Israel's Opacity about Nuclear Weapons

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Abstract

Israel is the only state in the world that uses opacity as strategy for its nuclear arsenal. Two game-theoretical models with three players, Israel, the U.S. and Iran, are used to research this behaviour. The first model is used to research the forces that drive Israel's behaviour and the second model is used to explain why the curious equilibria could hold over time. Israel's opacity is also beneficial for other parties, therefore those equilibria can hold.

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1. Introduction

This research is about Israel and its opacity around nuclear weapons. When someone writes or talks about Israel it is impossible to be neutral. Even the United Nations Secretary-General Ban Ki-moon admitted that the U.N. has a bias against Israel which leads to a disproportionate volume of resolutions against Israel. Israel's ambassador, Danny Danon, confirmed this and said that it had broken the record the past decade with 223 resolutions condemning Israel, while there were only eight resolutions condemning the Syrian regime as it massacred its citizens over the past six years (Bulman, 2016). On the other hand there are lobby groups for Israel, for instance AIPAC, with a lot of power. In the U.S. it is often argued that without AIPAC's support no politician can be elected and that no president can take the White House without affirming an alliance to Israel (Hsu, 2012). Due to AIPAC the U.S. has a positive bias towards Israel. It is hard to approach Israel without a bias.

Israel is in many ways a very different country from all other countries in the Middle-East. Since 1948, the year that Israel was declared as an independent state, there has been a lot of conflict in the Middle East. A substantial part of the Arabs around Israel were against the new state in the Middle East, because this would cause instability in the region. The civil war between the Palestinians and the Jews in 1947 and 1948 led to 700.000 Palestinian refugees, in combination with the 700.000 Jews who fled from Europa and Arab nations this changed the demographic situation of Israel dramatically. Right after the declaration in 1948 the countries around Israel attacked Israel to intervene to protect Arab lives and property, which lead to the first war for the new born state. In 1956 was the Suez Crisis, where Israel was involved again in a war with its neighbours. In 1967 Israel was in a Six-Day War with Egypt, Syria, Jordan and Iraq. And in 1973 Israel was attacked by surprise on their most important religious day, Yom Kippur, by Syria and Egypt. Since the declaration in 1948, Israel is trying to survive in a mostly hostile environment, this is one of the reasons why Israel has one of the highest ratios of defence spending to GDP of all developed countries (Fleurant, Perlo-Freeman, & Noel, 2014). This is also the reason why there is obligatory military service for most Israelis.

Reasons for those wars are religious differences and different views on who are the true inhibitors of Israel or Palestine, beside that the Islamic states do not want a Jewish state in their midst. Especially Iran is currently very threatening for Israel, especially after threatening messages of Iran. Iran wants to support the Palestinian Muslims against Israel,

they condemn the Israeli settlements and military occupations of Palestinian territories. The U.N. also condemn the Israeli government for those settlements, because the Fourth Geneva Convention of 1949 prohibits countries from moving population into territories occupied in war. Also while Israel is a democracy, the Palestinians are demoted as second-class citizens and Israel tries to keep the demographic majority by giving not all citizen suffrage. Khamenei wants the Zionist regime out of the region and he has a clear position towards Israel, Israel has no right to exist as a state (Taheri, 2015). After the nuclear deal that was made between a group of world powers and Iran, Khamenei said that Israel will not see the end of these 25 years (McLaughlin, 2015). So their threat towards Israel is serious.

In this hostile environment around Israel it is important to have some allies, the U.S. is Israel's most reliable ally, who provide Israel with weapons, as the Iron dome, financial support and political support. This support is important for Israel, it is an extra barrier for the states around them to attack Israel. As is their membership in the U.N., which can help with negotiations about peace with different parties. So in order to keep Israel safe it is important to have those big allies, the U.S. and the U.N., to support their case. Also in case of the nuclear deal with Iran it is very important to have the U.S. on their side and to have the opportunity to explain why Israel is afraid of it, which Netanyahu had (Zezima, 2015). It did not work out as Netanyahu hoped, but it still was important to have the opportunity to defend Israel against Iran, which is an enemy of Israel. The more support Israel can have from the U.S. and U.N. the better it is for them.

But Israel is not able to guarantee their safety with allies only, as can be seen in the short history of their state. They have had quite a few wars since their declaration and although currently the hostility towards Israel by Egypt and Syria have been tempered, over the years Iran tends to act more aggressive in words towards the state of Israel.

Israel is driven by self-preservation, which in modern warfare could be done by developing nuclear weapons. The cold war between the U.S. and Russia did never erupt into a physical war because of the destruction it would cause for both parties. A situation like that would be a win for Israel, because in that case they would not have enemy armies in their country. But the U.N. and the U.S. are not fond of countries that have nuclear weapons outside the NPT-agreement, the Non-Proliferation Treaty, because of the potential to kill millions and because nuclear weapons are jeopardizing natural environment and the lives of future generations through its long-term catastrophic effects. They only want to use nuclear

energy for peaceful use, which would not be totally the case for Israel. The U.S.'s feeling that they are responsible for the world's safety and peace, also called Pax Americana, makes Israel's case an interesting one for the U.S.

There are only five non-NPT parties, India, North Korea, Pakistan, South Sudan and Israel, the first three countries claim to have nuclear weapons, South Sudan does not claim to have nuclear weapons and is not suspected to have nuclear weapons, and Israel is the only country who allegedly has nuclear weapons. Why did Israel never declare whether they have nuclear weapons, while the other countries claim to have nuclear weapons?
On the other hand, there is a belief that Israel has nuclear weapons, why is that? There are signals that Israel has nuclear weapons, that they have a hidden bomb in the desert. This brings up stories about Israel having nuclear weapons, there is a lot of superstition about the fact whether Israel has nuclear weapons. There are clues that lead people to belief about the existence. (Borger, 2014)

In this research we want to explain why Israel would not claim to have any nuclear weapons but why there are clues which points toward a direction that they possess nuclear weapons. We want to research this in a game-theoretical model with three players, Israel, Iran and the U.S., the most important ally of Israel. In this model Israel has to choose whether they deny or claim that they have nuclear weapons, given that they have decided in the past whether they actually have nuclear weapons. Iran has the option to attack Israel, because they would want to see Israel disappear in the Middle East. The U.S. has the choice to support Israel, which they would if Israel does not have, or declare to have, nuclear weapons. They can reduce the support to Israel if they have nuclear weapons, because they would violate the NPT agreements and endanger the safety of the world, and they will pressure Israel to destroy the weapons. In history the U.S. withhold Israel support and weapons because Israel did not allow an investigation of Dimona (Cohen, 1998). This punishment could be the case because of some pressure on the U.S. from other NPT parties.

In this research we will use the model of Farrell and Gibbons about cheap talk with two audiences, to check whether Israel could be disciplined by relationships with parties to tell the truth about their situation (Farrell & Gibbons, 1989). This model can be used to check whether there could be a pooling or a separating equilibrium available. If we could reveal the mechanism behind the behaviour of Israel it could be useful for the U.S. to check how they could let Israel reveal their true state, both public or private revelation of state would

be satisfactory for them, because they will have the information and could act with this information. This could be good for the world's safety, which is the reason why the NPT is founded. So if they could find a way to let Israel become a NPT member it could be a good thing for the world's safety, but this would not be a necessity. It could also be an option that when the U.S. knows in private that Israel has nuclear weapons and that they do not have any pressure from the NPT that they could work together with Israel and do not punish them for having nuclear weapons. This could be better for world safety because it would not be publicly known which could lead to a stability which is beneficial for more parties.

Research Question

The case of Israel will be examined, whether they have nuclear weapons or not and how they will handle the situation that they are in. The main point of this research is the combination of Israel's actions in public and how the curious equilibria that we find can be equilibria which are sustainable over time. The equilibria that are found in public raise the question why no one would try to change the status quo. The question of the sustainability over time for those public equilibria will be examined through the relationship between Israel and the U.S. in private. We will look at the preferences and behaviour of the U.S. in private to see whether Israel's behaviour in private can be different from its behaviour in public and what that means for the public equilibria.

The main question of this research is:

How can Israel's opacity about nuclear weapons be explained, and why is this sustainable?

The research is divided in two parts, with for both parts a question. The first part is about Israel's behaviour regarding nuclear weapons: *Which forces drive Israel's behaviour around nuclear weapons?*

The second part will look the sustainability of Israel's behaviour. With Israel's behaviour in private we try to explain the sustainability of Israel's behaviour in public. The second research question is: *Why is Israel's public behaviour sustainable?*

Content

In chapter two we will see what related literature says about nuclear weapons in general, Israel's nuclear weapons, the Israel-U.S. and Israel-Iran relationship and Iran's pursuit for nuclear weapons. Chapter three will explain the general model with its payoffs and possible actions. With this model we are able to review how Israel will behave in public regarding its

nuclear weapons. In chapter four the first model will be elaborated, we will look for the equilibria and with those equilibria the behaviour of Israel will be explained. The equilibria raise some questions about sustainability over time and why no party would try to change the status quo. To answer those questions we need to apply a different model. In chapter five we will elaborate on the application and adjustments of the model from Farrell and Gibbons, we will explain the new payoffs and possible actions for all the parties. In this model Israel has the possibility to speak in private or in public and we investigate the impact of the relationship between Israel and the U.S. In that way we can answer the question why the curious equilibria of chapter five are sustainable in the long run. This will be illustrated in chapter six, where we will elaborate on the adjusted model of Farrell and Gibbons to look for the sustainability of Israel's behaviour of the first model. The results will be compared with events in the real world. Chapter seven will contain the conclusion of this research, where we place our results in the related literature. We end with some limitations and suggestions for further research.

2. Related Literature

Related literature for this research is divided in a few topics, first we will look at nuclear weapons in general. Two articles of Thomas Schelling will be used to see what it means to have a bomb and what a world without nuclear weapons would look like. Second we will treat articles about the global nuclear weapons inventories and Israel's case in specific. As third the background of the relationship between Israel, the U.S. and Iran will be the topic. The last subject is about the impact of Iran gaining nuclear weapons.

Nuclear weapons in general

In the first paper of Thomas Schelling (1976), Who Will Have the Bomb?, he explains what it means to have a bomb and how this could affect international security. Schelling explains first what having a bomb means. It is not per se that a country literally possesses a nuclear explosive. It is a combination of things, having the technological knowledge to produce a nuclear explosive, having or possibility to acquire enough explosion-grade fissile material and declaration to the world, done by an actual explosion, that a country can explode a nuclear device. Israel never performed the ceremony of nuclear demonstration, which causes their state as "non-nuclear-weapons state" by definition of the NPT. The question of who will have the bomb was treated as a yes or no question, but Schelling argues that from now on it will make more sense to answer the question with a time schedule. A given time that it will take a country to assemble them. Furthermore Schelling argues that for organizations or persons other than national government it is very difficult to gain a nuclear weapon, and therefore concludes that national governments are the organizations who are most likely to engage in nuclear terrorism. And the most likely form of terrorism would be passive terrorism, called "deterrence", which also could be referred to what we call "blackmail". The most passive deterrence of all is just letting be known, perhaps through an innocent leak of information, that a government has nuclear weapons, so that every potential addressee knows that he could provoke nuclear activity. Besides all alarm bells that Schelling is ringing about nuclear powers he concludes that till now there have been no nuclear weapons fired in warfare. (Schelling, 1976)

In the second paper, A World without Nuclear Weapons, Thomas Schelling (2009) asks the question whether total nuclear disarmament would be a good or bad thing for the stability in the world. If all governments would undergo a total disarmament, the question

will not be about current nuclear power, but it would be about how many weapons a government could mobilize on what time schedule. A crucial question is whether a government could hide weapons-grade fissile material from any possible inspection-verification. A responsible government would make sure that it is available for crisis or war, or at least assume that other responsible governments will do so. This will end in a few options as Schelling is suggesting. The first option is that the first to acquire weapons will use them, to disrupt its enemies' nuclear mobilization base, and build more weapons themselves to demand surrender. The second option is that there will be a demand, under threat of nuclear war, for abandonment of any nuclear mobilization with unopposed inspectors. A third option would be a "decapitation" nuclear attack with the surrender demand. And Schelling says that he could think of worse scenarios, because all of these scenarios are in the interest of self-defence. Schelling summarizes that without nuclear weapons every state would have hair-trigger mobilization plans to rebuild nuclear weapons, every crisis will end up as a nuclear crises and any war as a nuclear war. So all nuclear weapons should only be dismantled if we are sure we understand what we are getting into. In the wars that are fought since the Second World War there are no nuclear weapons introduced. There are two different phenomena that keep the stability, the "taboo" and mutual deterrence. Concern about North Korea and Iran is justified, but denuclearization of the U.S., Russia, China et cetera has no good prospects. We should not trade the current nuclear quiet for a nervous world with a world that is ready for a race to reacquire nuclear weapons. (Schelling, 2009)

Global and Israel's nuclear inventories

Norris and Kristensen (2010) did a research into the global nuclear weapons inventories between 1945 and 2010. Because of secrecy the public does not know the exact number of nuclear weapons in the world, so the results of Norris and Kristensen are particular estimates. The nations that are not recognized by the NPT have a minuscule stockpile in comparison with those of Russia and the U.S. In their research they look at nine countries and their stockpiles. However Israel has never acknowledged it possesses nuclear weapons, the U.S. intelligence community estimates that their arsenal is around 80 warheads. Norris and Kristensen suggest that Israel's nuclear arsenal depends on Iran, which appears to join the nuclear club between four and ten years. Russia and the U.S. are reducing their Cold War arsenals, so the global inventories will continue to decline, however eight out of the nine

nuclear weapons states continue to produce modernize nuclear weapons, and all nine insist that nuclear weapons are essential for their national security. (Norris & Kristensen, 2010)

Four year after this study Norris and Kristensen (2014) did a research into Israeli nuclear weapons. They extensive studied the nuclear policy, the nuclear alerts, the amount of warheads, the designs and the possible ways to deliver nuclear bombs. In 2011 the Israeli policy of nuclear opacity is publicly expressed by Netanyahu, with the phrase "We won't be the first to introduce nuclear weapons into the Middle East". Norris and Kristensen state that the Israeli governments have many interpretations to "introduce". This led to a diplomatic discussion between Israel and the U.S. There were a lot of negotiations where the Israeli nuclear program was a topic. The meaning of introduction was an important topic between the U.S. and Israel. The definition of the U.S. was that the possession of nuclear weapon was introduction. Israel's definition of introduction is not about possession, but about public acknowledgment of possession. Kissinger finally solved the diplomatic dilemma, the U.S. assume they have Israeli assurance that it will remain a non-nuclear state as defined in the NPT, which was the same interpretation as Israel had. Arms deals between the U.S. and Israel are made under agreement that Israel does not introduce nuclear weapons in the Middle East, so Israel should not make it public knowledge that they have nuclear weapons, because they would violate the nuclear ambiguity. A point in history where Israel could decide to "introduce" its nuclear arsenal was the Yom Kippur War, but none of all searches revealed that there was a nuclear alert or clear manipulation of its forces. However there was a study that the U.S. did observe some kind of Israeli nuclear weapons-related activity, this study says that "Israel appears to have taken preliminary precautionary steps to protect or prepare its nuclear weapons and/or related forces" (Kristensen & Norris, 2014, p. 101). There was no formal introduction of nuclear weapons in that war. Six years later there were also widespread rumours about Israel's involvement by the Vela incident, which was a nuclear test in the southern part of the Indian Ocean.

