Collective Defense by Common Property: the Rise and Fall of the Kibbutz

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Abstract

Common property have long been considered inefficient and short lived, since they encourage high-productivity individuals to leave and shirking among those who stay. In contrast, kibbutzim — voluntary common property settlements in Israel — have lasted almost a century. Recently, about 75% of kibbutzim abandoned their equal-sharing rule and paid differential salaries to members based on their contributions. To explain the long persistence of the kibbutzim and the recent privatization of income, a model of public defense is developed, which attributes equal sharing to the need of defending external threats, and attributes income privatization to the decline of external threats.

The insights of the model are supported by the institutional evidence in Chapter 4. In addition to the private income, the kibbutzim also forbade privacy, personal child rearing, and private consumptions. Those measures prevented members from free-riding on the public defense, thereby inducing a strong defense. As a result, the members successfully defended their settlements in civil and military conflicts, thereby consolidating the Jewish territory.

In addition to the institutional evidence, the theoretical model yields two predictions: (1) other things equal, a central planner places equal-sharing income communities in dangerous areas, while placing private income communities in safe areas; (2) communities maintain equal-sharing rules in relatively dangerous environments, while privatizing income when the external threats decrease.

To test prediction (1), a settlement dataset is constructed to study the location pattern of rural Jewish settlements. The empirical results in Chapter 5 and 6 reveal that the Jewish leadership systematically placed the kibbutzim at peripheral areas to expand the Jewish territory, and at the frontiers along the attacking routes to delay the offense, thereby protecting the Jewish territory.

To test prediction (2), a kibbutz dataset is constructed to study the asymmetric timing of the income privatization. The empirical results in Chapter 7 show that a safer environment in terms of a lower number of nearby conflicts significantly increases the probability for a kibbutz to shift away from equal sharing. The results are robust when using rainfall at the nearby refugee camp as an instrument for the conflicts.

Keywords: Kibbutz; Collective Defense; Common Property; Property Rights; Transaction Costs

Dedication

To my parents — Yan Diao and Ye Zheng
To my partner — Huiqian Song

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Chapter 1

Introduction

Since Ronald Coase (1960) pointed out the importance of choosing the appropriate social arrangement for dealing with harmful effects, economists have focused on the efficiency and rationale of various ownership structures. Economic historians (North and Thomas 1976, North, Hill, and Anderson 1983), for instance, have argued that the changing from common property to private property is essential to the economic growth of modern Western society, for common property regimes are relatively inefficient.[1] The inefficiency arises from the sharing of input resources and output products. With shared access to resources, owners rush to capture the resources before others do, creating rent dissipation (Gordon 1954, Cheung 1970, Clark 1980). When owners share output regardless of their contributions, they free-ride on the work of others, leading to the problem of moral hazard (Alchian and Demsetz 1972, Weitzman and Kruse 1990, Barzel 1997). In the cases where output is equally shared, low-productivity individuals tend to remain in the organization, while high-productivity individuals tend to leave, causing adverse selection (Akerlof 1976, Landers et al. 1996). Given the multitude of problems, it is often advised that common property regimes should be replaced by private property regimes (Smith 1981 pp. 467, Demsetz 1967).

Recently, this inefficiency view is facing challenges from an increasing account of successful common property regimes. For centuries, local communities have collectively managed mountain grazing pasture in Switzerland (Netting 1976 and 1981) and Japan (McKean 1982 and 1992), irrigation systems in China, Nepal, India, and the Philippine Islands (Coward 1980, Sengupta 1991, Martin and Yoder 1988, Siy 1982), and forest in Indian Himalayas (Agrawal, 1996). In addition to those stationary resources, the list also extends to mobile resources such as lobster in Maine (Acheson 1975 and 1987), fish in New Zealand, Canada, Micronesia, Sweden, Norway, Iceland, Brazil, Japan, and Sri Lanka (Sudo 1984, Durrenberger and Palsson 1987), groundwater in California (Blomquist 1992), and crude oil in the

[1]Common property regimes, where a group of owners share rewards and duties, are often confused with common-property resources (see Ostrom and Hess, 2007). Among various cases, I focus on common property where output is equally shared, as commonly practiced in gold mines (Umbeck 1977), alpine pastures, fishing grounds (Ostrom 1990), marriages (Allen 1992), and pirate organizations (Leeson 2007).

U.S. (Libecap and Wiggins 1984, Libecap 1994). Based on those evidence, scholars like Cheung (1970), Lueck (1994), and Ostrom (1990) have noticed advantages of common property regimes in managing common-pool resources.

But beyond their strength in managing natural resources, common property regimes receive little justification. It is probably due to the lack of successful examples — most common property communities are either short-lived or based on coercion. Early collectivized settlements at Jamestown, Plymouth, and Salt Lake City were privatized within a decade (Ellickson 1993). In a sample of 120 communes studied by Zablocki (1980), only one-fourth of them survived the first four years.[2] Forced collectivization, such as the people's communes in China and kolkhozes in the Soviet Union, dramatically reduced the agriculture productivity and led to the great famine in the Soviet Union between 1929 and 1932 and in China between 1959 and 1961 (Lin 1990, Lorimer 1946 pp. 133-136).

In this regard, kibbutzim in Israel stand as a rare exception — they are voluntary common property settlements with minimal natural resource, yet they have lasted for a century.[3] The kibbutzim started in 1910, flourished during the 1936-1939 Arab revolt, and started to decline in the 1970s (Near 2007a, pp. 1–9). Traditionally, kibbutz members hold common ownership over all properties and receive an equal share of total kibbutz output, regardless of individual productivity. From the late 1990s to the early 2010s, about 75% of kibbutzim abandoned this equal-sharing rule and introduced a "safety net" budget, which paid differential salaries to members based on working hours and the market value of jobs (see Chapter 4 for details of kibbutz institutions).

1.1 Ideological Explanations

The long persistence and recent income privatization of the kibbutzim have been studied by sociologists, economists, and historians. Sociologists typically view the kibbutzim as a social experiment fuelled by the Zionist movement, and attribute the recent income privatization of Kibbutzim to the decline of a pioneering spirit," and the rise of individualism among kibbutz members (Rosner and Getz 1996; Russel et al. 2013, pp. 5).

Certainly, one should not underplay the important role of ideology in constructing kibbutzim. However, ideology-based explanations are rarely testable and subject to concerns of reverse causality: high level of cooperation or altruism may be the consequence of the equal sharing rule in kibbutz through self-selection. In a recent field experiment kibbutz members, when paired with city residents, were found to be as uncooperative as city residents. Kibbutz members demonstrated a higher level of cooperation only when they were paired

[2] Although not all 120 communities in the sample shared income, most them practiced total or substantial communism (Zablocki 1980, pp. 307)

[3] Kibbutz Gan Shmuel, established in 1913, was still a common property community by 2014.

with anonymous kibbutz members (Ruffle and Sosis 2006). The experiment results suggest that the kibbutz institution is the cause, rather than the consequence, of the ideologies of kibbutz members.

A few economists have viewed kibbutzim as risk-sharing communities to provide insurance against fluctuations of income across its members, when the insurance market was under-developed in the early years. The fluctuations could result from "illness, unemployment, disability and occupation-specific demand shocks" (Abramitzky, 2008; Abramitzky, 2011). However, it is not clear why equal-sharing was still maintained, once the market or the state could provide life and unemployment insurance. Some elements of the traditional kibbutz are also inconsistent with the objectives of full risk sharing. For example, members develop similar skills through rotating positions and gain similar knowledge through collective education within the kibbutzim. The kibbutzim neither allow members to work outside nor hire outside workers. As a result, the low diversification of the human capital within the kibbutz hampers the efficacy of the insurance. The risk-sharing argument also fails to explain the rarity of the kibbutzim. The moshavim, an individually owned settlement, outnumbered the kibbutzim after the independence of Israel and became the dominant type of Israeli rural settlement. Yet these settlements did not adopt the equal sharing rule. The difference could be due to different constraints, or because moshav members were different from kibbutz members. Abramitzky (2011) suggests the latter and attributes the differences to ideology, arguing that "the presence of ideologically committed members is important for maintaining equal sharing, while mitigating brain drain and moral hazard." Once again, a back door reliance on an unobservable ideology is not a satisfactory explanation.

Historians, on the other hand, are on the right track in pointing out that the kibbutzim were the most appropriate type of settlement in defending against attacks, as they were placed by the Jewish agency in strategic areas to form first defense lines, and played an important role in the war of independence (Near 2007a, pp. 58; Bowes 1990; Ben-David 2015, pp. 58; Weintraub 1969, pp. 30). They attribute the high defensive abilities of the kibbutzim to the member characteristics — solidarity, discipline, and ideologies (Near 2007a, pp. 397). However, to the extent those personal characteristics are hard to measure, the explanation based on them is hardly testable.

1.2 Collective Defense Explanation

To explore a falsifiable explanation for the existence of kibbutzim and the timing of kibbutz income privatization, I develop a model that relates the high defense function to the equal-sharing arrangements. The model highlights the tradeoff between the high level of public defense and the incentive to stay. In a private income community, public defense is under-provisioned, since the members tend to free-ride on the contribution of others. Common property communities, on the other hand, can induce a first-best level of public defense,

since the sharing rule can be used to align the individual benefit of each resident with the collective benefit of the village — any choice that maximizes the wealth of the village is also the one that maximizes the wealth of each resident. Thus, common property solves the free-riding problem on the production of the public good.

The model yields two predictions: (1) other things equal, kibbutzim have higher defensive capacity than private income communities. Consequently, they were placed by the Jewish Agency in strategic areas to enhance legal recognition of the Jewish territory, and defend the territory against military intervention; (2) kibbutzim in safer environments shift away from equal sharing. When the threat faced by kibbutzim faded away, the benefit of higher public defense was outweighed by the cost of low productivity in private goods. Under the pressure of members, especially those of high productivity, kibbutzim introduced a differential wage system and abandoned the equal-sharing rule.

To test prediction (1), a settlement dataset is constructed that contains the year of establishment and the locations of different types of settlements. The empirical results show that kibbutzim had a larger chance of being placed in peripheral areas that defined the legal boundary of the Jewish state proposed in the 1947 UN partition plan.

They were also more likely to be placed at the frontier of the attacking routes, in order to delay the impending attacks of the surrounding Arab countries. The relatively rugged terrain further enhanced the high defense capacity induced by the equal-sharing arrangements. The placebo tests also confirm the prediction: the location pattern is less salient after the independence of Israel in 1948, since Israel had established a standing army; the pattern disappears after the Israel-Egypt treaty in 1979, since the two strongest Arab neighbors — Egypt and Jordan — recognized the existence of Israel and no longer imposed military threats.

The independent and asymmetric timing of income sharing reform across various kibbutzim allows a test of prediction (2).[4] A kibbutzim-level panel dataset is constructed that contains the conflicts near each kibbutz and the institutional status (preserving the equal-sharing rule or not) of each kibbutz in the years from 1986 to 2014. Using rainfall variation at the nearby refugee camp as an instrument for conflicts, the empirical results show that a decrease in the number of Israeli deaths near a kibbutz significantly increases the probability that the kibbutz abandons its equal sharing rule. The results are robust to various measures for external threats.

[4]Historically, kibbutzim were affiliated with several kibbutz federations, and mutually responsible for each other's debts. The kibbutz federations in 1989 formally permitted their member kibbutzim to introduce reforms, and ensured that each kibbutz was fully responsible for its own debt (Russel et al. 2013, pp. 42).

1.3 Relevant Literature

I am not aware of others who have pointed out the link between external threats and common property regimes, though scholars such as Cheung (1969), Umbeck (1977 and 1981), Lueck (1994), Allen and Lueck (1992, 1998), and Ostrom (1990) have discussed various functions of common property regimes and sharing contracts. Cheung (1969) developed one of the first theories emphasizing the risk sharing function assumed by income sharing arrangements. Using a similar theory, Umbeck (1977 and 1981) argues that the gold miners during the California Gold Rush adopted the sharing contracts to reduce the variance in the gold output. However, this risk sharing function receives little support from empirical studies (Allen and Lueck 1995). Instead, Allen and Lueck (1992 and 1998) propose that sharing contracts are used to reduce the overexploitation of land inputs. They show that share contracts are more likely to be used when soil exploitation is of a larger concern. Nevertheless, those arguments on the adoption of sharing contracts do not apply to larger organizations like kibbutzim. Agriculture contracts studied by Allen and Lueck (1992) typically involve only one farmer and one landowner. Umbeck (1977) notice that sharing contracts of gold were abandoned once the group size of gold miners exceeded sixteen, due to the increasing cost of preventing members from concealing gold. Meanwhile, an average kibbutz has hundreds of members.

In her seminal work, Ostrom (1990) emphasizes that common owners can efficiently govern, manage, and appropriate common-pool resources. She finds that mountain grazing pasture and forest in Switzerland and Japan and irrigation systems in Nepal, Spain and the Philippine Islands have been sustained over centuries under the collective management of local appropriators. The successful cooperations in those cases feature stable small communities where it is easy to know the information on the contribution of each individual and form close relationships through repetitive interactions. Lueck (1994) compares the wealth generated under common property regimes relative to that under private property regimes. He argues that one advantage of common property regimes is their costs of excluding outsiders from using underlying common-pool resources. In his study of Italian alps, Casari (2007) shows a formal institution like charter can facilitate the community cooperation, especially when the community is large and the underlying resources are valuable. Kibbutzim, however, were not established to manage valuable common-pool resources, as most kibbutzim were located in “substandard, poorly developed or undeveloped tracts of marsh, swamp, or sand dune..." (Anabtawi 1972). Instead, kibbutz members deliberately pooled all their output together through banning private assets, thereby concentrating on defending the whole community.

This thesis is related to a growing literature on state building under external threats. In reviewing the development of European states, Tilly (1990) argues the increasing scale of war during the fifteenth and the sixteenth century gave advantages to states capable of mo-

bilizing both capital and populations. Facing surging external threats, all states eventually converged on the same national states, with balanced access to both capital and large rural populations for standing armies. Along the same line, Besley and Persson (2009) model war as a public good that requires investment in state capacity and predict that external conflicts will increase legal and fiscal capacity. They then present preliminary empirical evidence drawn from cross-country data to support their prediction. Gennaioli and Voth (2015) extend the above studies by emphasizing the importance of military technology. They argue the link between military conflict and state-building only emerges after a series of technological advances in Europe after 1500. The "Military Revolution" increases the chance of richer countries winning a battle, thereby increasing the incentive of building fiscal capacity. While most attention has been given to the effects of external threats on institutions at the state level, those effects at the community level remain under-explored. To the best knowledge of the author, this thesis is the first one to analyze the institutional response to external threats at the community level, thereby freeing from concerns of cross-country endogeneity.

Finally, this thesis presents a framework for testing the military strength of institutions. To the extent that combat results hinge on many unobserved variables, directly measuring the military strength is difficult. Instead, this thesis theoretically ranks rural settlements of different income arrangements by their defensive capacity. Assuming that a central planner allocates the strongest institutions to the most dangerous places, it then tests their locations relative to the optimal attacking routes constructed from topography. The only other paper uses a similar method is Matranga (working paper), who tests the defensive capacity of Russian serfdom against the optimal raiding routes.[5]

1.4 Thesis Outline

To understand the rise of the kibbutzim, one has to know the environment nurtured it. Chapter 2 presents the history of Arab-Israeli Conflicts throughout the twentieth century. Facing the rising opposition from the local Palestinians and the surrounding Arab countries, the Jews used an arsenal of defenses, one of which was the kibbutzim. According to the model presented in Chapter 3, the high defense capacity of the kibbutzim was the direct result of their equal-sharing rule, which diverted the incentive of the members on producing private goods to producing public defense.

The theoretical insights are confirmed in Chapter 4 by the institutional evidence from the kibbutz rules and the performance of the members during civil and military conflicts. In

[5]The working paper titled "All Along the Watchtower: Linear Defenses and the Introduction of Serfdom in Russia" was accessed on Nov 24, 2019 from
https://economics.ucdavis.edu/events/papers/copy2_of_1029Matranga.pdf

addition to the anecdotal evidence, Chapters 5 and 6 exploit the settlement pattern to show the kibbutzim were placed at dangerous frontiers to expand the territory and to defend the attack from surrounding countries. Chapter 7 exploits the timing of kibbutzim privatization to show the income privatization happened first in those relatively safe areas. Chapter 8 concludes.

Chapter 2

History of Arab-Israeli Conflicts

Although many states have been involved in conflicts, few have faced the repeated wars and persistent hostilities from all surrounding neighbors as Israel has since its creation. Despite being the victor in six wars, Israel for most of the twentieth century made little progress in negotiating peace treaties with neighboring Arab countries. When Israel finally made peace with Egypt in 1978 and Jordan in 1994, it was still caught in a guerrilla war with armed Palestinian groups. Still today, it faces missiles fired by Hamas (Islamic Resistance Movement) from the Gaza Strip.

2.1 The Jewish Land Policy during the British Mandate

Facing rising anti-semitism in Europe, the Jews in the nineteenth century initiated Zionism, a movement aiming to re-establish a Jewish state. For a state, a territory is essential. The Jewish leadership understood this principle from the beginning and strove for consolidating the economic and legal property rights of the Palestine land held by the Jewish people.[1] In 1897, the first Zionist Congress established the Jewish National Foundation to purchase, develop, and settle lands as the property of the Jewish people (Weintraub 1968, pp. 5–7). The land policy includes "systematic carving out and progressive extension of solid blocks of Jewish-held territory, thus building the national home district by district", and "the acquisition of land for political purposes in order to confront the great powers and international organizations with established Jewish presence in areas susceptible to loss in possible negotiations." (Abu-Lughod 1971, p129)

However, the chaotic land system in the Ottoman Empire prevented the Jewish National Foundation from purchasing lands with clean titles. In some cases, Arab tenants, according to their customary land system, claimed partial property rights of the lands they had worked

[1]The legal property rights in this context refer to the support of other countries. Other things being equal, the more countries formally recognize the territory claimed by the Jews, the more legitimate the territory claim is.

for decades. In other cases, the real owners, fearing the tax and conscription imposed by the Ottoman Empire, left the lands unregistered or registered by local elites (Abu-Lughod 1971, pp. 120–124). Consequently, even if the Jewish National Foundation legally purchased the lands, they usually did not own the *complete* property rights. Local Arabs treated the Jewish rural settlers as squatters, and sought to drive them out of the lands the moment settlements were established (Lieblich 1981, pp. 22).

In 1920, the Arabs struck three Jewish settlements on the north of Lake Hula and forced settlers to abandon the settlements temporarily (Morris 2000, pp. 92–93). In 1929, the Arabs burned seven Jewish settlements near Jerusalem and attacked settlements in the Jezreel, Jordan and Beisan Valleys (Morris 2000, pp. 115). But the Jewish land purchases kept growing at the cost of thousands of landless Arab families.

To find a solution to the uprising by Palestinian Arabs, the Peel Commission appointed by the British government in 1937, for the first time, recommended partitioning the territory.[2] The Jewish state, according to the plan, was entitled to one-fifth of the Palestine region. The Arab state was entitled to the rest of the areas, except a small enclave, including Jerusalem and a path to the sea at Jaffa (Morris 2000, pp. 139).

Disappointed with the partition plan, the Arabs resumed the uprising and escalated into the Great Arab Rebellion from 1936 to 1939 (Morris 2000, pp. 123–124). Although the British succeeded in pushing the Arab militants out of the towns, they failed to disarm the rural bands. Consequently, the armed bands had launched about 800 attacks against Jewish targets and claimed more than 300 Jewish deaths, by the end of the rebellion (Near 2007a, p302; Morris 2000, pp. 144–157).

In response to the revolt, the British Mandate issued The MacDonald White Paper in 1939, limiting the Jewish immigrants to 75,000 over the next five years (Hadawi 1967, pp. 64).[3] After fruitless protests to the "White Paper", the Jewish Agency, anticipating the upcoming conflicts with the Arab states, went out of its way to smuggle arms from abroad, and organize illegal Jewish immigration to Palestine.[4] Most of the illegal immigrants, however, were intercepted by the Royal Navy, and were sent to internment camps.[5] Albeit cautiously

[2] The British government appointed Lord Robert Peel to "ascertain the ... causes of the disturbances... to ascertain whether ... either the Arabs or the Jews have any legitimate grievances ... and to make recommendations for their removal." (Morris 2000, pp. 138)

[3]Britain was granted a Mandate for Palestine in 1920 by the League of Nations.

[4]Against the backdrop of the Arab revolt, Ben-Gurion, the head of the Jewish Agency, had written in his diary: The danger we face is not riotsbut destruction. Because the attackers will not be only the Arabs of Palestine but perhaps [also] Iraq and Saudi [Arabia], and they have aircraft and artillery. And we must draw a political and military conclusion [from this]. (Morris 2008, pp. 199)

[5] During 1946-1949, 51,510 Jews were intercepted by the British and interned in Cyprus detention camps (Tucker and Roberts 2008, pp. 280). In the meantime, the total Jewish population in the region of Palestine was 630,000 (Morris 2008, pp. 81).

hidden in several young kibbutzim, 33 arms caches containing over 500 weapons and a large number of munitions (a significant part of Jewish armories) were confiscated by the British Mandate during the Operation Agatha (Charters 1998; Wagner 2008).

Various Jewish groups retaliated by attacking British targets, including bombing the south wing of the King David Hotel, which was the headquarters of the British government in Palestine (Morris 2000, pp. 175–179). The Jewish violence and reprisal became too big a burden for post-war Britain, which was weak and short on soldiers, and forced the British to relinquish the mandate.[6]

In response to the request of the British, United Nations Special Committee on Palestine (UNSCOP) in 1947 made a partition recommendation in UN Resolution 181 (Klausner and Bickerton 2007, pp. 83).[7] The resolution recommended a partition of the Israel-Palestine region into a Jewish State, an Arab State and a small internationally administered zone including Jerusalem and Bethlehem (see Figure 5.2).[8] The Jews, owning only 6 percent of the land of Palestine and making up a third of the population, were entitled to 56 percent of the land under the partition plan (Yusuf 2002, Asadi 1976).[9]

As before, the Arabs rejected any partition plan. If they could not establish an Arab state in the whole of Palestine through diplomatic negotiations, they would establish it through military operations.

2.2 Middle-East Wars

On 15 May 1948, Egyptian, Syrian, Iraqi, and Jordanian armies invaded Israel. In the first three weeks of the war, the Haganah troops, inferior in manpower and firepower, managed to halt and contain the four-pronged assault.[10] During the truce from June 11 to July 8, the Haganah transformed from a paramilitary group into a regular army. They bypassed the embargo, purchased foreign arms, and almost doubled their manpower with the arrival of immigrants. The Israelis had gained the strategic initiative since then and retained it until the end of the war (Morris 2008, pp. 263).

[6]The British sent almost 100,000 troops to Palestine, five times the amount of troops sent during the 1936–1939 Arab Revolt.

[7]The UN charter required the resolution passed by a two-thirds majority. 33 countries voted in favour of the partition plan, 13 against, and 10 abstentions. The two superpowers, the United States and the Soviet Union, both supported the plan.

[8]United Nations General Assembly Resolution 181, assessed on Sep 2, 2019 from https://avalon.law.yale.edu/20th_century/res181.asp

[9]In contrast, the Arabs were entitled to 44 percent of the land, while occupying 48.5 percent of the land of Palestine.

[10]See Morris (2008, pp. 204–206) for a comparison of the military forces from both sides.

Alongside the clear victory for Israel, the 1948 war also left some 700,000 Palestinian refugees, who were former inhabitants of Arab villages conquered by the Jewish State. Starting in June 1948, thousands of refugees, settling no more than three or four hours' walk from their abandoned homes, crossed the borderlines into Israel. Initially, the refugees came unarmed, sought to retrieve their possessions, reap crops, and resettle in their native villages. Increasingly, the refugees came armed with the purpose of taking from Jewish settlements, and attacked Israelis for revenge. Egypt and Jordan also trained and sent infiltrators called fedayeen ("self-sacrificers") to attack Israelis. Due to the long and unnatural borders, especially the one between Israel and Jordan along the West Bank, the Israel Defense Forces was too thinly spread to effectively prevent such incursions.[11] From 1949 to 1956, infiltration resulted in the death of some two hundred Israeli civilians and direct economic damage of 2.6 million Israel shekels (about 710,000 in 1950 US dollars) for stolen farm animals and agriculture equipment, and even larger losses due to the extra expenditure and manpower on anti-infiltration measures. (Morris 2011, p271; Morris 1995, p99-101). Worse still, settlers in some half dozen moshavim were so demoralized by the constant thefts, sabotage, and the occasional murder that they completely abandoned their settlements. The abandonment created gaps in the national defensive network and fresh access routes for infiltration.

Fed up with the constant harassment, the closure of the Suez Canal to Israeli shipping, and the blockade of the Gulf of Aqaba, the Israeli troops attacked the Egyptian armed forces on 29 Oct 1956 and conquered the entire Sinai before it accepted the United Nations demand for a cease-fire on 11 Nov 1956 (Klausner and Bickerton 2007, p123-127). Although Israeli troops later retreated to their pre-war position, it obtained the guarantees from the United Nations of free passage through the Gulf of Aqaba and the deployment of a United Nations Emergency Force (UNEF) between Israel and Egypt (Morris 2011, p296-300). This removed the fedayeen problem temporarily from the Israel-Egyptian border.

After the Suez Crisis, Egyptian and Jordanian leaders decided to control their borders to prevent the risk of another conflict. Consequently, Israelis enjoyed a long period of calm along Israels borders, perhaps the longest in the history. During the decade after the Suez Crisis in 1956, only 35 Israelis were killed by acts of hostility (Cohen 2010, p37).

The end of the Six-Day War in 1967 found Israel's occupation of the Sinai, the Golan Heights, the West Bank, and the Gaza Strip. The new territories provided Israel with strategic depth and more defensible borders. Israel offered withdrawal from the newly occupied regions in exchange for peace treaties with the neighboring Arab countries, but the answer they received was "no peace, no recognition, and no negotiations" (Klausner and Bickerton 2007, pp. 150–153).

The military defeat along with the loss of territory left Arab countries with a driving urge for revenge and made another round of conflict a certainty. In the following three years,

[11] See Morris 1995, p1-2 for a detailed account of the problematic border lines of Israel.

Egypt, with the modern weaponry and thousands of military advisors supplied by the Soviet Union, waged a limited warfare, later known as the "War of Attrition", based on intermittent artillery bombardment and occasional cross-Canal raids. Despite thousands of deaths, the Egyptian army was able to inflict heavy casualties on the seemingly invincible Israel Defence Forces and reacquired a self-confidence that had been destroyed in the previous defeats. More importantly, the Soviet-Egyptian air defense system had found a way to neutralize the air superiority maintained by the Israel Air Force (IAF) and advanced its army to a supremely advantageous starting position for the upcoming war (Morris 2011, p347-p363).

The showdown came in 1973. On Oct 6, Egyptian and Syrian armies jointly launched a surprise attack on the Israeli forces. In the Sinai Peninsula, the Egyptian armor demolished almost all Israeli fortifications and breached the Israel defense lines along the Suez Canal. By the second day, with 100,0000 men, 1,020 tanks, and 13,500 vehicles had crossed the waterway, the Egyptians forced the Israelis to retreat to a new defense line in the Sinai, and effectively regained the control of the Suez Canal. The Egyptian forces were only halted at the boundary of their anti-aircraft umbrella. On the Golan Heights, the Syrian armor broke through the Israel defense lines and was rolled down the slopes toward the Jordan valley. The situation for Israel was precarious and "the Third Temple [the State of Israel] is in danger" (warned by Dayan, the Israeli Defense Minister). Worse still, the Israel Air Force (IAF) failed to destroy the Syrian SAM anti-aircraft missiles and hence was unable to provide air support to the Golan battle. With the collapse of the 188th Armored Brigade, the one defending the Southern Golan Heights, Israel had to send the strategic reserve originally to be deployed to the Sinai front to contain the Syrian advance. Just as the Israeli defenses were almost at the point of collapse, the Syrians met fresh Israeli armour, broke first, and withdrew.[12] On Oct 24, the Soviet-American cease-fire proposal put an end to the 1973 war, without a decisive result (Morris 2011, p387-p440; Klausner and Bickerton 2007, p163-p171)

Israel turned the tide, but only at the edge of collapse. The narrow victory convinced many Israelis that the Sinai Peninsula could not be held indefinitely. On the other hand, the 1973 war restored the honor of the Arabs, thus enabling their leaders to contemplate peace with Israel. With the help of American mediation, Egypt and Israel signed a peace treaty in 1979 (Morris 2011, pp. 484–486).[13] Within three years, Israel withdrew all armed forces and civilian settlements from the Sinai, effectively handing over the territory back to Egypt. In return, Egypt became the first Arab country to officially recognize Israel and

[12]Colonel Ben-Gal, an Israel brigade commander, said: "I was already set to order all [my] forces to withdraw. I had already picked up the radiotelephone. But I said to myself: Let's wait a little longer.... I was sure we had lost the battle. Had it gone on for another half an hour, an hour, we would have lost. For some reason, the Syrians broke first and decided to retreat."

[13]The peacemaking momentum was interrupted by the collapse of the Nixon Administration as a result of the Watergate affair.

established a "normal relationship" with Israel.[14] The peace treaty won Israel a far less dangerous Middle East. Since then, no Arab states have waged a regular war against Israel.

2.3 The Rise of the Palestine Liberation Organization

While Israel and Arab states were shelling each other, the occupation of the Gaza Strip and the West Bank instilled a growing sense of separateness from the Arab governments among the Palestinians. Prior to the 1967 war, the Palestinians relied on the Arab governments to liberate them from the Israelis. The Palestine Liberation Organization (PLO) and its military department Palestine Liberation Army (PLA), originally established in 1964 on a council convened by Jordan, were financially dependent on, and served as an instrument of the Arab governments (Klausner and Bickerton 2007, p141). Fearing the retaliation strikes from Israel and being drawn into conflicts at inappropriate times and places, the Arab governments deliberately restrained popular armed struggles and suppressed independent initiatives.[15] However, the humiliating defeat in the 1967 war discredited the Arab governments along with the old PLO parliament(Klausner and Bickerton 2007, p141, p158).

In the meantime, Palestine National Liberation Movement, or Fatah, gained enormous popularity among the Palestinians through highly publicized guerrilla activities. In March 1968, Fatah fighters, aided by Jordanian regulars, fiercely resisted an Israeli assault and inflicted heavy casualties on the Israelis at a border town, Karameh. The heroic resistance of Fatah in Karameh became an instant legend, which earned itself financial support from the Persian Gulf states, and thousands of young volunteers (Morris 2011, p368-370). Within a few months, the number of Fatah fighters grew from a couple of thousand to ten to fifteen thousand. In 1969, Fatah completely took over the Palestine Liberation Organization. Its leader, Yasser Arafat, was elected as the chairman of the executive committee (and hold this position until his death) (Klausner and Bickerton 2007, p158-159).

In the following two years, the PLO launched more than a thousand attacks in the Gaza Strip, across the Jordan River, and over the Lebanese-Israeli Frontier. The IDF finally cracked down on the armed struggle in the Gaza Strip in late 1971, after killing some 100 guerrillas and capturing some 700 others. The guerrilla bases in Jordan, however, were demolished by the Jordan army. After the Karameh incident, the PLO moved its base to Amman and turned northern Jordan into a state-within-a-state. As the strength of the PLO grew, some groups within the PLO openly called for overthrowing the Jordan regime and attempted to assassinate the Jordan monarch, King Hussein. After having survived two

[14]The normal relationship means "full recognition, diplomatic, economic and cultural relations, termination of economic boycotts and discriminatory barriers to the free movement of people and goods."(Morris 2011, pp. 484)

[15]On January 2, 1965, Jordanians intercepted a Fatah squad, on its way back from a failed sabotage of the National Water Carrier in Israel, and arrested all of them (Morris 2011, p364).

assassinations, King Hussein had no choice but to order his army to attack the PLO in 1970, successfully forcing the PLO fighters to move on to southern Lebanon (Morris 2011, p371-373). The reallocation of the PLO bases turned out to be a nightmare for Israel and eventually dragged Israel into the 1982 Lebanon war.

Stemming from the delicate Christian-Muslim balance, the government of Lebanon was too weak to restrain the guerrillas. The PLO quickly turned Palestine refugee camps in southern Lebanon into forwarding bases, virtually forming an armed state-within-a-state. Terrorist operations from Lebanon against targets in northern Israel increased dramatically during the years 1970-1975, even though dozens of infiltrators were intercepted when crossing the border. In 1974 alone, 61 Israelis were killed by infiltrators from Lebanon. Interrupted by the Lebanese civil war in 1975, the PLO emerged better armed from battles with the Christian Lebanese and continued to raid northern Israel. In 1978, 11 PLO members hijacked a bus near Haifa, killing 38 Israeli civilians, including 13 children. To retaliate, Israel launched "Operation Litani." During the week-long operation, the IDF crossed the Israel-Lebanon border, and destroyed the PLO military bases in southern Lebanon, but failed to engage large numbers of PLO forces, who retreated to the north. The operation ended with the IDF withdrawing to a security zone some six miles from the frontier, after a UN force was deployed to assure the demilitarization of the area (Morris 2011, p499-502).

During the following three years, the PLO transformed into a paramount "army" , with some 250 artillery pieces and rocket launchers, four infantry "brigades", 100 obsolescent tanks, several dozen antiaircraft guns, and a few shoulder-held SAM-7s antiaircraft rockets. At the same time, PLO guerrillas were still able to launch artillery and rocket attacks against Israel, or crossed through the Security Zone and attacked targets in Israel. Despite repeated bombardment on PLO bases and military infrastructure, the PLO kept up sending rockets and shells against two northern Israel towns, Kiryat Shmonah and Nahariya, forcing thousands of border settlers to leave their homes (Morris 2011, p507-517).

As the Israel Defence Forces were proved incapable of silencing the PLO guns and rocket launchers through air raids, the full-scale ground attack became the only remaining option. Thanks to the peace treaty with Egypt, Israel was able to commit its entire army in Lebanon. On 6 June 1982, the IDF re-invaded Lebanon, and sieged the West Beruit, where PLO bases located, within one week. To avoid an unacceptable level of casualties in street battles, the Israel Defence Forces bombarded the city, cut off food and water supplies, and disconnected the electricity for seven weeks, but the PLO appeared to be unbending. The Israel Air Forces, assisted by agents with transmitters on the ground, also attempted to assassinate the PLO leaders by bombing their bunkers. At the cost of the destruction of numerous apartment houses, hundreds of Palestinians and Lebanese lives, the missions failed. In August, with US mediation, a peace agreement was finally implemented. Retaining their light weapons, the PLO guerrillas evacuated the besieged city and dispersed to Syria,

Algeria, Yemen, Iraq, Jordan and Sudan. The leadership re-established its headquarters in Tunisia (Morris 2011, p518-539).

According to the original plan, Israel was to install a pro-Israel Christian regime in Lebanon, sign a peace treaty between the two countries, and withdraw its troops. But the assassination of the newly elected Lebanon president, Bashir Gemayel, ruined the plan. The Israel Defence Forces had to delay its withdrawal and reoccupied West Beirut. The seemingly indefinitely occupation stirred bitterness among the Islamic Shi'ites. A group of devout families, led by a handful of Shi'ites clerics, organized themselves into Hizbollah, or the "Party of God". With funds and arms supplied by Iran and Syria and fighters recruited mainly from the Shi'ite refugees, the Hizbollah dominated the anti-Israeli guerrilla campaign, from spring 1983 on. Along with ambushes and roadside explosions, suicide bombers also emerged as a regular weapon in the Shi'ite armory, as they believed that their sacrifice would send them straight to Heaven. Despite the retaliation from the IDF after each major incident with mass arrests, intermittent raids, and occasional assassinations of suspected Shi'ite militants, the Hizbollah guerrillas stepped up their activities, mounting about one hundred attacks per month by mid-1984. The usual cycle of insurgencies from the Hizbollah and reprisals from the IDF spun out of control. Both sides took heavy casualties, but the Shi'ites, with their resolution and defiance of death, proved to be more endurable than the Israelis. In 1985, Israel withdrew to the security zone, leaving some 650 dead and close to 3,000 wounded in 1982 Lebanon War (Morris 2011, p540-566).

Israel expelled the PLO from Lebanon, but the vacuum was filled by the Hizbollah, which was far more deadly and determined than the PLO. The Hizbollah continued to attack the IDF in the Security Zone and in northern Israel until the IDF fully withdrew from Lebanon in 2000.

The successful Shi'ite guerrilla campaign also boosted the morale of Palestinians in the occupied territories — the West Bank and the Gaza Strip. Between 1967 and the early 1980s, the average living standards, personal income, and health conditions of Palestinians in the occupied territories increased considerably. But a large scale of extreme poverty continued to exist, especially in the refugee camps. Moreover, the inequality in water and land resources between the Palestinians and the Israelis widened, with the exploding Palestinian population. By 1987, the Israeli settlers in the Gaza Strip, some 0.4 percent of the total regional population, controlled over 28 percent of the total land. They used twelve times as much water as did Palestinians. To protect the Israeli economy, the Israel government also blocked Arabs from setting up manufacturing plants, turning Palestinians into menial labor, and the occupied territories into a vast market for Israeli goods. The feelings of discrimination, humiliation, and inequality coalesced into a time bomb, which was eventually ignited by a traffic accident (Morris 2011, p561-573).

On 8 Dec 1987, an Israel Defence Forces tank hit a number of vans carrying workers from the Jibalya refugee camp, killing four Palestinians and wounding six others. This

tragic accident resulted in the first "Intifada", the popular uprising in the occupied territories, with the aim to end Israel's occupation in the West Bank and Gaza Strip. Initially, the spontaneous uprising was organized by the various local groups. Above them, a loose umbrella organization, the "United National Leadership of the Uprising" (UNLU) emerged under the leadership of the PLO. Under the PLO prohibition, the rioters rarely used rifles, shotguns, and pistols, in order to maintain the revolt's "popular" image. During the first eighteen months of the Intifada, out of the 41,000 "violent incidents" registered by the Israel government, there were 41 light-weapons attacks; thirty-nine with grenades; 127 bombs; and 102 incidents involving "cold" weapons such as knives and hatchets. The civil disobedience mainly consisted of general strikes, demonstrations, refusal to pay taxes, and sabotages of Israel infrastructure within the West Bank and Gaza Strip. The Israelis tried almost everything: shooting to injure, beatings, mass arrests, torture, trials, detentions, and economic sanctions. All failed (Morris 2011, 575-592).

