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Commissioned by PAAIA
Public Affairs Alliance of Iranian Americans

Strengthening Compliance on the Iran Nuclear Deal

A Data-Driven Assessment of the Joint Comprehensive Plan of Action (JCPoA)

AUGUST 30, 2016

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Summary

Policymakers, Middle East analysts, and nuclear arms control experts want to know whether Iran will comply with the terms of the nuclear agreement (Joint Comprehensive Plan of Action—JCPoA). Empirical analysis and computer simulations conducted by giStrat indicate Iran is likely to comply with the JCPoA.

To date, Iran has fulfilled its compliance obligations. In return, the international community removed sanctions related to the Iranian nuclear program and released billions of dollars in frozen assets.[1] Critics of the deal worry that the Iranian government will violate the terms of the JCPoA once sanctions are removed. Advocates for the deal believe it is the best option to prevent Iran from acquiring nuclear weapons. Signatories to the JCPoA might not follow the United States should it choose to pull out of the agreement. The United States and wider international community should instead minimize incentives for Iran to violate the agreement and maximize the benefits of compliance.

Iran has fulfilled its compliance obligations since the agreement was reached on 14 July 2015. giStrat compiled data pertaining to all nuclear programs and compliance agreements across a sixty-two-year period (1950-2012) for both a large sample (170 countries) and a smaller sample (twenty-three countries) with nuclear programs. Our empirical analysis identified the most salient factors associated with a country developing nuclear weapons programs or complying with non-proliferation agreements. We then integrated our results with with our software giCompute, a proprietary decision science technology, to estimate whether Iran is likely to comply with the JCPoA and to identify conditions under which it would not comply. Below are the key findings supported by our empirical testing and game-theory modeling:

- **Likelihood of Compliance:** Iran is likely to comply with the JCPoA. A comparison of the JCPoA to other agreements indicates that the verification and data exchange protocols are highly robust and that this is the most stringent non-proliferation agreement in the history of the nuclear era.[2]

- **Verification, Data Exchange, and Strong Governing Bodies:** After comparing nuclear non-proliferation agreements from the last sixty-two years, we found that verification and data exchange protocols, coupled with a strong governing body that assures these mechanisms function robustly, are the most significant methods to assure compliance. The JCPoA mandates strong verification and data exchange mechanisms overseen by a strong governing body.

- **Economic Development and Sanctions:** The most significant motive for compliance with the JCPoA is economic development. Our findings show that the more a country develops economically, the more likely it is to comply with non-proliferation agreements. From a policy standpoint, we conclude that efforts aimed at developing the Iranian economy would significantly enhance the likelihood

1. Khalid Kazimov. "World Bank: Iran gains access to $30B in frozen assets." *Trend News Agency*. July 29, 2016. http://en.trend.az/iran/business/2564351.html.
2. Earnest Moniz. "Science-Based Nuclear Security and the Iran Agreement." *United States Department of Energy*. August 31, 2015. http://energy.gov/articles/science-based-nuclear-security-and-iran-agreement. See also: Broad, William J. "29 U.S. Scientists Praise Iran Nuclear Deal in Letter to Obama." *The New York Times*. August 8, 2015. http://www.nytimes.com/2015/08/09/world/29-us-scientists-praise-iran-nuclear-deal-in-letter-to-obama.html

of Iran not developing a nuclear weapons capability. In this context, the lifting of nuclear-related sanctions has been just as critical in preventing Iran from developing a nuclear weapons capability as the verification and data exchange mechanisms set in place by the JCPoA.

- **Future Opportunities:** Although Iran's accelerated ballistic missile program is not part of the JCPoA, President Rouhani himself has publicly stated it is a priority.[3] Contrary to most expert analysis, giStrat's combination of statistical analysis and game-theory based analytics suggest Iran is open to limiting its ballistic missile program in exchange for removal of missile-related sanctions. Under this scenario, Supreme Leader Ali Khamenei, President Hassan Rouhani, Foreign Minister Mohammad Javad Zarif, and the Islamic Revolutionary Guard Corps leadership might be willing to decelerate Iran's missile development without abandoning its current capabilities.

- **Conditions for Non-Compliance:** We identified two scenarios in which Iran is less likely to comply. (1) Under a scenario in which Iran is destabilized domestically, the Iranian government is more likely to break from the JCPoA and resume the path prior to the agreement. Domestic unrest can push leaders to pursue nuclear weapons as a means of bolstering nationalist sentiment while displaying power and prestige. (2) If the terms for relief of sanctions are not met, then the Iranian government is less likely to comply with the JCPoA.

Overview

This project provides empirical evidence, derived from a sample of all nuclear compliance cases, on the most significant factors that might ensure compliance with the Iran nuclear deal, formally known as the Joint Comprehensive Plan of Action (JCPoA). giStrat applied statistical modeling to analyze data from 170 countries across a sixty-two-year period (1950 – 2012). We evaluated relevant economic, social, and political factors considered significant indicators for whether a country pursues a nuclear program. We then analyzed data regarding characteristics of all non-proliferation agreements across a sixty-two-year period (1950 – 2012) to determine the factors that are significant in maximizing compliance regarding non-proliferation treaties. We integrated our empirical results with computer simulations using giCompute to estimate whether Iran is likely to comply with the JCPoA and to identify circumstances in which it would not comply.

Evaluation of all nuclear compliance cases in the last sixty-two years allowed us to discover systematic relationships and statistically significant patterns related to compliance. By working our way from the empirical evidence in the historical record to the specifics of the Iran nuclear deal, we were able to distinguish between general structural factors associated with compliance and unique factors needed to ensure that Iran complies with the JCPoA. Our overall findings indicate the Iran nuclear deal has many commonalities with historical cases and is not completely unique.

3. Michael Nienaber. "German exports to Iran soar after removal of sanctions". *Reuters World News*. August 22, 2016. http://www.reuters.com/article/us-germany-economy-trade-idUSKCN10X17I.

Terms of the Joint Comprehensive Plan of Action

The Joint Comprehensive Plan of Action is an agreement signed between the P5+1 (China, France, Germany, Russia, the United Kingdom, and the United States), the European Union, and Iran aimed at ensuring that Iran's nuclear program remains solely peaceful. The White House has stated that the deal "includes the most comprehensive and intrusive verification regime ever negotiated."[4] The agreement includes robust inspections, data exchange, and verification measures that make it extremely difficult for Iran to gain access to plutonium or highly enriched uranium.

The International Atomic Energy Agency (IAEA) verified that Iran met the nuclear requirements laid out in the JCPoA before the international community granted Iran relief from sanctions. IAEA officials confirmed that Iran significantly reduced its enriched uranium stockpile, dismantled more than 13,000 centrifuge machines, and removed the core of its Arak reactor before filling it with cement.

After Iran met its obligations it was able to receive billions of dollars of frozen assets. Approximately $32 billion of its approximately $100 billion in frozen assets was made available through the JCPoA.[5] The UN removed all nuclear-related UN Security Council resolutions except for arms-related sanctions, which will be lifted in five to eight years. The European Union and United States removed all nuclear-related sanctions. The removal of sanctions allows Iran to access international financial and banking systems and to increase its oil and gas exports. Iranian banks can also open and operate within EU member countries. Significant Iranian business sectors—including carpets, pistachios, caviar, and saffron—are now open for trade with the US. Carpet exports have already increased forty percent.[6]

Components of the JCPoA

Verification	IAEA is to verify compliance through continuous monitoring and containment.
Data Exchange	Iran is required to declare the number of centrifuges and quantity of uranium ore concentrate.
Inspections	Iran must allow both routine and challenge inspections. The IAEA must have access to all declared nuclear sites under routine inspections. Challenge inspections can occur at military and undeclared sites.
Governing Body	Signatories will create a Joint Commission, which is made up of representatives from the P5+1 countries. The Joint Commission will implement the treaty and resolve any issues that arise.

4. "The Iran Nuclear Deal: What You Need to Know About the JCPOA." *The White House*. https://www.whitehouse.gov/sites/default/files/docs/jcpoa_what_you_need_to_know.pdf.
5. Matt Pearce. "Where are Iran's billions in frozen assets, and how soon will it get them back?" *Los Angeles Times*. August 25, 2016. http://www.latimes.com/world/middleeast/la-fg-iran-frozen-assets-20160120-story.html.
6. "Iranian carpets recapture US market." *Press TV*. August 16, 2016. http://www.presstv.ir/Detail/2016/08/16/480275/Iran-carpets-exports-US-sanctions-Kargar.