Norris and Kristensen claim that many rumours about the stockpile of Israel are inaccurate, those rumours differ from 75-400 warheads, but the most credible number is 80. They also gave the options that Israel has for delivery and the types of design. In the end Norris and Kristensen conclude on page 111 that despite Israel's stated policy that they would not introduce nuclear weapons in the Middle East, "there is little doubt that Israel has already introduced nuclear weapons in the region and that only a deception based on a

narrow interpretation of what constitutes “introduction” keeps Israel from officially being a nuclear weapons state”. (Kristensen & Norris, 2014)

In the paper of Farr (1999), The Third Temple’s Holy of Holies: Israel’s Nuclear Weapons, he describes the history of Israel’s nuclear weapons program. Israel started their search for nuclear weapons at the beginning of the state in 1948, to compensate the small pool of military manpower. In 1956 Israel received, as payment for its participation in the Suez Crisis, nuclear expertise and the construction of a reactor complex at Dimona from France. The first period of Israel’s program, 1948-1962, was in cooperation with France, this was also important for France, because they benefitted from a strong Israel against Egypt, for Egypt openly supported Algeria against France. Besides that both states benefited from their joint research effort. When the U.S. gained knowledge from Israel’s nuclear aspiration their relationship became complicated. There was a difference between the public and private relationship, in public the U.S. had accepting attitude, while in private they pressured Israel. When the U.S. performed inspections in Dimona in 1962 the elevators to the secret underground plutonium reprocessing plant were bricked over. In the period between 1963 and 1973 the project came to completion. In those times Israel cooperated with South Africa. Israel leaked stories and numbers of assembled atomic bombs as a great psychological warfare tool. The opaque use of the Israeli bomb is also subtle used to ensure that the U.S. kept his pledge to maintain Israel’s conventional weapons edge over its foes. Besides that in 1967 the Arab strategies and war aims may have been restricted because of fear of a “bomb in the basement”. The period of 1974-1999 was the period of bringing the bomb up the basement stairs. The nuclear test in 1979 in the Indian Ocean is widely believed to be a South Africa-Israel joint nuclear test. There were a few times that Israel went on a nuclear alert, and so the bomb comes out the basement, with an open discussion. In 1998 Shimon Peres said “We have built a nuclear option, not in order to have a Hiroshima, but to have an Oslo”, referring to the peace process. Israel is concerned about Iran’s desire to obtain nuclear weapons. Israelis are considering actions capable of stopping nuclear programs, as they did in Iraq. Israel’s nuclear ambiguity has served their purposes well, but now Israel is entering a different phase of visibility, which may not be in the U.S.’s interest. Former Israeli President Ezer Weizman also stated that “the nuclear issue is gaining momentum and the next war will not be conventional”. (Farr, 1999)

Relationships Israel, U.S. and Iran

The paper of the Congressional Research Service, written by Jim Zanotti, describes the background of the Israel and U.S. relation, as information and analysis on the Israel-Gaza conflict of 2014. The paper starts with a historical view and stated that since 1948 the U.S. Presidents and Members of Congress have shown commitment towards Israel's security and to maintaining close U.S.-Israel defence, diplomatic and economic cooperation. The close relationship between the U.S. and Israel are based on common perceptions of shared democratic values and religious affinities. Policy makers in the U.S. often seek how their policy affects Israel's security, which is important for Israel, because they have many regional security concerns with the threat of Iran and Arab neighbours. But Zanotti concludes that "despite its unstable regional environment, Israel has developed a robust diversified economy and a vibrant democracy". A few key policy issues of the U.S are the security cooperation, the Israeli-Palestinian issues, the defence technology and intelligence issues and Israel's nuclear status and Non-Proliferation. (Zanotti, 2014)

In the paper Iran, Israel and the Middle East Conflict of David Menashri, he looks at the Iranian foreign policy, and what influence the Islamic revolution had on that policy. The regime became increasingly pragmatic, but on one area Iran's policy became excessively uncompromising, the inherent hostility to Israel, rejection of Zionism, the national movement of the Jewish people to re-establish a Jewish homeland in the territory defined as the historic land of Israel, and the legitimacy of the Jewish state. Iran made an exception for this case, the ideological hostility did not seem to conflict with the pragmatic interests. The paper researches the development of the Iranian policy since 1979. They conclude that the revolution has matured and did recognize its limits of power, and they also allowed greater room for shaping actual policy in more and more areas. But besides those changes there are no significant changes in Iran's attitude towards Israel. The hostility towards Israel has become the main tenet in Iran's revolutionary conviction, which made it even more to discard. The anti-American attitude is reduced, but the anti-Israel attitude remained high in the government's pronouncements, although some relatively mid statements were made from time to time. To have a meaningful change in the position of Iran towards Israel there are two main condition necessary, for Iran a clear incentive to change their policy combined with a leadership capable of implementing such policy and for the region a significant change in the Israeli-Palestinian and Israeli-Arab relations, which would lead to creating a

more peaceful atmosphere. But Menashri says that the current developments seemed to work against those changes. (Menashri, 2006)

In the paper of Ray Tekayh, about Iran, Israel and the Politics of Terrorism, is about the same topic as the paper of Menashri and researches Iran's hostility toward Israel. Menashri says that it "is one of the most enduring and perplexing aspects of the Middle East conflict" (Takeuh, 2006-2007, p. 83). Iran's politicians have persistently denounced Israel and question the legitimacy of the state and its right to exist since the inception of the Islamic state. He finds this attitude curious because there has never been a war or a territorial dispute between Israel and Iran. Iran's policy was designed to evict the Jewish populace from the Middle East, "the sacred land of Islam was not be partitioned to accommodate Zionist aspirations, but reclaimed for the Muslim world" (Takeuh, 2006-2007, p. 85). The Islamic Republic's approach to Israel is still largely conditioned by an ideology that sees Israel as a civilizational affront and an agent of American imperialism. Besides that it was an unforgivable sin to create a Jewish state that displaced Palestinian Muslims. From the start of the Jewish state the antagonism towards Israel exceeded even the opposition to the U.S., the U.S. actions were contested, but for Israel the right to exist was contested. The way that Iran tries to damage Israel is mostly indirect, not by a war, but by close ties with leading Palestinian militant groups as Hamas and Islamic Jihad and Lebanon's Hizbullah, which essentially was created by Iran. Also Tekayh says that "there has never been sufficient incentive for the clerical oligarchs to abandon a policy whose costs in terms of U.S. sanctions and criticism seemed bearable" (Takeuh, 2006-2007, p. 95). He does not expect to see Iran's policy change noticeably due to the current consolidation of conservative power within Iran and the collapse of the diplomatic efforts for the Israeli-Palestinian peace. The best manner to extract Iran from the Arab-Israeli conflict is to launch a diplomatic effort to resolve the remaining differences between Israel and the Palestinian Authority and to rebuild the Lebanon government to diminish Hizbullah's influence. (Takeuh, 2006-2007)

Iran as nuclear state

Kenneth Waltz has written a paper about the conflict between Israel and Iran, in this paper, Why Iran Should Get the Bomb: Nuclear Balancing Would Mean Stability, he suggests that Iran should get a nuclear bomb to get stability in the Middle East. Most U.S., European and Israeli policymakers warn that a nuclear-armed Iran would be the worst possible outcome,

but Waltz suggests that it would be the best result, because it will most likely restore stability in the Middle East. There are three ways how Iran's search for nuclear power could end; the first one is with sanctions to stop the pursuit of gaining nuclear weapons. This is highly unlikely as we look at countries as North Korea, he states "if Tehran determines that its security depends on possessing nuclear weapons, sanctions are unlikely to change its mind" (Waltz, 2012, p. 2). The second possible outcome is that Iran stops the testing of nuclear weapons, but develops a breakout capability, which means that they will have the capacity to build and test a nuclear weapon quickly. This might satisfy the domestic political needs for Iran by enjoining the benefits of having a bomb, but without the downside. A problem with this outcome is that a breakout capability might not work as intended, because Israel would not accept Iranian enrichment capacity. Israel would be less intimidated by a virtual nuclear weapon and continue its risky effort to sabotage Iran's nuclear program. This could lead Iran to conclude that a breakout capability is not the security they seek. The third outcome is that Iran continues their current course and publicly goes nuclear by testing the weapon. The U.S. and Israel have declared that such an outcome is unacceptable because of an existential threat, but such language is typical for major powers when other countries began developing nuclear weapons. Yet till now, current nuclear weapon states always decided to live with new nuclear powers. Waltz suggests that Israel's regional nuclear monopoly has long fuelled the instability of the Middle East; there is no other region where there is only one nuclear power. Israel has proven to strike potential nuclear rivals, in 1981 Iraq and in 2007 Syria. There are two types of unfounded fears that Waltz assesses, the first is that the Iranian regime is innately irrational, and that they would not hesitate to use the bomb on Israel, even though doing so would invite retaliation with the risk of destroying their own country. Waltz argues that although we cannot be certain of Iranian intentions it is far more likely that Iran desires nuclear weapons for own security reasons and not for its offensive capabilities. Other policymakers who accept rationality of the Iranian regime are worried that it would give Tehran a shield that would allow them to act more aggressively and increase its support for terrorism, and maybe provide terrorist with nuclear arms. Waltz argues that this contradicts history, because "history shows that when countries acquire the bomb, they feel increasingly vulnerable and become acutely aware that their nuclear weapons make them a potential target in the eyes of major powers" (Waltz, 2012, p. 4). Regarding a handoff to terrorists Waltz argues that no country

could transfer nuclear weapons without running a high risk of being found out and besides that a countries can never entirely control terrorist groups they sponsor. It makes little sense that they would transfer a costly and dangerous bomb to parties that cannot be trusted or managed. A last worry is that it will lead to a nuclear arms race in the Middle East, but if Israel did not trigger an arms race when they started, there is no reason that a nuclear Iran should now. Concluding he says that if Iran goes nuclear that Israel and Iran will deter each other as nuclear power always have, there has never been a full-scale war between two nuclear-armed states. He suggests that where nuclear capabilities emerge, stability emerges also. He ends on page 5 with: "When it comes to nuclear weapons, now as ever, more may be better". (Waltz, 2012)

Thanos Dokos gives a reaction on the paper on Waltz in his paper Why Kenneth Waltz is Both Right & Wrong About the 'Iranian Bomb'. At first Dokos reacts on the claim that there has never been a war between two nuclear armed states, Dokos says that this conclusion ignores the Cuban missile crisis, when the two superpowers got really close to a nuclear confrontation. The non-use of nuclear weapons rested on a few factors, "the fact that national survival nor territorial integrity was immediately at stake and that neither power has ever been at war with the other, the lack of common border, thereby lessening flash points for conflict and impeding escalation and as last adequate technical means to prevent accidental detonation and unauthorized use of nuclear weapons" (Dokos, 2012, p. 1). Without those features, when only fear of nuclear destruction holds, it could have led to use of nuclear weapons. Dokos further argues that the probability of the use of nuclear weapons as result of miscalculation or loss of control cannot be dismissed, with more nuclear proliferation there is more risk. As second point Dokos talks about the point that Waltz makes about Israel's nuclear arsenal being destabilizing for the region, Dokos says that that Israel's policies and actions can work destabilizing, especially around the Palestinian problem, but its nuclear behaviour can hardly described as irresponsible or destabilizing. Waltz statement that "If an atomic Israel did not trigger an arms race then, there is no reason a nuclear Iran should now", is rather controversial with his point that Israel's nuclear arsenal is the problem of the destabilization of the region. Furthermore Dokos argues that Iran's nuclear aspirations are not because of Israel's nuclear capability, but because of a combination between the countries historical sense of regional leadership, experiences of war with Iraq and finally we should also consider the distrust of the West, mainly as a result

of a sense of humiliation caused by a long colonial experience. There are a few points that Dokos gives to rethink Iranian nuclear arms. First of all, “the acquisition may not only increase Iran’s self-confidence but also its propensity for brinkmanship and risk-taking. Iranian official rhetoric often bombastic in style, will not help in this context” (Dokos, 2012, p. 2). Second, open nuclearization of Iran can deal a serious blow to the NPT regime. Third, if we see the Iranian regime with strategic goals which are limited to self-defence and regime survival, there will be no intentional use, but a higher probability of miscalculation. On the other hand, for those who regard Iran as an inherently revolutionary state, deterrence will be only wishful thinking. As forth, the complex way the Iranian foreign and military policy works, with actors with multiple agenda’s makes the situation on potential transfer to a terrorist organization more complex. He concludes that however the nuclearization of Iran will not cause a substantial increase in the probability of nuclear use in the region, it remains an unwelcome development, and will probably increase regional instability. (Dokos, 2012)

In the research of Anthony Cordesman for the Center for Strategic International Studies he looked at what kind of impact a nuclear Iran would have. He explains how far Iran is, which missiles they have and what their options are. He further investigates which possible wars could occur and what the theoretical outcomes will be. The first two options are the prevention options, one from Israel and one from the U.S. Those options are uncertain, because of a small window of opportunity. The third option is an arms race, a war of intimidation. After those options the options of warfighting with an Iranian nuclear force are highlighted, with hypothetical forces of Iran, Israel, the U.S., Syria, the Gulf States and non-state forces. Different scenarios and options are explained. If Israel and Iran would get to war with nuclear weapons both sides would be hit very hard. Iran will inflict 200.000 to 800.000 dead in 21 days; long term death rate cannot be calculated. Israel would inflict 16.000.000 to 28.000.000 dead in 21 days; also here the long term death rate cannot be calculated. The conclusion of this war is that Iranian recovery is not possible in normal sense of term, while Israeli recovery is theoretically possible in population and economic terms. For Israel the possibility of other powers who can capitalize on an Iranian strike is included, Israel has to reserve a strike capability for other Arab neighbours. An important statement from this research is about the “War Game” paradox: “The only way to win is not to play”. (Cordesman, 2008)

3. Theoretical model

This research has two parts, with two different models. For the first part a normal game theoretical model is used and for the second part we use a model that is developed by Farrell and Gibbons in their paper Cheap Talk with Two Audiences (Farrell & Gibbons, 1989). Both games are dynamic games with incomplete information. The second model will be explained in chapter 5. The first model will be used to see whether there could be a Perfect Bayesian Equilibrium (PBE) in the situation between Israel, Iran and the U.S.

Dynamic game with incomplete information

This game is a two-period game, with three players, Israel, Iran and the U.S., with private information[1]. The action of the U.S. is only a trigger strategy. The relationships between the players are very different. Israel and Iran have been allies since the early 50's till the 1979 Islamic Revolution, in 1988 there was a final break between them and they became enemies. Now the relations is so that Iran prophesizes that the state of Israel will disappear, while Israel denies Iran the right to nuclear technology (Latschan, 2014). The U.S. and Israel are close allies, the U.S. supports Israel since 1949 and their alliance is beneficial for both parties (Eisenstadt & Pollock, 2012). The relationship between the U.S. and Iran is complicated, sometimes they were allies till the revolution in 1979, after that there were different incidents between both countries, which lead to distrust and accusations (US-Iran relations: A brief guide, 2014).

In period 0 nature decides whether Israel has nuclear weapons, with α probability Israel has nuclear weapons and with $(1-\alpha)$ Israel does not have them, these are the prior beliefs for Iran and the U.S. Israel knows whether they have nuclear weapons, therefore they have a type-dependent strategy. In period 1 Israel could choose to reveal their private information about having nuclear weapons. They could claim or deny that they have nuclear weapons. In the second period Iran has to react to the information that they got from Israel. Iran has two options, attack Israel or not. The trigger strategy of the U.S. is about their support towards Israel, they can reduce their financial, political and military aid to Israel.

Israel has private information about what nature draws, whether they have nuclear weapons. Furthermore Israel assesses the danger that Iran is for the security of their state

[1] Game Tree can be found in Appendix 1

higher than the U.S. The U.S. is not aware about the precise danger that Iran is for Israel, but they know partly about the danger due to the huge lobby for Israel in the U.S. Iran has a prior belief about Israel having nuclear weapons and in game they observe Israel's message and actions around nuclear facilities which they can use to update their beliefs about the probability of Israel having nuclear weapons (α). For the U.S. it is important what Israel says about their nuclear capacity in combination with the expected true state, if Israel claims to have nuclear weapons the U.S. will punish them by reducing their support depending on their payoffs, if Israel denies to have nuclear weapons the U.S. will never reduce their support. The U.S. behaves like this because it is the status quo at the moment, Israel's neither confirms nor denies having nuclear weapons and the U.S. is not reducing their support towards Israel.

The payoffs for Israel are partly from national security, if there is an attack of Iran it is valued as $A < 0$, in case of no nuclear weapons, while payoffs in the absence of an attack is normalized and therefore zero. The second part is the support or backup of the U.S. is given as B, which would be $(1 - \beta)B$ if the U.S. reduces their support with β, which range is between zero and one. The payoff of a war with Iran is a very negative payoff, because of the damage that it will do to infrastructure, national safety, civilian casualties and costs of warfare. If Israel has nuclear weapons the war will be less destructive for Israel because they can strike back hard to Iran. So in that case the payoff of the war is $A + D$, where $D > 0$. But $A + D < 0$, because the effect of a war will always be negative.

Players	Variable	Meaning
Israel	A<0 (attack)	Utility from an attack from Iran
Israel	B>0 (backup)	Support and backup of the U.S.
Israel	D>0 (demolition)	Less demolision from use of NW
Iran	E<-1	Damage of nuclear war
U.S.	S1<0 (stability)	Negative stability in Middle-East
U.S.	S2>0 (stability)	Positive stability in Middle-East
U.S.	N<0 (NPT)	Damage to NPT agreement
U.S.	W<0 (world)	Negative stability in World

Table 1 - Meaning of variables

The payoffs for Iran are only dependable on the attack, if they attack Israel and Israel does not have nuclear weapons the payoff is 1. But if they attack and Israel has nuclear weapons the payoff is $E < -1$, for the damage that it does to their own country.

