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Evidence from Iranian Manufacturing Firms

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How Do State-Owned Enterprises Adjust During Downturns? Evidence from Iranian Manufacturing Firms

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ABSTRACT: This paper investigates the role that state-owned enterprises (SOEs) played during periods of economic sanctions against Iran. Using difference-in-difference techniques and exploiting survey data on the manufacturing sector, our analysis shows that the sanctions reduced revenues, profits, and productivity of both SOEs and private firms in targeted industries, with larger impacts in SOEs. In contrast to private firms, wages and employment levels increased in SOEs, suggesting that SOEs were used to protect employment during the economic crisis. In terms of distributional impacts, men were the hardest hit by the sanctions in private firms but benefited the most from the increase in wages in SOEs.

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WORKING PAPERS

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Contents

Introduction

State-owned enterprises (SOEs) are used around the world for a wide range of purposes, including to support national interests, promote social objectives and correct market failures in the supply of goods and services (OECD 2015a). In the Middle East and in Central Asia, the development of SOEs has been linked to the desire of governments to own strategic assets, particularly within the oil and gas sector (e.g., in the Gulf countries and Iran), or to promote the role of the state through the nationalization of major industries (e.g., in Algeria, Egypt, Iraq, Syria, Yemen, and Iran (Ramirez Rigo and others 2021).

While SOEs tend to be more concentrated in sectors dominated by natural monopolies, such as the provision of gas and electricity, water supply, waste management and transportation, they are present across the entire spectrum of the economy, including in sectors, like manufacturing, that are typically run by private firms. This wide presence raises questions about the rationale of the SOEs' role in the economy and whether their objectives are being achieved, particularly in light of the fiscal and financial risks they introduce (Lazzarini and Musacchio 2018, IMF 2020, and Ramirez Rigo and others 2021).

In terms of their relationship with private firms, the theory underlines how SOEs' political connections could help them achieve a better performance when they enjoy subsidies and tariff protections, easier access to financing, lighter taxation or stronger market power (Goldberg and others 2010, and Chen and others 2017). This could especially be the case in emerging markets where resources are scarce (Tao and others 2017), and Cao and others 2019). At the same time, politically connected firms might lack the incentive to operate efficiently and maximize the value for their shareholders (Boubakri and others 2008, and Chaney 2008). This is highlighted in the empirical literature that often finds SOEs underperforming private firms, with lower revenue, higher costs per employee and lower productivity due to resource misallocation (see, for example, Dewenter and Malatesta 2001, European Commission 2016, Wang and Shailer 2018, Richmond and others 2019, and Jurzik and Ruane 2021).

The empirical literature also underlines that SOEs enjoy lower profitability compared to private firms, reflecting the cost of providing goods and services at below-cost prices to underserved communities or promoting employment beyond what is efficient at significant wage premiums (Richmond and others 2019 and IMF 2019). In this context, Ki and Qotz 2019 and Gu and others 2019 show that SOEs played a role in offsetting the adverse effects of economic downturns in China by avoiding laying off or furloughing employees. Ramirez Rigo and others 2021 confirm that the COVID-19 pandemic had a sizeable impact on both SOEs and private firms in the Middle East, but SOEs' profitability suffered more because they were used to shield workers from the COVID-19 impact.

This paper adds to the literature on SOEs in the Middle East by focusing on Iran, a country that features a prominent role of SOEs in the economy but has received less attention so far. In particular, we investigate the role that SOEs played when international economic sanctions were imposed against Iran in 2012. Using a dataset produced by the Statistical Center of Iran (SCI), our analysis shows that sanctions reduced revenues, profits and productivity of both SOEs and private firms in targeted industries, but increased employment and wage levels only in SOEs. This lack of flexibility in adjusting the level of the workforce when revenues drop (e.g. during downturns) protected employment but also entailed a cost for SOEs in terms of sharper drops in profits and productivity compared to private firms. This leads to lower dividends to the state. In this sense,

SOEs introduce fiscal risks that the government will need to minimize by continuing to support employment, if this is among its objectives.

This paper also adds to the literature on the distributional impacts of economic sanctions across different types of employees, with a focus on women. Other studies (see e.g., Laudati and Pesaran 2019 and Demir and Tabrizy 2019) show that sanctions decreased female labor force participation in Iran. Our findings show that the 2012 sanctions had a more a significant impact on men overall. At the same time, male employment was protected more than female employment in SOEs. The Iranian Labor Law explains in part these heterogeneous impacts. For example, the law makes it extremely difficult to lay off workers in SOEs. Moreover, it disincentivizes employers to hire women by banning them from jobs that are considered dangerous and introducing hurdles to their employment, such as the need to request the husband's consent before hiring a married woman or setting up kindergartens for female employees' children.

In the remainder of the paper, Section 2 presents the data, Section 3 provides a background on the sanctions enforced against Iran in 2012 and identifies sanction shocks, Section 4 presents the empirical strategy of the paper, Sections 5 and 6 estimate the impact of the shocks on Iranian manufacturing firms' economic and employment performance, and Section 7 concludes.

Data

We use panel data of Iranian manufacturing firms with 10 or more workers in the period 2009-2013.[1] This data is produced by the Statistical Center of Iran (SCI) in the Survey of Manufacturing Firms (SMF) and covers between 12,556 and 14,168 firms each year. Each firm is attributed to one industry based on its production. The database also includes information on the entity controlling the firms, which allows to label as SOE any firm controlled and managed by the government. This is a departure from other studies, including Ramirez Rigo and others 2021, that define as SOE any firm with at least 50 percent direct or indirect state ownership. While this database does not include information on share ownership of publicly listed firms, it allows to take into consideration firms that are not publicly listed.

The database also includes nominal values (in Iranian rials (IRR)) of profits, revenues, exports, intermediate inputs, wages, investment and capital stock. In order to express these variables in real terms, we deflate them with price measures. Assuming no differences among firms within industries, revenues are deflated by industry-level PPI measures reported by the SCI; wages, intermediate inputs, investment and capital stock by PPI measures reported by the Central Bank of Iran (CBI); exports by Export PPI measures produced by the CBI.

By using the information of firms' control, we identify 330 SOEs in the Iranian manufacturing sector during the sample period. They represent 4 percent of firms in that sector, employ 11 percent of workers, use 14 percent of capital, and contribute to more than 10 percent of the sector's profits. Figure (1) presents the share of SOEs, their revenues, and employees in broad two-digit ISIC industries. SOEs are more present in the transport and media sectors, and less in sectors producing clothes and furniture. Though SOEs account for a small share

[1] The reasons to start from 2009 are that (i) data on firms' imports and exports are poorly reported in the early years of the survey and (ii) including 2008 would introduce data related to the financial crisis that – similarly to the sanctions – affected firms' imports and exports. This could result in underestimating the impact of the sanctions.

overall, they are important in some sectors. For example, above 30 percent of revenues in the metals and vehicles industries are produced by SOEs and around a third of employees in the metals, transport, media and recycling industries are employed in SOEs.

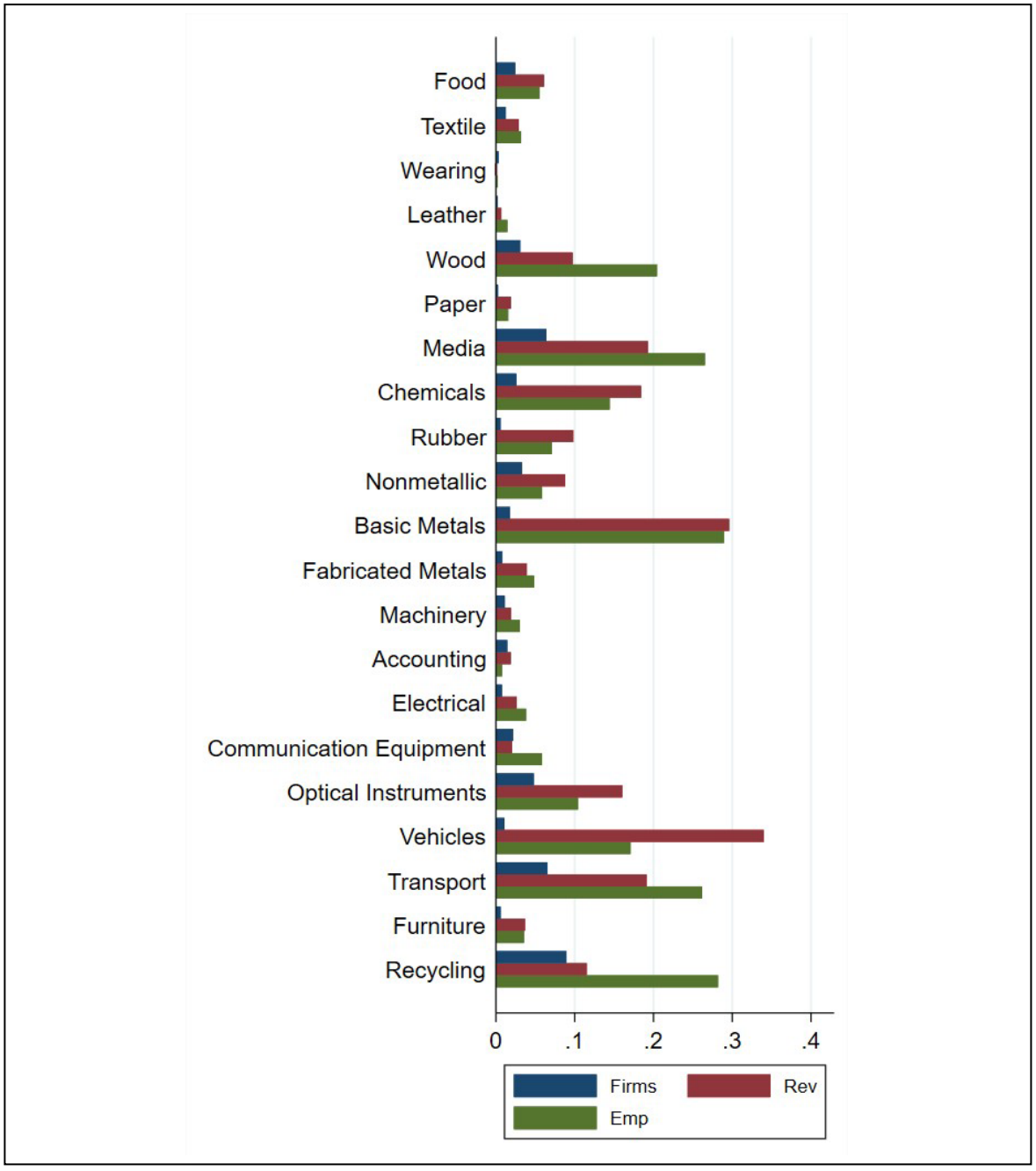
Table 1: compares privately-owned firms (POEs) and SOEs. It shows that SOEs are larger in terms of revenues, wages, employment levels, and capital stock. On average, revenues are 9 times larger in SOEs compared to POEs, while employment levels are 5 times larger. SOEs are more capital intensive with a capital-to-labor ratio of 105 million IRR per worker compared to 61 million IRR in the average private firm during the sample period. SOEs are also marginally less skill-intensive with a ratio of 6.7 non-college graduates per college graduate compared to a ratio of 6.3 in private firms.

