$$\Delta \ln (L_{j\tau}) = \alpha_{\tau} + \beta_1 \Delta IP_{j\tau} + \beta_2 HIS_{j2011} + \beta_3 HIS_{j2011} \times \Delta IP_{j\tau} + \eta X_{j0} + e_{j\tau} \quad (1)$$

where $\Delta \ln (L_{j\tau})$ is 100 times the annual log change in employment in industry j over period τ ; $\Delta IP_{j\tau}$ is 100 times the annual change in import exposure, defined below. HIS_{j2011} is a dummy variable indicating whether industry j 's import share in the year before the sanctions (i.e., 2011) is above the median, and zero otherwise.

We measure import share as import in 2011 divided by initial industry real output, $\frac{M_{j2011}}{Y_{j2008}}$. The interaction term, i.e., our main variable of interest, serves to explore how the effect of the change in import exposure induced by the sanctions varies across industries with import share above or below the median. This allows for a direct test of our first theoretical hypothesis, discussed in Section 2, that the sanctions would lead to the reallocation of employment from industries that are relatively closed (i.e., industries with import share below median) into industries that are relatively open to international trade (i.e., industries with import share above median). X_{j0} is a vector of industry-specific start-of-period controls (specified later); α_{τ} is a period-specific constant; and $e_{j\tau}$ is the error term.

We fit this equation for stacked first differences covering the two subperiods 2008–2010 and 2012–2014. The subperiod definition follows the timing of the imposition of the most severe, unexpected, and unprecedented sanctions in 2012. All variables in change are annualized, the nominal variables are deflated by the producer price index (PPI) and the import and export price indexes, and the control variables in X_{j0} are each normalized with mean zero so that α_{τ} in equation (1) reflects the change in employment conditional only on the import and export exposure variables. Regression estimates are weighted by the start-of-period industry employment, and standard errors are clustered at the three-digit industry level.

The change in the industry-level import exposure is defined as:

$$\Delta IP_{j\tau} = \frac{\Delta M_{j\tau}}{Y_{j2008} + M_{j2008} - X_{j2008}}$$

where for industry j , $\Delta M_{j\tau}$ is the change in imports over the period τ and $Y_{j2008} + M_{j2008} - X_{j2008}$ is the initial domestic absorption in Iran, which is measured as industry real output, Y_{j2008} , plus industry net imports, $M_{j2008} - X_{j2008}$. To capture the total effect of the sanctions, following Feenstra et al. (2019), in the robustness analysis we also include the industry's export exposure, which is defined as:

$$\Delta EP_{j\tau} = \frac{\Delta M_{j\tau}}{Y_{j2008}}$$

where $\Delta EP_{j\tau}$ is the change in exports in industry j over period τ .

Data on trade for 2008–2014 are Iran's Customs Administration database obtained from the Statistical Center of Iran (SCI).¹⁴ The dataset includes import and export in local currency for six-digit HS product level. The data is converted to four-digit International Standard Industrial Classification (ISIC, Rev 3.1) by the SCI. We then aggregate and merged this data into 116 ISIC industries to match the trade data to the employment data.

Our employment data is from the annual Survey of Manufacturing Firms with more than 10 workers of the SCI. All nominal values are deflated to their 2011 equivalent using the Import and Export Price indexes, for import and export amounts, respectively, and the Producer Price Index, for all the other variables.

We construct a panel of 116 (non-oil) manufacturing industries over the period 2008 to 2014. Summary statistics of the main variables used in the analysis are reported in

¹⁴ All the data are annual and collected according to Iranian calendar which begins within a day of March 21 of the Gregorian calendar. The analysis is carried out based on the Iranian calendar and the specific Gregorian date, for instance 2012, refers to the period 20 March 2012–20 March 2013 in this study. SCI is Iran's official statistics authority. The data collected by the SCI has been used extensively by the international organizations such as the IMF and the World Bank who liaise with the SCI and provide methodological advice and support to its staffs and are expected to report any statistical issues in their country reports (IMF, 2014; Guillaume et al., 2011). The data from the SCI has been also frequently used in scientific articles published in scholarly peer reviewed journals (see, for instance, Barkhordar and Saboohi, 2013; Gharehgozli, 2017; Zamani et al., 2018).

Table 1. The (non-oil) manufacturing sector represented 16% of total employment and 19% of non-oil GDP in 2011. The service sector is the largest sector in Iran, representing 48% of employment and 44% of GDP. In the top panel, the average manufacturing employment contracted by 1.02 log points per year between 2008 and 2010, that is the pre-sanctions period, while expanded by 4.04 log points per year in the post-sanctions period between 2012 and 2014. The average import exposure increased by 1.48 percentage points per year between 2008 and 2010 and fell sharply by 3.46 percentage points per year after the sanctions. In contrast, the average export exposure shows very little variation over the two subperiods, which justifies our main interest in import exposure.

[Table 1 here]

The bottom two panels in Table 1 report the pre- and post-sanctions changes in these variables by the industry import share. The high import share industries are defined as those above the median in the distribution of import share in 2011, i.e., the year before the sanctions. The overall pattern observed in the top panel is more pronounced in the high import share industries. The average import exposure decreased by 0.12 percentage points per year between 2008 and 2010 in the low import share industries. In contrast, the average import exposure increased by 6.09 percentage points per year between 2008 and 2010 in the high import share industries, which consequently, as was expected, decreased drastically by 9.27 percentage points per year post-sanctions.

Table 2 replicates similar summary statistics as in Table 1 for the six biggest industries by employment in Iran.¹⁵ Most of the top industries experienced contraction in import exposure during the post-sanctions period. Industries 1711 (i.e., preparation and spinning of textile fibers and weaving of textiles) and 2520 (i.e., manufacture of plastic products) are the

¹⁵ Table A.1 in the Appendix reports the same summary statistics for all industries in our sample, while Table A.2 describes the main activity associated with each industry.

exceptions. Import exposure was contracting fast in these two industries during the pre-sanctions period, perhaps because of Iran's investment in domestic production of plastics and petrochemical products, while the contraction rate dropped post-sanctions.

[Table 2 here]

5. Results

Table 3 presents our main results for the model specified in equation (1). Column 1 presents the results when only the period dummies are included in the model. The estimated coefficients indicate that while the pre-sanctions period is associated with a decrease in employment (though not statistically significant), the years following the sanctions are associated with a significant increase in employment.

[Table 3 here]

In column 2 we include the annual change in import exposure and test employment effect of import competition as in the main specification estimated in Acemoglu et al. (2016). Results suggest that overall there is no significant effect of import exposure on employment.

In column 3 we add the interaction of the annual change in import exposure with the industry import share (as a continuous variable) to verify if the employment effects of the sanctions-induced change in import exposure vary across industries with different degree of openness to international trade. Results show that the effect of an increase in import exposure decreases with the import share.

Column 4 reports the results for our baseline specification, where we now employ the dichotomous version of import share. The coefficient associated with the interaction term, our main parameter of interest, captures whether the effect on employment of an increase in import exposure varies for industries with import share above the median as opposed to

industries below the median.¹⁶ The estimates in column 4 indicate that a 1 percentage point rise in industry import exposure increases industry employment by 0.21 percentage points for industries with import share below the median, while it decreases employment by 0.06 (=0.209-0.269) percentage points for industries with import share above the median - although for the latter the estimated effect is not significant at conventional levels (p-value=0.154). This is consistent with our first hypothesis (outlined in Section 2) that the sanctions asymmetrically affect industries with different level of exposure to international trade, thus leading to reallocation effects in employment.

