

Iran-US Nuclear Standoff: A Game Theory Approach

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Abstract

For almost three decades since the Iranian Revolution of 1979, there has consistently been a conflict between Iran and the United States over a host of issues. The relations between the two countries became more challenging since 2003 after it came to light that Iran had been developing its nuclear program. Since then some US officials have even gone so far as to announce - and repeat - the possibility of a military strike against Iranian facilities to end the nuclear program. In reality, up to now no such drastic action has taken place. Rather instead, in a milder reaction, the US, aided by its European allies and enjoying Russian and Chinese lukewarm acquiescence, has imposed several rounds of sanctions against Iran through the adoption of obligatory resolutions by the United Nations Security Council. But, these actions have failed to force the Iranians to end their program. As a result, many experts argue that a new policy should be pursued toward Iran vis-à-vis its nuclear dossier.⁽¹⁾ So the main challenge which poses itself is to predict when and how this conflict will come to an end. In this paper, different game theory models are used to interpret the current situation of the crisis. It is shown that while at each step it may be more favorable for each party to insist on its claims, the overall result of this approach may not be so favorable for all. As a result, both parties should think about the long term effects of their decisions. It is also shown that the absence of mutual trust could be the main factor that has forced both sides to reach the current point of crisis. Therefore, any attempt towards re-establishing mutual trust between the two governments might be a major step leading to a lasting solution. Furthermore, different possible choices for the US government and the long term effects of each choice will be analyzed. The analysis will also address economic aspects of the conflict, and the long-term effects of any decision and the best possible choices for both governments will be presented.

Keywords: Iran, US, Nuclear, Game Theory, IAEA, NPT

Introduction

Game theory is a branch of applied mathematics used in a wide range of disciplines; economics, biology, engineering, political science, international relations, philosophy, and computer science - mainly for artificial intelligence. Game theory attempts to mathematically capture behavior in strategic situations, in which an individual's success in making choices depends on the choices of others. While initially developed to analyze competitions in which one individual does better at another's expense (zero sum games), it has been expanded to treat a wide class of interactions, which are classified according to several criteria. Today, "game theory is a sort of umbrella or 'unified field' theory for the rational side of social science, where 'social' is interpreted broadly, to include human as well as non-human players (computers, animals, plants)".(2) The application of game theory to political science is focused in the overlapping areas of fair division, political economy, public choice, positive political theory, and social choice theory. In each of



these areas, researchers have developed game theoretic models in which the players are often voters, states, special interest groups, and politicians (for instance see Downs⁽³⁾ and Myerson⁽⁴⁾).

Since 2003, the United States has alleged that Iran has a program with the aim of developing nuclear weapons. Iran has maintained that its nuclear program is peaceful and aims only at generating electricity. The United States' official position on Iran has been that a nuclear-armed Iran is not acceptable and that 'all options' - including the unilateral use of force and first-strike nuclear weapons - are on the table. However, they have denied on various occasions that the United States is preparing for an imminent strike. The tough US policy and posture came while three European countries, the United Kingdom (UK), France and Germany (the "EU-3"), were engaged in intensive negotiations with Iran on the cessation of its nuclear enrichment activities. Due to the confrontational policy of the Bush Administration on Iran, the UE-Iran talks were subjected to increasing pressures, which also led to a gradual toughening of the approach and position of the International Atomic Energy Agency (IAEA). In early 2006 IAEA reported Iran's non-compliance to the Security Council of the United Nations. The IAEA stated that Iran had been



in violation of the Safeguards Agreement relating to the NPT, due to insufficient reporting of nuclear material, its processing and its use, despite the fact that under Article IV, Iran had the right to develop its civilian nuclear energy program. From 2003, the already fraught relations between the US and Iran constantly worsened as a result of the on-going tension over the nuclear issue, notwithstanding Iran's continued cooperation with IAEA, including regular inspections of sensitive nuclear facilities and sites in Iran - in line with the provisions of the Additional Protocol to NPT which Iran voluntarily adhered to and later unilaterally withdrew from.