The U.S.'s payoffs are mainly due to stability, if Israel denies to have nuclear weapons there is a nuclear stability in the Middle-East ($S_2 > 0$), the U.S. want the Middle-East to be stable and do not want an introduction of nuclear weapons. If Israel claims to have nuclear weapons the payoffs are dependable of the credibility of the claim, when the claim is not

credible and Israel has actually no nuclear weapons the U.S. a payoff of S_2. But if Israel actually has nuclear weapons the payoff of the U.S. will consist of a negative stability in the Middle-East ($-S_1$), a negative stability in the world because of nuclear weapons ($-W$) and a negative payoff from the damage that the claim will do to the NPT-agreement($-N$). If the U.S. has a negative payoff from Israel's claim they will reduce their financial, military and political support with βB.

It is important to know that when the U.S. decides to punish Israel for their possession of nuclear weapons that it is not observable for Iran to know what the punishment is for. It is no sign for Iran that Israel has nuclear weapons. This is because the cause of the reduction of support can be reported for a different reason. For instance for Israel's settlement in the West-Bank or for suppressing Palestinians in Israel. Also in the paper of Farr he explained that the private and public relationship between the U.S. and Israel was different, publicly the U.S. was acceptant, while in private they pressured Israel (Farr, 1999).

Timeline of actions

In period 0 nature decides whether Israel has nuclear weapons or not. Israel obviously knows directly after the decision of nature whether they have nuclear weapons. Iran does not know whether Israel has nuclear weapons. They only hold a belief about the probability of Israel having nuclear weapons, the prior belief. This belief is α for Israel having nuclear weapons and $(1-\alpha)$ for Israel not having nuclear weapons.

In the first period Israel can either claim that they have nuclear weapons or they can deny that they have nuclear weapons. Iran and the U.S. observe the message that Israel is sending which they will use to adapt their beliefs.

In the second period Iran can either choose to attack Israel or do nothing. For their payoffs it is interesting to attack Israel when Israel has no nuclear weapons, but when Israel does have nuclear weapons it will be negative for them to attack and therefore it will be better to not attack Israel. For Israel an attack will gain a very negative payoff. The U.S. will decide, based on their payoff, whether they will punish Israel with reducing their support.

Assumptions

In order to do calculations in this model, we need to make some assumptions. This is because there are no numeric values given except the normalised value 1 for Iran. To check which decision players should make we have to make some assumptions for some variables.

Assumption 1: $B < |A|$

The first assumption is about the devastation of war and the support of the U.S. It says that the negative payoffs from devastation of war are always bigger than the positive payoffs of the total support of the U.S. The negative value of a war is always bigger than the positive value of the support that Israel is getting from the U.S. Israel would rather want no war and no support than a war and full support.

Assumption 2: $B < |A + D|$

The second assumption builds further on the first assumption. This assumption is a bit stronger, is assumes that also a war where Israel can use nuclear weapons has a more negative payoff than the full support of the U.S. So also in this case Israel would rather have no war and no support than a war with nuclear weapons and full support of the U.S.

Assumption 3: $E < -1$

The third assumption is from the side of Iran. Here there is assumed that the positive payoff of destroying Israel in a war is smaller than the negative payoff from the devastations of a war with Israel when Israel possesses nuclear weapons. The grave damage that a war with nuclear weapons will cause will be higher than the payoffs of the destruction of Israel. However this is rational, there will also be looked at the case that Iran has an irrational low value of E or an irrational high value for destroying Israel, which will cause the E value to be between 0 and 1.

Assumption 4: $|S_1| > S_2$

The negative payoff of a grounded claim of Israel to have nuclear weapons is more negative than the positive payoff of Israel denying having nuclear weapons. This assumption suggests that it is worse for the stability in the Middle-East to have Israel claim to have nuclear weapons than it is good for the stability that Israel denies to have nuclear weapons. A claim of nuclear weapons does almost always have negative consequences for the region, the fear of the surrounding countries can lead to instability.

4. Dynamic Game with Incomplete Information

In this first model we will look at the behaviour of Israel, Iran and the U.S. The U.S. has a trigger strategy, based on their payoffs, when Israel claims to have nuclear weapons. Iran chooses to attack Israel based on their payoffs. Both actions will determine what kind of strategy Israel will choose.

4.1. Players and strategies

To solve this model the α has to be a value between zero and one. α cannot be chosen by Israel because it is the belief that Iran holds about Israel's possession of nuclear weapons. Knowing this Israel can have some influence on α by giving some signs about whether they have nuclear weapons, which can change the posterior beliefs. We determine the equilibria for different values of α , because Iran's and the U.S.'s strategies are dependent on α.

We will split the parameter space based on the strategy change of Iran and the U.S. For Iran the value of E, the destruction if they end up in a war with nuclear weapons, is very important for the calculations, because that value influences the choice of Iran; the higher it is the higher the negative payment is when Israel strikes back with nuclear weapons. We search the point where Iran is indifferent between attacking and not attacking given the prior beliefs about possession of nuclear weapons. U.S.'s strategy depends on their expected payoff, when their expected payoff is higher than 0 they will not punish Israel with reducing their support, while when the payoffs will drop below 0 the U.S. will punish Israel. So for the U.S. and Iran the values of α will be searched where they are indifferent between their actions, we will look for those knife-edge conditions. The equilibria that rely on knife-edge conditions are mostly ignored, because the probability that it occurs is negligible, so we only use the conditions to separate different parameter spaces to find the equilibria in that space.

We mainly look at the pure actions that Israel could take, because otherwise it would say less about how they would behave in the different situations, so mixed equilibria will not be calculated when there are pure equilibria. Because when there are pure equilibria we can say something about Israel's and Iran's behaviour, which is the main goal of this model.

Payoffs and strategies

First we will give all the possible actions, the payoffs and the strategies for all players. Israel can either 'Claim' or 'Deny' whether they have nuclear weapons. Their type-dependent strategy 'CD' means that Israel claims to have nuclear weapons if they have them, and that

they deny that they have nuclear weapons if they do not have them. The strategy for Iran are 'Attack' and 'No Attack', their action 'AN' means that Iran will Attack after Israel claims to have nuclear weapons and that they will not attack if Israel denies to have nuclear weapons. For the U.S. the value of their payoffs is only important, if it will end up below 0 they will reduce their support towards Israel, while if their payoffs will be higher than 0 they will not reduce their support.

Iran's payoffs and strategy

For Iran's payoffs it is important to first look at the beliefs that they will hold per strategy of Israel, those beliefs are shown in a general way in table 2. As shown in the table the updated beliefs when Israel has a pooling strategy(CC and DD) will be the same as the prior beliefs. When Israel has a separating strategy(CD and DC) it will be clear for Iran whether Israel has nuclear weapons or not. Those strategies are theoretical identical, but Israel is using different words. The beliefs are one or zero in those cases.

Strategy Israel	Iran's beliefs $\hat{\alpha}(C)$	$\hat{\alpha}(D)$
CC	α	off-path
CD	1	0
DC	0	1
DD	off-path	α

Table 2 - Iran's updated beliefs

Iran's payoff		Iran AA	AN	NA	NN
Israel	**CC**	αE+(1-α)	αE+(1-α)	0	0
	CD	αE+(1-α)	αE	1-α	0
	DC	αE+(1-α)	1-α	αE	0
	DD	αE+(1-α)	0	αE+(1-α)	0

Table 3 – Iran's expected payoffs

The payoffs of Iran are given in Table 3. When Iran attacks their payoff is "1" or "E", and when they do not attack their payoff is "0". The beliefs α are important for Iran's best responses, for every case it depends on the beliefs and the value of E. From the payoffs we see that the best responses of Iran depend on α and E.

To find the best response strategy of Iran we will first look at the best responses after the different strategies of Israel. The best response after 'CD' and 'DC' is straight forward, after 'CD' Iran will choose 'NA', while they would choose 'AN' after 'DC'. If Israel chooses 'CD' or 'DC' it is for Iran clear whether Israel has nuclear weapons and therefore both options resolve in 'attack' if Israel has no nuclear weapons and 'no attack' when Israel has nuclear weapons, which is favourable for Iran. In case of 'CC' and 'DD' it is important to know which outcome will be higher, $\alpha E + (1 - \alpha)$ or 0. There is a combination of α and E where those payoffs are equal to each other, those combinations are given in table 4. In figure 1 those points are shown in a graph. Each point is $\bar{\alpha}_I$, the α where Iran is indifferent between

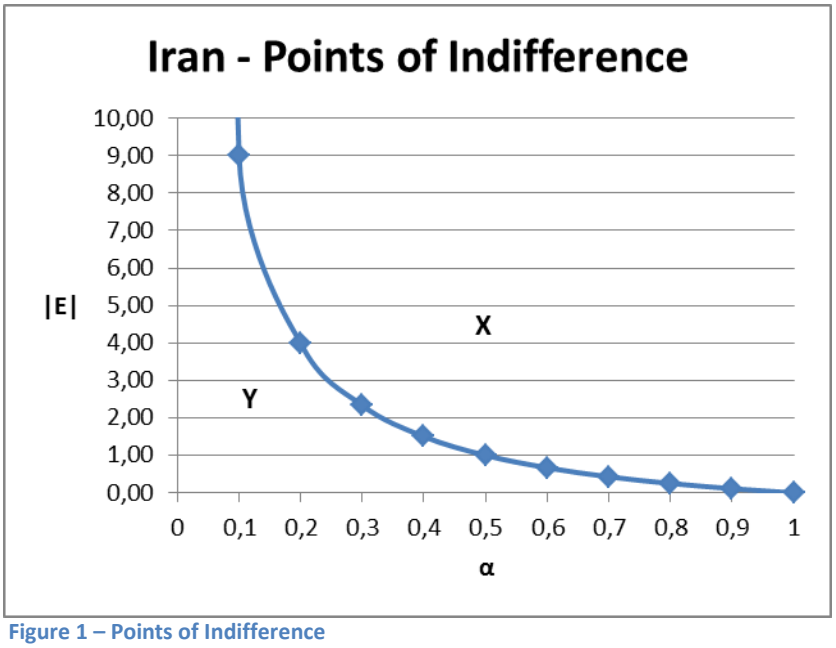

Figure 1 – Points of Indifference

|E|	$\bar{\alpha}$
9	0,1
4	0,2
2,33	0,3
1,5	0,4
1	0,5
0,67	0,6
0,43	0,7
0,25	0,8
0,11	0,9
0	1

Table 4 – Points of indifference Iran

$\alpha E + (1 - \alpha)$ and 0. We can conclude that $\bar{\alpha}_I = \frac{1}{1-E}$.[2] So for each E value if $\alpha > \bar{\alpha}_I(E)$ then $\alpha E + (1 - \alpha) < 0$, and vice versa. If we look at the graph, if the real point will be on the X-side, it will be better for Iran not to attack, while when the real point is on the Y-side the payoffs will be higher if Iran attacks Israel. From assumption 3 we know that in our case $E < -1$, so the maximum value of $\bar{\alpha}_I = 0{,}5$.

This means for the best responses of Iran that we have two cases, $\alpha > \bar{\alpha}_I(E)$ and $\alpha < \bar{\alpha}_I(E)$. In the first case Iran's best responses for 'CC' is 'NA' and 'NN', and for 'DD' it is 'AN' and 'NN'. The consistent beliefs for 'NA' after 'CC' are $\hat{\alpha}(C) \geq \frac{1}{1-E}$ and $\hat{\alpha}(D) \leq \frac{1}{1-E}$, for 'NN' after 'CC' they are $\hat{\alpha}(C) \geq \frac{1}{1-E}$ and $\hat{\alpha}(D) \geq \frac{1}{1-E}$. The consistent beliefs for 'AN' after 'DD' are $\hat{\alpha}(C) \leq \frac{1}{1-E}$ and $\hat{\alpha}(D) \geq \frac{1}{1-E}$, for 'NN' after 'DD' they are $\hat{\alpha}(C) \geq \frac{1}{1-E}$ and $\hat{\alpha}(D) \geq \frac{1}{1-E}$.

In the second case the best responses are 'AA' and 'AN' for 'CC' and for 'DD' they are 'AA' and 'NA'. The consistent beliefs for 'AA' after 'CC' are $\hat{\alpha}(C) \leq \frac{1}{1-E}$ and $\hat{\alpha}(D) \leq \frac{1}{1-E}$, for 'AN' after 'CC' they are $\hat{\alpha}(C) \leq \frac{1}{1-E}$ and $\hat{\alpha}(D) \geq \frac{1}{1-E}$. The consistent beliefs for 'AA' after 'DD' are $\hat{\alpha}(C) \leq \frac{1}{1-E}$ and $\hat{\alpha}(D) \leq \frac{1}{1-E}$, for 'NA' after 'DD' they are $\hat{\alpha}(C) \geq \frac{1}{1-E}$ and $\hat{\alpha}(D) \leq \frac{1}{1-E}$.

[2] $\bar{\alpha}_I E + (1 - \bar{\alpha}_I) = 0 \rightarrow \bar{\alpha}_I = \frac{1}{1-E}$

Proposition 1: *If $\alpha < \bar{\alpha}_I(E)$ Iran's best response strategy is:*

Strategy Israel	*Best Responses Iran*
CC	*AA and AN*
CD	*NA*
DC	*AN*
DD	*AA and NA*

Proposition 2: *If $\alpha > \bar{\alpha}_I(E)$ Iran's best response strategy is:*

Strategy Israel	*Best Responses Iran*
CC	*NA and NN*
CD	*NA*
DC	*AN*
DD	*AN and NN*

The U.S.'s payoffs and strategy

For the U.S.'s payoffs it is important to know that it depends on a combination of a claim and the true state of Israel, an empty claim will not give the U.S. a negative payoff, but a claim which is grounded will give them a negative payoff. The expected payoffs of the U.S. are given in table 5. First of all the payoffs will be explained, after the explanation the U.S.'s trigger strategy will be explained. Note that the updated beliefs are the same as Iran's updated beliefs.

	Israel			
	CC	**CD**	**DC**	**DD**
U.S.	α(-S1-W-N)+(1-α)S2	C: α(-S1-W-N) D: S2	S2	S2

Table 5 - Expected Payoffs U.S.

If Israel would use strategy 'CC' than the payoffs of the U.S. are expected payoffs. With probability α the claim will be grounded and the U.S. has the negative payoffs from that$(-S_1 - W - N)$, and with probability $(1-\alpha)$ the claim is not grounded and the U.S. will have the positive payoff of S_2, the payoffs for the U.S. is the expected value of those payoffs. The payoffs for strategy 'CD' are a bit different, Israel now claims when they have nuclear weapons, so the claim is grounded and the U.S. will get $(-S_1 - W - N)$ with the probability α, while when Israel denies the U.S. will get S_2 with $(1-\alpha)$. The payoffs are now dependent on the type of Israel. The payoffs for 'DC' are S_2, because if Israel has nuclear weapons they will deny that they have them, and when Israel has no nuclear weapons they will have an

empty claim. For 'DD' the payoffs are also S_2, in this case Israel will never claim to have nuclear weapons.

Now we need to check what kind of strategy the U.S. will have, their strategy is to reduce their support to Israel when their payoffs will be lower than zero. For strategy 'DC' and 'DD' it is clear, both payoffs are higher than zero, so the U.S. will not reduce their support. For strategy 'CD' it is a bit more complicated, in this case the U.S. will reduce their support if Israel claims to have nuclear weapons (C), and will not reduce their support if Israel denies to have nuclear weapons (D). If Israel claims to have nuclear weapons the payoffs are $(-S_1 - W - N)$, which is negative, while if Israel denies to have nuclear weapons the payoffs are S_2, which is positive. The last case is the most complicated case, 'CC', in this case it is not clear whether Israel would have nuclear weapons or not, so the payoffs of the U.S. are expected payoffs based on α. The U.S. will reduce their support if the expected payoffs will drop below zero, there is a value of α where the U.S. has a payoff of zero, $\overline{\alpha_U}$. When α is low the most weight of the payoff will be at S_2, while if α is higher the most weight will be at $(-S_1 - W - N)$. So if $\overline{\alpha_U} > \alpha$ the U.S. will not reduce their support to Israel, but if $\overline{\alpha_U} < \alpha$ the U.S. will reduce their support. If we take assumption 4 into account we see that $\overline{\alpha_U} < 0{,}5$, because $|S_1| > S_2$, but $\overline{\alpha_U}$ is probably a bit lower, because $-W - N$ are also negative payoffs when Israel claims to have nuclear weapons.

