Investigating the Effects of Sanctions on Iran's Economic Conditions Using a Combined Model of Sanctions Intensity and Modified Fuzzy DEMATEL

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Abstract:
Because colonial governments disrupt financial markets to exert political pressure on target countries. For this purpose, in this study, the effects of sanctions on the economic conditions of countries are examined. The criteria (sanctions) examined in this study were placed in international, property, commercial, knowledge, oil, finance and individual groups. These criteria are the sanctions imposed on Iran in the period 1984 to 2020. The method used for analysis is a combination of the Fuzzy Decision Making Trial and Evaluation Laboratory technique and sanctions intensity model. The results of this study indicate that in the introduced model, international sanctions are the most effective. These sanctions are most effective when the sanctioned government is in business. Thus, international sanctions have the greatest impact on the government's trade disputes (Commercial sanctions). International sanctions on a country like Iran, which trades in oil and sells its oil, affect oil sanctions as much as they affect Commercial sanctions, but less on individual sanctions. Finally, the results of the model indicate that the intensity of sanctions was at its peak between 2010 and 2015, with the greatest effect being due to international sanctions.

1. Introduction

Development to reduce poverty and raise living standards requires reliable access to modern energy resources. Given that global energy imbalance is due to a lack of access to modern fuels. Under such circumstances, nuclear energy can play an important role in providing increased access to cost-effective energy in many parts of the world. For this reason, the Islamic Republic of Iran, as a leading country among developing countries, for various reasons, including the need for energy development programs, acquisition of superior technologies, diversification and energy security, clean energy production, environmental considerations and technical and economic benefits, the development of nuclear power plants has considered as a necessity in the long-term energy supply plan (Shahi, Alavipoor, & Karimi, 2018). But Iran's nuclear developments was not accepted by the US government. The US Congress imposed sanctions on Iran following the capture of the US Embassy in Tehran (Khamenei, 2019), and since then, the scope of multilateral sanctions by the United States, the European Union and the United Nations Security Council has gradually expanded (Setayesh & Mackey, 2016). The international diplomatic landscape has faced increasing political tensions between countries with the threat and imposition of sanctions (Afesorgbor, 2019). Sanctions imposed on Iran include international, property, Commercial, knowledge, oil, finance, and individual sanctions. Despite these sanctions, Iranian stock market indicators show positive growth during the sanctions (Goudarzi, 2014). These sanctions were strengthened due to Iran's nuclear program in the period 2012-2015. In fact, the decline in Iran's GDP has shown that these sanctions are the most severe punishment imposed on a country. The sanctions limited Iran's exports of petroleum and petrochemical products, which account for about 13% of GDP and about 80% of total exports of Iran, as well as foreign investment in Iran's oil and energy industries.

Increasing restrictions, such as preventing the transfer of funds to Iran through the International Banking System (SWIFT), have jeopardized international trade with Iran. In 2015, an international agreement cancelled sanctions for three years, until May 2018, when the Trump administration scrapped the agreement and re-imposed economic sanctions. Since 2012, the sanctions have reduced GDP growth by 11.8 percent compared to 2011, 3.1 percent in 2011 and 7.7 percent in 2012, about 40 percent inflation and more than 200 percent devaluation of the Iranian currency. Eventually, it led to rising living costs and unemployment. Interestingly, a year after the end of sanctions, Iran's GDP growth has increased by 14.1% in 2016, from 1.6% in 2015 to 12.5% in 2016. It is clear that these changes are important at both the individual and population levels (Aloosh, Salavati, & Aloosh, 2019). Wang, Wang, and Chang (2019) found that economic sanctions significantly affect exchange rate fluctuations in target countries.

Rasoulinezhad and Popova (2017) finding showed a negative relationship between financial and non-financial sanctions and oil price shocks with Iran-

Russia trade. Taulbut, Mackay, and McCartney (2018) stated that the relationship between sanctions and labor market outcomes is unclear. Sanctions and threats of sanctions create market uncertainty that is reflected in stock price fluctuations for companies with commercial interests in the target countries. The stock prices of companies with commercial interests in the target states fluctuate more than the stock prices of similar companies without commercial interests in the target countries. This uncertainty not only reflects the costs of sanctions and the threat of sanctions for companies resulting from the cessation of business activities, but also reflects the significant costs for businesses (Webb, 2020). Rasouli Ghahroudi and Chong (2020) showed that macro factors such as infrastructures, exchange rate, inflation rate, return on investment and governance have a long-term effect on the inflow of foreign direct investment in Iran. Their findings also show that GDP growth rate and trade openness do not have a significant effect on foreign direct investment. Their results showed that sanctions do not play a significant moderating role in the relationship between macroeconomic factors and foreign direct investment. Surprisingly, international sanctions have a positive relationship with the inflow of foreign direct investment into Iran. Also, sanctions have a positive effect on inflation and the exchange rate in Iran. Finally, their findings show that sanctions have had a significant impact on Iran's economic growth in recent years due to the increasing level of sanctions intensity. Although many studies have examined the impact of sanctions on global trade, a little academic study has focused on the impact of sanctions on the economic conditions of target countries. Colonial governments disrupt financial markets to exert political pressure on target countries. For this purpose, in this study, the effects of sanctions on Iran's economy will be investigated.

2. Model criteria

The criteria (sanctions) examined in this study in international, property, Commercial, knowledge, oil, finance and individual groups are listed in Table 1. These criteria are the sanctions imposed on Iran in the period 1984 to 2020.

Table 1. Sanctions imposed on Iran

Sanctions	The names of the sanctions
1. January 19, 1984: The U.S. Department of State adds Iran to its list of state sponsors of terrorism, effectively imposing sweeping sanctions on Tehran. 2. Congress passes the Iran-Iraq Arms Nonproliferation Act of 1992, which prohibits the transfer of controlled goods or technology that might contribute "knowingly and materially" to Iran's proliferation of advanced conventional weapons. 3. December 1, 2016: Congress passes a 10-year extension of the Iran Sanctions Act (ISA), which becomes law on December 15th. Extension of the ISA is consistent with U.S. obligations under the JCPOA, although many of the ISA's	International

provisions are being waived under Washington's commitments under the agreement. 4. July 25, 2017: The U.S. House of Representatives passes H.R. 3364, the Countering Adversarial Nations Through Sanctions Act, which would impose new sanctions on Iran, North Korea and Russia. 5. June 6, 2018: The European Commission adopts an update of the Blocking Statute to include extraterritorial sanctions that the United States re-imposed on Iran and an update of the European Investment Bank (EIB)'s External Lending Mandate to make Iran eligible for investment activities by the EIB. "These measures are meant to help protecting the interests of EU companies investing in Iran and to demonstrate the EU's commitment to the Joint Comprehensive Plan of Action (JCPOA)," reads a European Commission press release. 6. September 20, 2019: The United States deploys additional troops to Saudi Arabia in response to the Aramco attack. Announcing the deployment, U.S. Defense Secretary Mark Esper condemns Iran for the Sept. 14 attack on the Aramco facility. a. The U.S. Treasury imposes new sanctions on the Central Bank of Iran, the National Development Fund of Iran, and the Etemad Tejarate Pars Co., an Iranian company implicated in concealing the military's financial transactions. 7. November 18, 2019: The IAEA verifies that Iran's heavy water stockpile has reached 131.5 metric tons, exceeding the 130 metric ton limit designated by the JCPOA. The United States announces it will no longer waive sanctions related to Iran's Fordow facility and the existing waiver will terminate Dec. 15. 8. January 31, 2020: The United States announces it will renew, for sixty days, four waivers that allow for European, Russian, and Chinese companies to continue work on cooperative non-proliferation projects with Iran. The United States also imposes new sanctions on the Atomic Energy Organization of Iran and its director, Ali Akbar Salehi. Responding to the U.S. designation, the AEOI tweets that the sanctions "will not in any way interrupt (Iran's) peaceful nuclear activities and policies."	
1. September 4, 2019: The U.S. Treasury sanctions a shipping network linked to the Islamic Revolutionary Guards Corps-Qods Force and Hezbollah, condemning Iran for its "provocative actions to destabilize the region and the world."	Property
1. ILATO DAMATO LAW, 1996 Passed by the US Congress: It banned investment of more than $ 40 million in the oil and gas industries of Iran and Libya, and reduced it to $ 20 million a year later. ILSA was the first extraterrestrial sanctions law under which the United States could penalize even non-US companies trading more than $ 20 million in Iran's oil and gas fields. Penalties under the law for non-US individuals include: denial of US Exim Bank assistance for exports, denial of special export licenses, denial of loans of more than $ 10 million per year from US institutions, denial of initial purchase of US bonds, Ban on the sale of goods or services to the US government, ban on exports to the US. 2. CISADA Law)Comprehensive Law on Sanctions(, Liability and Deprivation of Iran: Approved by the US Congress in 2010 following Security Council Resolution 1929. Investors who invested more than $ 20 million in Iran's oil and gas sector or sold more than $ 5 million worth of gasoline annually to Iran were subject to penalties for those who enforced the six-point Damato Act, as well as being barred from doing business with Americans, Denial of any account or payment with American financial institutions, deprivation of education,	Commercial