In March 2006 US and EU-3 representatives publicly stated that Iran had enough un-enriched uranium hexafluoride gas to make up to ten atomic bombs if it were to be highly enriched, and further added that it was "time for the Security Council to act". Up to now the US has consistently insisted that Iran should halt its program, and Iran has in turn resisted this pressure and has continued its nuclear program, insisting on its peaceful nature. Security Council resolutions 1696 (31 July 2006), 1737 (26 December 2006), 1747 (24 March 2007) and 1803 (3 March 2008) imposed a series of sanctions on Iran and successively widened the scope of these sanctions. In



December 2008, President-Elect Barack Obama made it clear that his policy toward Iran would be different from Bush's policy of confrontation and would be to "ratchet up tough but direct diplomacy with Iran".⁽⁵⁾ Later as President he pointed out that "if countries like Iran are willing to unclench their fist, they will find an extended hand from us."⁽⁶⁾

However, it was not initially clear whether such an approach meant that the US would accept Iran's pursuit of its peaceful nuclear activities or it would still continue its policy of pressuring Iran towards terminating its program – even if through offering a package of incentives. In 2009, contrary to initial promises, Obama's policy of unconditional negotiation with Iran ran into serious difficulty due to the growing pressure of conservative political quarters and lobbies. Simultaneously, Iran continued to insist on its peaceful nuclear program and standstill policy of continued enrichment activities. The disclosure in late September 2009 of unannounced enrichment activities at the Fordou facility once again pushed Iran's nuclear case to the center stage of international attention. This development led to a high-profile joint press conference in Pittsburg, Pennsylvania, by President Obama, President Sarkozy and Prime Minister Brown. Iran, in defiance, stated that the NPT regulations had

been followed in informing in time on the Fordou site. Furthermore, the ensuing ambiguity over Iran's surprise proposal in the course of the Geneva meeting on 1 October 2009 to the 5+1 group on swapping the bulk of its stock of low enriched uranium with the higher enriched fuel needed for Tehran's medical nuclear facility led to the worsening situation. The subsequent political-diplomatic wrangling between Iran and the 5+1 revolved around the volume as well as the venue for the swap. Apparently disappointed by the Iranian response and insistence on a much smaller volume than previously indicated and an Iranian venue for the swap, the 5+1 turned to IAEA and pushed the adoption of a strong-worded resolution by its Governing Council in November. The passage of the new resolution has further muddied the atmosphere and has pushed the US to take distance from Obama's initial policy of dialogue. Instead, there has been much talk of new sanctions against Iran, which has been met with further defiance from the Iranian side – threatening to downgrade the level of its cooperation with the Agency.

A Simple two player game

In Figure 1, a single step of the game modeling the struggle of Iran and US is presented. The game begins

with a decision by the US of whether to accept a nuclear Iran or not. If it accepts, the game terminates but costs 'a' units for the US. On the other hand, if the US decides to impose more sanctions on Iran, in response Iran may accept the suspension of its nuclear program (with a probability equal to p), again the game terminates and the total cost to the US will be 'c' units. However, if Iran insists on continuing its program, then we are on the middle branch of the model – up to this time the game costs 'b' units for US, but also the game continues on to the next step. Regarding this model we want to analyze the best decisions for the two parties. The answer is explained in different situations as follows:

