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RESEARCH ARTICLE

The Effect of Some Macroeconomic Variables on the Performance Indicators of Companies Listed on The Tehran Stock Exchange During Sanction Periods (before and after the JCPOA)

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Abstract

This study aims to investigate the effect of some macroeconomic variables on the performance indicators of companies listed on The Tehran Stock Exchange (selected industries) during sanction periods (before and after the Joint Comprehensive Plan of Action). This research is an applied and correlated study using deductive-inductive reasoning. Collected data is analyzed (financial reports). Therefore, this study is ex post facto. The sample of this study was collected over 11 years, spanning from 2010 to 2020, and included 181 firms listed on the Tehran Stock Exchange. Multivariate linear regression is conducted to test the hypotheses. The findings indicate that sanctions (both pre-and post-JCPOA) acted as moderators in the relationship between exchange rate fluctuations and firms' added value. Except for the automotive industry, sanctions (pre-and post-JCPOA) moderated the relationship between foreign investment and corporate investment activities in all industries. Sanctions (pre-and post-JCPOA) moderated the relationship between the production price index and corporate profitability in all industries except the automotive industry. Sanctions (pre-and post-JCPOA) moderated the relationship between the import of raw materials for intermediate and capital goods and corporate operational activities. America's withdrawal from Iran's nuclear deal, JCPOA, in 2018 caused great damage to Iran's economy. These sanctions are expected to have a more destructive impact on business enterprises in the post-JCPOA era. Testing the hypotheses, the results show that sanctions (pre-and post-JCPOA) moderated the relationship between the exchange rate fluctuations and corporate performance indicators. This research provides valuable insight into the sanction conditions and companies' reactions. It leads companies towards self-sufficiency and cooperation with knowledge-based firms for development and growth and reduces dependence on foreign resources and goods.

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1. Introduction

Countries use sanctions to persuade a government to change their policy. Sanction imposers force the targeted government to react in their favor. Economic sanctions are the most practical international bans, limiting the government in its international trading relationships. The objective of the sanctioning country is to impose high costs on the target country to coerce a policy change or attain a specific action from the target government, which will harm their resource allocation. Economic sanctions can vary from trade and trader barriers, limiting foreign investments, restrictions on financial transactions, stopping financial aid and avoiding technology updates.

America has always targeted Iran for sanctions, which greatly lowered Iran's economic ability. Imposed bans from 2012 to 2015, when Iran was under worldwide pressure, decreased oil exports enormously and prevented the government from repatriating approximately 120 billion dollars from foreign assets. According to the Joint Comprehensive Plan of Action (JCPOA), it was agreed to lift nuclear-related sanctions; however, primary US sanctions on Iran remained in place. These sanctions prohibit most commercial activities between the US and Iran. They banned Iran's advanced missile activities and Sepah Pasdaran. Iran's exports have increased by 7% from 2016 to 2017. However, on May 8th 2018, America withdrew from Iran's nuclear deal. Sanctions were reinstated in November 2018 (a 90-day plan) and expanded (a 180-day plan). The US Department of Treasury admitted Iran's sanction as one of the most restricted sanctions America has ever imposed on a country, significantly affecting the energy, shipping and financial sectors.

Iran has always been targeted for sanctions, especially after the 1979 revolution. The United States imposed the first sanctions when Dr Mosadegh was the prime minister. When oil nationalization was implemented, America and England, to control the plan, restricted Iran's only national income from exporting oil. Since the 1979 revolution, the United States has led international efforts to use sanctions to influence Iran's policy. Therefore, stronger economic sanctions were enforced by the United Nations Security Council in 2006 and the European Union in 2007.

However, America believed the imposed sanctions needed to be toughened; therefore,

First, they prohibited European countries from dealing with Iran by suggesting that it would be America or Iran with which they could trade.

Second, in 2002, attracting international and the United Nation's attention, they accused Iran of having a ballistic missile program.

Since America, England, France and Germany tried to stop Iran's nuclear program, the Atomic Energy Agency asked The United Nations Security Council to demand Iran suspend enrichment activities by issuing Resolution 1696, giving a 30-day deadline. Iran continued its program regardless of the mentioned resolution, which forced even European countries, who believed in encouraging politics rather than harsh sanctions (Ghasemi, 2014), to extend sanctions against Iran following the US. They imposed more economic embargoes against Iran in 2010, issuing the Resolution 1929. In 2012, they expanded the sanctions on the energy section and bank transactions.

Although Iran has always been boycotted since the 1979 revolution, it has never been under international pressure like it has been by the US and EU since 2010 (Khalatbari, 2018).

America used to impose embargoes on Iran for oil export, shipping lines, cargo, insurance, and financial sections. However, with the support of the EU and the United Nations, he prevented the circumvention of bans by imposing even tougher sanctions on small and medium enterprises, greatly affecting Iran's economy (Khalatbari, 2018).

The restrictive measures cause a decline in foreign exchange resources and a sharp increase in exchange rates, inflation and financial sanctions, which yield obvious results (Lopez, 2015). It decelerates economic development and commercial and financial relations between the sanctioning country and the targeted government (Hufbauer et al., 2009). Considering the above, this paper aims

to investigate the impacts of macroeconomic variables, i.e., real exchange rates (EXit), producer price index (PPIit), import of raw materials (IMit) and foreign direct investment (FDIit) on performance index, i.e., cash flow from operational activities (CFOit), cash flow from investment activities (CIFit), profitability (Iit)and firm added value (AVit) in listed companies on The The Tehran Stock Exchange in Pre- JCPOA (2010 to 2014), Joint Comprehensive Plan of Action- JCPOA (2015 to 2017) and Post- JCPOA (2018 to 2020) in selected industries (chemical, automobile manufacturing, pharmaceutical and steel). Four regression models are selected, tested, and analyzed considering four independent variables and hypotheses.