Limiting Supply Chain	Iranian uranium mines and mills, centrifuge production facilities, and all other declared nuclear sites will be monitored and inspected. Imports of nuclear or dual-use technology will be monitored and must be approved.
Dispute Resolution	If either Iran or the P5+1 believe the other party is not complying with the deal, then they can bring the issue to the Joint Commission. If the complainant does not feel the issue was properly addressed by the Joint Commission, they can then take their complaint to the Ministers of Foreign Affairs of signatory countries. The Joint Commission would adjudicate the case with the advice of foreign ministers. If the issue is not resolved, they can consider it grounds for non-performance and refer it to the UN Security Council. The Security Council would then vote on whether to continue lifting sanctions.

Iran's nuclear program is under severe limitations and strict oversight. Under the terms of the agreement, the IAEA is allowed to verify that Iran is not pursuing construction on its unfinished Arak reactor. The IAEA will also monitor the construction of the modernized Arak reactor and ensure that its construction is consistent with the approved designs. The reactor will be operated under continuous IAEA monitoring, and all heavy water that is beyond Iran's needs will be sold at international prices. The IAEA will monitor the quantities of heavy water retained and sold. The existing natural uranium pellets and IR-40 fuel assemblies will be stored under continuous IAEA monitoring until the modernized Arak reactor is operational. Iran is required to not produce uranium pellets, fuel assemblies, or fuel pins that were designed for the original Arak reactor. All spent fuel from future and existing reactors, including the modernized Arak reactor, will be shipped out of Iran under surveillance.[7]

The JCPoA includes multiple instruments for verification. Iran is required to provide long-term visas and work spaces for IAEA personnel and increase the number of IAEA inspectors. The IAEA will verify that Iran's uranium research and development activities are in line with the agreement. IAEA officials will implement continuous monitoring of equipment used to manufacture centrifuges. The IAEA is also permitted to use containment and surveillance to verify that stored centrifuges remain in storage.

For fifteen years or more the IAEA is allowed to use on-line enrichment measurement, electronic seals, and measurements collected by recording devices. For twenty years Iran is required to provide inventory of all centrifuge rotor tubes and bellows for the IAEA to monitor and verify. For twenty-five years the IAEA is permitted to utilize containment and surveillance measures to monitor Iran's uranium ore concentrate supply. Iran is also required to provide the IAEA with information to verify the production and inventory of uranium ore concentrate.

7. "Joint Comprehensive Plan of Action" United Sates Department of State. http://www.state.gov/e/eb/tfs/spi/iran/jcpoa/.

Iran was required to sign the Additional Protocol to the Nuclear Non-Proliferation Treaty. The Additional Protocol allows inspectors access to suspicious undeclared sites. The IAEA can request access to sites suspected of being involved in activities that violate the agreement. The IAEA is allowed access to the site within twenty-four days. If Iran fails to respond within fourteen days, then the Joint Commission has seven days to adjudicate the issue. If they reach a consensus or if a majority agrees with the IAEA's request, then Iran has three days to comply and allow access.[8]

When a dispute arises, there is a dispute resolution mechanism in place to deal with the disagreement. The JCPoA created a governing body, the Joint Commission. The Joint Commission is charged with several functions. Its most important duties are to approve the final design for the modernized reactor, review and approve any plans submitted by Iran for research and development on uranium, review any procurement of multi-point detonation systems or enrichment technologies, and review and attempt to resolve any complaints of noncompliance by any party.

Most Significant Attributes for Compliance: Verification and Data Exchange

In testing data for the twenty-three countries that currently have or previously had nuclear programs across a sixty-two-year period (1950 – 2012), our results indicate that the most significant mechanisms to strengthen compliance are data exchange, verification, and the creation of a governing body to oversee the agreement.

Verification can include measurements and monitoring equipment. The party responsible for overseeing verification varies among compliance agreements. For bilateral treaties, certification can rest with national governments. For international agreements, such as the Nuclear Non-Proliferation Treaty, the IAEA can oversee verification and submit notification of violation to the UN Security Council. In some cases, as in the JCPoA, a treaty will create a governing body that oversees verification. The creation of a governing body increases the likelihood of compliance.

Data exchange includes the exchange of information on nuclear sites, nuclear materials, and nuclear technology. When a treaty includes a data exchange mechanism, compliance is more likely.

8. "Joint Comprehensive Plan of Action" United Sates Department of State. http://www.state.gov/e/eb/tfs/spi/iran/jcpoa/.

Effects of Sanctions

The data indicates that sanctions and the threat of sanctions significantly increase the likelihood of a country developing a nuclear program. Sanctions can further isolate and anger an already isolated state. Isolated pariah states pursue nuclear weapons in order to protect themselves in a hostile international environment. However, if a country has already signed on to a nuclear treaty or agreement, the threat of sanctions can indirectly increase its likelihood of compliance by jeopardizing the country's economic development.

Domestic Instability

Domestic instability is a highly significant indicator of a country's desire to have a nuclear weapons program. Internal unrest can push leaders to pursue nuclear weapons as a means of diverting attention away from unfavorable national issues, bolstering nationalist sentiment, and displaying power and prestige. North Korea's nuclear weapons program, for example, projects national power and prestige in order to control the domestic population despite its failing economy.

Perception of Rival Threat and Involvement in a Conflict

Our results indicate that Iran is more likely to pursue nuclear weapons as a deterrent if they believe there is a strong rival threat in the region. A nuclear program can deter outside powers from destabilizing a country by signaling an ability to retaliate if attacked. For example, during the Cold War South Africa developed nuclear weapons as a deterrent against the Soviet Union and regional rivals such as Angola.

Similarly, countries involved in more conflicts are more likely to develop nuclear programs. For example, India and Pakistan were involved in ongoing skirmishes and conflicts, leading both countries to develop secret weapons programs despite their failing economies. India first began pursuing nuclear capabilities in 1947 to increase the country's prestige and defense capabilities. India tested its first nuclear device in 1974 amidst ongoing tensions with Pakistan over Jammu and Kashmir. Pakistan developed nuclear capabilities in direct response to India. In 1998, after India detonated five nuclear devices on May 11th and 13th, Pakistan responded with six nuclear explosions on May 28th and May 30th.

Economic Development

We find that the more developed a country becomes, the more likely it is to also develop a nuclear weapons program. At the same time, higher levels of economic development increase compliance with treaty obligations. In order for countries to produce a nuclear weapons program they must have the technical knowledge, fissile components, and the econoemic capacity to produce costly nuclear facilities. While countries have more easily gained the technical capability to develop nuclear weapons as nuclear knowledge proliferates, it is more difficult to attain fissile components or the economic capacity required for a nuclear weapons program. Countries must be able to afford not only the costs of building a nuclear weapons program but also the economic consequences of sanctions levied by the international community in response to weaponization.

Insignificant Factors

Countries with nuclear defenders were no more or less likely to comply with non-proliferation treaties. A country that acts as a nuclear defender guarantees protection, up to and including the use of nuclear force, for an ally without nuclear weapons. Previous analyses found that a country's decision calculus to develop nuclear weapons programs is significantly affected by the presence or absence of a nuclear defender.[9] The cases of South Korea and Ukraine seem to support the conventional wisdom that the presence of nuclear defenders affects a country's decision to develop a nuclear weapons program, but giStrat's empirical analysis shows that these are isolated cases that cannot be generalized into a rule. The US pressured South Korea to end its program and agreed to use nuclear weapons to defend South Korea if necessary. Ukraine ultimately gave up its nuclear weapons because it wanted to be accepted by the international system, and because three superpower countries provided the Ukrainian government with economic support and security assurances.[10]

Whether a country is democratic has no significant effect on compliance.

Case Studies

South Africa

South Africa remains the only country to dismantle voluntarily all nuclear weapons in its possession. In 1957 South Africa signed a collaboration agreement with the United States that supplied it with a nuclear reactor and highly enriched uranium. South African scientists gained nuclear technical knowledge and training in the United States under the Atoms for Peace program. Amidst a growing perceived threat by the Soviet Union, South Africa began developing nuclear weapons in 1973. By 1977

9. Dong Joon Jo & Erik Gartzke. "Determinants of Nuclear Weapons Proliferation". *Journal of Conflict Resolution 51*, no. 1 (2007), 167-194
10. Joseph Cirincione, Jon B. Wolfsthal, and Miriam Rajkumar. *Deadly Arsenals : Nuclear, Biological, and Chemical Threats* (2). Washington, US: Carnegie Endowment for International Peace, 2005.

South Africa had a nuclear explosive device. It committed to a nuclear weapons program after Cuban forces exacerbated regional insecurity by undermining South African efforts in the Angolan Civil War.