The Intifada came to a stalemate. The Palestinians were unable to expel the Israelis from the occupied territories, and the Israelis were unable to stop the violence. Under the mediation of the United States, the two parties signed the first peace accord in Oslo in 1993, in which the State of Israel and the Palestine Liberation Organization (PLO) formally recognized one another, and initiated the Oslo Process to negotiate a solution to their decades-long conflict. Two years later, Israel and the PLO agreed in Oslo II Accord on the temporary administrative division of the West Bank into three zones, referred to as Areas A, B, and C. Palestine retained civil control over Area A and B, which includes major Palestinian cities, and most Palestinian rural communities. Israel retained civil control over Area Cm including law enforcement, the building, and zone planning. Although the accord states that the permanent status of those territories was to be settled within five years, the negotiation regarding the final status of the West Bank was interrupted by a new round of hostilities and never yielded a result (Klausner and Bickerton 2007, pp. 277–292).[16]

2.4 Concluding Remarks

For most of the twentieth century, the Jews were facing persistent, yet varying degrees of threats from the local Palestinians and the surrounding Arab countries. This episode can be roughly divided into three phases according to the threat level faced by the Jews. Phase One was the British Mandate era from 1920 to 1948, during which the Jewish land purchasing along with their ambition of building a Jewish state clashed with Palestinian nationalism. The tension between the two ethnic groups invited the intervention of the surrounding Arab countries, which in turn posed increasing threats to the Jewish communities. The external

[16] Oslo II Accord is accessed from United Nations Peacemaker on July 17, 2020: https://peacemaker.un.org/israelopt-osloII95

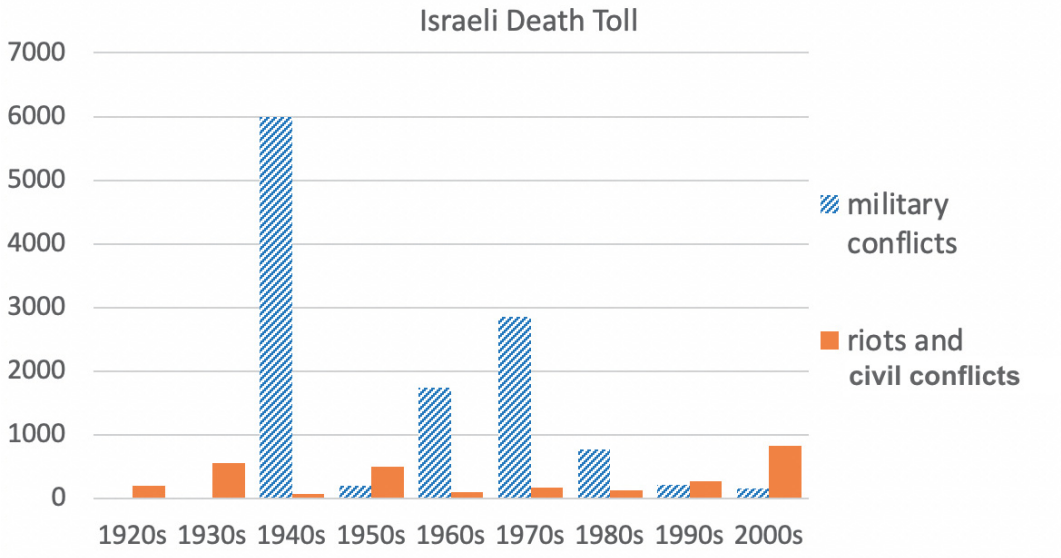


Figure 2.1: Israeli death numbers

threats peaked in 1948 when the British withdraw from the region and left nascent Israel alone to defend the imminent attacks from the surrounding Arab countries.

The victory of the 1948 Israel-Arab war won Israel a foothold in the Middle East. The newly established Israel Defense Force, while not invincible, were able to defend the borders. As a result, Phase Two from 1948 to 1979 saw a decreased threat level, albeit intermittent Arab-Israeli wars, and rejections from the Arab countries to recognize Israel. The 1979 Israel-Egypt peace treaty marked the beginning of Phase Three — the normalization between Israel and its Arab neighbours. The recognition from the strongest one meant the rest of the Arab neighbours were no longer threatening rivals to the Jews. Although civil conflicts arose in the late 1980s, the threats from civil conflicts were not comparable to those from regular wars.

The aforementioned division of Jewish history can be reaffirmed by Figure 2.1, in which the death number of the Israelis is used as an approximation for the threats faced by the Israelis (the numbers come from various sources, see Appendix A.1).[17] It is clear that the Israelis faced constant military threats from hostile Arabs within and surrounding Palestine throughout the twentieth century. Against this threat, the country used an arsenal of defenses, one of which was the kibbutzim.

[17]This thesis focuses on one side (Israel) of the conflict because the main interest is in the Kibbutz. It does not take sides on the Israeli-Palestinian conflict.

Chapter 3

A Model of Collective Defense

Here the kibbutz is modelled as an institutional defense strategy. To illustrate the superior defense capacity of the kibbutz, the analysis first presents the security concerns faced by private income communities due to the under-provision of public defense. Compared to the benchmark — the public defense level under zero transaction cost, the members under-produce the public defense under private income arrangements, because they can benefit from allocating more effort on producing private goods, while free-riding on others' provision of public defense. This free-riding problem is inevitable as long as it is costly to monitor the effort allocated on public defense.

The equal-sharing income rule adopted by the kibbutzim can solve this problem by constraining the incentive on consuming and producing private goods. When the income is equally shared, private goods become *de facto* public goods, and the members no longer have the incentive to under-provide the public defense. But the high defense of equal-sharing communities comes at the cost of adverse selection — the high productivity members suffer from sharing their output with the low productivity ones.

Now the choice of the income arrangements hinges on the external threat level. So long as the external threats are high, the loss of the high productivity members can be justified by the extra defense induced by the equal-sharing arrangements. But once the environment becomes safer, the cost of adverse selection under the equal-sharing arrangements surpass the benefit of inducing high defense capacity. As a consequence, the communities must privatize the income to retain those high productivity members.

To set up the model, consider a community with N members. Each member allocates the effort e_i between producing a private good (food), and a public good (public defense).[1] The total effort available is normalized to 1. The community foresees an expected damage S

[1] A private good refers to a rival and excludable good, in contrast to a public good. It does not imply private ownership.

from sabotage.[2] The damage can be mitigated by the aggregate public defense contributed by all members. For instance, defensive infrastrucutres like fences, mines, and trenches can deter attackers and reduce damages. The remaining damage is equally shared among the members. To avoid making any structural assumption on the utility function, the damage S is measured in the loss of food. Correspondingly, public defense is produced to preserve food.

Defense involves patrolling, digging trenches, building fences, manufacturing and laying mines, standing sentry, etc. Members are heterogeneous in their food productivity. However, it is assumed that members are homogeneous in the productivity of public defense, as every member receives the same military training and holds a gun on guard duty. While some members might be better at shooting, the variance in ability was unlikely large. Otherwise, specialization in the defense would have been observed in the kibbutzim — either kibbutzim hired outsiders for security, or some kibbutz members guarded the village for full time. The fact that neither was observed indicated that any variance in the defense abilities was not significan.[3] [4]

Member i's production function for food and public defense are $z_i F(1-e_i)$ and $G(e_i)$ respectively, where z_i is a shift parameter in food productivity to capture the heterogeneity and publicly known by every member. Both production functions are increasing and concave in effort, with $F(0)=0$, $G(0)=0$. To ensure an interior solution, it is assumed that the marginal productivity is zero when a member is exhausted: $F'(1)=0$ and $G'(1)=0$.

3.1 First-Best Solution

In terms of a benchmark, consider the first-best solution (the zero transaction cost solution). Here, the objective of the community is to maximize the food surviving from the damage caused by adversaries. To simplify the model, the damage S is assumed to be sufficiently large such that effort on public defense can always mitigate damage and preserve food (for a rigorous proof in Appendix B, this assumption will be relaxed to show the effect of

[2]Members are assumed to be risk neutral, so that the focus is on public good provision rather than on risk sharing.

[3]Even the security commander in Kibbutz Makom did regular job like the other members. See Lieblich 1981, p61

[4]Observations in California gold mines support that the miners have small variance in the ability to use pistols (Umbeck 1981).

decreasing damage S on institution choices). Thus, the community maximizes the total food surviving damage:

$$\max_{e_1,e_2...e_N} \quad \sum_{i=1}^{N} z_i F(1-e_i) - [S - \sum_{i=1}^{N} NG(e_i)] \tag{3.1}$$

The optimal effort e_i^* of each member equates the individual marginal product of food with the marginal product of public defense for the *whole community*:

$$\frac{dz_i F(1-e_i^*)}{d(1-e_i)} = \frac{NdG(e_i^*)}{de_i} \tag{3.2}$$

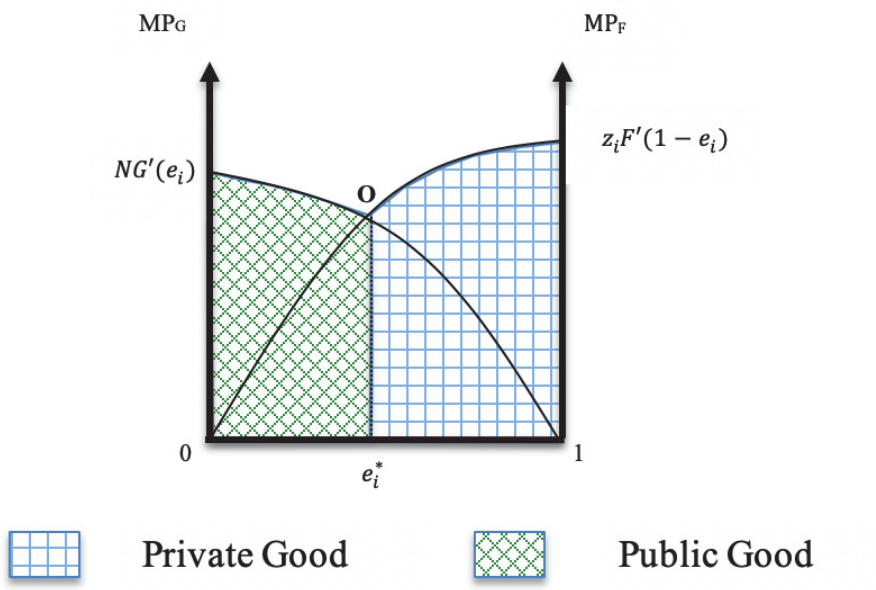


Figure 3.1: Model illustration: first-best effort

Figure 3.1 gives a geometric interpretation of the effort allocation by member i. The optimal choice for the whole community is at e_i^*. At this effort level, the marginal product curve of food ($z_iF'(1-e_i)$) intersects with the marginal product curve of public defense for the whole community ($G'(e_i)$), and the sum of food (in Figure 3.1) and public defense (in Figure 3.1) is maximized.

Of course, the first-best solution does not exist in a positive transaction costs world, where the allocation of effort is costly to measure. Members may save effort on public defense by reducing the frequency of patrolling the community border, taking a nap while standing sentry, building low quality fences, or simply carrying one's duty absently. Whenever the community incurs unexpected damage, everyone knows the public defense is under-provided,

but it is hard to assign blame to any specific member. Since every member's effort on the public defense is mixed together, no one can be solely held accountable for the under-provision of the public defense.

In the presence of transaction costs — in this case, the cost of monitoring and enforcing other members' effort on public defense — economic outcomes differ under various types of income arrangements. I analyze two income arrangements: the private income arrangement, under which each member consumes the food produced by oneself, and the equal-sharing income arrangement, under which each member equally shares the aggregate food produced by all members.

3.2 Private Income Solution

Under a private income arrangement, each member maximizes the sum of the food produced by the member and survives damage:

$$\max_{e_i} \quad z_i F(1-e_i) - \frac{1}{N}[S - \sum_{i=1}^{N} NG(e_i)] \tag{3.3}$$

The equilibrium effort $\hat{e}_i$ of each member equates the marginal product of food and the marginal product of the public defense for *himself*:

$$\frac{dz_i F(1-\hat{e}_i)}{d(1-e_i)} = \frac{dG(\hat{e}_i)}{de_i} \tag{3.4}$$

Proposition 1

Under a private income arrangement, public defense is under provided while food is over provided, as $G(e_i^*) \geq G(\hat{e}_i)$, and $F(1-e_i^*) \leq F(1-\hat{e}_i)$.

This is the classic public goods problem where public defense is under provided, because members only consider their own benefit and ignore the positive externality on the whole community. Yet, a contract over the level of effort on the public defense is not feasible, as some dimensions of effort allocation are not observable.

3.3 Equal-Sharing Income Solution

Under an equal-sharing income arrangement, each member only gets one Nth of the food produced. Each member maximizes an equal share of the food surviving damage:

$$\max_{e_i} \quad \frac{1}{N}\sum_{i=1}^{N} z_i F(1-e_i) - \frac{1}{N}[S - \sum_{i=1}^{N} NG(e_i)] \tag{3.5}$$

The equilibrium effort $\tilde{e}_i$ of each member equates the marginal product of one Nth of the food produced by oneself and the marginal product of public defense for *himself*:

$$\frac{1}{N}\frac{dz_i F(1-\tilde{e}_i)}{d(1-e_i)} = \frac{dG(\tilde{e}_i)}{de_i} \tag{3.6}$$

Notice that once Equation 3.5 is normalized by N, it is equivalent to Equation 3.1. Equilibrium equation 3.6 can also be rearranged to equilibrium equation 3.2. It naturally leads to Proposition 2:

Proposition 2

Under an equal-sharing income arrangement, the provision of the public defense and food is at the first-best level, as $G(\tilde{e}_i) = G(e_i^*)$ and $F(1-\tilde{e}_i) = F(1-e_i^*)$

Under an equal-sharing income arrangement, the incentive to produce food is suppressed, as each member only gets a share of the food produced by oneself. This moral hazard problem decreases the food effort level and increases the effort level on the public good. As a result, the effect of the moral hazard counteracts the effect of the positive externality on the public good. Thus, an equal-sharing income arrangement brings back the provision of the public good to the first-best level.[5]

In Figure 3.2(A), the optimal effort under a private income arrangement is $\hat{e}_i$, where the marginal product curve of food ($z_i F'(1-e_i)$) intersects with the marginal product curve of public defense for oneself ($\frac{1}{N}G'(e_i)$). The effort on public defense is under-provisioned, which leads to a dead weight cost (▨ in Figure 3.2).

In Figure 3.2(B), the optimal effort under an equal-sharing income arrangement is $\hat{e}_i$, where the marginal product curve of one-Nth food ($\frac{1}{N}z_i F'(1-e_i)$) intersects with the marginal product curve of public defense for oneself ($\frac{1}{N}G'(e_i)$). The equal-sharing income arrangement restores the equilibrium effect back to the first-best level, and avoid the dead weight cost.

3.4 The Choice over Income Arrangements

Though an equal-sharing income arrangement induces the first-best effort on the public good, it is not a free lunch. Otherwise, kibbutzim would not have privatized the income in the 1990s, and equal-sharing income arrangements would not have been so rare. The cost is adverse selection — the high productivity (in food) members incur a loss when sharing food

[5]Since the members cannot consume leisure, the problem of shirking does not enter the model. In reality, the shirking problem was minimized by the distinct rules of traditional kibbutzim (See Section 4.1).

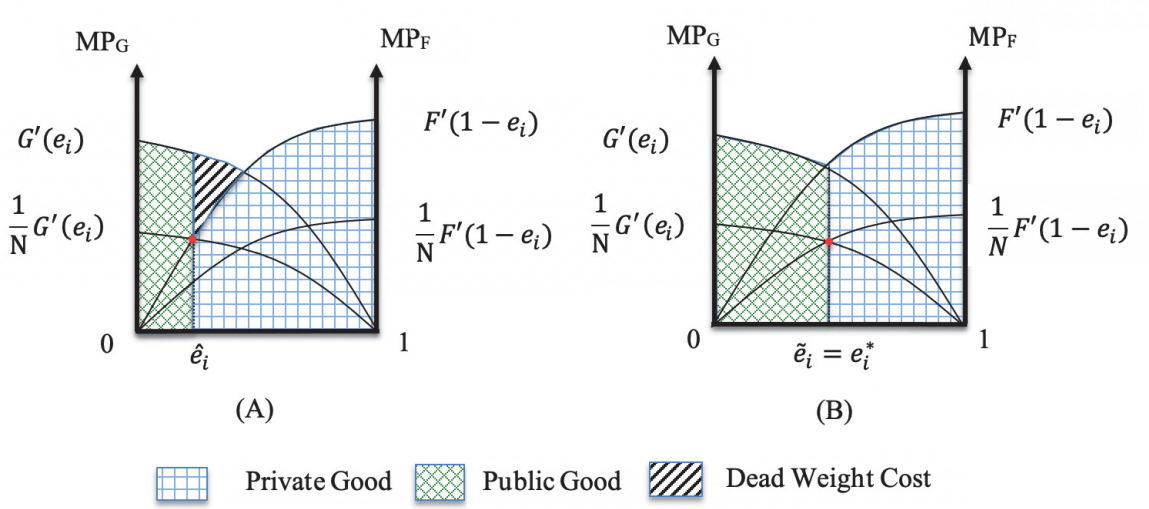


Figure 3.2: Model illustration: second-best effort.

On Figure (A), optimal effort under private income arrangements is $\hat{e}_i$. On Figure (B), the optimal effort under equal-sharing income arrangements is $\tilde{e}_i$

with others. The severity of the adverse selection increases in the degree of heterogeneous in food productivities among the members, and the total amount of food produced.

The members thus have to choose between the lesser of the two evils: (1) adopting an equal-sharing income arrangement, thereby inducing a high provision of public defense, but allowing high productivity members to leave, or (2) adopting a private income arrangement, thereby avoiding the adverse selection problem, but suffering an under-provision of public defense. The optimal choice depends on the security situation faced by each community.

Assume the income arrangement of the community is determined by a simple majority vote among formal members, as the mechanism used by kibbutzim in the 1990s. A member will vote for the income arrangement under which the food damage is larger. When a community locates in a dangerous area and foresees large damage, the members choose the equal-sharing income arrangement to maintain a high level of public defense. As the damage to the community decreases, the benefit of the additional public defense provided by the equal-sharing income arrangement diminishes. Also, the adverse selection problem gets worse, because the members shift effort from producing public defense to producing food. As a result, the most productive member will vote for the private income arrangements, then the second most productive one, then the third... Eventually, the median voter will vote for the private income arrangements increases, and the community will abandon the equal sharing rule and privatize income (see Appendix B for the proof).

Figure 3.3 illustrates the food remaining for the median voter. when the damage is large, equal-sharing arrangements can induce a higher public defense, and hence preserve more food (from Proposition 2). As the damage decreases, all members shift their effort from

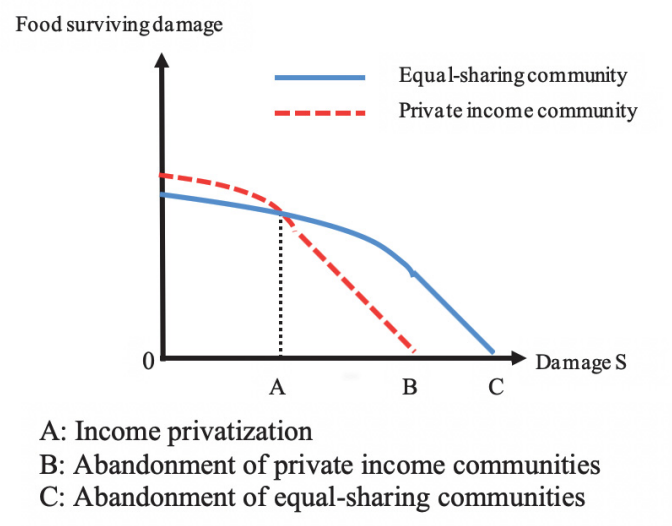


Figure 3.3: Model illustration: total food remaining for the median voter

producing public defense to producing food. As a result, the benefit of the higher public defense under equal-sharing arrangements reduces, while the cost of equal-sharing the food for the median voter increases. Once the damage is below point A, the median voter will vote for the equal-sharing community, and the community will privatize the income.

Prediction 1 *Communities maintain equal-sharing income arrangements in relatively dangerous environments, while privatizing income when the external threats decrease.*

3.5 Central Planner Decision

Since the Jewish settlements at the early years were heavily subsidized by the Jewish agency, it is also crucial to understand the choice of a central planner who can determine the location and the type of settlements.

Consider a simple sequential game. At the first stage, the central planner decide the type of community to be established on a specific location. At the second stage, given the external threat level, the members of the established community choose their effort allocation and whether they should abandon the community, as described in the previous sections.

Knowing the equilibrium efforts of the communities , a central planner (like the Jewish agency) at the first stage will place equal-sharing income communities in dangerous areas, and private income communities in safe areas. The reason is that such a placement strategy is efficient for both the settlements and the central planner. For settlements, the

placement strategy can avoid costs of switching the income arrangement, which typically involves delineating the contributions in the past and negotiating over the income in the future. For the central planner, the placement strategy can maximize its economic property rights over the territory, since equal-sharing income communities can hold longer under the attack of adversaries. To see that, suppose the communities can be abandoned when the external threats are too large.[6] To be consistent, members can vote for abandoning the community when their food surviving damage is lower than zero (this survival threshold can be interpreted as the value of an outside option).

As just shown in Figure 3.3, when the damage increases, the median voter will vote for abandoning the community at point B under a private income community, while at point C under an equal-sharing community. Hence, equal-sharing communities will hold longer under attacks than private income communities, even If the central planner can force the private income communities not to switch the income arrangement at point A.

Prediction 2 *Other things being equal, a central planner places equal-sharing communities in dangerous areas, while placing private income communities in safe areas.*

3.6 Concluding Remarks

Under external threats, there is no single regime that is both militarily and economically efficient: equal-sharing income arrangements induce strong defense at the cost of adverse selection; private income arrangements avoid this problem at the cost of under-provision of public defense. The optimal institution thus depends on the relative importance between military and economy. When a strong defense is vital to the survival of a community, the community members equal-share the income. Although they sacrifice the short-run economic efficiency, so long as the strong defense helps the community survive conflicts, its members can regain the economic efficiency in the future through income privatization.

In addition to the inter-temporal choice, the tradeoff between different income arrangements can also be reflected in their geographical locations. A central planner like the Jewish leadership will place equal-sharing communities at dangerous places to consolidate tenuous territory claim, while placing private income communities at safe places to achieve their full economic potential.

[6]For example, several kibbutzim were evacuated when they faced overwhelming attacks during the 1948 Israel-Arab war.

Chapter 4

Institutional Evidence

Before conducting empirical tests against the model predictions, I first use the model to explain the unique institutions of the kibbutzim and the extraordinary performance of the kibbutzim during civil and military conflicts.

In traditional kibbutzim, members are equal in all aspects. All products and income, including army pay, financial support from parents, and royalties from copyright material, go into a central treasury. To enforce the equal living standard among its members, the kibbutzim abolish private property. The moment newcomers arrive at a kibbutz, they transfer all their belongings to the kibbutz treasury (Leiblich 1981, pp. 19 and 78).

The kibbutzim, in turn, centrally sell all products in the market, and provide various goods and services, covering the needs of members, including housing, food, clothing, child rearing, education, medical care, laundering, and mending.[1] All members receive "equality of supply for equal needs". In principle, every member lives to the same standard, regardless of the amount or the quality of a member's work (Weisman 1966).

The economic equality is further secured by political equality among the kibbutz members. The basic instrument of government is the weekly meeting, in which every member has an equal vote on determining policy, electing a secretariat, and controlling the general operation of the community. While the weekly meeting determines the general policy and rules, the secretariat implements them. They are responsible for financing from banks, purchasing supplies, assigning daily work to the member, and selling kibbutz products (Kerem 1962, pp. 25–26). The managerial positions are rotated every two years to prevent the formation of a privileged class.[2]

[1]The living standards increased over time. Housing, for example, improved from tent to wooden shack without sanitary facilities to permanent housing with bathroom and shower (Kerem 1962, p138).

[2]In fact, a leadership position gives no material benefit, as every member is entitled to the same consumption. Consequently, "kibbutz elections are often one long series of declinations: one candidate protesting that his wife is sick, another confessing his inability to cope with the task. Elections in which candidates actively campaign for positions are unknown."(Kerem 1962, pp. 116)

4.1 Kibbutzim Institutional Confirmations

In light of the model, the distinct rules of traditional kibbutzim become reasonable and even necessary. While the model, based on one private good, argues that equal sharing could constrain the incentive on producing food, in reality there were multiple opportunities for private consumption. The members might still have incentive to save their effort on the public defense, so that they could better enjoy their leisure time, improve their private assets, and develop their personal hobbies. If the traditional kibbutzim were established for defensive purpose, one would also expect to observe supporting institutions suppressing all personal interests.

Indeed, kibbutz institutions were all designed around placing limits on private consumptions. In the absence of differential income, the members may instead spend their efforts in decorating houses, refitting vehicles, or gardening in the personal backyards, thereby increasing their market values. To prevent this, kibbutzim simply abolished all private assets.

But banning personal assets could not stop the members indulging themselves in their personal hobbies at their leisure time. To deal with this problem, kibbutzim adopted a two-pronged approach. On the one hand, the members gave up their privacy — any kibbutz member can go straight into others' rooms without knocking on the door.[3] On the other hand, the kibbutzim provided public facilities like swimming pools, basketball courts, and culture centers so that the members spent most of their leisure publicly (Gavron 2000, pp. 2).

Having suppressed the personal interests on income, asset and personal hobbies, there remained the last loophole — rearing one's own children. To prevent the members, especially the mothers, from spending too much time in accompanying their offsprings, the kibbutzim invented "communal sleeping".[4] Children did not sleep with their parents, but rather slept in designated buildings, where they lived, ate, slept, and studied together. The parents, however, could only visit their children for several hours during the day (Kerem 1962, pp. 78–81; Near 2007a, pp. 237–245). This system ensured that women were free from child rearing and equally contributed to the kibbutz defense.

Complemented with the constraints on personal assets, private leisure, and childrearing, the equal-sharing rule facilitated a high provision of public goods. Consequently, the kibbutzim used the comparative advantage to offer free services including housing, laundry, mending, tailoring, childrearing, newspapers, wedding celebrations, and dining. Compared to other communities, kibbutzim also had a higher provision of local public facilities such

[3] One member recalls "hanging red handkerchiefs on the door if privacy for sexual relations was desired" (Rayman 2014, pp. 52)

[4] Although the system was designed due to the limited housing capacity, it became "part of the ideology of most of the kibbutz movements", according to Near (2007a).

as swimming pools, basketball and tennis courts, cultural centers, and parks (Gavron 2000, pp. 2).

4.2 The Performance of Kibbutzim in Civil Conflicts

Among all the public goods, the high provision of public defense was the fundamental purpose of the kibbutz institutions. During the 1936–1939 Arab revolt, rural settlements had to defend by themselves with limited support from the Jewish leadership (Near 2007a, pp. 309). Kibbutzim, thanks to their institutions, quickly adapted to the dangerous environment.

Kibbutz Hulda increased the number of night guards to 18 — almost the limit for a settlement of 66 members.[5] Although the Jewish Agency provided material support, including extra land and rationed water, it was the kibbutz members who defended against the harassment from snipers, repulsed the storm from an organized band, and held the territory until the end of the revolt (Near 2007a, pp. 313–314).

Kibbutz Makom, with a total population of 40, had 6 to 8 people on duty every night. Since the kibbutz bordered on hostile Arab villages, working on the field while exchanging fires with the Arab neighbors became the daily life of the kibbutz members. All adults, men and women, received training in the use of weapons. Even children were responsible for communication to the regional headquarters, in cases of emergency (Leiblich 1981, pp. 60–63). Chaim Weismann, the first president of Israel, described the life during the period of tension: "The rifle has become a working tool. We don't move without it." (Near 2007a, pp. 312)

Defending the Jewish land against intermittent raids, and sometimes sieges, from Arab bands was not easy. Expanding the Jewish land to contested places within the range of Arab rifles was even harder. Yet, the kibbutzim made it by a novel strategy — "Tower and Stockade".

At the night before the day of settlement, the members of kibbutz Tel Amal departed from the nearest settlement with all their equipment loaded on trucks. Before dawn, they had arrived at the appointed land for their home, under the protection of Jewish police and volunteers from nearby settlements. At first light, they started to build the defense structures — a double wall, a tower with a searchlight, two barbed-wire fences, trenches, and defense posts. By evening, the settlement was ready to defend against the attack of the Arab neighbors. Kibbutz Tel Amal thus became the first Jewish settlement in the Beit She'an Valley, one of the attacking routes of the neighboring Arab countries (Near 2007a, pp. 316–318).

The success of kibbutz Tel Amal convinced the Jewish leadership that kibbutzim were the most appropriate type of settlement at a time of tension. The Jewish leadership thus

[5]The four policemen, sent to the kibbutz as official guards, were not trusted by the kibbutz members.

tilted resources from other settlements to kibbutzim and accelerated the rate of expansion in the strategic areas.

4.3 The Performance of Kibbutzim in Military Conflicts

The strong defense of the kibbutzim not only repulsed harassment and infiltrations during the civil conflicts but also delayed and halted the advance of regular armies during the 1948 Israeli-Arab War.

On the eastern front, Kibbutz Gesher, with the help of one Israeli brigade, withstood the attack from the Iraqis for five days and forced them to withdraw and redeploy in Samaria (Morris 2008, pp. 245–248). Kibbutz Degania Aleph and Degania Bet, with limited help from Jewish troops, halted the advance of two Syrian infantry battalions along with twelve tanks and twenty armored cars. They even immobilized two tanks by grenades and Molotov cocktails. After fighting grimly for two days, the kibbutzniks beat back the Syrians (Morris 2008, pp. 254–257).

On the southern front, one Egyptian battalion attacked Kibbutz Kfar Darom. After dozens of casualties, the battalion withdrew and bypassed the kibbutz. The next target was Kibbutz Yad Mordechai. Unlike Kfar Darom, the Egyptians had to conquer Yad Mordechai, as it is located on a hill, dominating the coastal road. The Jewish leaders also understood the importance of the kibbutz, ordering the defenders to withhold the attack and delay the Egyptians for as long as possible. On May 20th, 110 kibbutz members (twenty of them were women) and two squads of Jewish soldiers, resisted seven joint assaults from two Egyptian battalions, inflicting dozens of dead on the Egyptian side. The Egyptians added another battalion and resumed the attack on May 23rd. By nightfall, the toll of kibbutz casualties had exceeded 50 percent, but their reinforcement had been blocked by the Egyptian air force. They had no choice but to disobey the orders and retreat (which was criticized by the Jewish prime minister, Ben-Gurion). The Egyptians conquered Kibbutz Yad Mordechai, but their advance was delayed by at least four days. The delay gave the Israeli Giv'ati Brigade enough time to rally, and eventually halt the Egyptians at Isdud. The Egyptians lost the initiative from then on (Morris 2008, pp. 235–242).

In all cases, kibbutz members, with inferior weapons, contained the Arab armies. Although the battle results were affected by many unobserved factors, the actual performance of the kibbutzim provides strong anecdotal evidence for the claim that kibbutzim can induce a high public defense and survive under fierce attacks. It is also evident that the Jewish National Foundation and the Jewish government fully understood the strong defensive capacity of the kibbutzim, purposefully placed them at the frontiers to delay the attackers, and purchased enough time for the eventual victory.

4.4 Economic Distortion

The high provision of public goods comes at the cost of adverse selection. As predicted by the model, the more productive members in kibbutzim demand income privatization first. In reality, when institutional reforms were not feasible, they could simply quit the kibbutzim. Before the independence of Israel, kibbutzim already found it hard to retain high productivity members — only a handful of doctors were successfully integrated (Kerem 1962, pp. 48–49). The subsequent military success further undermined the foundation of the equal-sharing rule. In a survey involved 900 kibbutz members in 1969, Rosner et al. (1990, pp. 158) report that at least 23 percent of the old generation kibbutz members did not object to differential wages. This ratio rose to 36 percent when it came to the young generations, who were generally better educated and more productive. One direct consequence was the increase in the numbers of the kibbutz-born adults who left their home — between 1970 and 1977, 53 percent of them left their kibbutzim (Near 2007b, pp. 273).[6] Once the environment became safer, the adverse selection problem aggravated. In the late 1980s, 2000 to 3000 kibbutz members per year (or 610 residents per kibbutz per year) exited kibbutzim. Abramitzky (2008) provides empirical evidence showing that "kibbutz leavers are more educated, more skilled, and have higher expected earnings upon exit than stayers."

In addition to causing the exit of high productivity members, the equal-sharing rule also hindered the recruitment of the new members. Since low productivity members were detrimental to the equal-sharing institution, the kibbutzim set a stringent admissions requirement. Facing the large wave of European immigrants surviving WWII, the Kibbutz Me'uhad (one major kibbutz movement representing some 56 kibbutzim) generally refused to admit any one of 40 years old or more. Some kibbutzim only admitted "young intellectual Czechs or Yugosalvs, with no more than one child". As a result, the immigrants absorbed by kibbutzim between 1948 and 1949 only accounted for 15 percent of the total kibbutz population in 1949. Meanwhile, the percentage was at least 34.7 for other rural settlements (Near 2007b, pp. 173,174).

Consequently, the land per capita in the kibbutzim in 1949 was 13.6 dunams per member, which was more than double of the corresponding value in the moshavim (one type of private income settlements) (5.27 dunams per member).[7] Similarly, Sadan (1963) finds that the land per capita in the kibbutzim in 1954 was almost three times as large as the number in the moshavim. As a result, the marginal productivity of kibbutz labor was almost twice as high as that of moshav labor, while the marginal productivity of kibbutz land was 74

[6] While this number only applied to one movement — the Kibbutz Artzi, the proportion was "about the same for other movements" (Near 2007b, pp. 273).

[7] The landholdings of kibbutzim and moshavim in 1949 comes from Near (2007b, pp. 146). The population of kibbutzim and moshavim in 1949 comes from Near (2007b, pp. 174). 1 dunam is 1000 square meters.

percent of the corresponding value of moshav land.[8] Sadan estimates that the kibbutzim could increase their gross output by eight percent should they admit hired labor in the agricultural branches.

Sadan was not the only one who thought the kibbutzim underemployed labor. In the 1950s, the Israeli public blamed the kibbutzim for not absorbing new immigrants to their full capacity. The Prime Minister of Israel, Ben Gurion, expressed his disappointment in 1950: "What have they [the kibbutzim] done for the immigrants? ... There has never been such a failure ... how are they [immigrants who want to be simple farm-workers] being absorbed? What is the attitude towards them? The very values of pioneering are being called into question — and I know what pioneering used to be!" It was unambiguous that the kibbutzim were unwilling to recruit a large number of immigrants or to use them as hired labors. But it was quite ironic for the Israeli public, including Ben Gurion, to attribute the cause to the decline of the pioneering spirit. According to the model, the kibbutzim's pioneering spirit proved in defending the states was the direct result of the equal-sharing rule — an institution that could only survive when the kibbutzim exerted extreme cautious in admitting new members and refused to use hired labors.[9] After all, there was no free lunch in having equal-sharing communities to defend the state.

4.5 Concluding Remarks

The strong defense and the equal-sharing arrangement of the kibbutzim were the two sides of the same coin. On the one side, in order to induce high efforts on members on producing public defense, kibbutz must abolish private income, privacy, and private consumptions. Women left their children growing up in the children's house, so that they could equally participate in the defense. As a result, kibbutzim repelled numerous attacks during civil and military conflicts. To further exam how the environment affects the choice of various settlements, Chapter 5 and Chapter 6 uses a settlement-level dataset to test the prediction that the Jewish leadership places kibbutzim in dangerous areas, while placing non-kibbutzim in safe areas.

[8]Sadan fits the data on labor, land, capital, and gross output into a Cobb-Douglas function, and estimates the marginal productivity of those inputs. The sample he uses includes 198 observations in 66 kibbutzim during the period 1953–1955 and 330 observations in 66 family farms in 5 moshavim during the period 1954–1958. The sample size may be too small, but a larger sample including 32 moshavim and 221 kibbutzim stills shows that the land per capita in the kibbutzim was more than double of the corresponding value in the moshavim. Hence the results estimated from the small sample should be qualitatively similar to the results estimated from the larger sample.

[9]In fact, the adverse selection problem cannot be fully mitigated even under such stringent scrutiny. Abramitzky (2009) shows that individuals entering kibbutzim between 1983 and 1995 had lower pre-entry wage compared with non-entrants and individuals entering other rural settlements.

On the other side, the costs of the kibbutz institutions — the adverse selection problem and the underemployment of the labor — were justified by the strong defense required to protect the kibbutzim. So long as the kibbutzim still faced external threats, they could resist the pressure of adopting various reforms, including income privatization and loosening the admission standard. However, when the threats faded away, the kibbutzim had to begin their transformation. To further exam how the threats level determine the timing of income privatization, Chapter 7 uses a kibbutz-level dataset to test the prediction that kibbutzim privatizes their income only when the external threats decrease.

Chapter 5

The Jewish Territory Expanded by Kibbutzim

As discussed in Chapter 2, the Jews established the State of Israel through the 1948 Arab-Israeli War. This war could have been avoided, should the Arabs agreed with the UN partition plan. In that counterfactual world, the Israelis could have held 56 percent of the Palestine land. Albeit a smaller territory, it would still have been a miracle for the Jews, considering their starting point — 0.8 percent of the Palestine land in 1900. Evidence (see 5.2) from the partition plans attributed this rapid growth in the legal territory mainly to the facts created on the ground — the Jewish rural settlements.

The Jewish leadership understood the importance of the settlements from the beginning and set up Jewish National Foundation as the central planner to allocate lands to rural settlements.[1] According to Moshe Shertok, the head of the Jewish Agency's political department, the purpose was "to ensure that even if there is a decision in favour of partition or canonization, the damage it does will be minimized... I know of no more pressing task, no more effective weapon, than founding settlements in [border] areas, and thereby creating facts." (Near 2007a, p319) The fact that the Jewish National Fund knew the type of settlements that settlement members intended to establish when they apply for land grants, allowed it to assign lands to settlements according to their defensive capacity.

The model predicts that the Jewish leadership places kibbutzim in dangerous areas, while placing non-kibbutzim in safe areas. To test the model prediction, the following sections will use a settlement-level dataset to examine the response of settlement patterns to the changing security conditions faced in different locations and different times.

[1]Organized in 1901, the Jewish National Fund held 90 percent of land newly purchased by the Jews by 1930 (Abu-Lughod 1971, p128).

5.1 Settlement Data

To empirically test the prediction, I compile a settlement dataset covering 858 Jewish rural settlements of all types since 1900. For each settlement, the data includes the location, type, and year established. I then use Geographic Information System (GIS) to construct the attacking routes of surrounding Arab countries based on topography and measure the threats faced by different forms of settlements by their locations relative to the attacking routes. The data sources are explained below.

Settlement data

Settlement data containing the location and year of establishment, are compiled from various resources. The location of all existing rural settlements are obtained from Google Map API. The year of establishment are obtained from the Israel government.[2] Among the existing settlements, three of them are formed by an ideological split in 1952.[3] They are included in the kibbutz level data for income privatization analysis, as they make reform decisions independently since 1989. But they are excluded from the settlement level data for location analysis, to avoid double counting the establishment of the same settlements.

The information of settlements that once existed but were later deserted are compiled from various archives. During the 1948 Israel-Arab War, 8 settlements were destroyed by the Arab armies.[4] In 1982, as part of the Israel-Egypt treaty, Israel evacuated 13 rural settlements from the Sinai.[5] In 2005, Israel unilaterally disengaged from the Gaza Strip and North Samaria. As a result, 16 rural settlements in the Gaza Strip and 4 rural settlements in the North Samaria were evacuated.[6]

[2]Accessed on May 11, 2018 from https://www.cbs.gov.il/he/pages/default.aspx

[3]Ein Harod split into Ein Harod (Ihud) and Ein Harod (Meuhad). Ashdot Ya'akov split into Ashdot Ya'akov (Ihud) and Ashdot Ya'akov (Meuhad). Giv'at Hayyim split into Giv'at Hayyim (Ihud) and Giv'at Hayyim (Meuhad).