Proposition 3: *If $\alpha < \overline{\alpha_U}$, the U.S.'s best response strategy is:*

Strategy Israel	***Trigger strategy U.S.***
CC	*Full support*
CD	*Reduce support after C with β*
DC	*Full support for both types*
DD	*Full support*

Proposition 4: *If $\alpha > \overline{\alpha_U}$, the U.S.'s best response strategy is:*

Strategy Israel	***Trigger strategy U.S.***
CC	*Reduce support with β*
CD	*Reduce support after C with β*
DC	*Full support for both types*
DD	*Full support*

Israel's payoffs

The payoffs of Israel are written down in Table 6 and 7, table 6

Israel's payoff (NW)		**AA**	**AN**	**NA**	**NN**
Israel	**C**	A+(1-β)B+D	A+(1-β)B+D	(1-β)B	(1-β)B
	D	A+B+D	B	A+B+D	B

Table 6 - Israel's payoff with nuclear weapons

shows the payoffs if Israel has nuclear weapons and table 7 shows the payoffs if Israel has no nuclear weapons. There is no strictly or weakly dominated strategy for either type. So we will look at the type-dependent best response strategies for Israel. Something which is very important to know is that if both types claim to have nuclear weapons ('CC') than the U.S. will reduce support for both types with β if $\alpha > \overline{\alpha_U}$, and will support both types full if $\alpha < \overline{\alpha_U}$.

		Iran			
Israel's payoff (no NW)		**AA**	**AN**	**NA**	**NN**
Israel	**C**	A+B	A+B	B	B
	D	A+B	B	A+B	B

Table 7 - Israel's payoff without nuclear weapons

When Iran plays always 'attack' (AA), for Israel with nuclear weapons it is their best response to deny, which is quit logical, because whatever they would do, claim or deny, Iran will attack. So a claim of having nuclear weapons will not change Iran's decision of attacking, in that case they could better deny to have nuclear weapons to get full support of the U.S. instead of reduced support. Israel without nuclear weapons is indifferent between both claiming and denying to have nuclear weapons, because if they claim it the U.S. will know that it is not a grounded claim, and if they deny they would not be punished. The type-dependent best response strategies, when the strategy of Iran is 'AA', are 'DD' and 'DC'.

When Iran plays 'attack' after a claim of Israel and 'no attack' when Israel denies, so strategy 'AN', the best response for both types is deny. In that case Israel is certain that Iran would not attack them and they would get full support of the U.S. So the type-dependent best response strategy in this case is 'DD'.

In the case that Iran plays 'no attack' after a claim of Israel and 'attack' when Israel denies (NA), first Israel with nuclear weapons has to consider what payoff will be higher, the negative payoff of a war, or the reduction in support from the U.S. In appendix 1a, using assumption 2, we can see that Israel with nuclear weapons would claim to have nuclear weapons to avoid an attack. If we look at Israel without nuclear weapons we see that they obviously would claim to have nuclear weapons, but in that case we get strategy 'CC', which means that the U.S. does not know if the claim of Israel is grounded. So now there are two options, if $\alpha > \overline{\alpha_U}$ the U.S. reduces the support for both types of Israel, and if $\alpha < \overline{\alpha_U}$ the U.S. fully support both types of Israel.

After $\alpha > \overline{\alpha_U}$ the choice of Israel with nuclear weapons does not change, they still do not get full support, but the options of Israel without nuclear weapons does change, now

they would not receive full support. In appendix 1b, using assumption 1, we can see that Israel again would claim to have nuclear weapons to avoid a war.

If $\alpha < \overline{\alpha_U}$ both types of Israel would receive full support of the U.S., which means that both types obviously would want to avoid an attack of Iran and therefore claim to have nuclear weapons. The type-dependent best response strategy of Israel for Iran's strategy 'NA' is 'CC'. This strategy will be used for every α, but the payoffs can differ for different α values.

In the last case, where Iran will never attack (NN), it is obvious that it is better to deny than to claim for Israel with nuclear weapons. In both cases they will not end up in a war, but when they deny they get full support of the U.S. Israel without nuclear weapons is indifferent between claiming and denying, because in both cases they would get full support from the U.S. The type-dependent best response strategies are in this case are 'DD' and 'DC'.

The best response type-dependent strategies from Israel will be the same for every α, the different value of α do not affect the choices for both types. For Iran and the U.S. the α values define the strategy that they will take, but for Israel that is not the case.

Proposition 5: *the type-dependent best response strategies for Israel are:*

Strategy Iran	***Best Responses Israel***
AA	*DC and DD*
AN	*DD*
NA	*CC*
NN	*DC and DD*

4.2 Equilibria

We are looking for a Perfect Bayesian Equilibrium, which means at least that the beliefs have to be consistent with the strategy profiles. There are two cases that will be elaborated. The first case is where $\alpha < \overline{\alpha_I}$, which means that $\alpha E + (1 - \alpha) > 0$, so Iran chooses for the best response strategy that is given in proposition 1. The second case is where $\alpha > \overline{\alpha_I}$, which means that $\alpha E + (1 - \alpha) < 0$, in this case Iran chooses for the best response strategy that is given in proposition 2. We also look in both cases to the $\overline{\alpha_U}$, we check whether α is higher or lower. This will only change the possible payoffs of Israel, but will not influence the type of equilibria.

Case 1: $\alpha < \overline{\alpha_I}$ and $\alpha < \overline{\alpha_U}$ or $\alpha > \overline{\alpha_U}$

The first case where the equilibria will be searched is the case of $\alpha < \overline{\alpha_I}$, this means that the α is relatively low and has a maximum of $0{,}5$, the combination of α and E will be low and

will end up on the Y-side of figure 1. Iran's strategy is given in proposition 1, which will be combined with the type-dependent best response strategy of Israel, which is given in proposition 5, to find the possible equilibria. This combination gives one equilibrium, namely (DD,AA).

Proposition 6: *with $\alpha < \overline{\alpha_I}$ there is one pooling PBE: (DD, AA) with the beliefs $\hat{\alpha}(D) = \alpha$ and $\hat{\alpha}(C) < \overline{\alpha_I}$. For both $\alpha < \overline{\alpha_U}$* and $\alpha > \overline{\alpha_U}$ Israel receives full support of the U.S.

To find the Perfect Bayesian Equilibrium for equilibrium (DD,AA) we need to have consistent beliefs for the strategy profile of Iran. To find those consistent beliefs we use Bayes rule.

If we apply Bayes rule for $\hat{\alpha}(D)$ we find that $\Pr(NW|DD) = \alpha$.[3] This belief is consistent with the belief that Iran holds about Israel's possession of nuclear weapons, which is given in table 2. If we look at the consistent beliefs for $\hat{\alpha}(C)$ we see that this is off-path, which is also given in table 2. But the belief about $\hat{\alpha}(C)$ has to be consistent with an attack from Iran if Israel claims to have nuclear weapons. This means that the payoffs for Iran must be equal or better from 'attack' than 'no attack' if Israel claims to have nuclear weapons. This leads to a consistent belief of $\Pr(NW|CC) \leq \frac{1}{1-E}$.[4] As we concluded earlier, $\overline{\alpha_I} = \frac{1}{1-E}$, so the $\Pr(NW|CC) \leq \overline{\alpha_I}$. In combination with assumption 3 we know that the highest value of $\overline{\alpha_I}$ is 0,5, because $E < -1$.

Both types of Israel will receive full support, it does not matter whether $\alpha < \overline{\alpha_U}$ or $\alpha > \overline{\alpha_U}$, in both cases the U.S. will still fully support Israel as we can see in proposition 3 and 4.

This equilibrium satisfies the Intuitive Criterion(IC), because both types could try to get higher payoffs by claiming to have nuclear weapons so Iran would not attack, so neither type can convince Iran that it has nuclear weapons because the other type would say the same.

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[3] $\Pr(NW|DD) = \frac{\Pr(D|NW)*\Pr(NW)}{\Pr(D)} = \frac{1*\alpha}{1} = \alpha$

[4] $V_{\text{Iran}}(\text{A; D}) \geq V_{Iran}(N; D)$

$\alpha E + (1-\alpha) \geq 0 \rightarrow \alpha \leq \frac{1}{1-E}$

The payoffs in this equilibrium, if Israel has nuclear weapons, are for Israel, Iran and the U.S. respectively $A + B + D$, E and S_2. If Israel has no nuclear weapons the payoffs are $A + B$, 1 and S_2.

Case 2: $\alpha > \overline{\alpha_I}$ and $\alpha < \overline{\alpha_U}$ or $\alpha > \overline{\alpha_U}$

In the second case the equilibria will be searched in case of $\alpha > \overline{\alpha_I}$, which means that the combination of α and E will be high enough to let Iran end up on the X-side of figure 1. In this case Iran will not attack Israel if they are in uncertainty about Israel's true state. Iran's strategy is given in proposition 2, this strategy in combination with Israel's best response strategy in proposition 5 lead to the following equilibria: (CC,NA),(DD,AN) and (DD,NN).

Proposition 7: *with $\alpha > \overline{\alpha_I}$ there are the following pooling PBE with corresponding beliefs:*
(CC,NA) with $\hat{\alpha}(C) = \alpha$ and $\hat{\alpha}(D) < \overline{\alpha_I}$, for $\alpha < \overline{\alpha_U}$ both types receive B and for $\alpha > \overline{\alpha_U}$ both types receive βB.
(DD,AN) with $\hat{\alpha}(D) = \alpha$ and $\hat{\alpha}(C) < \overline{\alpha_I}$, for $\alpha < \overline{\alpha_U}$ and $\alpha > \overline{\alpha_U}$ both types receive B.
(DD,NN) with $\hat{\alpha}(D) = \alpha$ and $\hat{\alpha}(C) > \overline{\alpha_I}$, for $\alpha < \overline{\alpha_U}$ and $\alpha > \overline{\alpha_U}$ both types receive B.

To find the Perfect Bayesian Equilibria for those equilibria we need consisting beliefs for the strategy profiles of Iran. Again we use Bayes rule to calculate those beliefs.

First we look at equilibrium (CC,NA), and we apply Bayes rule for $\hat{\alpha}(C)$ we find that $\Pr(NW|CC) = \alpha$. This belief is consistent with Iran's beliefs from table 2. If we look at the consistent beliefs for $\hat{\alpha}(D)$ we see that this is off-path, which is also given in table 2. But the belief about $\hat{\alpha}(D)$ has to be consistent with an attack from Iran if Israel denies to have nuclear weapons. This means that the payoffs for Iran must be equal or better from 'attack' than 'no attack' if Israel denies to have nuclear weapons. This leads to a consistent belief of $\Pr(NW|DD) \leq \frac{1}{1-E}$. As we concluded earlier, $\overline{\alpha_I} = \frac{1}{1-E}$, so the $\Pr(NW|DD) \leq \overline{\alpha_I}$. In this equilibrium Israel claims to have nuclear weapons, so the beliefs of the U.S. about the probability that Israel has nuclear weapons is important, if $\alpha > \overline{\alpha_U}$ the U.S. will reduce their support, as stated in proposition 4, if $\alpha < \overline{\alpha_U}$ the U.S. will still fully support Israel, as stated in proposition 3.

The first PBE partly satisfies IC, if $\alpha < \overline{\alpha_U}$ Israel has their maximum payoff that they can get and there is no reason to deviate, however, if $\alpha > \overline{\alpha_U}$ both types of Israel could get higher payoffs if they would deny to have nuclear weapons, because then they would get full

support from the U.S. If both types would deny to get a higher payoff then both types could convince Iran that if they deviate from the strategy that the probability of having nuclear weapons is still α because both types would deviate. In that case it is still better for Iran to choose 'no attack' over 'attack'.

The payoffs in this equilibrium, if Israel has nuclear weapons and $\alpha < \overline{\alpha_U}$, are for Israel, Iran and the U.S. respectively B, 0 and $(-S_1 - W - N)$. If $\alpha > \overline{\alpha_U}$ the payoffs are βB, 0 and $(-S_1 - W - N)$. If Israel has no nuclear weapons and $\alpha < \overline{\alpha_U}$, the payoffs are B, 0 and S_2. If $\alpha > \overline{\alpha_U}$ the payoffs are βB, 0 and S_2.

For the second equilibrium (DD,AN) we follow the same steps as the first. The consistent belief for $\hat{\alpha}(D)$ is $\Pr(NW|DD) = \alpha$, while $\hat{\alpha}(C)$ is off-path again. Now Iran would attack after a claim from Israel, so $\Pr(NW|CC) \leq \overline{\alpha_I}$. In both states Israel receives full support from the U.S. because they deny to have nuclear weapons. This equilibrium satisfies IC, because Israel has no intention to deviate, they have the highest possible payoffs.

The payoffs in this equilibrium, if Israel has nuclear weapons, are for Israel, Iran and the U.S. respectively B, 0 and S_2. If Israel has no nuclear weapons the payoffs are B, 0 and S_2.

The third equilibrium (DD,NN) is almost the same as the second equilibrium. The consistent beliefs for $\hat{\alpha}(D)$ is again $\Pr(NW|DD) = \alpha$. $\hat{\alpha}(C)$ is off-path again, but the beliefs of Iran after a claim is different, because they choose not to attack. The beliefs are now $\Pr(NW|CC) \geq \overline{\alpha_I}$. Also in this case both types of Israel receive full support of the U.S. This equilibrium also satisfies IC because Israel has their highest possible payoffs.

The payoffs in this equilibrium, if Israel has nuclear weapons, are for Israel, Iran and the U.S. respectively B, 0 and S_2. If Israel has no nuclear weapons the payoffs are B, 0 and S_2.

Unreasonably low E values

In the cases that are calculated the assumption that $E < -1$ is used, which gave the equilibria that are found. While it is very reasonable for Iran that the payoff in absolute terms for a war with nuclear weapons is higher than the payoff for destroying Israel, it is important to look what will happen if Iran has an unreasonable high payoff of the destruction of Israel, or an unreasonable low payoff for war with nuclear weapons. In both cases the E will be lower in absolute terms, because the value for destroying Israel is

normalized to 1. Because Iran is the arch enemy of Israel it could be that they would have a higher payoff than reasonable, for Israel it is important to take such possibilities into account, because it is about the survival of the nation. So the question is what would happen if E takes a value between 0 and -1? This could lead to different equilibria, dependent on α. As we can see in figure 1, it depends on where Iran will end up, on the X or Y-side. So this question can be answered with the side that Iran will end up, based on the sides the conclusions of case 1 or case 2 can be drawn. If Iran ends up on the Y-side the conclusion of case 1 is applicable, while when they end up on the X-side the conclusion of case 2 is applicable.

The point of indifference is where $\alpha + (1-\alpha)E = 0$, which leads to $\alpha = \frac{1}{1-E}$, the line in figure 1 shows the graph of α. So for each E value we can calculate the α where Iran is indifferent, which is important for Israel's case, because if the α is higher they avoid a war, because Iran will end up on the X-side.

E	$\overline{\alpha_I}$
-1,00	0,50
-0,75	0,57
-0,50	0,67
-0,25	0,80

Table 8 – Points of indifference

Table 8 give the α value for some E values. The interpretation is quite straight forward, when Iran values, in absolute terms, the destruction of Israel the same as a war with nuclear weapons than Iran would be indifferent if α is a half. So for each E value if the real α is higher than the α in table 8 the equilibria will be the same as case 2: (CC,NA), (DD,AN) and (DD,NN). In this case there will be no attack, so for Israel this is the most favourable case. If for each E value the real α is lower than the α in table 8 the equilibrium of case 1 will be the equilibrium: (DD,AA). In this case a war is the only option, so for Israel this is very unfavourable. A last remark about this table is that if we look at α, we can conclude that if $\alpha = 0.8$ there will be no attack as long Iran does not value the destruction of Israel higher than four times the negative outcome of a war with nuclear weapons.

4.3 Conclusions from model 1

From the cases that are treated we can conclude that for Israel it is better to have a higher α, dependent on the value of E. E is private information of Iran, so Israel does not know which value it has. To be more sure that Iran will not attack a high α is needed for Israel. Because Iran is a known enemy of Israel, Israel could believe that Iran has unreasonable payoffs, which lead to the case that Israel would want that Iran has a very high belief about

whether Israel has nuclear weapons. Israel wants to be as sure as possible to avoid a war with Iran.