maintenance and trade of property based in the United States. The United States has also called for transparency in the law, meaning that under the terms of the law, foreign companies are required to certify in a contract with the US government that they have not violated Sisada law.

3. June 9, 2010: The UN Security Council adopts Resolution 1929, significantly expanding sanctions against Iran. In addition to tightening proliferation-related sanctions and banning Iran from carrying out nuclear-capable ballistic missile tests, the resolution imposes an arms embargo on the transfer of major weapons systems to Iran.

4. June 24, 2010: Congress adopts the Comprehensive Iran Sanctions, Accountability, and Divestment Act; tightening U.S. sanctions against firms investing in Iran's energy sector, extending those sanctions until 2016, and imposing new sanctions on companies that sell refined petroleum to Iran.

5. July 26, 2010: The EU agrees to further sanctions against Iran. A statement issued by EU member state foreign ministers refers to the new sanctions as "a comprehensive and robust package of measures in the areas of trade, financial services, energy, [and] transport, as well as additional designations for [a] visa ban and asset freeze.

6. Executive Order 13590: November 2011, Provision of goods, services, technology or assistance to the development of Iran's oil resources for each transaction of one million dollars or a total of five million dollars for 12 months was banned and the same restrictions on the development of Iran's petrochemical sector for each transaction 250 thousand dollars, or a total of $ 1 million, was banned for 12 months. The law extended the sanctions of the Sisada law to Iran's petrochemical sector, and violations included sanctions such as a ban on foreign exchange, banking and real estate transactions in the United States, a ban on exports and imports to the United States, and a ban on government loans and contracts.

7. National Defense Authorization Act for Fiscal Year 2012: (NDAA 2012) Approved by the US Congress on charges of money laundering, terrorism, and proliferation of weapons of mass destruction by Iran. Section 1245 prohibits the purchase of oil from Iran. In addition to banning transactions with the Central Bank of Iran and freezing the assets of the government and all Iranian financial institutions, the law targets US banks and financial institutions involved in the transfer of money from the sale of Iranian oil unilateral US sanctions. US finance is coming out. Under the law, the US Energy Information Administration submits a bi-monthly report on the state of world oil to allow the US president to decide whether to impose sanctions on Iranian oil or issue certain exemptions to buyers of Iranian oil. One of the differences between this sanction and previous sanctions against Iran's oil and gas industry is the expansion of its sphere of influence to non-US companies and institutions that have financial relations in the field of oil with Iran. Individuals and institutions outside the United States that have financial ties to Iran related to the oil industry were also sanctioned.

8. CFSP / 35/2012 Council of the European Union: Concurrent with US sanctions in 2012, the European Union approved a ban on oil purchases from Iran. Examples of sanctions include a ban on the import, purchase or transfer of crude oil, petroleum products and petrochemical products from Iran. These restrictions were to be fully implemented by July 1, 2012, and the Union countries would withdraw from existing oil contracts with Iran and terminate

them; Sanctions on the transportation of Iranian oil to any other country by oil tankers of member countries; Prohibition of the provision of any financial services, including insurance for the transportation of Iranian oil by member countries; Blocking all accounts of the Central Bank of Iran in Europe and banning financial transactions with it; Prohibition of export of equipment and technology and prohibition of investment and lending to oil and gas industries to Iran; Control of all money transfers from the EU to Iran; Stricter control of the activity of the commercial network of the Iranian shipping network. With the implementation of this law, at the same time with the US sanctions, the most severe sanctions were formed against Iran.

9. Executive Order 13622: 2012; The United States, under this law and in the wake of sanctions 1245 of the National Defense Authority Act for Fiscal Year 2012 declared subject to sanctions intentionally doing or facilitating any significant transactions with private financial or foreign government institutions or any other organization for the purchase of Iranian oil and petrochemical products. Announced sanctions. The purpose of the sanctions was to prevent Iran or any other country from establishing payment mechanisms for the purchase of Iranian oil in order to circumvent the sanctions. The purpose of the sanctions was to prevent Iran or any other country from establishing payment mechanisms for the purchase of Iranian oil in order to circumvent the sanctions.

10. Regulation 267/2012 of the Council of the European Union on the Iranian petrochemical industry. Sales of equipment and technology to Iran, investment in Iran's petrochemical industry, imports and purchases of Iranian petrochemical products by EU member states, transportation of petrochemical products, and providing financial services such as transportation insurance and reinsurance were sanctioned.

11. Iran Threat Reduction Law and Syrian Human Rights (TRA). According to this law, any assistance to enhance Iran's ability to expand Iran to expand its oil, gas and petrochemical industries (both in Iran and abroad), assistance to Iran for the transportation of crude oil and refined oil (Includes providing guaranteed and insurance services for the National Iranian Oil Company and NITC (National Iranian Tanker Co)), the purchase or facilitation of Iran's debts and the provision of financial messaging services to Iranian banks and the exchange of Iranian crude oil with other goods was prohibited (08/10/2012).

12. Executive Order 13628: On October 9, 2012, Obama signed this order under the pretext of human rights violations and censorship in Iran. According to the executive order, individuals and companies that facilitate financial exchanges, as well as the sale and transportation of Iranian oil and petroleum products, will be subject to sanctions. Also, if companies and their commercial branches violate the sanctions, the parent companies associated with these branches can also be targeted. The plan would give the Treasury and the State Department more power to enforce sanctions more effectively.

13. June 6, 2018: The European Commission adopts an update of the Blocking Statute to include extraterritorial sanctions that the United States re-imposed on Iran and an update of the European Investment Bank (EIB)'s External Lending Mandate to make Iran eligible for investment activities by the EIB. "These measures are meant to help protecting the interests of EU companies investing in Iran and to demonstrate the EU's commitment to the Joint Comprehensive Plan of Action (JCPOA)," reads a European Commission press release.

14. August 7, 2018: Certain sanctions measures reimposed by Trump May 8 come into full effect. The measures include restricting Iran's purchase of U.S.