[4]The established years and types of those settlements are obtained from Fischbach (2003, p157). The locations are obtained from Lorch and Moshe (2007).

[5]The established years, types, and the locations of those settlements are obtained from Lesch (1977) and MERIP Reports (1977).

[6]The established years and types of those settlements are obtained from the Israel government central bureau statistics 2004 locality list file, cross checked with the changes in localities from 1948 to 2016 file. The two files are accessed on Aug 27th, 2019 from
https://www.cbs.gov.il/he/publications/doclib/2019/ishuvim/index2004.xls
https://www.cbs.gov.il/he/publications/doclib/2019/ishuvim/change2016.xls
The locations are obtained from Israel Ministry of Foreign Affairs, which is accessed on Aug 27th, 2019 from: https://mfa.gov.il/MFA/AboutIsrael/Maps/Pages/Israels%20Disengagement%20Plan-%202005.aspx.

Geographic Information

The military intervention of the neighbouring Arab armies was the major threat faced by the Jewish settlements before the peace treaties with Egypt and Jordan. In order to measure that, I use QGIS to construct the optimal attacking routes based on geographic information, including the elevation and impassable places like lakes in the Israel-Palestine region.

The elevation data comes from the Global Multi-resolution Terrain Elevation Data (GMTED2010) developed by the National Geospatial-Intelligence Agency.[7] Elevations in GMTED2010 are spaced at 7.5 arc-seconds, or 225 meters at the equator, across the entire surface of the Earth.

Vilnay (1968) records the location of the two large lakes (the Lake Kinneret and the Dead Sea) at the Israel-Jordan border. The map is digitalized, and the area covered by the two lakes is marked as impassable in the GIS system. The maps of the partition plans are obtained from United Nations.[8]

Apart from the military pressure, the Jewish National Foundation may also place the settlements in fertile land to maximize the economic benefit. To control the land fertility, the analysis uses the wheat cultivation potential, which is obtained from the Global Agro-Ecological Zones (GAEZ) project run by the Food and Agriculture Organization (FAO).[9] GAEZ estimates the upper bound for individual crop yields at a resolution of 30 arc-seconds, or 900 meters at the equator, based on detailed grid cell-level data on agroclimatic (precipitation, temperature, wind speed, sunshine exposure and rainfall), soil types, elevation, terrain slopes.[10] This analysis uses the agro-climatically attainable yield for intermediate input level irrigated wheat, because it is largely consistent with the land quality classification, based on a soil survey carried out in 1946 by the Departments of Agriculture, Lands, Irrigation and Statistics for the Anglo-American Committee of Enquiry (Hadawi 1957, pp. 6; see Appendix C.1 for a comparison).

[7]Danielson, J.J., and Gesch, D.B., 2011, Global multi-resolution terrain elevation data 2010 (GMTED2010): U.S. Geological Survey Open-File Report 20111073, 26 p. http://pubs.usgs.gov/of/2011/10pdf/of2011-1073.pdf

[8]The 1947 UN partition plan: https://www.un.org/unispal/document/auto-insert-208958/
The 1937 Peel Commission partition plan https://www.un.org/unispal/document/auto-insert-207683/

[9]FAO/IIASA, 2011. Global Agro-ecological Zones (GAEZ v3.0). FAO Rome, Italy and IIASA, Laxenburg, Austria. The data is downloaded from http://gaez.fao.org/Main.html on May 4, 2019

[10]Documentation on GAEZ data is available on
http://pure.iiasa.ac.at/id/eprint/13290/1/GAEZ_Model_Documentation.pdf

Table 5.1: Summary statistics for Peripheral Settlements before 1935

	Obs	Mean	Std. Dev.	Min	Max
Kibbutz	92	.5	.503	0	1
Peripheral Settlement 1km	92	.239	.429	0	1
Peripheral Settlement 2km	92	.337	.475	0	1
Peripheral Settlement 3km	92	.38	.488	0	1
Peripheral Settlement 4km	92	.478	.502	0	1
Neighbouring Jewish Settlements within 1km	92	.244	.375	0	1.39
Neighbouring Jewish Settlements within 2km	92	.66	.575	0	2.08
Neighbouring Jewish Settlements within 3km	92	1.01	.7	0	2.48
Neighbouring Jewish Settlements within 4km	92	1.3	.785	0	3.04
Water Distance	92	3.98	2.95	.175	14.5
Agriculture Potential	92	6.21	.504	3.97	6.47

Table 5.2: Summary statistics for Peripheral Settlements before 1947

	Obs	Mean	Std. Dev.	Min	Max
Kibbutz	219	.63	.484	0	1
Peripheral Settlement 1km	219	.251	.435	0	1
Peripheral Settlement 2km	219	.329	.471	0	1
Peripheral Settlement 3km	219	.438	.497	0	1
Peripheral Settlement 4km	219	.534	.5	0	1
Neighbouring Jewish Settlements within 1km	219	.147	.312	0	1.39
Neighbouring Jewish Settlements within 2km	219	.502	.546	0	2.08
Neighbouring Jewish Settlements within 3km	219	.831	.686	0	2.48
Neighbouring Jewish Settlements within 4km	219	1.13	.767	0	3.04
Water Distance	219	5.2	6.54	0	49.2
Agriculture Potential	219	6.08	.726	0	6.52

Table 5.3: Summary statistics for Peripheral Settlements after 1967

	Obs	Mean	Std. Dev.	Min	Max
Kibbutz	247	.17	.376	0	1
Neighbouring Jewish Settlements within 1km	247	.0342	.162	0	1.1
Neighbouring Jewish Settlements within 2km	247	.227	.414	0	1.79
Neighbouring Jewish Settlements within 3km	247	.418	.563	0	2.2
Neighbouring Jewish Settlements within 4km	247	.64	.673	0	2.3
Water Distance	247	19.2	30.1	.121	269
Agriculture Potential	247	4.8	1.67	0	6.52

Table 5.4: Variable Definitions

Kibbutz	Binary variable indicating whether the settlement is a kibbutz: equals to 1 if yes; 0 otherwise.
Peripheral Settlement 1, 2, 3, 4km	Binary variable indicating whether the settlement is located in peripheral areas: equals to 1 if the distance to the boundary of the Jewish state in the partition plan is less than 1, 2, 3, 4km; 0 otherwise.
Neighbouring Jewish Settlements within 1, 2, 3, 4km	the log transformation of the number of Jewish settlements within 1, 2, 3 ,4km of the settlement
Water Distance	Distance to the nearest water resource, including perennial rivers, springs containing less than 500 mg chlorine per litres, and Lake Kinneret (km)
Agriculture Potential	Attainable yield for intermediate input level irrigated wheat (ton dry weight per ha)

5.2 Settlements in the Expansion of the Legal Territory

Before conducting empirical test against the settlement locations, I shall first show that the Jewish rural settlements were the main factor to which those partition committees referred, when proposing the territory ruled by the Jews.

According to the Peel Commission report, "the natural principle for the Partition of Palestine is to separate the areas in which the Jews have acquired land and settled from those which are wholly or mainly occupied by Arabs..." (Peel Commission Report, pp. 382).[11] Most frontiers were drawn along the rural settlements, while the northern part was considered as "a reasonable allowance ... for the growth of [Jewish] population and colonization..."

[11]the full report of Peel Commission is accessed on Oct 2, 2019 from https://unispal.un.org/pdfs/Cmd5479.pdf

(Peel Commission Report, pp. 383). The UN partition plan follows the similar principle. It allocated areas with "no Jews" or "only a very small minority of Jews" to the Arab State, while increased "the proportion of Arabs to Jews in the Jewish State" so that the Jewish State can include a "a larger number of Jews as well as a larger land area" (UN Resolution 181). Fair or not, the two committees assigned the Jewish State mainly the lands that the Jews had already settled .

Figure 5.1 shows the relationship between the Jewish rural settlements in 1935 and the Jewish territory (the blue area) recommended in the Peel partition plan.[12] A red star represents a moshav, while a blue triagle represents a kibbutz. Though not obvious in Figure 5.1, kibbutzim made a greater contribution than other forms of settlement in shaping the legal boundary (see the following subsections).

Figure 5.2 shows the relationship between the rural settlements in 1947 and the Jewish territory (the blue area) recommended in the UN partition plan.[13] Once again, the borders of the Jewish state in the partition plan were mainly defined by the kibbutzim established at the peripheral areas (see the following subsections).

5.3 Kibbutzim as Peripheral Settlements

The above observations can be verified by the following Linear probability regression (Logit regressions show similar results. See Appendix C.3):

$$Kibbutz_i = \beta_1 Peripheral\ settlement_i + \gamma X_i + \epsilon_i \tag{5.1}$$

where $Kibbutz_i$ is a binary variable: equal to 1 if the settlement i is a kibbutz, 0 otherwise; $Peripheral\ settlement_i$ is a binary variable: equal to 1 if the distance to the boundary of the Jewish state in the partition plan is less than 3km, 0 otherwise (the results are robust for 1km, 2km, or 4km. See Appendix C.2); X_i is a set of control variables, including the distance to the nearest source of water, and the agriculture potential (see Table 5.1 for the summary statistics).

Table 5.5 presents the regression results on the probability of each settlement being a kibbutz. One issue in analyzing the effect of settlements on the proposed Jewish state is how to deal with the 16 settlements that were located outside the boundary. In column (1) and (2), all settlements established up to 1935 are included in the analysis. Settlements that were located outside the proposed Jewish State were assumed to have zero distance to the boundary of the state. In column (3) and (4), only settlements that were located inside

[12]The Peel Commission wrote report mainly based on Settlement patterns in 1935 (Near 2007a, p320).

[13]The UNSCOP made the partition recommendation mainly based on their investigation in the summer of 1947 (Morris 2000, pp. 182–184).

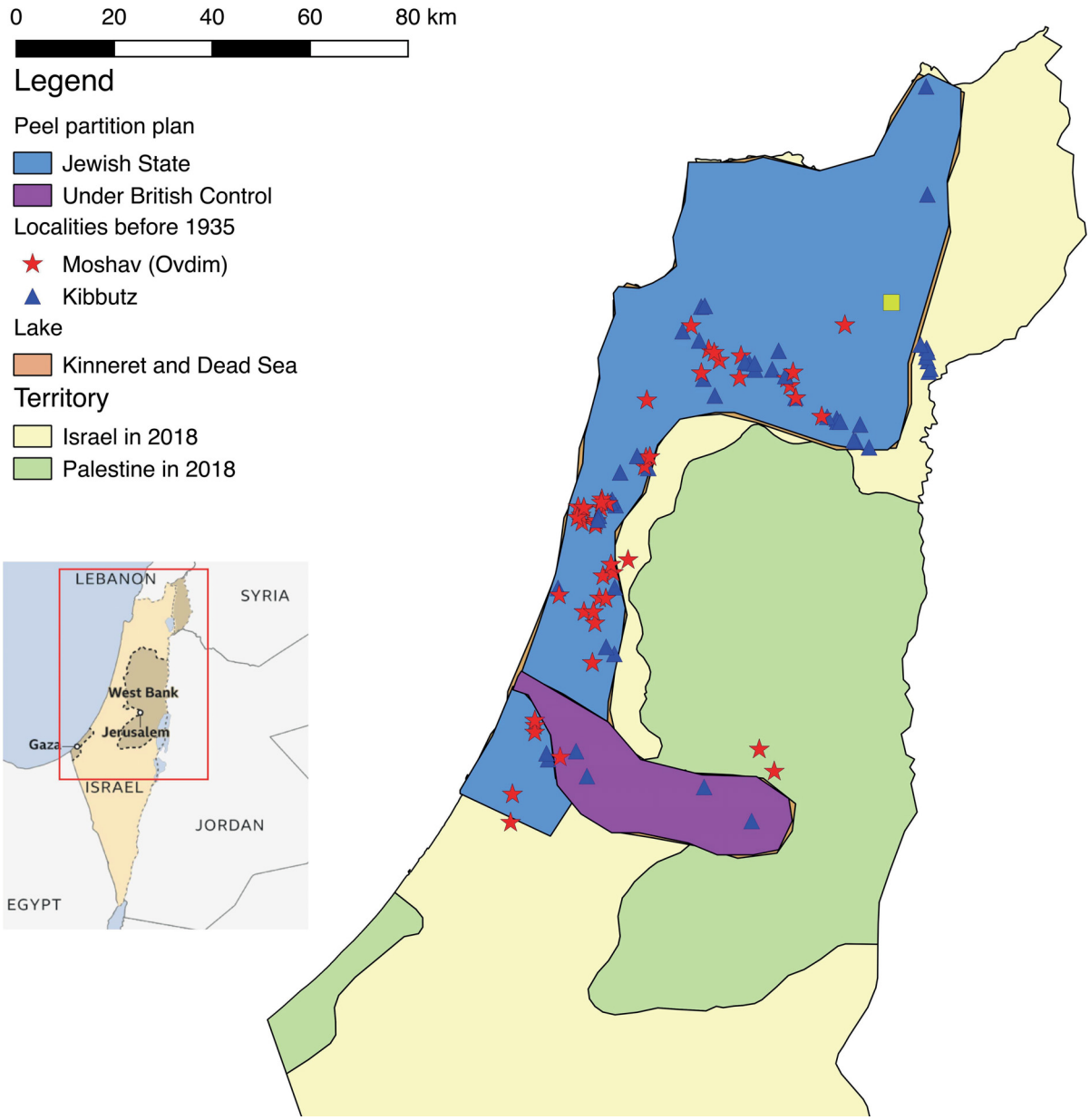


Figure 5.1: Settlement locations relative to the partition plan proposed by the Peel Commission in 1937

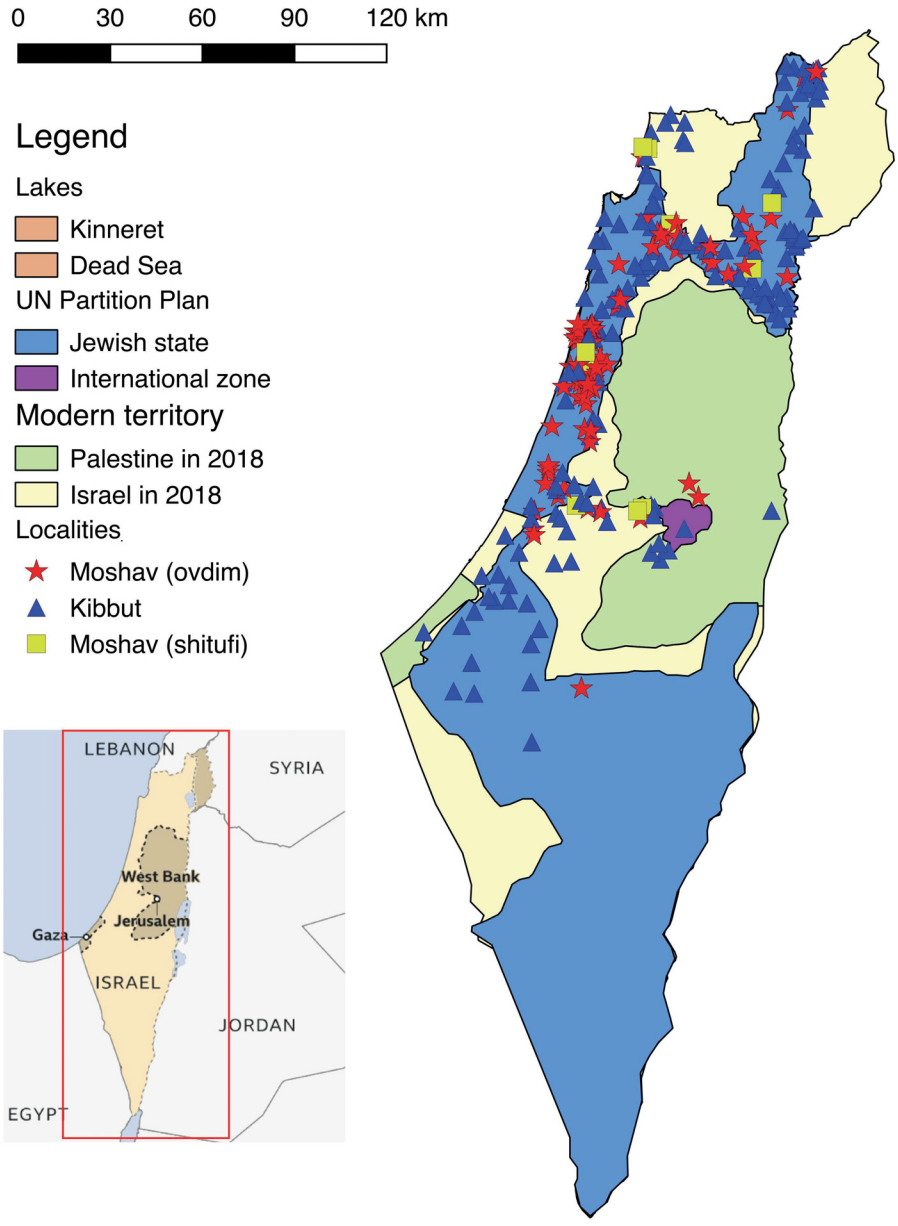


Figure 5.2: Settlement locations relative to the partition plan approved by the United Nations General Assembly in 1947

Table 5.5: Peripheral settlements in the 1937 Peel partition plan

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.208*	.187	.158	.132
	(.106)	(.113)	(.133)	(.136)
Water Distance		-.0239		-.00394
		(.0178)		(.0203)
Agriculture Potential		-.00708		-.257
		(.109)		(.263)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 3km of the boundary of the partition plan. The results are robust for 1km, 2km, or 4km (see Appendix C.2).

the boundary were included in the sample. No matter which method is adopted, the results are biased against the contribution of kibbutzim, as there are more kibbutzim (11) than non-kibbutzim (5) among the settlements located outside the proposed Jewish State (see Figure 5.1).

In all specifications, a peripheral settlement that shaped the boundary of the Jewish state proposed in the 1937 Peel partition plan had a larger chance of being a kibbutz. Taking column 2 for example, the coefficient of **Peripheral Settlement** means settlements established in the peripheral areas were 19 percent more likely to be kibbutzim. The coefficients are not significant, except in column (1), since the Jewish leadership had not fully realized the defense capacities of kibbutzim by 1935.

Once kibbutzim had fully demonstrated their defense capacities during the Arab revolt from 1936 to 1939, peripheral settlements were more likely to be kibbutzim. Using settlements established up to 1947 and the proposed Jewish state in the 1947 UN partition plan, previous linear probability regression is conducted again (Logit regressions show similar results. See Appendix C.5).

Table 5.6 presents the regression results on the probability of each settlement being a kibbutz in the 1947 UN partition plan. The analysis deals with 35 settlements that were located outside the boundary in the same way. In column (1) and (2), all settlements established up to 1947 are included in the analysis. Settlements that were located outside the proposed Jewish State are assumed to have zero distance to the boundary of the state. In column (3) and (4), only settlements that were located inside the boundary were included in the sample. Again, the results are biased against the contribution of kibbutzim, as there are more kibbutzim (31) than other settlements (4) (see Figure 5.2).

Table 5.6: Peripheral settlements in the 1947 UN partition plan

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.277***	.281***	.27***	.267***
	(.065)	(.0672)	(.0756)	(.0762)
Water Distance		.00598		.00228
		(.00517)		(.00573)
Agriculture Potential		-.0175		-.187*
		(.0473)		(.0952)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 3km of the boundary of the partition plan. The results are robust for 1km, 2km, or 4km (see Appendix C.4).

In all specifications, peripheral settlements that shaped the boundary of the Jewish state proposed in the 1947 UN partition plan were more likely to be kibbutzim. The coefficients of **Peripheral Settlements** are positive, and significant at the 1 percent level across all specifications. Taking column 2 for example, the coefficient means settlements established in the peripheral areas were 28 percent more likely to be kibbutzim. The results show that the Jewish leadership systematically placed kibbutzim at the peripheral areas to establish the Jewish legal terrotiry.

5.4 Territory Expansion in the West Bank

The Jewish territory expansion did not end with the independence of Israel. The Six-Day War in 1967 saw Israel occupied the West Bank. While a military presence in the West Bank provided Israel a breathing space when facing a strike from the Jordanian borders, it was not sufficient for securing this region. In a report written by Mattityahu Dropbless to the World Zionist Federation, it stated "... everything will be mainly determined by the facts we establish in these territories" and the West Bank should be settled to "reduce to the minimum the danger of an additional Arab state being established in these territories."

Those settlements eventually helped Israel retain "near-exclusive control over 60 percent of the West Bank" including over law enforcement, planning, and construction, through the Oslo II Accord in 1995.[14] Figure 5.3 shows the relationship between the areas over which

[14]Israel and the Palestine Liberation Organization (PLO) agreed in Oslo II Accord on the temporary administrative division of the West Bank into three zones, referred to as Areas A, B, and C. Palestine retained civil control over Area A and B. Israel retained civil control over Area C (Area C Humanitarian Response Plan Fact Sheet, UNOCHA 2010).

Palestine retained civil control (commonly known as Areas A, B) and the distribution of the Israeli rural settlements in the West Bank when the Oslo II Accord was signed.

The consolidation of the territory in the newly occupied West Bank was mainly carried out by the non-kibbutzim settlements, which were economically efficient but militarily weak. This strategy stood in stark contrast to the pre-state expansion, which was carried out mainly by the kibbutzim. The contrast in the settlement strategy reflects the markedly different security situations faced by the Israeli settlements and provides another test for the theory.

Unlike the hostile environments faced by the rural settlements before the independence of Israel, the heartland of the West Bank was relatively peaceful before 1987. Internally, the Palestinians there had not been desperate enough to commit to armed struggles.[15] Externally, kibbutzim and moshavim had been established at the border to stop infiltrations from Jordan. The different functions assumed by different types of settlements can be better illustrated by looking at the order in which settlements were established. Figure 5.4a shows all Israeli settlements established before 1977. Kibbutzim were the major settlement types at that time, and most of them were located close to the western Jordanian borders. Figure 5.4a shows all Israeli settlements established after 1978. Non-kibbutzim was the major type at that time, and most of them were located in the heartland of the West Bank. The two figures deliver a clear picture: the economically efficient but militarily weak settlement type — non-kibbutzim — were only adopted under the protection of the strongholds — kibbutzim.

The above observation can be verified by the following linear probability regression:

$$Kibbutz_i = \alpha + \beta_1 Jordan_i + \beta_2 Palestine_i + \gamma X_i + \epsilon_i \tag{5.2}$$

where $Kibbutz_i$ is a binary variable: equal to 1 if the settlement i is a community settlement, 0 otherwise; $Jordan_i$ is the distance of the settlement to the Israel-Jordan border; $Palestine_i$ is the distance of the settlement to the areas under Palestine civil administration.

Table 5.7 presents the linear probability regression results. The coefficients on *Distance to Palestine* are positive, suggesting that the farther away a settlement to the Palestinian civil administration areas was, the less likely it was a kibbutz. On the contrary, the coefficients on *Distance to Jordan* are negative, suggesting that the closer a settlement to the Jordanian borders was, the more likely it was a kibbutz. The two distance coefficients are not significant in column (1) due to the multicollinearity problem — the high correlation between two independent variables. Once they are separately included in the regressions,

[15] According to Global Terrorism Database, 55 Israelis were killed under terrorist attacks from 1972 to 1987 in the West Bank or Jerusalem. The death number surges to 267 for the 1990s, and 817 for the 2000s.

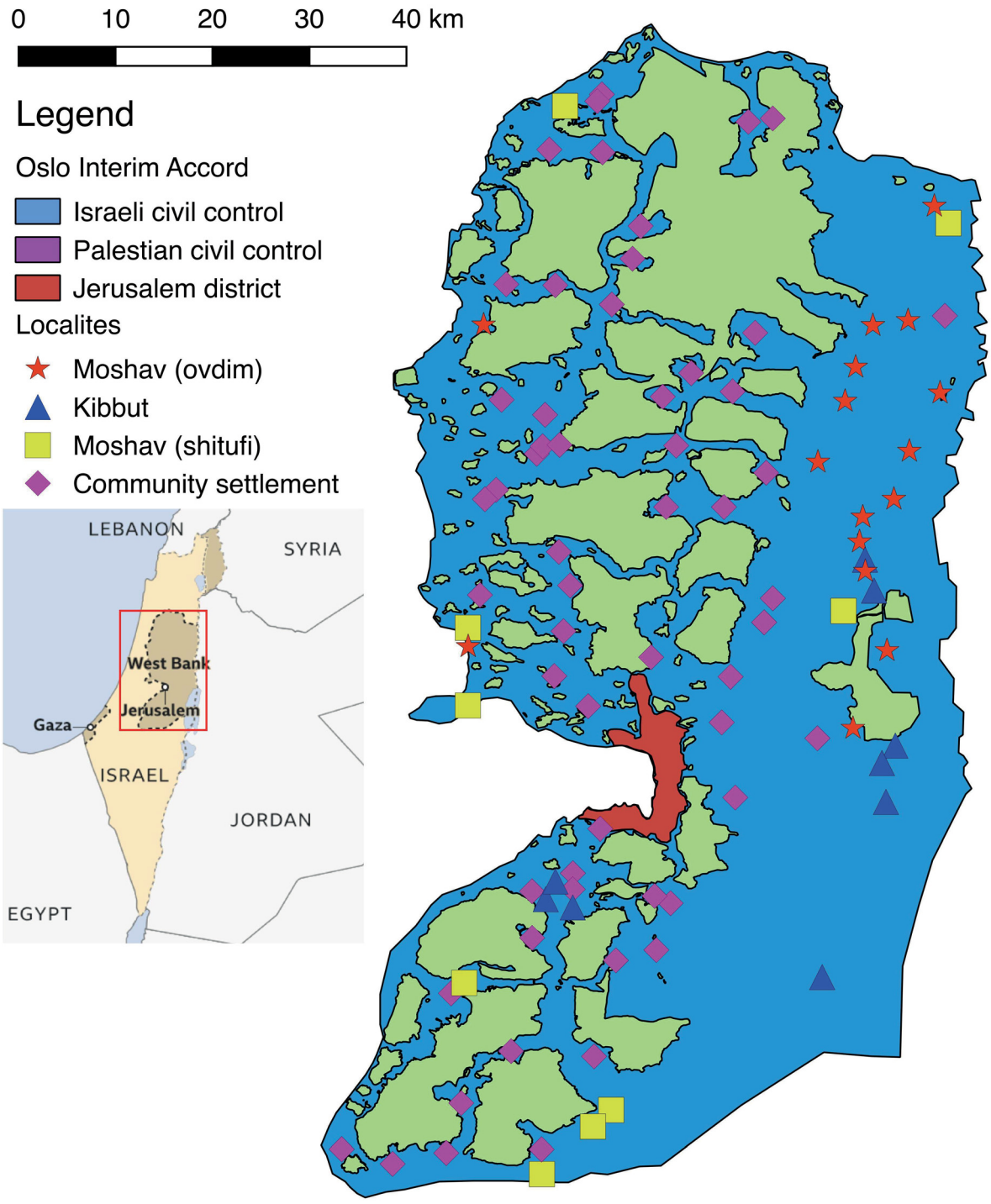
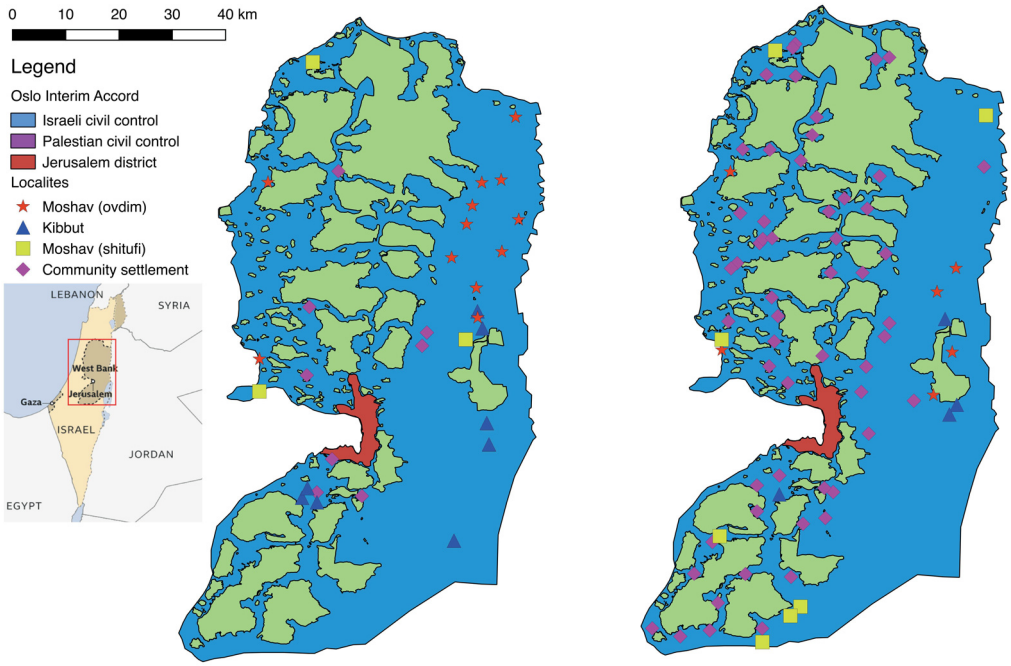


Figure 5.3: Israeli settlements in the West Bank established between 1967 and 1995



(a) Established before 1977 **(b)** Established after 1977

Figure 5.4: Israeli settlements in the West Bank established before and after 1977

the coefficient on *Distance to Palestinian* is significant at the 5 percent level in column (2); the coefficient on *Distance to Jordan* is significant at the 10 percent level in column (3).

In terms of the magnitude, the coefficient on the *Distance to Palestine* in column (3) is 0.0432, suggesting that a 1 km increase in the distance to Palestine civil administration areas increased the probability of the settlement being a kibbutz by 4 percent, a 40 percent increase for an average settlement.[16]. The coefficient on *Distance to Jordan* in column (2) is -0.0056, suggesting that a 1 km increase in the distance to Jordanian borders decreased the probability of the settlement being a kibbutz by 0.56 percent.

Since *Distance to Palestine* better predicts the dependent variable, the analysis uses the result in column (3) to show that the Jewish leadership no longer used the kibbutzim to expand the Jewish territory in the largly peaceful West Bank before 1987. It is consistent with the model prediction that the kibbutzim were only established at the dangerous areas.

[16]For an average settlement, the probability of being a kibbutz in 1977 is 0.099

Table 5.7: Settlements in the West Bank

Dependent variable: kibbutz			
	(1)	(2)	(3)
Distance to Palestine	0.0354*		0.0432**
	(0.0189)		(0.0174)
Distance to Jordan	-0.00325	-0.00557*	
	(0.00313)	(0.00292)	
Water Distance	0.000523	0.00102	-0.00295
	(0.00534)	(0.00541)	(0.00417)
Agriculture Potential	-0.0000642	0.0114	-0.00577
	(0.0325)	(0.0324)	(0.0320)
Constant	0.123	0.185	0.0909
	(0.191)	(0.191)	(0.189)
Observations	91	91	91

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise.

5.5 Support from the Nearby Jewish Settlements

To investigate the channel behind the distinct location pattern of different settlement types, I conduct the following linear regression (Logit regressions show similar results in Appendix C.6).

$$Kibbutz_i = \beta_1 Number\ of\ Jewish\ Settlements_i + \gamma X_i + \epsilon_i \tag{5.3}$$

where $Kibbutz_i$ is a binary variable: equal to 1 if the settlement i is a kibbutz, 0 otherwise; $Number\ of\ Jewish\ Settlements_i$ is the logarithmic number of other Jewish settlements within 3km (similar results for 1km, 2km or 4km), when settlement i is established; X_i is a set of control variables, including the distance to the nearest source of water and the agriculture potential (see Table 5.3 for the summary statistics).

Table 5.8 presents the linear regression results. The dependent variable in Column 1, 2, 3, and 4 is the number of nearby Jewish settlements within 1, 2, 3, and 4 km respectively. In all specifications, the coefficients of **Jew Settlements, log** is negative, which means kibbutzim established before the independence have a lower number of nearby friendly settlements than non-kibbutzim. Taking column 3 for example, the coefficient -0.128 means for each 1% increase in the number of nearby Jewish settlement number, the probability of the settlement being a kibbutz decreases by 0.128 %. The coefficients are significant under all specifications except in column (1).

Consistent with the theoretical prediction, the Jewish leadership placed kibbutzim in the peripheral areas to shape the boundaries of the Jewish state, because they realized

Table 5.8: Number of nearby Jewish settlements before 1948

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
	1km	2km	3km	4km
Jew Settlements, log	-0.162	-0.215***	-0.128***	-0.111**
	(0.105)	(0.0594)	(0.0483)	(0.0431)
Water Distance	0.00259	0.000230	0.000782	0.000989
	(0.00518)	(0.00510)	(0.00520)	(0.00519)
Agriculture Potential	-0.0704	-0.0646	-0.0638	-0.0620
	(0.0463)	(0.0451)	(0.0457)	(0.0458)
Constant	1.068***	1.130***	1.120***	1.128***
	(0.292)	(0.285)	(0.290)	(0.291)
N	219	219	219	219

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. *Jew Settlement, log* is the log transformation of the number of Jewish settlments within 1 km, 2km, 3km, and 4km in column 1, 2 ,3, and 4 respectively.

kibbutzim had a higher defense capacity and were able to hold longer without supports from other Jewish settlements.

In contrast, when the same regression is conducted on all settlements before 1936 (see Table 5.9) and all settlements in the West Bank (see Table 5.10), the coefficients of **Jew Settlements, log** are smaller and not significant (in the former case) or reverse to positive (in the latter case). The contrast shows kibbutzim were placed further away from other Jewish settlements only when the Jewish agency strived to expand the legal territory into hotly contested areas.

5.6 Concluding Remarks

The Jewish leadership placed settlements strategically to create facts on the grounds, thereby consolidating territories with tenuous legal claims. Against the rising opposition of the local Palestinians, it was crucial for the Jewish settlements to withstand the civil conflicts and occupy the land as long as possible. Consistent with the theoretical prediction, the Jewish leadership placed settlements according to their defense capacity — placing kibbutzim in the peripheral areas of Palestine and non-kibbutzim in the heartland. As a result, kibbutzim made more contribution in shaping the legal boundary of the Jewish State, especially when the relationship between the Jews and the Arabs deteriorated after the Arab revolt in 1936.

Kibbutzim made a larger contribution, because they could hold longer without any outside help. As a result, they required less support from nearby Jewish settlements, and

Table 5.9: Number of nearby Jewish settlements before 1936

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
	1km	2km	3km	4km
Jew Settlements, log	0.0249	-0.116	-0.0544	-0.0413
	(0.146)	(0.0924)	(0.0765)	(0.0680)
Water Distance	-0.0268	-0.0315*	-0.0301	-0.0294
	(0.0186)	(0.0180)	(0.0182)	(0.0181)
Agriculture Potential	-0.0643	-0.0675	-0.0610	-0.0602
	(0.105)	(0.104)	(0.104)	(0.105)
Constant	1.000	1.121*	1.053	1.044
	(0.655)	(0.656)	(0.657)	(0.657)
N	92	92	92	92

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. *Jew Settlement, log* is the log transformation of the number of Jewish settlments within 1 km, 2km, 3km, and 4km in column 1, 2 ,3, and 4 respectively.

Table 5.10: Number of nearby Jewish settlements in the West Bank after 1967

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
	1km	2km	3km	4km
Jew Settlements, log	-0.202	-0.0302	0.00950	0.0538
	(0.147)	(0.0578)	(0.0431)	(0.0365)
Water Distance	0.00132	0.00125	0.00131	0.00142
	(0.00114)	(0.00115)	(0.00115)	(0.00115)
Agriculture Potential	-0.0120	-0.0139	-0.0140	-0.0173
	(0.0206)	(0.0206)	(0.0206)	(0.0207)
Constant	0.209*	0.219*	0.208*	0.192
	(0.118)	(0.119)	(0.119)	(0.119)
N	247	247	247	247

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. *Jew Settlement, log* is the log transformation of the number of Jewish settlments within 1 km, 2km, 3km, and 4km in column 1, 2 ,3, and 4 respectively.

were more likely to be placed in less populated areas that were further away from established settlements.

In contrast, kibbutzim made little contribution to the expansion of legal territory in the West Bank after 1967, because the heartland of the West Bank, unlike the peripheral areas under the British mandate Palestine, was largely secured by a regular army. Instead, kibbutzim were established at the western border to prevent the infiltrations from Jordan.

As anticipated by the Jewish leadership, the facts created by the peripheral settlements were an important, if not decisive, factor shaping the Jewish legal territory proposed in 1937 Peel Commission, 1947 UN Resolution, and 1995 Oslo Accord II.

While those Israeli settlements in the West Bank have gained little legal recognition the international community, the facts on the ground created by them won Israel civil control over half of the West Bank under the Oslo Accord II.[17] In turn, the legal rights over law enforcement, the building, and zone planning further enhanced Israel's economic property rights — most Palestinian buildings in that area were considered illegal and subject to demolition by the Israeli authority.The continuing occupation eventually gained the first international recognition over their West Bank territory claim from the United States in 2019.[18]

The UN partition plan rejected by the Arab states also had tremendous legal and economic ramifications in the following decades. In 1948, the partition plan was taken as "a legal justification for both Israel's existence as a state and its subsequent admission to the United Nations" (Elaraby 1968).[19] In 1988, when the Palestine National Council declared the independence of the State of Palestine, they also invoked the UN partition plan as a legal basis (Khalidi 1990).[20] Palestinian President Mahmoud Abbas in 2011 even acknowledged that rejecting the 1947 UN proposal that would have created a Palestine state was "our

[17]Although the areas under the Israeli Civil Administration (commonly known as Area C) was temporary, and the Oslo Accords called for the gradual transfer of civil control of Area C to the Palestinian Authority, this transfer was frozen in 2002 (Area C Humanitarian Response Plan Fact Sheet, UNOCHA 2010).

[18]In the "Trump peace plan", the U.S. President Donald Trump "proposed an independent Palestinian state and the recognition of Israeli sovereignty over West Bank settlements." (BBC News accessed on Jun 19th, 2020, from https://www.bbc.com/news/world-middle-east-51288218)

[19] "Recalling its resolutions of 29 November I947 [where the partition plan was approved by the UN majority] and 11 December 1948 and taking note of the declarations and explanations made by the representative of the Government of Israel before the ad hoc Political Committee in respect of the implementation of the said resolution" (United Nations General Assembly Resolution 273 accessed on Oct 8, 2019 from https://www.securitycouncilreport.org/un-documents/document/unmembers-ares273-iii.php)

[20]In the independence declaration, the Palestine National Council stated:" Despite the historical injustice done to the Palestinian people by their dispersion and their being deprived of the right of self-determination after UN General Assembly Resolution 181 of 1947, which partitioned Palestine into two states, one Arab and one Jewish, that resolution still provides the legal basis for the right of the Palestinian Arab people to national sovereignty and independence." (Khalidi 1990)

mistake".[21] It is reasonable to believe that the UN partition plan would be a reference point for the territory claims made by the Palestinians, should they negotiate with the Israelis to recognize a Palestine State.