Figure 2: compares the levels of capital and labor used in SOEs and POEs within each industry. SOEs in metals and vehicle industries are the most capital intensive. Even excluding these outliers, SOEs use more capital and labor resources in almost all industries.[2]

SOEs hire more employees compared to POEs in all manufacturing industries. They also employed more men relative to women. We argue that this is in part explained by the disincentives to hiring women introduced by the Iranian Law. For example, Article 1117 of the Iranian Civil Code states that a husband can prevent his wife from engaging in any profession or industry if that conflicts with his dignity or the family's interests. In addition, Section 78 of the law states that" in workplaces employing women, nursing mothers shall be granted a half hour break every three hours to nurse until their children reach two years of age; such breaks shall be regarded as part of the hours of work. Furthermore, the employer shall set up children's care centers according to the number of children, with due regard to their age."

[2] Figure (A.1) in Appendix III compares the levels of capital and labor used in SOEs and POEs, excluding metals and vehicle industries.

Figure 1: Shares of Firms labeled as SOEs, their Revenues and Employment in Manufacturing Industries



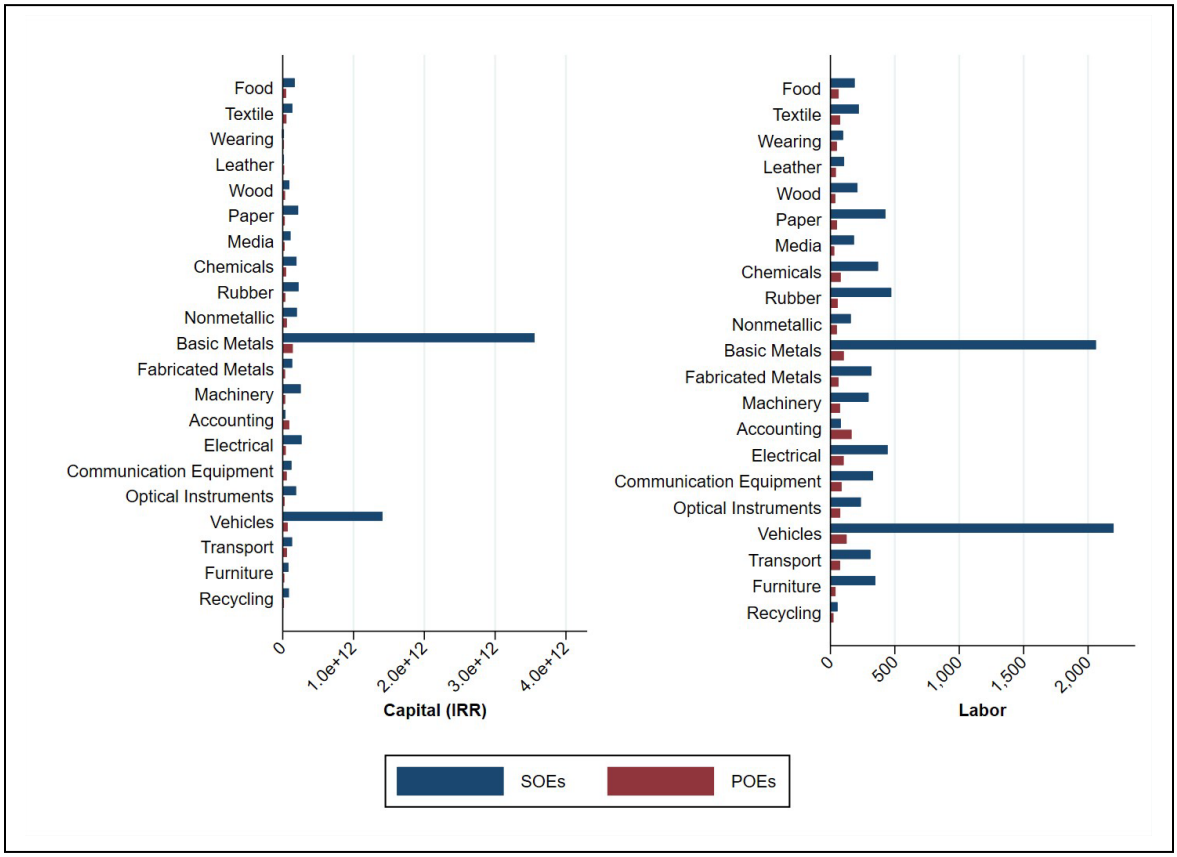
Notes: This figure shows the shares of firms labeled as SOEs, SOEs' revenue and SOEs' employment in various manufacturing industries (2digit ISIC industry levels). Though few firms are SOEs, they are large in terms of revenue or employment in some industries, including basic metals, vehicles, media, and recycling. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

Table 1: Summary Statistics for Privately-owned enterprises (POEs) and State-owned enterprises (SOEs)

	POEs			SOEs		
	Mean	Median	St Dev	Mean	Median	St Dev
Revenues (billion tomans)	76	8.8	670	700	37	5100
Domestic revenues (billion tomans)	72	8.3	630	660	36	4900
Intermediate inputs (billion tomans)	55	5.1	490	490	19	4100
Capital (billion tomans)	4.7	0.11	110	40	0.4	470
Labor	77	28	260	380	66	1500
Male Employee	68	24	240	360	63	1500
Female Employee	9	2	46	18	1	76
College (or above) Employee	11	3	46	61	4	220
Non-College Employee	70	25	270	410	49	1800
Male Employee - PL Unskilled	20	8	61	66	11	260
Male Employee - PL Skilled	20	6	86	110	17	540
Male Employee - NPL	11	3	51	88	15	310
Female Employee - PL Unskilled	3	0	27	2	0	21
Female Employee - PL Skilled	1	0	10	2	0	19
Female Employee - NPL	3	1	9	9	0	42
Wage (billion tomans)	4.7	1.3	24	38	4	210

Notes: This Table reports the mean, median, and standard deviation of variables of interest across private and state-owned enterprises. Values are in billion tomans (1 billion tomans = 10 billion IRR). PL stands for workers in "production lines", and NPL shows the number of workers that are not in production lines. The table covers over 12,801 firms annually between 2009-2013 in 130 4digit ISIC industries.