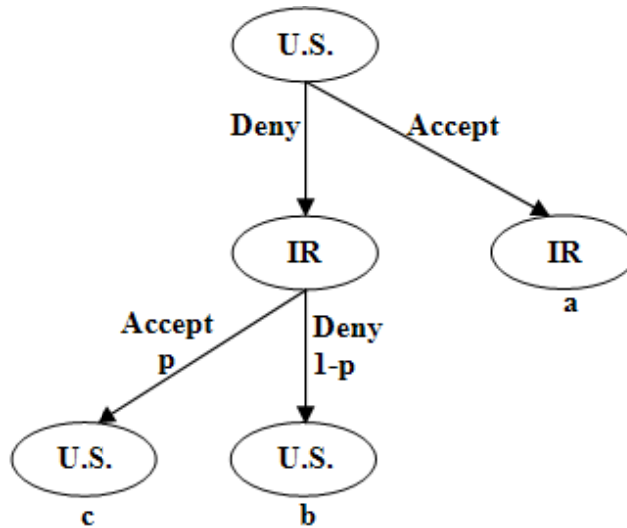


Figure 1: Step one of the game, with probabilities of Iran's gain & US loss

1. Single Step of the Game

Assuming a game with a single step follows thus: if the US accepts a nuclear Iran, then the game terminates and this choice costs a units for the US ($C_A = a$). On the other hand, if the US denies a nuclear Iran, and decides upon more sanctions or other actions, then Iran in response may insist on further progress in its nuclear program with a probability equal to $1-p$ or it may accept to leave its programs with a probability equal to p . If the US costs for either of these decisions are c and b respectively, then the average cost for the US is equal to:

$$C_D = p \times c + (1 - p) \times b \quad (1)$$

No doubt the best decision for the United States is the one which minimizes its cost. So we have the following decision strategy:

$$C_D \begin{matrix} \text{Accept} \\ > \\ < \\ \text{Deny} \end{matrix} C_A \quad (2)$$

So we have:

$$p \begin{matrix} \text{Accept} \\ > \\ < \\ \text{Deny} \end{matrix} \frac{a - b}{c - b} \quad (3)$$

Hence, if the probability of Iran's acceptance is less than the difference between the US acceptance and Iran's denial compared to the difference of the cost of Iran's acceptance and US denial, then it is



wiser for the US to accept a nuclear Iran, otherwise it can press on for further sanctions. The above inequality can also be interpreted differently. If acceptance of a nuclear Iran is considered highly costly for the US, it should in any case go for further sanctions. However, if Iran's denial is highly costly for the US then accepting a nuclear Iran is a wiser choice.

2. Repeated game

If we assume that the game is repeated up to n^{th} step, i.e. for n times, and the US has denied a nuclear Iran and Iran has insisted on the further progress of its program, what is the wisest decision for US?

Up to n^{th} step, the net cost for the US reaches $n \times b$. In the next step if the US accepts a nuclear Iran then its cost reaches:

$$C_A = n \times b + a \quad (4)$$

On the other hand, if it presses on for further sanction then the average cost reaches:

$$C_D = n \times b + p \times c + (1 - p) \times a \quad (5)$$

Once again we should use the following decision strategy:

$$C_D \begin{matrix} \textit{Accept} \\ > \\ < \\ \textit{Deny} \end{matrix} C_A \quad (6)$$

Also it results in:

$$p \begin{matrix} \textit{Accept} \\ > \\ < \\ \textit{Deny} \end{matrix} \frac{a-b}{c-b} \quad (7)$$

The outcome of this game is interesting. If the first step is beneficial to the US, then the US will be interested to continue the game forever, otherwise wiser choice would be to terminate the game at the first step. This fact explains why many international crises continue for a protracted period of time in the same manner. In this case, the cost function is additive at each step, so if a single step of the game is beneficial for one player then it will prefer to continue the game indefinitely. However, as is explained in the next section, this is not the whole story.

3. Repeated game considering final result

If the US insists that under any and all conditions Iran should terminate its program, then the game continues until Iran accepts to suspend its program. The average cost of this decision for the US is:

$$C_D = c + \frac{1-p}{p}b \quad (8)$$

So the decision is as follows:

$$c + \frac{1-p}{p}b \begin{matrix} \textit{Accept} \\ > \\ < \\ \textit{Deny} \end{matrix} a \quad (9)$$

Surprisingly, the condition is different from



previous situations. So maybe a single step of the game is beneficial for one or both parties. However, regarding the final result it may be wiser to accept the conditions. This means that if either party, let's say, US, looks at the momentary cost of its decision, it seems that it is more beneficial to continue the game on to the next step, however such a decision can cause the game to continue for an extended period and the total costs of the whole game may not turn out to be favorable for that party (US). This fact claims for a long term prediction of any decision by any party.