Apart from the long-run legal consequences, the UN partition plan also had an immediate impact on the unfolding of the 1948 Israel-Arab War. Throughout the war, the Jordan army "avoided attacking the territory of the UN partition plan Jewish state" (Morris 2008, pp. 231), while the Jewish leadership felt it was legitimate to conquer the Arab area dubbed "the Little Triangle" south of Haifa, because "this will be a police action... as their area is ours [that is, inside Israeli territory as defined by the UN partition resolution] and they [the Arabs] are inhabitants of the [Jewish] state, (Morris 2008, pp. 296). The legal territory gave the Jews an edge in the upcoming war, but the eventual victory still hinged on their performance during the battles. Once again, kibbutzim proved their institutions could induce high public defense in the military conflicts.

[21]See the news report from Reuters accessed on Oct 8, 2019 from https://www.reuters.com/article/us-palestinians-israel-abbas/abbas-faults-arab-refusal-of-1947-u-n-palestine-plan-idUSTRE79R64320111028

Chapter 6

The Jewish Territory Defended by Kibbutzim

Most modern independent countries have a regular army for civil security and national defense. However, the Jewish people, under the close surveillance of the British Mandate before 1948, could only use Haganah, a paramilitary organization that was both outmanned and outgunned by the Arab armies at the eve of the 1948 ArabIsraeli War. Therefore, they had to rely on rural settlements to defend *strategic areas*, which are defined to be areas along the attacking routes of neighboring Arab countries, and delay the advance of the attackers.

Based on the model, kibbutzim are expected to yield the highest level of public defense due to their equal-sharing arrangement. Consequently, the Jewish leadership, given the limited resources, was expected to implement two related strategies: (a) placing settlements in *strategic areas*, and (b) placing kibbutzim at the frontiers in order that they can hold as long as possible in the face of attacks, thereby consolidating the economic property rights of lands purchased, through deterring, or even repelling impending attack of its Arab neighbors.[1]

After the independence of Israel in 1948, such a pattern of settlement locations was predicted to be less salient, because the rural settlements were no longer exposed directly to the military intervention of neighbouring countries, thanks to the formation of the Israel Defense Force. However, the deep hostility from surrounding Arab countries continued, as none of them was willing to negotiate with Israel. The possibility of intervention still posed a threat, though smaller than in the pre-independence period, to the rural settlements. Consequently, those *strategic areas* were less dangerous and became habitable for less equalitarian communities of lower defending capacity.

Once Israel and its strongest neighbor — Egypt — had signed the peace treaty, such a pattern of settlement locations was predicted to disappear. Because the rest of the Arab

[1]Following Allen (1991), I define economic property rights as the range of choices can be freely exercised over these lands.

armies could not break through Israel's border defenses, the *strategic areas* were suitable to communities of the lowest defending capacity. Consequently, private income communities like community settlements were predicted to be placed more often in those areas.

6.1 The Optimal Attacking Routes

To formally test the above idea, one may attempt to measure the strategic importance of various areas in the Israel-Palestine region by the actual military operations of the Arab armies during the Arab-Israeli War. But such an attempt suffers from two problems. First, the actual progress of a war is highly unpredictable. Unexpected events, like natural disaster, plague, or even a change in the wind direction, may drastically change the course of one decisive battle, and in turn, change the progress of the war. Second, the actual military operations are endogenous to the strength of the defenders. The resistance in strategic areas may be so strong that the attackers have no choice but to take a detour, and conquer less valuable land, as happened in Israel (the actual performance of kibbutzim in the war is examined in Section D.5). Therefore, the actual attacking routes can deviate from the original plan wildly, and hence are not a good measure for the optimal attacking routes.

To overcome those problems, I exploit the terrain of the Israel-Palestine region. The region is 470 km in length and 135 km at the widest point, which can be crossed by armored cars within several hours, in the absence of resistance (see Figure 6.1).[2] It is bordered by Lebanon to the north, Syria to the northeast, Jordan to the east, Egypt to the southwest and the Mediterranean Sea to the west. The region can be roughly divided into four geographic areas: The Mediterranean coastal plain, the Central Hills, the Jordan Valley, and the Negev Desert. The Mediterranean coastal plain stretches from the Lebanese border in the north to the Egyptian border in the south. The Central Hills is a mountainous region parallel to the coastal plain, but interrupted by the Jezreel Valley. The Jordan Valley lies at the Israel-Jordan border. In the valley runs the Jordan River, flowing from north to south through the Lake Kinneret and emptying into the Dead Sea. Except in the winter rainy season, the river is usually quite shallow. The southern half of the region lies in the Negev Desert, at the tip of which is Red Sea.[3]

Given the local geography, the settlements were placed to defend population centers. For example, settlements at the Valley of Beit She'an were established partially "as barriers on

[2]Though the border of Israel is controversial, the border of the region ruled by the British Mandate was clearly delineated, and recognized by the surrounding Arab countries. Jordan, for example, refused to cross the border before the British left, when planning the military operations with other Arab countries (Morris 2008, pp. 182).

[3]The geographic information is obtain from Israel Ministry of Foreign Affairs on Aug 9th, 2019. https://mfa.gov.il/mfa/aboutisrael/land/pages/the%20land-%20geography%20and%20climate.aspx.

the route of terrorist gangs emanating from TransJordan" (Hasson and Gosenfeld 1980).[4] Kibbutz Har was established at the border Galilee area, because that place was "one of the principle passage of entering and leaving Palestine... and a main thoroughfare from Syria to Haifa." (Rayman 2014, p33)

To capture those anectotal accounts of pathways, I construct the optimal attacking routes based on a grid analysis of the terrain. The main advantage of this approach is that both the attackers and the defenders have the same knowledge about the terrain. The target towards which the attackers will march is also the target to be guarded by the defenders. The procedures are described below:

1. Calculate the least-cost paths by Dijkstra algorithm (Dijkstra 1959), using each grid on Israel-Lebanon border as the starting point and Haifa as the destination (see Appendix D.1 for parameters for traveling costs).

2. Label the lowest least-cost path obtained in step 1 as one optimal attacking route.

3. Add a penalty of 20 percent to the traveling cost of all cells that are within 5km of the optimal attacking route obtained in step 2.

4. Iterate over steps 1–3, until three best optimal attacking routes are generated. However, the same cell can only be penalized once.

5. Repeat steps 1–4 for Egypt-Israel, Jordan-Israel, and Syria-Israel borders.[5]

Step 3 allows multiple attacking routes, because the attackers would play a mixed strategy in choosing the attacking route, especially when the multiple routes are of similar travelling costs. However, given the constraint on the logistics, and the intermittent arriving of Jewish men of military age and weapons at the Haifa port, the attackers still had to keep a somewhat direct route towards Haifa, or risk losing their temporary local superiority in manpower and weaponry. Therefore, a penalty of 20 percent in step 3 is imposed to allows a secondary, and a third best attacking route, so long as they take less than 1.2 times of the travelling cost of the primary attacking route (same optimal attacking routes are obtained for a penalty of 40 percent).

The final result is displayed in Figure 6.2. Several attacking routes from Egypt in the south have similar traveling costs, since the large plain allows an army to bypass local strongholds and outflank its target. In contrast, constrained by the narrow pathway, the

[4]Beit She'an lies at the crossroad of the Jezreel Valley and Jordan Valley.

[5]Iraq army crossed Jordan and invaded Israel, as Iraq and Israel do not border each other.

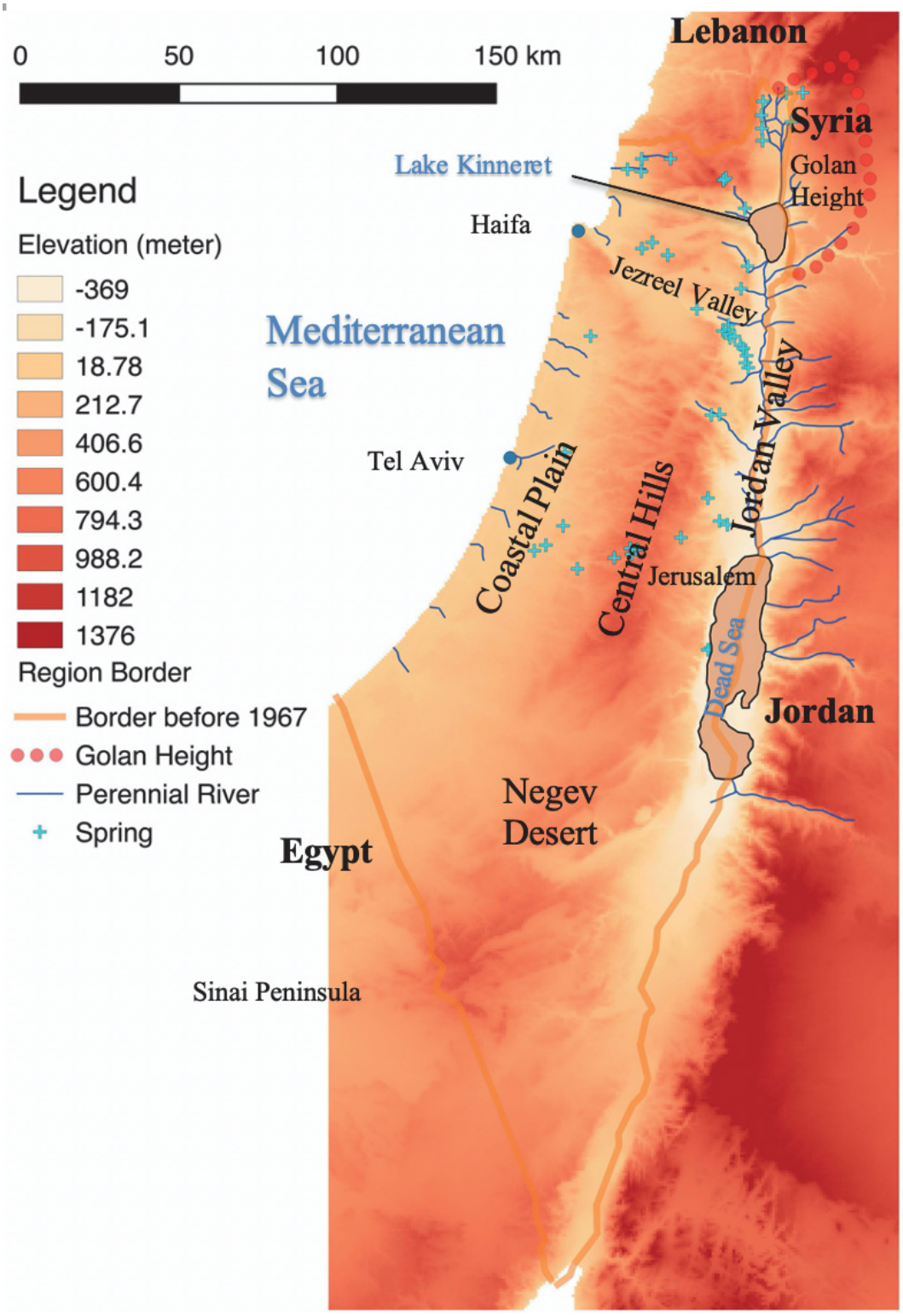


Figure 6.1: Israel geography

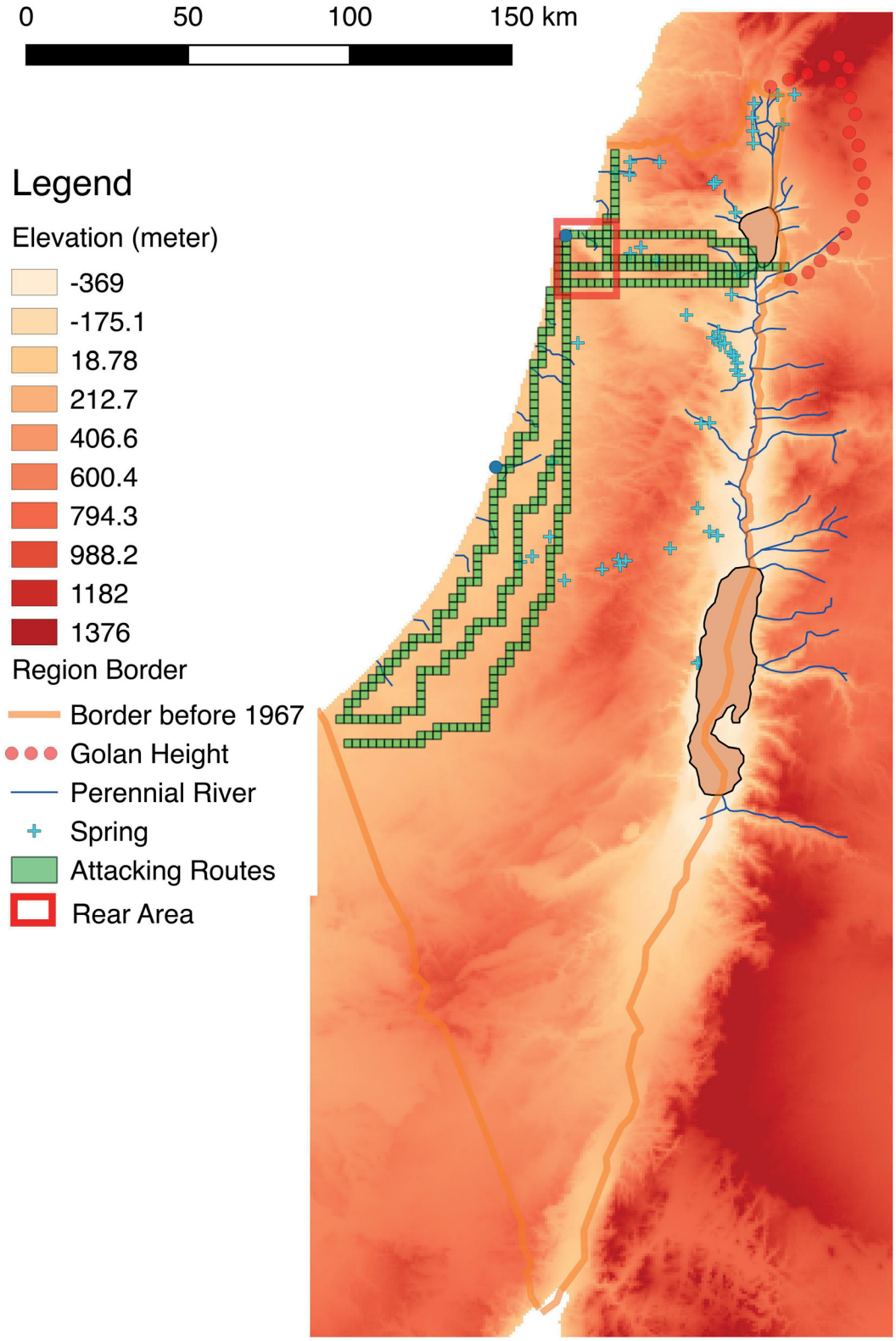


Figure 6.2: Least cost routes from the borders to Haifa

route from the Lebanon in the north is unique (see Appendix D.5 for a comparison with the actual historical attacking routes).[6]

It is then expected that most settlements were along the attacking routes before the independence. Among the various types of settlement, kibbutzim were predicted to be placed in more strategically important areas.

6.2 The Strategic Locations of Kibbutz

Figure 6.3 presents settlement locations before the independence of Israel in 1948. The majority of the settlements were established along the attacking routes. Among them, kibbutzim were placed at the frontiers to defend against the first wave of attacks. In the south, settlements, especially kibbutzim, were spread out across the whole plain, to block the multiple attacking routes from the southern border. At the eastern frontier, settlements gathered along the Jordan Valley and Jezreel Valley, so that they could support each other in the times of war. At the northern frontier, they were sparsely placed along the attacking route, probably because Lebanon had the weakest army among all the neighbouring Arab countries.[7] In contrast, the majority of non-kibbutzim were located at the hinterland, under the protection of kibbutzim.

Table 6.1: Summary statistics

	all settlements			settlements before 1948		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Kibbutz	858	.322	.467	255	.631	.483
Border Distance	858	63	46.8	255	61.9	48.3
Distance to Attacking Routes	858	10.4	22.4	255	5.43	8.5
Terrain Ruggedness Index	858	542	1052	255	315	627
Water Distance	858	.112	.201	255	.0506	.0617
Agriculture Potential	858	5.58	1.34	255	6.09	.717
Nearby settlement number	858	2.27	2.37	255	2.04	2.62
Nearby town number	858	.263	.627	255	.424	.748
Soil quality	806	1.33	.62	251	1.63	.509

To confirm the casual observation, I use the subsample of all defensive settlements, defined as those within 4km of the attacking routes (see Table 6.1 and Table 6.2 for the

[6]For settlements that once existed on the Sinai Peninsula, but evacuated in 1982, the attacking routes were constructed from the Suez Canal to the Gaza Strip (see Figure D.3).

[7]According to Morris (2000, pp. 217), there were only “a handful of Lebanese" out of the 28,000 Arab troops.

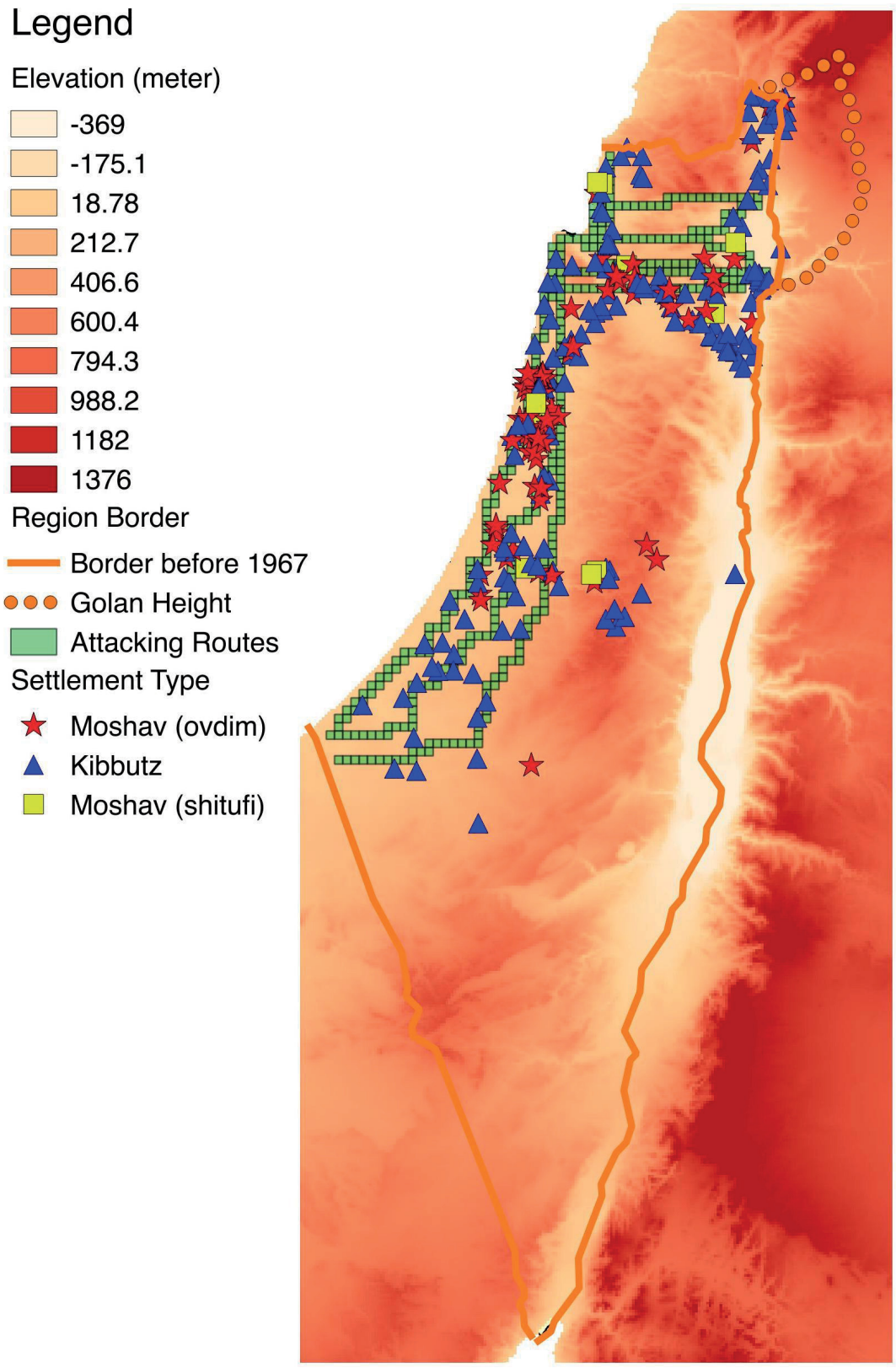


Figure 6.3: Settlements established before the independence in 1948

Table 6.2: Variable Definitions

Kibbutz	A binary variable indicating whether the settlement is a kibbutz: 1 for kibbutz; 0 for non-kibbutz.
Distance to Attacking Routes	Distance of each settlement to the nearest constructed attacking route (km)
Border Distance	Distance of each settlement to the border of the country, from which the nearest attacking route starts (km)
Terrain Ruggedness Index	The standard deviation of elevation within 30arc seconds (900m at equator)
Water Distance	Distance to the nearest water resource, including perennial rivers, Lake Kinneret, and springs containing less than 500 mg chlorine per litres (km)
Agriculture Potential	Attainable yield for intermediate input level irrigated wheat (ton dry weight per ha)
Nearby settlement number	Number of Jewish settlements within 4km when the settlements was established
Nearby town number	Number of Jewish towns within 4km when the settlements was established
Soil quality	A categorical variable indicating the soil quality: 0 for poor quality; 1 for medium quality; 2 for good quality.

summary statistics and the definitions of the variables). Settlements are assigned into groups according to the nearest attacking route from Egypt, Lebanon, or the east (including Syria, Jordan and Iraq), in order to capture the threat levels imposed by countries of different military strength. All settlements at the rear area are excluded (the red frame in Figure 6.2), as it is hard to identify to which attacking route they belong. I then conduct the following linear regression:[8]

$$Kibbutz_{ij} = \beta Border\ Distance_{ij} + \gamma X_{ij} + Attacking\ Routes_j + \epsilon_{ij} \tag{6.1}$$

where $Kibbutz_{ij}$ is a binary variable: equal to 1 if the settlement i is a kibbutz, 0 otherwise; $Border\ Distance_{ij}$ is the distance of each settlement to the borders of the country (Lebanon, Egypt, or the east) in which the attacking routes starts; X_{ij} is a set of control variables, including distance to the nearest water resources, terrain ruggedness index, number of nearby Jewish settlements and towns, soil quality and agriculture potential, measured by the attainable yield for intermediate input level irrigated wheat where the settlement is located; $Attacking\ Routes_j$ is the attacking route fixed effect. Robust standard errors are

[8]Varying the definition of the defensive settlements yield robust and interesting results (see next subsection).

Table 6.3: Kibbutz vs. non-Kibbutz Locations

Dependent variable: kibbutz					
	(1)	(2)	(3)	(4)	(5)
Border Distance	-.00686***	-.0066***	-.00438***	-.00462***	-.0172***
	(.00104)	(.00129)	(.00124)	(.00119)	(.00187)
Terrain Ruggedness		.000342***	.000255***	.000263***	.00022***
		(.000065)	(.0000492)	(.0000467)	(.0000495)
Agriculture Potential		-.0639	-.0442		.153***
		(.0783)	(.0718)		(.0311)
Water Distance			.128	.353	1.01***
			(.451)	(.29)	(.201)
Nearby settlement #			-.0236*	-.0234**	-.0232*
			(.0125)	(.0115)	(.0125)
Nearby town #			-.157***	-.159***	-.139***
			(.014)	(.015)	(.0123)
Soil quality				.0376	
				(.0569)	
Border Distance^2					.0000752***
					(.0000103)
Attacking Route FE	Yes	Yes	Yes	Yes	Yes
Observations	166	166	166	166	166

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if the settlement is a kibbutz, 0 otherwise. The sample is restricted to the settlements established before the independence that are within **4km** of the attacking routes; **Attacking routes FE**: Settlements are grouped according to the nearest attacking routes from Egypt, Lebanon, or the east (including Syria, Jordan and Iraq). All settlements at the rear area are excluded (the red frame in Figure 6.2). Robust standard errors in parentheses are robust to arbitrarily heteroskedasticity and allow for unrestricted spatial correlation between all settlements within 150 kilometres of each other (Conley 1999).

clustered using the Conley (1999) GMM approach, allowing for arbitrary spatial correlation in unobservables between all villages within 150 kilometres of one another, but inference is robust to alternative clustering specifications.[9]

Table 6.3 presents the linear regression results. The coefficients on **Border Distance** in all specifications are significant at the one percent level and negative, meaning that before the independence the kibbutzim are located closer to the borders than non-kibbutzim. Taking the specification with all control variables in Column 3 as an example, when the distance of a settlement to the borders increases by one standard deviation, the settlement

[9]The distance cutoff of spatial correlation is chosen at 150 kilometres because it is the largest distance between a border settlement and Haifa. The result is robust for distance cutoff at 50km, 150km and 300km.

is 21 percent less likely to be a kibbutz.[10] The results on the relative locations of the kibbutzim confirm the prediction of the model that the Jewish leadership placed kibbutzim at the frontiers of the attacking routes to withstand the first wave of attacks, while placing non-kibbutzim behind the protection of kibbutzim.

The coefficients on **Terrain Ruggedness Index** are positive, meaning that before the independence the kibbutzim are located in more rugged places than non-kibbutzim. The point estimates of 0.00026 in Column 4 means when the terrain ruggedness index of a location increases by one standard deviation, the settlement located there is 16 percent more likely to be a kibbutz.[11] Rugged terrain gives defenders several advantages over attackers. First, rugged terrain complements fortifications in defending: towers can be built on highlands to cover larger areas, and trenches can be dug in lowlands so that they are harder to cross. Second, rugged terrain slows down the speed of the attackers, helping the defenders hold until the arrival of reinforcements. Finally, to the extent that defenders typically know the terrain better than the attackers, rugged terrain enlarges the information advantage held by the defenders.

The negative coefficients on **Nearby settlement number** and **Nearby town number** means that pre-independence kibbutzim are located further away from other existing Jewish settlements and towns. The isolated locations show that each kibbutz covers a larger defense area and received less support in the wartime.

6.3 Robust Checks and Placebo Tests

To make sure that the results in Table 6.3 are robust for different definitions of defensive settlements, the same regression is repeated for pre-independent settlements within varying distance of the attacking routes. The coefficients on **Border Distance** are summarized in Fig 6.4. As the definition for the defensive settlements becomes stricter from those within 6km of the attacking routes to those within 1km of the attacking routes, **Border Distance** increases its impact on the settlement type. This pattern once again validates the claim that the kibbutzim were placed in strategically more important places.

If placing kibbutzim at the frontiers was a defensive strategy against the external threats, one would expect the pattern to disappear as the threats go away. As discussed in Chapter 2.4, the threats faced by the Jewish settlements were partially mitigated by the Israel Defense Force after the independence, and became insignificant when Israel signed a peace treaty with Egypt, who had the strongest army among the neighbouring Arab countries.

[10] A one standard deviation (which is 48.3km) increase in the distance to the borders corresponds to the average marginal effect: -0.00438 per km * 48.3km = -0.21

[11] A one standard deviation (which is 282.4) increase in the terrain ruggedness index corresponds to the average marginal effect: 0.00026 * 282.4 = 0.16.

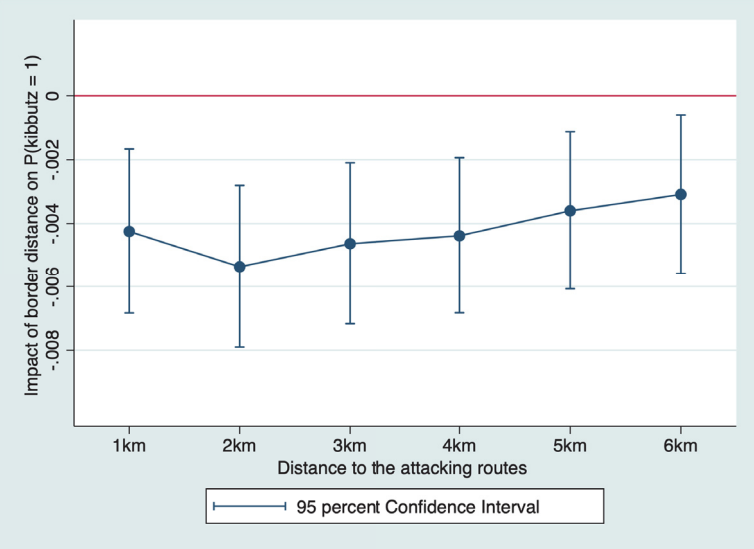


Figure 6.4: Robust check for coefficients on Border Distance

The figure shows the coefficients on **Border Distance** (together with 95 percent confidence bounds) when varying the subsample of defensive settlements in the main specification (Table 6.3 Column4). Each point represents a separate regression. For example, 2km means the subsample is all pre-independence settlements within 2km of the attacking routes.

Therefore, it is expected that the location pattern found in the previous subsection is less salient after the independence and disappear after the Egypt-Israel peace treaty.

Indeed, after the independence, such a pattern was less salient (see Figure D.1 in Appendix D.1). Many settlements were still placed along the attacking routes, but a significant number of them were located in other places. The pattern became almost unidentifiable, once Israel signed the peace treaty with Egypt in 1979 (see Figure D.2 in Appendix D.1). In fact, the opposite seems true: settlements were no longer placed along the attacking routes (this observation can be confirm by the regression results in Appendix D.2).

This contrast also eliminates an alternative explanation — settlements may be located along those routes to trade with neighbouring countries, for the optimal attacking routes are also the optimal trading routes. While there is no trading data to directly rule out this alternative explanation, it is inconsistent with the fact that the settlements along the routes were established when the neighbours were hostile, and the settlements further away to the routes were established in peacetime.

As the external threats decreased, the relative locations of kibbutzim also changed. After the independence of Israel, non-kibbutzim started to appear at the frontiers. To confirm the casual observations, I run the same specification in Table 6.3 Column 4 for the settlements established after the independence of Israel.

Table 6.4 presents the results of the placebo tests. For settlements established after the independence, the effects of **border distance** are not negligible. As the threats of military

Table 6.4: Kibbutz vs. non-Kibbutz Locations over time

Dependent variable: kibbutz			
	(1)	(2)	(3)
	Pre Ind.	Ind. to Treaty	Post Treaty
Border Distance	-.00438***	-.000748	-.000594
	(.00124)	(.000811)	(.00124)
Terrain Ruggedness Index	.000255***	-.0000136	8.44e-06
	(.0000492)	(8.61e-06)	(.0000129)
Agriculture Potential	-.0442	-.0463	-.0375
	(.0718)	(.0372)	(.0505)
Water Distance	.128	-.303	-.61
	(.451)	(.683)	(.49)
Nearby settlement number	-.0236*	-.0315***	-.0149
	(.0125)	(.00596)	(.0122)
Nearby town number	-.157***	-.062***	-.0918***
	(.014)	(.012)	(.0194)
Attacking Route FE	Yes	Yes	Yes
Observations	166	269	57

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if the settlement is a kibbutz, 0 otherwise. The sample is restricted to the settlements within **4km** of the attacking routes, and further restricted to the settlements established before the independence in **Column 1**, between the independence and the Israel-Egypt peace treaty in **Column 2**, and after the treaty in **Column 3**; **Attacking routes FE**: Settlements are grouped according to the nearest attacking routes from Egypt, Lebanon, or the east (including Syria, Jordan and Iraq). All settlements at the rear area are excluded (the red frame in Figure 6.2). Robust standard errors in parentheses are robust to arbitrarily heteroskedasticity and allow for unrestricted spatial correlation between all settlements within 150 kilometres of each other (Conley 1999).

intervention decreased after the independence, the locations of different forms of settlements no longer depends on the distance to the borders.

The coefficients on **Terrain Ruggedness Index** are much smaller in Column 2 and 3 than those in Column 1. As soon as the threats faded away after the independence, the Jewish leadership no longer placed the kibbutzim in rugged terrain to reinforce their defense capacity. Consequently, the sharp contrast of the geographic locations between kibbutzim and non-kibbutzim disappeared.

If defending the territory was the reason for placing the kibbutzim in front of the non-kibbutzim, one would not expect to observe this pattern for settlements far away from the attacking routes. To check this, I repeat the main regression for settlements more than 6km away from the attacking routes. Table 6.5 shows that the pattern is not observed for settlements established before the independence (Column 1) or those established after the peace treaty (Column 3). Interestingly, kibbutzim established between the independence and the Israel-Egypt peace-treaty were located significantly closer to the border (Column 2).

Table 6.5: Kibbutz vs. non-Kibbutz Locations away from the attacking routes

Dependent variable: kibbutz			
	(1)	(2)	(3)
	Pre Ind.	Ind. to Treaty	Post Treaty
Border Distance	.000163	-.00218*	-.00012
	(.00179)	(.00118)	(.00165)
Terrain Ruggedness Index	.0000132	.0000476*	-.000047***
	(.0000241)	(.000028)	(.0000171)
Agriculture Potential	-.0947	.0153	.0147
	(.0695)	(.0176)	(.0295)
Water Distance	.35	.332***	.651**
	(.314)	(.105)	(.286)
Nearby settlement number	-.00099	-.0487***	.0269
	(.00942)	(.0112)	(.0303)
Nearby town number	.277***	.069	-.0717
	(.0821)	(.0774)	(.0536)
Attacking Route FE	Yes	Yes	Yes
Observations	63	155	85

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if the settlement is a kibbutz, 0 otherwise. The sample is restricted to the settlements of more than **6km** away from the attacking routes, and further restricted to the settlements established before the independence in **Column 1**, between the independence and the Israel-Egypt peace treaty in **Column 2**, after the treaty in **Column 3**; **Attacking routes FE**: Settlements are grouped according to the nearest attacking routes from Egypt, Lebanon, or the east (including Syria, Jordan and Iraq). All settlements at the rear area are excluded (the red frame in Figure 6.2). Robust standard errors in parentheses are robust to arbitrarily heteroskedasticity and allow for unrestricted spatial correlation between all settlements within 150 kilometres of each other (Conley 1999).

That is because Israel placed the kibbutzim in the Sinai peninsula and the Golan Height, in order to consolidate the legal claim of the territories that were conquered during the Six-Day War in 1967.[12]

6.4 Additional Validation and Alternative Channels

In the analysis, Haifa is set as the only target when constructing the attacking routes. One might argue that Tel-Aviv is also a plausible target, due to its large Jewish population. To address this concern, I restrict the sample of settlements to those along the Egyptian attacking routes. Because both Haifa and Tel-Aviv are along the same attacking routes from the Egyptian borders, the strategic placement of settlements will be the same regardless

[12]Besides defending the land, the rural settlements also consolidate the legal territory. This function is being studied by the author in a working paper.

of which cities is considered as the attacking target. Results are presented in Table D.3 in Appendix D.3, which are similar to those in Table 6.3.[13] Additional robust checks regarding the exclusion of the religious kibbutz, inclusion of settlements in the rear area, treating moshav (shitufi) as kibbutz, and allowing for spatial correlations within different areas are presented in Table D.4 in Appendix D.3.

Due to the data limitation, the above analysis cannot control the composition of the settlement members, which raises the concern that the strong defense of the kibbutzim may be attributed to the high physical and mental quality of the members, because they self-selected into the kibbutzim.

Although demographic variables are not available for the early years, they are included in the analysis of kibbutz privatization process in the 1990s. After controlling the age of each kibbutz and the average household size, the threat levels faced by each kibbutz still have a significant impact on the income privatization decisions. Also, the impact of external threats is much larger than those of demographic control variables.

Still, kibbutz members might be more committed to the Zionist ideology of establishing a Jewish state, and hence were more fervent in defending the territory. To address this concern, I measure the ideology by the kibbutz movement as commonly used in the kibbutz literature (Rosner and Getz 1996, Simons and Ingram 1997, and Abramitzky 2008, 2011, 2018). Historically, kibbutzim affiliated with several movements. Among them, the Ichud movement had the strongest Zionist ideology and was considered as "the most responsive federation to opportunities to provide settlement, defense, and absorption" (Simons and Ingram 2000, 2003). If the Zionist motivation of the members plays an important role in bolstering the defense of kibbutzim, one would expect the kibbutzim affiliated with the Ichud movement would have a stronger defense and hence were more likely to be placed in the strategic areas than other kibbutzim. To test this, I run the same regression specifications in Table 6.3, with the probability of belonging to Ichud movement being the dependent variable.[14] Table 6.6 shows the coefficients on **Border Distance** in most columns are negative but insignificant. Also, the size of the coefficients are much smaller than the those in Table 6.3, meaning the differences across kibbutzim of different ideologies are much smaller than the differences across settlement of different institutions. While the above results cannot falsify the mechanism based on Zionist ideology, it is doubtful whether a mechanism based on ideology is falsifiable after all.

[13]The same regression using post-treaty settlements (as in Table 6.3 Column 3) cannot be conducted due to the small sample size (only one kibbutz was established along Egyptian attacking routes in that period).

[14]The regression in Column 3 is not conducted, because all kibbutzim established after the peace treaty belong to the same movement.

Table 6.6: Kibbutz Locations — Ichud Movement

Dependent variable: kibbutz belonging to the more Zionist movement						
	(1)	(2)	(3)	(4)	(5)	(6)
Border Distance	-.000957*	-.000805	-.00136	-.00106	-.00172**	-.00361
	(.000567)	(.000744)	(.00085)	(.000873)	(.000699)	(.00328)
Border Distance^2						.0000152
						(.0000176)
Terrain Ruggedness		.000282***	.000289***	.000284***	.000288***	.000285***
		(.0000881)	(.0000847)	(.0000913)	(.0000815)	(.0000901)
Agriculture Potential		-.0638	-.115*	-.108*		-.0717
		(.0543)	(.0627)	(.0626)		(.083)
Water Distance			-.976	-1	-.654	-.812
			(.727)	(.732)	(.776)	(.678)
Nearby settlement #				-.000171	.000777	.000747
				(.00533)	(.00593)	(.0059)
Nearby town #				-.0729	-.077	-.0672
				(.0744)	(.0756)	(.0718)
Soil quality					.0321	
					(.0731)	
Attacking Route FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	90	90	90	90	90	90

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if the kibbutz belongs to Artzi movement, 0 otherwise. The sample is restricted to the kibbutzim within **4km** of the attacking routes, and further restricted to the settlements established before the independence in **Column 1**, between the independence and the Israel-Egypt peace treaty in **Column 2**. All settlements at the rear area are excluded (the red frame in Figure 6.2). Robust standard errors in parentheses are robust to arbitrarily heteroskedasticity and allow for unrestricted spatial correlation between all settlements within 150 kilometres of each other (Conley 1999).

6.5 Concluding Remarks

Israel is one of the most successful states in the modern history in terms of expanding and consolidating its territory. The study of its settlement strategy shows one reason — the strength of institutions. The Jewish leadership systematically put defensive organizations at the strategic locations. A few states in Africa and Middle East are facing the threats of rebellions and cannot effectively protect their peripheral territories. The case study of kibbutz may present an solution for building their state capacities.

In addition to that, this chapter illustrates a novel empirical method for measuring the impact of directional military threats through constructed attacking routes. This method can be extended to test theoretical predictions based on external threats (Alesina and Spolaore 2005, Ko et al. 2018, Acemoglu and Robinson 2020). Alesina and Spolaore (2005) predict larger nations will rise in a more bellicose world; Ko et al. (2018) attribute the

political centralization of China to the unidirectional threat of external threats and the political fragmentation of Europe to the multisided external threats. Acemoglu and Robinson (2020) predict that external threats can shift weak states into inclusive ones and inclusive states into despotic ones.