Figure 2: Capital and Employment Levels in SOEs and POEs



Notes: The left panel shows the average amount of capital used while the right panel presents the average number of employees in the average SOE and POE within each particular manufacturing industry in the sample period. On average, SOEs acquired more capital and hired more workers than private firms. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

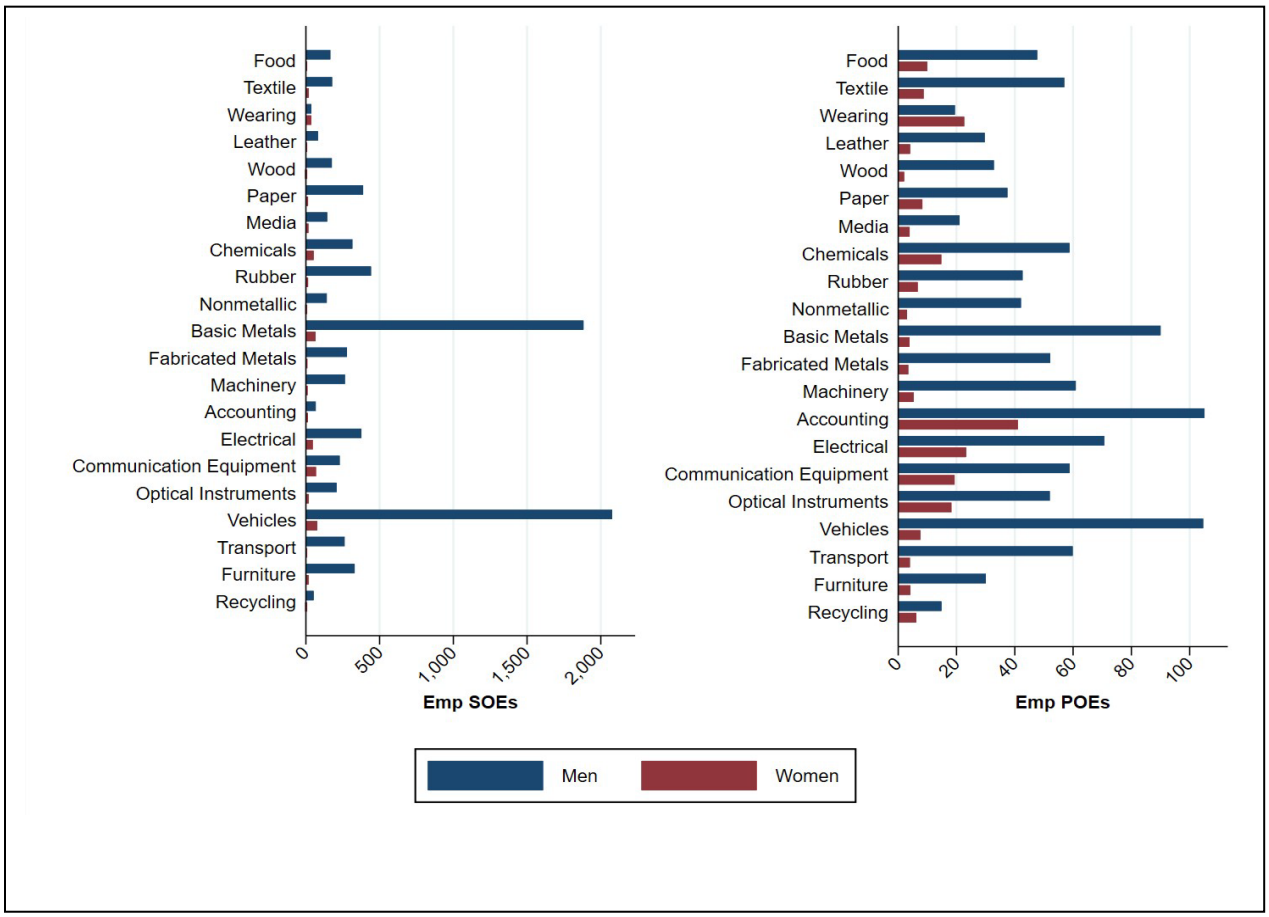
Figures (3) and (4) present employment and wage levels for men and women in SOEs and POEs in the manufacturing sector. On average, 21 men were hired per each female employee in SOEs and around 9 in POEs during 2009-2013. SOEs in metals and vehicle industries (the most capital and labor intensive) employed very few women compared to men.[3] This fact can be linked to the Iranian Labor Law banning women from being employed in dangerous jobs like in mining. In particular, Section 75 of the law prohibits employees from assigning women "to perform dangerous, arduous, or harmful work or to carry loads heavier than the authorized maximum manually and without mechanical means".

Iranian manufacturing firms also paid men more than women working in the same industries. On average, men were paid almost 10 times more than women in POEs and 23 times more in SOEs, with wage inequality

[3] Figure (A.2) in Appendix III compares the employment levels of men and women in SOEs and POEs, excluding metals and vehicle industries.

present in all industries but more pronounced in the metals and vehicle's industries.[4] Lower salaries for women are in part explained by the fact that women are generally employed in lower-level positions. For example, by proxying a higher-level position with a position outside the production line, in SOEs (private firms) there were 10 (4) men per every woman in positions outside the production line (Table 1).

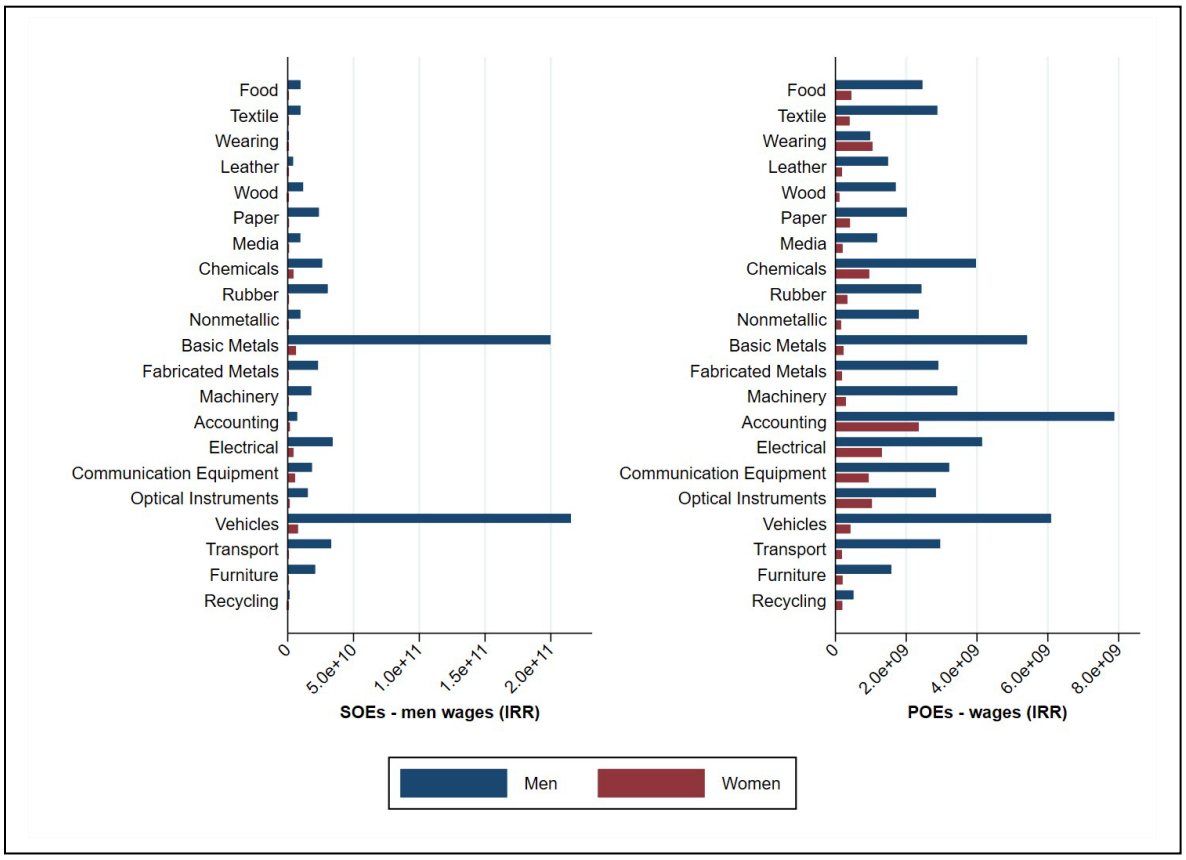
Figure 3: Male and Female Employment Levels in SOEs and POEs



Notes: The panels show the average number of employees (men and women) in the average SOE and POE within each manufacturing industry in the sample period. On average, SOEs hired more men than women relative to private firms. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

4. Figure (A.3) in Appendix III compares the wages of men and women in SOEs and POEs, excluding metals and vehicle industries.

Figure 4: Male and Female Wages in SOEs and POEs



Notes: The panels show the average level of wages for both men and women in the average SOE and POE within each manufacturing industry in the sample period. On average, SOEs paid more to men than women relative to private firms. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

Background of Sanctions Against Iran and Identification of Sanctioned Industries

Iran has been under various sanction regimes for decades. While U.S. sanctions started with the capture of American diplomats in Tehran in 1979, the U.N. introduced multilateral sanctions in 2006 when negotiations between France, Germany and the United Kingdom with President Ahmadinejad on Iran's nuclear activities collapsed. European Union (EU) countries followed, eventually leading to a full embargo of Iranian oil and sanctions against financial institutions and other economic sectors by 2012. These sanctions were lifted in 2015 when Iran reached an agreement known as the Joint Comprehensive Plan of Action (JCPOA) with the five permanent members of the U.N. Security Council – plus Germany, together with the EU. But in 2018 the United States withdrew from the agreement and re-imposed primary and secondary sanctions that are still ongoing.

This paper focuses on the economic sanctions enacted between 2010 and 2013. These sanctions, which peaked in 2012, were unprecedented in scope and targeted both entire sectors and specific firms in order to

weaken the economy and force Iran to negotiate over its nuclear program. The US administration started in 2010 to intensify its targeting of the Iranian petrochemical industry, and entities and individuals involved in the nuclear program (Comprehensive Iran Sanctions, Accountability and Divestment Act (CISADA)). After the International Atomic Energy Agency (IAEA) report came out detailing the potential military dimension of such a program, economic sanctions were intensified as well in late 2011.

In particular, under Section 311 of the USA Patriot Act, the US labeled the entire financial system, including the CBI that was suspected of helping Iranian banks circumvent sanctions, a “jurisdiction of primary money laundering concern”. At the end of 2011, Obama signed the National Defense Authorization Act (NDAA 2012), section 1425 of which barred foreign banks to process oil receipts through the CBI. Furthermore, the administration ordered domestic banks to confiscate all remaining Iranian assets and introduced secondary sanctions against third countries buying Iranian oil and petroleum products. In August 2012, Congress passed the Iran Threat Reduction and Syria Human Rights Act (TRA) that banned provision of messaging services for conducting financial transactions and shipping insurance and prohibited the repatriation of Iran’s oil receipts. At this point, most trade with Iran was de facto barred by the absence of acceptable payment mechanisms.