dollars, trade in gold, precious metals, aluminum, steel, coal, software, and transactions related to sovereign debt and the automotive sector. Licenses allowing certain foodstuffs to be exported to the United States and Iran to purchase commercial aircraft are also revoked. 15. October 3, 2018: The International Court of Justice (ICJ) rules unanimously that the United States "must remove, by means of its choosing, any impediments" to the export of food, agricultural products, medicine, aircraft parts, and other humanitarian goods. The 15-member panel concludes that Trump's decision to reimpose sanctions on Iran was unfounded given Tehran's compliance with the JCPOA, but the court did not order the United States to remove all sanctions or compensate Iran for damages. 16. May 8, 2019: Iran announces that it will no longer be bound by stockpiles limitations on enriched uranium and heavy water reserves in the JCPOA and could restart construction on its unfinished heavy water reactor at Arak and resume higher level enrichment in the future if the other parties to the agreement do not deliver on sanctions relief. In late April, Iranian Foreign Minister Javad Zarif told state broadcaster IRIB that Iran was considering leaving the NPT as one of Iran's numerous choices. The United States also announces new sanctions targeting Iran's industrial metal exports.	
1. August 7, 2018: Certain sanctions measures reimposed by Trump May 8 come into full effect. The measures include restricting Iran's purchase of U.S. dollars, trade in gold, precious metals, aluminum, steel, coal, software, and transactions related to sovereign debt and the automotive sector. Licenses allowing certain foodstuffs to be exported to the United States and Iran to purchase commercial aircraft are also revoked. 2. September 3, 2019: The U.S. Treasury sanctions the Iran Space Agency and two affiliated research institutes under an executive order directed at proliferators of weapons of mass destruction. 3. October 31, 2019: The U.S. State Department issues a 90-day renewal of sanctions waivers on certain nuclear cooperation projects in Iran, but it remains unclear which waivers are renewed. As of July 2019, the Trump administration waived sanctions to allow for China, Russia, and the European members of the JCPOA to continue certain nonproliferation activities mandated by the nuclear deal, including conversion of Iran's Arak reactor and Fordow enrichment facility, the transfer of 20 percent enriched uranium fuel for the Tehran Research Reactor, and the removal of spent fuel from the Buesher reactor. The July 2019 waivers expired in October.	Knowledge
1. ILATO DAMATO LAW, 1996 Passed by the US Congress: It banned investment of more than $ 40 million in the oil and gas industries of Iran and Libya, and reduced it to $ 20 million a year later. ILSA was the first extraterrestrial sanctions law under which the United States could penalize even non-US companies trading more than $ 20 million in Iran's oil and gas fields. Penalties under the law for non-US individuals include: denial of US Exim Bank assistance for exports, denial of special export licenses, denial of loans of more than $ 10 million per year from US institutions, denial of initial purchase of US bonds, Ban on the sale of goods or services to the US government, ban on exports to the US. 2. CISADA Law)Comprehensive Law on Sanctions(, Liability and Deprivation of Iran: Approved by the US Congress in 2010 following Security Council Resolution 1929. Investors who invested more than $ 20 million in Iran's oil and	Oil

gas sector or sold more than $ 5 million worth of gasoline annually to Iran were subject to penalties for those who enforced the six-point Damato Act, as well as being barred from doing business with Americans, Denial of any account or payment with American financial institutions, deprivation of education, maintenance and trade of property based in the United States. The United States has also called for transparency in the law, meaning that under the terms of the law, foreign companies are required to certify in a contract with the US government that they have not violated Sisada law.

3. Executive Order 13574: Damato's six punishments targeted deprivation of US economic resources, but in Decree 13574, 2011, In addition to the sanctions, Barack Obama ordered the Interior Ministry to freeze the assets of violators of the ILSA embargo in order to tighten sanctions on investment in Iran's energy sector and threaten foreign parties. As a result, the assets of companies investing more than $ 20 million in Iran's oil and gas sector were frozen in the United States.

4. Executive Order 13590: November 2011, Provision of goods, services, technology or assistance to the development of Iran's oil resources for each transaction of one million dollars or a total of five million dollars for 12 months was banned and the same restrictions on the development of Iran's petrochemical sector for each transaction 250 thousand dollars, or a total of $ 1 million, was banned for 12 months. The law extended the sanctions of the Sisada law to Iran's petrochemical sector, and violations included sanctions such as a ban on foreign exchange, banking and real estate transactions in the United States, a ban on exports and imports to the United States, and a ban on government loans and contracts.

5. National Defense Authorization Act for Fiscal Year 2012: (NDAA 2012) Approved by the US Congress on charges of money laundering, terrorism, and proliferation of weapons of mass destruction by Iran. Section 1245 prohibits the purchase of oil from Iran. In addition to banning transactions with the Central Bank of Iran and freezing the assets of the government and all Iranian financial institutions, the law targets US banks and financial institutions involved in the transfer of money from the sale of Iranian oil unilateral US sanctions. US finance is coming out. Under the law, the US Energy Information Administration submits a bi-monthly report on the state of world oil to allow the US president to decide whether to impose sanctions on Iranian oil or issue certain exemptions to buyers of Iranian oil. One of the differences between this sanction and previous sanctions against Iran's oil and gas industry is the expansion of its sphere of influence to non-US companies and institutions that have financial relations in the field of oil with Iran. Individuals and institutions outside the United States that have financial ties to Iran related to the oil industry were also sanctioned.

6. CFSP / 35/2012 Council of the European Union: Concurrent with US sanctions in 2012, the European Union approved a ban on oil purchases from Iran. Examples of sanctions include a ban on the import, purchase or transfer of crude oil, petroleum products and petrochemical products from Iran. These restrictions were to be fully implemented by July 1, 2012, and the Union countries would withdraw from existing oil contracts with Iran and terminate them; Sanctions on the transportation of Iranian oil to any other country by oil tankers of member countries; Prohibition of the provision of any financial services, including insurance for the transportation of Iranian oil by member countries; Blocking all accounts of the Central Bank of Iran in Europe and

banning financial transactions with it; Prohibition of export of equipment and technology and prohibition of investment and lending to oil and gas industries to Iran; Control of all money transfers from the EU to Iran; Stricter control of the activity of the commercial network of the Iranian shipping network. With the implementation of this law, at the same time with the US sanctions, the most severe sanctions were formed against Iran.

7. Regulation 267/2012 of the Council of the European Union on the Iranian petrochemical industry. Sales of equipment and technology to Iran, investment in Iran's petrochemical industry, imports and purchases of Iranian petrochemical products by EU member states, transportation of petrochemical products, and providing financial services such as transportation insurance and reinsurance were sanctioned.

8. Executive Order 13622: 2012; The United States, under this law and in the wake of sanctions 1245 of the National Defense Authority Act for Fiscal Year 2012 declared subject to sanctions intentionally doing or facilitating any significant transactions with private financial or foreign government institutions or any other organization for the purchase of Iranian oil and petrochemical products. Announced sanctions. The purpose of the sanctions was to prevent Iran or any other country from establishing payment mechanisms for the purchase of Iranian oil in order to circumvent the sanctions. The purpose of the sanctions was to prevent Iran or any other country from establishing payment mechanisms for the purchase of Iranian oil in order to circumvent the sanctions.

9. Iran Threat Reduction Law and Syrian Human Rights (TRA). According to this law, any assistance to enhance Iran's ability to expand Iran to expand its oil, gas and petrochemical industries (both in Iran and abroad), assistance to Iran for the transportation of crude oil and refined oil (Includes providing guaranteed and insurance services for the National Iranian Oil Company and NITC (National Iranian Tanker Co)), the purchase or facilitation of Iran's debts and the provision of financial messaging services to Iranian banks and the exchange of Iranian crude oil with other goods was prohibited (08/10/2012).

10. Executive Order 13628: On October 9, 2012, Obama signed this order under the pretext of human rights violations and censorship in Iran. According to the executive order, individuals and companies that facilitate financial exchanges, as well as the sale and transportation of Iranian oil and petroleum products, will be subject to sanctions. Also, if companies and their commercial branches violate the sanctions, the parent companies associated with these branches can also be targeted. The plan would give the Treasury and the State Department more power to enforce sanctions more effectively.