Defending against military attack is costly, because it calls for transferring resources from production sectors to military sectors, and distortions in the institutions. While the former has been well understood and thoroughly studied, the latter has been largely overlooked. In this chapter, I present one such example of distorted institutions under military pressure — kibbutzim.

Facing the imminent danger of a multi-pronged assault, the Jewish leadership placed settlements along the optimal attacking routes to defend the heartland of the nascent Jewish state. Among various settlements, kibbutzim were placed at the frontiers to absorb the first wave of attacks. To further enhance the defensive capacity of the kibbutzim, the Jewish leadership also placed them in more rugged terrain. The kibbutzim, in turn, contained the attacks from the Arab armies and delay their advances, thereby purchasing enough time for the Jewish leadership to equip a regular Jewish army and turned the tide of the war.

The victory greatly reduced the external threats as well as the reliance on the kibbutzim for defending the borders. As a result, the fore-mentioned location pattern was less obvious for settlements established after the independence of Israel and no longer applied to settlements established after the signature of the Israel-Egypt peace treaty. Along the same line, the percentage of kibbutzim out of all rural settlements decreased from 60 percent before the independence to 25 percent after the independence and further decreased to 13 percent after the peace treaty.

After all, the strong defense provided by the kibbutzim comes at the cost of economic inefficiency (as mentioned in Section 4.4). Due to the strict entrance screening, the kibbutzim suffered economically from an under-employment of labor. The equal-sharing arrangements of the kibbutzim aggregate this problem by reducing efforts exerted on agriculture production. Before the independence of Israel, the Jewish leadership was willing to pay this institutional cost and heavily subsidized the kibbutzim, only because they had no other choice to defend their territory — a Jewish regular army was not tolerated by the British Mandate. Once they had established a regular army along with the confidence of defending borders, they gradually reduced their reliance along with their support on the kibbutzim. The kibbutzim then had to embark on the road of transformation.

Chapter 7

The Income Privatization of Kibbutzim

The victory did not bring peace to Israel immediately. Israel annexed the Sinai Peninsula from Egypt and the Golan Heights from Syria through three major wars: the Sinai campaign in 1956, the Six-Day war in 1967, and the Yom Kippur war in 1973. The strategic depth gained through the annexation and the increasingly powerful Israel Defense Forces greatly improved the security situation in Israel. Against this background, the kibbutzim gradually adopted reforms in child rearing, consumption decisions, and eventually income distribution.

7.1 Kibbutz Transformation

Starting in the 1950s, a growing number of kibbutzim abandoned communal childrearing — children slept with their parents instead of in the children's houses (Russell et al. 2013, pp. 27).[1] Kibbutzim also switched from strict equal distribution of consumption goods to a personal budget system. Under the system, the members were endowed with a certain amount of money in each category of consumption — clothing, furniture, toilet articles, etc. The members were free to allocate the money within each category, but could not spend money in the category of furniture for clothes or recreation. The category restriction was gradually loosened. In the 1970s, kibbutzim started to adopt comprehensive budgets with a lump sum of money for each member to spend without restriction (Russell et al. 2013, pp. 26–27).

As explained in Chapter 4.1, the children's houses could be used to forbid members from indulging in childrearing, and sustain an efficient level of effort on public defense. As the external threats decreased post the independence, the collective child rearing could no longer justify its cost of separating children from their parents. The abandoning of it marked the beginning of kibbutz transformation.

[1]The first kibbutz to abandon communal childrearing was Gesher Haziv in 1949 Near (1997, pp. 303)

Despite the privatization of consumption decisions and childrearing, kibbutzim still preserved most of the traditional practices. The members rotated their job, including managerial positions, and received equal pay. Their demands for electricity, meals, housing, medical care, and education, were still collectively provided.

The transformation of kibbutzim accelerated after their political support, Labor party, lost in 1977 for the first time in the history. The newly elected Likud party was entirely opposed to the kibbutz movement (Bowes 1990). The political changes amid a securer external environment were not a coincidence. In the 1970s, Israelis voters started to emphasis domestic issues more than security issues (Arian and Arian 1995, p153), which contributed to the loss of Labour party.[2]

Without the financial support from the government, the kibbutzim was hit heavily by an economic crisis in the late 1980s. The net outflow of kibbutz members amounted to 2000 to 3000 per year (or 6–10 residents per kibbutz per year). As a result, Kibbutz federations were forced to allow individual kibbutz to adopt more aggressive reforms, and be responsible for their own debt (Russell et al. 2013, pp. 42; Ashkenazi and Katz 2009).[3] In the following years, the reforms made by kibbutzim can be roughly divided into three categories: involvement of nonmembers, decision-making process and privatization of consumption and services.[4]

The kibbutzim increasingly allowed the members to work outside, and pursue a career of their own choice. Kibbutzim established pension plans and began to purchase health insurance for their members. Individual members were responsible for more consumption expenses, including electricity, recreation, travel, meals, health services, laundry, higher education, etc, which was described as "privatization of kibbutz expenditures" (Russell et al. 2013, pp. 58–62).

Correspondingly, outsiders became involved in kibbutz operations as workers, managers, investors, and consumers. Nonmembers sometimes even held the position of committee chairs. Stocks and raised capital were issued by some kibbutzim publicly. The education system was open to children of nonmembers. Houses, initially vacant ones and later newly built ones, were rented out to generate profits (Russell et al. 2013, pp. 49–58).

Economically, the general assembly was replaced by independent boards of directors consisting of knowledgeable members in governing kibbutz industrial ventures. Managers served longer terms and were not required to be rotated out of the positions. To limit the power of the managers, internal control committees were also formed. In accounting,

[2]Security issues were a less concern for the voters who shifted from Labor party to Likud party in 1977 than those who were loyal to Labor party (Arian and Arian 1995, p136).

[3]In 1989, each kibbutz was officially given the right to determine which reforms it would or would not adopt (Russell et al. 2013, pp. 42)

[4]From 1990 to 2001, University of Haifas Institute for Research of the Kibbutz and the Cooperative Idea conducted yearly surveys on the reforms adopted by each kibbutz (see the tables in Russell et al. 2013, Chapter 2).

kibbutzim recorded kibbutz members' "shadow wages", wages that were calculated based on the general labor market (Russell et al. 2013, pp. 44–49).

Among all the reforms, the most fundamental one was the adoption of the safety net budget. Kibbutz members received differential, contribution-based wages, but were taxed progressively to maintain a minimal living standard for older and weaker members (Palgi 2002). Of course, such a major decision can not be made lightly. Since 75 percent of votes in the general assembly were required to adopt the differential pay reform, intense debates, with members of both sides threatening to leave, could take years. However, once the reform was made, it was never reversed in any kibbutz (Russell et al. 2013, pp. 85–89). The "privatization" of income (in an economic sense as well as in kibbutz jargon, see Russell et al. 2013, pp. 99) started in Kibbutz Gesher Haziv and Kibbutz Naot Mordechai in 1995 (Russell et al. 2013, pp. 84). By 2014, 75% of non-religious kibbutzim were privatized.[5]

While the timing of most reforms were not available, the dates of income privatization of kibbutzim are well recorded thanks to Abramitzky (2008). It allows an empirical test against the prediction: communities privatize income when the external threats decrease. The threats are measured by the number of civilian deaths under conflicts near each kibbutz, since the civil conflicts became the major threat to Israeli civilians in the 1990s.

7.2 Identification Strategy and Data

To test Prediction 2 — kibbutzim privatize income when the external threats decreases, I compile a kibbutz-level panel dataset covering 223 kibbutzim from 1989 to 2014.[6] For each kibbutz, the dataset includes the year of income privatization, the number of conflicts nearby, and other control variables.

7.2.1 Kibbutz Data

Kibbutz reform data are compiled by Ran Abramitzky (2018).[7] It covers 223 secular kibbutzim, which accounts for 83% of the 268 existing kibbutzim. Kibbutzim were excluded if they were religious or had not yet decided on whether to adopt reforms by 2014.

For each kibbutz, the data also includes its year of establishment, average household size, the movement affiliation, and the economic strength assessed by the banks and the government in 1994 (hereafter "static" control. See Table 7.1 and Table 7.2 for the summary

[5]After wage reforms, several kibbutzim went further to privatize profitable assets, by distributing shares of the profit-making business to the members (Russell et al. 2013, pp. 116–117).

[6]The kibbutz federations in 1989 formally permitted their member kibbutzim to introduce various reforms.

[7]Retrieved on March, 2018 from https://ranabr.people.stanford.edu/sites/g/files/sbiybj5391/f/data-on-kibbutzim.docx

Table 7.1: Summary statistics

	Obs	Mean	Std. Dev.
Dependent Variable			
Privatization Decision	3593	.0481	.214
External Threats			
Conflict Intensity	2480	.0356	.0952
Conflict Intensity, log	2480	.0318	.0755
Kibbutz Static Control			
Average Household Size	3511	2.18	.326
Movement Affiliation	3593	.345	.476
Economic Strength	3105	2.49	.897
Year of Establishment	3593	43.8	15.4
Kibbutz Dynamic Control			
Nighttime Light	2874	35.5	17.9
Kibbutz Population	3563	482	246
Regional Employment Rate	3370	.48	.0578
Regional Employment Rate ÷ Dist.	3370	8.4	7.72
Instrument and Refugee Control			
Refugee Rainfall × Refugee Pop. ÷ Refugee Dist.	2259	.000127	.00217
Refugee Pop. ÷ Refugee Dist.	3593	3597	5448
Refugee Population	3593	17464	27100
Refugee Distance	3593	4.63	.858
Kibbutz Rainfall	2259	88.7	334
Refugee Camp Long Run Average Rainfall	3593	437	85.7
Kibbutz Long Run Average Rainfall	3593	417	154
External Threats			
Conflict Intensity	2480	.0356	.0952
Conflict Intensity, log	2480	.0318	.0755

statistics and the definitions of the variables). The movement affiliation is a common measure for kibbutz ideology. Since religious kibbutzim are excluded, there are two movements in the sample: Artzi and Takam. Between them, Artzi is more devoted to in preserving kibbutz values, and kibbutzim affiliated with Artzi are considered to be more conservative in maintaining equal-sharing.

Since the above demographic and economic variables only provide a cross-sectional measure of kibbutz at the beginning of the sample period, additional time-variant control variables are included to account for the changes of kibbutz overtime. I first obtain kibbutz locations from Google Map API, cross checked by the subdistrict that each kibbutz belongs to.[8] Based on their locations, nighttime light intensity is used as a proxy for kibbutz

[8]There are 7 districts and 16 subdistricts in Israel. The district and subdistrict of each kibbutz is obtained from Israeli Central Bureau of Statistics.

Table 7.2: Variable Definitions

Privatization Decision	Probability of a kibbutz privatizing its income
Conflict Intensity	Total number of civilian deaths under civil conflicts within 20km of a kibbutz in this year and previous five years, adjusted by the population density
Conflict Intensity, log	log transformation of Conflict Intensity
Economic Strength	Kibbutzim are divided into four groups according to their economic strength, with 1 being the weakest and 4 being the strongest
Movement Affiliation	1 if the kibbutz belongs to the more ideological movement: Artzi; 0 otherwise
Nighttime Light	Annualized nighttime light intensity provided by the National Oceanic and Atmospheric Administration
Kibbutz Population	Yearly population of each kibbutz interpolated from population in 1983,1995,2005, and 2015
Regional Employment Rate	Yearly employment rate of the subdistrict to which kibbutz belongs
Regional Employment Rate ÷ Dist	Regional Employment Rate divided by the distance between a kibbutz and the nearest localities with more than 10,000 population
Refugee Rainfall	Total rainfall deviation from long run average in the nearest refugee camp in the previous six years
Refugee Population	Population at the nearest refugee camp in 1996
Refugee Distance	Distance between a kibbutz and its nearest refugee camp
Kibbutz Rainfall	Total rainfall deviation from long run average at the kibbutz in the previous six years
Refugee Camp Long Run Average Rainfall	Average rainfall at the nearest refugee camp from 1970 to 1990
Kibbutz Long Run Average Rainfall	Average rainfall at the kibbutz from 1970 to 1990

economic strength.[9] Recent work shows that nighttime light is a proxy for local economic activity (Henderson, Storeygard, and Weil 2011; Doll, Muller, and Morley 2006; Sutton, Elvidge, and Ghosh 2007). The yearly kibbutz population is interpolated from the population in 1983, 1995, 2005, and 2015. To measure the outside option of kibbutz members, the analysis also includes regional employment rate of subdistricts in which kibbutzim locates and its interaction with the distance to the nearest regional council (hereafter "dynamic" control).[10]

[9]"Version 4 DMSP-OLS Nighttime Lights Time Series." National Oceanic and Atmospheric Administration. http://www.ngdc.noaa.gov/dmsp/downloadV4composites.html (accessed Feburary 22, 2020).

[10]Kibbutz population in 1983, 1995, 2005, and 2015 is obtained from Israeli Central Bureau of Statistics. Regional employment rates are compiled from Statistical Abstract of Israel 1990-2017.

7.2.2 Civil Conflicts

After the peace treaties with Egypt and Jordan, Israel alleviates the military threats from its two most powerful Arab neighbors. The attacks initiated by Palestinian armed groups, which have caused thousands of civilian casualties, then become the major threat to Israeli settlements. Since attacks directly targeting kibbutzim are scarce, the analysis measures the threats faced by a kibbutz by the number of Israeli civilian deaths under conflicts near each kibbutz. [11] A large number of civilian deaths near a kibbutz means the kibbutz located in a place vulnerable to attacks, and requires a high level of local public defense, in addition to the security service provided by the government.

The conflict data are obtained from the Uppsala Conflict Data Program Armed Geo-referenced Event Dataset (UCDP GED), which has information on global armed conflict events with at least one dead since 1989 (Sundberg and Melander 2013). The dataset is constructed to maximize the comparability and consistency across time and space, thus best suited for a panel analysis of the fatal outcomes of violent on Israeli communities.

To focus on the incidents of most concern to Israeli settlements, the analysis restricts the sample to attacks targeting civilians and conducted by Palestinian armed groups in Israel-Palestine region. This leaves a sample of 244 attacks resulting in 847 civilian deaths from 1989 to 2014.

The threat level faced by each kibbutz is then measured by the total number of civilian deaths within 20 kilometres of each kibbutz in current year and prior five years. The large area reflects the long distance traveled by attackers. [12] However, the plain death number may be simply driven by the population density at the incidence location. To the extent that attacks result in more casualty in an urban shopping center than at a rural bus stop, the same civilian death number in the more sparsely populated areas reflects a more dangerous environment. To correctly measure the conflict *intensity*, the death number is divided by the population density at the incidence locations.[13]

[11] Only two attacks happened in kibbutzim: five civilians were killed in Kibbutz Metzer in 2002, and one civilian was killed in kibbutz Nir-Oz in 2008.

[12] Based on a datasets of 120 Palestinian suicide attacks in Israel, the West Bank, and Gaza Strip from 1994 to 2005, Kilot and Charney (2006) find that attackers traveled between 10k to 90km, with closer targets more favorable than distance ones. Therefore, the analysis in this paper also uses attack incidents in a large area, and show results are robust to include attacks ranging from 5km to 45km.

[13] The population density data is obtained from Global Rural-Urban Mapping Project and Gridded Population of the World with resolution at 1km. Specifically, incidents during the five years before 1990, 1995, 2000, 2005, 2010, 2015 are adjusted correspondingly by the population density in 1990, 1995, 2000, 2005, 2010, 2015

7.2.3 Refugee Camp and Rainfall Data

The death of civilians under conflicts can be correlated with unobserved factors. For example, kibbutzim are largely identified with the Labor Party. The rise to power of the Likud party, known for its support of Israeli settlements in the West Bank and Gaza Strip, may provoke Palestinians, while at the same time reduces the official support for kibbutzim.

To address this concern, the analysis uses an instrument for the number of civilian deaths under conflicts near each kibbutz. The instrument is the total rainfall surplus in the previous six years at the nearest refugee camp to each kibbutz, multiplied by the camp population, and then divided by the distance between the kibbutz and the camp.

Since many Palestine refugees were displaced in the wars in 1948 and 1967, their camps were often the breeding ground for anti-Israel attacks (Kliot and Charney 2006). The First Intifada (the Palestinian's war for independence from Israel) started with a mass demonstration in the Jibalya refugee camp, and soon spread to the other refugee camps in the Gaza Strip and in the West Bank (Morris 2011, pp. 573-574). In the following years, Palestine refugee camp residents are more supportive of military operations against Israeli targets than residents in cities and villages (Bloom 2004). They are represented among the suicides at more than twice their share of the general population (Yufit and Lester, 2004).

One of the main factors that fuels the resentment of Palestinians is the water crisis arising from the over-extraction by Israel settlements and the constraints on the water supply and sanitation infrastructure imposed by the occupying power. Most of the West Banks natural water resources lie beneath its soil in three shared aquifers collectively known as the Mountain Aquifer. The three aquifers derive most of their recharge from rainfall and snowmelt. While the Palestinians extract 20% of the estimated aquifer potential lying beneath the West Bank, which is in line with its allocation in the Oslo agreement, the Israelis over-extract by more than 50%, in addition to the balance of the estimated potential.[14] The over-extraction of the aquifers has lowered water levels in the West Bank, and reduced Palestinian extraction from 138 MCM (Million Cubic Metre) in 1999 to 113 MCM in 2007. As a result, more than 200,000 people in West Bank are served by rainwater and expensive tanker water (World Bank, 2009).

The water supply coverage in the Gaza Strip is better than in the West Bank, but the quality of water has been deteriorating, due to high concentrations of salts and nitrates. In the past three decades, heavy over-drafting of groundwater and a decline in the rainfall, the main source of groundwater recharge, has led to the groundwater quality decline and seawater intrusion (Baalousha 2006). Consequently, agriculture productivity is harmed, and

[14]In 1995, the Government of Israel and the Palestine Liberation Organization signed the Oslo II agreement. In the Article 40, the aggrement recognized Palestinian water rights, and assigned 20% of estimated rechargeable potential of West Bank aquifers to the Palestinians, 80% to the Israelis.

less than 10% of water supplied through the network in Gaza Strip meets potable standards (World Bank, 2009; UNOCHA, 2010).

Water supply and sanitation infrastructure could have mitigated the water crisis in the West Bank and the Gaza Strip. The 1995 Oslo agreement aimed to provide a stable framework for investment in water infrastructure, and to improve water and sanitation services, but the actual outcome has been the opposite. It was often impossible for Palestinians to obtain Israeli permits to construct or repair water infrastructure, including digging new wells, restoring old wells and constructing water collection structures (UNCTAD, 2015). Only 38 out of the 202 well-drilling projects and 3 out of the 16 waste water projects submitted by the Palestinians were eventually implemented. No agricultural water applications, whether linked to drilling of new or replacement wells or mobilization of surface water streams, were approved (World Bank, 2009). Israeli governments also denied the establishment of small and medium-sized dams that could have been used to store water and release it at appropriate times throughout the year (UNCTAD, 2015); at the same time, numerous dams on the Israeli side cut the upstream water supply, drying the Wadi coastal wetlands in Gaza Strip (Shomar, 2011).

Given the low coverage and the poor quality of the water network, rainfall in Palestine is vital for those who live there to recharge groundwater and prevent seawater incursion. Though the amount of rainfall is exogenous, the Palestinians have good reasons to blame the Israelis for their low living standard in a dry year, and direct their rage on nearby Israeli settlements. Thus, it is expected that variation in rainfall at the nearest refugee camp of a kibbutz is strongly correlated with the number of civilian deaths under conflicts near the kibbutz in a given year.

The Palestinian Central Bureau of Statistics provides the population of 19 Palestinian refugee camps in West Bank and 8 in Gaza Strip in 1996.[15] The analysis then links each kibbutz to its nearest refugee camp, as well as the rainfall at the camp in each year. The rainfall amount is obtained from the daily gridded observational dataset for precipitation, temperature and sea level pressure in Europe (E-OBS). [16] Using the ECA&D blended daily station data, the E-OBS daily gridded dataset provides rainfall estimates at 0.1 degree (about 10km in Israel) latitude longitude intervals. Considering the small size of Israel, this high spatial resolution data is crucial to obtain reasonable rainfall variation.

[15] Accessed on April 9, 2019 from Palestinian Central Bureau of Statistics http://www.pcbs.gov.ps/Downloads/book31.pdf

[16] I acknowledge the E-OBS dataset from the EU-FP6 project UERRA (http://www.uerra.eu) and the Copernicus Climate Change Service, and the data providers in ECA&D project (https://www.ecad.eu)

7.3 OLS Specification and Results

Since the main interest is the timing of privatization *decision* instead of the income arrangement *status*, the sample is limited to pre-privatization years and the year of privatization. The data post privatization is not informative, as it is much harder for a kibbutz to reimpose the equal-sharing rule than abandoning it, especially when the privatization decision is made after years of debate. Historically, no kibbutz has readopted the equal sharing rule after abandoning it.

To estimate the effect of conflict intensity on the kibbutzim income privatization, the analysis uses the following linear regression model:

$$Y_{it} = \beta^{OLS} Conflicts_{it} + \lambda^{OLS} X_{it} + \theta_i + \eta_t + \epsilon_{it} \tag{7.1}$$

where Y_{it} is the probability of kibbutz i privatizes its income in year t; $Conflicts_{it}$ measures threat level — the number of civilian deaths under conflicts within 20 kilometres of the kibbutz in year t and the previous five years;[17] θ_j captures fixed kibbutz characteristics; η_t captures state-wide, period-specific trends; and X_i is a vector of kibbutz time-variant variables, (see Table 7.1 and Table 7.2 for the summary statistics and the variable definitions). The coefficient β^{OLS} thus captures the changes in privatization probability of a kibbutz associated with an increase in the conflict intensity. Since nearby kibbutzim face similar threats, error terms are assumed to be correlated across kibbutzim within a 100 kilometre radius (Conley, 1999) (the results are robust for other distances in Appendix D.4 Table D.4).

Table 7.3 reports the linear regression results. The negative coefficients of **Conflict Intensity** mean an increase in the number of civilian deaths near each kibbutz reduces the probability of kibbutz adopting income privatization, which is consistent with the prediction of the model. Regarding the magnitude, the point estimate of -0.112 (Column 6) shows that a standard deviation increase (0.095) in the conflict intensity reduces the income privatization probability of a kibbutz by 1.1 percent.

Nevertheless, even after controlling all static kibbutz characteristics by the fixed effect, the OLS estimates might still be biased, because the privatization decisions are correlated with the error terms. For example, a new government may simultaneously suppress civil attacks while facilitating kibbutz privatization.

[17] Results are robust to civilian deaths within 5km to 45km

Table 7.3: OLS Estimates of Main Effect

Dependent variable: Privatization Decision					
	(1)	(2)	(3)	(4)	(5)
Conflict Intensity, log	.0457	.0528	.00992	-.108	-.112
	(.0885)	(.087)	(.106)	(.131)	(.13)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Time-varying control		X	X		X
Static control			X		
N	2480	2425	2064	2480	2425

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each observation is a kibbutz-year. The sample is limited to pre-privatization years and the year of privatization. Dependent variable equals one in the income privatization year, 0 otherwise. **Conflict Intensity, log** is the log transformation of the number of civilian deaths in the year of privatization and five years prior within 20km of the kibbutz, adjusted by the population density at the conflict location. Control variables are described in Table 5.4. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

7.4 Instrumental-Variables Strategy

To overcome the issues raised above, I use an instrument for armed-group violence, as discussed in Section 7.2. The instrument is the total rainfall surplus in the previous six years at the nearest refugee camp to each kibbutz, multiplied by the camp population, and then divided by the distance between the kibbutz and the camp. The time span for the rainfall surplus is one year prior to the conflicts, a reasonable lag for refugees to turn their resentment into attacks.

A valid instrument needs to satisfy the exclusion restriction that absent conflicts, distance to the nearest refugee camp interacted with the rainfall variation at the camp, and the population of the camp has no effect on the timing of kibbutz income privatization. This is unlikely to be true, as the instrument, determined by the relative location of kibbutzim and refugee camps, and the local climate, is likely to be correlated with the productivity of rain-fed products within each kibbutz. These characteristics may in turn affect the income privatization decision.

To address these concerns, the analysis only uses the rainfall deviation from the long-term (from 1970 to 1990) average at refugee camps. Furthermore, the analysis controls for the rainfall at each kibbutz in the previous six years, the distance to the nearest refugee camp, the population at the nearest refugee camp, and the interaction between the distance and the population. In the following analysis, these are called “refugee controls. Identification then only stems from short-term variation in rainfall at the nearest refugee camp,

which is arguably exogenous and only affects income privatization decisions through the number of civilian deaths.

To further ensure the validity of the instrument, I provides more anecdotal evidence together with several indirect tests which all strongly support the identification assumption (see Appendix E.1). For instance, the results are the strongest when the conflicts are instrumented by the rainfall one year ahead. The instrument is only valid for civilians killed by Palestinian armed groups, but not for those killed by Israel Government. To exam the exclusion restriction, I show that the instrument is uncorrelated with regional employed rate at the subdistrict level, thus eliminating the concern that rainfall at nearby refugee camp may affect the privatization decision through labor market.

I then run the following first-stage regression:

$$Conflicts_{it} = \beta(Rainfall_{it} \times Pop_i \div Dist_i) + \lambda X_{it} + \theta_i + \eta_t + \epsilon_{it} \tag{7.2}$$

where $Conflicts_{it}$ is the total number of civilian deaths in year t and previous five years within 20km of the kibbutz, adjusted by the population density at the conflict location; $Rainfall_{it}$ is rainfall surplus in the previous six before year t at the nearest refugee camp to kibbutz i; Pop_i is the population of the nearest refugee camp in 1996; $Dist_i$ is the distance between the kibbutz i and its nearest refugee camp; θ_j captures fixed kibbutz characteristics; η_t captures state-wide, period-specific trends; ϵ_{it} is the error term; X_i is a vector of kibbutz and refugee control variables explained in detail above (see Table 7.1 and Table 7.2 for the summary statistics and the definitions of the variables). The coefficient β thus captures the increase in conflict intensity caused by the rainfall deficit in the nearby refugee camp.

The second-stage equation becomes:

$$Y_{it} = \beta^{IV}\widehat{Conflicts_{it}} + \lambda^{IV}X_{it} + \theta_i + \eta_t + \epsilon_{it} \tag{7.3}$$

where $\widehat{Conflicts_{it}}$ is estimated from the first stage. The coefficient β captures the causal effect of conflict intensity on kibbutz income privatization for those attacks induced by rainfall variation at the nearest refugee camp.

7.5 Instrumental-Variables Results

Table 7.4 reports regression results under the instrumental variable approach. The first-stage relationships between the instrumental variable and conflicts intensity are negative

Table 7.4: First stage and main effects of conflicts on kibbutz privatization

First Stage, Dependent variable: Conflict Intensity, log					
Refugee Rainfall × Pop. ÷ Dist.	-5.22***	-5.49***	-3.77***	-3.77***	-4.02***
	(1.02)	(1.07)	(.868)	(.807)	(.851)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Refugee control	X	X	X	X	X
Time-varying control		X	X		X
Static control			X		
F-stat	26.17	26.15	18.81	21.81	22.33
N	2259	2209	1877	2259	2209
Main Stage, Dependent variable: Income Privatization					
Conflict Intensity, log	-.856**	-.946**	-1.21**	-2.28***	-2.2***
	(.355)	(.378)	(.588)	(.827)	(.82)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Refugee control	X	X	X	X	X
Time-varying control		X	X		X
Static control			X		
N	2259	2209	1877	2259	2209

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each observation is a kibbutz-year. The sample is limited to pre-privatization years and the year of privatization. Dependent variable in the main stage equals one in the income privatization year. **Conflict Intensity, log** is the log transformation of the number of civilian deaths in the year of privatization and five years prior within 20km of the kibbutz, adjusted by the population density at the conflict location. **Rainfall** is the total rainfall surplus in the previous six years at the nearest refugee camp; **Pop** is the population of the nearest refugee camp in 1996; **Dist** is the distance to the nearest refugee camp; Control variables are described in Table 5.4. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

at the 1 percent level across all specifications.[18] The instrument variable is strong, as the F-statistic among all specifications are much larger than 10.

The instrumental-variables point estimates are about four times as large as the analogous OLS estimates: a standard deviation increase in the conflict intensity reduces the income privatization probability of a kibbutz by $2.2 \times 0.03 = 6.6\%$ (column 6 in the Main Stage in Table 7.4), about one thirds of the standard deviation of privatization probability (21%). The results are once more robust across all specifications and significant throughout at the 5 percent level.

The large difference between OLS and Instrumental-variables estimates may be explained by three reasons. First, the instrumental-variables strategy might be correcting for random measurement error in the conflict incidence. Second, the positive bias of OLS estimates suggests that conflicts induced by rainfall deficit may target strategically to originally safe areas, where kibbutzim are more likely to privatize the income.[19] Finally, I measure the local average treatment effect (LATE) induced by changes in conflict intensity due to the instrument. Highly motivated attackers suffering from rainfall deficit might have been particularly desperate, causing a large death toll and resulting in a high local average treatment effect.

If the decision of income privatization of the kibbutzim is truly driven by security concerns, one would expect the conflicts closer to the kibbutzim have a larger impact on the privatization than those further away from the kibbutzim have. To test this, I rerun the same regression (as in column 6 in Table 7.4) for conflicts within 5km to 45km. Figure 7.1 shows the effects of conflicts on the income privatization decays as they locate further away from the kibbutz (see Table E.4 in Appendix E.2 for corresponding regression results). Furthermore, in Appendix E.2 I provide several additional robustness and placebo checks. For instance, the income privatization decisions are mainly driven by the conflicts in the recent years than those in the early years. To exam reverse causality, I show kibbutz privatization decisions are only correlated to conflicts in the past, not conflicts in the future.

7.6 Concluding Remarks

To some extent, the kibbutzim were forced into transformations by their own success in defending the Jewish territory. Their traditional equal-sharing arrangement along with the

[18] As a reminder, the instrument is the total rainfall surplus in the previous six years at the nearest refugee camp to each kibbutz, multiplied by the camp population, and then divided by the distance between the kibbutz and the camp.

[19] If there were an unobserved factor that would indicate safe areas and hence increase the probability of kibbutz privatization, then the attackers should be more likely to attack those areas where the unobserved factor is high. The two conditions combined together means the correlation between the error term and the regressor is positive, which gives OLS estimates an upward bias.

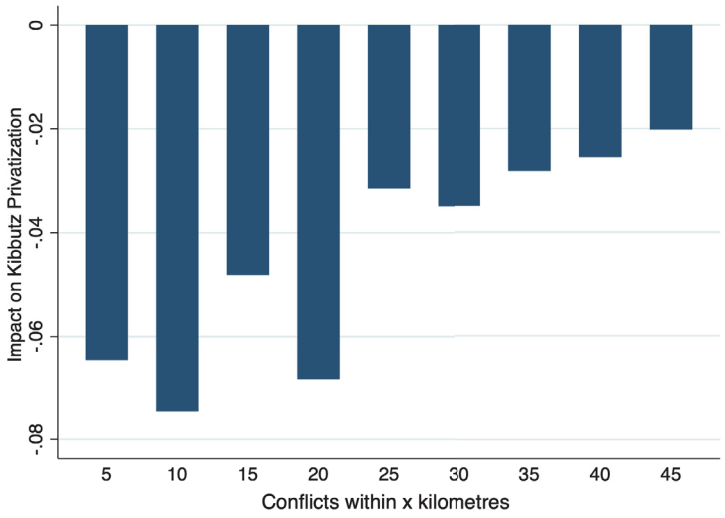


Figure 7.1: Placebo check of the main regression — different range of conflicts

The impact of conflict within x kilometres of kibbutzim on the probability of income privatization.

high defense induced by it was no longer demanded under the secure environment. In the early 1990s, the only remaining threats came from the civil conflicts mainly from the Palestinian refugees. and those threats were not comparable to the shadow of full-scale war. Consequently, the kibbutzim privatized their income one after another.

Specifically, those kibbutzim experienced fewer conflicts privatized their income first. To overcome the potential endogeneity problem, I used the rainfall as an instrumental variable for the conflicts fuelled by water conflicts between the Israeli settlements and Palestinian refugees. Those Palestinian refugees received less rainfall were more likely to direct their anger at nearby kibbutzim in the form of attacks. Those kibbutzim in turn were less likely to privatize their income in the following years.

The case study of kibbutzim privatization also sheds light on the rarity of equal-sharing communities. Those communities will privatize income when the external threats are too large and will be abandoned when the external threats are too small. Also, for the presence of equal-sharing communities, the size of external threats must also be stable in the foreseeable future. Since income privatization, or abandoning a community incurs a large fixed cost, the members will not build a community in a highly uncertain environment.

The strict condition of equal-sharing arrangements illustrates the constraint on the collective organizations. Ideological commitment might motivate the pioneers to sacrifice their personal gains in the short run, and experiment collective organizations. But continued commitment in the long run can only be justified a public good that requires the continuous input from members. This public good has to be tangible and almost equally beneficial to everyone in the organization.

In the case of Israel kibbutzim, this public good is the strong defense in face of the persistent threats imposed by their adversaries. In other collective organizations, the public interest takes the form of mutual offense in the case of pirates looting merchant ships in the 17th century (Leeson 2007), protecing the land rights in the case of Tanzanian farmers facing competing claim from sisal estates in the late 20th century (Greco 2017), and avoiding the costly bloodshed in the case of gold miners during Carlifornia gold rush in the 19th century (Umbeck 1977, 1981). While those organizations were disbanded soon after pirates, Tanzanian farmers, and Carlifornia gold miners achieved their common goal, their historical influences once again demonstrated the strength of institutions.

Chapter 8

Conclusion

The strength and weakness of equal-sharing arrangements for managing natural resources have been studied for centuries. The role of equal-sharing communities in defending territories, however, has received little attention. In this thesis, I examine this function through studying the rise and the fall of kibbutzim in Israel against the persistent external threats faced by the Jews over the 20th century.

Theoretically, kibbutzim could provide a high defense because their equal-sharing income arrangements constrain the incentive on producing private goods, thereby inducing a high provision of the public defense, which would otherwise be under-provided under private income arrangements. However, the benefit of high defense comes at the cost of adverse selection. It is costly for kibbutzim to retain high productivity members while screening out low productivity ones. As the external threats decrease, the costs outweigh the benefits, and kibbutzim are predicted to privatize their income.

Given the optimal choice of income arrangements under different external threats, a central planner will place different kibbutzim and non-kibbutzim according to the local environment — placing kibbutzim in dangerous areas, since they can survive longer under siege; placing non-kibbutzim in safe areas so that they can focus on economic production.

Those predictions are then tested against the strategic locations of Jewish settlements and kibbutz privatization in history. In the first half of the twentieth century, the Jews established rural settlements to lay the legal claim over Palestine to reclaim their ancestral homeland. Facing the rising hostility from the local Arabs, the Jewish leadership centrally purchased lands and allocated them to settlements according to the local environment. Kibbutzim were typically located to peripheral areas due to their low dependence on support from other settlements. On the contrary, Non-kibbutzim were often located in clusters in order to reinforce each other. As a result, kibbutzim made a larger contribution in shaping the legal territory as suggested in several partition plans. Those legal territories, in turn, gave nascent Israel an edge in the upcoming war and served as a legal basis for establishing a Palestinian State.

While diplomatic solutions to the territory disputes eventually gave away to the military ones, kibbutzim still played an important role in delineating the boundary of Israel by forces, due to their strategic locations and strong defense. Compared to private income settlements, kibbutzim were more likely to be located at the frontiers of the attacking routes to absorb the first wave of military attacks. The rugged terrain further enhances their defense so that kibbutzim could hold longer and bought more time for settlements behind them. As a result, kibbutzim delayed and even halted the attacks of Arab armies on several fronts thereby burying enough time for the Jewish leadership to equip more troops, organize a counter strike, and push back the attackers.

The stubborn defense put up by the kibbutzim helped secure Israel borders, but the safe environment, in turn, paved the way to the fall of the kibbutzim. As the external threats decline, the rules designed to constrain incentive on private consumptions became too costly. The kibbutzim abandoned collective child rearing, forfeit the equal distribution of consumption goods, and allowed outside workers. Eventually in the late 1980s, each kibbutz became independent financially and was allowed to adopted income reforms according to its own situation. The idiosyncratic timing of the income privatization of kibbutzim permits direct analysis of underlying causes. The major determinant turned out to be a secure environment in terms of a small number of deaths under civil conflicts. By 2014, some one hundred years since the establishment of the first kibbutz at the lakeside of Galilee, about three-fourth of the kibbutzim had abandoned their equal-sharing rule and were considered as "renewed" kibbutzim.

While the strong defense of equal-sharing arrangements is based on a single case study of the kibbutzim in Israel, historical examples indicate that institutions play an important role in other areas of conflicts. Ellickson (1993) noticed that pioneers living in Jamestown, Plymouth, and Salt Lake refused to parcel out land in the early years, partly to defend against Indian raids. However, pioneers in places without strong Indian threats established city lots and farmstead within a month of arrival. Allen (1999, 2019) argues that the United States in the mid-nineteenth century adopted the Homestead Act — giving away lands in the West for free — in order to defend the land in face of the competing land claims from Indians. Matranga and Natkhov (working paper) provide evidence that Russian adopted serfdom to lock peasants at the southern frontier to defend against the raids of Crimean Tatars.[1]

Just like traditional kibbutzim are going extinct along with its equal-sharing rules, those defensive institutions are rarely seen nowadays. But it is hard to say they will not come back again in the future. We have witnessed perhaps the longest global peace in history —

[1]The working paper titled "All Along the Watchtower: Linear Defenses and the Introduction of Serfdom in Russia" was accessed on Nov 24, 2019 from
https://economics.ucdavis.edu/events/papers/copy2_of_1029Matranga.pdf

so long that many people take it for granted. However, the number of conflicts has been shooting up since 2010, reaching the peak of the post Cold War period (Dupuy et al 2017, Cederman and Pengl 2019). Therefore, it is more pressing than ever before to study the costs and the effects of various defensive institutions in competing and defending land claims under external threats. After all, no country can survive without territory, and no country can develop land well under the shadow of military threats.

Bibliography

Abramitzky, Ran (2008). The limits of equality: Insights from the Israeli kibbutz. *The quarterly journal of economics 123*(3), 1111–1159.

Abramitzky, Ran (2011). Lessons from the kibbutz on the equality-incentives trade-off. *Journal of Economic Perspectives 25*(1), 185–208.

Abramitzky, Ran (2018). *The Mystery of the Kibbutz: Egalitarian Principles in a Capitalist World*, Volume 73. Princeton University Press.

Abu-Lughod, Ibrahim A. (1971). *The Transformation of Palestine: Essays on the Origin and Development of the Arab-Israeli Conflict*. Northwestern University Press.

Acemoglu, Daron and James A. Robinson (2020). *The Narrow Corridor: States, Societies, and the Fate of Liberty*. Penguin Books.

Acheson, James M. (1975). The lobster fiefs: Economic and ecological effects of territoriality in the Maine lobster industry. *Human Ecology 3*(3), 183–207.

Acheson, James M. (1987). The lobster fiefs revisited: Economic and ecological effects of territoriality in Maine lobster fishing. *The question of the commons. The culture and ecology of communal resources*, 37–65.