At the end of 2012, the US government also adopted the Iran Freedom and Counter-Proliferation Act (IFCAP) that blacklisted the entire energy, shipping, shipbuilding and port operating sectors. Moreover, it banned the sale, supply and transfer of precious and semi-finished metals to Iran, thereby preventing Iran’s ability to be paid in gold for its oil exports and damaging some manufacturing and housing sectors, which depended on the import of iron and steel. Provision of insurance and reinsurance to backlisted entities was prohibited and the state-owned radio and television agency were sanctioned. The campaign against the automotive sector also intensified in 2012. United Against Nuclear Iran (UANI), a non-profit organization formed to combat the threat of a nuclear-armed Iran, highlighted that the automotive industry represented the regime’s second most lucrative after oil and gas and was instrumental to import advanced foreign technology that could be used in the military. It then proposed a bill (DRIVE Act, 2012) requiring automakers to certify that they were not engaging in any business or agreement with Iranian entities in order to be eligible for US government contracts or financial assistance. That year, Hyundai, Porsche, Peugeot and Fiat ended their business with Iran and stopped shipments of auto parts. Vehicle production was halved compared to 2011. The US government followed with the implementation of formal sanctions.

Reacting to Iran’s nuclear activities, the EU joined the US in pressuring Iran. At the beginning of 2012, Brussels decided to boycott Iranian oil and petrochemical products (effective as of 1 July 2012), ban insurance for their shipments, freeze CBI assets, block exports of petrochemical equipment and technology, and bar the trade of diamonds and precious metals with Iran (Council Conclusions on Iran, 23 January 2012). Particularly damaging was the EU’s March 2012 decision to prevent Iran’s access to financial messaging services for clearing banking transactions, which effectively cut off Iranian banks from the SWIFT network, thereby preventing any foreign transactions with them. Several other countries, including Japan, South Korea, Canada, Switzerland and Australia, joined in the US and EU sanctions (see International Crisis Group (2013) for a basis and an expansion of this discussion, and an introduction of the main legal acts introducing US and EU sanctions (in pages 62-64).

Based on these accounts, key sectors impacted by economic sanctions in 2012 were related to petrochemical and oil activities, financial and insurance services, shipping and shipbuilding, aircraft and automotive production. Given that the database we use only covers manufacturing firms, the financial and insurance

sectors are not included in this analysis. The oil and petrochemical sector is also excluded for its specific characteristics and to avoid that dynamics in oil prices, that increased significantly between 2009 and 2013, obfuscate the impact of sanctions on the firms' performance. Consequently, we identify the following sanctioned industries defined at a two-digit ISIC level: shipping and shipbuilding, aircraft and automotive. These industries account for around 20 percent of the manufacturing sector's revenues and 13 percent of its employment over the sample period.

We map these industries to 6 four-digit ISIC industries in the sample data. These are: manufacture of motor vehicles, manufacture of bodies (coachwork) for motor vehicles, manufacture of trailers and semitrailers, manufacture of parts and accessories for motor vehicles and their engines, building and repairing of ships, building and repairing of pleasure and sporting boats, and manufacture of aircraft and spacecraft. We label all firms belonging to these six industries as targeted by sanctions. Targeted firms consist of about 25 percent of Iranian manufacturing firms' revenue before the sanctions. Half of these revenues were produced by SOEs. The proportion of sanctioned SOEs considered in this analysis can be interpreted as a lower bound, taking into account the exclusion of the petrochemical and oil industry and any other nonmanufacturing industry from the analysis, and the reliance on the official classification of firms' ownership and control produced by the SCI.

Empirical Strategy and Impacts of Sanctions on SOEs and POEs

We estimate the following model using difference-in-difference to measure how manufacturing firms were impacted directly[5] by sanctions enforced against Iran. In particular, we compare the average dependent variable in years 2009-2011 (before the sanctions) to the average in years 2012-13 (after the sanctions). Since these sanctions were unanticipated and exogenous to the Iranian economy, this model represents a quasi-natural experiment:

$$\ln Y_{it} = \delta S_{jt} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (1)$$

where Y_{it} shows the dependent variable (revenues, profits, firm-level productivity, employment levels, and wages) for firm i at year t. S_{jt} is 1 for firms in industry j sanctioned in or after 2012 and zero otherwise, and δ represents the impact of the sanction shock to the firms located in the targeted industries. α_i and α_t are firm and year fixed effects. While we are not using industry-year fixed effects to capture the impact of sanctions on firms, the standard errors ε_{it} are clustered at an industry-year level in all specifications.

After measuring the impact of sanctions on all manufacturing firms, we focus on the SOEs' response to the shock by estimating the following model:

$$\ln Y_{it} = \beta S_{jt} + \delta SOE_i \times S_{jt} + SOE_i + \alpha_i + \alpha_t + \varepsilon_{it} \quad (2)$$

[5] Sanctions can also impact firms indirectly through the input-output linkages. Ebadi (2021) extended the impact of the 2012 sanctions on the Iranian economy to all industries in the manufacturing sector using the industry input-output linkages.

where SOEi is 1 if firm *i* is controlled and managed by the state before the sanctions in 2012, and it is zero otherwise.[6] Thus, coefficient β presents the impact of sanctions on targeted firms, while $\beta + \delta$ captures the impact of sanctions on targeted SOEs. Furthermore, the coefficient δ presents the difference between POEs and SOEs under the sanctions. In this analysis, we are interested in signs and magnitudes of δ to understand the difference between how state- and privately-owned firms react differently to the sanction shock.

Sanctions against Iran affected firms through mainly the imported intermediate inputs and the export channels. In particular, by restricting access to foreign intermediate inputs needed in the production of Iranian firms, the sanctions reduced profits, revenues, productivity, and employment of the firms in the targeted industries (Ebadi, 2021). Additionally, by restricting access to export markets, the sanctions decreased revenues in foreign markets and the production of exporting firms.

Table (2) displays the impact of sanctions on Iranian manufacturing firms' revenues, profits, employment levels, and wages.[7] Columns (1) and (2) show that sanctions reduced revenues and profits by 20 percent and 30 percent.[8] The number of people employed and wages also dropped in targeted firms by 14.5 percent, and 14.7 percent. In SOEs, revenues decreased by almost 40 percent and profits were more than halved but employment levels and wages increased by 0.4 percent and 6.4 percent respectively.[9] In comparison, employment levels decreased by 15 percent and wages by 16 percent in POEs.

The different impact on wages and employment levels echo the literature on SOEs mentioned in the introduction. This literature suggests that SOEs often promote employment beyond what is efficient at significant wage premiums and are limited in the possibility to lay off workers to respond to a negative shock (Richmond and others 2019 and IMF 2019). The Iranian Labor Law makes it indeed extremely difficult to lay off workers even when firms make losses. For example, Division III of the law attributes most bargaining power to the employees and makes it expensive for employers to terminate an employment contract (see Section 22 of the law:" On termination of employment, all amounts due to a worker under his employment contract for the given employment period, shall be paid to the worker").

[6] SOEi does not feature independently in the equation because it is a time-invariant variable whose impact is captured through the firm fixed effects αi.

[7] As a robustness check, Table (A.2) in Appendix IV shows the same impacts on a sample of firms that includes those operating in the oil and petrochemical sector.

[8] The formula to compute the effect is $(e\beta - 1) * 100$, where β is the estimated coefficient of the sanctions in regression (1). The same formula can be used to translate estimated coefficients into economic impacts in all other regressions.

[9] One reason why the impact of sanctions may differ between SOEs and POEs could be related to differences in trade patterns. For example, a stronger decline in revenues and profits for SOEs could be caused by stronger impacts of sanctions on SOEs through the export and import channels. Appendix I tests this hypothesis but concludes that sanctions did not have significantly different effects on SOEs' exports and imports compared to POEs.

Table 2: Impacts of Sanctions on Firms' Profits, Revenues, Employment Levels, and Wages

Dependent variables are in log	$Profit_{i,t}$	$Total\ Rev_{i,t}$	$Emp_{i,t}$	$Wage_{i,t}$
$Sanctions_{jt}$	-0.358***	-0.228***	-0.157***	-0.160***
	(0.062)	(0.056)	(0.015)	(0.024)
Obs	54324	62015	65062	65052
Adjusted R-squared	0.677	0.820	0.910	0.872
Firm FEs + Year FEs	X	X	X	X
Heterogeneous impacts on SOEs				
$Sanctions_{jt}$	-0.323***	-0.211***	-0.166***	-0.173***
	(0.064)	(0.056)	(0.015)	(0.025)
SOEs × $Sanctions_{jt}$	-0.524***	-0.279**	0.170***	0.238***
	(0.139)	(0.127)	(0.039)	(0.070)
Observations	52222	59558	62494	62484
Adjusted R-squared	0.679	0.821	0.911	0.876
Firm FEs + Year FEs	X	X	X	X

Notes: In all regressions, firm and year fixed effects are included. Robust standard errors are corrected for clustering at the industry-year level in parentheses. Dependent variables are in log values.
Significance levels: * 10 percent, ** 5 percent, *** 1 percent.