We perform a battery of tests to check the robustness of these results. To begin, in Table 4 we probe the robustness of the results in Table 3 by controlling for industry-level export exposure and for potential industry confounding factors. First, in column 1 we add the industry export exposure to capture the total effect of the sanctions. Second, in column 2, we incorporate a set of dummies for 10 one-digit sectors. This allows to account for differential trends across the 10 one-digit sectors, therefore purging the effect of an industry's trade exposure from common trends within the one-digit sectors and leveraging variation in import growth across industries that are relatively similar in terms of skill intensities.

[Table 4 here]

Third, in column 3, we include a set of industry-level start-of-period controls to measure the intensity of the use of production labor, namely the share of production workers in total employment and the log of the average wage. The inclusion of such variables is meant to capture the extent to which industries are exposed to technical change. Finally, in column 4, we add both one-digit sector dummies and production controls. Reassuringly, the estimates in columns 1-4 of Table 4 are very similar to those reported in column 4 of Table 3.

¹⁶ While the coefficient associated to Δ *Import Exposure* reflects the effect for industries below the median, the sum of the coefficients for Δ *Import Exposure* and its interaction with the dummy *HIS*₂₀₁₁ reveals the effect for industries above the median.

As a second robustness check, in Table 5 we test if the results depend on our definition of industry import share based on year 2011. Specifically, we replicate the estimates in columns 3-4 of Table 3 using two alternative pre-sanction years to construct the import share variables, namely 2009 (in columns 1-2) and 2010 (in columns 3-4). The estimates in Table 5 are qualitatively similar to those obtained using 2011 as base year, indicating that our main results are not driven by the specific year we pick to define the import share.

[Table 5 here]

Third, in Table 6 we conduct a placebo test in which we replicate the specifications 1 to 4 in Table 3 but using the subperiods 2008–2009 and 2010–2011. In other words, we now fit equation 1 for stacked first differences covering two pre-sanctions subperiods. As sanctions were imposed in 2012, we should expect to find no effects on employment of a change in import exposure between these two subperiods. Reading across the results in Table 6, we show evidence consistent with this prediction.

[Table 6 here]

Finally, in Table 7 we further challenge the robustness of our main findings by trimming the sample to verify that results are not driven by industries that belong to the top/bottom 5% of the import share distribution. Reading the results across columns 1 to 3 of Table 7, we find that the estimates are remarkably similar in magnitude to the baseline estimates presented in Table 3.

[Table 7 here]

5.1 Heterogeneous Effects

To assess the heterogeneity in the impact of trade exposure on employment, in Table 8 we replicate the analysis by quartile of industry import share as for 2011. The estimates in column 1 indicate that the employment effect of the change in import exposure induced by the

sanctions is highly asymmetric when moving from the 1st to the 4th quartile of the industry import share distribution, with the effect being positive for the former and negative for the latter. This pattern is confirmed in columns 2 to 4 in which we gradually augment our specification to control for all confounding factors discussed above.¹⁷

[Table 8 here]

Figure 3 provides a visual inspection of the estimated effect (based on the estimates in column 4 of Table 8) of import exposure on employment for industries belonging to each quartile of the import share distribution. A 1 percentage point increase in import exposure is significantly associated with an increase in employment by around 0.1 percentage points for industries belonging to the 1st quartile, while it is significantly associated with a decrease in employment of almost the same magnitude for industries belonging to the 4th quartile. These findings lend further empirical support to our first hypothesis formulated in Section 2, according to which the reduction in import exposure induced by the sanctions is expected to favor the reallocation of employment from relatively closed industries into industries that are relatively more exposed to international trade.

[Figure 3 here]

Next, in Table 9 we explore whether our main results are heterogeneous across industries with different level of dependence on imported inputs,¹⁸ or with different type of technology, i.e., labor-intensive versus capital-intensive industries. In line with our second hypothesis in Section 2, the results in column 1 show that our main results are mostly driven by those industries with a high propensity to import inputs from abroad,

¹⁷ The test of joint significance rejects the null hypothesis that the baseline effect and the interaction for the different quartiles are zero at least at the 90% significance level across all specifications of Table 8.

¹⁸ Imported-input intensity of industry j is measured by the share of material spending allocated to imported inputs in 2008 in that industry. The data is from the annual Survey of Manufacturing Firms with more than 10 workers of the SCI.

likely intermediate goods that are complement in the production process.¹⁹

This reasonably explains the positive employment effect of an increase in import exposure for relatively closed industries, that is, with import share below the median. In fact, to the extent that extra imports represent capital/intermediate goods (which feature disproportionately in international trade), one would expect both final-good production and employment within the industry to rise.

[Table 9 here]

In columns 3-4 we investigate whether results vary across industries with different labor intensity in the production process using the United Nations Industrial Development Organization' classification of labor- versus capital-intensive industries from Van Beers (1998).²⁰ In principle, the employment response to a rise in import penetration should be larger in labor-intensive industries than in industries that rely more on machineries and capital in the production process. Interestingly, results in columns 3 to 4 provide empirical support to this assumption and show that indeed the employment effects of import exposure are detectable only in the subsample of labor-intensive industries.²¹

5.2 Effects Including Input-Output Linkages

Next, we extend our main analysis to account for the sectoral linkages by means of the input-output table. The methodology follows directly from Acemoglu et al. (2016). We apply the input-output table for 2001 from the SCI. The choice of the 2001 input-output table ensures that the measured sectoral linkages are not endogenous to the imposition of

¹⁹ In fact, capital and intermediate goods accounted for 83% of Iran's total imports in 2011.

²⁰ We obtain similar results when we use the classification from Kucera and Sarna (2006).

²¹ This finding does not depend on the different sample size across the two subsamples in columns 3-4. In fact, we obtain the same results if we estimate our model adding the interaction terms with a dummy for high imported-input intensity instead of splitting the sample in two subgroups.

sanctions. First-order upstream (downstream) import exposure is a weighted average of the direct trade shocks experienced by a given industry's purchasers (suppliers) defined as:

$$\Delta IP_{j\tau}^{up} = \sum_g \omega_{gj}^{up} \Delta IP_{g\tau}, \quad \Delta IP_{j\tau}^{down} = \sum_g \omega_{gj}^{down} \Delta IP_{g\tau}$$

where ω_{gj} is the use coefficient in the input-output matrix which identifies the share of industry j 's output that are used as inputs by industry g . The inverse Leontief matrix has been used for the full input-output linkages. Results are summarized in Table 10. Column 1 replicates our main specification for the sample of industries for which we have information of the input-output linkages.²² Reassuringly, results are qualitatively similar to the main results reported in column 4 of Table 3, though they are, as expected, larger in magnitude given that we are now examining industries at a more aggregate level.

[Table 10 here]

Columns 2 and 3 report the results for the first-order and full input-output linkages, respectively. As shown in columns 2-3 of Table 10, we document no significant indirect effects of the sanctions-induced change in import exposure. To put it differently, we find that while industry employment strongly reacts to an increase in import exposure within the industry, it seems to be unresponsive to changes in import exposure of upstream or downstream industries.