Despite that fact, Israel will not just claim to have nuclear weapons to get Iran believe that they actually have nuclear weapons, they will handle in a strategic way to give Iran no information but let them believe that they have nuclear weapons. A reasons why Israel will not just claim to have nuclear weapons is that they will face consequences from the U.S. Due to the payoffs Israel will never reveal their true state in both states, it could be that they are telling the truth, but Iran cannot be sure. Israel will always let their words be questionable, the message that they will send are, despite the state that they are in, always the same. In all equilibria their messages are uninformative for Iran, and for the outside world.

4.4 Israel's strategy

The prior belief of Iran about the possession of nuclear weapons is very important for Israel, as is explained before. Israel cannot choose this belief of Iran, but maybe there is a way to influence this belief to improve Israel's position in the game. Israel could send information about nuclear weapons which indicates their possible possession. Israel could send some of this information irrespectively whether they possess nuclear weapons actually. Those messages could be costly, as the construction of a Nuclear Research Center.

Various actions of Israel can be seen in light of this point, an action as not accepting the NPT agreement can give a suggestion that Israel could use nuclear energy for non-peaceful uses. The build of the Negev Nuclear Research Center near to Dimona could also point toward the development of nuclear weapons. But also the quote from Ernst David Bergman, first chairman of the Israel Atomic Energy Commission, can be interpreted in different ways. He said: "There is no distinction between nuclear energy for peaceful purposes or warlike ones" (Leibowitz, 2008). Also the resignation of the head of the Development Authority in the Israeli Ministry of Defense, Dan Tolkovsky, which might have been related to his opposition to Peres's attempt to obtain nuclear weapons, can be a message. Also the agreements involved heavy water, exchange of information on uranium chemistry and other necessities for nuclear weapons are messages which make the probability of having nuclear weapons higher. (Cohen, 1998)

Such actions can give the idea that Israel has nuclear weapons, the probability about their possession will be higher due to those actions. Which makes the probability of a war

smaller, because when α will be higher for Iran the probability that they want a war will be lower.

In reality we can see this happen, the world's belief about whether Israel possesses nuclear weapons is quite high, Iran's belief will be the same as the world's belief. It does not have to be the same, but it is high. The fact that Israel is one of the non-NPT countries which allegedly has nuclear weapons strengthens this belief.

On the other hand, Israel keeps denying to have nuclear weapons. Israel also tried to hide it from the U.S. for as long as possible, their secrecy, deception and Bergmann's confusing references misled the U.S., which was a reason that the U.S. started around 1960 with deeper investigation instead of 1958 when there were facts that could have alerted the atomic energy intelligence community. This was done to maintain the full support of the U.S. The U.S. later threatened that they would stop or reduce support if they could not inspect Dimona, which eventually lead to visits between 1964 and 1967. After those inspections there are born theories that Israel fooled the inspectors. After the investigations the U.S. concluded that there were no weapons, however investigators believed that they could not investigate properly. The U.S. wanted to reassure Nasser, the former president of Egypt who was concerned about Dimona, that there were no weapons. Eshkol, the former premier of Israel, asked the U.S. not to give them information about the results of the investigation because Nasser constantly threatens to attack, and he thought that it would be good for Nasser to worry about Israel's military capabilities. (Cohen, 1998)

The fact that Israel does not want to get messages into the world that confirm that they do not have nuclear weapons says something about their wish to hold a high probability. Seen the history of Israel it seems that they want a high probability of having nuclear weapons, but on the same time they want no one to be sure and they keep denying to have nuclear weapons.

The combination of a high probability and the denial is explained by this model, the behaviour of Israel is rational and can be explained by applying game theory. Also in reality this behaviour is seen and it seems like an equilibrium.

Sustainable

How this situation is sustainable is a serious question. How could Israel keep denying to have nuclear weapons while the prior probability of Israel having nuclear weapons is very high? It

seems that Israel can get away with this situation, Israel still gets a lot of support from the U.S. and does not get invaded by Iran because of a high prior belief about possession. It seems logical that the high probability of their possession should lead to something. In 2015 a resolution of Egypt, for inspection of the nuclear reactor in Dimona, is voted down by the International Atomic Energy Agency's General Conference, with 61-43 (Keinon, 2015)[5]. In past years Israel has defeated similar measures. So in some way it is sustainable how Israel behaves around their possible possession with nuclear weapons, but how is this total picture sustainable? The sustainability of this case will be handled in the next chapter where the model is changed in a model with two audiences, Iran and the U.S. On the background other countries of the U.N. play a role.

Iran's options

What kind of options does Iran have to reach their goal to end a Jewish state without getting destroyed? First of all Iran could pressure more for inspections of Dimona to gain more information about the true state of Israel, when Iran has more information they can made a better informed choice. If they would be sure that Israel has no nuclear weapons they could be more offensive towards them. But if they would find out that Israel has nuclear weapons they cannot reach their goal to end the Jewish state. A second option is to build nuclear weapons themselves, to shaken up the balance. Israel would not be the only one who could use nuclear weapons in a war, which could make the outcomes different because of the values of A, $A + D$ and E would be different. In that case they could hurt Israel more or can be more offensive towards Israel without real retaliation from Israel because of the threat of Iran's nuclear arsenal. This option is a dangerous option because Israel would try to prevent that Iran would get nuclear weapons, just as Israel did in Iraq and Syria in 1981 and 2007 (Waltz, 2012). An option for Iran to hurt Israel is to support Israel's enemies to attack or bomb Israel. In this way they can hurt Israel without retaliation if they can keep the support secret.

[5] In light of this model such resolution can be a way to collect more information about α, Iran is not the only enemy of Israel, maybe other enemies and Iran want to get more information about the probability so they can make more informed decisions.

5. Theoretical model with two audiences

The second model is the model of Farrell and Gibbons, it is a model with one sender who can make a statement in private or in public and two receivers who hear the message from the sender and have to act with the given information. This model will be used to see whether Israel can reveal truthfully their state to the U.S. or Iran in private or in public. The model that is used in this research is slightly different than the one in the paper of Farrell and Gibbons. In the paper of Farrell and Gibbons the payoffs for the receivers are the same in public and in private, but in this research the payoffs for the U.S. will be different if the private information of Israel is privately to the U.S. or publicly revealed. Besides that there are some differences in the timeline and possibilities of speaking for Israel.

Application and adjustments

In this model Israel has more options than in the first model, Israel can choose to speak in public or in private. Israel has to send a message to Iran and the U.S., they can choose to reveal their true state in public or in private, but they can also choose a pooling strategy in public, in that case Israel will give no information in their statement. Israel can choose to reveal their true state in private to one of the parties in combination with a pooling strategy in private to the other party, in that case both parties receive a message.[6]

The application of this model in the situation of Iran and Israel is straight forward, it is quite the same as the original model. For Iran it is dependable of the true state whether they want to attack or not. The payoffs and actions stay the same as in the first model for Iran. The case of Israel with Iran is a little bit different than in the first model, Israel now can choose to speak in private or public to Iran. The payoffs of Israel are also partly due to Iran, the costs of war and the benefits of the use of nuclear weapons are bound to the actions of Iran ($A\ and\ D$).

This model is mainly used to investigate the case between the U.S. and Israel. We look at the relationship between Israel and the U.S. and the payoffs of the U.S. that depend on the choices that Israel make. We investigate how the U.S. will react on Israel's messages and whether they will be a reliable ally for Israel. We use this to see whether Israel trusts the U.S. and whether they will reveal their true state to the U.S.

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[6] Game Trees can be found in Appendix 2

For the situation of the U.S. we need to adjust the model of Farrell and Gibbons, in the original model there was no difference in payoffs for a receiving party in public or in private, however in this research Israel's revelation in public or in private will lead to different payoffs of the U.S. Besides those options there is also an option that Israel uses a pooling strategy in public and does not speak in private. Those three options all have different effects on the payoffs of the U.S.

The actions of Israel now determine in which stage the U.S. and Israel end up. If Israel speaks in public the truth about their state they end up in the case that it is public knowledge what Israel's true state is and what the U.S. do about it. The U.S. has two actions in that case, they can take position or do nothing. Taking position when Israel has nuclear weapons means that they will punish Israel for having nuclear weapons, which leads to a reduction in support. If the U.S. takes position when Israel has no nuclear weapons, it means that the U.S. will backup Israel, they will be partners in the Middle-East and Israel could use the U.S., and their nuclear arsenal, as threat against Iran. Those two options are also the options of the U.S. in private, but in that case the whole world does not know about the actions they take. When Israel decides not to give any information, and uses the pooling strategy, the U.S. can choose to pressure Israel in telling the truth, or do nothing. If the U.S. chooses to pressure Israel, Israel could choose to reveal their true state in the third period.

Letter	Meaning	Neg/Pos
A (attack)	Attack from Iran	-
B (backup)	Support and backup of the U.S.	+
D (demolition)	Less demolision from use of NW	+
F (foreign NW)	Foreign backup of nuclear weapons (U.S.)	+
R1 (relationship)	Pressure on relationship with U.S.	-
R2 (relationship)	U.S. as reliable ally	+

Table 9 – Meaning of variables of Israel

The payoffs of Israel from the actions of the U.S. are not very different from the first model. The payoffs from the support of the U.S. stay the same, if the U.S. punish Israel the payoff is $(1-\beta)B$, otherwise just B. The new payoffs are due to the positioning of the U.S., if the U.S., in public or in private, take position when Israel has nuclear weapons there will be pressure on Israel's relationship with the U.S. (R_1), while when they take position if Israel has no nuclear weapons the payoff will be R_2, which is the backup of the threat of the nuclear weapons of the U.S. to Israel. Also when the U.S. decides to do nothing, when Israel possesses nuclear weapons it is a sign that the U.S. is a reliable ally for Israel (R_2), this is in both cases, public or private. When the U.S. does nothing when Israel has no nuclear

weapons there is no extra payoff. In case of a pooling strategy from Israel and the U.S. pressure Israel to tell the truth the relationship is also under pressure, which also leads to the payoff of R_1.

The payoffs of the U.S. are different in each situation that they get in. This is due to the sensibility of the information that Israel is giving and the choices that the U.S. has to make with that information. The first payoff that matters for the U.S. is about their influence in the Middle-East. Their influence can be with Israel and with the Arab world, I_1 is the

Letter	Meaning	Neg/Pos
I1 (influence)	Influence Middle-East from choosing against Israel or Arab world	-
I2 (influence)	Influence Middle-East from choosing Israel's side	+
I	I1+I2	+
L (loss of face)	Loss of Face for investigation, NPT agreement, when they do nothing	-
L'(loss of face)	Loss of Face for investigation, NPT agreement, when they act, but too late	-
P (politics)	Domestic politics (pressure or support from AIPAC)	+
S1 (stability)	Stability Middle-East, public knowledge nuclear weapons	-
S2 (stability)	Stability Middle-East, public knowledge no nuclear weapons	+
S3 (stability)	Stability Middle-East, nuclear opacity with a strong democratic country	+
U (U.N.)	Relationship U.N. if the U.S. does not take action against nuclear powers	-
W (world stability)	Stability in world if U.S. would back up with nuclear weapons in public	-
X	Relationship Israel if unfairly punished	-

Table 10 – Meaning of variables of the U.S.

negative payoff of choosing a side, this could be against Israel or against the Arab world. The U.S. chooses against Israel if they punish them for having nuclear weapons, and they are choosing against the Arab world when they do nothing against Israel having nuclear weapons, this only happens in public, because otherwise the Arab world will not know anything about it. Choosing against Israel can happen in each stage. The influence of the U.S. in the Middle East can also be positive, when they choose Israel's side they gain more influence with Israel due to more trust of Israel in the alliance with the U.S. When the U.S. choose in public for Israel their payoff will be $I = I_1 + I_2$, because both cases are true. This is a positive payoff due to assumption 5, which is explained below.

The second payoffs of the U.S. are about the loss of face that they will have when Israel seems to have nuclear weapons. This is partly due to the investigation of Dimona that they have done, which concluded that Israel did not have nuclear weapons. If it is public knowledge that Israel has nuclear weapons the investigation can be questioned, or the U.S. did a bad investigation, or Israel had the investigators fooled, both are not good for the reputation of the U.S. On the other side, also the NPT agreement will be damaged, because

that was the U.S.'s policy and Israel could develop nuclear weapons in those times. (Cohen, 1998)

The payoffs will differ depending on what the U.S. do about Israel's claim to have nuclear weapons, if they act and punish Israel they save something of their reputation (L'), but if they do nothing their reputation will be damaged more(L). So in definition $|L| > |L'|$.

For the U.S. also the domestic politics are important, AIPAC is an important lobby group who with the mission: "To strengthen, protect and promote the U.S.-Israel relationship in ways that enhance the security of the United States and Israel" (AIPAC, W.D.). An important focus point of AIPAC is education the U.S. about the danger of Iran. AIPAC has an influence on the politics in the U.S., if the U.S. chooses against Israel they will pressure to make it undone, and if the U.S. chooses for Israel they will support that choice, the payoff P is a positive parameter and can be used positively and negatively, dependable on the action of the U.S. Because AIPAC has of course ties to political workers their payoff is in public and in private, they will also know in private if the U.S. punish Israel. After a pooling action of Israel, AIPAC will also act after pressure of the U.S. against Israel, while it will not act if the U.S. do nothing.

Another important payoff for the U.S. is the stability in the Middle-East, the U.S. often feels responsible for peace around the world. The Middle-East is a region where there is often war or irregularities. The payoffs for the U.S. for peace are divided in three ways, there is a negative payoff for public knowledge that there are nuclear weapons in Israel (S_1), there is a positive payoff for public knowledge that there are no nuclear weapons (S_2), and there is a positive payoff for the U.S. in case that there is nuclear opacity, combined with a strong democratic country, Israel, in the Middle-East, which can defend itself (S_3). The first two payoffs can only occur in public, while the third payoff can only occur in the private situation between the U.S. and Israel. In case when the U.S. supports Israel when they have no nuclear weapons with backup from their arsenal the payoff is sS_3, with $s < 1$, because Israel is less strong than when they own nuclear weapons. If Israel has nuclear weapons and the U.S. will reduce support the payoff is $(1 - t)S_3$, with $t < 1$, because Israel is somewhat weaker due to less support. Those payoffs do not occur in the pooling equilibria. When the U.S. choose to backup Israel with nuclear weapons in public there is also a negative effect on the stability in the world, because the use of nuclear weapons, or the threat of this, will affect the stability that there is now in the world around nuclear weapons(W).

The relationship with the U.N., or the position of the U.S. in it, is damaged if the U.S. do not act against Israel if they have nuclear weapons. The U.S. has to take action if there is a country that has nuclear weapons, irrespectively which country it is. The negative payoff of this case is U.

The last payoff of the U.S. will only occur if Israel uses a pooling strategy. It is when the U.S. unfairly punishes Israel, this is the case that they pressure but Israel has no nuclear weapons, but tries to keep Iran in doubt. X stands for the damage that this decision that this action will do to the relationship with Israel.

Timeline of actions

The timeline is quite the same as the timeline of the first model, only there are more options to choose from for Israel and the U.S.

Period zero stays exactly the same as in the first model, nature decides whether Israel has nuclear weapons, and this is private information for Israel. Iran and the U.S. only have a prior belief about whether Israel has nuclear weapons.

In the first period Israel can act again, but now their possibilities are broader. Israel can reveal or not reveal their true state in public or in private. If Israel wants to not reveal their true state in public, they choose to play a pooling strategy, which means that the message that they send contains no information. In private Israel can choose to reveal their true state towards one or both parties, besides revealing Israel can play a pooling strategy with both parties in private. Israel will always send a message to both parties, so if Israel reveals their true state to one party, it means that they use a pooling strategy towards the other party. After this period Iran and the U.S. can adapt their beliefs about whether Israel has nuclear weapons. They could both have private or public information from Israel's statement.

In the second period Iran and the U.S. can act. For Iran the same is true as in the first model, the only difference is that Iran can get a message in different ways, via a public or private channel. The situation of the U.S. did change more. Depending on the strategy of Israel the U.S. will end up in a particular platform, the public or private platform where Israel revealed their true state or the public or private pooling platform. If the U.S. end up in the public or private platform where Israel revealed its true state, the U.S. choose to take position or do nothing, after their action everyone gets their payoff and the game is finished.

If however Israel chooses not to reveal their true state there are other options, the U.S. could pressure Israel in telling the truth or they can do nothing. If the U.S. do nothing, it is the end of the game and everyone gets their payoff, but if the U.S. decide to pressure Israel there will be a third period.