11. EU sanctions against Iran's petrochemical industry expanded in December 2012. Pursuant to Regulation No. 1263/2012, the provision of ships to any Iranian individual or company for the transportation and storage of petrochemical products was prohibited. September 25, 2018: U.S. President Donald Trump speaks at the UN General Assembly in New York. "Iran's leaders sow chaos, death, and destruction," he says, adding that many countries in the Middle East supported his decision to withdraw from the JCPOA and reimpose nuclear-related sanctions on Iran. "Additional sanctions will resume November 5th, and more will follow. And we're working with countries that import Iranian crude oil to cut their purchases substantially.... We ask all nations to isolate Iran's regime as long as its aggression continues. And we ask all nations to support Iran's people as they struggle to reclaim their religious and

righteous destiny." 12. November 5, 2018: The second round of sanctions on Iran following Trump's withdrawal from the JCPOA, targeting Iran's banking, oil, shipping and ship-building sectors, come back into effect. In addition to redesignating entities removed from the SDN list under the JCPOA, United States designates an additional 300 new entities. The administration grants temporary waivers to China, India, Italy, Greece, Japan, South Korea, Taiwan and Turkey to continue importing Iranian oil at reduced levels, as well as waivers to allow nonproliferation projects at Arak, Bushehr and Fordow to continue.	
1. August 5, 1996: The U.S. Congress passes the Iran-Libya Sanctions Act, also known as the Iran Sanctions Act, that penalizes foreign and U.S. investment exceeding $20 million in Iran's energy sector in one year. 2. July 26, 2010: The EU agrees to further sanctions against Iran. A statement issued by EU member state foreign ministers refers to the new sanctions as "a comprehensive and robust package of measures in the areas of trade, financial services, energy, [and] transport, as well as additional designations for [a] visa ban and asset freeze. 3. December 31, 2011: As part of the fiscal year 2012 National Defense Authorization Act, Congress passes legislation that will allow the United States to sanction foreign banks if they continue to process transactions with the Central Bank of Iran. 4. CISADA Law)Comprehensive Law on Sanctions(, Liability and Deprivation of Iran: Approved by the US Congress in 2010 following Security Council Resolution 1929. Investors who invested more than $ 20 million in Iran's oil and gas sector or sold more than $ 5 million worth of gasoline annually to Iran were subject to penalties for those who enforced the six-point Damato Act, as well as being barred from doing business with Americans, Denial of any account or payment with American financial institutions, deprivation of education, maintenance and trade of property based in the United States. The United States has also called for transparency in the law, meaning that under the terms of the law, foreign companies are required to certify in a contract with the US government that they have not violated Sisada law. 5. Executive Order 13574: Damato's six punishments targeted deprivation of US economic resources, but in Decree 13574, 2011, In addition to the sanctions, Barack Obama ordered the Interior Ministry to freeze the assets of violators of the ILSA embargo in order to tighten sanctions on investment in Iran's energy sector and threaten foreign parties. As a result, the assets of companies investing more than $ 20 million in Iran's oil and gas sector were frozen in the United States. 6. Executive Order 13590: November 2011, Provision of goods, services, technology or assistance to the development of Iran's oil resources for each transaction of one million dollars or a total of five million dollars for 12 months was banned and the same restrictions on the development of Iran's petrochemical sector for each transaction 250 thousand dollars, or a total of $ 1 million, was banned for 12 months. The law extended the sanctions of the Sisada law to Iran's petrochemical sector, and violations included sanctions such as a ban on foreign exchange, banking and real estate transactions in the United States, a ban on exports and imports to the United States, and a ban on government loans and contracts. 7. National Defense Authorization Act for Fiscal Year 2012: (NDAA 2012) Approved by the US Congress on charges of money laundering, terrorism, and	Finance

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and insurance services for the National Iranian Oil Company and NITC (National Iranian Tanker Co)), the purchase or facilitation of Iran's debts and the provision of financial messaging services to Iranian banks and the exchange of Iranian crude oil with other goods was prohibited (08/10/2012). 12. Executive Order 13628: On October 9, 2012, Obama signed this order under the pretext of human rights violations and censorship in Iran. According to the executive order, individuals and companies that facilitate financial exchanges, as well as the sale and transportation of Iranian oil and petroleum products, will be subject to sanctions. Also, if companies and their commercial branches violate the sanctions, the parent companies associated with these branches can also be targeted. The plan would give the Treasury and the State Department more power to enforce sanctions more effectively. 13. May 8, 2018: President Trump announces that he is withdrawing the United States from the JCPOA and signs a presidential memorandum to institute the "highest level" of economic sanctions on Iran. In a statement, Secretary of the Treasury Steve Mnuchin states that sanctions will be reimposed subject to certain 90 day and 180 day "wind-down periods." In an address following Trump's announcement Iranian President Rouhani announces that Iran will continue negotiations with the other states in the agreement in order to try to continue the deal without the United States. British Prime Minister May, German Chancellor Merkel and French President Macron re-state their continued commitment to the deal and pledge to work with all parties to make sure its terms are upheld. EU foreign policy chief Federica Mogherini states that the EU is committed to the JCPOA as long as Iran continues to implement its nuclear related commitments, as it has so far. 14. June 6, 2018: The European Commission adopts an update of the Blocking Statute to include extraterritorial sanctions that the United States re-imposed on Iran and an update of the European Investment Bank (EIB)'s External Lending Mandate to make Iran eligible for investment activities by the EIB. "These measures are meant to help protecting the interests of EU companies investing in Iran and to demonstrate the EU's commitment to the Joint Comprehensive Plan of Action (JCPOA)," reads a European Commission press release. 15. October 31, 2019: The U.S. Treasury Office of Foreign Asset Control issues new sanctions against Iran under Section 1245 of the Iran Freedom and Counter-Proliferation Act of 2012 (IFCA).	
1. December 23, 2006: The UN Security Council unanimously adopts Resolution 1737, imposing sanctions on Iran for its failure to suspend its enrichment-related activities. The sanctions prohibit countries from transferring sensitive nuclear- and missile-related technology to Iran and require that all countries freeze the assets of ten Iranian organizations and twelve individuals for their involvement in Iran's nuclear and missile programs. 2. March 3, 2008: The UN Security Council passes Resolution 1803, further broadening sanctions on Iran. It requires increased efforts on the part of member states to prevent Iran from acquiring sensitive nuclear or missile technology and adds 13 persons and seven entities to the UN blacklist. 3. July 26, 2010: The EU agrees to further sanctions against Iran. A statement issued by EU member state foreign ministers refers to the new sanctions as "a comprehensive and robust package of measures in the areas of trade, financial services, energy, [and] transport, as well as additional designations for [a] visa ban and asset freeze. 4. January 17, 2016: The U.S. Treasury Department issues an announcement	Individual

that new sanctions will be imposed on 11 individuals and entities involved with Iran's ballistic missile programs. U.S. President Barack Obama says that with implementation of the nuclear deal Iran will not obtain nuclear weapons and that "the region, the United States, and the world will be more secure." Iranian President Hassan Rouhani gives a speech saying that "Iran's nuclear rights have been accepted by all."

5. June 24, 2019: The United States sanctions the Supreme Leader of Iran and his office.

6. July 31, 2019: The U.S. State Department issues a 90-day renewal on sanctions waivers to allow certain nuclear cooperation and nonproliferation projects to continue in Iran

The United States sanctions Iranian Foreign Minister Javad Zarif for acting on behalf of the Supreme Leader.

7. September 25, 2019: Iranian President Hassan Rouhani announces that Iran will not engage in negotiations while under sanctions and affirms that talks with the United States will only begin if all parties return to compliance with the JCPOA.

U.S. Secretary of State Mike Pompeo delivers a speech at the United Against Nuclear Iran annual summit, criticizing Iran's behavior in the region and calling the Saudi Aramco attack an "act of war." Pompeo announces the imposition of secondary sanctions on Chinese entities implicated in importing Iranian oil.

The White House issues a proclamation suspending entry of senior Iranian government officials to the United States, calling Iran's government a "state sponsor of terrorism."

8. January 31, 2020: The United States announces it will renew, for sixty days, four waivers that allow for European, Russian, and Chinese companies to continue work on cooperative non-proliferation projects with Iran. The United States also imposes new sanctions on the Atomic Energy Organization of Iran and its director, Ali Akbar Salehi.

Responding to the U.S. designation, the AEOI tweets that the sanctions "will not in any way interrupt (Iran's) peaceful nuclear activities and policies."

3. Fuzzy DEMATEL integrated model and sanctions intensity
3.1. Theory of fuzzy sets

In decision-making issues, the evaluations made by the experts in the form of verbal expressions are consistent with their experiences. These linguistic evaluations are ambiguous and difficult to analyze. Hence, the fuzzy set theory can be used to measure vague concepts that are related to human mental judgments. A fuzzy set is a set of members with membership degrees.