Achouch, Yuval and Yoann Morvan (2012). The Kibbutz and "Development Towns" in Israel: Zionist utopias: Ideals ensnared in a tormented history. *justice spatiale-spatial justice 5*, http://www. jssj. org/article/les–utopies–sionistes–des–ideaux–pieges–par–une–histoire–tourmentee–kiboutz–et–villes–de–developpement–en–israel/.

Agrawal, Arun (1996). *Group Size and Successful Collective Action: A Case Study of Forest Management Institutions in the Indian Himalayas*. International Forestry Resources and Institutions Research Program, Indiana ....

Akerlof, George (1976). The economics of caste and of the rat race and other woeful tales. *The Quarterly Journal of Economics*, 599–617.

Alchian, Armen A. and Harold Demsetz (1972). Production, information costs, and economic organization. *The American economic review 62*(5), 777–795.

Alesina, Alberto and Enrico Spolaore (2005). *The Size of Nations*. Mit Press.

Allen, Douglas and Dean Lueck (1992). Contract choice in modern agriculture: Cash rent versus cropshare. *The Journal of Law and Economics 35*(2), 397–426.

Allen, Douglas W. (1991). Homesteading and Property Rights; Or," How the West Was Really Won". *The Journal of Law and Economics 34*(1), 1–23.

Allen, Douglas W. (1992). "What Does She See in Him?" The Effect of Sharing on the Choice of Spouse. *Economic Inquiry 30*(1), 57–67.

Allen, Douglas W. (2019). Establishing economic property rights by giving away an empire. *The Journal of Law and Economics 62*(2), 251–280.

Allen, Douglas W. and Dean Lueck (1995). Risk preferences and the economics of contracts. *The American Economic Review 85*(2), 447–451.

Allen, Douglas W. and Dean Lueck (1998). The nature of the farm. *The Journal of Law and Economics 41*(2), 343–386.

Anabtawi, Samir N. (1972). The Transformation of Palestine: Essays on the Origin and Development of the Arab-Israeli Conflict. *American Political Science Review 66*(4), 1370–1370.

Anderson, Terry L. (Terry Lee), Peter Jensen Hill, and Douglass C. (Douglass Cecil) North (1983). *Growth and Welfare in the American Past : A New Economic History / Douglass C. North, Terry L. Anderson, Peter J. Hill.* (3rd ed. ed.). Englewood Cliffs, N.J. : Prentice-Hall.

Arian, Asher and Alan Arian (1995). *Security Threatened: Surveying Israeli Opinion on Peace and War*. Cambridge University Press.

Asadi, Fawzi (1976). Some geographic elements in the Arab-Israeli conflict. *Journal of Palestine Studies 6*(1), 79–91.

Ashkenazi, Maayan Hess and Yossi Katz (2009). From cooperative to renewed kibbutz: The case of kibbutz 'Galil', Israel. *Middle Eastern Studies 45*(4), 571–592.

Baalousha, Husam (2006). Desalination status in the Gaza Strip and its environmental impact. *196*(1-3), 1–12.

Balk, D. L., U. Deichmann, G. Yetman, F. Pozzi, S. I. Hay, and A. Nelson (2006 20210206). Determining Global Population Distribution: Methods, Applications and Data. *Advances in Parasitology 62*, 119–156.

Barjamovic, Gojko, Thomas Chaney, Kerem Coşar, and Ali Hortaçsu (2019). Trade, merchants, and the lost cities of the bronze age. *The Quarterly Journal of Economics 134*(3), 1455–1503.

Barzel, Yoram (1997). *Economic Analysis of Property Rights*. Cambridge university press.

Barzilai, Gad (2012). *Wars, Internal Conflicts, and Political Order: A Jewish Democracy in the Middle East*. SUNY Press.

Ben-David, Joseph (1964). Agricultural planning and village communicaty in Israel. Technical report, UNESCO.

Besley, Timothy and Torsten Persson (2009). The origins of state capacity: Property rights, taxation, and politics. *American economic review 99*(4), 1218–44.

Besley, Timothy and Torsten Persson (2011). *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton University Press.

Bickerton, Ian J. and Carla L. Klausner (2007). *A History of the Arab-Israeli Conflict*. Pearson Prentice Hall Upper Saddle River, NJ.

Bisharat, George E. (1993). Land, Law, and Legitimacy in Israel and the Occupied Territories. *Am. UL Rev. 43*, 467.

Blomquist, William (1992). *Dividing the Waters: Governing Groundwater in Southern California.* ICS Press Institute for Contemporary Studies.

Bloom, Mia M. (2004). Palestinian suicide bombing: Public support, market share, and outbidding. *Political Science Quarterly 119*(1), 61–88.

Blundell, Richard and James L. Powell (2003). Endogeneity in nonparametric and semiparametric regression models. *Econometric society monographs 36*, 312–357.

Bowden, Tom (1975). The politics of the Arab rebellion in Palestine 1936–39. *Middle Eastern Studies 11*(2), 147–174.

Bowes, Alison M. (1990). The Experiment that did not fail: Image and Reality in the Israeli Kibbutz. *International Journal of Middle East Studies 22*(1), 85–104.

Casari, Marco (2007). Emergence of endogenous legal institutions: Property rights and community governance in the Italian Alps. *Journal of Economic History*, 191–226.

Cederman, L. and Yannick Pengl (2019). Global Conflict Trends and their Consequences*.

Center for International Earth Science Information Network - CIESIN - Columbia University (2018 20210206). *Gridded Population of the World, Version 4 (GPWv4): Population Density, Revision 11*. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC).

Center for International Earth Science Information Network - CIESIN - Columbia University, International Food Policy Research Institute - IFPRI, The World Bank, and Centro Internacional de Agricultura Tropical - CIAT (2011 20210206). *Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Population Density Grid*. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC).

Charters, David A. (1998). Eyes of the underground: Jewish insurgent intelligence in Palestine, 1945–47. *Intelligence and National Security 13*(4), 163–177.

Cheung, Steven NS (1969). The theory of share tenancy. *The theory of share tenancy.*.

Cheung, Steven NS (1970). The structure of a contract and the theory of a non-exclusive resource. *The Journal of Law and Economics 13*(1), 49–70.

Clark, Colin W. (1980). Restricted access to common-property fishery resources: A game-theoretic analysis. In *Dynamic Optimization and Mathematical Economics*, pp. 117–132. Springer.

Coase, Ronald H. (1960a). The problem of social cost. In *Classic Papers in Natural Resource Economics*, pp. 87–137. Springer.

Coase, Ronald H. (1960b). The problem of social cost. In *Classic Papers in Natural Resource Economics*, pp. 87–137. Springer.

Cohen, Hillel (2015). *Year Zero of the Arab-Israeli Conflict 1929*. Brandeis University Press.

Cohen, Samy (2010). *Israel's Asymmetric Wars*. Springer.

Conley, Timothy G. (1999). GMM estimation with cross sectional dependence. *Journal of econometrics 92*(1), 1–45.

Cornes, Richard C., Gerard van der Schrier, Else JM van den Besselaar, and Philip D. Jones (2018). An Ensemble Version of the E-OBS Temperature and Precipitation Data Sets. *Journal of Geophysical Research: Atmospheres 123*(17), 9391–9409.

Coward, E. Walter (1980). *Irrigation and Agricultural Development in Asia: Perspectives from the Social Sciences*. Cornell University Press.

Daniel, Rosolio (1999). System and Crisis: Crisis, Adjustments and Changes in the Kibbutz Movement. *Tel Aviv: Am Oved*.

Danielson, Jeffrey J. and Dean B. Gesch (2011). *Global Multi-Resolution Terrain Elevation Data 2010 (GMTED2010)*. US Department of the Interior, US Geological Survey.

Davis, Anthony (1984). Property rights and access management in the small boat fishery: A case study from southwest Nova Scotia. *Atlantic fisheries and coastal communities: fisheries decision-making case studies*, 133–164.

Demsetz, Harold (1967). Towards a Theory of Property Rights. *The American Economic Review 57*(2), 347–359.

Dijkstra, Edsger W. (1959). A note on two problems in connexion with graphs. *Numerische mathematik 1*(1), 269–271.

Doll, Christopher NH, Jan-Peter Muller, and Jeremy G. Morley (2006). Mapping regional economic activity from night-time light satellite imagery. *Ecological Economics 57*(1), 75–92.

Dupuy, Kendra, Scott Gates, Håvard Mokleiv Nygård, Ida Rudolfsen, Siri Aas Rustad, Håvard Strand, and Henrik Urdal (2017). Trends in armed conflict, 1946–2016. *Conflict Trends 2*, 1–4.

Durrenberger, E. Paul and Gísli Pálsson (1987). Ownership at sea: Fishing territories and access to sea resources. *American ethnologist 14*(3), 508–522.

Elaraby, Nabil (1968). Some legal implications of the 1947 Partition Resolution and the 1949 Armistice Agreements. *Law and Contemporary Problems 33*(1), 97–109.

Ellickson, Robert C. (1993). Property in Land. *Yale Law Journal*, 1315–1400.

Fischbach, Michael R. (2003). *Records of Dispossession: Palestinian Refugee Property and the Arab-Israeli Conflict*. Columbia University Press.

Frenken, Karen (2009). Irrigation in the Middle East region in figures AQUASTAT Survey-2008. *Water Reports* (34).

Gavron, Daniel (2000). *The Kibbutz: Awakening from Utopia*. Rowman & Littlefield.

Gennaioli, Nicola and Hans-Joachim Voth (2015). State capacity and military conflict. *The Review of Economic Studies 82*(4), 1409–1448.

Gilbert, Martin (2005). *The Routledge Atlas of the Arab-Israeli Conflict*. Routledge.

Gordon, H. Scott (1954). The economic theory of a common-property resource: The fishery. In *Classic Papers in Natural Resource Economics*, pp. 178–203. Springer.

Greco, Elisa (2017). Farmers or squatters? Collective land claims on sisal estates, Tanzania (1980s–2000s). *Journal of Agrarian Change 17*(1), 166–187.

Hadawi, Sami (1957). *Land Ownership in Palestine*. Palestine Arab Refugee Office New York.

Hadawi, S. (1967). *Bitter Harvest; Palestine between 1914-1967*. New World Press.

Hasson, Shlomo and N. Gosenfield (1980). Israeli frontier settlements: A cross-temporal analysis. *Geoforum 11*(4), 315–334.

Hutchinson, M. F. and P. E. Gessler (1994). Splines—more than just a smooth interpolator. *Geoderma 62*(1-3), 45–67.

Johnson, David E. (2011). Hard Fighting: Israel in Lebanon and Gaza. Technical report, Santa Monica, CA: RAND Corporation.

Kellerman, Aharon (2012). *Society and Settlement: Jewish Land of Israel in the Twentieth Century*. SUNY Press.

Kerem, M. (1962). *Life in a Kibbutz*. Zionist Organization, Youth and Hechalutz Department.

Khalidi, Ahmed S. (1973). The war of attrition. *Journal of Palestine Studies 3*(1), 60–87.

Khalidi, Rashid (1990). The Resolutions of the 19th Palestine National Council. *Journal of Palestine Studies 19*(2), 29–42.

Kliot, Nurit and Igal Charney (2006). The geography of suicide terrorism in Israel. *GeoJournal 66*(4), 353–373.

Ko, Chiu Yu, Mark Koyama, and Tuan-Hwee Sng (2018). Unified china and divided Europe. *International Economic Review 59*(1), 285–327.

Kober, Avi (2009). *Israel's Wars of Attrition: Attrition Challenges to Democratic States*. Routledge.

Korn, David A. (1992). *Stalemate: The War of Attrition and Great Power Diplomacy in the Middle East*. Boulder, CO: Westview Press.

Landers, Renee M., James B. Rebitzer, and Lowell J. Taylor (1996). Rat race redux: Adverse selection in the determination of work hours in law firms. *The American Economic Review*, 329–348.

Langmuir, Eric (1984). *Mountaincraft and Leadership: A Handbook for Mountaineers and Hillwalking Leaders in the British Isles*. Scottish Sports Council Edimburgh.

Leeson, Peter T. (2007). An-arrgh-chy: The law and economics of pirate organization. *Journal of political economy 115*(6), 1049–1094.

Leiblich, Amia (1981). Kibbutz Makom: Report from Israeli Kibbutz. *New York: Pantheon*.

Lesch, Ann Mosely (1977). Israeli Settlements in the Occupied Territories, 1967-1977. *Journal of Palestine Studies 7*(1), 26–47.

Libecap, Gary D. (1994). 7. The Conditions for Successful Collective Action. *Journal of Theoretical Politics 6*(4), 563–592.

Libecap, Gary D. and Steven N. Wiggins (1984). Contractual responses to the common pool: Prorationing of crude oil production. *The American Economic Review 74*(1), 87–98.

Lieblich, Amia (1981). *Kibbutz Makom*. Pantheon Books.

Lin, Justin Yifu (1990). Collectivization and China's agricultural crisis in 1959-1961. *Journal of Political Economy 98*(6), 1228–1252.

Lorch, Netanel and Moshe Pearlman (2007). War of Independence. In Michael Berenbaum and Fred Skolnik (Eds.), *Encyclopaedia Judaica* (2nd ed. ed.), Volume 20, pp. 652–665. Detroit, MI: Macmillan Reference USA.

Lorimer, Frank (1946). *The Population of the Soviet Union: History and Prospects*, Volume 61. Geneva: League of Nations.

Lueck, Dean (1994). Common property as an egalitarian share contract. *Journal of Economic Behavior & Organization 25*(1), 93–108.

Mansour, Hani (2010, December). The effects of labor supply shocks on labor market outcomes: Evidence from the Israeli–Palestinian conflict. *Labour Economics 17*(6), 930–939.

Martin, Edward D. and Robert Yoder (1988). A comparative description of two farmer-managed irrigation systems in Nepal. *Irrigation and Drainage systems 2*(2), 147–172.

McKean, Margaret A. (1992). Success on the commons: A comparative examination of institutions for common property resource management. *Journal of theoretical politics 4*(3), 247–281.

McKean, Margaret A. and Thomas R. Cox (1982). The Japanese experience with scarcity: Management of traditional common lands. *Environmental Review: ER 6*(2), 63–91.

Metz, Helen Chapin (1990). Israel, a country study.

Miaari, Sami H. and Robert M. Sauer (2011). The labor market costs of conflict: Closures, foreign workers, and Palestinian employment and earnings. *Review of Economics of the Household 9*(1), 129–148.

Morice, Colin P., John J. Kennedy, Nick A. Rayner, and Phil D. Jones (2012). Quantifying uncertainties in global and regional temperature change using an ensemble of observational estimates: The HadCRUT4 data set. *Journal of Geophysical Research: Atmospheres 117*(D8).

Morris, Benny (1993). Israel's Border Wars, 1949-1956: Arab Infiltration. *Israeli Retaliation, and the Countdown to the Suez War*, 364–9.

Morris, Benny (2003). *The Birth of the Palestinian Refugee Problem Revisited*. Cambridge, United Kingdom: Cambridge University Press.

Morris, Benny (2008). *1948: A History of the First Arab-Israeli War*. Yale University Press.

Morris, Benny (2011). *Righteous Victims: A History of the Zionist-Arab Conflict, 1881-1998*. Vintage.

Near, Henry (2007a). *The Kibbutz Movement. Volume 1, Origins and Growth, 1909-1939 : A History / Henry Near.* Littman Library of Jewish Civilization (Series). The Littman Library of Jewish Civilization.

Near, Henry (2007b). *The Kibbutz Movement. Volume 2, Crises and Achievement, 1939-95 : A History / Henry Near.* Littman Library of Jewish Civilization (Series). The Littman Library of Jewish Civilization.

Netting, Robert McC (1996). What Alpine peasants have in common: Observations on communal tenure in a Swiss village. In *Case Studies in Human Ecology*, pp. 219–231. Springer.

Netting, Robert M. and Robert McC Netting (1981). *Balancing on an Alp: Ecological Change and Continuity in a Swiss Mountain Community*. CUP Archive.

NOAA, NGDC (2010). *Version 4 DMSP-OLS Nighttime Lights Time Series*. National Geophysical Data Center Boulder, CO.

North, Douglass C. and Robert Paul Thomas (1976). The Rise of the Western World. *Cambridge Books*.

Ostrom, E. (1990). *Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press.

Ostrom, Elinor and Charlotte Hess (2000). Private and common property rights. In *Encyclopedia of Law and Economics*. Edward Elgar Publishing Limited.

Palgi, Michal (2002). Organizational change and ideology: The case of the kibbutz. *International review of sociology 12*(3), 389–402.

Palgi, Michal (2005). Women in the Changing World of the Kibbutz. *Women in Judaism: A Multidisciplinary e-Journal 1*(1).

Rayman, Paula M. (2014). *Kibbutz Community and Nation Building*. Princeton University Press.

Rees, W. G. (2004). Least-cost paths in mountainous terrain. *Computers & Geosciences 30*(3), 203–209.

Reports, MERIP (1977). A Survey of Israeli Settlements. (60), 13–20.

Rosner, Menahem, Itzhak Ben David, Alexander Avnat, Neni Cohen, Uri Leviatan, and Uni Leviatan (1990). *The Second Generation: Continuity and Change in the Kibbutz*, Volume 2. Greenwood Publishing Group.

Rosner, Menachem and Shlomo Getz (1996). The Kibbutz in the era of changes. *Haifa: Hakibbutz hameouchad & University of Haifa (en hébreu)*.

Ruffle, Bradley J. and Richard Sosis (2006). Cooperation and the in-group-out-group bias: A field test on Israeli kibbutz members and city residents. *Journal of Economic Behavior & Organization 60*(2), 147–163.

Russell, Raymond, Robert Hanneman, and Shlomo Getz (2013). *The Renewal of the Kibbutz: From Reform to Transformation*. Rutgers University Press.

Sadan, Ezra (1963). Cooperative settlements in Israel: Problems of resource allocation. *Journal of Farm Economics 45*(3), 547–557.

Safran, Nadav (1977). Trial by Ordeal: The Yom Kippur War, October 1973. *International Security*, 133–170.

Scarf, Philip (2007). Route choice in mountain navigation, Naismith's rule, and the equivalence of distance and climb. *Journal of Sports Sciences 25*(6), 719–726.

Schlager, Edella and Elinor Ostrom (1992). Property-rights regimes and natural resources: A conceptual analysis. *Land economics*, 249–262.

Schneer, Jonathan (2010). *The Balfour Declaration: The Origins of the Arab-Israeli Conflict*. Bond Street Books.

Segev, Tom (2000). *One Palestine, Complete: Jews and Arabs under the British Mandate*. Macmillan.

Sela, Avraham (2007). Civil society, the military, and national security: The case of Israel's security zone in South Lebanon. *Israel Studies*, 53–78.

Sengupta, Nirmal (1991). *Managing Common Property: Irrigation in India and the Philippines.* Sage Publications India Pvt Ltd.

Shomar, Basem (2011). Water scenarios in the Gaza Strip, Palestine: Thirst, hunger and disease. *International journal of environmental studies 68*(4), 477–493.

Simons, Tal and Paul Ingram (1997). Organization and ideology: Kibbutzim and hired labor, 1951-1965. *Administrative Science Quarterly*, 784–813.

Simons, Tal and Paul Ingram (2000). The kibbutz for organizational behavior. *Research in organizational behavior 22*, 283–343.

Simons, Tal and Paul Ingram (2003). Enemies of the state: The interdependence of institutional forms and the ecology of the kibbutz, 1910–1997. *Administrative Science Quarterly 48*(4), 592–621.

Siy, Robert Y. (1982). *Community Resource Management: Lessons from the Zanjera*. University of the Philippines Press Quezon City.

Smith, Robert J. (1981). Resolving the tragedy of the commons by creating private property rights in wildlife. *Cato J. 1*, 439.

Sundberg, Ralph and Erik Melander (2013). Introducing the UCDP georeferenced event dataset. *Journal of Peace Research 50*(4), 523–532.

Sutton, Paul C., Christopher D. Elvidge, and Tilottama Ghosh (2007). Estimation of gross domestic product at sub-national scales using nighttime satellite imagery. *International Journal of Ecological Economics & Statistics 8*(S07), 5–21.

Tal, Alon (2007). To make a desert bloom: The Israeli agricultural adventure and the quest for sustainability. *Agricultural History*, 228–257.

Talmon, Yonina (1972). *Family and Community in the Kibbutz*, Volume 67. Harvard University Press.

Tilly, Charles (1990). Capital, coercion and European states. *Cam-bridge, MA: Basil Blackwell*.

Tucker, Spencer C. and Priscilla Roberts (2008). *The Encyclopedia of the Arab-Israeli Conflict: A Political, Social, and Military History [4 Volumes]: A Political, Social, and Military History*. Abc-Clio.

Umbeck, John (1977). A theory of contract choice and the California gold rush. *The Journal of Law and Economics 20*(2), 421–437.

Umbeck, John R. (1981). *A Theory of Property Rights: With Application to the California Gold Rush*. Iowa State Press.

UNCTAD (2015). *The Besieged Palestinian Agricultural Sector*. United Nations Geneva.

UNOCHA (2010). Farming Without land, Fishing Without Water: Gaza Agriculture Sector Struggles to Survive. *Fact Sheet, UN Office of the Coordination of Humanitarian Affairs. http://unispal. un. org/UNISPAL. NSF/0/9A265F2A909E9A1D8525772E004FC34B (last accessed 21 October 2015)*.

Vilnay, Zev (1968). *The New Israel Atlas, Bible to Present Day*. HA Humphrey Limited.

Wagner, Markus (2020). The impending demise of the WTO Appellate Body: From centrepiece to historical relic? In *The Appellate Body of the WTO and Its Reform*, pp. 67–90. Springer.

Wagner, Steven (2008). British intelligence and the Jewish resistance movement in the Palestine mandate, 1945–46. *Intelligence and National Security 23*(5), 629–657.

Warszawski, L., K. Frieler, V. Huber, F. Piontek, O. Serdeczny, X. Zhang, Q. Tang, M. Pan, Y. Tang, and Q. Tang (2017). Center for International Earth Science Information Network—CIESIN—Columbia University.(2016). Gridded population of the World, Version 4 (GPWv4): Population density. Palisades. NY: NASA Socioeconomic Data and Applications Center (SEDAC). doi: 10. 7927/H4NP22DQ. *Atlas of Environmental Risks Facing China Under Climate Change*, 228.

Weintraub, Dov (1969). Moshava, kibbutz, and moshav. Patterns of Jewish rural settlement and development in Palestine. *Moshava, kibbutz, and moshav. Patterns of Jewish rural settlement and development in Palestine.*.

Weisman, Joshua (1966). The kibbutz: Israel's collective settlement. *Israel Law Review 1*(1), 99–131.

Weiss, Yoram and Robert J. Willis (1985). Children as collective goods and divorce settlements. *Journal of Labor Economics 3*(3), 268–292.

Weitzman, Martin and Douglas Kruse (1990). Profit sharing and productivity. *1990*, 95–142.

World Bank (2009). West Bank and Gaza - Assessment of Restrictions on Palestinian Water Sector Development. Technical report, The World Bank.

Yufit, Robert I. and David Lester (2004). *Assessment, Treatment, and Prevention of Suicidal Behavior*. John Wiley & Sons.

Yusuf, Muhsin (2002). The Partition of Palestine (1947)-An Arab Perspective. *Palestine-Israel Journal of Politics, Economics, and Culture 9*(4), 39.

Zablocki, Benjamin David (1980). *Alienation and Charisma: A Study of Contemporary American Communes*. Free Press.

Appendix A

Extension to Chapter 2

A.1 Israeli Death Tolls Sources

Table A.1: Israeli Death Tolls Sources

Event	Year	Death #	Reference
Battle of Tel Hai	1920	6	Segev 2001, pp. 124
Nebi Musa riots	1920	5	Segev 2001, pp. 138
Jaffa riots	1921	47	Segev 2001, pp. 183
Jerusalem riots	1921	5	Segev 2001, pp. 188
1929 riots	1929	133	Cohen 2015, pp. xxi
Arab revolt	1936–1939	547	Bowden 1975
Jewish insurgency	1945–1947	65	Charters 1989, pp. 205
1947 Civil War	1947	2000	Morris 2004, pp. 35
1948 Israel-Arab War	1948	4000	Morris 2004, pp. 35
Fedayeen attacks	1951–1956	450	Morris 1993, pp. 415
Sinai War	1956	190	Morris, pp. 296
Fedayeen attacks	1957–1967	135	Korn 1992, pp. 215
Six-day War	1967	983	Klausner and Bickerton 2007, pp. 147
War of attrition	1967–1970	750	Korn 1992, pp. 275
Civil Conflicts	1970–1979	160	Global Terrorism Database[1]
Yom Kippur	1973	2838	Klausner and Bickerton 2007, pp. 170
Operation Litani	1978	18	Kober 2009
Civil Conflicts	1980–1989	120	Global Terrorism Database
First Lebanon War	1982–1985	657	Barzilai 2012, pp. 148
Civil Conflicts	1990–1999	267	Global Terrorism Database
Lebanon Conflicts	1985–2000	319	Sela 2007
Civil Conflicts	2000–2009	817	Global Terrorism Database
Second Lebanon War	2006	157	Johnson 2011, pp. 78

Notes:
Death number that happens across two decades are assigned into each decade proportionally in Figure 2.1. For example, for 135 deaths due to fedayeen attacks from 1957 to 1967, 30 percent of deaths (40) is counted towards the total deaths in the 1950s, and 70 percent of deaths (95) is counted towards the total deaths in the 1960s.

Appendix B

Extension to Chapter 3

To provide a rigorous proof to Prediction 1 and 2, I have to relax the assumption that the damage S is sufficiently large such that effort on public defense can always mitigate damage and preserve food. Instead, a constraint is introduced that any public defense larger than the damage S will be wasted. This constraint will be used to derive the timing of income privatization.

First-Best Solution

In terms of a benchmark, consider the first-best solution (the zero transaction cost solution). Here, the objective is to maximize the total food surviving from the damage, subject to the constraint. Denote the total public defense by $D = \sum_{i=1}^{N} NG(e_i)$. The objective function is:

$$\begin{aligned} \max_{e_1, e_2 \ldots e_N} \quad & \sum_{i=1}^{N} z_i F(1 - e_i) - [S - \sum_{i=1}^{N} NG(e_i)] \\ s.t. \quad & D = \sum_{i=1}^{N} NG(e_i) \leq S \end{aligned} \tag{B.1}$$

The socially optimal effort e_i^* of every member is one that equates the marginal product of the food and the public defense for the *whole community*:

$$\frac{dz_i F(1 - e_i^*)}{d(1 - e_i)} = \frac{N dG(e_i^*)}{de_i} \tag{B.2}$$

Let the aggregate public defense at this level be called *first-best defense*: $D^* = \sum_{i=1}^{N} NG(e_i^*)$. It should be noted that at the optimum, the constraint is not binding ($D^* \leq S$). In this case, there is some damage not mitigated by the *first-best defense*, since it is not worthwhile for members to exert any more effort on public defense.

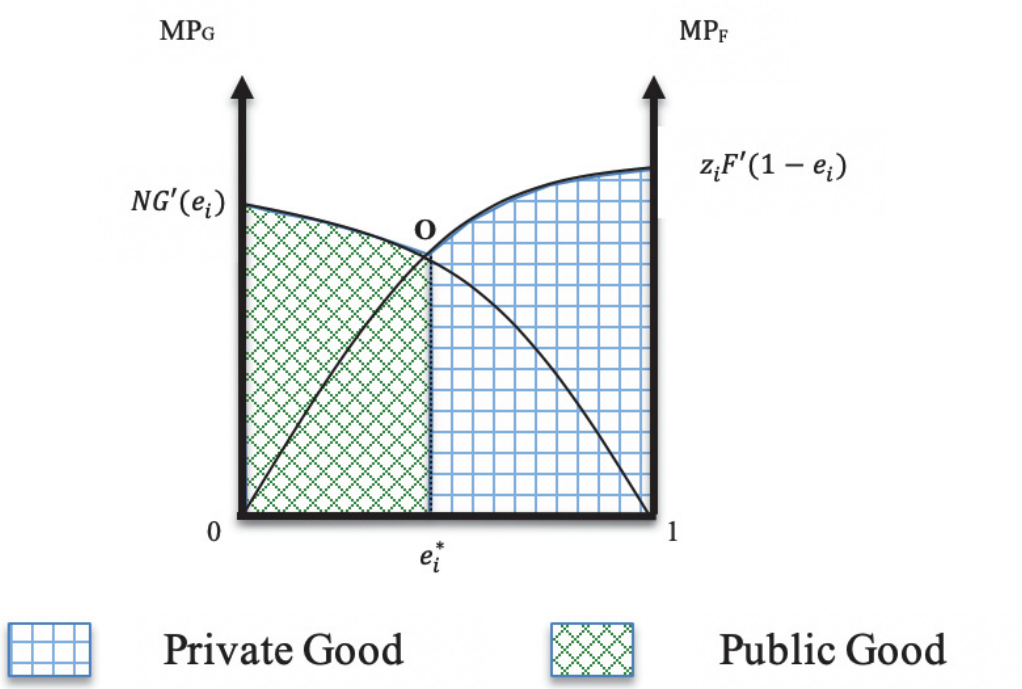


Figure B.1: First-best allocation of effort between food and public defense

Figure B.1 gives a geometric interpretation of the effort allocation by member i. $z_iF'(1-e_i)$ is the marginal product of the private good; $\frac{1}{N}z_iF'(1-e_i)$ is the marginal product of the private good under equal sharing; $G'(e_i)$ is the marginal product of the public good for the member oneself; $NG'(e_i)$ is the marginal product of the public good for the whole community. The optimal choice for the whole community is point O, which maximizes the sum of food (in Figure B.1) and public defense (in Figure B.1).

To provide a comparison between high productivity members (in food only) and low productivity members, consider a kibbutz called Doubletown, as illustrated in Figure B.2. In Doubletown live two members ($N = 2$). Member H has a higher productivity in food than Member L ($z_H > z_L$), but their productivity in defense is the same. With zero transaction costs, they would maximize the total food surviving from the damage caused by adversaries, and the social optimal choice for them would be the point O where the marginal productivity curve of food intersects the marginal productivity curve of public defense for the *whole community*. In this case, the total public defense D^* (the total in Figure B.2) is less than the damage.

If the socially optimal public defense is larger than the damage caused by adversaries ($D^* > S$), members will save effort on the public defense until $D = S$, and use the effort on private good instead. The equilibrium e_i^* then satisfies

$$\frac{dz_iF(1-e_i^*)}{d(1-e_i)} = \alpha(S)\frac{NdG(e_i^*)}{de_i} \tag{B.3}$$

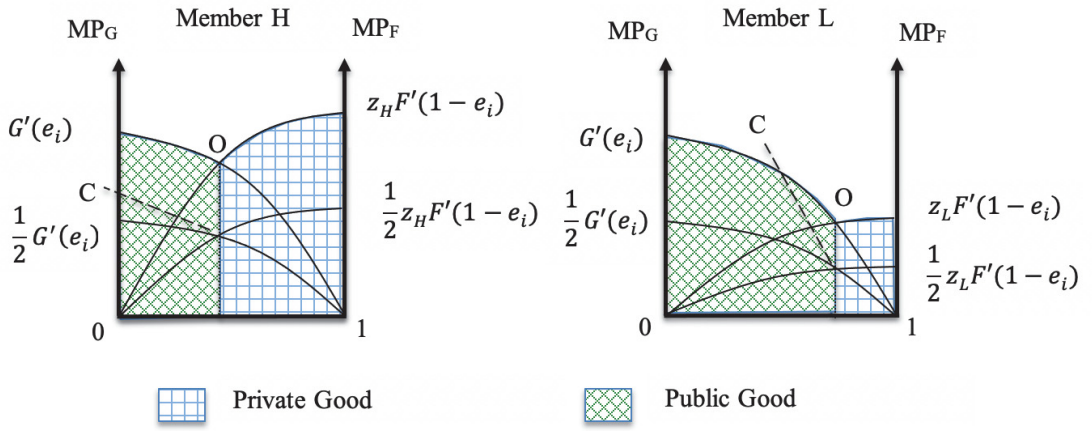


Figure B.2: First-best allocation of effort in Doubletown

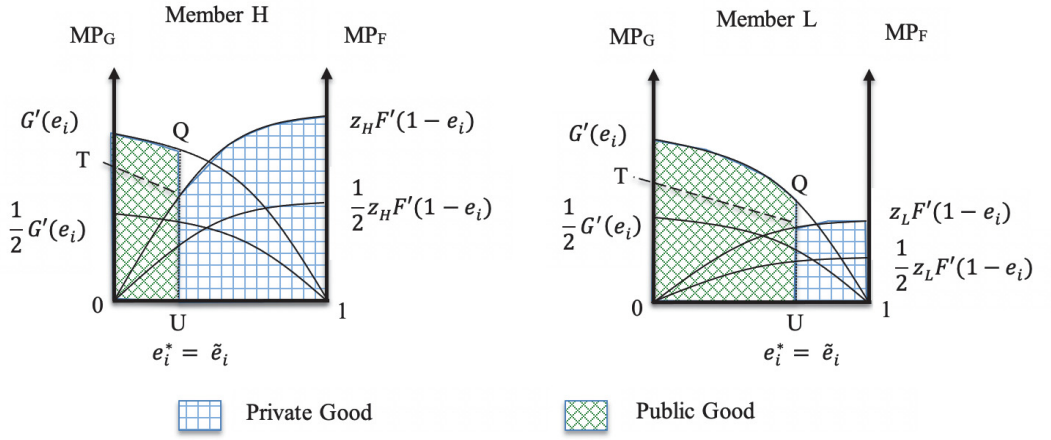


Figure B.3: First-best allocation of effort in Doubletown, when the damage is less than D^*

where $\alpha(S)$ is chosen such that the amount of public defense just mitigates the damage (i.e. $\sum_{i=1}^{N} NG(e_i^*) = S$).[1] Equation B.3 states that for each member the ratio of the marginal product of food to public defense for the whole community must be equal to a constant $\alpha(S)$, when the constraint is binding (i.e. $S < D^*$).

The two members in Doubletown (see Figure B.3) now face a damage lower than their total public defense (the total ▨ in Figure B.2). They shift their effort from the public defense to the food, in the most efficient way — each member exerts effort at the point T in Figure B.3, where they have the same ratio between food productivity to the public defense productivity ($\frac{TU}{QU}$ in Figure B.3), and the total public defense (the total ▨ in Figure B.2) is equal to the damage. Since the ratio is larger tha one, any increase in the food production comes at

[1]The Lagrange equation is $\max_{e_1,e_2\ldots e_N} \sum_{i=1}^{N} z_i F(1-e_i) - [S - \sum_{i=1}^{N} NG(e_i)] - \lambda \sum_{i=1}^{N} NG(e_i^*)$
The first order condition is $\frac{dz_i F(1-e_i^*)}{d(1-e_i)} / \frac{NdG(e_i^*)}{de_i} = \lambda$ for $\forall i$ and $\sum_{i=1}^{N} NG(e_i^*) = S$

a cost of a larger increase in the damage due to the lower public defense. Consequently, no one will decrease their effort on the public defense, which will yield a lower remaining food. No one will increase their effort on the public defense either, since the damage has already been fully mitigated, and any extra public defense will be wasted. Because no one wants to deviate from the status quo, exerting effort at point T in Figure B.3 constitutes a Nash equilibrium.

The first-best effort can be summarized by Equation B.3, where the ratio between the marginal productivity in food and the marginal productivity in public defense $\alpha(S)$ is equal to one, when the damage is larger than or equal to the *first-best defense* D^*. The ratio $\alpha(S)$ is less tha one, when the damage is below the *first-best defense* D^*, and decreases as the damage decreases.

Private Income Arrangement Solution

Under a private income arrangement, each member maximizes the food that is produced by the member, and survives from the damage, subject to the constraint that any public defense larger than the damage will be wasted:

$$\begin{aligned} \max_{e_i} \quad & z_i F(1-e_i) - \frac{1}{N}[S - \sum_{i=1}^{N} NG(e_i)] \\ s.t. \quad & \sum_{i=1}^{N} NG(e_i) \leq S \end{aligned} \tag{B.4}$$

The private optimal effort $\hat{e}_i$ of every member is one that equates the marginal product of the food and the public defense for *himself*:

$$\frac{dz_i F(1-\hat{e}_i)}{d(1-e_i)} = \frac{dG(\hat{e}_i)}{de_i} \tag{B.5}$$

Let the aggregate public defense at the current level be called *second-best defense* $\hat{D} = \sum_{i=1}^{N} NG(\hat{e}_i)$. It should be noted that at the optimum, the constraint is not binding ($\hat{D} \leq S$). In this case, there is some damage not mitigated by the *second-best defense*, since it is not worthwhile for members to exert any more effort on the public defense (See Appendix B.2 for a graphical illustration of the equilibrium).

When the damage caused by adversaries is smaller than the *second-best defense* ($S < \hat{D}$), members will save effort on the public defense, and direct it to the private good. The equilibrium $\hat{e}_i$ then satisfies:

$$\frac{dz_i F(1-\hat{e}_i)}{d(1-e_i)} = \beta(S)\frac{dG(\hat{e}_i)}{de_i} \tag{B.6}$$

where $\beta(S)$ is chosen such that the amount of public defense just mitigates the damage ($\sum_{i=1}^{N} NG(\hat{e}_i) = S$). Equation B.6 states that under a private income arrangement, for each member the ratio of the marginal product of the food to the public defense for *oneself* must be equal to a constant $\beta(S)$, given $\hat{D} > S$.

The equilibrium effort under private income arrangements can be summarized by Equation B.6, where the ratio between the marginal productivity in food and the marginal productivity in public defense $\beta(S)$ is equal to one, when the damage is larger than or equal to the second-best defense $\hat{D}$. The ratio $\beta(S)$ is less tha one, when the damage is below the second-best defense $\hat{D}$, and decreases as the damage decreases (See Appendix B.2 for a graphical illustration of the equilibrium).

Proposition 1

Under a private income arrangement, public defense is under provided while food is over provided, as $G(e_i^*) \geq G(\hat{e}_i)$, and $F(1-e_i^*) \leq F(1-\hat{e}_i)$.

The public defense is under provided, because members only consider their own benefit and ignore the positive externality on the whole community. Yet, a contract over the level of effort on the public defense is not feasible, as the effort allocation is not observable.

Equal-Sharing Income Solution

Under an equal-sharing income arrangement, each member only gets one-Nth shares of the food produced. Therefore, each member maximizes an equal share of the food surviving from the damage, subject to the constraint that any public defense larger than the damage will be wasted:

$$\begin{aligned} \max_{e_i} \quad & \frac{1}{N}\sum_{i=1}^{N} z_i F(1-e_i) - \frac{1}{N}[S - \sum_{i=1}^{N} NG(e_i)] \\ s.t. \quad & \sum_{i=1}^{N} NG(e_i) \leq S \end{aligned} \tag{B.7}$$

The equilibrium effort $\tilde{e}_i$ of every member is one that equates marginal product of one Nth of the food produced by oneself and the public defense for *himself*:

$$\frac{1}{N}\frac{dz_i F(1-\tilde{e}_i)}{d(1-e_i)} = \frac{dG(\tilde{e}_i)}{de_i} \tag{B.8}$$

Now the public defense is $\tilde{D} = \sum_{i=1}^{N} NG(\tilde{e}_i)$. Again, the above equilibrium happens only when the constraint is not binding ($\tilde{D} \leq S$), and some damage is not mitigated (See Appendix B.3 for a graphical illustration of the equilibrium).