2. Literature

Many studies have examined the impact of macroeconomic variables on firm performance indexes. Notably, we distinguish each macroeconomic variable, its effects on firm performance and sanctions' impact on the relationship between macroeconomic variables and firm performance (Boyd et al., 2005; Ozmen et al., 2012; Bhattacharjee and Han, 2014; Barakat et al., 2016; Issah and Antwi, 2017; Doruk, 2023).

Oil is one of the most political commodities in Iran's economy due to its injection of revenue. Thus, it is used as a vulnerable lever to put pressure on the Iranian economy. Export sanctions, Central Bank sanctions and currency fluctuations profoundly affect production (Nademi and Hasanvand, 2018). Sanctions on energy sources not only have severe consequences on exports, but they also affect petrochemical exports. Iran used to enjoy a strategic location, which resulted in outstanding development in petrochemical exports. However, imposed sanctions limited petrochemical exports (Amini and Zare, 2017). From 2012 to 2013, the restrictions on financial transactions led to a severe decline in the import of auto parts, approximately halved compared with previous years. The automobile industry's dependency on the import of auto parts shows its vulnerability to the sanctions. The sanctions influence the banking system since international banks refuse to cooperate with Iranian banks. Unclear economic status puts firms at higher risks in terms of investment.

This paper considers four dependent variables: added value, investment, profitability and operational activities.

Economic sanctions adversely affect society's welfare by reducing the added value of beneficiaries (shareholders, clients, governments, lenders and other beneficiaries).

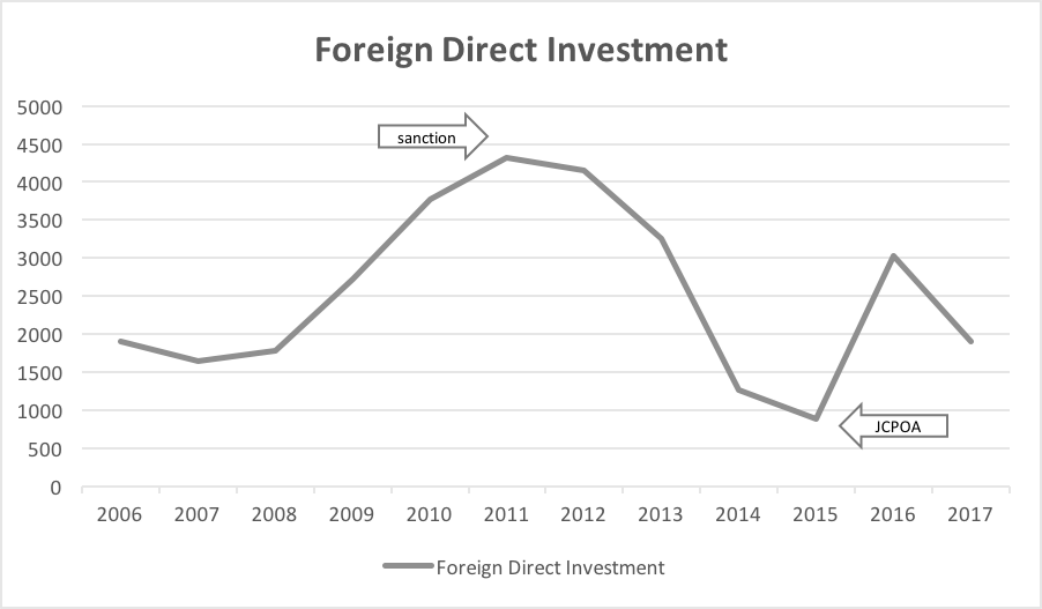
Sanctions have been used to advance a range of foreign policy goals. One of which is to isolate the target country from interacting internationally, mainly in three sections:

1. Technology
2. Trading
3. Banks and financial institutions

Therefore, sanctions disrupted transactions and reduced cash flows (Fakhari et al. 2012).

The Central Bank of Iran (CBI) lost control over exchange rate fluctuations, which enormously inflated the exchange rate. Sanctions postponed the cash flow from exporting oil from 1 to 5 months in 2005; therefore, the CBI could not maintain the market's equilibrium. Undeveloped countries depend on industrialized countries to import raw materials, technology and machinery. If exchange rates rise due to sanctions, reduced exchange resources, and economic changes, firms will be forced to pay larger amounts to source their needs. Observing companies from 2014 to 2020 indicated that although it results in income enlargement, it increases the expenses accordingly, resulting in an excess of expenses over income and, consequently, a decline in added value. Therefore, the exchange rate directly relates to added value (Izadi and Izadi, 2007).

Iran's average foreign direct investment (FDI) was 4 billion dollars in 2004, and more than 50% belonged to the petroleum, automobile manufacturing, pharmaceutical, and steel sectors.