Is a function of real numerical membership of the range (0 and 1) (Alavipoor, Ghorbaninia, Karimi, & Jafari, 2016; Zadeh, 1975). Among all kinds of fuzzy number shapes, the triangular fuzzy number is the most common. A triangular fuzzy number can be defined as $\tilde{A} = (l, m, u)$ which is $x \leq y \leq z$. The parameters l, m and u are the smallest possible values, the average possible values and the largest possible values, respectively, which describe a fuzzy event. The membership function of a fuzzy number is defined as Equation 1 (Figure 1).

$$\mu_{\tilde{A}} = \begin{cases} 0, & x < l \\ \dfrac{(x-l)}{(m-l)}, & l \le x \le m \\ \dfrac{(u-x)}{(u-m)}, & m \le x \le u \\ 0, & x \ge u \end{cases} \quad (1)$$
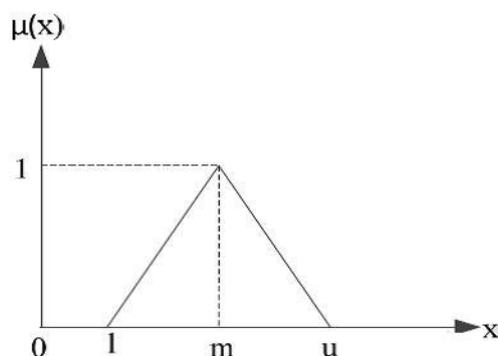

Figure 1- Triangular fuzzy number

The corresponding relationship between verbal expressions and triangular fuzzy numbers can be determined according to Table 2 (Baykasoğlu, Kaplanoğlu, Durmuşoğlu, & Şahin, 2013).

Table 2. Verbal expressions used in research and their equivalent values

Numerical scale	Verbal expression
(1.00, 1.00, 1.00)	No effect
(2.00, 3.00, 4.00)	Very low effect
(4.00, 5.00, 6.00)	Low effect
(6.00, 7.00, 8.00)	High effect
(8.00, 9.00, 9.00)	Very high effect

The mathematical calculation of both triangular fuzzy numbers $\tilde{A} = (l\_1, m\_1, u\_1)$ and $\tilde{A} = (l\_2, m\_2, u\_2)$ is as follows:

Addition of triangular fuzzy numbers:

$\tilde{A}\_1 + \tilde{A}\_2 = (l\_1 + l\_2, m\_1 + m\_2, u\_1 + u\_2)$ (2)

Fraction between triangular fuzzy numbers:

$\tilde{A}\_1 - \tilde{A}\_2 = (l\_1 - u\_2, m\_1 + m\_2, u\_1 + l\_2)$ (3)

Multiplication of triangular fuzzy numbers:

$\tilde{A}\_1 \times \tilde{A}\_2 = (l\_1 \times l\_2, m\_1 \times m\_2, u\_1 \times u\_2)$ (4)

Fuzzy triangular numbers calculation tool:

$kxÃ\_1=(kxl\_1,kxm\_1,kxu\_1),(k>0)$ (5)
$Ã\_1/k=(l\_1/k,m\_1/k,u\_1/k),(k>0)$ (6)

3.2. DEMATEL Technique

The DEMATEL technique was introduced to discuss comprehensive and complex decision-making issues (Gabus & Fontela, 1972). This technique is usually recognized as one of the best practical tools for finding the cause-effect relationship between evaluation criteria (C.-L. Lin & Tzeng, 2009). This technique is based on graph theory, which makes it possible to study and describe problems through visualization (R.-J. Lin, 2013). This technique shows the internal dependence between the factors along with the amount of effect. The basic steps of the DEMATEL method are briefly described below (Abbasi, Hosnavi, & Tabrizi, 2013; Jassbi, Mohamadnejad, & Nasrollahzadeh, 2011; Jeng, 2015; R.-J. Lin, 2013; Najafinasab, Karbassi, & Ghoddousi, 2015).

Step 1: The purpose of the first step is to construct a fuzzy matrix of the initial direct connection for pairwise comparison. A group of decision-makers who have knowledge and experience about the issue is identified. They are then asked to evaluate the effectiveness of each factor pair. Therefore, the language evaluation of the decision-maker becomes real values. Based on this, a direct connection matrix is established. $A = \left[a_{ij}\right]$, where A is a matrix $n \times n$, a_{ij} shows the direct effect of the factor i on the factor j, and when $i = j$, the diameter element is $a_{ij} = 0$.

Step 2: In this step, the initial direct connection matrix is normalized by comparing the factors. The normalized direct connection matrix $D = \left[d_{ij}\right]$ can be obtained by Equation 7. All elements in the matrix D correspond to $0 \leq d_{ij} \leq 1$ and all elements of diameter are equal to zero.

$$D = \frac{1}{\max\limits_{1<i<n}\sum_{j=1}^{n} a_{ij}} \quad (7)$$

Step 3: The general connection matrix (T) is calculated using Equation 8 where I represents the $n \times n$ matrix. The element t_{ij} represents the indirect effects that criterion i has on criterion j, so that the matrix T gives the general relationship between each pair of factors.

$$T = D(1 - D)^{-1} \quad (8)$$

Step 4: In this step, the sum of the rows and columns of the T matrix is calculated. r_i and c_j are determined according to Equations 9 and 10,

respectively. In this formula, while r_i represents all the direct and indirect effects of the criterion i on other factors, c_j represents the degree of the effect.

$$r_i = \sum_{1 \le j \le n} t_{ij} \quad (9)$$

$$c_j = \sum_{1 < i < n} t_{ij} \quad (10)$$

When $i = j$, $r_i + c_j$ shows all the effects received by the criterion i. In other words, $r_i + c_j$ shows the effect of criterion i on the whole system and the effect of other system factors on factor i. Therefore, $r_i + c_j$ can represent the importance degree of criterion i in the whole system. In contrast, the difference between the two ($r_i - c_j$) presents the net effect of criterion i on the system. If the value of $r_i - c_j$ is positive, the factor i will be the net cause. When $r_i - c_j$ is negative, this factor will be the net result that will be placed in the effect group (Lee, Kang, Hsu, & Hung, 2009; Yang, Shieh, Leu, & Tzeng, 2008).

Step 5: In the last step, the cause-effect relationship diagram is drawn according to $r_i + c_j$ and $r_i - c_j$. Thus the complex relationship between the factors is easily illustrated.

3.3. Modified Fuzzy DEMATEL technique
- Selection of an expert group: In this step, the opinions of political-economic experts were collected to obtain votes.
- Determining factors and constructing a fuzzy scale: In this section, significant factors are not found for proper analysis and evaluation. The linguistic variable was used according to five fuzzy scales (no effect, very low effect, low effect, high effect and very high effect). The corresponding triangular fuzzy numbers were then determined.
- Results of decision-making group evaluation: Paired comparison was obtained in terms of language variables. Also, fuzzy evaluations became defuzzy and were aggregated as a discontinuous value. Then, fuzzy initial matrix ($\tilde{E}$) was created:

$$\tilde{E} = \begin{bmatrix} 0 & \cdots & \tilde{E}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{E}_{n1} & \cdots & 0 \end{bmatrix} \quad (11)$$

$$\tilde{e}_{ij} = (l_{ij}, m_{ij}, u_{ij}) \quad (12)$$

- Creating a normalized fuzzy matrix: In the presence of an initial relational matrix with a direct connection, a normalized fuzzy matrix was created. To achieve this, $\tilde{\beta}_i$ and γ were considered as fuzzy triangular numbers. The following formulas were used in order:

$$\tilde{\beta}_i = \sum \tilde{e}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} u_{ij} \right) (13)$$

$$\gamma = max \left(\sum_{j=1}^{n} u_{ij} \right) (14)$$

The linear scale was then used to convert these factors into comparable scales. The normalized fuzzy matrix ($\tilde{F}$) of the decision group is shown below.

$$\tilde{F} = \begin{bmatrix} \tilde{F}_{11} & \cdots & \tilde{F}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{F}_{n1} & \cdots & \tilde{F}_{nn} \end{bmatrix} (15)$$

Where $\tilde{f}_{ij} = \frac{\tilde{e}_{ij}}{\gamma} = \left(\frac{\tilde{e}_{ij}}{\gamma}, \frac{\tilde{e}_{ij}}{\gamma}, \frac{\tilde{e}_{ij}}{\gamma} \right)$