4. Cost-benefit analysis of the game

Within the game, there are costs and gains for the two players, associated with the decision of each of them. For Iran, continuing its current nuclear program means the continuation and possibility of even harsher unilateral US sanctions and also further biting UN sanctions. Although a distant reality to some extent, it has been claimed that the absence of US sanctions will enable Iran to increase its current GDP by around 30% (61 billion USD according to 2005 prices)⁽⁷⁾. There is some truth to this. There has not been any independent study on the real cost of sanctions on the Iranian economy, however its direct and indirect costs are clearly evident. Expensive commodities on the black market, an insecure investment environment, the



retardation of the growth of various industries, are some more obvious consequences. However, one should also add to the economic cost the political and psychological risks resulting from sanctions. Furthermore, there has been a risk, though a minor probability, of military strikes against Iranian nuclear facilities. But its psychological impact adds to the political costs just mentioned. President Bush insisted on 31 August 2006 that "there must be consequences" for Iran's defiance of demands that it stop enriching uranium.⁽⁸⁾

On the other hand, if Iran accepts to terminate its nuclear program, it should dismantle some of the facilities and suspend many others and relieve scientists working in these facilities. In the longer term, Iran should invest in the development of fossil fuel power plants to make up for the loss of nuclear ones currently under development. Such a replacement would make the currently built or under construction nuclear facilities redundant; the country would also become more dependent on fossil fuels and it would force the government to spend more on environmental issues. In addition, withdrawing from a nationally perceived strategic and prestigious project such as the nuclear energy industry would be very disconcerting for many Iranians. For many of them



such a decision would be seen as undermining their independence. Such social and emotional costs should never be ignored in any decision and the weighing up of the various costs involved.

As far as US policy is concerned, if the Obama administration continues to insist on its current claims against Iran, it should maintain its policy of sanctions against Iran. There is no accurate estimate for the cost of such sanctions on the US economy. However, the CIA has estimated that these sanctions have led to a 10% increase in crude oil prices which costs annually between \$38 billion (at 2005 prices of \$50/bbl) and \$76 billion (at average 2008 prices of \$100/bbl). Furthermore, many US companies have lost the lucrative market of Iran's 70 million population and major oil and gas contracts which totals billions of dollars, clearing the market for their Chinese, Russian and European competitors. In addition, the US government needs to spend more money and exert greater political and diplomatic efforts to encourage other courtiers to impose and maintain such sanctions against Iran. Undoubtedly there are extra costs and benefits for other countries who cooperate with either of the players, or even if they maintain a neutral position.

On the other hand, if the US accepts a nuclear

Iran, it is argued that the balance of power in the region - in the Greater Middle East and especially in the Persian Gulf area - will change in favor of Iran. But here arises a question: is it not possible (or even less costly) for Iran to change the regional condition in its favor without nuclear missiles?

For Iran, while pursuing peaceful nuclear technology seems a national imperative any diversion to a hypothetical nuclear arsenal would be extremely costly. A dangerous regional race for nuclear arsenal would turn the region into an even more dangerous and unstable neighborhood. Iran, given its size, population, and also its huge and ever-growing long-term development needs, would suffer the most in an unstable neighborhood. Its long-term national security interests, including long-term comprehensive development, lie in a stable region free from unnecessary tension and conflict. For those who believe that the current threats against Iran have forced it to seek acquiring nuclear military capability, it will suffice to mention that the country's current overall military prowess, inclusive of the missile stock, is generally considered sufficient to address the kind and level of current threat posed to it in the Middle East. In addition, the teachings of Islam prohibit the usage of WMD. Iran has manifested in action its sense



of restraint in this regard - most notably in response to the widespread use of banned chemical weapons by Iraq during the 8-Year War. Any diversion from such teachings and oft-stated official policy will most probably have significant socio-cultural costs for the government. Apart from the stated policy that nuclear military technology plays no role in Iran's defense doctrine, there exists internationally-sanctioned and well-established monitoring procedures and mechanisms; that is, the IAEA Safeguards system, which Iran has cooperated with in the past and continues to reiterate its commitment.