Based on the estimates shown in Table 10, we also compute the economic magnitude of the impact of economic sanctions. We follow Acemoglu et al. (2016) and Feenstra et al. (2019) and construct the counterfactual changes in employment that would have occurred in the absence of the sanctions, and hence, import changes. The difference between the actual and the counterfactual manufacturing employment in year t is expressed as follows:

²² A combination of 28 two-digit and three-digit ISIC manufacturing sectors is identified from the input-output table.

$$\Delta L_t^{cf} = \sum_j L_{jt} (1 - e^{-\widehat{\Delta IP}_{jt}})$$

where $\widehat{\Delta IP}_{jt} = (\widehat{\beta}_1 + \widehat{\beta}_2 HIS_{j2011}) \times \Delta IP_{j\tau}$. The coefficient estimates are those from column 3 of Table 10 and $\Delta IP_{j\tau}$ is the observed import change.

The results reported in Table 11 show that had there been no sanctions imposed on Iran in 2012, Iranian manufacturing employment would have expanded by 17,731 additional jobs over the period 2012–2014. For the first subperiod over 2008–2010, import changes led to 27,913 job losses. The observed employment between 2012 and 2014 increased by 108,365 jobs. Our estimates, therefore, suggest that in the absence of the sanctions, the expansion of manufacturing employment in Iran would have been 16.4 ($= \frac{17,731}{108,365}$) percentage points greater after 2012. This finding is in agreement with our second hypothesis in Section 2 that the sanctions would have negatively impacted on Iran’s overall manufacturing employment.

[Table 11 here]

The implied job change in employment for more open industries during 2012–2014 is consistent with the findings in Acemoglu et al. (2016) that reducing import exposure generates manufacturing employment gains. Turning to the magnitude of the effect by industry’s import share, we document that most of the reduction in job losses caused by the sanctions would be attributable to industries with import share below the median.

This is in line with the results in Table 9, columns 1-2, which attribute the positive employment effect of an increase in import exposure to industries that feature high dependency on imported inputs. This seems, therefore, to imply that import exposure is affecting manufacturing employment mainly through increasing production costs and reducing labor demand in industries with import share below the median. Interestingly, this suggests that the sanctions caused significant reallocation effects across industries with different exposure to import competition, in line with our first hypothesis in Section 2.

6. Conclusions

This paper estimates the effect of economic sanctions on employment in the short run. We use the imposition of unexpected and unprecedented international sanctions on Iran in 2012 and build on Acemoglu et al. (2016) to estimate the effect of a change in import competition on employment in Iran's manufacturing sector. We find significant asymmetric effects of import competition on industries with different ex-ante import share, indicating important employment reallocation effects across industries with different degree of exposure to international trade.

We document that the sanctions had an overall negative effect on employment. Our estimates suggest that, due to the sanctions, the employment growth rate in the manufacturing sector declined by 16.4 percentage points over 2012–2014. We cannot exclude the possibility that the effect we estimate might partly capture the impact of government policies happening at the same time as the sanctions. Nonetheless, the results from the robustness tests we run together with the short sample period we consider in our analysis should alleviate this concern to a large extent.

Importantly, we show that the effect is mostly driven by industries characterized by high imported inputs intensity. Consistent with Etkes and Zimring (2015), our findings would therefore suggest that, especially in the context of developing economies, where the manufacturing sector heavily depends on access to inputs from the world markets, trade shocks can have large short-run adverse effects on employment likely via a decline in productivity. In this sense, our results offer key insights to the analysis of trade policy in that extreme and unexpected changes in trade policy can cause important reductions in trade volume and, as a consequence, in employment.

The results of this study also expand our understanding of the possible implications of international economic sanctions, a foreign policy tool that is still very much used in

international relations. Our findings highlight, in fact, that the detrimental effects of sanctions on the economy of the target country extends also to the labor market.

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Tables and Figures

Table 1: Summary Statistics

	2008–2010				2012–2014			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Δ Employment	-1.02	7.55	-60.50	16.24	4.04	6.89	-112.56	39.36
Δ Import Exposure	1.48	12.07	-212.40	64.55	-3.46	6.23	-31.09	19.96
Δ Export Exposure	3.29	32.66	-58.66	586.47	2.68	31.23	-784.92	1340.55
Low Import Share Industries								
	2008–2010				2012–2014			
Δ Employment	-0.14	7.67	-37.65	15.04	3.83	6.41	-67.64	36.08
Δ Import Exposure	-0.12	9.00	-50.37	64.55	-1.44	1.87	-7.22	6.30
Δ Export Exposure	1.84	6.99	-30.73	115.15	1.92	5.09	-12.98	80.43
High Import Share Industries								
	2008–2010				2012–2014			
Δ Employment	-3.54	6.73	-60.50	16.24	4.64	8.19	-112.57	39.36
Δ Import Exposure	6.09	17.55	-212.40	45.87	-9.27	9.79	-31.09	19.96
Δ Export Exposure	7.46	63.34	-58.66	586.47	4.88	61.15	-784.91	1340.55

Notes: The sample includes N=116 four-digit ISIC manufacturing industries. For each manufacturing industry, employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. The quantities used in these computations are deflated by the import and export price indexes. Low (High) Import Share Industries are defined as industries below (above) the median in the distribution of import share in 2011. All observations are weighted by 2008 industry employment.

Table 2: Summary Statistics: Main Employment Industries

Industry	Activity	Employment Share	Import Exposure		Export Exposure	
			2008–2010	2012–2014	2008–2010	2012–2014
2710	Basic iron and steel	7.39	3.99	-3.77	0.20	2.08
3430	Parts for motor vehicles	6.22	2.73	0.34	0.08	0.09
3410	Motor vehicles	6.06	1.57	0.05	0.27	-0.20
1711	Textile fibres/weaving	4.10	-11.01	-1.45	-0.15	0.45
2520	Plastic products	3.64	-8.17	-1.89	0.76	5.24
1520	Dairy products	2.90	0.49	-2.92	1.76	2.47

Notes: For each manufacturing industry, employment changes are expressed as $100 \times$ annual log changes, while changes in import exposure are defined as $100 \times$ annual changes. The quantities used in these computations are deflated by the import and export price indexes. Employment share is defined as the industry employment divided by the total employment in Iran manufacturing sector in 2011. All observations are weighted by 2008 industry employment.