- Calculating the general relation fuzzy matrix: After establishing the normalized direct relation fuzzy matrix, a two-sided fuzzy matrix is calculated with confidence $\lim_{\omega \to \infty} F^{\omega} = 0$. In this context, the definitive example of a general relation matrix is defined as follows:

$$\tilde{T} = \lim_{\omega \to \infty} \left(\tilde{F} + \tilde{F}^2 + \cdots + \tilde{F}^{\omega} \right) (16)$$

$$\tilde{T} = \begin{bmatrix} \tilde{t}_{11} & \cdots & \tilde{t}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{t}_{n1} & \cdots & \tilde{t}_{nn} \end{bmatrix} (17)$$

Where $\tilde{t}_{ij} = \left(l''_{ij}, m''_{ij}, u''_{ij} \right)$

$$Matrix[l''_{ij}] = F_l x (I - F_l)^{-1} (18)$$
$$Matrix[m''_{ij}] = F_m x (I - F_m)^{-1} (19)$$
$$Matrix[u''_{ij}] = F_u x (I - F_u)^{-1} (20)$$

• Structural model analysis:

After calculating the $\tilde{T}$ matrix, $\tilde{r}_i + \tilde{c}_j$ and $\tilde{r}_i - \tilde{c}_j$ are specified. In this formula, $\tilde{r}_i$ and $\tilde{c}_j$ mean the sum of the rows and columns of the matrix $\tilde{T}$. While $\tilde{r}_i + \tilde{c}_j$ represents the importance of factor i, $\tilde{r}_i - \tilde{c}_j$ means the net effect of factor i.

Defuzzification of $\tilde{r}_i + \tilde{c}_j$ and $\tilde{r}_i - \tilde{c}_j$: In this step $\tilde{r}_i + \tilde{c}_j$ and $\tilde{r}_i - \tilde{c}_j$ use the Defuzzification technique of centre of the region were defuzzied (this technique was used by Ross (2004) to determine the numbers, the best non-fuzzy performance was defined). For a convex fuzzy number $\tilde{\delta}$, the real number z^* corresponding to its regional centre can be estimated by the following equation (Gumus, Yayla, Çelik, & Yildiz, 2013).

Creating a cause-effect relationship diagram: In the last step, the cause-effect relationship diagram is drawn by depicting the data sets $\tilde{r}_i + \tilde{c}_j$ and $\tilde{r}_i - \tilde{c}_j$. This calculation can be done according to step 6.

$$Z^* = \frac{\int \mu_{\tilde{\delta}}(z)z\,dz}{\int \mu_{\tilde{\delta}}(z)\,dz} \tag{21}$$

The BNP value of the fuzzy number $\tilde{G} = \left(l_{ij}, m_{ij}, u_{ij}\right)$ is obtained by the following formula (Akyuz & Celik, 2015).

$$BNP_{ij} = \frac{u_{ij} - l_{ij} + m_{ij} - l_{ij}}{3} + l_{ij} \tag{22}$$

In the next section, the application of the Fuzzy DEMATEL method to evaluate sanctions is illustrated.

3.4. Final value of criteria (modified Fuzzy DEMATEL model)

In this section, the Fuzzy DEMATEL method is used to evaluate sanctions. The final value of the criteria is based on their causal relationships (Ren & Sovacool, 2014), which will be the last step in this model. Based on many studies, different computational methods were investigated and finally, according to the results of Table 4, the following formula was used to determine the final value of the criteria based on their causal relationships.

$$W_i = r_i + c_j + r_i - c_j \tag{23}$$

$$W_{final} = W_i / Sum W_i \tag{24}$$

The model for estimating the intensity of the sanctions is as follows:

$$Intensity\ of\ sanctions_{year} = \sum N.W_{final} \tag{25}$$

In this formula, $Intensity\ of\ sanctions_{year}$ represents the intensity of the sanctions in a given year, N is the number of sanctions, W_{final} is the final value of any sanctions.

4. Results
4.1. Formation of the fuzzy direct connection matrix
The table below shows the direct correlation matrix, which is the pair of expert comparisons. If several experts are used in the evaluation, the following matrix is the arithmetic mean of all experts.

Table 3. Direct connection matrix

Sanction	Individual	Financial	Oil	Knowledge	Commercial	Property	International
International	(4.333,5.333,6.333)	(6.667,7.667,8.333)	(7.333,8.333,8.667)	(3.333,4.333,5.333)	(7.333,8.333,8.667)	(3.333,4.333,5.167)	(0.000,0.000,0.000)
Property	(5.667,6.667,7.333)	(4.333,5.333,6.167)	(2.833,3.667,4.500)	(2.167,3.000,3.833)	(5.333,6.333,7.000)	(0.000,0.000,0.000)	(3.000,3.667,4.333)
Commercial	(5.333,6.333,7.000)	(7.000,8.000,8.333)	(6.333,7.333,7.833)	(2.500,3.333,4.167)	(0.000,0.000,0.000)	(5.667,6.667,7.500)	(6.000,7.000,7.667)
Knowledge	(4.667,5.667,6.333)	(2.167,3.000,3.833)	(3.667,4.667,5.667)	(0.000,0.000,0.000)	(4.667,5.667,6.500)	(3.500,4.333,5.167)	(2.833,3.667,4.500)
Oil	(2.667,3.667,4.667)	(5.667,6.667,7.500)	(0.000,0.000,0.000)	(2.333,3.000,3.667)	(7.000,8.000,8.333)	(4.667,5.667,6.500)	(7.333,8.333,8.667)
Financial	(5.000,6.000,6.833)	(0.000,0.000,0.000)	(6.667,7.667,8.333)	(3.333,4.333,5.333)	(7.000,8.000,8.500)	(5.000,6.000,6.833)	(5.333,6.333,7.167)
Individual	(0.000,0.000,0.000)	(3.500,4.333,5.000)	(1.667,2.333,3.000)	(4.500,5.333,6.000)	(3.833,4.667,5.500)	(4.500,5.333,6.000)	(2.833,3.667,4.500)

Also in the table below is the fuzzy spectrum used in the model.

Table 4. Fuzzy spectrum

Code	Verbal expression	U	M	L
1	No effect	1	1	1
2	Very low effect	4	3	2
3	Low effect	6	5	4
4	High effect	8	7	6
5	Very high effect	9	9	8

4.2. Normalization of the fuzzy direct connection matrix
After normalizing the fuzzy direct connection matrix, the following table was obtained.

Table 5. The fuzzy direct connection matrix

Sanction	Individual	Financial	Oil	Knowledge	Commercial	Property	International
International	(0.097, 0.120, 0.142)	(0.150, 0.172, 0.187)	(0.165, 0.187, 0.195)	(0.075, 0.097, 0.120)	(0.165, 0.187, 0.195)	(0.075, 0.097, 0.116)	(0.000, 0.000, 0.000)
Property	(0.127, 0.150, 0.165)	(0.097, 0.120, 0.139)	(0.064, 0.082, 0.101)	(0.049, 0.067, 0.086)	(0.120, 0.142, 0.157)	(0.000, 0.000, 0.000)	(0.067, 0.082, 0.097)
Commercial	(0.120, 0.142, 0.157)	(0.157, 0.180, 0.187)	(0.142, 0.165, 0.176)	(0.056, 0.075, 0.094)	(0.000, 0.000, 0.000)	(0.127, 0.150, 0.169)	(0.135, 0.157, 0.172)
Knowledge	(0.105, 0.127, 0.142)	(0.049, 0.067, 0.086)	(0.082, 0.105, 0.127)	(0.000, 0.000, 0.000)	(0.105, 0.127, 0.146)	(0.079, 0.097, 0.116)	(0.064, 0.082, 0.101)
Oil	(0.060, 0.082, 0.105)	(0.127, 0.150, 0.169)	(0.000, 0.000, 0.000)	(0.052, 0.067, 0.082)	(0.157, 0.180, 0.187)	(0.105, 0.127, 0.146)	(0.165, 0.187, 0.195)
Financial	(0.112, 0.135, 0.154)	(0.000, 0.000, 0.000)	(0.150, 0.172, 0.187)	(0.075, 0.097, 0.120)	(0.157, 0.180, 0.191)	(0.112, 0.135, 0.154)	(0.120, 0.142, 0.161)
Individual	(0.000, 0.000, 0.000)	(0.079, 0.097, 0.112)	(0.037, 0.052, 0.067)	(0.101, 0.120, 0.135)	(0.086, 0.105, 0.124)	(0.101, 0.120, 0.135)	(0.064, 0.082, 0.101)

4.3. Calculation of complete fuzzy connection matrix

In this step, the complete fuzzy connection matrix is formed. In other words, first, the inverse of the normal matrix is calculated and then subtracted from matrix I, and finally, the normal matrix is multiplied by the resulting matrix. The table below shows the complete fuzzy connection matrix.