Needless to say, accepting a nuclear Iran will bear some cost for the US. Such a recognition would imply that the US should also accept the development of nuclear industries in other countries, whether developed or developing. However, building and governing nuclear industries will be in some measure beneficial for US companies if it were to impose some form of oligopoly. Simultaneously, it would also imply a net loss for US allies in the Middle East, most notably Israel, and also some Arab governments. It could be reasonably argued that this consideration, along with the still existing "wall of mistrust" between the two countries - as alluded to by President Khatami in his interview with CNN back in 1977 - and perhaps



some idealistic assumptions in US foreign policy, have all colluded to cause the US insistence so far on the imperative of a total halt to the Iranian nuclear program.

As has been mentioned in the case of the simple model, if a single step of the game is favorable for either party, then this party would prefer to continue the game indefinitely. This can explain the current state of the conflict. In each step both Iran and US have found it more favorable to insist on their claims/positions. However, regarding the final result of the game it seems that these momentary decisions and gains are not the best long term solutions for either party. So both parties should think about the overall result and make their best possible decision.

In the next section, the paper explains why the crisis has reached a point of impasse, and will also look into the best possible solution for it. Then it will try to explain the long-term political and economic effects of the on-going crisis.

Prisoners' dilemma: The best solution with the least cost?

Part of the Iran-US conflict on the nuclear issue may be explained using prisoner's dilemma. During the year 2003, some evidence was found that Iran had a

secret nuclear program. Being secret, satisfied many opponents that the program was certainly military oriented. This paper has not attempted to prove whether this was in fact the case or not. However referring to the prisoner's dilemma,⁽⁹⁾ it is possible to find another meaningful interpretation of this event. The conflict is modeled as figure 2, below:

		IRAN	
		Non-secret Program	Secret Program
U.S.	Announcing it Civil	A+C	B+C
	military	A+D	B+D

Figure 2: The case of Iranian civilian nuclear program

Iran actually had two choices for its program; the first one was to announce its program at the beginning, and the alternative was to carry out its development secretly. It is clear that if there were no international pressure, the cost of a secret program was many times more than a non-secret or public one. We assume that the cost of a non-secret program is A, while the cost of the alternative is B. The same is true for the opponent party (USA): if Iran's nuclear program is disclosed, it is not costly for US (as the IAEA will monitor it), but it is more difficult to investigate a secret program.

For the US there also exists two solutions, the first one is to insist that the program is entirely military-oriented, which costs too much for both Iran and the US because the latter should try to end the Iranian program and Iran should try to resist such pressure. On the other hand, the US can accept that the program is civilian oriented. In this case, a mild investigation by IAEA can be done periodically to report any divergence, so the cost is significantly less for the US.

But what happened in reality is quite interesting. Iranians because of their experiences in the aftermath of the revolution have assumed that any program, even a civilian-oriented program, will not be accepted by US. During the Iraqi imposed war on Iran, while it was clear that Iraq was the aggressor and the initiator of the war⁽¹⁰⁾, many Western countries including the US never disclosed such a fact and even helped Saddam Hussein in the perpetuation of his aggression. Even though Iraq attacked Iranian cities with scud missiles and used WMD not only at the war front but also against civilians, none of these powers made any significant attempts to prevent Iraq (while there are now proven facts that these forbidden materials were sent to Iraq by Western firms). As a result, the majority of Iranians took for granted that the Western



world would do all it could to topple their popular government. Hence, in their mind, even a civilian nuclear project was not acceptable to the US and the only solution was to build it secretly. This view has been expressed in clear, unambiguous terms and on many occasions by many Iranian officials, including (former) President Rafsanjani.⁽¹¹⁾