Table 3: Employment Effects of Import Exposure

	(1)	(2)	(3)	(4)
Δ Import Exposure		0.030 (0.048)	0.031 (0.046)	0.209* (0.116)
Import Share ₂₀₁₁ \times Δ Import Exposure			-0.035* (0.018)	
HIS ₂₀₁₁ \times Δ Import Exposure				-0.269** (0.115)
Import Share ₂₀₁₁			-0.435 (0.415)	
HIS ₂₀₁₁				-1.554 (1.411)
1{2008–2010}	-1.016 (1.320)	-1.061 (1.325)	-1.487 (1.175)	-0.503 (1.494)
1{2012–2014}	4.037*** (0.881)	4.142*** (0.907)	3.704*** (0.764)	4.517*** (1.097)

Notes: The sample includes N=232 observations (116 four-digit ISIC manufacturing industries over two subperiods). Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in 2011. Production controls include the share of production workers in total employment and the log of average wage at the industry level. In all specifications observations are weighted by 2008 employment. In column (3) the variables Δ *Import Exposure* and *Import Share*₂₀₁₁ are centered around mean to favor the interpretation of the baseline effects. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 4: Employment Effects of Import Exposure Including Industry-Level Controls

	(1)	(2)	(3)	(4)
Δ Import Exposure	0.209*	0.137	0.170**	0.146*
	(0.116)	(0.086)	(0.083)	(0.076)
$HIS_{2011} \times \Delta$ Import Exposure	-0.270**	-0.182**	-0.239***	-0.194**
	(0.116)	(0.091)	(0.088)	(0.084)
HIS_{2011}	-1.547	-0.834	0.665	0.585
	(1.416)	(1.213)	(1.122)	(1.161)
Δ Export Exposure	-0.002	0.000	0.006	0.006
	(0.009)	(0.006)	(0.007)	(0.006)
$1\{2008-2010\}$	-0.497	-0.719	-1.085	-1.100
	(1.499)	(1.209)	(1.164)	(1.055)
$1\{2012-2014\}$	4.519***	4.292***	3.864***	3.911***
	(1.100)	(0.882)	(0.989)	(0.922)
One-digit sector dummies	No	Yes	No	Yes
Production controls	No	No	Yes	Yes

Notes: The sample includes N=232 observations (116 four-digit ISIC manufacturing industries over two subperiods). Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in 2011. Production controls include the share of production workers in total employment and the log of average wage at the industry level. In all specifications observations are weighted by 2008 employment. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 5: Employment Effects of Import Exposure Using Different Base Year for the Industry Import Share

	(1)	(2)	(3)	(4)
	Import Share 2009		Import Share 2010	
Δ Import Exposure	0.028 (0.043)	0.134* (0.077)	0.033 (0.045)	0.154* (0.089)
Import Share _{20xx} \times Δ Import Exposure	-0.021 (0.013)		-0.012 (0.009)	
HIS _{20xx} \times Δ Import Exposure		-0.190** (0.090)		-0.198** (0.095)
Import Share _{20xx}	-0.157 (0.226)		-0.118 (0.207)	
HIS _{20xx}		2.878* (1.470)		0.889 (1.895)
1{2008–2010}	-1.316 (1.190)	-1.792 (1.223)	-1.305 (1.225)	-0.968 (1.227)
1{2012–2014}	3.883*** (0.786)	3.049*** (1.018)	3.898*** (0.778)	3.841*** (1.194)

Notes: The sample includes N=232 observations (116 four-digit ISIC manufacturing industries over two subperiods). Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. Import Share is defined as the sector import in the year as specified, 2009 in columns 1-2 and 2010 in columns 3-4, divided by the sector real output in 2008. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in the relevant year. In all specifications observations are weighted by 2008 employment. In columns 1 and 3 the variables Δ *Import Exposure* and *Import Share* are centered around mean to favor the interpretation of the baseline effects. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* p < 0.10

** p < 0.05

*** p < 0.01

Table 6: Employment Effects of Import Exposure: Placebo Test

	(1)	(2)	(3)	(4)
Δ Import Exposure		-0.006 (0.020)	0.012 (0.022)	0.023 (0.026)
Import Share ₂₀₁₁ \times Δ Import Exposure			-0.017 (0.015)	
HIS ₂₀₁₁ \times Δ Import Exposure				-0.051 (0.039)
Import Share ₂₀₁₁			-1.798** (0.703)	
HIS ₂₀₁₁				-2.296 (2.084)
1{2008-2009}	-1.030 (1.494)	-1.030 (1.498)	-0.325 (1.586)	-0.402 (1.759)
1{2010-2011}	2.667 (1.727)	2.623 (1.725)	3.370* (1.841)	3.357* (1.948)

Notes: The sample includes N=232 observations (116 four-digit ISIC manufacturing industries over two subperiods). Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in 2011. Production controls include the share of production workers in total employment and the log of average wage at the industry level. In all specifications, observations are weighted by 2008 employment. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* p < 0.10

** p < 0.05

*** p < 0.01

Table 7: Employment Effects of Import Exposure: Trimmed Sample

	(1) No top 5%	(2) No bottom 5%	(3) No top & bottom 5%
Δ Import Exposure	0.209* (0.116)	0.317** (0.150)	0.316** (0.150)
$HIS_{2011} \times \Delta$ Import Exposure	-0.270** (0.115)	-0.376** (0.157)	-0.377** (0.157)
HIS_{2011}	-1.565 (1.428)	-1.799 (1.438)	-1.810 (1.455)
$1\{2008-2010\}$	-0.471 (1.496)	-0.286 (1.531)	-0.253 (1.533)
$1\{2012-2014\} *$	4.485*** (1.097)	4.793*** (1.102)	4.759*** (1.103)
Observations	220	220	208

Notes: Columns (1)–(3) show the estimates by dropping the top five percent, the bottom five percent, and the top and bottom five percent of observations in Import Share in 2011, respectively. Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in 2011. Production controls include the share of production workers in total employment and the log of average wage at the industry level. In all specifications, observations are weighted by 2008 employment. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 8: Employment Effects of Import Exposure by Quartile of Industry Import Share

	(1)	(2)	(3)	(4)
Δ Import Exposure	0.150*	0.101*	0.122***	0.086**
	(0.086)	(0.059)	(0.039)	(0.042)
Q2 Import Share ₂₀₁₁ x Δ Import Exposure	0.152	0.122	0.148	0.212
	(0.251)	(0.186)	(0.221)	(0.194)
Q3 Import Share ₂₀₁₁ x Δ Import Exposure	-0.177**	-0.117*	-0.181***	-0.109
	(0.081)	(0.068)	(0.055)	(0.068)
Q4 Import Share ₂₀₁₁ x Δ Import Exposure	-0.240**	-0.167**	-0.212***	-0.160***
	(0.099)	(0.074)	(0.061)	(0.057)
1{2008–2010}	-0.117	-1.096	-2.404*	-2.759**
	(1.795)	(1.567)	(1.369)	(1.357)
1{2012–2014}	4.970***	3.988**	2.582	2.340
	(1.819)	(1.656)	(1.745)	(1.715)
One-digit sector dummies	No	Yes	No	Yes
Production controls	No	No	Yes	Yes

Notes: The sample includes N=232 observations (116 four-digit ISIC manufacturing industries over two subperiods). Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. The i-th Quartile Import Share is a dummy for industries belonging to the i-th quartile in the distribution of import share in 2011. Quartile dummies are included in all specifications, but they are not reported. Production controls include the share of production workers in total employment and the log of average wage at the industry level. In all specifications, observations are weighted by 2008 employment. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* p < 0.10

** p < 0.05

*** p < 0.01

Table 9: Employment Effects of Import Exposure: Heterogeneity by Imported-Input Intensity and Technology Type

	(1) High imported input	(2) Low imported input	(3) Labor intensive industries	(4) Capital intensive industries
Δ Import Exposure	0.408** (0.192)	-0.009 (0.065)	0.423** (0.166)	-0.100 (0.115)
$HIS_{2011} \times \Delta$ Import Exposure	-0.486** (0.222)	-0.040 (0.080)	-0.452** (0.178)	-0.006 (0.143)
HIS_{2011}	-1.859 (1.945)	-1.326 (2.410)	-2.428 (1.742)	-2.160 (2.262)
$1\{2008-2010\}$	-1.006 (2.335)	1.035 (1.596)	-1.797 (1.970)	2.877 (1.880)
$1\{2012-2014\}$	4.219*** (1.265)	5.203** (2.167)	4.421*** (1.486)	5.421*** (1.508)
Observations	116	116	152	80

Notes: Columns (1)–(2) show the estimates for imported–input intensity above median and for imported–input intensity below median subsamples, respectively; columns (3)–(4) for labor-intensive and capital-intensive industries subsamples (based on the United Nations Industrial Development Organization’s classification from Van Beers, (1998)), respectively. Employment changes are expressed as $100 \times$ annual log changes, while changes in import exposure are defined as $100 \times$ annual changes. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in 2011. Imported-Input intensity of the industry is measured by the share of material spending allocated to imported inputs in 2010. In all specifications, observations are weighted by 2008 employment. Robust standard errors in parentheses are clustered on three-digit ISIC industries.