Cuban forces supported the People's Movement for the Liberation of Angola (MPLA) while South Africa supported the National Liberation Front of Angola (FNLA) and the National Union for the Total Independence of Angola (UNITA). South Africa, concerned about the growing influence of the Soviet Union in Africa, hoped to become a dominant regional power by developing weapons. However, apartheid and open aspirations for nuclear weapons isolated South Africa from the international community. This only increased South Africa's willingness to develop weapons.

In 1975 the US and the international community learned about the nuclear weapons program. Throughout the 1970s and 1980s the international community pushed for IAEA inspections in South Africa, which the country continuously refused. Relations between South Africa and the international community deteriorated. The United States ended their nuclear partnership, and the Group of 77 pushed to expel South Africa from the IAEA. South Africa responded by agreeing to sign the Nuclear Non-Proliferation Treaty, and the decision to expel South Africa was halted.[11] In 1989 F.W. de Klerk was elected State President of South Africa, and that year he called for an end to the nuclear weapons program.

The end of the Cold War and more favorable regional political conditions significantly contributed to the change in nuclear policy. The tripartite agreement between South Africa, Angola, and Cuba established an agreement for the withdrawal of Cuban troops from Angola. De Klerk publicly stated that the end of the Cold War, the independence of Namibia, and the withdrawal of Cuban troops made nuclear weapons not just unnecessary but even detrimental to the fortunes of South Africa.
The changing political scene in South Africa itself also influenced the government's decision to disarm. The de Klerk government ended the nuclear weapons program so the post-apartheid government would not inherit nuclear capabilities.

Belarus, Kazakhstan, and Ukraine

Belarus, Kazakhstan, and Ukraine all inherited weapons from the Soviet Union after it collapsed. All three countries also gave up their nuclear capacity, although at different paces and under varying conditions.

Belarus and Kazakhstan both gave up their weapons shortly after gaining independence. President Alexander Lukashenko of Belarus initially attempted to maintain control of the weapons to keep NATO from placing weapons in Poland. However, Belarus was finally compelled to give up the nuclear weapons due to ongoing internal instability. Belarus signed the Lisbon Protocol in 1992 and the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in 1993 as a non-nuclear weapon state. All

11. Zondi Masiza. "A Chronology of South Africa's Nuclear Program". *The Nonproliferation Review*. Fall 1993. https://www.nonproliferation.org/wp-content/uploads/npr/masiza11.pdf.

remaining weapons were transferred to Russia. Kazakhstan signed the NPT in 1994 and disposed of its warheads and nuclear weapons.

Ukraine became the world's third largest nuclear power after inheriting a stockpile of nuclear weapons following independence from the Soviet Union. The Ukrainian government worried that Russia remained a threat and wanted to keep its nuclear weapons as a deterrent. Ukrainian officials justified their decision to keep the inherited nuclear weapons by claiming that Ukraine could use the material for peaceful energy. To further justify its ownership of nuclear weapons, the Ukrainian parliament attached to the Strategic Arms Reduction Treaty (START) conditions that Russia and the United States would not accept: Ukraine offered to give up only about half of its nuclear warheads and delivery vehicles.

Clinton and Yeltsin were able to produce the Trilateral Statement with Leonid Kravchuk in 1994.[12] The agreement allowed Ukraine to monitor the transfer of the weapons to Russia. It also called for Russia to dismantle the warheads, downgrade the highly enriched uranium into low-enriched uranium, and transfer the low-enriched uranium back to Ukraine for use as nuclear reactor fuel. The US and Russia were also required to provide economic and technical assistance to help facilitate the dismantlement process, and they agreed to provide security assurances to Ukraine. The Ukrainian parliament ratified START once these assurances were guaranteed. Ukraine only signed onto the NPT after Russia, the United States, and the United Kingdom agreed to protect its sovereignty and territory. Ukraine ultimately gave up its weapons in order to be accepted by the international system, and only after three superpower countries provided the Ukrainian government with economic support and security assurances.

Brazil and Argentina

The bilateral cooperation that led Brazil and Argentina to end their nuclear weapons programs counts as one of the greatest successes of the nonproliferation regime. From the 1960s to the 1980s, Argentina and Brazil secretly pursued nuclear weapons as part of a rivalry for regional hegemony and military prestige. Neither country initially signed on to the NPT or the Treaty for the Prohibition of Nuclear Weapons in Latin America, also known as the Tlatelolco Treaty. Both countries developed nuclear weapons programs through dual track efforts by benefiting from the transfer of technology.

Argentina is one of the few countries to develop a nuclear program without being fully dependent on foreign countries for technology.[13] A US-designed reactor was built in 1958 after Argentina signed a nuclear cooperation agreement. Argentina then built three reactors based on the plans for the RA-1. Brazil also began a weapons program after receiving outside assistance. During this time, both countries refused to accede to the NPT and the Tlatelolco Treaty.

Argentina and Brazil's nuclear policy positions shifted after democratically elected governments took power from a military junta in the 1980s. In 1985 Argentina began to work with Brazil to build

12. T.V. Paul. F*oreign Policy, Security and Strategic Studies: Power versus Prudence: Why Nations Forgo Nuclear Weapons.* (Montreal, CA: McGill-Queen's University Press, 2000).
13. Joseph Cirincione, Jon B. Wolfsthal, and Miriam Rajkumar. *Deadly Arsenals : Nuclear, Biological, and Chemical Threats* (2). Washington, US: Carnegie Endowment for International Peace, 2005.

confidence and engage in bilateral nuclear cooperation. In 1992 Argentina constructed an agreement with Brazil wherein each country would accept the supervision of its rival to guarantee that each country was maintaining peaceful nuclear facilities. They both signed a comprehensive safeguards agreement with the IAEA. In 1993 the Argentine Senate ratified the Treaty of Tlatelolco and in 1995 acceded to the NPT as a non-nuclear weapon state. It also joined the Nuclear Suppliers Group in 1994. Argentina remains a major nuclear supplier, especially for developing countries in Latin America. The changing dynamics of the international system, and the fear of starting a nuclear war, led Brazil and Argentina to abandon their weapons programs. The domestic environment and political leaders also played a major role in the decision and ability to forgo nuclear weapons.

North Korea

North Korea is the classic example of a failed non-proliferation process. North Korea sought assistance in building a nuclear capability from the Soviet Union in 1963. The USSR assisted the North Koreans in building the Yongbyon reactor. The tenuous relationship between North Korea and the international community began in 1985 when North Korea acceded to the NPT: while North Korea acceded to the treaty, it failed to complete the safeguards requirement until 1992, well after the required deadline. Soon after North Korea signed the safeguards agreement, the IAEA found discrepancies between its own findings and North Korea's report, and relations with the international community rapidly declined. Inspectors demanded access to North Korea's nuclear waste facilities due to suspicions that North Korea was cheating on their agreements. North Korea refused and stated that they were leaving the NPT.

Amidst collapsing relations, the United States and North Korea signed the Agreed Framework to suspend North Korea's bid to leave the NPT. Before this agreement collapsed in 2002, North Korea agreed to freeze its illicit weapons program in exchange for aid. North Korea withdrew from the NPT in 2003 and began operating its nuclear facilities once again. The North Korean government was brought to the table again in the Six Party Talks which included China, Japan, North Korea, South Korea, Russia, and the United States. Talks broke down in 2009 due to disagreements about the verification process and a rocket launch by North Korea.

North Korean officials feel that they must compensate for their country's limited size and resources with nuclear weapons in order to project power in the region. North Korea is also a pariah state, and unlike the case of South Africa it is not in a position where it is likely to gain positive outcomes for its government. Rather North Korea can potentially gain concessions from the international community and protect itself from fallout related to regional instability by possessing nuclear weapons. North Korea is also a major exporter of nuclear components and ballistic missiles, so it generates much needed revenue from its nuclear program. These security and economic factors create an unfavorable scenario that is unlikely to improve without dramatic changes in the region or domestic politics of North Korea.

14. Curtis Martin. "Rewarding North Korea: Theoretical Perspectives on the 1994 Agreed Framework". *Journal of Peace Research 39*, no. 1 (2002): 51-68. doi: 10.1177/0022343302039001003.15. "North Korea." *Nuclear Threat Initiative*. Last modified May, 2016. http://www.nti.org/learn/countries/north-korea/.

15. "North Korea." *Nuclear Threat Initiative*. Last modified May, 2016. http://www.nti.org/learn/countries/north-korea/.

Game Theory Impact Modeling: Pathways to Strengthen Compliance

giStrat applied its cloud computing technology to estimate game theory-based benefits (payoffs) of the major groups and actors associated with the Iran nuclear deal. Our analysts ranked the known preferences of key stakeholders across five of the compliance determinants deemed significant from our empirical findings: (1) verification for compliance; (2) data exchange for compliance; (3) degree of domestic stability; (4) degree of regional rivalries; and (5) degree of sanctions. Using this process, we estimated the overall utility value each stakeholder places on the variety of potential outcomes related to JCPoA compliance. This allows us to estimate the likelihood of Iran's compliance and to identify pathways for strengthening adherence to the agreement.