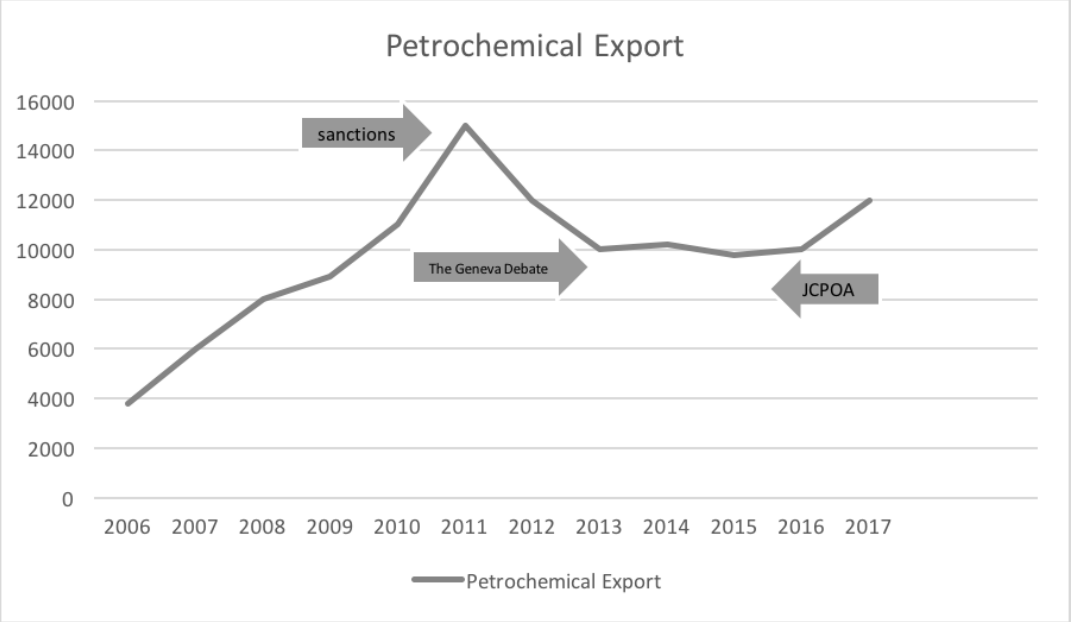


Source: Central Bank of Iran

Figure 1. Foreign Direct Investment

Foreign investors focus more on petroleum, automobile manufacturing, copper extraction, and the food and pharmaceutical industries. Iran attracted 34.6 billion dollars in foreign direct investment from 1992 to 2009 and has completed over 485 projects.

Sanctions not only deduct the raw materials, intermediate goods and capital goods' imports but also add import expenses and the cost of goods sold. The ascending exchange rate trend directly modifies production expense and negatively relates to profitability. Consequently, their production capacity will be lower, and their competition in international markets will be questioned. For instance, the petrochemical and automobile manufacturing industries seriously suffered from sanctions. The production of petrochemical products is significantly inclined due to the ban on selling raw materials, the purchase of final products and updating maintenance technology from 2006 to 2017 (the Parliament Research Center, 2017).



Source: Central Bank of Iran

Figure 2. Petrochemical Export from 2006 to 2017

Automobile spare part imports rose to 3.2 billion dollars in 2014, but sanctions played an important role in quality by importing from countries like China (Parliament Research Center, 2017).

The import of raw materials, intermediate goods and capital goods also decreased from 26.6% to 7.4% from 2012 to 2015.

Sanctions affect the currency market, causing an obstacle to access to the target country's financial sources, reducing international trading and direct investment, deducting export revenue, and increasing import volume. Limiting foreign trading and industrial activities leads to unemployment. Forcedly, goods are bought at higher rates; thus, inflation rises.

Arratibel et al. (2011) claimed that a decline in currency fluctuation results in economic development. Ozmen et al. (2012) believed that the exchange rate negatively relates to firm performance. However, financial growth and gross domestic product directly impact performance. Vătavu (2014) stated that the interaction of inflation and the crisis has a negative effect on company performance in the Romanian economy. Chikeziem and Ikenna (2016) believe no significant relationship has been concluded between Nigeria's currency rates and economic development. Barguellil et al. (2018) claimed that currency fluctuations negatively affect economic growth. Wesseh and Lin (2018) stated that a reduction in currency rate results in an increase in gross domestic product; however, a rise in currency rate has no significant effect on production. Korotin et al. (2019) imposed sanctions from 2014 to 2015, and Ruble rates are unrelated. Ahn and Ludema (2020) compared sanctioned and non-embargoed firms. Their results showed that sanctioned firms faced huge losses and reductions in asset values. Huynh et al. (2022) found that imposed sanctions have no impact on the energy sector; however, they affect other sectors in Russia. He claimed that sanctions are related negatively to capital costs and research and development but positively affect political risks. Azhdari et al. (2016) found that a 100% increase in currency rate rises 13% of the added value of the industry sector. Tehranchian et al. (2017) claimed that exchange rate fluctuations positively and negatively affect production in lower than threshold areas and higher than threshold areas, respectively. Predicted and unforeseen impulses in currency rates are negatively correlated with production. In the service sectors, exchange rate fluctuations are negatively correlated with production in lower than

threshold areas, but in higher than threshold areas, they are positively related. However, currency fluctuations have a neutral effect on production in the agriculture sector. It is recommended that governments make more transparent decisions due to the power of predicted impulses of the exchange rates. Considering the above, the following is the first hypothesis:

H1: Sanctions (pre-and post-JCPOA) are moderated in the relationship between exchange rate fluctuations and the firm's added value.

Reduction in trading and foreign investment resulting from sanctions imposes severe economic constraints and forces countries to change their economic policies, which results in a fall in exchange rates. Moreover, a lack of international trust in the target country's banking system causes a reduction in foreign investments.

Fadhil and Almasafir (2015) believed that foreign direct investment and human resources greatly help economic growth. However, technology obtained from foreign direct investment is not sufficiently combined with human resources to lead to economic growth.

Mirkina (2018) expressed that the impact of sanctions on foreign investments varies over time depending on the cost of sanctions, the initially imposed sanctions and the decades. Expensive sanctions lead to a significant decrease in direct investment in the short term, although they have no long-term impact. In the 1990s, direct investment had negative effects in short term runs; however, it liquidates through time.