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 10: Employment Effects of Import Exposure Including Input-Output Linkages

	(1)	(2)	(3)
Δ Direct Import Exposure	0.530*** (0.143)	0.729** (0.282)	0.728** (0.213)
HIS ₂₀₁₁ \times Δ Direct Import Exposure	-0.706*** (0.190)	-0.818** (0.328)	-0.812*** (0.261)
Δ Upstream Import Exposure		-0.069 (0.387)	-0.122 (0.184)
Δ Downstream Import Exposure		-0.760 (0.785)	-0.471 (0.506)
HIS ₂₀₁₁ \times Δ Upstream Import Exposure		0.226 (1.158)	0.098 (0.630)
HIS ₂₀₁₁ \times Δ Downstream Import Exposure		-0.077 (1.415)	-0.011 (0.794)

Notes: The sample includes N=56 observations (a combination of 28 two-digit and three-digit ISIC manufacturing industries over two subperiods). Employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. High Import Share (HIS) is a dummy for industries above the median in the distribution of import share in 2011. First-order upstream (downstream) import exposure, in column (1), is a weighted average of the direct exposure experienced by a given industry's customers (suppliers), provided by Statistical Center of Iran's 2001 input-output table. We use the inverse Leontief matrix for the estimates in column 3 to capture the full input-output linkages. In all specifications, observations are weighted by 2010 employment. Robust standard errors in parentheses.

* p < 0.10

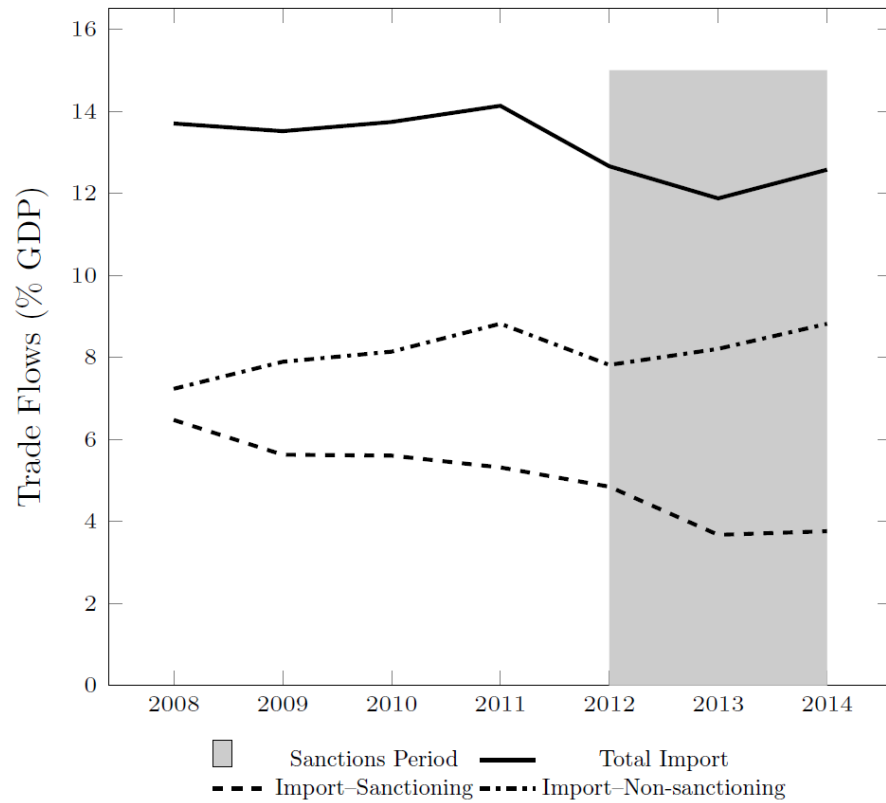
** p < 0.05

*** p < 0.01

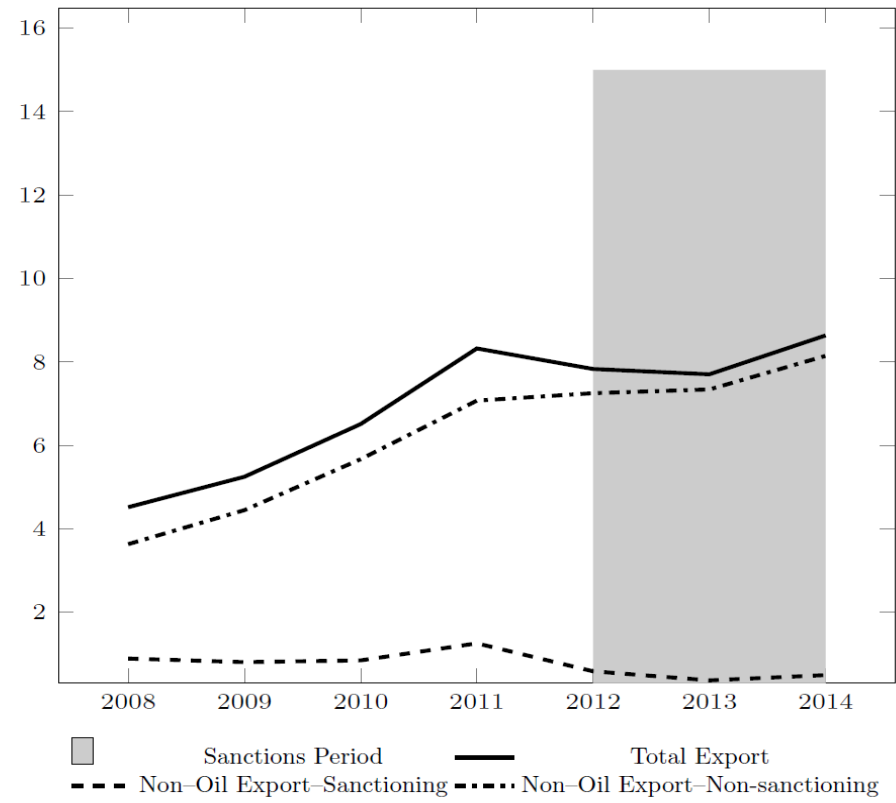
Table 11: Implied Employment Changes

	(1)	(2)	(3)
	2008–2010	2012–2014	2008–2014
Net	-27,913	-17,731	-45,644
Import Share ₂₀₁₁ > median	-4,456	4,340	-116
Import Share ₂₀₁₁ < median	-23,456	-22,072	-45,528

Notes: Reported quantities represent the change in employment attributed to the sanctions-induced changes in import exposure. Negative (positive) values indicate that trade exposure is estimated to have reduced (increased) employment. We first use the estimated coefficients in Table (10), column (3), to predict the changes in each industry’s log employment induced by changes in import and export exposure over the periods 2008–2010 and 2012–2014. To do so, we multiply the coefficient of interest by the observed change in import exposure. We then use each industry’s observed end-of-period employment to convert these estimates from logs into levels.



a) Import



b) Non-Oil Export

Figure 1: Trends in Import and Non-Oil Export

Notes: In panel a (b) the solid line shows the aggregate import (export) of Iran over 2008–2014, and the dash and dash-dot lines show import (export) from (to) the sanctioning countries and non-sanctioning countries, respectively. All values are reported as percentage of Iran’s GDP (in real US dollars) in 2008. The grey band indicates the post-sanction period. Sanctioning countries include the European Union, United States, and countries that enforced sanctions against Iran more aggressively, namely Canada, Japan, South Korea, Australia, Mexico, and Singapore. Data source: Iranian Customs.