On the other hand, as a result of three decades of mistrust between the US and Iran and the larger enduring conflict between the Western and Islamic worlds, many Western politicians seem to espouse the assumption that Muslims in general and Muslim/Islamic governments in particular are determined to pursue hostile and injurious anti-Western policies in every and all their actions and endeavors. The course of post-September 11 events have all but galvanized such a blanket assumption. So, it is not difficult to understand why and how such quarters uncritically assume that Iranians are developing their own nuclear weapons – for which the previously undisclosed efforts of the Iranian government are regarded as definitive proof. This line of argument has been frequently repeated by different Western officials and political quarters.

Such presumptions on the part of both players have forced the game toward a point of equilibrium

with B+D cost which is the most costly solution for both parties (Figure 2). This notwithstanding that the best solution is A+C, which offers the least cost for both parties! This fact suggests that the major problem is that the two sides do not trust one another, so any attempt for confidence building and establishing trust between these two countries and governments will move the game to A+C solution with the least cost for both parties. Although some unofficial and even official meetings have taken place between the two sides during 2009, notably on and around the nuclear dossier, the move to A+C position does not seem to be a reachable goal in the short-term. Part of this uncertainty lies in the fact that both Iran and the US doubt the sincerity of the intention of the other side for any positive move.

International impact of the crisis

As already mentioned, apart from the outcome of the Iran-US conflict for the two parties directly involved, it is bound to have a considerable impact on other countries, including both developed countries interested in maintaining their superiority and developing countries desiring to acquire the capability. Different scenarios are possible in this regard. The worst scenario for others is if the crisis continues until



Iran completes its program – a peaceful nuclear capability - and the US accepts a nuclear Iran. Such an outcome would suggest to many countries that the US had brought to bear a weak and unpersuasive strategy in the Iranian case.⁽¹²⁾ It would be thus perceived that it is permissible for the US to accept another nuclear power. Although before such acceptance, the United States enforces continuous pressure on any country who wishes to pursue to acquire a nuclear technology, even a peaceful one. This is what happened in the cases of India and Pakistan and the recent nuclear agreements between India and the US⁽¹³⁾, are especially indicative of this fact.

However, the case of Iran seems somewhat different from those of India and Pakistan. Since Iran and the US have had some quite serious differences over a wide array of issues, the US – ultimate - acceptance of a nuclear Iran in such a manner might prove that it is possible even for an adversary of the US to develop and maintain nuclear capability at the least cost. This would be the case because a US acceptance of a nuclear Iran would expose – and discredit - the US strategy towards similar possible future cases. If such a situation –scenario - were to prevail, we could possibly end up with a world-wide nuclear arms proliferation, which would be the worst



possible solution and the most dire consequences for all.

Another possible scenario is that US ends the Iranian nuclear project through political or even military means. While this might solve the problem in the short term, the long-term consequences and repercussions should be considered carefully. Such a policy would serve to convince other countries that even a civilian nuclear project -as in the case of Iran - would not be acceptable to the United States, which might in turn tend to persuade them to opt for a secret program. On the other hand, as the requisite technology is becoming less and less expensive; many countries may become interested in developing their own programs. In this scenario, some countries may finally decide to proceed to develop their nuclear programs – albeit secretly. In the long run, some of these countries might fully succeed in their enterprise, and by means of a domino effect⁽¹⁴⁾, some of them will end up with their own nuclear industries. However, because of the secrecy factor - at least in initial stages - the projects/programs tend to evade adequate outside monitoring and control. In this scenario, even non state actors, such as terrorist groups, may gain access to nuclear weapons. This scenario thus addresses and tackles the short-term costs but it transfers the

problem to the future without any permanent solution, which would in all probability accumulate the costs as well. For example, nations who have experienced pressure from the West in achieving their nuclear rights might, once having established their capability, even seek compensation for the hardships they have undergone in the course of realizing what they perceive as their legitimate rights. Such a possible course of action would certainly be found worrisome.