In the third period, if the U.S. pressured Israel, Israel has the option to reveal their true state in public, in private to the U.S. or not at all. If Israel chooses to reveal it not at all, it is the end of the game, and after a revelation of Israel state in public or in private the U.S. has to act again, they can take position or do nothing. After that the game is ended and everyone gets their payoffs.

Assumptions

We made a few assumptions to work with this model.

Assumption 5: $I_1 + I_2 > 0$

The U.S. will have more influence for choosing for Israel than the negative influence of choosing against the Arab world. This because Israel is a well-known ally, who is Western focussed, a democracy and a more stable country than the Arab countries. The U.S. has more benefits for their influence by a good relationship with Israel than a worse relationship with the Arab world.

Assumption 6: $|S_1| > |S_2|$

The negative payoff of the public knowledge that Israel has nuclear weapons is higher than the positive payoff of public knowledge that Israel had no nuclear weapons. This is because the second part, the knowledge of no nuclear weapons, is doubtful, because Israel would look weak and there would be a chance of an attack on Israel, which would not lead to stability in the Middle-East.

Assumption 7: $|A + D| > |-B + G|$

This assumption builds further on assumption 2, now the assumption is slightly stronger. A war with nuclear weapons is less favourable than no support of the U.S. pressure on the relationship with the U.S. This means that Israel would avoid a war, also if it would mean that they do not get any support anymore from the U.S. and if it means that the relationship between them and the U.S. will be under pressure. This is because a war with Iran will endanger the existence of Israel, and maybe cause a bigger war with more Arab countries.

Assumption 8: $R > F$ if Israel has nuclear weapons, while $F > R$ if Israel has no nuclear weapons.

This assumption suggests that the U.S. as a reliable ally, who knows the truth, is better for Israel than the backup with nuclear weapons if Israel has already nuclear weapons, because Israel would not need backup with nuclear weapons in that case. In case Israel has no nuclear weapons they would prefer backup with nuclear weapons over the payoff of a reliable ally, because due to the backup the U.S. seems to be a reliable ally. So the payoffs where the U.S. can support Israel in the state that Israel is, is the best for Israel.

6. Analysis of the Game with Two Audiences

This model will be used to find a sustainable equilibrium for Israel, which can explain the situation for Israel and the U.S. The equilibria of the previous model suggest that Israel never reveal any information in public because it could lead to a war or a punishment by the U.S. There is an equilibrium where both types of Israel claim to have nuclear weapons, but there are more equilibria where both types deny to have nuclear weapons. In reality Israel denies to have nuclear weapons and there is no 100 percent knowledge about whether Israel actually has nuclear weapons. In this model there will be looked at why nowadays there is not much pressure towards Israel to reveal their true state. In the past the U.S. has pressured Israel to sign the NPT agreement which would let to disclosure about whether they are a nuclear weapon state (Cohen, 1998). This model also gives some information about why the public attitude of the U.S. can change.

6.1 Strategies of the Players

To find equilibria in this model backward induction is used. First the strategy of Iran will be shortly looked at, the strategy of Iran is the same as in the first model, and their payoffs did not change. The difference with the first model is that there is now a difference between private and public for Israel, in private Israel will only take the payoffs with Iran into account, while Israel will take into account all payoffs, from the U.S. and Iran, in public. When the strategy of Iran is reviewed we will review the strategy of the U.S., we will look at how they will respond in public, in private and in a pooling equilibrium. For the U.S. those cases will give them different payoffs, so each case will be reviewed. After the strategies of the U.S. we will look at Israel's strategy, how they will act with the strategies of the U.S. and Iran in mind. At last the outcomes for all parties will be given for the equilibria.

Because the case of Israel is reviewed where in reality the probability of having nuclear weapons is high, we use a high probability in this case. We are looking to explain the sustainability of the case where Israel has a high probability. We assume that the α would be at least 0.7.

6.1.1 Strategy Iran

Table 11 shows the payoffs of Iran, they are the same as in the first model. If Israel reveals their state to Iran, they will not attack when Israel has

Iran's Payoffs		True State	
		NW	NNW
Iran's Action	no attack	0	0
	attack	E	1

Table 2 - Iran's payoffs

nuclear weapons, and they will attack when Israel has no nuclear weapons, because $0 > E$ and $1 > 0$. If Israel has a pooling strategy Iran will have the same consideration as in the first model, they will use their prior beliefs to choose which action will give the highest payoff. As explained in the first model the best response is dependable from the E value and the belief of Iran. In this model the α is at least 0.7, which means with assumption 3, $E < -1$, that Iran will end up on the X-side of figure 1 and has a better payoff if they would not attack, because $\alpha * E + (1-\alpha) * 1 < \alpha * 0 + (1-\alpha) * 0$ with $E < -1$ and $\alpha > 0.7$. So Iran's best response on a pooling strategy is their pooling action 'no attack', which is the same in case 2 in chapter 4.

Iran will behave the same in private as in public, it does not matter whether Israel would tell the truth in private or in public for Iran. The pooling signal of Israel means that Israel is not revealing their true state to Iran, in public or private. Israel would not talk in private with Iran, and Israel would give no information in public.

Signal Israel	***Best Responses Iran***
NW	*No attack*
NNW	*Attack*
Pooling	*No attack*

Proposition 8: *Iran's best response strategy is:*

6.1.2 Strategy Israel private with Iran

In table 12 the payoffs of Israel are shown, it is obvious that they prefer no attack in both cases. A is negative and $A + D < 0$, because the payoffs of war will never be positive.

Israel's Payoffs with Iran		True State	
		NW	NNW
Iran's Action	no attack	0	0
	attack	A+D	A

Table 3 - Israels payoffs with Iran

To check whether there is a private separating equilibrium, we use backward induction. If Israel has a separating strategy, Iran will not attack when the true state is that Israel has nuclear weapons, and Iran will attack when the true state is that Israel has no nuclear weapons. Using the rules for the existence of a separating equilibrium we see that $U(NW, \text{"s=NW"}) \geq U(NW, \text{"s=NNW"})$ and $U(NNW, \text{"s=NNW"}) \geq U(NNW, \text{"s=NW"})$ must be true. The first part is true, if Israel has nuclear weapons, they will can tell that in private to Iran and Iran will not attack. However, the second part is not true, if Israel has no nuclear weapons, in private with Iran they rather claim to have nuclear weapons, so Iran will not attack. This means that there is no separating equilibrium in private with Iran.

Therefore Israel will have a pooling strategy, which means that their claim or denial will contain no information for Iran. Iran will have to decide which action they will do based on their prior beliefs about Israel having nuclear weapons, this leads to no attack from Iran.

Proposition 9: *In private Israel's best reply is always a pooling strategy towards Iran.*

6.1.3 Strategy U.S. Public revelation

U.S.'s Payoffs in Public		True State	
		NW	NNW
U.S.'s Action	Take position	βB+I1+L'-P+S1	I+P+S2+W
	Do nothing	I+L+P+S1+U	S2

Table 4 - U.S.'s payoffs in public

In table 13 the payoffs of the U.S. are given, the U.S. only can get those payoffs if Israel uses a separating strategy to speak in public. If Israel gives a public statement about their true state, the whole world will know and watch to the U.S. what their reaction will be. If Israel chooses not to use a separating strategy in public the U.S. will not get in this position to make an action in public. So if Israel uses a pooling strategy, or speaks to the U.S. in private, this table will not be used, but tables 14 and 15.

So to check what the best response for the U.S. is, if Israel reveals that their true state is that they have nuclear weapons, the payoffs have to be explained. First the payoffs of taking position will be explained, the U.S. saves a part of their support to Israel, this has a positive effect on their payoffs (βB). It however has a negative payoff on their influence in the Middle-East, because they choose against Israel (I_1). Also the U.S.'s reputation will be damaged, due to the investigation which will seem a farce, and it will damage the NPT agreement, but because the U.S. intervene now the damage is less in comparison with when they do nothing (L'). In the domestic politics the U.S. will have some problems with AIPAC, which is also a negative payoff for the U.S. ($-P$). And last, but not least, the stability in the Middle-East will be damaged, because it is publicly know that Israel has nuclear weapons. The states around Israel would want to intervene and the tempers can rise (S_1). Altogether, this is not a pleasant payoff for the U.S.

On the other hand, the payoffs when the U.S. do nothing are also not preferable. Their influence will have a slightly positive influence, see assumption 5, because they choose against the Arab world, but for Israel (I). Their reputation however will be more damaged than in case of taking position, because now they do not intervene after their mistakes and even 'support' Israel's possession, which also leads to grave damage to the NPT agreement (L). In this case, because the U.S. chooses for Israel, they will have a positive payoff from

AIPAC whom will now support the government more($+P$). Again the payoff for the stability in the Middle-East is the same (S_1). And at last the relationship between the U.S. and the U.N. will be damaged because the U.S. do not intervene and follow the rules regarding nuclear weapons (U).

Both payoffs for the U.S. if Israel reveals in public that they have nuclear weapons are not good for the U.S. When we compare the payoffs we can neglect the stability in the Middle-East, because it is in both payoffs (S_1). Furthermore we know that $I > I_1$, $L' > L$ and $P > -P$. This means that when the U.S. takes position their influence in the Middle-East is lower, their reputation is damaged less and the domestic politics is under more pressure than when they do nothing. Besides those facts when the U.S. takes position they save their support (βB) and their relationship with the U.N. is not damaged (U). U.S.'s action depends on how heavy those separate payoffs weigh on the total payoffs. It could go either way.

The best response for the U.S. if Israel has no nuclear weapons is more straight forward. The payoffs for taking position consist from the influence on the Middle-East from choosing Israel's side (I), the support from AIPAC in domestic politics ($+P$), stability in the Middle-East because it is publicly known that Israel has no nuclear weapons (S_2), and at last the negative payoffs of stability in the world because the U.S. decide to threaten with their nuclear weapons, which could be very negative (W). On the other side, if the U.S. do nothing, their payoffs consist only from the positive payoffs of the stability of the public knowledge that Israel has no nuclear weapons (S_2).

Because the U.S. cannot risk the stability of the world for Israel they would not backup Israel with their nuclear weapons. The negative payoffs which their backup could let happen exceeds are tremendous and exceed the positive payoffs that they would have in that case, $-W > I + P$. So their best response when Israel publicly reveals that they have no nuclear weapons is to do nothing.

Proposition 10: *In public the U.S.'s best response strategy is:*

Signal Israel	***Best Responses U.S. public***
NW	*Take position/Do nothing*
NNW	*Do nothing*

6.1.4 Strategy U.S. Private revelation

The payoffs when Israel reveals their true state in private to the U.S. are given in table 14. In this case the world would not know anything more about whether Israel has nuclear weapons. So when Israel talks in private, Iran will not know anything more about their true

state. In that case Iran will make their decision based on their prior beliefs. For the U.S. it would be better if Israel talks in private to them, because in that case the whole world is not watching at them to take an action. The differences between the payoffs of the U.S. in private and public have to do with the fact that the U.S. do not have to act in public and that there will be no public information about whether Israel has nuclear weapons.

U.S.'s Payoffs in Private		True State	
		NW	NNW
U.S.'s Action	Take position	βB+I1-P+(1-t)S3	I2+P+sS3
	Do nothing	I2+P+S3	0

Table 5 - U.S.'s payoffs in private

So when Israel has nuclear weapons and reveals that to the U.S. in private the U.S. can choose to take position against them by punishing them with less support. That payoff is the same as in public (βB). In that case it is a decision which is against Israel, which leads to less influence in the Middle-East, which is also the same as in public (I_1). In this case the reputation of the U.S. will not be damaged, because the rest of the world does not know about the nuclear weapons of Israel. AIPAC will know about the measures that the U.S. have taken, because they are a domestic organisation with a lot of political information channels, so they will again pressure the government of the U.S. ($-P$). The negative payoff for stability in the Middle-East is not present, because now it is not publicly known that Israel has nuclear weapons, which results in no difference in the stability. There is however a positive payoff for stability in the Middle-East, the fact that it remains unknown whether Israel has nuclear weapons and that they are a strong democratic country in the Middle-East. Due to the reduction in support from the U.S. this payoff will not reach its full potential ($(1-t)S_3$).

If the U.S. do nothing against the fact that Israel has nuclear weapons, their influence in the Middle-East will be improved, and because the Arab world will not know their position, their relationship will not be deteriorated. So the negative part of the payoffs from influence in the Middle-East will be gone, so the payoff will only be the positive part of influence through Israel (I_2). The reputation of the U.S. will again not be damaged because it happens in private. AIPAC will now know about the support of the U.S. for Israel and support the government (P). From the view of some leaders in the U.S. the stability in the Middle-East is now up to its full potential, because Israel is a strong democratic country in the Middle-East, but there is no agitation about nuclear weapons (S_3). The last difference between the public and private payoff for the U.S. is that their relationship with the U.N. will not be damaged.

The payoffs in private are far more favourable for the U.S. than the payoffs in public. To check which action would be the best response for the U.S. the payoffs will be compared. We see that in terms of influence in the Middle-East doing nothing is better, on both sides, with taking position the U.S. has a negative payoff with Israel, while with doing nothing they have a positive payoff. Also on the area of domestic politics the U.S. has double gain from choosing to do nothing. And for the stability in the region doing nothing will also gain a higher payoff for the U.S., because Israel now is stronger with their support. Those three positive sides from doing nothing will weigh up against the less costs that the U.S. will have from reducing the support, which is supported by the fact that the U.S. chooses to support Israel in the first place for influence, domestic political reasons and stability in the region. The best response for the U.S. will be doing nothing if Israel has nuclear weapons and reveals it in private to the U.S.

When Israel has no nuclear weapons the U.S. can again take position of do nothing, taking position is a bit different than in public, because in that case the U.S. in public announce that the stand behind Israel with their nuclear weapons. In this case Israel knows that they can rely on the U.S.'s arsenal, because they have the promise that if Iran attacks they could use the threat of the weapons or the weapons themselves. If the U.S. chooses to take position and backup Israel it will have a positive effect on their influence in the Middle East (I_2). In the domestic politics the government will have the support of AIPAC (P), and in the Middle-East there is a stability because it is unknown whether there are nuclear weapons, and Israel is a relatively strong Israel in the area (sS_3). When they do nothing the payoffs for the U.S. is zero.

The best response for the U.S. is now to take position for Israel, this because now there are no negative side effects for the rest of the world. Only Israel knows that the U.S. will back them. And the other payoffs are all positive, so the choice is not that hard for the U.S. There is a downside, because it is only a claim to backup Israel, what will happen if Iran would attack would be quite unclear, because in that case it becomes known in public again.

Proposition 11: *In private the U.S.'s best response strategy is:*

Signal Israel	***Best Responses U.S. private***
NW	*Do nothing*
NNW	*Take position*

6.1.5 Strategies of Israel

The payoffs of Israel with the U.S. are given in table 15, those payoffs are the same in public and private with the U.S. In this model the payoffs for Israel differ slightly from the first model. The difference has to do with the relationship with the U.S. If the U.S. decides to punish Israel because they have nuclear weapons, the relationship between the two countries will be under pressure, which gives a negative payoff for Israel (R_1). If however the U.S. decides to support Israel, when the have nuclear weapons, by doing nothing, Israel has the positive payoffs from the U.S. as a reliable ally (R_2). If Israel has no nuclear weapons and the U.S. will choose to take position for Israel by threaten, or let Israel threaten, with nuclear weapons if necessary, they have the positive payoffs from the backup of the U.S. (F). If Israel has no nuclear weapons and the U.S. do nothing, Israel only has the payoffs of the support of the U.S. (B), which is the same as the first model.

Israel's Payoffs with U.S.		True State	
		NW	NNW
U.S.'s Action	Take position	(1-β)B-R1	B+F
	Do nothing	B+R2	B

Table 15 - Israel's payoffs with the U.S. after revealing their true state

If Israel wants to reach their best payoffs with the U.S. they want the U.S. to do nothing if their true state is NW, and they want the U.S. to take position if their true state is NNW. Israel has three options to choose from with the U.S., they can reveal their true state in public or in private, or they can use a pooling strategy. If Israel speaks in public, Iran would also know the true state of Israel. To see whether a separating equilibrium exist in public or private we use $U(NW, \text{"s=NW"}) \geq U(NW, \text{"s=NNW"})$ and $U(NNW, \text{"s=NNW"}) \geq U(NNW, \text{"s=NW"})$, if both are true there will be a separating equilibrium, if not there will be a pooling equilibrium.