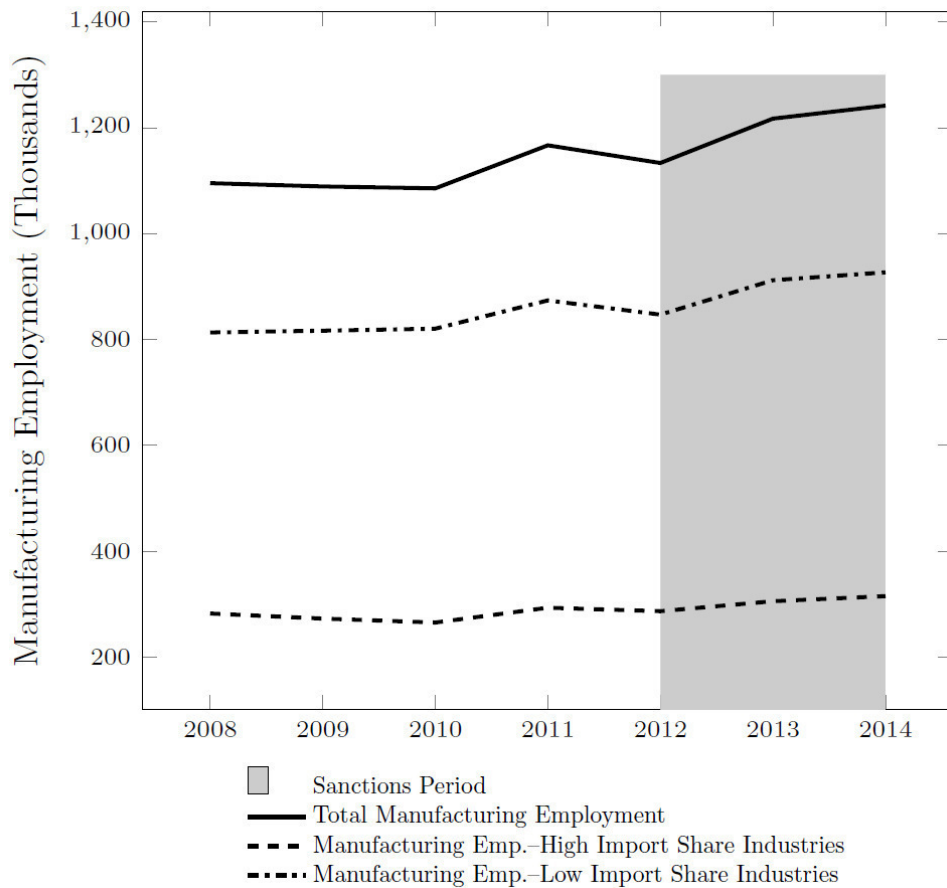


Figure 2: Trends in (Non-Oil) Manufacturing Employment

Notes: The solid line shows the total manufacturing employment of Iran over 2008–2014, and the dash and dash–dot lines show manufacturing employment for industries above and below the median in the distribution of import share as of 2011, respectively. The grey band indicates the post-sanctions period. Data source: Statistical Center of Iran (SCI).

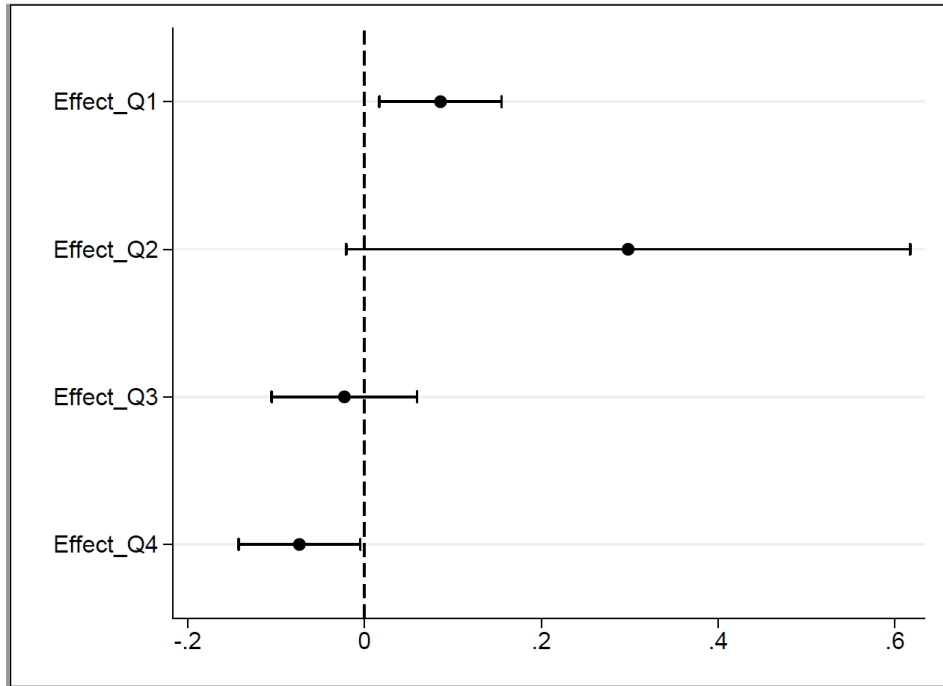


Figure 3: Employment Effect of Import Exposure by Quartile of Industry Import Share

Notes: The figure plots the effect of import exposure on employment for each quartile of the distribution in industry import share as of 2011. Effects are computed on the basis of the estimates obtained in column 4 of Table 8. Horizontal bars indicate confidence intervals at the 90% level of significance.