Even when the employee violates the rules of the workplace, an employer should go through a long and hefty process to terminate the employee's contract (see Section 27: "Where a worker is negligent in discharging the worker's duties or if, after written warnings, the worker continues to violate the disciplinary rules of the workplace, the employer shall, provided that the Islamic Labor Council is in agreement, be entitled to pay to the worker a sum equal to the last monthly wage for each year of service as a length of service allowance, in addition to any deferred entitlements, and to terminate the employment contract"). Moreover, the government introduced the "Mehr-Afarin" plan in Fall 2012 aimed at supporting employment during the sanctions with the objective of increasing employees by half a million over four years. As highlighted in Table (2), difficulties in laying off workers and incentives to hire even during downturns imply a cost for SOEs that can result in lower profits and revenues compared to privately owned firms, or in the need for the central government to recapitalize the SOEs to cover the losses.

The difficulty of adjustment and implied costs imposed by the Iranian Labor Law on SOEs also exacerbated the drop in firm-level productivity. Table (3) shows the impact of sanctions on firm-level productivity of POEs and

SOEs.[10] Column (1) and (2) show that sanctions reduced firm-level productivity in the targeted industries by 21 percent and 16 percent respectively. The lower panel of Table (3) shows that productivity of SOEs dropped by around 40 percent compared to 13 percent for POEs in the aftermath of the sanctions.

Table 3: Impact of Sanctions on Firm-Level Productivity

Dependent variables are in log	**TFP-OP.ACF$_{i,t}$**	**TFP-LP.ACF$_{i,t}$**
Sanctions$_{jt}$	-0.240***	-0.171**
	(0.073)	(0.072)
Obs	50384	50384
Adjusted R-squared	0.964	0.848
Firm FEs + Year FEs	X	X
Heterogeneous impacts on SOEs		
Sanctions$_{jt}$	-0.215***	-0.145**
	(0.072)	(0.071)
SOEs ×*Sanctions$_{jt}$*	-0.372***	-0.387***
	(0.108)	(0.110)
Observations	49326	49326
Adjusted R-squared	0.965	0.848
Firm FEs + Year FEs	X	X

Notes: In all regressions, firm and year fixed effects are included. Robust standard errors are corrected with clustering at the industry-year level in parentheses. Dependent variables are in log values. The first column shows TFP estimations obtained using the method introduced by Olley and Pakes (1992) (OP) with the correction introduced by Ackerberg et al. (2015). The second column presents the method introduced by Levinsohn and Petrin (2003) (LP) with the correction proposed by Ackerberg et al. (2015). Significance levels: *10 percent, **5 percent, ***1 percent.

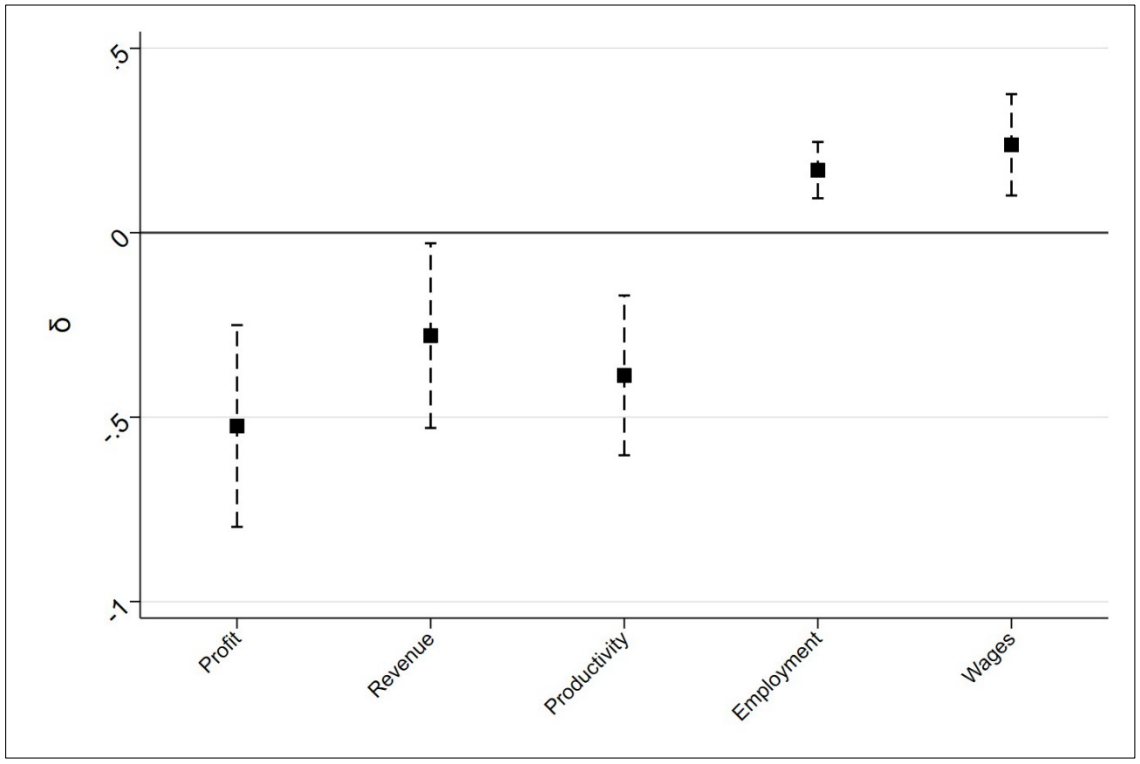
A productivity gap between POEs and SOEs is documented in the literature. Jurzik and Ruane 2019 focus on China and show how cheaper costs of financing for SOEs incentivized Chinese SOEs to take on more debt and accumulate more assets. This led to productivity losses due to the misallocation of innovative inputs. A similar point is for SOEs in Latvia and Serbia by Richmond and others 2019.

Figure (5) presents the difference of the impacts on revenues, profits, employment levels, wages and productivity between sanctioned SOEs and POEs. In particular, coefficient δ in equation (2) is plotted with its

[10] To measure total factor productivity (TFP), we follow the approach introduced in Olley and Pakes (1992) (OP) and Levinsohn and Petrin (2003) (LP), using the method discussed by Ackerberg et al. (2015) (see Appendix II).

confidence interval for each regression in Tables (2) and (3). In summary, sanctions decreased employment levels in POEs, while employment remained resilient in SOEs. Higher employment and wage levels in SOEs contributed to lower revenues, profits and productivity.

Figure 5: Difference in the Impacts of Sanctions Between SOEs and POEs



Notes: This figure shows the estimated coefficients δ in equation (2). These coefficients show the difference in the impacts of the sanctions between SOEs and POEs. On average, profits, revenues, and productivity decreased more in SOEs than in POEs, while wage and employment increased more in SOEs than in POEs.

Impacts of Sanctions on Different Types of Employees in SOEs and POEs

Table (4) shows how sanctions impacted employees with different educational backgrounds (college/non college) and skill levels (skilled/unskilled).[11] Column (1) and (2) show that employment of college and non-college graduates dropped by 7 percent and 12 percent in the aftermath of sanctions, with no significant difference between POEs and SOEs. Columns (3) and (4) report the impact of sanctions on unskilled and skilled workers. Sanctions reduced employment of skilled workers by 19.7 percent, with no significant

[11] Skill levels are based on the International Standard Classification of Occupations (ISCO). ISCO skill levels deal with the cases when the formal educational backgrounds may not be the most appropriate way to measure skill levels for occupations.

difference between SOEs and POEs. For unskilled workers, employment levels were 33.3 percent higher in SOEs than POEs in the aftermath of sanctions, suggesting that SOEs protected unskilled workers relatively more. The increase in the employment level of unskilled workers in the aftermath of the sanctions could be another factor contributing to the drop in productivity experienced by SOEs relatively to POEs.

Table 4: Impacts of Sanctions on Different Groups of Employees Based on their Education and Skill levels

Dependent variables are in log	**College Emp$_{i,t}$**	**Non-College Emp$_{i,t}$**	**Unskill Emp$_{i,t}$**	**Skilled Emp$_{i,t}$**
Sanctions$_{jt}$	-0.071**	-0.128***	-0.033	-0.220***
	(0.035)	(0.026)	(0.041)	(0.025)
Obs	25631	31722	59773	60071
Adjusted R-squared	0.882	0.917	0.705	0.759
Firm FEs + Year FEs	X	X	X	X
Heterogeneous impacts on SOEs				
Sanctions$_{jt}$	-0.073**	-0.134***	-0.047	-0.223***
	(0.034)	(0.026)	(0.044)	(0.026)
SOEs ×*Sanctions$_{jt}$*	0.086	0.078	0.288**	-0.023
	(0.068)	(0.059)	(0.146)	(0.075)
Observations	24732	30613	57382	57715
Adjusted R-squared	0.882	0.917	0.706	0.760
Firm FEs + Year FEs	X	X	X	X

Notes: In all regressions, firm and year fixed effects are included. Robust standard errors are corrected for clustering at the industry-year level in parentheses. Dependent variables are in log values.
Significance levels: * 10 percent, ** 5 percent, *** 1 percent.