Likely Outcome: Iran Complies with JCPoA but Accelerates Ballistic Missile Program

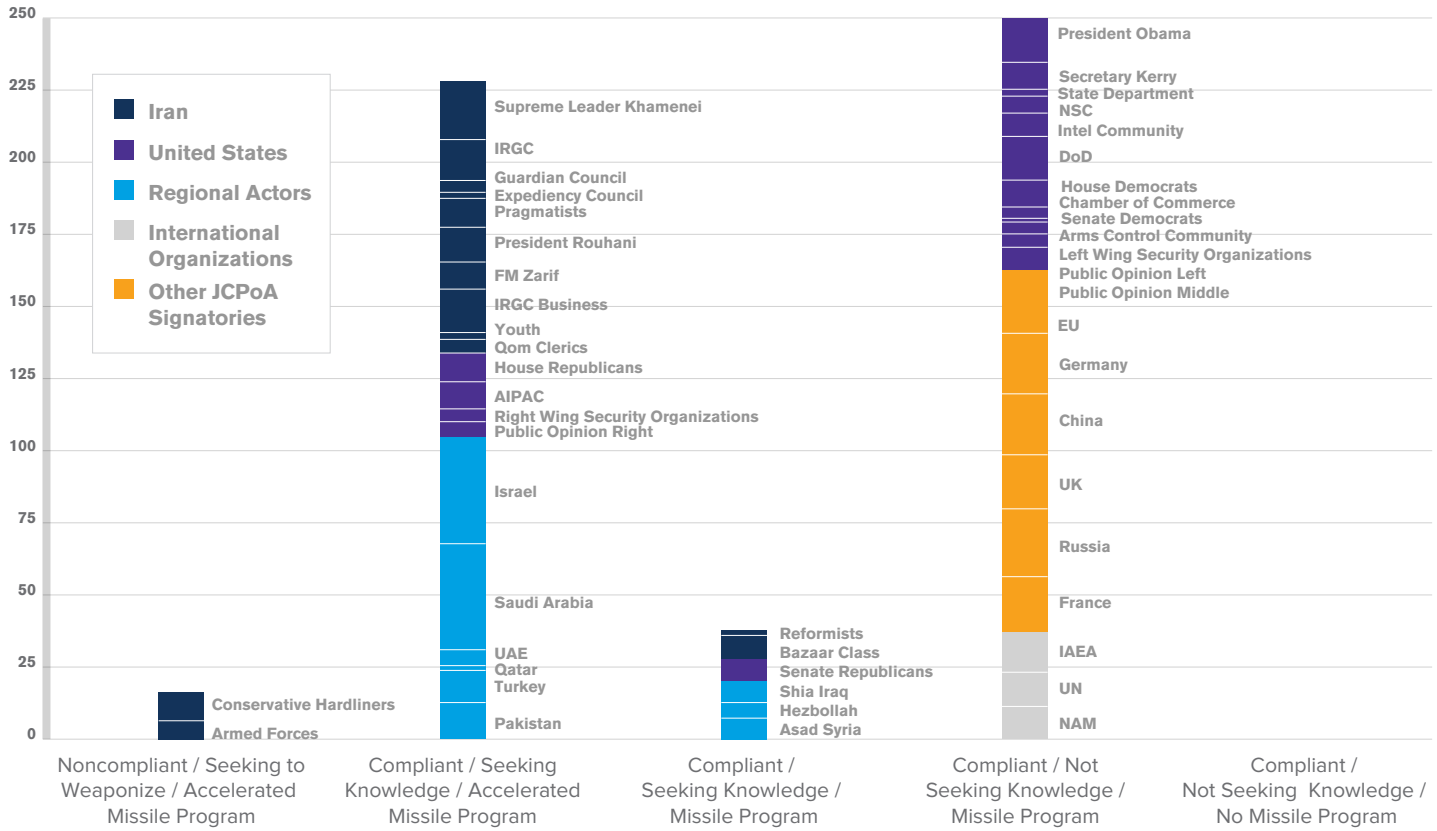
Components

Scenario Pathways	Verification	Data Exchange	Domestic Stability	Regional Rival Threat	Sanctions
Noncompliant / Seeking to Weaponize / Accelerated Missile Program	No Verification	No Data Exchange	Unstable	Rival with Nukes	Stringent Sanctions
Compliant / Seeking Knowledge / Accelerated Missile Program	International Verification	Data Exchanged	Semistable	Rival with Nukes	Minor Sanctions
Compliant / Seeking Knowledge / Missile Program	International Verification	Data Exchanged	Semistable	Rival with Nukes	Sanctions Relief
Compliant / Not Seeking Knowledge / Missile Program	International Verification	Data Exchanged	Stable	Rival with Conventional Capabilities	Sanctions Relief
Compliant / Not Seeking Knowledge / No Missile Program	International Verification	Data Exchanged	Stable	Limited Rivalries	No Sanctions

Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	United States	Regional Actors	Other P5 Signatories	International Orgs	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Compliant / Seeking Knowledge / Accelerated Missile Program	35.37	14.85	56.82	-11.4	-1.0	22.17	18.8	6821.0
2	Compliant / Seeking Knowledge / Missile Program	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Compliant / Not Seeking Knowledge / Missile Program	-143.8	0.59	-78.0	52.92	16.0	-38.02	-30.6	19672.0
4	Compliant / Not Seeking Knowledge / No Missile Program	-228.81	-89.3	-253.15	5.68	-23.0	-133.13	-117.6	25881.0
5	Noncompliant / Seeking to Weaponize / Accelerated Missile Program	-113.05	-237.19	-72.21	-237.53	-306.0	-174.82	-193.0	16532.0

Strategic Preferences Based on the Costs and Benefits of Individual Actors (Net Payoffs)



Outcome: giStrat's decision analytics indicate Iran is likely to comply with the JCPoA, though the Iranian government is also likely to accelerate its ballistic missile program. President Rouhani has publicly stated that progress on the ballistic missile program is a priority.[16]

Gradual circumstances such as the lack of economic reforms will likely not affect whether Iran withdraws or does not comply with the JCPoA, although it will continue to place a heavy toll on underemployed youth and the middle class in Iran. Rising expectations will have to be met with an improved economic reality for Iranians. Increased revenue from lifted sanctions might be enough to bolster quasi-state owned enterprises without forcing economic reform. However, this circumstance is not unique to Iran and remains a problem in countries with large oil exports.

Strengths: Iran continues to comply with the nuclear deal. The agreement has already increased economic cooperation with the international community. The central bank of Iran also believes it can improve the livelihood of the Iranian population and expects economic growth upwards of five percent in 2016.

Weaknesses: Regional tensions continue due to Iran's acceleration of its missile program. Iran can comply with the JCPoA while continuing nuclear-related research and development.

Opportunities: There is a potential for increased regional stability through greater economic cooperation and improved economic stability.

Threats: Fast-paced development of delivery capabilities with potential for dual use can pose a risk to Iran's neighbors, as Iran continues to seek knowledge of advanced nuclear capabilities.

16. Sam Wilkin. "Rouhani expands Iran's missile program despite U.S. sanctions threat." *Reuters World News*. December 31, 2015. http://www.reuters.com/article/us-iran-nuclear-usa-sanctions-idUSKBN0UE0QT20151231.