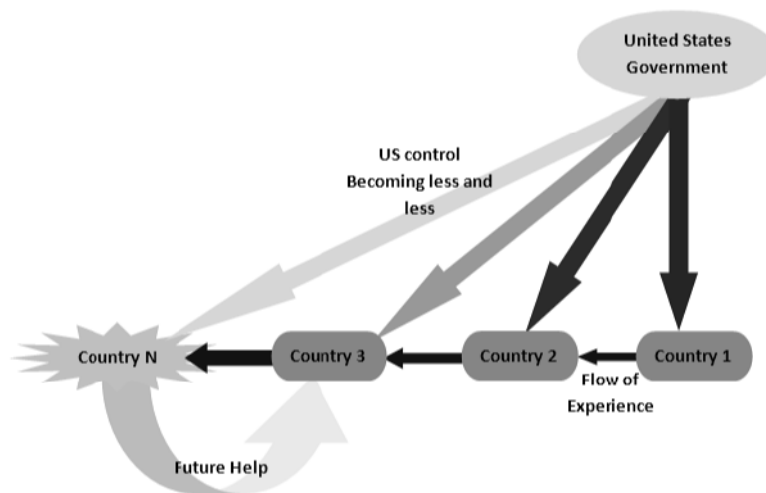


Figure 3: Extreme pressure scenario and US limits on control over nations

Figure 3 shows the high global cost for the US in continuing a policy of strict control of the development of nuclear facilities worldwide. If the US continues to forcefully prevent other countries from developing their own nuclear technology, over time

more and more countries might feel persuaded to opt for secret program in order to avoid and evade effective US control. Moreover, these countries might also as part of their pursuit engage in sharing experiences and help each other towards further undermining effective US, and finally rendering it ineffective. Given the grim prospects of such a scenario, the next wise choice for the US might instead be to accept an Iranian civilian nuclear program, supported simultaneously through IAEA full and effective monitoring of the Iranian facilities and activities. Such an approach and policy by the US would help convince the international community that the US is genuinely engaged in global efforts against the proliferation of nuclear arsenals and toward a more secure world. Many would thus consequently support multilateral efforts geared towards instituting forceful international control programs against those countries found violating established international rules and norms – so to speak, the “red lines”. As a result, opting for secret programs would also become quite limited and rare. However, this scenario requires an additional, important step by the major powers, the US and Russia in particular, to progressively reduce their own nuclear arsenals.

The next section explains the last scenario and



how such an eventuality is economically preferable as well.

High-tech transfer and its economic probability

Currently that Iran is trying to build its uranium enrichment industry and heavy water facilities, the relevant technologies and nuclear power plants are categorized as high-tech industries, owned and controlled by a limited number of countries and companies – a monopoly or at best an oligopoly situation on a global scale. For others, the fixed costs needed to acquire such technology or to build a plant are exceedingly high, as illustrated in Figure 4 below.

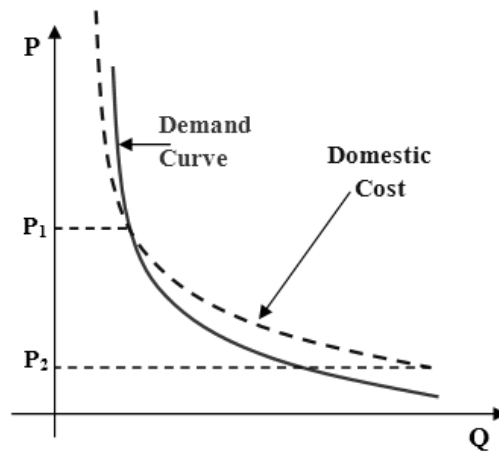


Figure 4: Supply and demand curve for a high-tech product

As shown in this Figure, the price for the first product (unit) is much higher than when more products (units) is produced. Hence, the start up costs are too high (P_1 in this figure) for the newcomer who does not have the technology, , but for the second country with experience in this field, the cost is much less (P_2). However if the latter suggests to the former a price less than P_1 , then it is reasonable for the first country to buy the industry instead of developing its own plant. As a result, such an industry turns out to be more beneficial for the countries/companies owning the technology.