Table (5) reports the impact of sanctions on men and women employed in manufacturing firms. Men were hardest hit by the sanctions with male employment decreasing by 16.2 percent compared to 7.5 percent for women. Wages dropped by 15.2 percent and 11.6 percent for men and women, respectively. Though men were hit harder by the sanctions in general, the lower panel of Table (5) shows that they were better off both in terms of employment and wages in SOEs (their employment levels and wages were 18.4 percent and 31.8 percent higher in SOEs compared to POEs in the aftermath of sanctions). While male employment levels dropped by 2 percent in SOEs when the firms were targeted, wages for men showed an increase of 10 percent after the sanctions. Impacts do not significantly differ for women's employment and wages between POEs and SOEs.

Table 5: Heterogeneous Impacts of Sanctions on Men and Women

Dependent variables are in log	Emp		Wages	
	Men	Women	Men	Women
Sanctions$_{jt}$	-0.177***	-0.078***	-0.166***	-0.123***
	(0.014)	(0.017)	(0.027)	(0.027)
Obs	48953	44250	64849	43821
Adjusted R-squared	0.920	0.816	0.869	0.789
Firm FEs + Year FEs	x	x	x	x
Heterogeneous impacts on SOEs				
Sanctions$_{jt}$	-0.189***	-0.081***	-0.181***	-0.130***
	(0.013)	(0.020)	(0.026)	(0.027)
SOEs ×*Sanctions$_{jt}$*	0.169***	0.065	0.276***	0.110
	(0.043)	(0.111)	(0.075)	(0.197)
Observations	47053	42446	62286	42045
Adjusted R-squared	0.922	0.818	0.871	0.790
Firm FEs + Year FEs	x	x	x	x

Notes: In all regressions, firm and year fixed effects are included. Robust standard errors are corrected for clustering at the industry-year level in parentheses. Dependent variables are in log values.
Significance levels: * 10 percent, ** 5 percent, *** 1 percent.

Conclusion

This paper studies the impacts of the 2012 sanctions on Iranian manufacturing firms. Our results show that sanctions depressed revenue, profits and productivity in both SOEs and private firms. Employment levels and wages, though, increased in SOEs, suggesting that, similarly to other countries, they were used to protect employees during periods of economic crisis. This, in turn, had adverse implications for Iran's fiscal position.

Moreover, we investigated the heterogeneous impacts of the sanctions across different types of employees. We found that low-skilled males were the most protected after the sanctions, which could help explain the productivity gap between SOEs and private firms. With respect to gender dynamics, although men were generally hit harder by the sanctions, they were also better supported in SOEs compared to women both in terms of wages (which increased for men and dropped for women) and with respect to employment levels (since male employment contracted by less than women's after the shock). These findings can be associated with parts of the Iranian Labor Law supporting employment in SOEs, introducing incentives in hiring unskilled employees and men, and disincentives in hiring women.

In terms of policy implications, SOEs' lack of flexibility in adjusting their workforce to protect employees during downturns negatively impacted profits and productivity and could create the need for government intervention and recapitalization. Assuming that the mandate of the government is to protect workers during recessions, it would be important to clarify the SOEs' objectives and whether avoiding layoffs achieves such objectives while minimizing the fiscal costs, or whether it would be better to support workers directly through unemployment insurance (as proposed in Richmond and others 2019). If the government chooses to help workers indirectly by keeping them employed, it would be important to treat workers in SOEs and private firms equally and set out clear policies and conditions for when to provide support to firms in order to minimize fiscal risks. If the government were interested in reducing discrimination against women and boosting their inclusion in the workforce, it could relax the law and allow women to work in all jobs while reducing the obstacles to their employment (e.g., the need to obtain their husbands' consent to be able to hire them).

Appendix I: Impacts of Sanctions on Trade in SOEs and POEs

Differences in trade patterns could explain why the impacts of sanctions were different on SOEs and POEs. We test this hypothesis in Table (A.1) that shows the impact of sanctions on both intensive margins (i.e. the average exports per exporting firm, or the average imports per importing firms) and extensive margins (i.e. number of exporting or importing firms) of the firms' trade. In particular, we estimate the impact of sanctions on the intensive margins of trade using the Poisson Pseudo Maximum Likelihood (PPML) estimation due to the presence of large frequency of zero trade values (Silva and Tenreyro 2006 and 2019). For a full discussion on the impacts of sanctions on intensive and extensive trade margins of Iranian firms see Ebadi (2021).

Table A 1: Impact of Sanctions on Firms' Exports (Ex) and Imports (Im)

	Intensive Margin		**Extensive Margin**	
	Ex_{it}	**Im_{it}**	**$Exporting_{i,t}$**	**$Importing_{i,t}$**
$Sanctions_{jt}$	-0.634*	-0.465***	0.004	-0.031**
	(0.325)	(0.167)	(0.006)	(0.015)
Observations	68980	69636	62017	64920
(Adjusted/Pseudo) R-squared	0.573	0.555	0.593	0.455
Heterogeneous impacts on SOEs				
$Sanctions_{jt}$	-1.920***	-0.712**	0.004	-0.036**
	(0.688)	(0.319)	(0.004)	(0.015)
SOEs ×$Sanctions_{jt}$	1.775**	0.501	-0.017	0.074
	(0.723)	(0.514)	(0.043)	(0.063)
Observations	68980	69636	59559	62353
(Adjusted/Pseudo) R-squared	0.573	0.555	0.595	0.458
Firm & Year Fes	X	X	X	X
Industry & Year Fes	X	X	X	X
Control × Year Fes	X	X	X	X

Notes: In all regressions, firm and year fixed effects are included. Robust standard errors are corrected for clustering at the industry-year level in parentheses. columns 1 and 2, include industry fixed effects with time-invariant firm observation interaction with year fixed effects to prevent the dropping of observations from the regressions. In column 3 (respectively, column 4), dependent variable is one if a firm is in at least one export market (respectively, import market). Pseudo R2s are reported for PPML estimations and adjusted R2s are reported for OLS regressions in columns 3 and 4.
Significance levels: * 10 percent, ** 5 percent, *** 1 percent.

Results in columns (1) and (2) show that sanctions reduced the average firm-level exports and imports by 47 percent and 37 percent, respectively, compared to firms not subject to sanctions. Columns (3) and (4) shows that the numbers of importing firms dropped by 3 percent, while the impact on exporting firms was not significant. But impacts on trade between POEs and SOEs were not significantly different (see lower panel of Table (A.1), except for a lower impact on exports for targeted SOEs). Due to the results from the table, we argue that it is unlikely that the differences between SOEs and POEs in the aftermath of sanctions are due to changes in firms' export and import channels. For example, while changing import and export patterns can have an impact on production costs and productivity (Blalock and Gertler, 2004, Van Biesebroeck, 2005, De Loecker, 2007, Topalova and Khandelwal, 2011, Gopinath and Neiman, 2014, Ebadi, 2021), the different impact of the sanctions on Iranian firms' productivity between SOEs and POEs cannot be explained through the changes in trade values. However, labor laws constrain SOEs relatively more than POEs by making it difficult for SOEs to lay off employees or decrease real wages, and incentivizing hiring during a downturn could be factors contributing to the more severe drop in productivity in SOEs.

Appendix II: TFP Estimation

To construct a measure of firm-level total factor productivity (TFP), we follow the methodology of Ackerberg et al. (2015) corrected for a functional dependence problem in production function estimation techniques introduced by Olley and Pakes (1992) (OP) and Levinsohn and Petrin (2003) (LP). Ackerberg et al. (2015) introduce an alternative estimation that inverts input demand functions conditional on labor input, while OP/LP input demand functions were unconditional. Using this method for LP intermediate input function, firm's raw material inputs are used as a proxy for unobserved productivity shocks to correct for simultaneity in the production function. We assume a Cobb-Douglas production function for each industry. Due to a small number of firms in 3-digit or 4-digit industries, the production function parameters were estimated at a 2-digit ISIC level industry. For each 2-digit industry level, we estimate the following equation:

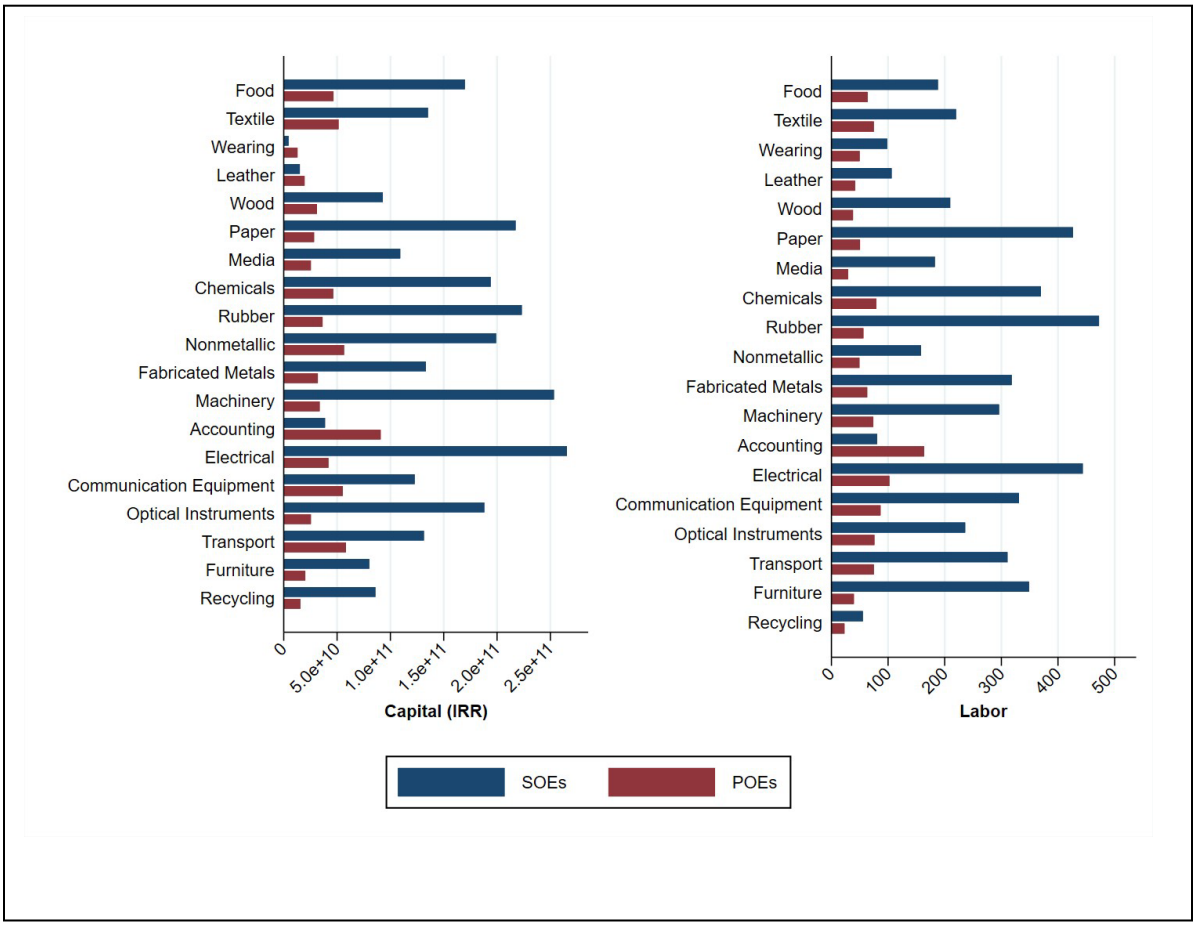
$$y_{ijt} = \beta_0 + \beta_1 l^S_{ijt} + \beta_2 l^U_{ijt} + \beta_3 k_{ijt} + \omega_{ijt} + \epsilon_{ijt}$$

where *y* denotes value-added, l^S denotes skilled labor, l^U denotes unskilled labor, and *k* denotes capital. All variables are in natural logarithm form. The simultaneity problem arises from the time-varying firm-specific productivity level, ω_{ijt}, that may be correlated with the firm's inputs. If the demand function of intermediate input, *m*, is strictly monotonic in firm's productivity of all levels of capital, $m_{ijt} = f_t(k_{ijt}, l^S_{ijt}, l^U_{ijt}, \omega_{ijt})$, then intermediate input m_{ijt} serves as a valid proxy. Inverting the raw materials demand function gives an expression for productivity as a function of capital and other firm-level inputs: $\omega_{ijt} = f_t^{-1}(k_{ijt}, l^S_{ijt}, l^U_{ijt}, m_{ijt})$.

Substituting this expression in the value-added equation, we estimate the coefficients on the variable inputs using semi-parametric techniques. In a second stage, the coefficients on the firm's inputs are estimated using GMM techniques to identify assumptions. Productivity follows a Markov process, and capital adjusts to productivity with a lag.

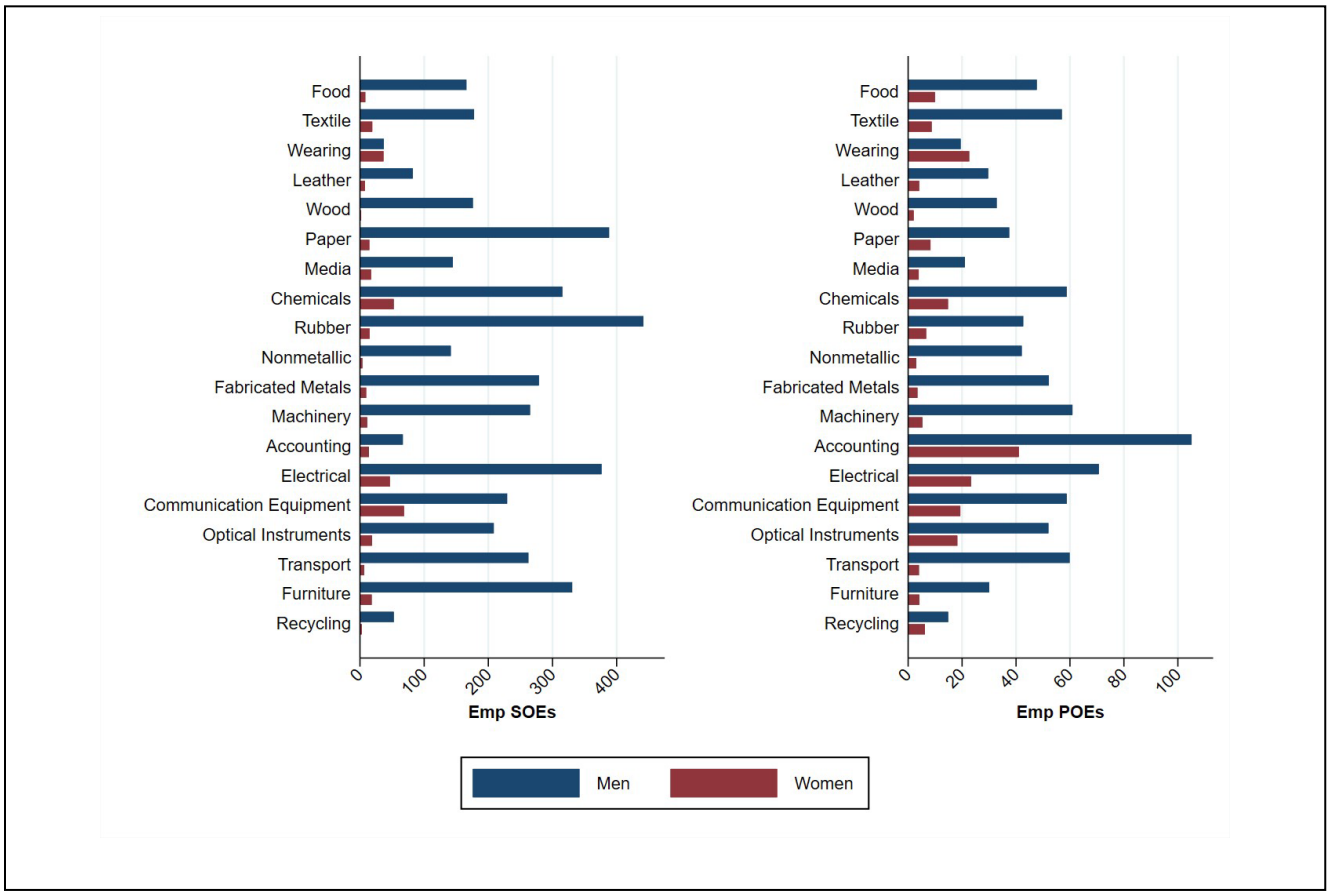
Appendix III: Figures

Figure A 1: Capital and Employment Levels in SOEs and POEs
(Excluding Basic Metals and Vehicle Industries)



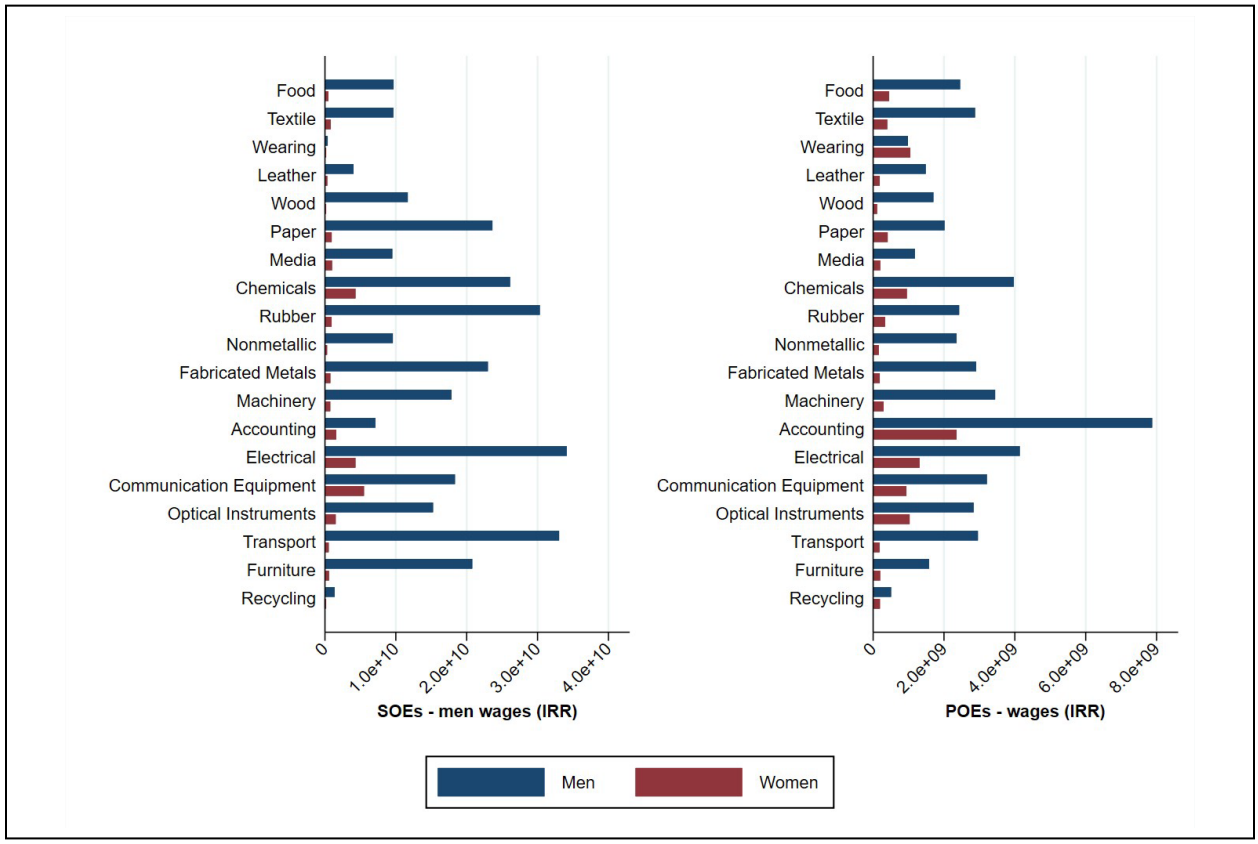
Notes: The left panel shows the average amount of capital used while the right panel presents the average number of employees in the average SOE and POE within each particular manufacturing industry in the sample period. On average, SOEs acquired more capital and hired more workers than private firms. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