Public with U.S. and Iran

First the public case of Israel will be examined. Israel has to take the payoffs with Iran and with the U.S. into account. With both players the payoffs of Israel are differently obtained, with Iran the true state and the action of Iran determine the payoffs for Israel, while with the U.S. the message of Israel and the action of the U.S. determine the payoffs. This is because the U.S. will treat Israel based on their message, while with Iran the payoffs are based on what is the true state.

So to compare $U(NW, \text{"s=NW"})$ and $U(NW, \text{"s=NNW"})$ we use proposition 6 and 8. Proposition 6 states that Iran will attack Israel after NNW and that they will not attack Israel after NW. So the payoffs of Israel are $-C$ for $s = NW$ and $A - C + D$ for $s = NNW$. Proposition 8 states that the U.S.'s action after NW is undefined, it could be both actions, while after NNW the U.S. chooses 'do nothing'. Israel's payoffs are $(1 - \beta)B - R_1$ or $B + R_2$ for NW, and B for NNW. Using assumption 7 we can conclude that Israel rather does not want an attack weighed against the support and relationship with the U.S., so they would send the message that they have nuclear weapons. So the first part of the equation is true.

For the second part we compare $U(NNW, \text{"s=NNW"})$ and $U(NNW, \text{"s=NW"})$, again the same propositions are used. So the payoffs for Israel with Iran are A for NNW and 0 for NW. With the U.S. Israel has the same payoffs as previous, $(1 - \beta)B - R_1$ or $B + R_2$ for NW, and B for NNW. With the use of assumption 7 we can conclude that Israel again will choose $s = NW$ over $s = NNW$. So the second part of the equation is not true, Israel would choose to lie about their state if they are in state NNW. This means that Israel would not have a public separating equilibrium, and they will use a pooling strategy.

Proposition 12: *In public there is no separating equilibrium, Israel's best reply is always a pooling strategy.*

The optimal outcome for Israel would be that they could let Iran believe that they have nuclear weapons, and that they could let the U.S. believe that they do not have nuclear weapons. Because in that case they would not have a war with Iran, but still have the support from the U.S., including a good relationship with the U.S. This would be true for both types of Israel.

Private with U.S.

Also in this case the message of Israel and the action of the U.S. determine the payoffs for both parties. The payoffs can only occur when Israel would choose to reveal their true state to the U.S. in private. But to let that be true, Israel must have no incentive to deviate from revealing their true state.

In case of Israel having nuclear weapons we need to compare $U(NW, \text{"s=NW"})$ and $U(NW, \text{"s=NNW"})$, furthermore we use proposition 11. Proposition 11 states that the best responses of the U.S. are 'do nothing' if Israel has nuclear weapons and 'take position' when

Israel has no nuclear weapons. So the payoffs for Israel when $s = NW$ is $B + R_2$, while for $s = NNW$ it would be $B + F$. Given assumption 8, $B + R_2$ would be a higher payoff for Israel if they have nuclear weapons, because the action of the U.S. fits better in their state. The first part of the equation is true in that case, because Israel would prefer to send the message that they have nuclear weapons when they have nuclear weapons.

In the other case, where Israel has no nuclear weapons we need to compare $U(NNW, \text{"s=NNW"})$ and $U(NNW, \text{"s=NW"})$, also here we use proposition 11, the best responses are given above. The payoffs for Israel when s=NNW is $B + F$, and for s=NW Israel gets $B + R_2$. Again we use assumption 8 here, which suggest that in this case $B + F$ would be a better fit for Israel and give the highest payoff. So also in this case Israel would prefer to signal their right state towards the U.S. Therefore the second part of the equation is also true, which suggests that there is a separating equilibrium.

Proposition 13: *The equilibrium strategy of Israel in private with the U.S. is revealing their true strategy:*

True state	***Signal Israel***
Nuclear weapons	*"s=NW"*
No nuclear weapons	*"s=NNW"*

Public pooling platforms

When Israel uses a pooling strategy in public it means that there was no separating equilibrium. No player has received some information of Israel regarding their possible possession of nuclear weapons. Israel and the U.S. will automatically get into this payoff scheme if Israel does not reveal anything. When the U.S. and Israel are in this position, it could be that there is an equilibrium, but it could also lead to another equilibrium if Israel decides after this period to reveal their true state to the U.S.

Israel's Payoffs if Pooling		True State	
		NW	NNW
Action	Reveal Private	DN: B+R2	TP: B+F
	Reveal Public	TP: (1-β)B-R1 DN: B+R2	DN: B
	Not Reveal	(1-β)B-R1	(1-β)B-R1

Table 66 - Israel's payoffs in the Public Platforms

To find the best response of the U.S. we first need to know what Israel would do after the pressure of the U.S. in public. Israel could reveal their true state in public, in private or not at all after the pressure. We already know how the U.S. would react on those revelations from proposition 10 and 11. In table 16 the payoffs of Israel are given. When Israel would not reveal their true state at all, the pressure of the U.S. would lead to less support and pressure on the relationship between the two countries.

If we look at the payoffs, we see that both types of Israel would prefer to reveal their true state in private, for Israel with no nuclear weapons this is always the case, while Israel with nuclear weapons would be indifferent between revealing in public or in private if the U.S. would always do nothing after the revelation in public. This however is unknown to Israel, because the U.S. could want to take position after a public revelation. So private revelation would never be worse than public revelation for Israel. Iran cannot deduce new information from this decision of Israel, because both types of Israel would choose to reveal their true state in private.

Proposition 14: *After pressure from the U.S. in public Israel's best response is:*

Best Response Israel (NW)	***Best Response Israel (NNW)***
Reveal true state in private	*Reveal true state in private*

Private pooling platform

This platform is almost the same as the previous one, the only difference is that in this case Israel cannot choose to reveal their state in public. The revelation in private will always dominate not revealing for Israel, so in this case Israel's best response is also to reveal their true state in private. This platform however is an off-path platform, because in private Israel would reveal its true state to the U.S.

Proposition 15: *After pressure from the U.S. in private Israel's best response is:*

Best Response Israel (NW)	***Best Response Israel (NNW)***
Reveal true state in private	*Reveal true state in private*

6.1.6 Strategy U.S. after a Pooling strategy

In table 17 the payoffs are given for the U.S. after a pooling strategy from Israel. Those payoffs are from the private and the public pooling platform. In this case the U.S. obviously do not know what the true state is, but they do know how Israel would behave after they pressure Israel into revealing its true state, Israel's best responses are given in proposition 14 and 15. The U.S. can pressure with reducing their support and setting the relationship under pressure.

U.S.'s Payoffs if Pooling		True State	
		NW	NNW
U.S.'s Action	Pressure	I2+P+S3	I2+P+sS3
	Do nothing	0	0

Table 77 - U.S.'s payoffs after a pooling strategy

As we can see, the payoffs for the U.S. when they pressure Israel are higher than the payoffs from doing nothing. On both platforms, public and private, the U.S. would decide to pressure Israel when Israel does not reveal their true state.

Proposition 16: *After a pooling strategy, in public or in private, the U.S.'s best response strategy is 'Pressure'.*

6.1.7. Public or private

The choice for Israel to speak in public or private depends on the outcome in both cases. We use backward induction to see whether Israel would prefer to speak in public or in private. In public Israel would choose a pooling strategy according to proposition 12. Proposition 8 and 16 suggest that Iran will not attack and the U.S. will pressure Israel. After the pressure Israel would reveal their true state in private according to proposition 14. As we see in proposition 11 the U.S. will do nothing after Israel's revelation if Israel has nuclear weapons and will take position if Israel has no nuclear weapons. Israel with nuclear weapons will have the following payoffs: $B + R_2$. While Israel without nuclear weapons will have $B + F$ as payoffs.

In private Israel would choose to use a pooling strategy towards Iran (proposition 9) and Israel would reveal the true state to the U.S. (proposition 13). After this revelation the U.S. will react with 'do nothing' when Israel has nuclear weapons and with 'take position' when Israel has no nuclear weapons (proposition 11). This will lead to the same payoffs as in public, which means that Israel is indifferent between speaking in public or in private. Both options can happen.

Proposition 17: *In the first period Israel is indifferent between a pooling strategy in public and revealing their true state towards the U.S. in combination with using a pooling strategy towards Iran in private.*

6.2 Equilibria with Two Audiences

There are no equilibria where Iran knows the true state about Israel's nuclear capability, as proposition 9 and 12 establish. The only message that Iran will receive is based on a pooling strategy of Israel, which is corresponding with the first model, where Israel also only had pooling strategies in public. The best response of Iran is given in proposition 8, which states that the best response of Iran is 'no attack' after a pooling strategy, because they would take too much risk due to the high probability that Israel has nuclear weapons. The case between

Iran and Israel stays the same as the cases between Israel and Iran in the first model where Israel had a high probability.

If Israel chooses to use a pooling strategy in public, the U.S. has to choose between pressuring Israel in revealing their true state or doing nothing. As proposition 16 suggests the U.S. would choose always to pressure Israel in revealing their true state.

In the first case is that the U.S. choose to pressure Israel after a pooling strategy and Iran would again not attack Israel. Israel would choose to reveal their true state in the second period to the U.S. in private, as suggested in proposition 14. After that the U.S. use their strategy from proposition 11.

Equilibrium 1: *If Israel chooses to speak in public, Israel will use a pooling strategy, the U.S. 'pressure' Israel, Iran chooses 'no attack'. In the third period Israel reveals their true state to the U.S. in private, after the revelation the U.S. will 'do nothing' if Israel has nuclear weapons and 'take position' if Israel has nuclear weapons.*

Iran will again get a payoff of 0, while the U.S. eventually get a payoff of $I_2 + P + sS_3$ when Israel has no nuclear weapons and $I_2 + P + S_3$ when Israel has nuclear weapons. The payoffs for Israel with the U.S. are $B + F$ when they have no nuclear weapons and $B + R_2$ when they have nuclear weapons. With Iran the payoffs with and without nuclear weapons are both 0. So the total payoffs are with and without nuclear weapons $B + R_2$ and $B + F$. In this case the U.S. and Israel had both negative experiences from the temporary pressure on their relation.

The second equilibrium is when Israel directly chooses to reveal their true state to the U.S. in private, as stated in proposition 13. Israel would use a pooling strategy in private towards Iran, Iran would again not attack. Towards the U.S. Israel would use a separating strategy which will result in a separating equilibrium. The U.S. will again use their strategy from proposition 11.

Equilibrium 2: *If Israel chooses to speak in private, Israel will use a pooling strategy towards Iran, after that Iran chooses 'no attack'. Israel reveals their true state to the U.S., after the revelation the U.S. will 'do nothing' if Israel has no nuclear weapons and 'take position' if Israel has nuclear weapons.*

The payoffs are exactly the same as the first equilibrium, however the pressure of the U.S. towards Israel will not occur in this case.

6.3 Conclusion from a Model with Two Audiences

The situation with Iran stays exactly the same as in the first model, there are no new conclusions that can be drawn from this model. The situation with the U.S. did change, those changes are used to check the sustainability of Israel's situation. The main question that this model is answering is how having a high probability of the possession of nuclear weapons without getting punished is sustainable for Israel.

Because there is a possibility to speak in private to the U.S., it is not necessary for the U.S. to punish Israel anymore. This fact gives Israel a reason to reveal their true state to the U.S., which can make the U.S. a 'partner in crime'.

If we look at the different equilibria we can see that there could be different reasons for the sustainability. It could be that the U.S. do not care enough about the knowledge of Israel's nuclear power, which cause the U.S. not to pressure to know Israel's true state. Another reason could be that the U.S. do care about the knowledge, and therefore pressures Israel in revealing their true state, but because the relationship of the U.S. with Israel is important for foreign and domestic political reasons the U.S. chooses to take Israel's side when Israel reveals their true state. The last option is that Israel told the U.S. from the first period about their true state, and the U.S. took Israel's side because of the importance of the relationship with Israel.

6.4 Place in Reality

When we go back in history we see that Israel has tried to let the U.S. belief that they do not have nuclear weapons. On the other hand they wanted the countries around them to belief that the probability that they have nuclear weapons is high. We see that this was not sustainable for a long time, the U.S. wanted to know what was really going on in Israel. They had different ways in pressuring Israel in revealing the truth, by pressuring them to sign the NPT agreement and by pressuring to agree that Dimona would be investigated. The U.S. also wanted to know the truth for stability in the region, the investigation of Dimona was to reassure Nasser that Israel had no nuclear weapons, so Egypt would not attack Israel.

In the time that Dimona was visited the investigators felt that they were left in the dark, also by the government of the U.S. and the CIA, they did not get enough information, and time, to properly investigate. For the investigators it seemed that also the U.S. government did not wanted to find anything in Dimona. The U.S. wanted to reassure Nasser

after the conclusion was drawn that Dimona was not for weaponry. Eshkol, the former premier, of Israel wanted to leave Nasser in the dark so he would have to worry about Israel's military capabilities because Nasser often threatens to attack Israel.

When the White House got to know more about Israel nuclear programs and commitment to acquire nuclear weapons the former U.S. ambassador Barbour interpreted Johnson's interests and wishes so that the White House did not want to know the details. It was a given that Israel would sooner or later have nuclear weapons and would not give this up, so the best way to handle the situation was to make sure that Israel would not introduce nuclear weapons as first country. Israel would try to keep the Arab-Israeli conflict conventional.

In 1967 it became clear for the U.S. that Israel had nuclear weapons, but it was not in their best interest that Israel would publicly acknowledge it in 1968, because that would do grave damage to the NPT, which was political important for Johnson. Also it would be publicly known that the investigations of the U.S. were a farce and that the assurances of the U.S. to Nasser were false, this would be bad for the U.S.'s position in the Arab world.

Nixon and Meir eventually made an agreement so Israel would keep its nuclear profile low and the U.S. would accept the reality of Israel's possession. The U.S. stopped with pressuring Israel in signing the NPT agreement, but Israel supported the principle of the universality. Nixon's administration was convinced that Israel would not use nuclear weapons if it was no emergency. (Cohen, 1998)

The U.S. and Israel became more and more partners around Israel's nuclear possession. It was a difficult road for both countries, but both had important benefits from keeping it a secret. In this model this new stability is explained, and also that it could go with a fair amount of trouble.

7. Conclusion and Discussion

The scope of this research is the situation of Israel and their opacity about nuclear weapons. Israel's behaviour around nuclear weapons is different from all other nuclear powers in the world. The question how Israel behaves around nuclear weapons and how this is sustainable was the main topic of this research. Two different models were used to answer this question, the first model to explain the forces that drive Israel's behaviour in public and the second model for the sustainability of this behaviour.

Israel's behaviour around nuclear weapons is in this research explained by a combination between the threat of Iran and a possible punishment of the U.S. Due to the threat of Iran Israel want them to believe that they have nuclear weapons, but because of the possible punishment of the U.S. Israel cannot publicly claim to have nuclear weapons. In Israel's statements there is no information, because they would always choose a pooling action. Israel wants Iran to think that they have nuclear weapons to prevent an attack, so they need to influence the belief of Iran about Israel's possession, because for a low probability Iran could choose to attack Israel. For Israel it is important to accomplish the "War Game" paradox, which states: "The only way to win is not to play". In this way Israel can accomplish that goal because Iran would choose to not attack when the prior probability of Israel's possession is high, which it is in reality. The second part of the research is about the sustainability of this situation, because the combination of a very high probability and Israel opacity should raise questions. With the second model it is explained why Israel could behave like they do, which is because the U.S. has more benefits from Israel's public opacity than a clear answer in public. The U.S. would have some degree of information about the true state of Israel, it could be that the U.S. know about everything, but another possibility is that they know partly. So because there is a powerful country that benefits from Israel's opacity their behaviour is sustainable. This conclusion can be drawn a bit broader, the sustainability in reality is not only due to the U.S.'s interests in Israel, but also other countries that benefit in a way from the situation as it is, or are content with the status quo. Which could be the reason why the resolution of Egypt, to inspect the nuclear reactor in Dimona, is voted down by the IAEA with 61-43 in 2015 (Keinon, 2015).

Place in literature

The current literature about nuclear weapons, Israel's possession and relationships between Israel, Iran and the U.S. are used to fill the model with credible variables. Those papers were necessary for the analyses that are made in this research. On the other side this research also added some things to the current literature.

First of all the application of Game-Theory is new to the behaviour of Israel regarding nuclear weapons, there are researches where other behaviour or choices of Israel are analysed, but there are none on this topic. The applied economic view on this behaviour and the underlying reasons for this behaviour is new in the literature. Also the application of the second model is not earlier used to explain such a situation, and the adjustment of the second model is also new in total literature. The way that it is used in this research can be copied for other researches, or even used to expand the general model.