Alternative Outcome: Iran Complies with JCPoA and Decelerates Ballistic Missile Program

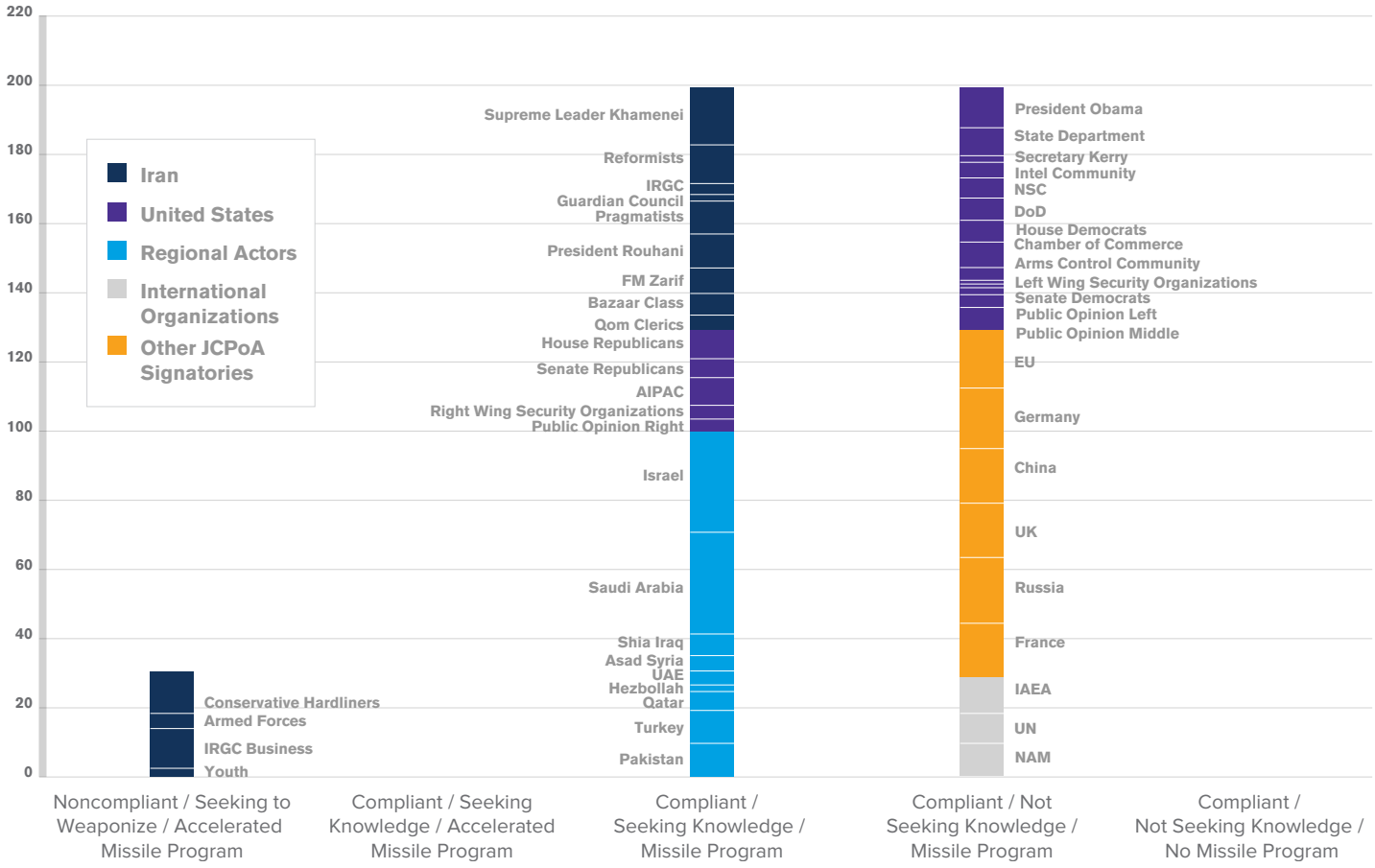
Components

Scenario Pathways	Verification	Data Exchange	Domestic Stability	Regional Rival Threat	Sanctions
Noncompliant / Seeking to Weaponize / Accelerated Missile Program	No Verification	No Data Exchange	Unstable	Rival with Nukes	Stringent Sanctions
Compliant / Seeking Knowledge / Accelerated Missile Program	Verification	Data Exchanged	Semistable	Rival with Limited Capabilities	Sanctions Relief
Compliant / Seeking Knowledge / Missile Program	Verification	Data Exchanged	Semistable	Rival with Nukes	Sanctions Relief
Compliant / Not Seeking Knowledge / Missile Program	Verification	Data Exchanged	Stable	Rival with Conventional Capabilities	Sanctions Relief
Compliant / Not Seeking Knowledge / No Missile Program	Verification	Data Exchanged	Stable	Limited Rivalries	No Sanctions

Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	United States	Regional Actors	Other P5 Signatories	International Orgs	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Compliant / Seeking Knowledge / Missile Program	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Compliant / Seeking Knowledge / Accelerated Missile Program	-11.02	-12.0	-37.24	-8.42	-12.0	-16.8	-16.0	3363.0
3	Compliant / Not Seeking Knowledge / Missile Program	-143.8	0.59	-78.0	52.92	16.0	-38.02	-30.6	19672.0
4	Compliant / Not Seeking Knowledge / No Missile Program	-228.81	-89.3	-253.15	5.68	-23.0	-133.13	-117.6	25881.0
5	Noncompliant / Seeking to Weaponize / Accelerated Missile Program	-113.05	-237.19	-72.21	-237.53	-306.0	-174.82	-193.0	16532.0

Strategic Preferences Based on the Costs and Benefits of Individual Actors (Net Payoffs)



Outcome: Contrary to some analysts' judgment, our results suggest Iran is open to limiting its ballistic missile program in exchange for removal of missile-related sanctions. Under this scenario, a coalition including Supreme Leader Ali Khamenei, President Hassan Rouhani, Foreign Minister Mohammad Javad Zarif, and the Islamic Revolutionary Guard Corps leadership might be willing to decelerate Iran's missile development without abandoning its current capabilities. This coalition would face significant resistance from the conservative hardliner bloc. Although Iran's ballistic missile program is not part of the JCPoA, our simulated scenarios indicate the likelihood of compliance with the nuclear agreement would be even higher if the international community lifted additional sanctions in return for Iran decelerating its ballistic missile program.

Strengths: Iran continues to comply with the nuclear deal. The agreement has already increased economic cooperation with the international community. The central bank of Iran also believes it can improve the livelihood of the Iranian population and expects economic growth upwards of five percent in 2016.

Weaknesses: Iran continues nuclear-related research and development within the confines of the JCPoA while remaining open to seeking additional nuclear knowledge and capabilities.

Opportunities: Regional tensions significantly decrease due to the possibility of a decelerated ballistic missile program and continued Iranian compliance with the JCPoA.

Threats: Iran maintains the capacity to deliver nuclear devices. Future nuclear weaponization remains possible because Iran remains open to seeking knowledge.