Figure A 2: Male and Female Employment Levels in SOEs and POEs
(Excluding Basic Metals and Vehicle Industries)



Notes: The panels show the average number of employees (men and women) in the average SOE and POE within each manufacturing industry in the sample period. On average, SOEs hired more men than women relative to private firms. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

Figure A 3: Male and Female Wages in SOEs and POEs
(Excluding Basic Metals and Vehicle Industries)



Notes: The panels show the average level of wages for both men and women in the average SOE and POE within each manufacturing industry in the sample period. On average, SOEs paid more to men than women relative to private firms. The sample contains 130 4digit ISIC level industries in 21 broad 2digit ISIC level industries.

Appendix IV: Robustness Checks

Table A 2: Impact of Sanctions on Firms' Profits, Revenues, Employment Levels, and Wages (Including the Oil and Petrochemical Sector)

Dependent variables are in log	$Profit_{i,t}$	$Total\ Rev_{i,t}$	$Emp_{i,t}$	$Wage_{i,t}$
$Sanctions_{jt}$	-0.229**	-0.136**	-0.062*	-0.081**
	(0.092)	(0.069)	(0.037)	(0.037)
Observations	56183	64201	67281	67270
Adjusted R-squared	0.688	0.827	0.912	0.871
Firm FEs + Year FEs	X	X	X	X
Heterogeneous impacts on SOEs				
$Sanctions_{jt}$	-0.223***	-0.136**	-0.070*	-0.095**
	(0.084)	(0.066)	(0.039)	(0.037)
SOEs ×$Sanctions_{jt}$	-0.038	0.012	0.097**	0.163***
	(0.152)	(0.089)	(0.049)	(0.060)
Observations	53970	61624	64592	64581
Adjusted R-squared	0.690	0.828	0.913	0.875
Firm FEs + Year FEs	X	X	X	X

*Notes: In all regressions, firm and year fixed effects are included. Robust standard errors are corrected for clustering at the industry-year level in parentheses. Dependent variables are in log values. Significance levels: * 10 percent, ** 5 percent, *** 1 percent.*

References

Ackerberg, D. A., K. Caves, and G. Frazer (2015). Identification Properties of Recent Production Function Estimators. *Econometrica* 83(6), 2411–2451.

Blalock, G. and P. J. Gertler (2004). Learning from Exporting Revisited in a Less Developed Setting. *Journal of Development Economics* 75(2), 397–416.

Boubakri, N., J.-C. Cosset, and W. Saffar (2008). Political Connections of Newly Privatized Firms. *Journal of Corporate Finance* 14(5), 654–673.

Cao, Y., Z. Feng, M. Lu, and Y. Shan (2021). Tax Avoidance and Firm Risk: Evidence from China. *Accounting and Finance* (Parkville) 61(3), 4967–5000.

Chaney, T. (2008). Distorted Gravity: Heterogeneous Firms, Market Structure, and the Geography of International Trade. *American Economic Review* 98(4), 1707–1721.

Commission, E. (2016). State-owned Enterprises in the EU: Lessons Learnt and Ways Forward in a Post-Crisis Context. European Commission.

De Loecker, J. (2007). Do Exports Generate Higher Productivity? Evidence from Slovenia. *Journal of International Economics* 73(1), 69–98.

Demir, F. and S. S.Tabrizy (2021). Gendered Effects of Sanctions on Manufacturing Employment: Evidence from Iran. Mimeo.

Dewenter, K. L. and P. H. Malatesta (2001). State-Owned and Privately Owned Firms: An Empirical Analysis of Profitability, Leverage, and Labor Intensity. American Economic Review 91(1), 320–334.

Drury, A. C. and D. Peksen (2014). Women and Economic Statecraft: The Negative Impact International Economic Sanctions Visit on Women. European Journal of International Relations 20(2), 463–490.

Ebadi, Ebad, Adapting to Sanctions: Evidence from Firm Response and Market Reallocation in Iran (Jan 10, 2022). Available at SSRN: https://ssrn.com/abstract=4025431 or http://dx.doi.org/10.2139/ssrn.4025431

Ernesto Ramirez Rigo, Christine J. Richmond, Oluremi Akin Olugbade, Gareth Anderson, Maria Atamanchuk, Hatim Bukhari, Iacovos Ioannou, Deeksha Kale, Tannous Kass-Hanna, Maximilien Queyranne, Wei Shi and Joyce Wong (2021). State-Owned Enterprises in Middle East, North Africa, and Central Asia: Size, Role, Performance, and Challenges. IMF Departmental Paper 2021/019.

Goldberg, P. K., A. K. Khandelwal, N. Pavcnik, and P. Topalova (2010). Imported Intermediate Inputs and Domestic Product Growth: Evidence from India. The Quarterly Journal of Economics 125(4), 1727–1767.

Gopinath, G. and B. Neiman (2014). Trade Adjustment and Productivity in Large Crises. American Economic Review 104(3), 793–831.

Group, I. C. (2013). Spider Web: The Making and Unmaking of Iran Sanctions. Middle East Report N 138.

Gu, X., S. Ying, W. Zhang, and Y. Tao (2020). How Do Firms Respond to Covid-19? First evidence from Suzhou, China. Emerging Markets Finance and Trade 56(10), 2181–2197.

IMF (2020). Fiscal Monitor, April 2020. International Monetary Fund.

Jurzik, E. and C. Ruane (2021). Resource Misallocation Among Listed Firms in China: The Evolving Role of State-Owned Enterprises. IMF Working Paper, Volume 2021, Issue 075.

Laudati, D. and M. H. Pesaran (2021). Identifying the Effects of Sanctions on the Iranian Economy Using Newspaper Coverage. CESifo Working Paper No. 9217.

Lazzarini, S. G. and A. Musacchio (2018). State Ownership Reinvented? Explaining Performance Differences Between State-Owned and Private Firms. Corporate Governance: An International Review 26(4), 255–272.

Levinsohn, J. and A. Petrin (2003). Estimating Production Functions Using Inputs to Control for Unobservables. The Review of Economic Studies 70(2), 317–341.

OECD (2015). OECD Guidelines on Corporate Governance of State-Owned Enterprises, 2015 Edition. OECD Publishing.

Olley, G. S. and A. Pakes (1992). The Dynamics of Productivity in the Telecommunications Equipment Industry. Technical report, National Bureau of Economic Research.

Qi, H. and D. M. Kotz (2020). The Impact of State-Owned Enterprises on China's Economic Growth. Review of Radical Political Economics 52(1), 96–114.

Richmond, C. J., M. D. Benedek, E. Cabezon, B. Cegar, M. P. Dohlman, M. Hassine, B. Jajko, P. Kopyrski, M. Markevych, M. J. A. Miniane, et al. (2019). Reassessing the Role of State-Owned Enterprises in Central, Eastern and Southeastern Europe. IMF Departmental Paper Volume 2019, Issue 010.

Silva, J. S. and S. Tenreyro (2006). The Log of Gravity. The Review of Economics and Statistics 88(4), 641–658.

Silva, J. S. and S. Tenreyro (2011). Further Simulation Evidence on the Performance of the Poisson Pseudomaximum Likelihood Estimator. Economics Letters 112(2), 220–222.

Tao, Q., Y. Sun, Y. Zhu, and X. Yang (2017). Political Connections and Government Subsidies: Evidence from Financially Distressed Firms in China. Emerging Markets Finance and Trade 53(8), 1854–1868.

Topalova, P. and A. Khandelwal (2011). Trade Liberalization and Firm Productivity: The Case of India. Review of Economics and Statistics 93(3), 995–1009.

Van Biesebroeck, J. (2005). Exporting Raises Productivity in Sub-Saharan African Manufacturing Firms. Journal of International economics 67(2), 373–391.

Wang, K. T. and G. Shailer (2018). Does Ownership Identity Matter? A Meta-Analysis of Research on Firm Financial Performance in Relation to Government Versus Private Ownership. Abacus 54(1), 1–35.

PUBLICATIONS

How Do State Owned Enterprises Adjust During Downturns? Evidence from Iranian Manufacturing Firms

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