When the damage caused by adversaries is smaller than the above equilibrium public defense ($S < \tilde{D}$), members will save effort on the public defense, and direct it to the private good. The equilibrium $\tilde{e}_i$ then satisfies:

$$\frac{1}{N}\frac{dz_i F(1-\tilde{e}_i)}{d(1-e_i)} = \gamma(S)\frac{dG(\tilde{e}_i)}{de_i} \tag{B.9}$$

where $\gamma(S)$ is chosen such that the amount of public defense just mitigates the damage ($\sum_{i=1}^{N} NG(\tilde{e}_i) = S$). Equation B.9 states that under a private income arrangement, for each member the ratio of one Nth of the marginal product of food to the public defense for *himself* must be equal to a constant $\gamma(S)$, given $\tilde{D} > S$ (See Appendix B.3 for a graphical illustration of the equilibrium).

Proposition 2

Under a common property arrangement, the provision of the public defense and food is at the first-best level, as $G(\tilde{e}_i) = G(e_i^*)$ and $F(1 - \tilde{e}_i) = F(1 - e_i^*)$

Under a common property arrangement, the incentive to produce food is suppressed, as each member only gets a share of the food produced by oneself. This moral hazard problem decreases the food effort level and increases the effort level on the public good. As a result, the effect of the moral hazard counteracts the effect of the positive externality on the public good. Thus, a common property arrangement brings back the provision of the public good to the first-best level.

Figure B.4 compares the equilibrium effort levels under different income arrangements. When the damage faced by a community increases (the equilibrium points move to the right along the curves), members exert more effort on public defense, and aggregate public defense goes up. The public defense under private income arrangements (--- in Figure B.4) first hits the *second-best defense*: $\hat{D} = \sum_{i=1}^{N} NG(\hat{e}_i)$, and the members stop increasing their effort. In contrast, members in equal-sharing income arrangements continue to increase their effort on the public defense (— in Figure B.4), until the public defense hitting the *first-best defense*: $\tilde{D} = \sum_{i=1}^{N} NG(\tilde{e}_i)$.

The Choice over Income Arrangements

Assume members can vote to decide the income arrangement of the community. Once the approval rating for a certain income arrangement is greater than a threshold, the community adopts the income arrangement.

Consider the net benefit of staying in a equal-sharing community for member j:

$$\begin{aligned}\pi_j &= \frac{1}{N}\sum_{i=1}^{N} z_i F(e_i^*(S)) - \frac{1}{N}(S - \sum_{i=1}^{N} NG(1 - e_i^*(S))) - z_j F_j(\hat{e_j}(S)) + \frac{1}{N}(S - \sum_{i=1}^{N} NG(1 - \hat{e}_i(S))) \\ &= \frac{1}{N}\sum_{i=1}^{N} z_i F(e_i^*(S)) + \frac{1}{N}\sum_{i=1}^{N} NG(1 - e_i^*(S)) - z_j F_j(\hat{e_j}(S)) - \frac{1}{N}\sum_{i=1}^{N} NG(1 - \hat{e}_i(S))\end{aligned} \tag{B.10}$$

where $\frac{1}{N}\sum_{i=1}^{N} z_i F(e_i^*(S))$ and $\frac{1}{N}\sum_{i=1}^{N} NG(1 - e_i^*(S))$ are the food and public defense received by member j at the equilibrium under equal-sharing arrangements; $z_j F_j(\hat{e_j}(S))$ and

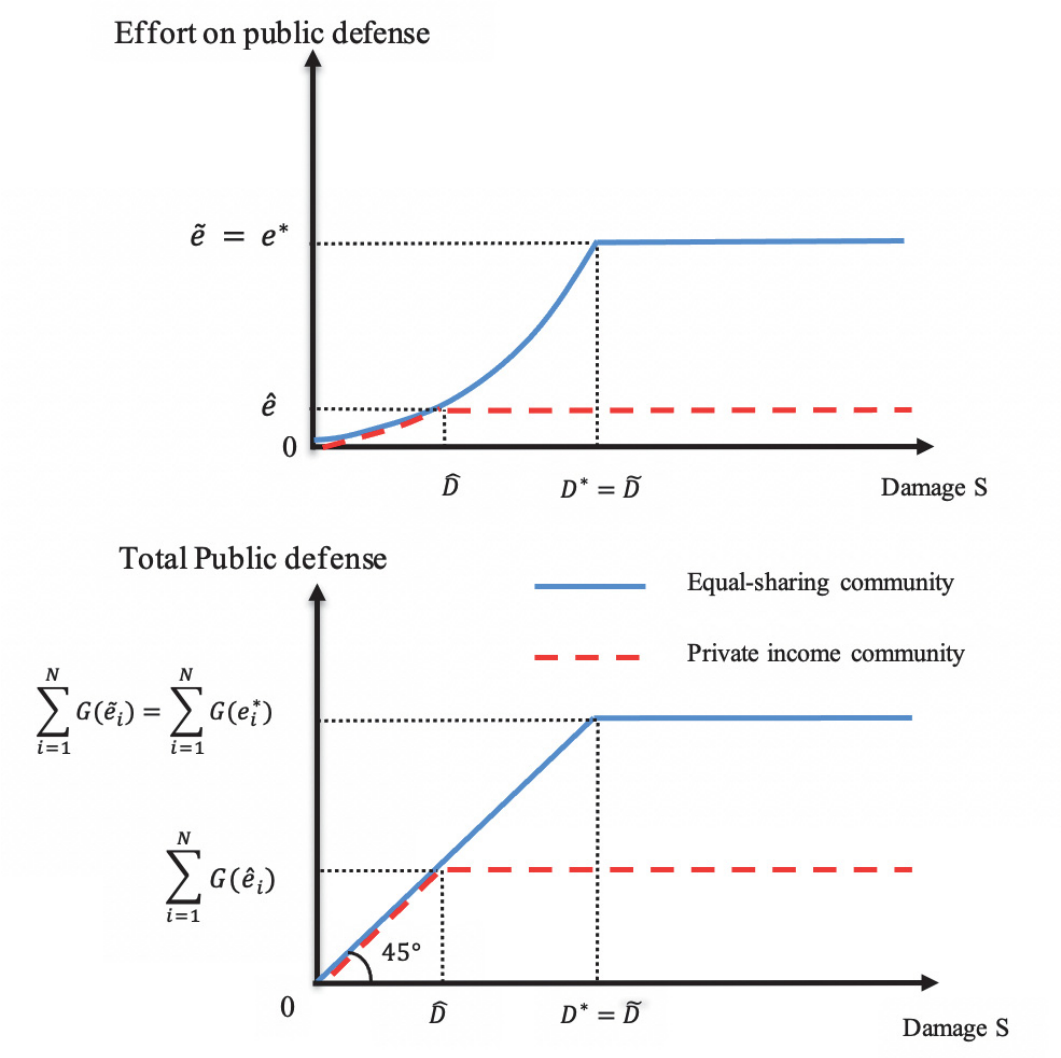


Figure B.4: Public defense and corresponding effort under different income arrangements

$\frac{1}{N}\sum_{i=1}^{N} NG(1-\hat{e}_i(S))$ are the food and public defense received by member j at the equilibrium under private income arrangements.

Prediction 1

(a) For $S \geq D^*$, π_j stays the same as damage S decreases.
(b) For $S \in (\hat{D}, D^*)$, π_j decreases as damage S decreases.
(c) $\pi_i > \pi_j$ whenever $z_i < z_j$
Prediction 1(a) and 1(b) (See Appendix B.4 for the proof) state that as the community becomes safe, the net benefit of the common property arrangement over the private income arrangement decreases. Proposition 1(c) states that the more productive (in food) a member is, the smaller the net benefit the member has.

When a community locates in a dangerous area, and foresees a large damage, members choose the common property arrangement to maintain a high level of public defense. As the damage to the community decreases, the benefit of the additional public defense provided by the common property arrangement diminishes; initially the most productive member, then the second most productive one, then the third ... will vote for the private income arrangements. As the number of members voting for the private income arrangements increases, the community will, at one point, abandon the equal sharing rule and privatize income.

As the damage decreases, the total surplus receive by H under a common property arrangement will eventually be lower than that under a private income arrangement, and H will vote for the private income arrangement.

B.1 The Rarity of Equal-Sharing Communities

The analysis so far is based on the existence of communities. However, the external threats can be so large that communities cannot keep operating.[2] Assume that the members abandon their communities when the total food surviving from the damage is below certain threshold.

Figure B.5, an extension of Figure B.4, illustrates the total food under different income arrangements. As discussed in previous sections, when the damage is larger than the first-best defense level (D^* in Figure B.5), equal-sharing arrangements can induce a higher public defense, and hence preserve more food. As the damage decreases, more food survives, and the total food remaining increases at a constant rate equal to one. Once the damage falls below the first-best defense level (D^* in Figure B.5), no more food is damaged by the adversaries, as the damage is completely mitigated by the public defense. The total food remaining still increases, but at a decreasing rate, since the members can substitute effort on the public defense into effort on the food at a decreasing rate.

The same pattern applies to the private income communities. The total food remaining grows at a constant rate equal to one, before the damage hits the second-best defense level ($\tilde{D}$ in Figure B.5). Once the damage falls below the second-best defense level, the total food remaining still increases, but at a decreasing rate.

The abandonment thresholds B and C are ones at which the surviving threshold intersects the curves of total remaining food. Once the damage is larger than abandonment thresholds, the members have to run away. However, as the surviving threshold decreases in Figure B.5, the abandonment thresholds B and C move to the right. That is, the more subsidy provided by the government, the larger damage the members can endure or the longer the members can hold out before abandoning their communities.

[2]For example, four isolated kibbutz were defeated by the Jordanian army during the 1948 Israel-Arab war.

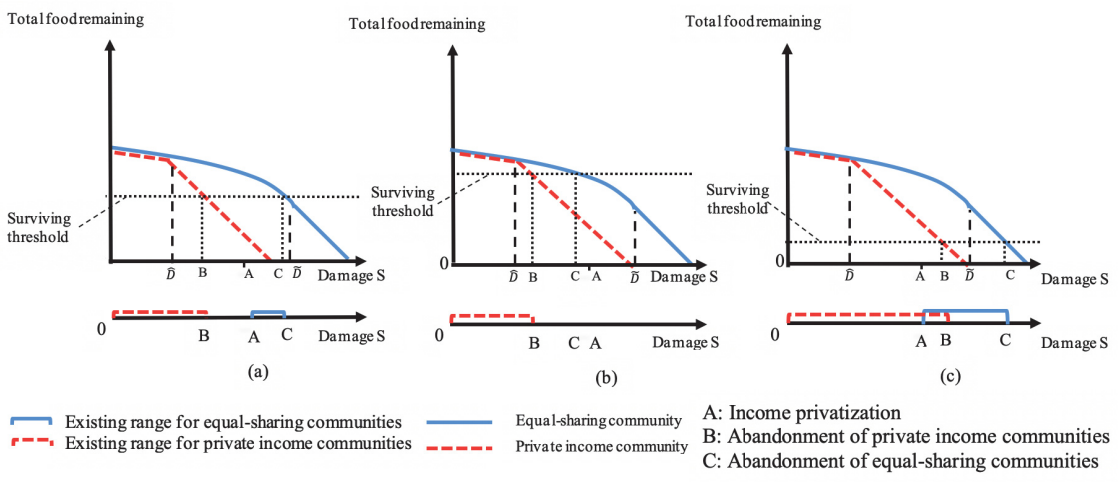


Figure B.5: Range of the existence for different communities

Prediction 2

Other things being equal, a central planner places equal-sharing communities in dangerous areas, while placing private income communities in safe areas.

Threshold C always lies to the right of threshold B, as shown in Figure B.5. But the relative position of the income privatization threshold A is uncertain, because it depends on the productivity of both goods and the surviving threshold. Therefore, I consider all three possible scenarios. (a) If A is located between B and C, equal-sharing communities can survive in dangerous environment, while private income communities can only survive in safe environment, but they can not survive at the same area. (b) If A is located to the right of C, equal-sharing communities are never present, while private income communities are present in safe environment. (c) If A is located to the left of B, equal-sharing communities are present dangerous environment, while private income communities are present in safe environment, and they co-exist at the same area.

It naturally follows that equal-sharing communities are rarer than private income communities, not only because equal-sharing communities are present in smaller number of scenarios, but mainly because the range of damage, in which equal-sharing communities are present, is more restrictive. The members in equal-sharing communities will privatize income when the damage is too low, and run away when the damage is too high. Also, for the presence of equal-sharing communities, the damage must also be relatively stable in the foreseeable future. Since income privatization, or abandoning a community is so costly, the members will not build a community in a highly uncertain (in terms of the damage they anticipate) environment.

B.2 Illustration of Private Income Arrangement Solution in Doubletown

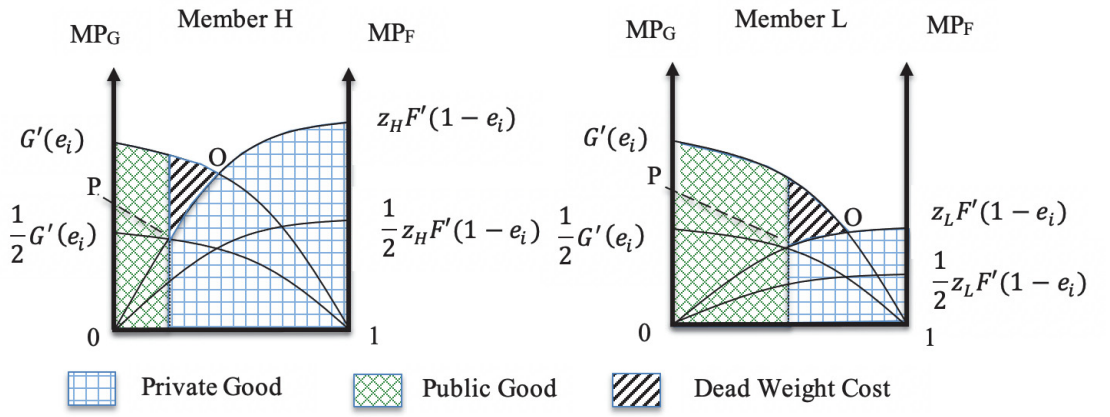


Figure B.6: Allocation of effort in Double town under a private income arrangement

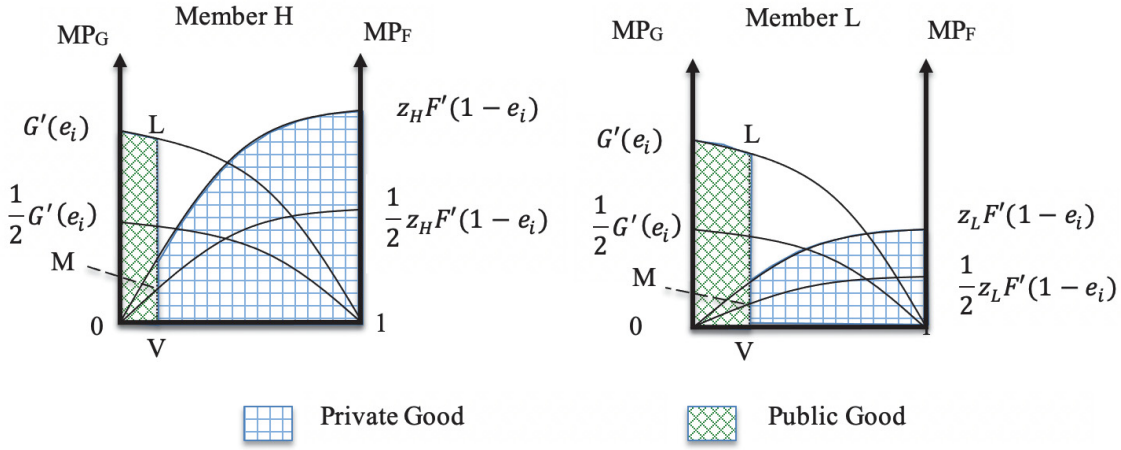


Figure B.7: Allocation of effort in Double town under a private income arrangement, when the damage is low

Figure B.6 illustrates the equilibrium in Doubletown in the present of positive transaction costs and private income. Every member maximizes their own food surviving from the damage caused by adversaries, and exerts effort at the point P where the marginal productivity curve of food intersects the private marginal productivity curve of public defense. Even though they can exert effort level at the point O, and get more food for *both of them* and avoid a dead weight cost (in Figure B.6), they are not able to sustain the equilibrium at the point O, as each of them has an incentive to deviate to the point P, and produce more food for *oneself*. In this case, the total public defense $\hat{D}$ (total in Figure B.6) is less than the damage.

The two members in Doubletown (see Figure B.7) now face a damage lower than their total public defense (the total in Figure B.6). They reduce their effort on public defense

and exert effort at the point M, where both members have the same ratio of marginal productivity of food to marginal productivity of public defense for *oneself* ($\frac{MV}{LV}$ in Figure B.7), and the total public defense (the total  in Figure B.7) just mitigates the damage.

B.3 Illustration of Equal-sharing Income Arrangement Solution in Doubletown

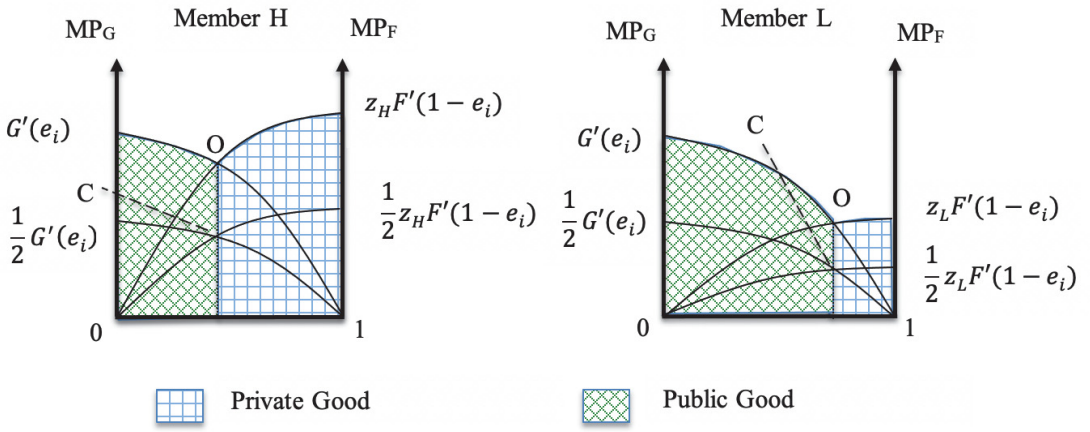


Figure B.8: Allocation of effort in Double town under an equal-sharing income arrangement

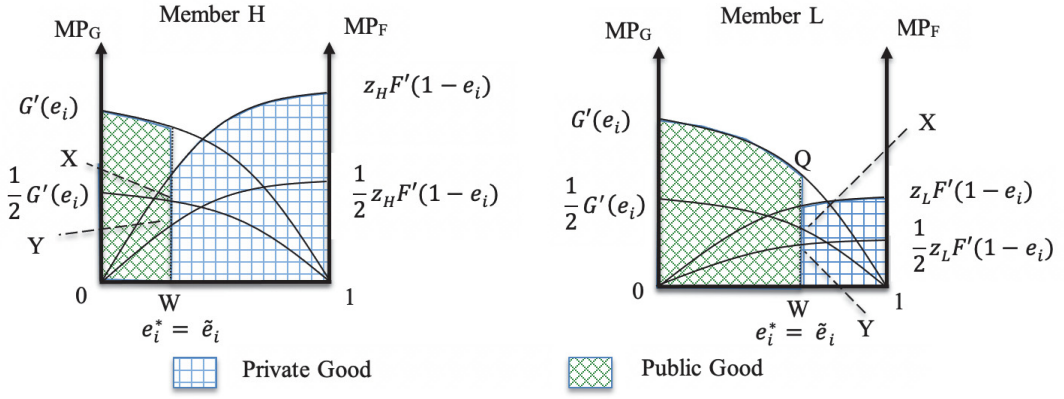


Figure B.9: Allocation of effort in Double town under an equal-sharing income arrangement, when the damage is low

Figure B.8 illustrates the equilibrium in Doubletown when food is equally shared between the two members. Every member maximizes their equal share of food surviving from the damage caused by adversaries, and exerts effort at the point C where one Nth of the marginal productivity curve of food intersects the marginal productivity curve of public defense for *himself*. In this case, the total public defense $\tilde{D}$ (the total ▨ in Figure B.8) is less than the damage.

The two members in Doubletown (see Figure B.9) now face a damage lower than their total public defense (the total ▨ in Figure B.8). They reduce their effort on the public defense, and exert effort at the point B, where both members have the same ratio of half of the marginal productivity of food to marginal productivity of public defense for *oneself* ($\frac{DA}{BA}$

in Figure B.9), and the total public defense (the total  in Figure B.9) just mitigates the damage.

B.4 Proof of Proposition 3(b)

For $S \in (\hat{D}, D^*)$

$$\begin{aligned}
\pi_j =& \frac{1}{N}\sum_{i=1}^{N} z_i F(1-e_i^*(S)) + \frac{1}{N}\sum_{i=1}^{N} NG(e_i^*(S)) - z_j F(1-\hat{e_j}) \\
& - \frac{1}{N}\sum_{i=1}^{N} NG(\hat{e_i}) \\
\frac{d\pi_j}{dS} =& -\frac{1}{N}\sum_{i=1}^{N} \frac{dz_i F(1-e_i^*(S))}{d(1-e_i^*(S))}\frac{de_i^*(S)}{dS} + \frac{1}{N}\sum_{i=1}^{N} \frac{NdG(e_i^*(S))}{d(e_i^*(S))}\frac{de_i^*(S)}{dS} \\
\frac{d\pi_j}{dS} =& \sum_{i=1}^{N} (1-\alpha(S))\frac{NdG(e_i^*(S))}{d(e_i^*(S))}\frac{de_i^*(S)}{dS}
\end{aligned}$$

where the last equality comes from equation B.3 and the envelope theorem: $\frac{dz_i F(1-e_i^*)}{d(1-e_i)} = \alpha(S)\frac{NdG(e_i^*)}{de_i}$

Then we have: $\frac{d\pi_j}{dS} > 0$, since $1-\alpha(S) > 0$, $\frac{NdG(e_i^*(S))}{d(e_i^*(S))} > 0$, $\frac{de_i^*(S)}{dS} > 0$ □

Appendix C

Extension to Chapter 5

C.1 Agriculture Potential

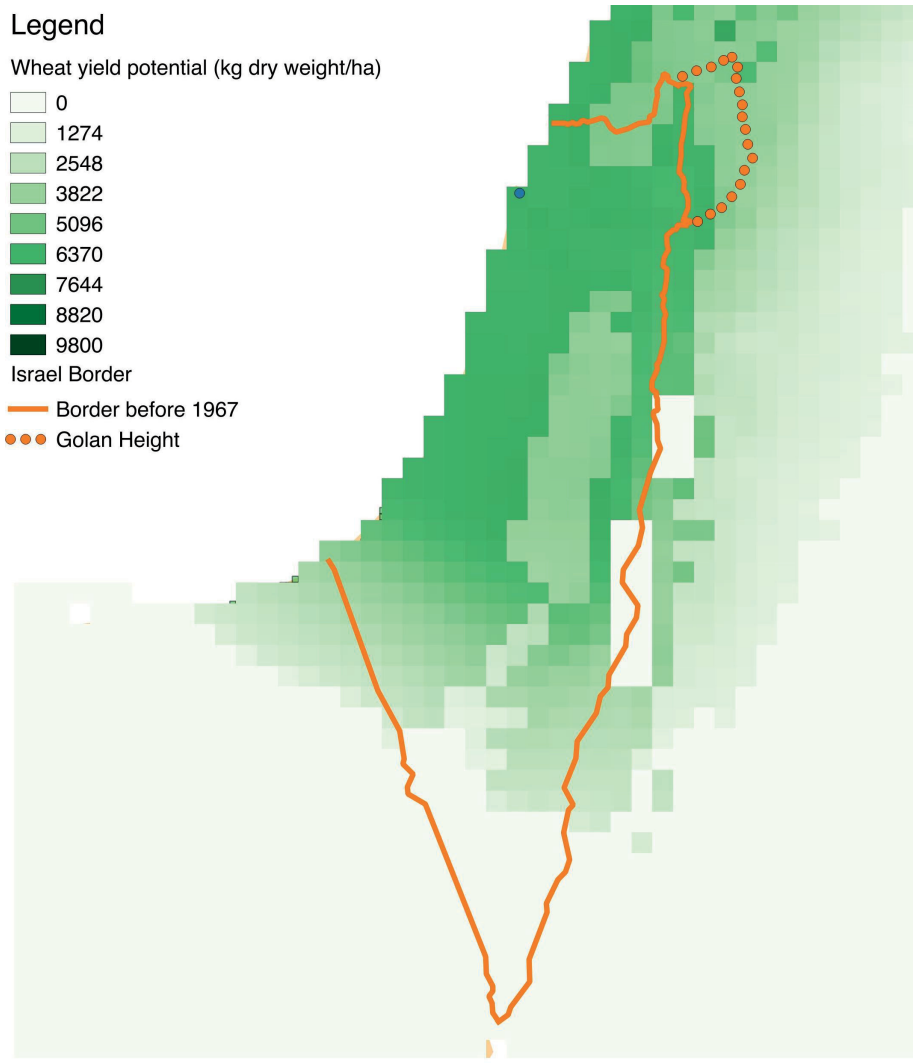


Figure C.1: The attainable yield for intermediate input level irrigated wheat from FAO

C.2 Robustness Checks for Peripheral Settlements Before 1937

The tables in this section replicates the results of Table 5.5, with slightly different definitions of peripheral settlements. The coefficients on *Peripheral Settlement*, *Water Distance*, and *Agriculture Potential* are quantitatively similar.

Table C.1: Peripheral settlements in the 1937 Peel partition plan — 1km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.256**	.237*	.306	.322
	(.125)	(.136)	(.257)	(.26)
Water Distance		-.0234		-.00198
		(.0178)		(.0204)
Agriculture Potential		.00798		-.324
		(.111)		(.26)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 1km of the boundary of the partition plan.

Table C.2: Peripheral settlements in the 1937 Peel partition plan — 2km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.17	.139	.0907	.0508
	(.11)	(.119)	(.145)	(.151)
Water Distance		-.024		-.00448
		(.0181)		(.0206)
Agriculture Potential		-.0182		-.28
		(.111)		(.267)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 2km of the boundary of the partition plan.

Table C.3: Peripheral settlements in the 1937 Peel partition plan — 3km

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.208*	.187	.158	.132
	(.106)	(.113)	(.133)	(.136)
Water Distance		-.0239		-.00394
		(.0178)		(.0203)
Agriculture Potential		-.00708		-.257
		(.109)		(.263)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 3km of the boundary of the partition plan.

Table C.4: Peripheral settlements in the 1937 Peel partition plan — 4km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.261**	.235**	.232*	.221*
	(.102)	(.109)	(.117)	(.122)
Water Distance		-.0188		.00261
		(.0179)		(.0204)
Agriculture Potential		-.00465		-.256
		(.106)		(.257)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 4km of the boundary of the partition plan.

C.3 Logit Regressions for Peripheral Settlements Before 1937

The tables in this section replicates the results in the previous section with Logit regressions. The coefficients on *Peripheral Settlement*, *Water Distance*, and *Agriculture Potential* are quantitatively similar.

Table C.5: Peripheral settlements in the 1937 Peel partition plan — 1km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	1.07**	1.02*	1.32	1.56
	(.543)	(.595)	(1.18)	(1.21)
Water Distance		-.101		.00349
		(.0765)		(.0838)
Agriculture Potential		.0417		-5.76
		(.471)		(5.8)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 1km of the boundary of the partition plan.

Table C.6: Peripheral settlements in the 1937 Peel partition plan — 2km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.69	.57	.364	.25
	(.45)	(.488)	(.578)	(.606)
Water Distance		-.102		-.0102
		(.0763)		(.0833)
Agriculture Potential		-.0798		-4.31
		(.463)		(5.54)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 2km of the boundary of the partition plan.

Table C.7: Peripheral settlements in the 1937 Peel partition plan — 3km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.845*	.775*	.637	.613
	(.441)	(.471)	(.537)	(.56)
Water Distance		-.101		-.00623
		(.0752)		(.083)
Agriculture Potential		-.032		-5.13
		(.458)		(5.79)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 3km of the boundary of the partition plan.

Table C.8: Peripheral settlements in the 1937 Peel partition plan — 4km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	1.07**	.971**	.946*	1.01*
	(.433)	(.458)	(.488)	(.525)
Water Distance		-.0807		.0272
		(.0766)		(.087)
Agriculture Potential		-.0215		-6.53
		(.449)		(6.08)
Observations	92	92	76	76

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 4km of the boundary of the partition plan.

C.4 Robustness Checks for Peripheral Settlements Before 1947

The tables in this section replicates the results of Table 5.6, with slightly different definitions of peripheral settlements. The coefficients on *Peripheral Settlement*, *Water Distance*, and *Agriculture Potential* are quantitatively similar.

Table C.9: Peripheral settlements in the 1947 UN partition plan — 1km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.25***	.247***	.289**	.28**
	(.0754)	(.0793)	(.115)	(.115)
Water Distance		.00454		.000704
		(.00524)		(.0058)
Agriculture Potential		-.0163		-.205**
		(.0491)		(.0967)
Observations	208	208	175	175

Odds ratios; Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 1km of the boundary of the partition plan.

Table C.10: Peripheral settlements in the 1947 UN partition plan — 2km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.264***	.264***	.275***	.268***
	(.069)	(.0719)	(.089)	(.0895)
Water Distance		.00522		.00145
		(.00521)		(.00577)
Agriculture Potential		-.0151		-.195**
		(.0482)		(.096)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 2km of the boundary of the partition plan.

Table C.11: Peripheral settlements in the 1947 UN partition plan — 3km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.277***	.281***	.27***	.267***
	(.065)	(.0672)	(.0756)	(.0762)
Water Distance		.00598		.00228
		(.00517)		(.00573)
Agriculture Potential		-.0175		-.187*
		(.0473)		(.0952)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 3km of the boundary of the partition plan.

Table C.12: Peripheral settlements in the 1947 UN partition plan — 4km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	.306***	.312***	.296***	.302***
	(.0643)	(.0659)	(.0714)	(.0715)
Water Distance		.00653		.00272
		(.00512)		(.00564)
Agriculture Potential		-.0241		-.202**
		(.0462)		(.0933)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 4km of the boundary of the partition plan.

C.5 Logit Regressions for Peripheral Settlements Before 1947

The tables in this section replicates the results in the previous section with Logit regressions. The coefficients on *Peripheral Settlement*, *Water Distance*, and *Agriculture Potential* are quantitatively similar.

Table C.13: Peripheral settlements in the 1947 UN partition plan — 1km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	1.21***	1.19***	1.49**	1.45**
	(.387)	(.402)	(.647)	(.654)
Water Distance		.02		-.000368
		(.025)		(.0301)
Agriculture Potential		-.105		-1.56*
		(.271)		(.865)
Observations	208	208	175	175

Odds ratios; Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 1km of the boundary of the partition plan.

Table C.14: Peripheral settlements in the 1947 UN partition plan — 2km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	1.24***	1.24***	1.31***	1.28***
	(.344)	(.357)	(.453)	(.46)
Water Distance		.023		.00124
		(.0251)		(.03)
Agriculture Potential		-.0956		-1.53*
		(.266)		(.863)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 2km of the boundary of the partition plan.

Table C.15: Peripheral settlements in the 1947 UN partition plan — 3km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	1.25***	1.26***	1.21***	1.19***
	(.31)	(.321)	(.357)	(.364)
Water Distance		.0262		.0033
		(.0252)		(.0298)
Agriculture Potential		-.104		-1.46*
		(.26)		(.838)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 3km of the boundary of the partition plan.

Table C.16: Peripheral settlements in the 1947 UN partition plan — 4km

Dependent variable: the probability of being a kibbutz				
	(1)	(2)	(3)	(4)
Peripheral Settlement	1.34***	1.37***	1.29***	1.32***
	(.302)	(.311)	(.331)	(.338)
Water Distance		.0282		.00441
		(.0251)		(.0298)
Agriculture Potential		-.142		-1.53*
		(.261)		(.833)
Observations	208	208	175	175

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. A settlement is a peripheral settlement if it is located within 4km of the boundary of the partition plan.

C.6 Robust Checks for Settlements in the West Bank

The table in this section replicates the results of Table 5.8, Table 5.9, and Table 5.10 with Logit regressions. The coefficients on *Distance to Jordan* are quantitatively similar — they are only significantly correlated with the type of settlment before 1948.

Table C.17: Number of nearby Jewish settlements before 1948

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
	1km	2km	3km	4km
Jew Settlements, log	-0.685	-0.944***	-0.563***	-0.498**
	(0.449)	(0.274)	(0.217)	(0.196)
Water Distance	0.0120	0.000311	0.00359	0.00393
	(0.0258)	(0.0263)	(0.0265)	(0.0264)
Agriculture Potential	-0.395	-0.389	-0.376	-0.375
	(0.266)	(0.269)	(0.267)	(0.269)
Constant	2.997*	3.412**	3.304*	3.392**
	(1.685)	(1.716)	(1.703)	(1.726)
N	219	219	219	219

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. *Jew Settlement, log* is the log transformation of the number of Jewish settlments within 1 km, 2km, 3km, and 4km in column 1, 2 ,3, and 4 respectively.

Table C.18: Number of nearby Jewish settlements before 1936

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
	1km	2km	3km	4km
Jew Settlements, log	0.101	-0.482	-0.223	-0.168
	(0.587)	(0.381)	(0.309)	(0.275)
Water Distance	-0.111	-0.132*	-0.125	-0.122
	(0.0772)	(0.0764)	(0.0763)	(0.0757)
Agriculture Potential	-0.271	-0.289	-0.258	-0.255
	(0.436)	(0.438)	(0.437)	(0.436)
Constant	2.102	2.638	2.325	2.282
	(2.737)	(2.782)	(2.755)	(2.749)
N	92	92	92	92

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. *Jew Settlement, log* is the log transformation of the number of Jewish settlments within 1 km, 2km, 3km, and 4km in column 1, 2 ,3, and 4 respectively.

Table C.19: Number of nearby Jewish settlements in the West Bank after 1967

Dependent variable: kibbutz				
	(1)	(2)	(3)	(4)
	1km	2km	3km	4km
Jew Settlements, log	0	-0.237	0.0667	0.382
	(.)	(0.449)	(0.312)	(0.261)
Water Distance	0.00580	0.00520	0.00569	0.00640
	(0.00699)	(0.00700)	(0.00699)	(0.00701)
Agriculture Potential	-0.0952	-0.114	-0.115	-0.140
	(0.142)	(0.142)	(0.142)	(0.143)
Constant	-1.220	-1.121	-1.206	-1.333*
	(0.792)	(0.798)	(0.795)	(0.796)
N	236	247	247	247

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Logit regressions. The dependent variable is binary: 1 if it is a kibbutz, 0 otherwise. *Jew Settlement, log* is the log transformation of the number of Jewish settlments within 1 km, 2km, 3km, and 4km in column 1, 2 ,3, and 4 respectively. Since *Jew Settlement, log* = 0 predicts the dependent variable perfectly in column (1), the coefficient for *Jew Settlement, log* is not estmiated and 11 obs not used.

Appendix D

Extension to Chapter 6

D.1 Constructing Optimal Attacking Routes between Two Points

The analysis constructs optimal travel routes based on elevation data from the Global Multi-resolution Terrain Elevation Data (GMTED2010) developed by the National Geospatial-Intelligence Agency (NGA).[1] The Palestine region is covered by a find grid (each pixel is 1.5 arc minutes, or about 2.5 km).[2] Based on this fine elevation grid, the analysis computes the travel times between any pixel and its four neighbours (North, South, East, and East). Following Barjamovic et al. (2019), the analysis uses the parameters from Langmuir (1984): it takes 0.72 seconds to travel 1 meter horizontally; going up hill adds an additional 6 seconds per vertical meter; going downhill on a gentle slope (less than or equal to 21.25%) saves 2 seconds per vertical meter; going downhill on a steep slope (more than 21.25%) adds an additional 2 seconds per vertical meter. Major lakes and the Mediterranean sea are assumed to be impassible for armies, since projecting force by ships was impracticable given the navel strength of the surrounding Arab countries. However, no penalty is imposed on crossing rivers, since the Iraqis easily crossed the Jordan river, the largest one in Palestine region during the 1948 Israeli-Arab war (Morris 2008, pp. 247). Having defined travel times between any pixel and its four neighbours, the analysis applies Dijkstras algorithm to compute the optimal travel paths between any two pixels (Dijkstra 1959).

[1] Danielson, J.J., and Gesch, D.B., 2011, Global multi-resolution terrain elevation data 2010 (GMTED2010): U.S. Geological Survey Open-File Report 20111073, 26 p. http://pubs.usgs.gov/of/2011/10pdf/of2011-1073.pdf

[2] Including Sinai Peninsula when constructing the attacking route from the Suez Canal.