Appendix

Table A.1: Summary Statistics: All Industries

Industry	Δ Employment		Δ Import Exposure		Δ Export Exposure	
	2008–2010	2012–2014	2008–2010	2012–2014	2008–2010	2012–2014
1512	-8.95	2.65	0.22	6.30	2.18	2.03
1514	-14.97	-0.35	13.35	-17.29	-0.13	0.28
1515	1.01	6.62	0.00	-18.22	0.00	4.81
1516	2.57	10.74	64.55	-0.02	-10.13	1.34
1519	-6.57	11.61	-0.28	-4.45	-2.05	34.43
1520	6.26	9.73	0.49	-2.92	1.76	2.47
1531	-2.30	3.64	15.05	-0.30	3.84	-0.92
1532	-9.88	6.49	4.08	-6.07	-0.06	1.92
1533	5.88	-0.29	1.44	-0.15	-0.09	1.64
1542	7.10	10.27	20.04	-31.09	1.39	-0.18
1543	2.29	9.48	10.53	-5.47	17.34	13.01
1544	-5.44	-1.03	-2.18	0.00	-0.22	0.00
1545	-11.74	6.26	-0.22	-0.36	115.15	80.43
1547	-6.44	1.19	10.04	-13.19	3.47	3.53
1551	-18.88	-4.91	-4.53	0.20	-15.56	3.49
1553	12.55	21.82	-2.22	-0.10	-0.01	0.00
1556	5.46	-0.29	2.11	-5.72	-8.25	3.51
1600	8.42	-1.09	-18.33	-5.87	0.06	0.34
1711	-9.14	0.17	-11.01	-1.45	-0.15	0.45
1721	-13.05	16.15	-29.11	-0.43	-0.88	5.15
1723	-18.27	36.08	-21.49	-1.33	-8.86	2.28
1724	-12.17	1.06	1.14	0.31	557.00	144.98
1729	-8.17	34.41	-27.96	-2.65	3.86	11.75
1731	4.17	6.68	-50.37	-1.67	-30.73	3.85
1810	-9.14	4.38	-28.97	-1.36	-0.88	17.79
1911	-10.32	8.51	-8.50	0.15	-2.77	-8.22
1912	-19.31	-17.55	-9.84	-10.42	16.71	-2.63
1920	-13.98	2.29	-31.07	-0.58	7.61	3.25
2010	-3.65	-2.51	14.81	-21.70	-2.16	0.66
2021	-15.62	17.05	2.93	-8.05	-0.56	0.66
2022	10.10	5.48	-9.81	-7.35	-1.35	4.88
2023	-37.52	20.46	-28.36	1.24	0.46	4.33
2029	-8.56	39.36	-26.34	-5.23	76.49	16.68
2101	-6.02	6.61	16.29	-11.06	-0.74	0.83
2102	-4.43	7.03	4.62	-7.22	-0.10	0.27
2109	-2.59	10.74	2.24	0.65	-0.14	0.25
2211	-21.92	-31.62	-1.79	-1.91	3.45	-1.14
2212	5.97	-10.01	0.07	-0.35	-0.00	0.16
2219	-19.87	-112.56	22.43	-11.79	-2.16	-7.70
2221	-7.26	6.21	-1.82	-0.60	0.02	0.09
2222	-21.39	-23.30	11.03	-13.75	0.05	-0.01

Continue on the next page

Table A.1: Summary Statistics: All Industries (cont.)

Industry	Δ Employment		Δ Import Exposure		Δ Export Exposure	
	2008–2010	2012–2014	2008–2010	2012–2014	2008–2010	2012–2014
2310	-19.09	15.86	45.21	-0.60	-0.27	1340.55
2320	3.19	5.42	-6.73	0.13	3.78	7.20
2411	9.33	12.22	-0.91	-4.13	-1.53	9.25
2412	14.40	8.74	-6.80	2.31	10.89	4.31
2413	15.04	6.20	-1.14	-2.39	5.75	5.94
2421	1.38	9.08	13.09	1.54	0.36	0.77
2422	0.92	8.88	5.18	-1.67	7.37	-0.05
2423	2.68	9.24	8.13	-7.49	0.98	1.09
2424	6.03	5.53	2.85	-0.74	1.63	1.27
2429	1.96	12.64	13.28	-9.96	5.01	-4.41
2430	-0.73	10.25	13.06	-8.90	-0.05	1.14
2511	-4.14	-2.70	5.10	-1.72	0.51	0.37
2519	-4.48	-1.78	-12.28	-2.26	-0.41	0.84
2520	-1.11	2.57	-8.17	-1.89	0.76	5.24
2611	-1.20	10.12	-11.32	-2.53	-0.08	-0.23
2691	-3.45	3.59	5.03	0.21	4.06	4.92
2692	-9.79	14.08	2.50	-6.71	0.58	-2.64
2694	-0.18	-0.09	-0.06	-0.03	6.86	2.18
2695	-1.89	-2.42	-0.20	-1.50	0.80	1.22
2696	-1.66	-12.94	-1.14	-1.07	-0.37	3.17
2698	1.50	0.26	0.05	-0.24	4.30	3.94
2699	-6.98	7.36	-1.11	-0.56	0.67	1.48
2710	14.92	5.98	3.99	-3.77	0.20	2.08
2721	-0.19	5.80	-0.81	-2.58	8.34	0.73
2811	1.86	1.75	0.62	-1.21	2.37	1.15
2812	-1.88	4.74	10.82	-6.53	2.50	-0.99
2813	-15.44	3.68	-9.51	-9.36	5.18	1.73
2893	-11.51	3.94	-8.95	-6.82	-0.98	-1.45
2899	-11.39	2.66	-0.34	-2.43	1.59	0.47
2911	-0.29	12.54	23.72	-1.39	1.43	0.00
2912	-1.68	0.01	19.75	-5.11	-0.23	1.10
2913	-3.98	19.00	23.14	-7.10	0.65	-2.13
2914	-3.61	-3.10	28.51	-4.80	0.11	0.46
2915	-11.82	1.06	19.99	-14.34	-0.28	-0.83
2919	-2.44	5.97	4.49	-3.84	1.34	0.27
2921	-4.90	-2.53	3.29	4.39	-2.28	-1.53
2922	-10.44	5.14	25.77	-23.45	-0.08	4.60
2923	-5.28	31.84	35.49	-0.82	-4.33	0.99
2924	-12.47	12.56	18.73	4.98	2.38	0.76
2925	-5.51	-7.55	11.84	-1.00	-0.15	0.25
2926	-7.52	19.79	45.87	-13.78	0.53	0.19
2929	-2.53	-4.36	39.60	-7.66	33.31	-0.07
2930	-2.54	3.85	9.34	-4.06	0.51	0.14

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Table A.1: Summary Statistics: All Industries (cont.)

Industry	Δ Employment		Δ Import Exposure		Δ Export Exposure	
	2008–2010	2012–2014	2008–2010	2012–2014	2008–2010	2012–2014
3000	-2.47	7.24	20.47	-25.76	0.11	-0.40
3110	-4.28	7.22	3.37	-3.64	-0.30	0.82
3120	-3.13	8.82	1.84	-3.64	0.98	0.25
3130	-3.99	4.33	0.26	-5.77	2.08	0.97
3140	1.63	-33.65	4.28	-6.99	-0.23	0.13
3150	-14.58	3.14	-3.88	-0.73	0.68	0.11
3190	-3.08	-24.21	3.72	-2.16	0.00	0.02
3210	-12.88	11.52	-13.84	-6.57	-0.77	1.76
3220	-13.19	-5.66	5.59	19.96	-4.89	3.89
3230	-6.69	3.07	26.43	-19.28	0.14	0.67
3311	0.57	4.41	-18.89	-6.86	0.32	0.72
3312	-0.30	-2.71	-8.94	-4.07	-0.03	1.30
3313	-60.50	-14.59	25.59	-8.15	-1.99	0.26
3320	-1.47	24.69	-32.03	-0.37	2.35	10.39
3330	-6.29	0.71	16.10	-11.66	-58.66	2.25
3410	2.42	2.79	1.57	0.05	0.27	-0.20
3420	2.16	7.29	29.48	-12.64	3.84	5.73
3430	0.01	10.63	2.73	0.34	0.08	0.09
3511	-11.58	-10.25	-7.21	-0.73	-0.28	-12.98
3512	-37.64	-9.17	-0.35	-0.47	0.00	-0.02
3520	-8.12	6.89	-3.63	4.47	-12.54	0.01
3530	-6.15	1.84	-29.76	-29.37	-0.39	-16.60
3591	-13.70	2.65	5.15	0.43	0.36	-0.08
3592	-17.22	-2.83	23.27	-0.24	0.18	0.14
3599	-6.17	35.85	1.33	0.00	-1.73	0.00
3610	-5.06	-0.37	-0.41	-1.82	0.59	-0.69
3691	-10.22	-5.65	-212.40	-9.86	586.47	-784.92
3692	7.16	26.53	-47.58	-0.48	9.95	17.20
3693	-21.16	2.79	-45.91	-0.43	-4.92	-1.01
3694	16.24	-6.41	-40.62	-2.53	-22.53	-2.46
3699	4.23	4.15	-6.84	-0.91	0.55	0.18
3720	10.81	-67.64	0.23	-0.86	76.01	-0.36