Table 6. The complete fuzzy connection matrix

Sanction	Individual	Financial	Oil	Knowledge	Commercial	Property	International
International	(0.273,0.500,0.922)	(0.338,0.571,0.985)	(0.344,0.569,0.963)	(0.194,0.370,0.712)	(0.379,0.634,1.073)	(0.255,0.477,0.887)	(0.195,0.399,0.783)
Property	(0.249,0.429,0.773)	(0.235,0.421,0.771)	(0.200,0.379,0.718)	(0.139,0.277,0.559)	(0.273,0.477,0.850)	(0.133,0.291,0.617)	(0.199,0.370,0.703)
Commercial	(0.293,0.518,0.929)	(0.343,0.574,0.979)	(0.323,0.548,0.941)	(0.179,0.352,0.688)	(0.236,0.473,0.903)	(0.297,0.516,0.921)	(0.311,0.530,0.922)
Knowledge	(0.218,0.392,0.731)	(0.181,0.359,0.705)	(0.202,0.377,0.714)	(0.083,0.199,0.460)	(0.246,0.443,0.815)	(0.194,0.361,0.697)	(0.184,0.352,0.683)
Oil	(0.232,0.448,0.849)	(0.309,0.531,0.926)	(0.190,0.387,0.755)	(0.166,0.328,0.648)	(0.359,0.601,1.017)	(0.266,0.476,0.864)	(0.325,0.533,0.902)
Financial	(0.284,0.508,0.933)	(0.203,0.417,0.828)	(0.326,0.549,0.957)	(0.193,0.366,0.713)	(0.368,0.621,1.071)	(0.282,0.501,0.916)	(0.297,0.516,0.921)
Individual	(0.121,0.267,0.573)	(0.199,0.367,0.687)	(0.161,0.321,0.633)	(0.173,0.297,0.553)	(0.225,0.409,0.757)	(0.208,0.365,0.677)	(0.177,0.336,0.645)

4.4. Defuzzification of the complete communication matrix values

The output of the cfcs algorithm is a matrix with definite values. The table below shows the defuzzified values of the complete correlation matrix.

Table 7. Complete definite connection matrix

Sanction	Individual	Financial	Oil	Knowledge	Commercial	Property	International
International	0.534	0.601	0.595	0.399	0.665	0.512	0.444
Property	0.466	0.463	0.421	0.312	0.521	0.337	0.413
Commercial	0.548	0.603	0.576	0.383	0.523	0.546	0.559
Knowledge	0.431	0.406	0.42	0.237	0.491	0.403	0.396
Oil	0.487	0.564	0.432	0.361	0.634	0.51	0.561
Financial	0.542	0.466	0.58	0.397	0.655	0.535	0.549
Individual	0.311	0.409	0.364	0.328	0.456	0.404	0.378

4.5. Threshold calculations

All values of the confirmed complete correlation matrix that are less than the mean of the complete connection matrix are identified and zeroed using the following equation, in other words, that causal relationship is not considered.

$$TS = \frac{\sum_{i=1}^{n} \sum_{j=1}^{m} V_{ij}}{m \times n}$$

$$U_{ij} = \begin{cases} V_{ij} & V_{ij} \geq TS \\ 0 & Others \end{cases}$$

The table below shows the complete correlation matrix in which values below the threshold are omitted. Based on the table below, causal relationships between elements are plotted. The threshold value (TS) in this study is 0.47

Table 8. A complete definite correlation matrix with the removal of values below the threshold

| Sanction	Individual	Financial	Oil	Knowledge	Commercial	Property	International
International	0.534	0.601	0.595	0	0.665	0.512	0
Property	0	0	0	0	0.521	0	0
Commercial	0.548	0.603	0.576	0	0.523	0.546	0.559
Knowledge	0	0	0	0	0.491	0	0
Oil	0.487	0.564	0	0	0.634	0.51	0.561
Financial	0.542	0	0.58	0	0.655	0.535	0.549
Individual	0	0	0	0	0	0	0

4.6. Final output and creation of the causal diagram

According to c and r, the values of r + c and r-c are obtained, which indicate the degree of interaction and the power of influence of factors, respectively.

The final output is shown in the table below.

Table 9. The final output

Code	Criteria	r-c	r+c	r	c
Criterion 1	International	0.45	7.05	3.75	3.3
Criterion 2	Property	-0.315	6.181	2.933	3.248
Criterion 3	Commercial	-0.206	7.685	3.74	3.945
Criterion 4	Knowledge	0.367	5.202	2.785	2.418
Criterion 5	Oil	0.161	6.938	3.549	3.388
Criterion 6	Financial	0.212	7.237	3.724	3.512
Criterion 7	Individual	-0.67	5.969	2.649	3.319

The following figure also shows the pattern of meaningful relationships. This pattern is in the form of a diagram in which the longitudinal axis is r + c and the transverse axis is based on r-c. The position and relationships of each factor are determined by a point with coordinates (r + c, r-c) in the device.
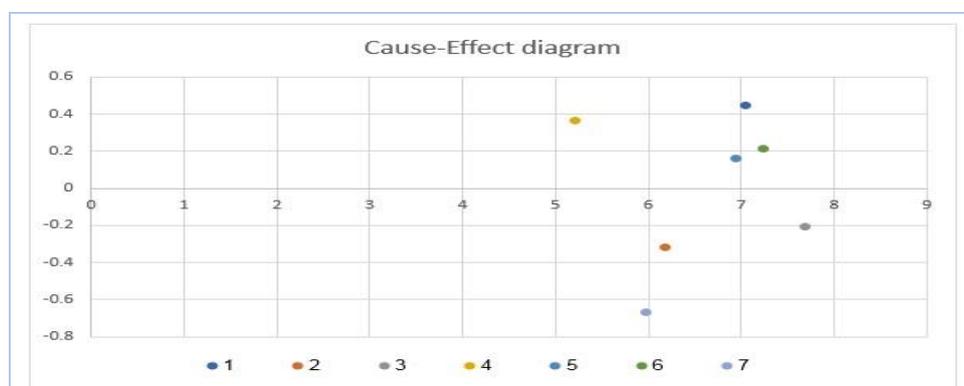
Figure 3. Diagram of the pattern of the causal relation between sanctions imposed on Iran

The sum of the elements of each row (r) for each factor indicates the extent to which that factor influences other factors in the system. In this study, international sanctions are the most effective, and sanctions on property, trade, knowledge, oil, finance and individuals are in the next degree of impact. The sum of the elements of column (c) for each factor indicates the degree to which that factor is affected by other factors in the system. In this study, commercial sanctions are the most affected, and financial, oil, individuals, international, property and knowledge sanctions are the next most affected. The horizontal

vector (r+c) indicates the cause and effect of the desired factor in the system. In other words, the higher the r+c factor, the more it interacts with other system factors. In this study, commercial sanctions have the most affectedness, and financial, international, oil, property, people and knowledge sanctions are in the next degree of affectedness. The vertical vector (r-c) indicates the causal power of each factor. In general, if r-c is positive, the variable is a causal variable, and if it is negative, it is an effect. In this study, international, knowledge, oil, and financial sanctions are causal, and sanctions on property, trade, and individuals are considered effect. International sanctions are the most influential in this study, followed by property sanctions, commercial sanctions, knowledge sanctions, oil sanctions, financial sanctions, and individual sanctions. In this study, commercial sanctions are the most influential and financial sanctions, oil sanctions, individual sanctions, international sanctions, property sanctions and knowledge sanctions are in the next degree of affectedness. In this study, international sanctions, knowledge sanctions, oil sanctions, financial sanctions are causal and property sanctions, commercial sanctions, sanctions for individuals are considered effect.