Alternative Outcomes in Which Iran Does Not Comply with the JCPoA

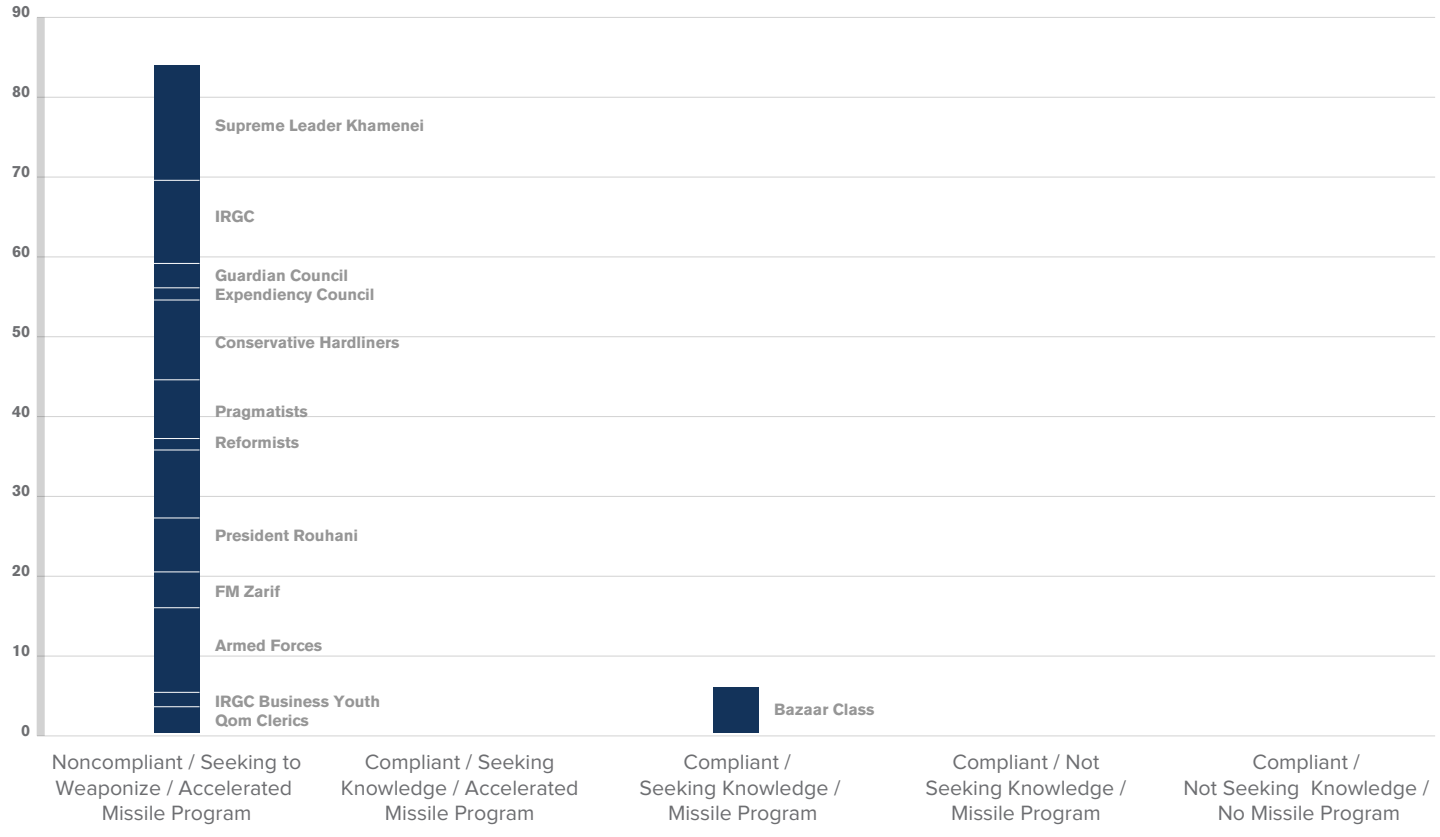
Components

Scenario Pathways	Verification	Data Exchange	Domestic Stability	Regional Rival Threat	Sanctions
Noncompliant / Seeking to Weaponize / Accelerated Missile Program	No Verification	No Data Exchange	Unstable	Rival with Nukes	Stringent Sanctions
Compliant / Seeking Knowledge / Accelerated Missile Program	Verification	Data Exchanged	Semistable	Rival with Limited Capabilities	Sanctions Relief
Compliant / Seeking Knowledge / Missile Program	Verification	Data Exchanged	Semistable	Rival with Nukes	Sanctions Relief
Compliant / Not Seeking Knowledge / Missile Program	Verification	Data Exchanged	Stable	Rival with Conventional Capabilities	Sanctions Relief
Compliant / Not Seeking Knowledge / No Missile Program	Verification	Data Exchanged	Stable	Limited Rivalries	No Sanctions

Game Theory Payoffs for Each Scenario

Ranking From Most to Least Likely	Scenario Pathways	Iran	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Noncompliant / Seeking to Weaponize / Accelerated Missile Program	94.51	94.51	94.0	0.0
2	Compliant / Seeking Knowledge / Missile Program	0.0	0.0	0.0	0.0
3	Compliant / Seeking Knowledge / Accelerated Missile Program	-11.02	-11.02	-11.0	0.0
4	Compliant / Not Seeking Knowledge / Missile Program	-104.78	-104.78	-104.0	0.0
5	Compliant / Not Seeking Knowledge / No Missile Program	-189.79	-189.78	-189.0	0.0

Strategic Preferences Based on the Costs and Benefits of Individual Actors (Net Payoffs)



Iran is Rapidly Destabilized: Significant domestic instability could force the Iranian government to break from the JCPoA and resume its pursuit of nuclear weapons. Destabilization includes acute events such as massive anti-government protests, attempted coups, or an insurgency. Under a scenario of internal destabilization, Supreme Leader Khamanei, pragmatists led by President Rouhani, and reformists would rally to secure the country from a perceived threat. This unlikely coalition would support the resumption of advanced centrifuge development as a deterrent to destabilizing forces.

Great Expectations from Sanctions Relief: Iran might also cease to comply if the international community does not relieve sanctions according to the terms in the agreement. This non-compliance scenario is less dramatic but more likely than a sudden destabilization of the country. Mismanagement of the economy, along with the effects from years of strict sanctions, continues to exact a heavy toll from the population. Iranian businesses cannot take advantage of unfrozen assets because of unresolved problems in the banking industry and continued apprehension from Western companies wary of business with Iran. Foreign Minister Zarif, under tremendous pressure in Tehran, continues to bring up this issue in the JCPoA Joint Commission.

Strengths: Iran's economy has benefitted from the JCPoA in spite of the imperfect implementation of sanctions relief. Although the economy grew only by half a percent in 2015, it is expected to grow approximately four percent in 2016.[17] Iran has seen some benefits from the deal already. Since the enactment of the agreement, German exports to Iran increased by fifteen percent in the first six months of 2016.[18] Iranian carpet exports, a significant source of revenue for the economy, have increased forty percent.[19]

Weaknesses: Cooperation betwen Iran and the United States remains limited because of domestic political constraints.

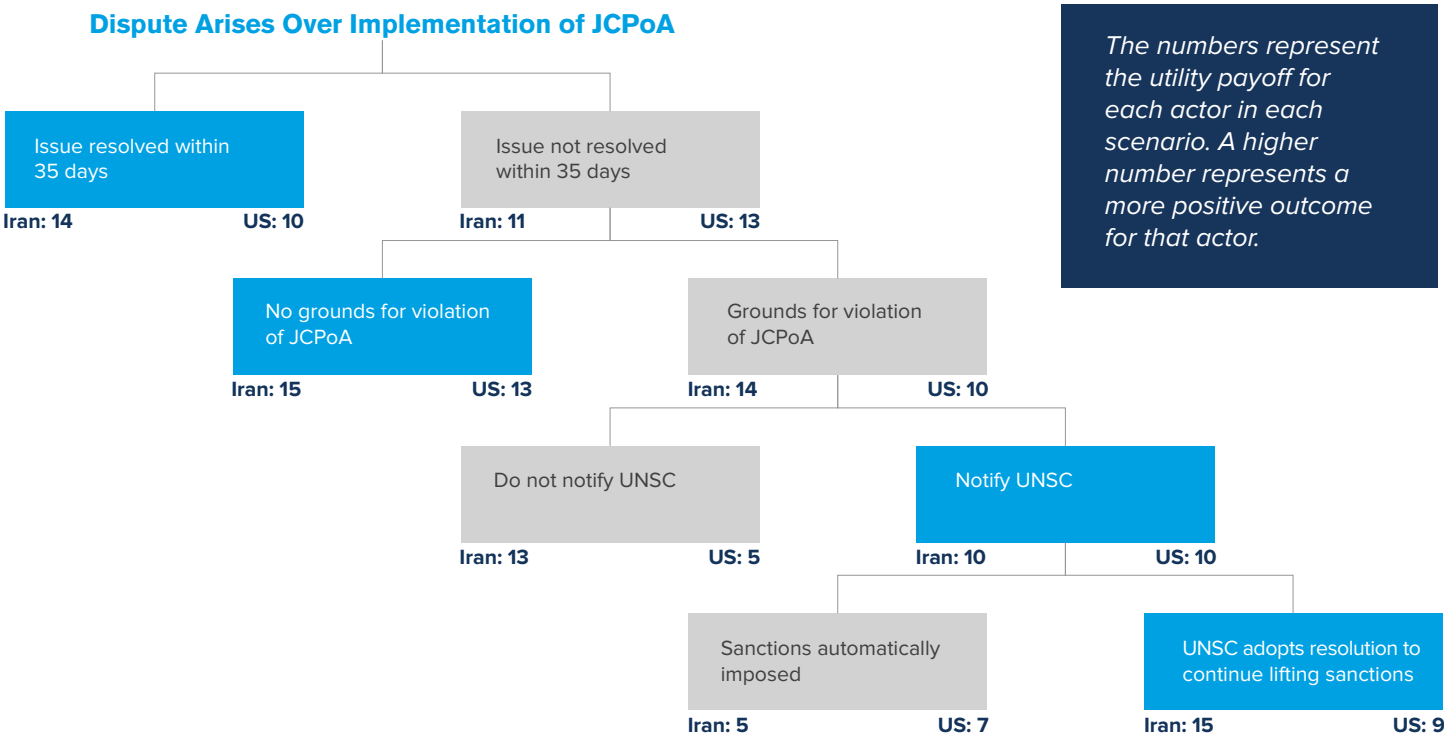
Opportunities: Cooperation among P5+1 partners increases to prevent Iran from developing nuclear weapons capabilities.

Threats: Pulling out from the JCPoA would signal Iran's desire to develop a nuclear weapons capability. Potential conflict could ensue as countries seek to remove Iran's ability to acquire nuclear weapons.

17. "Iran Overview." *The World Bank*. Last modified Aril 1, 2016. http://www.worldbank.org/en/country/iran/overview.
18. Michael Nienaber. "German exports to Iran soar after removal of sanctions". *Reuters World News*. August 22, 2016. http://www.reuters.com/article/us-germany-economy-trade-idUSKCN10X17I.
19. "Iranian carpets recapture US market." *Press TV*. August 16, 2016. http://www.presstv.ir/Detail/2016/08/16/480275/Iran-carpets-exports-US-sanctions-Kargar.