In other literature there is rarely focussed on why the situation of Israel's opacity is stable. Other literature explains the relationship between the U.S. and Israel regarding nuclear weapons, but not to explain the stability of Israel's public behaviour around nuclear weapons. This research is focussed on the combination of explaining Israel's behaviour and finding the reasons why this behaviour is stable. Former research was more descriptive while this research is more focussed on the explanation. This new way of looking at the situation is an addition to the current research.

Besides those point the models can give a new view on the situation between Iran and Israel regarding nuclear weapons. Waltz(2012) suggests that Israel's nuclear arsenal is one of the reasons of the instability in the Middle East, Dokos(2012) however says that some of Israel's actions can bring instability, but that their behaviour around nuclear weapons is not destabilizing. This research is also suggesting that Israel's behaviour around nuclear weapons is not per se destabilizing, mainly because it is avoiding a war between Israel and Iran. The fact whether Israel's behaviour around nuclear weapons is destabilizing is of course also dependent on from which point it is viewed and how there is looked at preferences and possible actions of different governments. But if Iran would get nuclear weapons the outcomes in this model will change as is explained in chapter four, this will enlarge the probability of an attack of Iran against Israel, which will not lead to a more stable Middle East. In the short term the new payoffs will lead not to a mutual total destruction, but Israel could theoretically recover, as Farr(1999) has shown in his research, but if Iran's arsenal will

be more advanced it can lead to mutual destruction, which can change the payoffs of Iran and therefore maybe their actions. So if Iran would get an advanced nuclear arsenal it could lead to more instability. Besides that it could also lead instability in the short term, because Israel has shown to intervene when enemies were developing nuclear weapons. It would destabilize the region when Israel would intervene in Iran's nuclear pursuit.

Limitations and further research

In the models that are used the scope was one enemy and one ally or interested party of Israel, other countries also have interest in Israel to a certain extent. They could be less interested in Israel than Iran and the U.S., but this study is unable to encompass the entire interested parties or enemy of Israel. Besides that it is beyond the scope of this study to come up with other solutions between Israel and Iran, there is no diplomatic way in the models how the situation between Israel and Iran could be handled.

Furthermore it was not in the scope of this research to add the option of Iran going nuclear. This could be a very interesting topic for further research, what would Iran's pursuit for nuclear weapons change in this model, and what would it change in reality? Those outcomes could be very useful as information to prevent a larger conflict.

An interesting topic for further research is the attitude of the West towards the situation of Israel's nuclear arsenal. It is interesting to research whether the status quo is the best solution for the West and stability in the Middle East, or whether there must be some actions from the West or the U.N. Besides that further research towards Iran's nuclear capability could also be useful to explore, and their intentions with it, as well towards Israel and the West, are also important.

One of the most important subjects to do further research on is about diplomatic solutions between Israel and Iran, mainly because if Iran would pursue nuclear weapons it could quickly evolve into a weaponized conflict. It is interesting and important to do further research how such a conflict could be prevented, and if that is not possible, how it could be solved.

The last suggestion for further research is to use the models for other countries, like North Korea, to see whether behaviour of those states can be explained. The forces that drive the behaviour of those countries could be used to find possible solutions.

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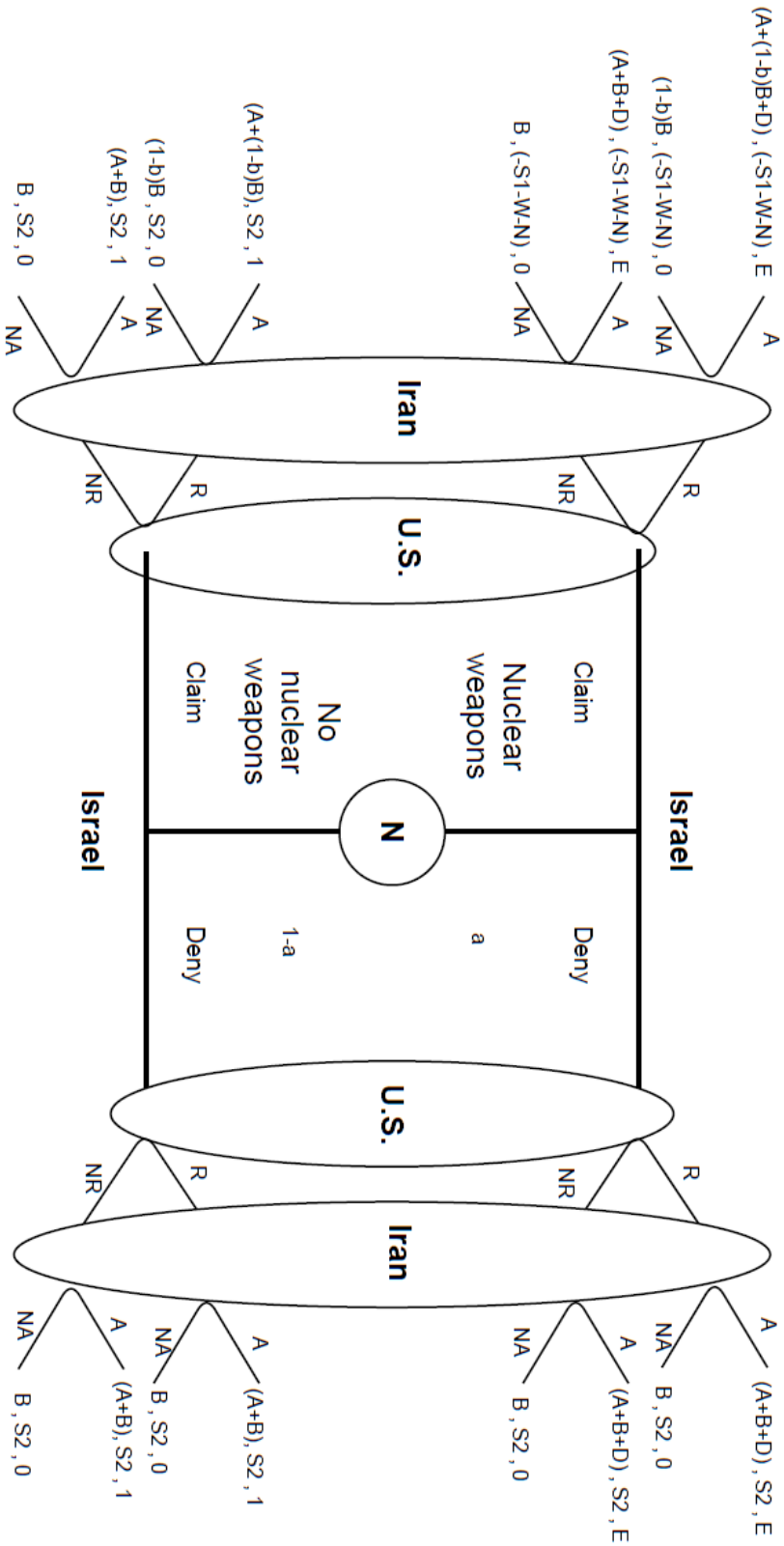
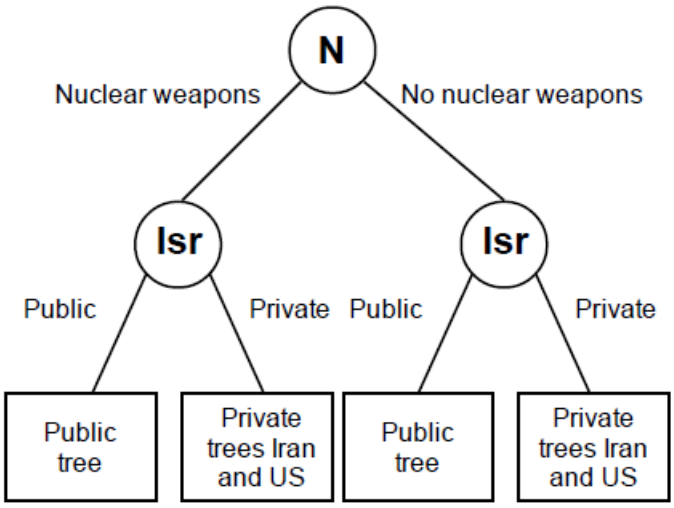
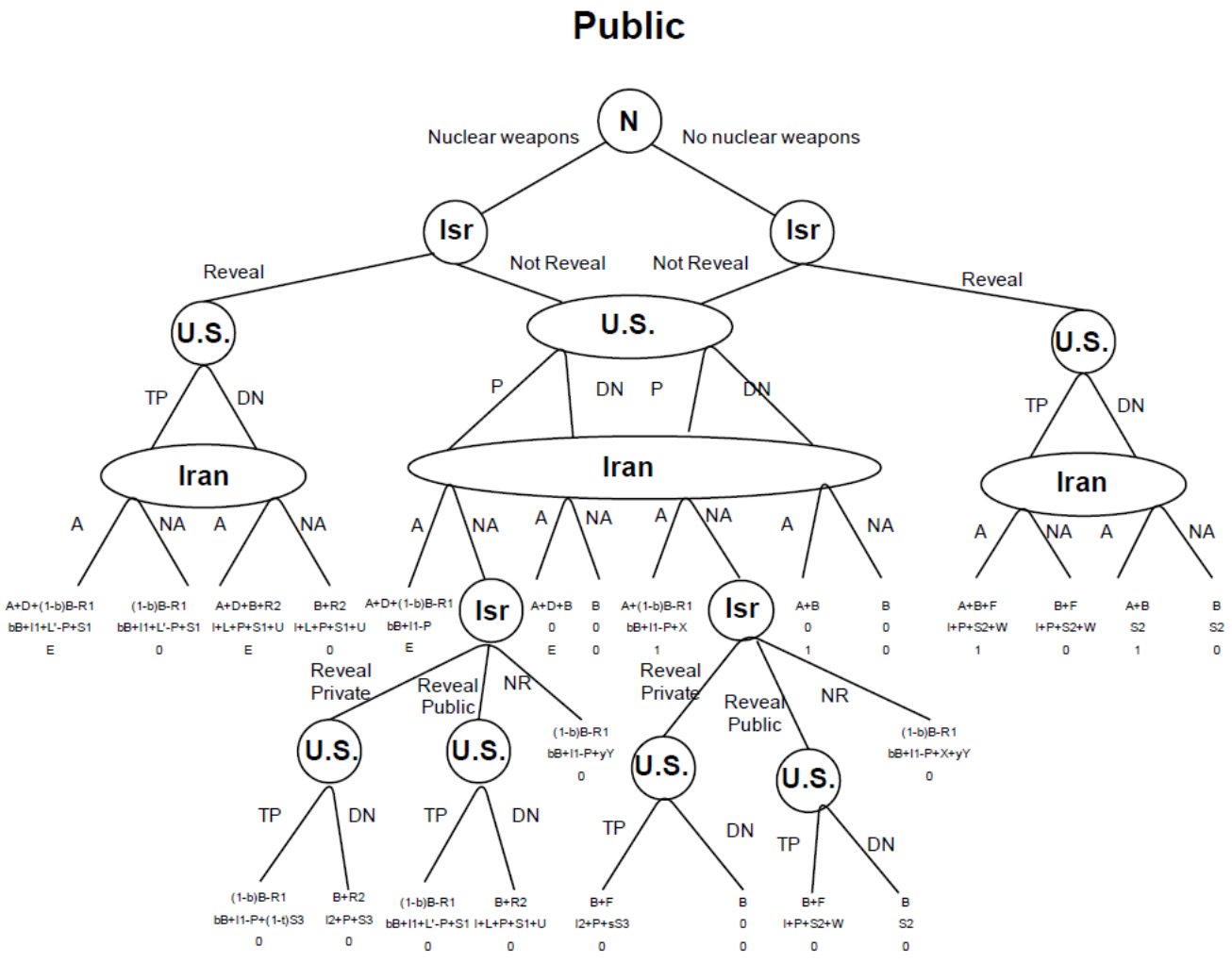
9. Appendices

Appendix 1 –Game Tree Model 1

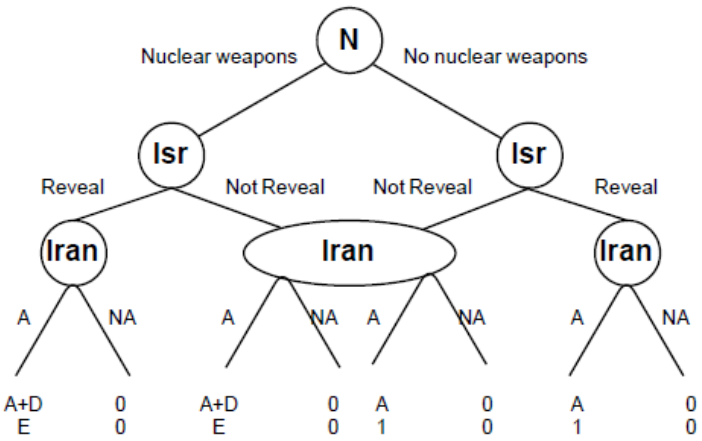


Appendix 2 – Game Trees Model with Two Audiences

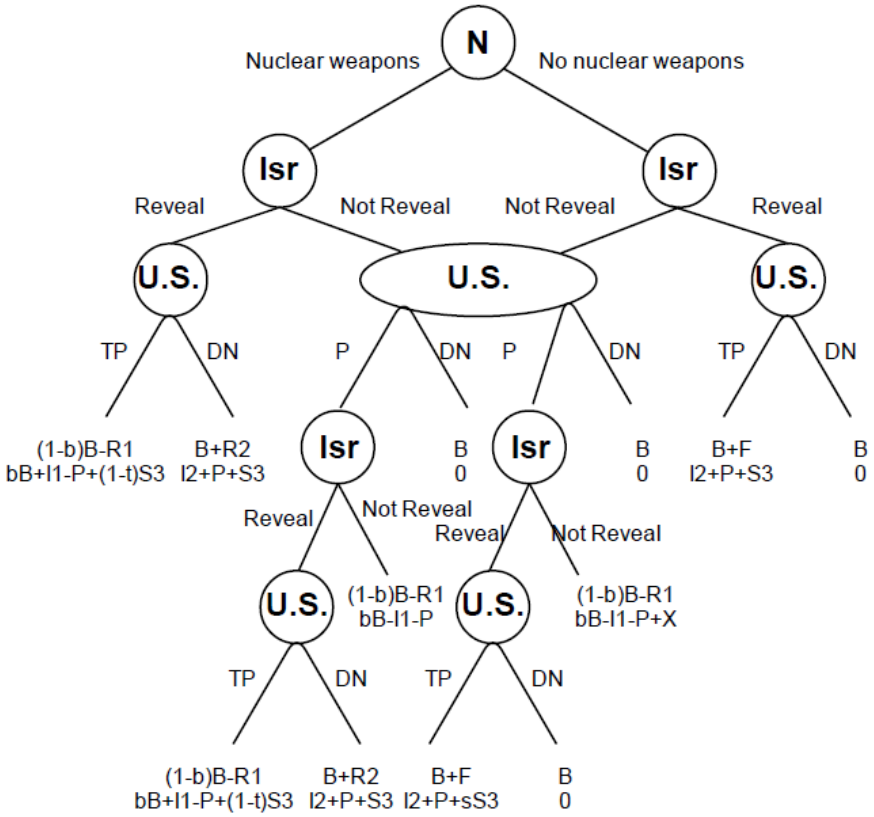




Private Iran



Private U.S.



Appendix 3 – Strategy Israel for Iran's strategy 'NA'

1a. Payoff Israel with nuclear weapons after Iran's strategy 'NA'.

$V_{Is\ (NW)}(C; NA) = (1 - \beta)B$

$V_{Is\ (NW)}(D; NA) = A + B + D$

Differences between payoffs due to war: $A + D$

Differences between payoffs due to support of the U.S.: $-\beta B$

Assumption 2: $B < |A + D|$

$(1 - \beta)B \gtrless A + B + D$

$-\beta B > A + D$

Best response of Israel with nuclear weapons for 'NA' is C.

1b. Payoff Israel with no nuclear weapons after Iran's strategy 'NA', if $\alpha > \overline{\alpha_U}$.

$V_{Is\ (no\ NW)}(C; NA) = (1 - \beta)B$

$V_{Is\ (no\ NW)}(D; NA) = A + B$

Differences between payoffs due to war: A

Differences between payoffs due to support of the U.S.: $-\beta B$

Assumption 1: $B < |A|$

$(1 - \beta)B \gtrless A + B$

$-\beta B > A$

Best response of Israel without nuclear weapons for 'NA' is C.