4.7. Sanction Intensity

The final chart of the intensity of sanctions (Figure 4) shows that the intensity of sanctions was at its peak from 2010 to 2015.
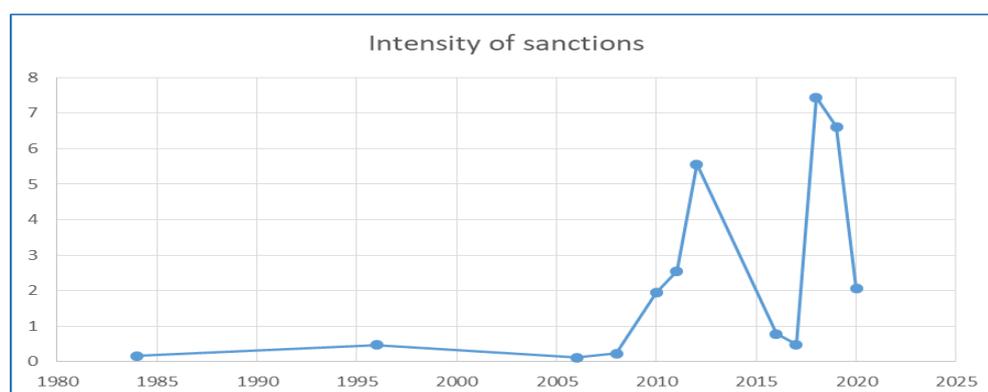

Figure 4. Intensity of sanctions against Iran from 1984 to 2020

5. Disscusion

Sanctions imposed on Iran include international, property, commercial, knowledge, oil, financial, and individual sanctions. Each of these sanctions takes into account dimensions that may vary from a country to another country.

According to the findings of this study, international sanctions are the most

influential. International sanctions are generally sanctions that affect several countries. These sanctions are multilateral and target more governments than individuals. These sanctions are most effective when the sanctioned government is in business. Thus, international sanctions have the greatest impact on a state's trade disputes (commercial sanctions). International sanctions on a country like Iran that trades in oil and sells its oil affect oil sanctions as much as they affect trade sanctions, but less on individual sanctions. Rasouli Ghahroudi and Chong (2020) also concluded that sanctions do not play a significant moderating role in the relationship between macroeconomic factors and foreign direct investment.

Surprisingly, international sanctions have a positive relationship with the inflow of foreign direct investment into Iran. Also, sanctions have a positive effect on inflation and the exchange rate in Iran. Finally, their findings show that sanctions have had a significant impact on Iran's economic growth in recent years due to the increasing level of sanctions intensity. The property is owned by a natural person (individuals) or legal entities (government institutions). When Iran is sanctioned by the property, then the people of this country are sanctioned, so the sanction of property shows its greatest impact on individuals. The oil sanction has several dimensions. In the oil sanction, real people generally do not have an interest, so the oil sanction has very little effect on individuals. Governments also make money from the oil trade, so when it imposes an oil sanction on the target country that sells oil, the biggest impact of the oil sanction is on that country's trade (trade sanctions). In this study, commercial sanctions are the most affected.

Commercial sanctions seem to be the most widespread. In these sanctions, the target government cannot buy and sell, so the target government turns to intermediaries. The sanctioning government imposes financial sanctions here.

Therefore, trade must be cut off to cut off the financial exchanges of the target country. Commercial sanctions also have a huge impact on finances. They have a huge impact on oil for Iran. Knowledge sanctions are both very rare and have little effect, for example, certain drugs or student exchanges are sanctioned.

Knowledge sanction has a great impact on individuals because it is related to people. Knowledge sanctions have much less effect on financial sanctions, but they still affect commercial sanctions. That is why commercial sanctions are the basis of sanctions because in knowledge sanctions, drugs or essential substances are bought, thus affecting trade mechanisms and can not import drugs or essential substances.

Thus, knowledge sanction affects the business system (business sanctions) as well as the sanction on individuals. For an oil-rich country, knowledge sanctions have less effect on oil because the need to import scientific principles of oil knowledge is less felt, but this does not mean that it has no effect, but compared to other sanctions, it has less effect on oil sanctions. At present, Iran needs to sell more oil than new oil knowledge. Financial sanctions are also money transfer mechanisms. Finance is an institutional sanction, but it is considered an

individual. Therefore, when Finance is sanctioned, individuals are also sanctioned. The person may not be sanctioned at all, but the person to whom the money should be paid is abroad and it is not possible to pay for him. Financial sanctions will affect all sanctions. Wang et al. (2019) also found that economic sanctions significantly affect exchange rate fluctuations in target countries.

Rasoulinezhad and Popova (2017) also showed a negative relationship between financial and non-financial sanctions and oil price shocks with Iran-Russia trade.

6. Conclusion

Colonial governments disrupt financial markets to exert political pressure on target countries. For this purpose, in this study, the effects of sanctions on the economies of countries were investigated. After examining the various sanctions, their effect on the economic conditions of the countries was examined.

International sanctions have the greatest impact on other sanctions imposed on countries. Commercial sanctions are also the most affected. Commercial sanctions are the basis of sanctions because in knowledge sanctions drugs or essential substances are purchased and thus affect trade mechanisms and can not import drugs or essential substances. Thus, knowledge sanction affects the business system (business sanctions) as well as the sanction on individuals.

Therefore, the intensity of sanctions will be greatest where international sanctions are at their peak. It is suggested that future research examine the effect of these sanctions on different financial markets within countries.

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بررسی اثرات شرایط تحریمی بر شرایط اقتصادی ایران با استفاده از مدل تلفیقی شدت تحریم و Fuzzy DEMATEL اصلاح شده

چکیده

از آنجا که دولت‌های استعمارگر جهت اعمال فشار سیاسی بر کشورهای هدف، در بازارهای مالی اختلال ایجاد می‌کنند. بدین منظور در این مطالعه به بررسی اثرات شرایط تحریمی بر شرایط اقتصادی کشورها پرداخته می‌شود. بدین منظور معیارهای (تحریم‌های) مورد بررسی در این تحقیق در گروه‌های بین‌المللی، اموال، تجاری، دانشی، نفتی، مالی و افراد قرار داده شدند. این معیارها، تحریم‌های وارده بر ایران در بازه زمانی ۱۹۸۴ تا ۲۰۲۰ می‌باشند. روش مورد استفاده جهت آنالیز، تلفیق تکنیک Fuzzy DEMATEL و مدل شدت تحریم می‌باشد. نتایج این تحقیق بیانگر آن است که در مدل معرفی شده، تحریم‌های بین‌المللی از بیشترین تأثیرگذاری برخوردار هستند. این تحریم‌ها زمانی اثر خود را بیشتر نشان می‌دهند که دولت تحریم شده در حال تجارت است. بنابراین تحریم‌های بین‌المللی بیشترین تأثیرش را روی بحث‌های تجاری یک دولت (تحریم‌های تجاری) نشان می‌دهد. تحریم‌های بین‌المللی برای کشوری مثل ایران که روی نفت تجارت می‌کند و نفت خود را می‌فروشد، همان‌قدر که روی تحریم‌های تجاری اثر دارد روی تحریم نفتی هم اثر می‌گذارد ولی روی تحریم‌های افراد کمتر اثر می‌گذارد. در نهایت نتایج مدل حاکی از آن است که شدت تحریم‌ها در بازه زمانی ۲۰۱۰ تا ۲۰۱۵ در اوج خود قرار داشته است که بیشترین اثر آن ناشی از تحریم‌های بین‌المللیست.

کلمات کلیدی: تحریم، تجارت، Fuzzy DEMATAL، شدت تحریم، اقتصاد کشور.