Le and Bach's (2022) study showed that sanctions' impact on direct investment varies when different embargoes are imposed. Foreign investment reduces significantly during and after the crisis period.

Nguyen et al. (2022) concluded that sanctions destructively affect foreign investment. Considering the above, the following is the second hypothesis:

H2: Sanctions (pre-and post-JCPOA) are moderated in the relationship between direct foreign investment and firm investment activities.

The rise in the producer price index is directly correlated with an increase in the producer cost, reducing firm profitability. Since profitability is considered a factor of economic growth, it is directly affected by the impact of sanctions on sales and purchase rates (Ahn and Ludema, 2020). Developing economies are more vulnerable to macroeconomic conditions (Doruk, 2023). Sanctioned countries are more exposed to export and import costs and less likely to find suppliers. One of the main effects of embargoes is the increase in the cost of investments. Companies are forced to hire more employees to increase production. Obviously, the prices of the goods are boosted, inflation is created, and export profits decline dramatically.

Karshenasan and Soleimani (2014) expressed that sanctions and profitability are negatively related.

Kimasi et al. (2015) believed sanctions imposed on the target country's banking system have negative effects on profitability (ROA and ROE rates). Banks' refusal to provide LC services indirectly affects ROA and ROE.

Ezzati et al. (2019) found that production reduction from sanctions decreased employment in Iran's industrial sector. Considering the above, the following is the third hypothesis:

H3: Sanctions (pre-and post-JCPOA) play a moderator role in the relationship between the production cost index and firm profitability.

Increasing acceleration of countries' reciprocal dependency, stable development, productive production and modern goods are believed to be the primary means of success (Glöser et al. 2015). Companies have no choice but to update their production lines to adapt to the market needs (Hsu et al., 2014). Therefore, the inquiry for imports increases, greatly affecting the dependent companies

that import (Ahn and Ludema, 2020).

Sanctions limit companies' access to potential imported goods, which causes disruption in product processing plans, supply chain management, and material and resource management, ultimately reducing cash flow (Cimprich et al., 2018).

Sucky and Zitzmam (2018) and Georgise et al. (2014) claimed that importing raw materials benefits firms in terms of efficiency, creativity, flexibility and productivity. Thus, its effect on cash flow from operational activity is undeniable. However, Foroutan (1996) reported that the impact of imports on profit-cost margin is negative and neglectable.

Garshasbi and Dindarlou (2015) stated a positive relationship exists between international sanctions and Iran's macroeconomic variables, such as business, investment, employment, and economic growth. A direct relationship between sanction severity and its effects on economic factors was found. Considering the above, the following is the fourth hypothesis:

H4: Sanctions (pre-and post-JCPOA) play a moderator role in the relationship between the import of intermediate and investing in raw materials and firm operational activities.

3. Research Design and Variables

All firms on the Tehran Stock Exchange meeting the following criteria are included in our sample. Table 1 shows the sample and our sorting strategy.

Table 1. Sample

	The number of listed companies until 2021	**680**
First sort	Lack of access to financial information	9
Second sort	Active transactions after 6 months	34
Third sort	Listed after 2002	121
Fourth sort	Non-chemical, pharmaceutical, automobile and steel listed companies	335
	Number of companies	181

To test hypothesis 4, dependant variables are employed as performance indicators (added-value, profitability, cash flows and investement).

The following regression model is used to test the first hypotheses:

Equation 1)

$$AV_{it} = \alpha\alpha_0 + \beta_1 EX_{it} + \beta_2 FDI_{it} + \beta_3 PPI_{it} + \beta_4 IM_{it} + \beta_5 JCPOA_{it} + \beta_6 EX_{it} * JCPOA + \beta_7 Size_{it} + \beta_8 CPI_{it} + \beta_9 GDPR_{it} + \beta_{10} SHIM_{it} + \beta_{11} LIQ_{it} + \beta_{12} SQ_{it} + \beta_{13} IQ_{it} + \beta_{14} B\ Hold_{it} + \beta_{15} ROA_{it} + \varepsilon_{it}$$

The following regression model is used to test the second hypothesis:

Equation 2)

$$CFI_{it} = \alpha\alpha_0 + \beta_1 EX_{it} + \beta_2 FDI_{it} + \beta_3 PPI_{it} + \beta_4 IM_{it} + \beta_5 JCPOA_{it} + \beta_6 FDI_{it} * JCPOA + \beta_7 Size_{it} + \beta_8 CPI_{it} + \beta_9 GDPR_{it} + \beta_{10} SHIM_{it} + \beta_{11} LIQ_{it} + \beta_{12} SQ_{it} + \beta_{13} IQ_{it} + \beta_{14} B\ Hold_{it} + \beta_{15} ROA_{it} + \varepsilon_{it}$$

The following regression model is used to test the third hypothesis:

Equation 3)

$$I_{it} = \alpha\alpha_0 + \beta_1 EX_{it} + \beta_2 FDI_{it} + \beta_3 PPI_{it} + \beta_4 IM_{it} + \beta_5 JCPOA_{it} + \beta_6 PPI_{it} * JCPOA + \beta_7 Size_{it} + \beta_8 CPI_{it} + \beta_9 GDPR_{it} + \beta_{10} SHIM_{it} + \beta_{11} LIQ_{it} + \beta_{12} SQ_{it} + \beta_{13} IQ_{it} + \beta_{14} B\ Hold_{it} + \beta_{15} ROA_{it} + \varepsilon_{it}$$

The following regression model is used to test the fourth hypothesis:

Equation 4)

$$CFO_{it} = \alpha\alpha_0 + \beta_1 EX_{it} + \beta_2 FDI_{it} + \beta_3 PPI_{it} + \beta_4 IM_{it} + \beta_5 JCPOA_{it} + \beta_6 IM_{it} * JCPOA + \beta_7 Size_{it} + \beta_8 CPI_{it} + \beta_9 GDPR_{it} + \beta_{10} SHIM_{it} + \beta_{11} LIQ_{it} + \beta_{12} SQ_{it} + \beta_{13} IQ_{it} + \beta_{14} B\ Hold_{it} + \beta_{15} ROA_{it} + \varepsilon_{it}$$

The above models are conducted and analyzed in four sectors on The Tehran Stock Exchange: petrochemical, automobile manufacturing, pharmaceutical and steel.