If a country such as Iran insists – though for its own peculiar national reasons - that it needs such a technology and plants, it offers potential profits for those who have the technology. However, if they refuse to sell and build the industry, the insisting country may feel that it has no other option but to proceed to produce its own industry at whatever price thought reasonable – or expedient. Imposing sanctions would further raise the cost of such a project. But the cost declines substantially once some experience is gained. In other words, in the long run it would be economically more beneficial for a country such as Iran to pay an initial high cost and enter the club of nuclear technology owners. Hence, firstly, the



monopoly over the technology would be reduced and secondly, the pioneering owners of technology would also stand to lose their potential profits on a global scale.

Conclusions

As the result of a series of events over the past thirty years Iran and the United States have reached a point of crisis – considered by some as insoluble. This paper has attempted, through using different game theory models, to look into the current conflict between the two countries over the Iranian nuclear program. It has argued that the main problem is the absence of mutual trust between the two countries, which has forced both of them to opt for a decision in their nuclear game with the highest cost for the other side. Given the impasse, in the authors' view, establishment of mutual trust between the two parties is a major initial step towards a permanent solution. While at every step of the game it may be favorable for either party to insist on its claims, the long-term resolution may be somewhat different. It means that the momentary cost of each step of the game might be quite different from the total cost of the game reaching a reasonable conclusion – whether the US accepts a nuclear Iran or Iran willingly accepts to end its program. This calls for

a long-term consideration of any decision by either of the parties to the game. This was explored both in terms of the impact on international relations as well as economic cost-benefit analysis.

Using game theory models, it was shown that the US acceptance of a nuclear Iran after the country has acquired the technology despite the US opposition and pressures is one solution, but it is the worst possible option for the US Government. Because it proves that the US opposition has failed – even scorned by its detractors as a mere bluff - and that any country pursuing and gaining nuclear technology, with sufficient resolution, can force the US to accept its newly found status as a nuclear state – regardless of whether the IAEA Safeguards have been fully complied with or not. The other possible solution is to terminate Iran’s nuclear program through resort to extreme pressures – whether through imposition of harsh, crippling sanctions or even through a military option. However, this short-term solution can only transfer the problem to another future scenario – most probably a much more complicated situation. This would also serve to accumulate the costs globally. The models discussed in the paper show that the least-costly - and safest - solution for both parties is for the US government to accept a civilian nuclear program



inside Iran while ensuring effective international monitoring of the Iranian nuclear facilities. Moreover, such an approach and decision would also be found reassuring to other countries that while they enjoy the policy space to develop their national peaceful-oriented programs, they would be put on notice that any divergence toward a military program will be effectively resisted – and rebuffed - by the entire weight of the international community. This mutual international trust would as well contribute to the promotion of the much-needed support for global security and help prevent “irrational” ambitions.

Since nuclear technology is a high-tech phenomenon and there exists a monopoly over its ownership and control, exertion of undue limitations on those who seek to acquire it might prove counter-productive and ultimately result in the gradual weakening of this monopolistic situation.

And finally, as argued in the paper, politically as well as economically, the wisest option in the long-term for the United States and also IAEA will be to help provide the needed policy space for the countries aspiring to acquire peaceful nuclear technology; by recognizing in action of their rights under the NPT, selling them requisite technology and plants, and instituting forceful monitoring and regulatory mechanisms.

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problem, two prisoners are jailed for the same crime. If both accept that they are guilty, the court will condemn both, say two years of jail for each. But because each one claims the other one is guilty, the court may decide, say 8 years of jail for each. For further reading, please see Rapoport, Anatol, Chammah, Albert M & Orwant, Carol J, "Prisoner's Dilemma: A Study in Conflict and Cooperation", *Michigan*: Michigan University Press, 1965.

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