Estimating Compliance Outcomes Through the JCPoA Dispute Resolution Process

giStrat applied game theory modeling to simulate the dispute resolution mechanism established by the JCPoA. As part of this process, we modeled the decision calculus of the United States and Iran vis-a-vis two main issues: 1) the risk of escalating Iranian nuclear activity, and 2) the risk of sanctions imposed on Iran. Iran seeks to minimize the risk of new sanctions while maximizing its ability to pursue its nuclear program within the constraints of the JCPoA. The United States seeks to maximize the threat of sanctions while minimizing the risk of Iran escalating its nuclear activities.



Outcome: The JCPoA established a formal dispute resolution mechanism to adjudicate cases when a party believes Iran is violating the terms of the agreement. After a party refers a dispute to the Joint Commission, the governing body has a period of thirty-five days to resolve the issue. If the issue is not resolved within the required period, it becomes grounds for violation of the JCPoA, and the UN Security Council (UNSC) receives a notification. The UNSC must adopt a resolution within a thirty-day

period to maintain sanctions relief. If a resolution is not adopted, sanctions are automatically imposed for violation of the JCPoA. Any permanent member of the UNSC can veto ongoing sanctions relief, but no member can veto the imposition of sanctions. Therefore, the dispute resolution process applies to ongoing sanctions relief only and not to sanctions that have already been relieved.

The game theory model indicates that once the dispute is brought before the joint commission, Iran will likely comply. Should the joint commission refer an issue to the UNSC, Iran will likely attempt to resolve a compliance issue to prevent the imposition of sanctions. The United Sates, for its part, will attain the best payoff (i.e. net benefit) by resolving issues within the joint commission structure. The model suggests that the likelihood of resolving an issue diminishes as the issue progresses through the dispute mechanism chain. This occurs because in the initial stages of the dispute process, differing sides can use the mechanism to practice brinksmanship by testing the limits on what they can get away with, knowing that there are multiple steps designed to place breaks on a small violation that could otherwise spiral without the chance of making corrections. However, all sides know that the further the dispute mechanism escalates, the less chances there are to resolving the issues, and therefore they are incentivized to address issues earlier in the process.

In sum, our testing of the JCPoA dispute resolution process suggests it is a robust mechanism for maintaining compliance.

Policy Implications

The verification and data exchange protocols outlined in the JCPoA, coupled with a mandate for a strong governing body to enforce these mechanisms, are the most important tools available to ensure Iran complies with the agreement. A comparison of the JCPoA with other agreements indicates that this is the most stringent nuclear non-proliferation agreement in history. In addition to reducing Iran's opportunity for developing a nuclear weapon, policy-makers should also consider minimizing Iran's motive to weaponize its nuclear program. The most significant motive for compliance with the JCPoA is economic development. Our findings clearly show that the more a country develops economically, the more likely it is to comply with non-proliferation agreements. From a policy standpoint, we conclude that efforts aimed at developing the Iranian economy would significantly decrease the likelihood of Iran developing a nuclear weapons capability. In this context, the lifting of nuclear-related sanctions has been just as critical in preventing Iran from developing a nuclear weapons capability as the verification and data exchange mechanisms set in place by the JCPoA.

Relief from sanctions has removed a major obstacle to Iran's economic development. But it is not enough. Highly inefficient state controlled enterprises and high levels of corruption are more vexing obstacles to economic development in Iran. These factors create a business environment that is unfriendly to foreign investment. The Rouhani administration is attempting to remove these obstacles by pushing for robust economic reforms that pull the Iranian economy out of isolation and into a global market. However, significant factions within Iranian domestic politics seek to prevent economic reform. A transformation of the economy would likely make Iran more responsive to the international community, including the West. This runs counter to the resistance ideology of many politicians in Tehran, as is evident by the quasi-state owned enterprises that control so much of the Iranian economy. We conclude that the biggest threat to Iranian noncompliance is not their ability to skirt around the JCPoA verification mechanisms but rather their limited ability to enact the reforms required to re-join the global economy.

Appendix A: Regression Model

giStrat developed two econometric regression models to empirically identify the factors most significantly associated with having a nuclear program and complying with non-proliferation agreements. The first econometric regression model captures all countries and analyzes the factors that determine whether a country chooses to develop a nuclear weapons program. The second model analyzes the countries that pursued nuclear weapons and assesses the factors that affect compliance.[22] We use the White standard errors to correct for spatial and temporal autocorrelation.

In Model 1 we use several independent variables that include both macro level variables and a variable identifying whether verification occurs at the national or international level, or not at all. We also include whether a country was under nuclear sanctions or threat of nuclear sanctions.[21] We use GDP per capita (logged) to show whether the economic capacity of the country affects nuclear weapons development.[22] We use the Polity[23] data to include a measure of democracy. Our macro level variables include measures of domestic instability[24] (measured by riots, protest, and demonstrations against the government), interstate conflicts,[25] rival threat,[26] and whether a country has a nuclear defender.[27,28]

20. These variables were found to affect compliance by Rudolf Avenhaus, Nicholas Kyriakopoulos, Michael Richard, and Gotthard Stein, eds. Verifying Treaty Compliance: Limiting Weapons of Mass Destruction and Monitoring Kyoto Protocol Provisions. Berlin: Springer, 2006.
21. T. Clifton Morgan, Navin Bapat, and Yoshiharu Kobayashi. "Threat and Imposition of Sanctions: Updating the TIES dataset." *Conflict Management and Peace Science 31*, no. 5 (2014): 541-558. http://www.unc.edu/~bapat/TIES.htm.
22.Arthur Banks and Kenneth A. Wilson. "Cross-National Time-Series Data Archive." *Databanks International*. http://www.cntsdata.com/.
23. Monty Marshall, Ted Gurr, and Keith Jaggers. "Polity IV Project: Political Regime Characteristics and Transitions, 1800-2013." Last modified June 6, 2014. http://www.systemicpeace.org/polity/polity4.htm.
24. Arthur Banks and Kenneth A. Wilson. "Cross-National Time-Series Data Archive." *Databanks International*. http://www.cntsdata.com/.
25. Glenn Palmer, Vito D'Orazio, Michael Kenwick, and Matthew Lane. "The MID4 Data Set: Procedures, Coding Rules, and Description." *Conflict Management and Peace Science*. Last modified February 5, 2013. http://cow.dss.ucdavis.edu/data-sets/MIDs.
26. Scott Bennett. "Security, Bargaining, and the End of Interstate Rivalry." 1997. http://www.personal.psu.edu/dsb10/datasets.htm.
27. Nuclear defender was coded ourselves.
28. Dong Joon Jo and Erik Gartzke. "Determinants of Nuclear Weapons Proliferation." *Journal of Conflict Resolution 51*, no. 1 (2007): 167-194. doi: 10.1177/0022002706296158

Model 1: Nuclear Program

Variables	(1) Coefficients	Variables	(1) Coefficients
Democracy	-0.00494 (0.0371)	Nuclear Defender	-0.181 (0.288)
Domestic Unrest	0.0709*** (0.0133)	Verification	-1.070*** (0.297)
Interstate Disputes	0.357*** (0.0771)	Sanctions	1.604*** (0.486)
Rival	0.751** (0.342)	Constant	-2.319*** (0.484)
Logged GDP per Capita	0.215*** (0.0579)	Observations	5,560

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Additional interstate conflicts increase the likelihood of starting a nuclear weapons program. An increase in domestic instability increases the likelihood of a nuclear weapons program. Sanctions are associated with a greater likelihood of a nuclear weapons program. An increase in logged GDP per capita is associated with a greater probability of having a nuclear program. If a country has a rival it is more likely to have a nuclear weapons program than a country that does not have a rival. Democracy, presence of nuclear defender, and verification are statistically insignificant at reasonable levels.

Model 2: Noncompliance

Variables	(1) Coefficients	Variables	(1) Coefficients
Logged GDP per Capita	-0.999*** (0.275)	Verification	-2.218*** (0.693)
Data Exchange	-3.454*** (0.361)	Sanctions	-0.0881 (0.385)
On-Site Inspections	8.801*** (0.411)	Constant	4.755** (1.934)
Governing Body	-1.318*** (0.491)	Observations	1,402

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

In Model 2 we use a probit model with compliance as the dependent variable (measured as whether a country was pursuing a weapons program while a member of a non-proliferation treaty).[29] We find that verification at the international level decreases the probability of noncompliance. Logged GDP per capita decreases the likelihood of noncompliance. When data exchange is included in a treaty it decreases the probability of noncompliance. The creation of a governing body reduces the likelihood of noncompliance. A combination of routine and challenge inspections increases noncompliance. Sanctions are not statistically significant.