Table 2. Variables

Variable Type	Details	Measurement
Dependent	Added-value	Net method= profit of stopped performance+ investment return+ cost of goods purchased- operating income
Dependent	Investment	Net cash flows from investment activities
Dependent	Profitability	Net profit/loss
Dependent	Operating activities	Net cash flows from operating activities
Independent	Exchange rate fluctuations	Real exchange rate fluctuations
Independent	Foreign Direct Investment	Foreign direct investment
Independent	Cost of production index	Cost of production index
Independent	Intermediate goods import	Intermediate and capital goods import
Dummy	Sanctions	During pre-JCPOA and post-JCPOA, is one; otherwise zero
Control	Inflation rate	Consumers price index
Control	Firm size	Natural Logarithm of sale and asset average sum
Control	Gross production growth	The cost of goods produced
Control	Share growth index	Dividing the market price of shares by their price on a chosen date (origin date)
Control	Liquidity growth index	Summing up the positive and negative cash flows and calculating the monetary ratio
Control	Sale quality	Dividing the cash flow from sale by the total sale
Control	Profit quality	Dividing cash flows from operational activities by total assets
Adjusted	Government ownership and influence	If the biggest investor is the government, it is one; otherwise, it is zero.
Adjusted	Return on Assets	Dividing net profit by total assets
Adjusted	Return on Equity	Dividing net profit by equity

4. Findings

4.1 Descriptive statistics

A sample of 181 firms from 2010 to 2020 is chosen to test the hypothesis. The following are the results.

Table 3. Descriptive statistics

Variables	Average	Median	Maximum	Minimum	Standard Deviation	Sample
Added-value	-0.159	-0.071	0.990	-0.989	0.419	1991
Investment	0.071	0.049	0.597	-0.0107	0.079	1991
Profitability	0.156	0.131	0.660	-0.362	0.160	1991
Operating activities	0.115	0.090	0.831	-0.399	0.149	1991
Exchange rate fluctuations	0.402	0.214	1.631	0.022	0.472	1991
Foreign Direct Investment	0.554	0.056	6.335	-0.720	1.863	1991
Cost of production index	0.278	0.3240	0.675	0.049	0.182	1991
Intermediate goods import	0.266	0.030	3.150	-0.223	0.919	1991
Sanctions	0.636	0.000	1.000	0.000	0.481	1991
Firm size	14.777	14.611	20.768	10.031	1.905	1991
Inflation rate	0.231	0.220	0.410	0.090	0.114	1991
Gross production growth	1.845	3.000	7.400	-6.800	4.024	1991
Share growth index	0.643	0.468	1.870	-0.208	0.632	1991
Liquidity growth index	0.278	0.251	0.406	0.201	0.066	1991
Sale quality	0.135	0.107	0.967	-0.769	0.201	1991
Profit quality	0.203	0.160	1.392	-0.695	0.273	1991
Government ownership and influence	0.157	0.078	0.991	0.000	0.208	1991
Return on Assets	0.134	0.113	0.764	-0.600	0.177	1991

4.2 Normal distribution test

One of the criteria that needs to be examined to test the hypothesis is the normal distribution test for dependent variables.

Table 4. Normal Distribution Test

Variable	Jarque-Bera Test	Value
Added-value	5.652	0.069
Investment activities	4.420	0.072
Profitability	5.420	0.069
Operational activities	4.964	0.714

According to Table 4, the distribution for dependent variables is normal.

4.3 First hypothesis result

Add value is used as the dependent variable to test the first hypothesis. The independent variable is exchange rate fluctuations, and the dummy variable is sanction.

Table 5. First Hypothesis Result (Added-value)

Variables	Sample		Automobile Manufacturing		Petrochemical		Pharmaceutical		Steel	
	Coefficient	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**
Exchange rate fluctuation	0.019	0.028	0.075	0.001	0.001	0.014	0.001	0.001	-0.001	0.204
Foreign Direct Investment	-0.021	0.000	0.015	0.001	-0.001	0.001	-0.001	0.436	-0.001	0.004
Cost of production index	-0.260	0.000	-0.292	0.001	-0.013	0.001	-0.001	0.004	-0.001	0.268