Notes: The sample includes N=116 four-digit ISIC manufacturing industries. For each manufacturing industry, employment changes are expressed as 100 x annual log changes, while changes in import exposure are defined as 100 x annual changes. The quantities used in these computations are deflated by the import and export price indexes.

Table A.2: List of All the Industries

Industry	Activities
1512	Processing/preserving of fish/fish products
1514	Manufacture of vegetable and animal oils and fats
1515	Animal slaughtering
1516	Production, processing and preserving of meat and meat products
1519	Processing and preserving of fruit and vegetables ex. pistachio and dates
1520	Dairy products
1531	Manufacture of grain mill products
1532	Manufacture of starches and starch products
1533	Manufacture of prepared animal feeds
1542	Manufacture of sugar
1543	Manufacture of cocoa, chocolate and sugar confectionery
1544	Manufacture of macaroni, noodles, couscous and similar farinaceous products
1545	Manufacture of bakery products
1547	Manufacture of tea
1551	Distilling, rectifying, and blending of spirits; ethyl alcohol production from fermented materials
1553	Manufacture of malt liquors and malt
1556	Manufacture of Doogh drinks and production of mineral waters
1600	Manufacture of tobacco products
1711	Textile fibres/weaving
1721	Manufacture of made-up textile articles, except apparel
1723	Manufacture of cordage, rope, twine, and netting
1724	Manufacturing of carpet
1729	Manufacture of other textiles n.e.c.
1731	Manufacture of knitted and crocheted fabrics and articles
1810	Manufacture of wearing apparel, except fur apparel
1911	Tanning and dressing of leather
1912	Manufacture of luggage, handbags and the like, saddlery, and harness
1920	Manufacture of footwear
2010	Sawmilling and planing of wood
2021	Manufacture of veneer sheets; manufacture of plywood . . .
2022	Manufacture of builders' carpentry and joinery
2023	Manufacture of wooden containers
2029	Manufacture of other products of wood/articles of cork, straw, and plaiting materials
2101	Manufacture of pulp, paper, and paperboard
2102	Manufacture of corrugated paper and paperboard and of containers of paper, and paperboard
2109	Manufacture of other articles of paper and paperboard
2211	Publishing of books, brochures, and other publications
2212	Publishing of newspapers, journals, and periodicals
2219	Other publishing
2221	Printing
2222	Service activities related to printing

Continue on the next page

Table A.2: List of All the Industries (cont.)

Industry	Activities
2310	Manufacture of coke oven products
2320	Manufacture of refined petroleum products
2411	Manufacture of basic chemicals, except fertilizers and nitrogen compounds
2412	Manufacture of fertilizers and nitrogen compounds
2413	Manufacture of plastics in primary forms and of synthetic rubber
2421	Manufacture of pesticides and other agrochemical products
2422	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
2423	Manufacture of pharmaceuticals, medicinal chemicals, and botanical products
2424	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes, and toilet preparations
2429	Manufacture of other chemical products n.e.c.
2430	Manufacture of man-made fibres
2511	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres
2519	Manufacture of other rubber products
2520	Manufacture of plastics products
2611	Manufacture of glass and glass products
2691	Manufacture of non-structural non-refractory ceramic ware
2692	Manufacture of refractory ceramic products
2694	Manufacture of cement, lime, and plaster
2695	Manufacture of articles of concrete, cement, and plaster
2696	Cutting, shaping, and finishing of stone
2698	Manufacture of structural non-refractory clay and ceramic products
2699	Manufacture of other non-metallic mineral products n.e.c.
2710	Manufacture of basic iron and steel
2721	Manufacture of basic copper
2811	Manufacture of structural metal products
2812	Manufacture of tanks, reservoirs, and containers of metal
2813	Manufacture of steam generators, except central heating hot water boilers
2893	Manufacture of cutlery, hand tools and general hardware
2899	Manufacture of other fabricated metal products n.e.c.
2911	Manufacture of engines and turbines, except aircraft, vehicle, and cycle engines
2912	Manufacture of pumps, compressors, taps and valves
2913	Manufacture of bearings, gears, gearing and driving elements
2914	Manufacture of ovens, furnaces, and furnace burners
2915	Manufacture of lifting and handling equipment
2919	Manufacture of other general-purpose machinery
2921	Manufacture of agricultural and forestry machinery
2922	Manufacture of machine tools
2923	Manufacture of machinery for metallurgy
2924	Manufacture of machinery for mining, quarrying and construction
2925	Manufacture of machinery for food, beverage, and tobacco processing
2926	Manufacture of machinery for textile, apparel, and leather production
2929	Manufacture of other special-purpose machinery
2930	Manufacture of domestic appliances n.e.c.

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Table A.2: List of All the Industries (cont.)

Industry	Activities
3000	Manufacture of office, accounting, and computing machinery
3110	Manufacture of electric motors, generators, and transformers
3120	Manufacture of electricity distribution and control apparatus
3130	Manufacture of insulated wire and cable
3140	Manufacture of accumulators, primary cells, and primary batteries
3150	Manufacture of electric lamps and lighting equipment
3190	Manufacture of other electrical equipment n.e.c.
3210	Manufacture of electronic valves and tubes and other electronic components
3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
3230	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
3311	Manufacture of medical and surgical equipment and orthopaedic appliances
3312	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
3313	Manufacture of industrial process control equipment
3320	Manufacture of optical instruments and photographic equipment
3330	Manufacture of watches and clocks
3410	Manufacture of motor vehicles
3420	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
3430	Manufacture of parts and accessories for motor vehicles and their engines
3511	Building and repairing of ships
3512	Building and repairing of pleasure and sporting boats
3520	Manufacture of railway and tramway locomotives and rolling stock
3530	Manufacture of aircraft and spacecraft
3591	Manufacture of motorcycles
3592	Manufacture of bicycles and invalid carriages
3599	Manufacture of other transport equipment n.e.c.
3610	Manufacture of furniture
3691	Manufacture of jewellery and related articles
3692	Manufacture of musical instruments
3693	Manufacture of sports goods
3694	Manufacture of games and toys
3699	Other manufacturing n.e.c.
3720	Recycling of non-metal waste and scrap

Notes: List of all the 116 four-digit Iranian ISIC manufacturing industries in our sample.