About giCompute: giStrat applied its cloud computing analytics software to estimate game theory-based benefits (payoffs) of the major groups and actors regarding the issue of Iran's nuclear compliance by ranking their known preferences across five of the compliance determinants deemed significant from our empirical findings: (1) verification for compliance; (2) data exchange for compliance; (3) degree of domestic stability; (4) degree of regional rivalries; and (5) degree of sanctions. Using this process, we estimated the overall utility values of the various factions and stakeholders in Iran and internationally on the variety of potential outcomes related to JCPoA compliance. This allows us to estimate the likelihood of Iran's compliance along with pathways for strengthening it. These calculations helped us estimate the degree to which leaders in Iran, the United States, and the international community would support and influence outcomes related to compliance on the Joint Comprehensive Plan of Action (JCPOA). giCompute incorporates the principles of game theory and decision science to calculate the positions leaders adopt and more importantly the impact of their actions on the overall outcome. Game theory is a subfield of micro-economics focused on the mathematical study of conflict and cooperation between decision-makers.

29. For data prior to 1992 we used Jo and Gartzke to determine which countries were pursuing nuclear weapons programs. Dong Joon Jo and Erik Gartzke. "Determinants of Nuclear Weapons Proliferation." *Journal of Conflict Resolution 51*, no. 1 (2007): 167-194. For data post 1992 we used Matthew Fuhrmann and Jeffrey D. Berejikian. "Disaggregating Noncompliance: Abstention Versus Predation in the Nuclear Nonproliferation Treaty." *Journal of Conflict Resolution 56*, no. 3 (2012): 355-381.

Appendix B: Game Theoretic Analysis

Stakeholders

Iran	United States	International Community
Supreme Leader Khamenei	President Obama	Israel
IRGC	Secretary Kerry	Saudi Arabia
Guardian Council	State Dept	Shia Iraq
Expediency Council	NSC	Asad Syria
Conservative Hardliners	Intel Community	UAE
Pragmatists	DoD	Qatar
Reformists	House Democrats	Hezbollah
President Rouhani	Senate Democrats	Turkey
FM Zarif	House Republicans	Pakistan
Armed Forces	Senate Republicans	EU
IRGC Business	Arms Control Community	Germany
Bazaar Class	AIPAC	China
Youth	Chamber of Commerce	UK
Qom Clerics	Right Wings Security Orgs	Russia
	Left Wing Security Orgs	France
	Public Opinion Left	IAEA
	Public Opinion Right	UN
	Public Opinion Middle	NAM

giCompute Baseline Outcome Results: Components

Scenario Pathways	Verification	Data Exchange	Domestic Stability	Regional Rival Threat	Sanctions
Noncompliant / Seeking to Weaponize / Accelerated Missile Program	No Verification	No Data Exchange	Unstable	Rival with Nukes	Stringent Sanctions
Compliant / Seeking Knowledge / Accelerated Missile Program	International Verification	Data Exchanged	Semistable	Rival with Nukes	Minor Sanctions
Compliant / Seeking Knowledge / Missile Program	International Verification	Data Exchanged	Semistable	Rival with Nukes	Sanctions Relief
Compliant / Not Seeking Knowledge / Missile Program	International Verification	Data Exchanged	Stable	Rival with Conventional Capabilities	Sanctions Relief
Compliant / Not Seeking Knowledge / No Missile Program	International Verification	Data Exchanged	Stable	Limited Rivalries	No Sanctions

giCompute Baseline Outcome Results: Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	United States	Regional Actors	Other P5 Signatories	International Orgs	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Compliant / Seeking Knowledge / Accelerated Missile Program	35.37	14.85	56.82	-11.4	-1.0	22.17	18.8	6821.0
2	Compliant / Seeking Knowledge / Missile Program	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Compliant / Not Seeking Knowledge / Missile Program	-143.8	0.59	-78.0	52.92	16.0	-38.02	-30.6	19672.0
4	Compliant / Not Seeking Knowledge / No Missile Program	-228.81	-89.3	-253.15	5.68	-23.0	-133.13	-117.6	25881.0
5	Noncompliant / Seeking to Weaponize / Accelerated Missile Program	-113.05	-237.19	-72.21	-237.53	-306.0	-174.82	-193.0	16532.0

giCompute Results on JCPoA Dispute Resolution Pathway

The rankings show the strategic preferences of both the US and Iran. The US prefers to minimize Iran's escalation of nuclear activity while maximizing allowable sanctions. Iran prefers to maximize its ability to pursue a nuclear weapons program and minimize the risk of sanctions. The outcome scores show the payoff for each actor, with a higher number representing a more positive outcome. Iran and the US will proceed through the first two steps of the dispute resolution mechanism if there is a limited risk of both sanctions and Iranian nuclear activities. This escalation allows for additional bargaining and negotiation. However, once the actors notify the UN it is more likely that the issue will not be resolved.

JCPoA Dispute Resolution Pathway | *Step 1: Issue in question is referred to Joint Commission*

Components

Component	Resolved Within 35 Days	Not Resolved in 35 Days
Nuclear activities	Medium	Limited
Sanctions	Medium	Limited

US Preference Rankings

Nuclear activities: Risk of escalating Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

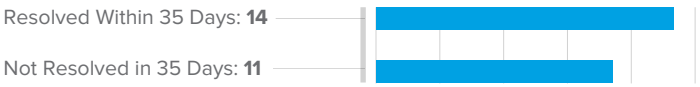
Outcome Scores

Iran Preference Rankings

Nuclear activities: Ability to escalate Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

Outcome Scores



Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	US	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Resolved Within 35 Days	14.0	10.0	12.0	12.0	400.0
2	Not Resolved Within 35 Days	11.0	13.0	12.0	12.0	200.0

JCPoA Dispute Resolution Pathway | *Step 2: Joint Commission member determines if there are grounds for violation*

Components

Component	No Grounds	Grounds
Nuclear activities	Limited	Medium
Sanctions	Limited	Medium

US Preference Rankings

Nuclear activities: Risk of escalating Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

Outcome Scores

Iran Preference Rankings

Nuclear activities: Ability to escalate Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

Outcome Scores

Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	US	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	No Grounds	15.0	13.0	14.0	14.0	200.0
2	Grounds	10.0	10.0	10.0	10.0	0.0

JCPoA Dispute Resolution Pathway | *Step 3: Joint Commission member determines whether to notify UNSC*

Components

Component	Do Not Notify UNSC	Notify UNSC
Nuclear activities	Limited	High
Sanctions	Very high	High

US Preference Rankings

Nuclear activities: Risk of escalating Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

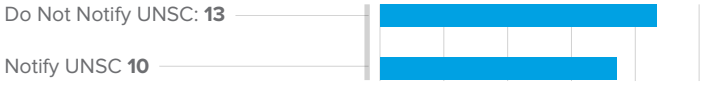
Outcome Scores

Iran Preference Rankings

Nuclear activities: Ability to escalate Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

Outcome Scores



Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	US	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Notify UNSC	10.0	10.0	10.0	10.0	0.0
2	Do Not Notify UNSC	13.0	5.0	9.0	9.0	800.0

JCPoA Dispute Resolution Pathway | Step 4: *UNSC adopts resolution to continue lifting sanctions or sanctions are automatically reimposed*

Components

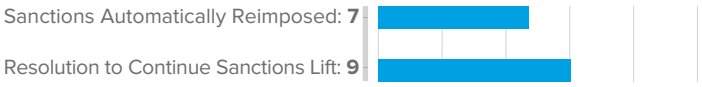
Component	Sanctions Automatically Reimposed	Resolution to Continue Sanctions Lift
Nuclear activities	High	Medium
Sanctions	High	Limited

US Preference Rankings

Nuclear activities: Risk of escalating Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

Outcome Scores

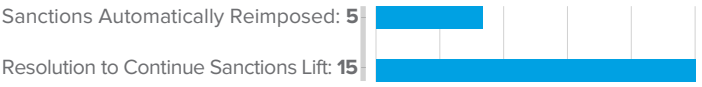


Iran Preference Rankings

Nuclear activities: Ability to escalate Iranian nuclear activities

Sanctions: Threat of imposing sanctions on Iran

Outcome Scores



Game Theory Payoffs for Each Scenario

Ranking from Most to Least Likely	Scenario Pathways	Iran	US	Influence Driven Outcome	Egalitarian Outcome	Cost of Friction
1	Resolution to Continue Sanctions Lift	15.0	9.0	12.0	12.0	600.0
2	Sanctions Automatically Reimposed	5.0	7.0	6.0	6.0	200.0

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