Intermediate goods import	0.034	0.000	0.032	0.001	0.001	0.007	-0.001	0.393	0.001	0.011
Exchange rate fluctuation*sanction	-0.442	0.000	-0.452	0.001	-0.014	0.001	-0.001	0.038	-0.002	0.050
Firm size	0.053	0.000	0.001	0.058	0.003	0.003	-0.001	0.937	0.001	0.067
Inflation rate	-0.788	0.000	1.573	0.001	-0.019	0.038	0.001	0.242	-0.006	0.027
Gross production growth	-0.010	0.001	0.015	0.001	-0.001	0.016	0.001	0.019	-0.001	0.004
Share growth index	0.047	0.001	-0.168	0.001	0.001	0.877	-0.001	0.679	0.001	0.179
Liquidity growth index	0.551	0.000	0.427	0.001	0.025	0.001	0.001	0.019	0.003	0.001
Sale quality	0.117	0.001	-0.001	0.721	0.004	0.040	0.001	0.007	0.002	0.007
Profit quality	0.037	0.006	0.001	0.253	-0.001	0.474	0.001	0.366	-0.001	0.082
Government ownership and influence	-0.033	0.040	-0.001	0.004	-0.001	0.738	-0.001	0.329	0.001	0.170
Return on Assets	0.387	0.000	0.001	0.056	0.010	0.001	0.001	0.001	0.004	0.001
Width Origin	-0.931	0.000	-0.492	0.000	0.234	0.003	0.319	0.005	0.291	0.001
AR (1)	-	-	0.293	0.000	0.234	0.003	0.319	0.005	0.291	0.001
Adjusted coefficient	0.915		0.988		0.983		0.841		0.764	
Durbin-Watson	1.526		1.825		1.677		2.039		1.930	
F Value	0.000		0.000		0.000		0.000		0.000	
	Probability	Result	Probability	Result	Probability	Result	Probability	Result	Probability	Result
Variance heterogeneity	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar
Autocorrelation	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed
Limer	0.000	panel	0.000	panel	0.000	panel	0.000	panel	0.000	panel
Hausman	0.000	constant	0.048	constant	0.000	constant	0.012	constant	0.017	constant

The probability value of the overall coefficient statistic (F statistic) is smaller than 5% in all cases, which indicates that the regression has the necessary statistical validity.

4.4 Second hypothesis result

Investment activities are used as the dependent variable to test the second hypothesis. The independent variable is foreign direct investment and the dummy variable is sanction.

Table 6. Second Hypothesis Result (Investment activities)

Variables	Sample		Automobile Manufacturing		Petrochemical		Pharmaceutical		Steel	
	Coefficient	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**
Exchange rate fluctuation	-0.120	0.001	0.001	0.001	-0.001	0.076	-0.001	0.009	-0.001	0.000
Foreign	-0.007	0.00	-0.001	0.80	-0.001	0.06	-0.001	0.00	-0.001	0.00

Direct Investment		0		0		5		0		0
Cost of production index	0.029	0.019	-0.001	0.002	0.003	0.144	0.001	0.009	0.003	0.001
Intermediate goods import	-0.002	0.000	0.001	0.002	-0.001	0.003	-0.001	0.912	-0.001	0.031
Exchange rate fluctuation*sanction	-0.009	0.000	-0.001	0.513	-0.001	0.016	-0.001	0.000	-0.001	0.000
Firm size	-0.008	0.001	-0.001	0.094	-0.001	0.293	0.001	0.499	-0.001	0.001
Inflation rate	0.038	0.002	0.001	0.001	0.004	0.269	-0.001	0.533	-0.003	0.000
Gross production growth	0.001	0.003	0.001	0.002	0.001	0.228	-0.001	0.798	-0.001	0.000
Share growth index	-0.006	0.001	-0.001	0.000	-0.001	0.046	-0.001	0.139	0.001	0.001
Liquidity growth index	-0.050	0.004	0.002	0.000	-0.008	0.040	-0.001	0.013	-0.005	0.000
Sale quality	-0.014	0.016	0.001	0.975	-0.003	0.001	0.001	0.878	0.001	0.506
Profit quality	0.061	0.000	0.001	0.001	0.007	0.000	0.001	0.001	0.000	0.247
Government ownership and influence	-0.009	0.016	-0.001	0.013	-0.001	0.201	-0.001	0.103	0.001	0.162
Return on Assets	0.001	0.916	-0.001	0.091	0.001	0.065	0.001	0.502	0.001	0.588
Width Origin	0.196	0.000	0.009	0.000	0.034	0.000	0.017	0.000	0.018	0.000
AR (1)	0.222	0.001	0.482	0.001	-	-	-	-	0.206	0.012
Adjusted coefficient	0.744		0.792		0.742		0.899		0.793	
Durbin-Watson	2.077		2.142		1.524		1.694		2.087	
F Value	0.000		0.000		0.000		0.000		0.000	
	Probability	Result	Probability	Result	Probability	Result	Probability	Result	Probability	Result
Variance heterogeneity	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar
Autocorrelation	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed
Limer	0.000	panel	0.000	panel	0.000	panel	0.000	panel	0.000	panel
Hausman	1.000	random	0.000	constant	0.000	constant	0.001	constant	0.123	random

The probability value of the overall coefficient statistic (F statistic) is smaller than 5% in all cases, which indicates that the regression has the necessary statistical validity.

4.5 Third hypothesis result

To test the third hypothesis, profitability is used as the dependent variable. The independent variable is the cost of production index, and the dummy variable is sanction.

Table 7. Third Hypothesis Result (Profitability)

Variables	Sample		Automobile Manufacturing		Petrochemical		Pharmaceutical		Steel	
	Coefficient	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**	**Coefficient**	**Value**
Exchange rate fluctuation	0.023	0.060	-0.001	0.003	0.006	0.001	0.001	0.001	-0.006	0.000
Foreign Direct Investment	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.000
Cost of production index	-0.063	0.154	0.003	0.005	0.024	0.024	-0.001	0.006	0.024	0.000
Intermediate goods import	0.001	0.877	-0.001	0.345	-0.001	0.751	-0.001	0.131	-0.001	0.959
Exchange rate fluctuation*sanction	-0.216	0.020	0.001	0.541	-0.010	0.031	-0.002	0.000	-0.034	0.000
Firm size	0.003	0.137	-0.001	0.059	0.001	0.395	-0.001	0.070	0.001	0.348
Inflation rate	0.023	0.707	-0.003	0.049	0.008	0.435	0.002	0.001	-0.036	0.000
Gross production growth	-0.001	0.236	-0.001	0.012	-0.001	0.010	0.001	0.000	-0.001	0.000
Share growth index	0.005	0.624	0.001	0.201	-0.001	0.564	-0.001	0.264	0.001	0.079
Liquidity growth index	0.225	0.011	-0.004	0.062	0.050	0.006	0.002	0.001	-0.038	0.000
Sale quality	-0.009	0.335	-0.001	0.385	-0.009	0.005	-0.001	0.880	0.001	0.129
Profit quality	0.069	0.001	0.001	0.053	0.010	0.001	0.001	0.040	0.001	0.446
Government ownership and influence	0.005	0.600	-0.001	0.526	0.002	0.142	-0.001	0.568	0.001	0.719
Return on Assets	0.788	0.000	0.007	0.001	0.104	0.000	0.001	0.002	0.023	0.000
Width Origin	-0.076	0.011	0.016	0.000	0.017	0.625	0.040	0.000	0.056	0.000
AR (1)	-	-	0.358	0.001	0.408	0.001	0.529	0.001	0.590	0.001
Adjusted coefficient	0.791		0.679		0.888		0.948		0.841	
Durbin-Watson	1.572		1.959*		1.919		1.849		1.773	
F Value	0.000		0.000		0.000		0.000		0.000	
	Probability	Result	Probability	Result	Probability	Result	Probability	Result	Probability	Result
Variance heterogeneity	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar
Autocorrelation	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed
Limer	0.000	panel	0.000	panel	0.000	panel	0.000	panel	0.000	panel
Hausman	0.212	random	0.000	constant	0.000	constant	0.001	constant	0.471	random

The probability value of the overall coefficient statistic (F statistic) is smaller than 5% in all cases,

which indicates that the regression has the necessary statistical validity.

4.6 Forth hypothesis result

Operational activities are used as the dependent variable to test the fourth hypothesis. The independent variable is intermediate, capital goods import and the dummy variable is sanction.

Table 8. Fourth Hypothesis Result (Operational activities)

Variables	Sample		Automobile Manufacturing		Petrochemical		Pharmaceutical		Steel	
	Coefficient	Value	Coefficient	Value	Coefficient	Value	Coefficient	Value	Coefficient	Value
Exchange rate fluctuation	0.010	0.004	-0.001	0.076	0.009	0.016	0.021	0.001	-0.002	0.622
Foreign Direct Investment	0.004	0.001	-0.001	0.042	0.002	0.056	0.005	0.014	0.001	0.336
Cost of production index	-0.019	0.058	0.005	0.180	-0.044	0.001	-0.061	0.009	0.041	0.021
Intermediate goods import	0.002	0.001	0.001	0.001	-0.001	0.152	0.005	0.001	0.002	0.007
Exchange rate fluctuation*sanction	-0.108	0.003	-0.015	0.106	-0.062	0.038	-0.090	0.071	0.070	0.124
Firm size	-0.003	0.010	-0.001	0.825	0.001	0.193	-0.005	0.001	-0.003	0.070
Inflation rate	0.056	0.005	-0.013	0.035	0.074	0.004	0.126	0.003	-0.101	0.007
Gross production growth	0.001	0.002	-0.001	0.021	0.001	0.017	0.002	0.002	-0.001	0.307
Share growth index	-0.002	0.135	0.001	0.014	-0.004	0.011	-0.009	0.021	0.007	0.003
Liquidity growth index	0.031	0.107	-0.006	0.332	0.056	0.009	0.034	0.387	0.047	0.137
Sale quality	0.041	0.000	0.019	0.001	-0.026	0.001	0.055	0.002	0.002	0.828
Profit quality	0.485	0.000	0.001	0.773	0.100	0.000	0.055	0.001	0.125	0.000
Government ownership and influence	0.001	0.899	0.001	0.327	0.004	0.031	-0.012	0.001	0.012	0.215
Return on Assets	0.026	0.000	-0.001	0.339	0.009	0.202	0.007	0.429	0.031	0.071
Width Origin	0.031	0.004	0.016	0.000	-0.011	0.222	0.052	0.003	0.039	0.018
Adjusted coefficient	0.987		0.437		0.813		1.177		0.233	
Durbin-Watson	2.373		2.054		1.795		1.744		1.585	
F Value	0.000		0.000		0.000		0.000		0.000	
	Probability	Result	Probability	Result	Probability	Result	Probability	Result	Probability	Result
Variance heterogeneity	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar	0.000	dissimilar
Autocorrelation	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed	0.000	confirmed
Limer	0.001	panel	0.000	panel	0.000	panel	0.000	panel	0.000	panel
Hausman	0.000	constant	0.000	constant	0.000	constant	0.01	constant	0.724	random

The probability value of the overall coefficient statistic (F statistic) is smaller than 5% in all cases, which indicates that the regression has the necessary statistical validity.

The summary of findings is indicated in Table 9:

Table 9. Findings summary

Hypotheses	Sections	Results
Sanctions (pre-and post-JCPOA) have a moderating role in the relationship between exchange rate fluctuations and added value.	All Sections	Confirmed
	Automobile Manufacturing	Confirmed
	Petrochemical	Confirmed
	Pharmaceutical	Confirmed
	Steel	Confirmed
Sanctions (pre-and post-JCPOA) have a moderating role in the relationship between foreign direct investment and investment activities.	All Sections	Confirmed
	Automobile Manufacturing	Rejected
	Petrochemical	Confirmed
	Pharmaceutical	Confirmed
	Steel	Confirmed
Sanctions (pre-and post-JCPOA) have a moderating role in the relationship between the cost of production index and profitability.	All Sections	Confirmed
	Automobile Manufacturing	Rejected
	Petrochemical	Confirmed
	Pharmaceutical	Confirmed
	Steel	Confirmed
Sanctions (pre-and post-JCPOA) have a moderating role in the relationship between intermediate and capital goods import and operational activities.	All Sections	Confirmed
	Automobile Manufacturing	Rejected
	Petrochemical	Confirmed
	Pharmaceutical	Rejected
	Steel	Rejected

5. Conclusion

This study aimed to examine the impact of macroeconomic factors during sanctions (pre- and post-JCPO) on firm performance indicators in selected industries in listed companies on the Tehran Stock Exchange. The sample of this study is collected over 11 years spanning from 2010 to 2020, including 181 firms listed on the Tehran Stock Exchange.

The results indicated that sanctions increase the exchange rate fluctuations; therefore, companies need to buy their required capital goods at a higher price. This increases the required capital and raises the cost of goods produced. Consequently, the national currency drops, the cost of production increases, and stagnation and industry bankruptcy are caused. Risks in investing internally and internationally in Iran increase significantly due to the fluctuations of exchange rates, and consequently, production insufficiency leads to the decline of firms' added value. Therefore, there is a negative relationship between sanctions and the relationship between exchange rate fluctuations and the firm's added value. The results of our study comply with the results from Arratibel et al. (2011), Ozmen et al. (2012), Vătavu (2014), Barguellil et al. (2018), Ahn and Ludema (2020), Huynh et al. (2022), Doruk (2023) and Tehranchian et al. (2017). However, the results are in contrast with the findings from Chikeziem and Ikenna (2016), Wesseh and Lin (2018) and Azhdari et al. (2016).

The impact of sanctions on different economic sectors such as trading, investment and employment, is undeniable. Sanctions avoid attracting foreign investors. Therefore, foreign investments in companies listed on the Tehran Stock Exchange declined due to the sanctions. Sanctions denigrate Iran's market as a high-risk investing option, which prevents foreign investors from injecting money into the market. Thus, sanctions (pre-and post-JCPOA) and the relationship between direct foreign investment and firm investment activities are negatively related in all sectors except automobile manufacturing. Our findings are in line with the results from Pegkas (2015), Fadhil and Almsafir (2015), Mirkina (2018), Le and Bach (2022), Nguyen et al. (2022), Ezzati et al. (2019) and Garshasbi and Dindarlou (2015).

Reducing the import of raw materials, intermediate and capital goods, and sanctions causes an increase in the cost of domestic products by multiplying the import costs. As the rate of exchange gets higher, the cost of product index and cost of production increase. As a result, the production capacity is reduced, so the products cannot compete in the international market. The above has negative effects on firm profitability. Our findings show that sanctions (pre-and post-JCPOA) and the relationship between the production cost index and firm profitability are indirectly related. The results are in line with Barry and Kleinberg (2015), Doruk (2023), Ezzati et al. (2019), Kimasi et al. (2015), Garshasbi and Dindarlou (2015), Karshenasan and Soleimani (2014). However, they contradict the results from Korotin et al. (2019).

With the increase of exchange rates and import costs, foreign investments and national currency values descend, reducing export prices and multiplying the import prices. Sanctions obligate companies to import their capital goods at a higher price, which requires larger amounts of capital. Weaker national currency and ascending production costs lead to stagnation and industry bankruptcies. Considering the above, internal and international investors' interests vanish; therefore, production and the cash flow from operational activities decrease. Thus, sanctions (pre-and post-JCPOA) and the relationship between the import of intermediate and investing in raw materials and firm operational activities are negatively related. The findings are consistent with Barguellil et al. (2018), Cimprich et al. (2018), Ezzati et al. (2019) and Garshasbi and Dindarlou (2015).

6. Practical implications

Investors, especially those who aim for the Iranian Stock Exchange, analysts, portfolio managers, market regulators and market observers can benefit from this study. Therefore, the following suggestions are offered:

Sanctions (pre-and post-JCPOA) modify the relationship between exchange rate fluctuations and the added value of firms. Accordingly, it is suggested that the banks and the Central Bank of Iran balance the exchange market to overcome stagnation because exchange rate fluctuations deduct the firm's added value.

Sanctions (pre-and post-JCPOA) modify the relationship between foreign direct investment and the investing activities of firms. The government is offered the opportunity to invest in self-sufficient manufacturing industries because they soften the sanctions' effects on listed companies on the Tehran Stock Exchange. This increases the export and investing activities.

Moreover, sanctions (pre-and post-JCPOA) modify the relationship between the cost of production index and profitability. It is suggested that knowledge-based companies substitute manufacturing the required goods for importing them in order to reduce their dependency on foreign goods.

Sanctions (pre-and post-JCPOA) modify the relationship between the import of the intermediate and capital goods and operational activities in the petrochemical sector. We suggest to the stock exchange organizations, relevant institutions and economic policymakers to improve the macroeconomic index, reduce economic risks, correct managerial and executive processes, secure the country's interests in concluding foreign contracts, formulate industrial development strategies and allocate foreign resources to productive sectors. When attracting funds, it is important to allocate foreign investments to the real economic sectors rather than the financial and nominal sectors.

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