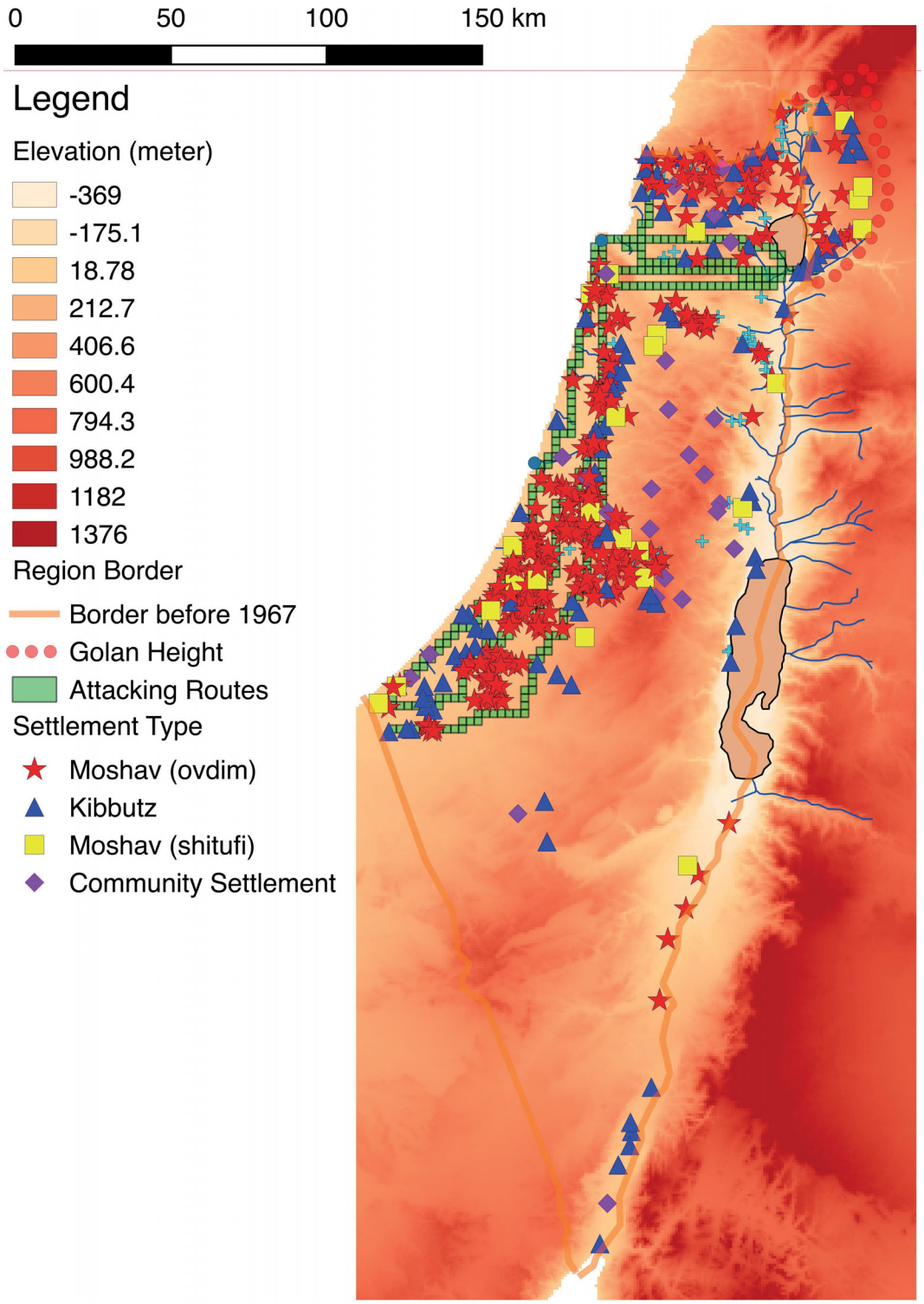


Figure D.1: Settlements established between the independence in 1948 and the Israel-Egypt peace treaty in 1979

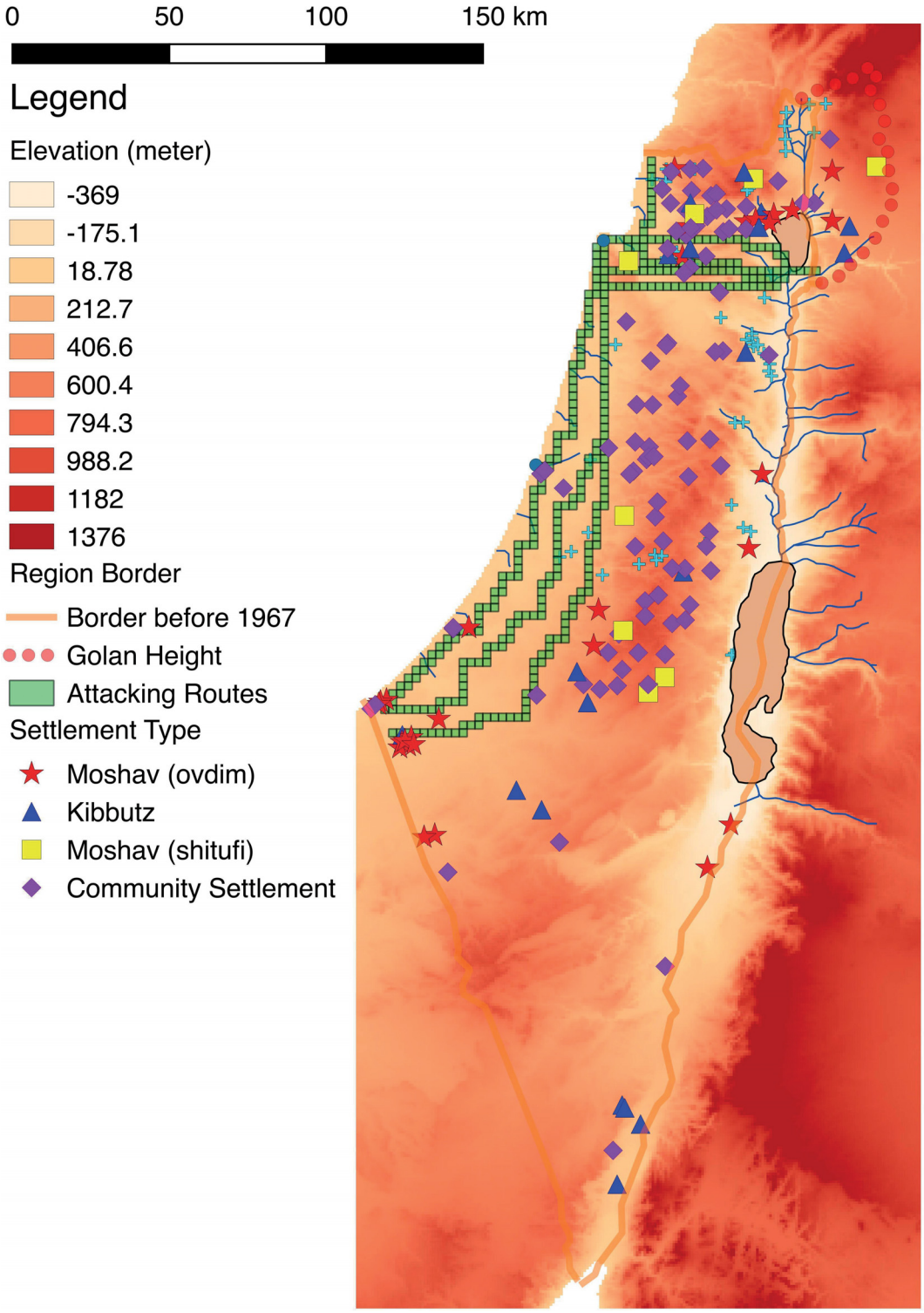


Figure D.2: Settlements established after the Israel-Egypt peace treaty in 1979

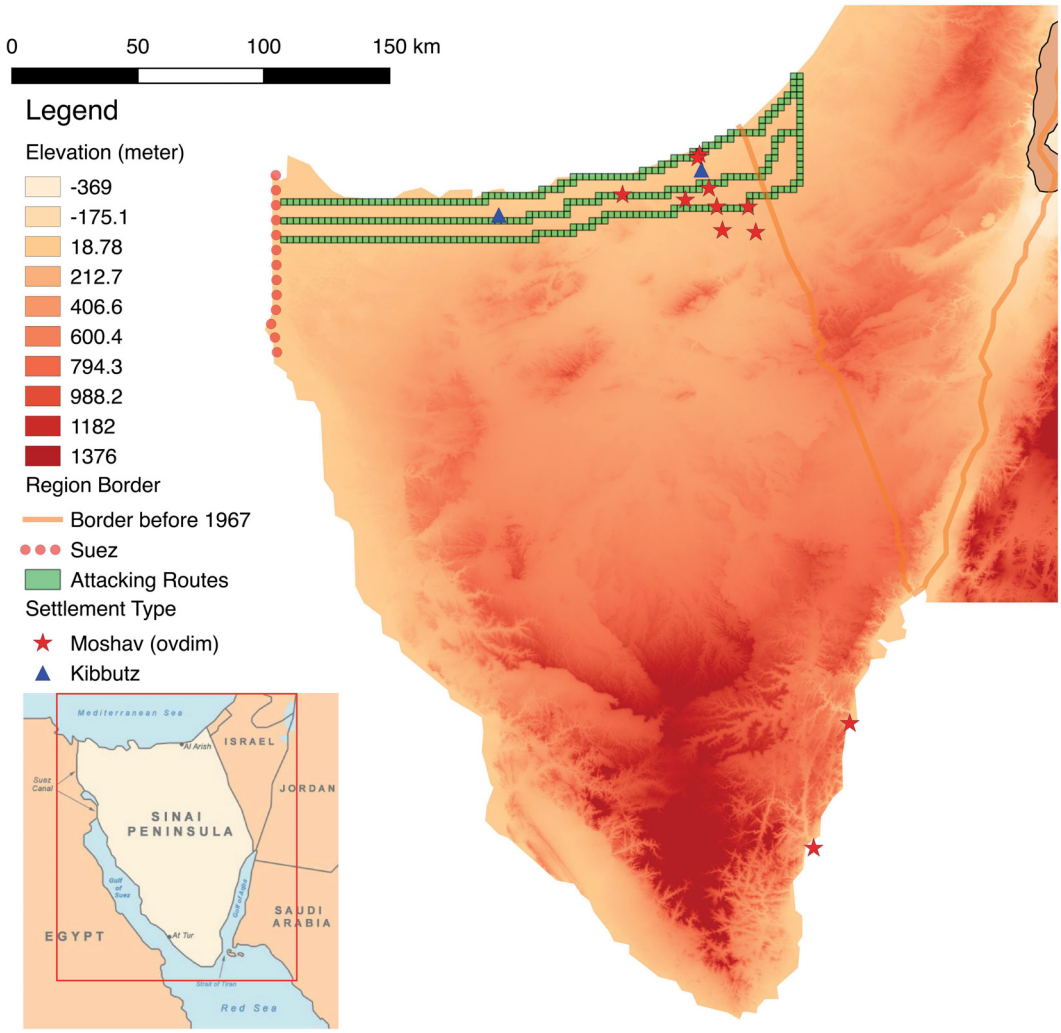


Figure D.3: Settlements established after 1968 and evacuated in 1982 on the Sinai Peninsula

D.2 Number of Settlements along the Attacking Routes

To confirm the casual observation that most settlement along the attacking routes were established before the independence in 1948, I conduct the following linear regression:

$$Defensive\ Settlement_{ij} = \beta_1 Independence_{ij} + \beta_2 Treaty_{ij} + Attacking\ Routes_j + \epsilon_{ij} \tag{D.1}$$

where $Defensive\ Settlement_{ij}$ is a binary variable: equal to 1 if the settlement i located within 4 kilometres of the attacking route j, 0 otherwise (results for 2km, 3km, or 5km are similar); $Independence_{ij}$ is a binary variable: equal to 1 if the settlement is established after the independence of Israel, 0 otherwise; $Treaty_{ij}$ is a binary variable: equal to 1 if the settlement is established after the Israel-Egypt treaty, 0 otherwise; $Attacking\ Routes_j$ is the attacking route fixed effect. Geographic control variables are excluded in the regression, since they are highly correlated with the attacking routes which mainly go through plains and valleys. Standard errors are clustered using the Conley (1999) GMM approach, allowing for arbitrary spatial correlation in unobservables between all villages within 150 kilometres of one another.

Table D.1: Settlement Locations in Different Times

Dependent variable: Defensive Settlement				
	(1)	(2)	(3)	(4)
	within 2km	within 3km	within 4km	within 5km
After Independence	-0.104*	-0.121**	-0.129**	-0.129**
	(0.0562)	(0.0603)	(0.0617)	(0.0607)
After Treaty	-0.0965	-0.153*	-0.186*	-0.193*
	(0.0801)	(0.0922)	(0.0975)	(0.0990)
Attacking Route FE	Yes	Yes	Yes	Yes
Observations	836	836	836	836

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is Defensive Settlement. A settlement is a defensive settlement if it is located within 2km in **Column 1**, 3km in **Column 2**, 4km in **Column 3**, or 5km in **Column 4**; **Independence** is a binary variable: equal to 1 if the settlement is established after the independence of Israel, 0 otherwise; **Treaty** is a binary variable: equal to 1 if the settlement is established after the Israel-Egypt treaty, 0 otherwise; **Attacking routes FE**: Settlements are grouped according to the nearest Attacking route from Egypt, Lebanon, or the east (including Syria, Jordan and Iraq). All settlements at the rear area are excluded (the red frame in Figure 6.2)

Table D.1 presents the Logit regression results on the probability of each settlement being a defensive one. The coefficients on **Independence** are negative, meaning that the settlements established after the independence of Israel are less likely to be located near the attacking routes, compared to the settlements established before the independence. The coefficients on **Treaty** are also negative, meaning that the settlements established after the treaty have a smaller chance of being defensive settlements, even compared to the set-

tlements established between the independence and the Israel-Egypt treaty. They are all significant at the 5 percent level, meaning that the above results are robust to different definitions of defensive settlements.

The above results show that most rural settlements were placed along the attacking routes when the invasion threats were imminent before the Israeli-Arab War in 1948. In contrast, they were less likely to be placed in those strategically important places once the threats of invasion were partially mitigated by a standing army after the independence and went away with the signature of the Israel-Egypt peace treaty. The contrast confirms the observation that deterring the military intervention was the main task for the rural settlements located along the invasion routes.

D.3 Placebo Checks for Kibbutz Locations

Table D.2 in this section replicates the results of Table 6.3, with logit regressions. The coefficients on *Border Distance*, *Terrain Ruggedness Index*, and *Agriculture Potential* are quantitatively similar.

Table D.2: Kibbutz vs. non-Kibbutz Locations

Dependent variable: kibbutz					
	(1)	(2)	(3)	(4)	(5)
Border Distance	-.0327***	-.0316***	-.0224**	-.0249***	-.0849**
	(.00715)	(.00818)	(.00937)	(.0087)	(.0381)
Terrain Ruggedness Index		.00309**	.00257*	.0022*	.00245
		(.00141)	(.00142)	(.00128)	(.00149)
Agriculture Potential		-5.76*	-6.61*		-2.21
		(3.41)	(4)		(4.33)
Water Distance			2.29	2.09	6.65
			(6.27)	(5.26)	(6.94)
Nearby settlement number			-.138*	-.113	-.115
			(.0746)	(.0726)	(.0744)
Nearby town number			-.898***	-.97***	-.815***
			(.289)	(.292)	(.291)
Soil quality				.154	
				(.517)	
Border Distance^2					.000357*
					(.00021)
Attacking Route FE	Yes	Yes	Yes	Yes	Yes
Observations	166	166	166	166	166

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Logit regressions. The dependent variable is binary: 1 if the settlement is a kibbutz, 0 otherwise. The sample is restricted to the settlements established before the independence that are within **4km** of the attacking routes; **Attacking routes FE**: Settlements are grouped according to the nearest attacking routes from Egypt, Lebanon, or the east (including Syria, Jordan and Iraq). All settlements at the rear area are excluded (the red frame in Figure 6.2). Robust standard errors in parentheses are robust to arbitrarily heteroskedasticity and allow for unrestricted spatial correlation between all settlements within 150 kilometres of each other (Conley 1999).

D.4 Other Robustness Checks

Table D.3: Kibbutz vs. non-Kibbutz Locations — Settlements along Egyptian Attacking Routes

Dependent variable: Kibbutz		
	(1)	(2)
	Pre Ind.	Ind. to Treaty
Border Distance	-.00258**	-.00146
	(.00116)	(.00138)
Terrain Ruggedness Index	.00022***	-.0000974
	(.0000455)	(.0000729)
Agriculture Potential	.139***	.0806***
	(.0163)	(.0211)
Water Distance	1.21***	-.652**
	(.202)	(.327)
Nearby settlement number	-.0423***	-.041***
	(.00555)	(.00435)
Nearby town number	-.154***	-.0729***
	(.0102)	(.0103)
Observations	114	216

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if the settlement is a kibbutz, 0 otherwise. The sample is restricted to the settlements within **4km** of the Egyptian attacking route, and further restricted to the settlements established before the independence in **Column 1**, between the independence and the Israel-Egypt peace treaty in **Column 2**. All settlements at the rear area are excluded (the red frame in Figure 6.2). Robust standard errors in parentheses are robust to arbitrarily heteroskedasticity and allow for unrestricted spatial correlation between all settlements within 150 kilometres of each other (Conley 1999).

Table D.4 shows the main results (replicated in Column 1) is robust for other specifications. Column 2 and 3 show the impact of **Border Distance** is significant when allowing for unrestricted spatial correlation within larger or smaller areas. Column 4 excludes all religious kibbutzim from the sample and show the impact of **Border Distance** on settlement type actually becomes larger, meaning religious kibbutzim were not placed in front of secular kibbutzim. To the extent that moshav (shitufi) also enforce equal-sharing of outputs, Column 5 categorizes moshav (shitufi) as if they are kibbutzim and show the size of **Border Distance** remains the same. Column 6 includes all settlements in the rear area. Because it is hard to assign those settlements to any attacking route, the specification removes the **Attacking Route Fixed Effect** and has a smaller size of **Border Distance**.[3]

[3]The smaller size of **Border Distance** is mainly driven by the removal of the **Attacking Route Fixed Effect**, as a similar specification without the settlements in the rear area displays a similar size of **Border Distance**: -0.00198

Table D.4: Kibbutz vs. non-Kibbutz Locations — Other Robust Checks

Dependent variable: Kibbutz						
	(1)	(2)	(3)	(4)	(5)	(6)
	Spatial corr. 150km	Spatial corr. 300km	Spatial corr. 50km	No Religious Kibbutz	Moshav (Shitufi)	Include Rear Area
Border Distance	-.00438***	-.00438***	-.00438**	-.00502***	-.00481***	-.00178***
	(.00124)	(.000846)	(.00194)	(.00138)	(.00113)	(.000605)
Terrain Ruggedness	.000255***	.000255***	.000255***	.00031***	.000259***	.0000756***
	(.0000492)	(.0000348)	(.0000888)	(.0000525)	(.0000523)	(.0000279)
Agriculture Potential	-.0442	-.0442	-.0442	-.152	-.0674	.126***
	(.0718)	(.0494)	(.0784)	(.111)	(.0948)	(.00857)
Water Distance	.128	.128	.128	-.608	-.0603	1.2**
	(.451)	(.332)	(.506)	(.876)	(.51)	(.472)
Nearby settlement #	-.0236*	-.0236***	-.0236	-.0326**	-.0196*	-.0345***
	(.0125)	(.00879)	(.019)	(.0128)	(.01)	(.00861)
Nearby town #	-.157***	-.157***	-.157***	-.124***	-.0859***	-.161***
	(.014)	(.00977)	(.0187)	(.0207)	(.0188)	(.0136)
Attacking Route FE	Yes	Yes	Yes	Yes	Yes	No
Observations	166	166	166	137	166	182

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: the dependent variable is binary: 1 if the settlement is a kibbutz, 0 otherwise. The sample is restricted to the settlements established before the independence within **4km** of the attacking routes. **Column 1 Column 2** and **Column 3** allow for unrestricted spatial correlation between all settlements within 150, 300, and 50 kilometres of each other (Conley 1999). **Column 4** excludes religious kibbutz from the sample. **Column 5** consider moshav shitufi as a variation of kibbutz. **Column 6** excludes settlements in the rear areas (the red frame in Figure 6.2) from the sample.

D.5 Actual Attacking Routes and Kibbutz Performance

The planned attacking routes in the 1948 Israeli-Arab war were largely consistent with the constructed attacking routes. But the actual unfolding of the war was quickly out of the Arab countries' control. Lebanon withdrew from the joint invasion at the last minute. Jordan unilaterally changed the plan from attacking the Jews to occupying the Arab area later known as the West Bank (Morris 2008, pp. 189). Syria and Iraq, fiercely resisted by the kibbutzim at the frontier, gave up the original plan of marching through Jezreel Valley, and conquered the West Bank instead. The Egyptian in the south were delayed by the Kibbutz Yad Mordechai, and was eventually halted by the Israeli army.

The 1948 Israeli-Arab war started on May 14th (see Figure D.4 for the actual invasion routes). The goal of the Arab countries (Egypt, Lebanon, Syria, Jordan and Iraq) was "the elimination of the Jewish state" (Morris 2008, pp. 184). They initiated a four pronged invasion at the time and location of their choices, with a larger army (20,000 Arab combat troops vs. 16,500 Jewish combat troops) and heavy weapons (artillery, armour, and combat aircraft) that the Jews did not have (Morris 2008, pp. 197).

The Jewish goal was simply "surviving the onslaught and establishing a Jewish state" (Morris 2008, pp. 196). Although only 60 percent of the Jewish troops were under-equipped at the start of the war, large shipments would soon arrive by the start of June. Heavy weapons, including tanks, armored cars, three half-tracks, artillery pieces, antiaircraft or antitank cannon, and Czech-made air fighters, were on the way. The underground arms factories were also producing submachine guns, mortars, antitank projectiles, grenades, mines, and ammunition (Morris 2008, pp. 204). Aside from the weapons, thousands of volunteers from abroad, including hundreds of air and ground crew, would soon expand the Jewish army from nine brigades to twelve (Morris 2008, pp. 200–207). But all those reinforcements had to be accepted at the port, Haifa. If Haifa had been conquered, the Jews would not have reversed the war.

It came down to a race against time, and the Jewish leadership had to count on their rural settlements, especially kibbutzim, to delay the invasion and buy enough time. On the eastern front, Kibbutz Gesher, with the help of one Israeli brigade, withstood the attack from the Iraqis for five days, and forced them to withdraw and redeploy in Samaria (Morris 2008, pp. 245–248). Kibbutz Degania Aleph and Degania Bet, with limited help from Jewish troops, halted the advance of two Syrian infantry battalions, along with twelve tanks and twenty armoured cars. They even immobilized two tanks by grenades and Molotov cocktails. After fighting grimly for two days, the kibbutzniks beat back the Syrians (Morris 2008, pp. 254–257).

On the southern front, one Egyptian battalion attacked Kibbutz Kfar Darom. After dozens of casualties, the battalion withdrew and bypassed the kibbutz. The next target was Kibbutz Yad Mordechai. Unlike Kfar Darom, the Egyptians had to conquer Yad Mordechai, as it is located on on a hill, dominating the coastal road. The Jewish leaders also understood the importance of the kibbutz, ordering the defenders to withhold the attack and delay the Egyptians for as long as possible. On May 20th, 110 kibbutz members (twenty of them were women) and two squads of Jewish soldiers, resisted seven joint assaults from two Egyptian battalions, inflicting dozens of dead on the Egyptian side. The Egyptians added another

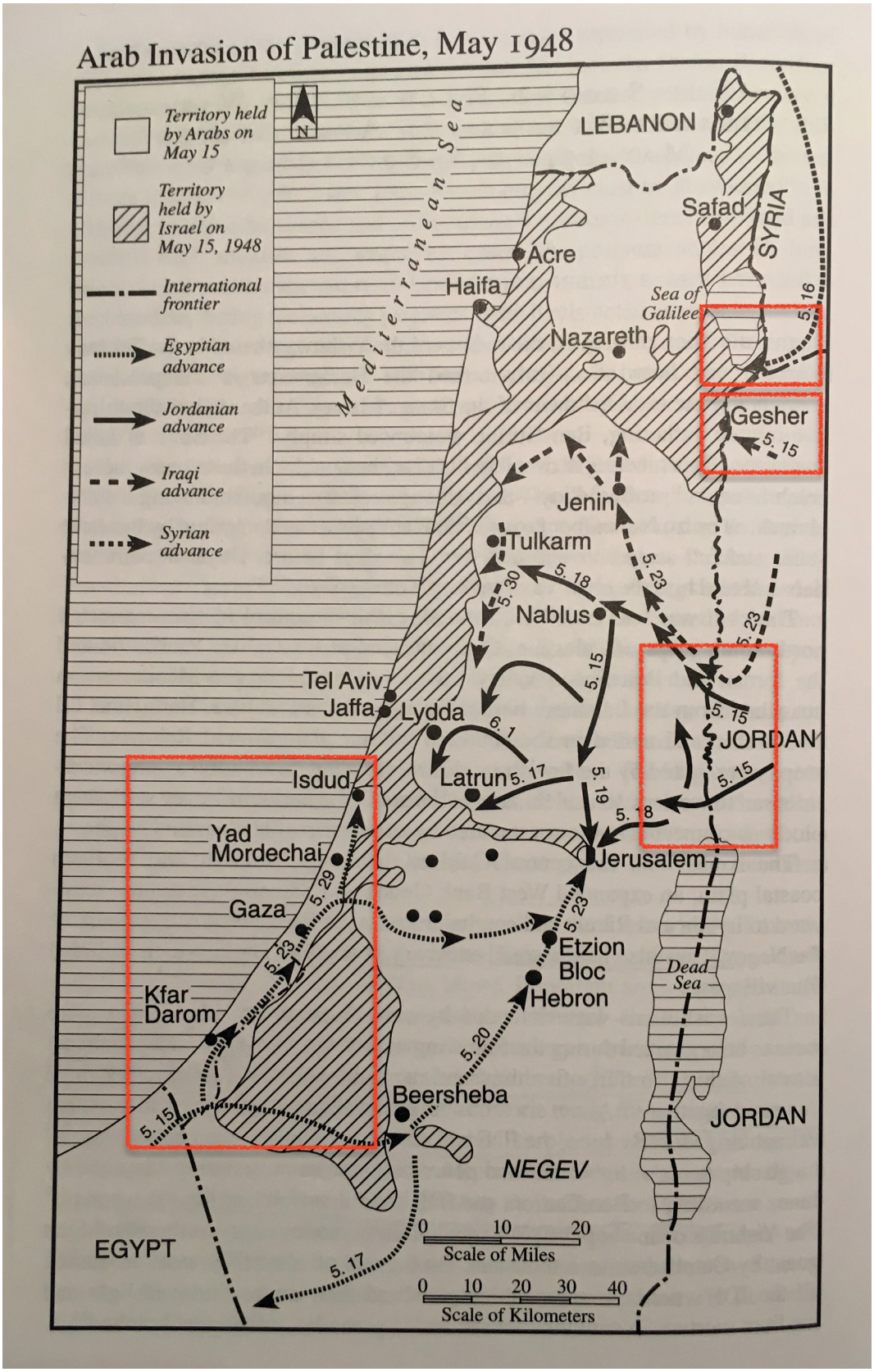


Figure D.4: Historical attacking routes
The map comes from Morris (2011, pp. 216). The author labels the initial attack by the red frames.

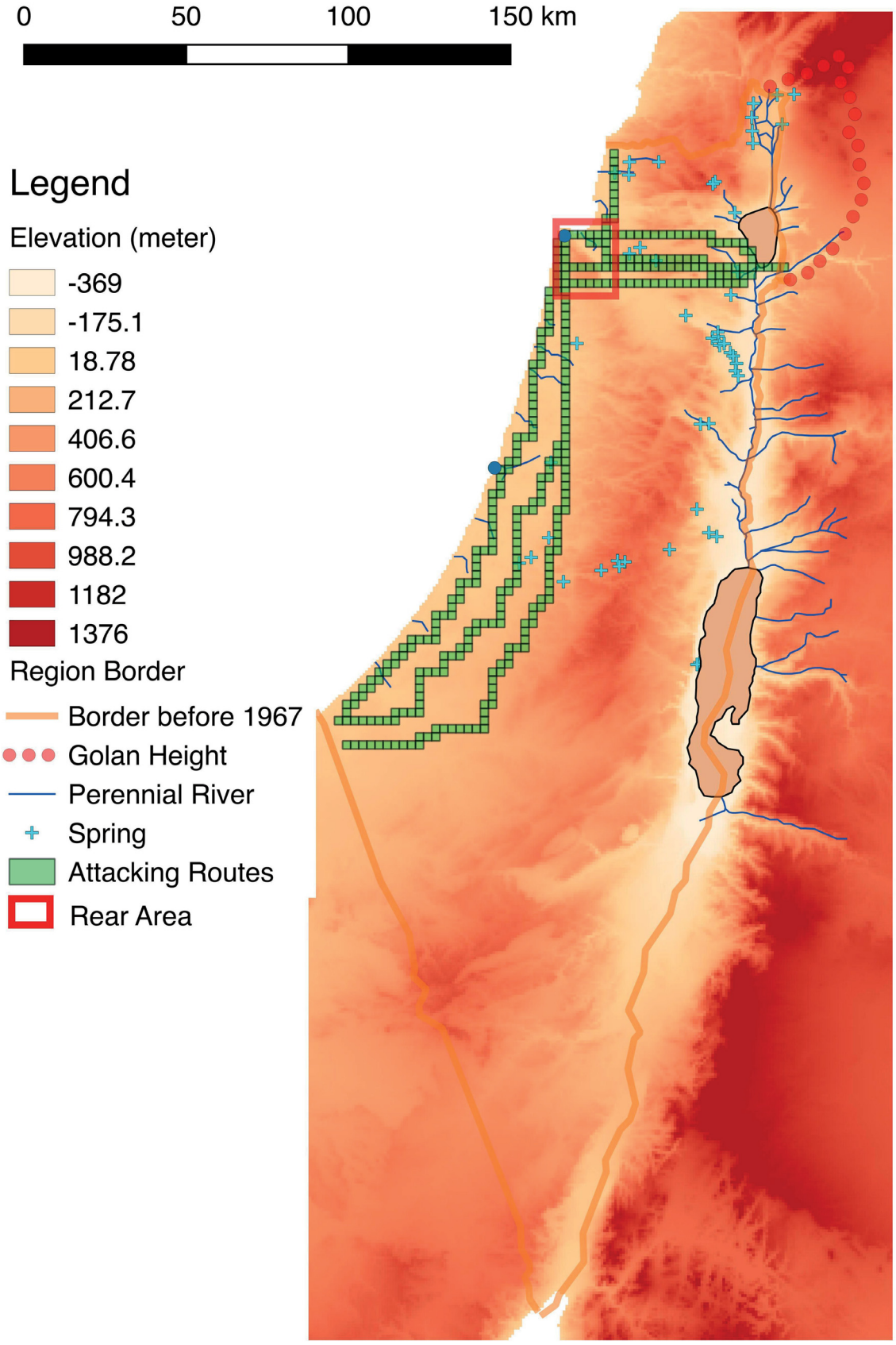


Figure D.5: Constructed optimal attacking routes

battalion, and resumed attack on May 23rd. By nightfall, the toll of kibbutz casualties had exceeded 50 percent, but their reinforcement had been blocked by the Egyptian air force. They had no choice but to disobey the orders and retreat (which was criticized by the Jewish prime minister, Ben-Gurion). The Egyptians conquered Kibbutz Yad Mordechai, but their advance was delayed by at least four days. The delay gave the Israeli Giv'ati Brigade enough time to rally, and eventually halt the Egyptians at Isdud. The Egyptians lost the initiative from then on (Morris 2008, pp. 235–242).

Appendix E

Extension to Chapter 7

E.1 Robustness Checks for the First Stage

To further exam the validity fo the instrument, I rerun the first-stage regressions (column 6 in Table 7.4) for rainfall at the nearest refugee camp over different time windows. The coefficient of the instrument used in the analysis is the largest among all cases (see the red bar in Figure E.1), thereby eliminating the concern that the strong correlation between rainfall and civilian deaths is due to some measurement errors.

The analysis use cumulative rainfall deficit over six years only to match the cumulative conflicts over six years. To better understand the relationship between rainfall at the refugee camps and nearby conflicts, I rerun the first-stage regressions using conflicts and rainfall in a single year. Figure E.2 shows the similar result: the rainfall in the previous year is the best predictor for the nearby conflicts.

Since the rainfall instrument is a proxy for the resentment of the Palestinian refugee, one would expect to observe the same impact on the number of civilian (mostly Palestinian protestors) killed by Israel government. Table E.2 replicates Table 7.4 and shows the F stats across all specifications are less than 3, which means the instrument is a very weak predictor for the civilians killed by Israel government.

An alternative channel through which a low rainfall at the nearest refugee camp can increase probability of kibbutz income privatization may violate the exclusion restriction. For example, might decrease labour demand in nearby Palestine region, thereby increasing labour supply to the kibbutzim. In order to hire external workers, the income of kibbutzim were privatized. To address this concern, I show in Table E.1 that the instrument used in the main regression has no correlation with regional employed rate of the subdistrict, in which the nearby kibbutz locates.

While data on the number of employed Palestinian in Israel is unavailable at the subdistrict level, the general trend since 1990 is downward, due to the closures on the West Bank and Gaza Strip and new Israeli policies that aimed to reduce the dependency on Palestinian

unskilled labour (Mansour 2010; Miaari and Sauer 2011).[1] Therefore, a higher Palestinian labour supply induced by rainfall is unlikely to the be the reason behind the income privatization of the kibbutzim.

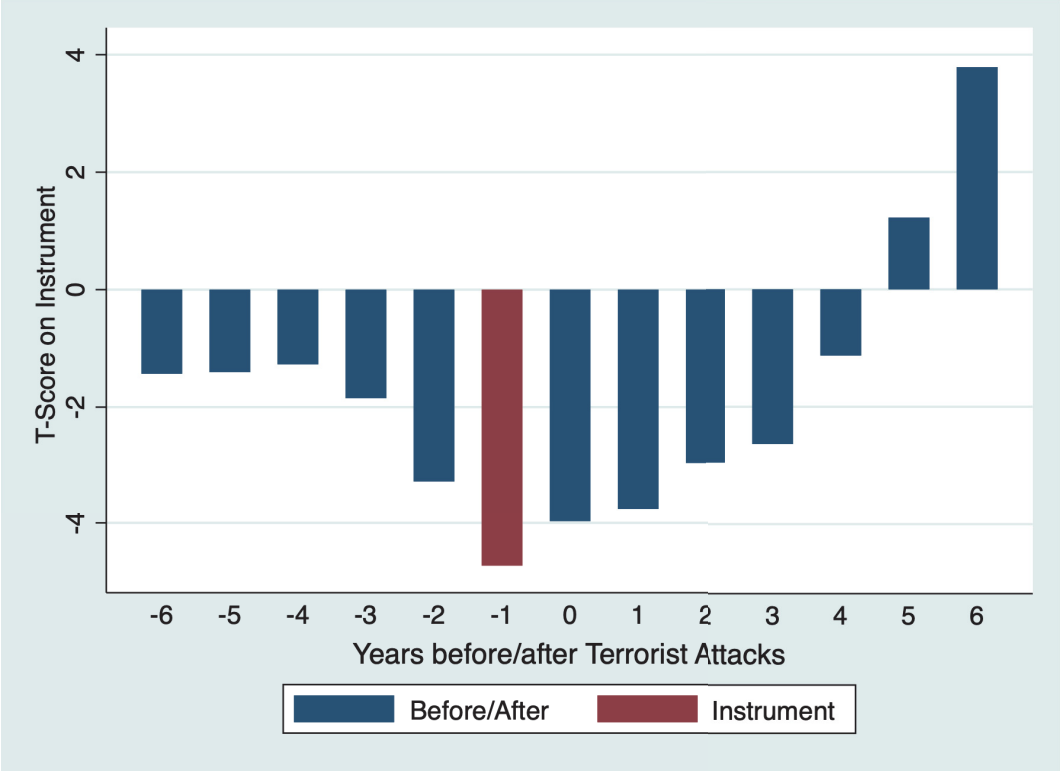


Figure E.1: Placebo check of the instrument — different time windows
The x-axis gives the total rainfall surplus at the nearest refugee camp over six years ending in the xth year after (before) the civilian deaths. To illustrate, 0 on the x-axis means that the civilian deaths under civil conflicts over previous six years ending in year t is instrumented by the rainfall over six years ending in year t. Similarly, -3 means that the civilian deaths under civil conflicts over previous six years ending in year t is instrumented by the rainfall over six years ending in year $t-3$.

[1]Employed Palestinians in the Israeli business sector decreased from 10 percent in 1990 to 3 percent in 2005 (Mansour 2010). Foreign non-Palestinian workers increased from 8,000 In 1991 to 120,000 in 1995 and 180,000 in 2004 (Miaari and Sauer 2011)

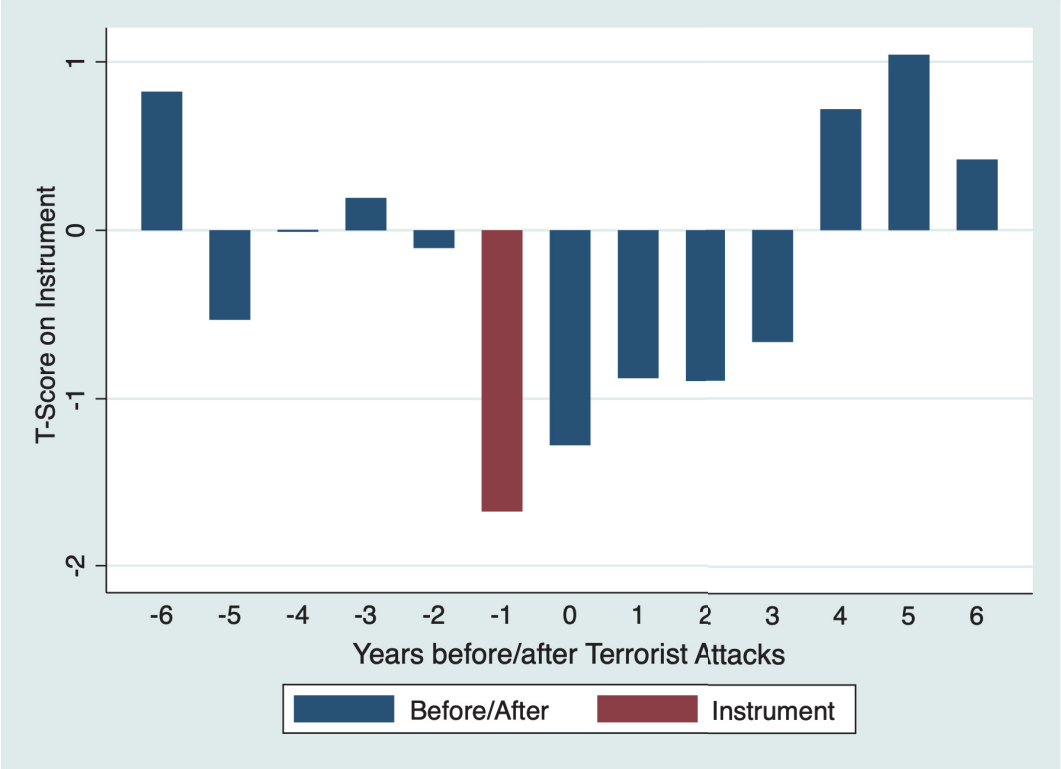


Figure E.2: Placebo check of the instrument — different time windows
The x-axis gives the rainfall surplus at the nearest refugee camp x year after (before) the civilian deaths. To illustrate, 0 on the x-axis means that the civilian deaths under civil conflicts in year t is instrumented by the rainfall in year t. Similarly, -3 means that the civilian deaths under civil conflicts in year t is instrumented by the rainfall in year $t-3$.

Table E.1: Impact of the Instrument on Regional Employed Rate

First Stage, Dependent variable: Regional Employed Rate					
	(1)	(2)	(3)	(4)	(5)
Refugee Rainfall × Pop. ÷ Dist.	.472	.476	.394	.738*	.643
	(.443)	(.478)	(.565)	(.411)	(.441)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Refugee control	X	X	X	X	X
Time-varying control		X	X		X
Static control			X		
N	2259	2209	1877	2259	2209

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each observation is a kibbutz-year. The sample is limited to pre-privatization years and the year of privatization. Dependent variable in the main stage equals one in the income privatization year. **Conflict Intensity, log** is the log transformation of the number of civilian deaths in the year of privatization and five years prior within 20km of the kibbutz, adjusted by the population density at the conflict location. **Reginal Employed Rate** is the yearly employment rate of the subdistrict to which kibbutz belongs. **Rainfall** is the total rainfall surplus in the previous six years at the nearest refugee camp; **Pop** is the population of the nearest refugee camp in 1996; **Dist** is the distance to the nearest refugee camp; Control variables are described in Table 5.4. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

Table E.2: Impact of the Instrument on number of civilians killed by Israel Government

First Stage, Dependent variable: Conflict Intensity, log					
	(1)	(2)	(3)	(4)	(5)
Refugee Rainfall × Pop. ÷ Dist.	-2.68**	-3.15***	-2.03*	-1.31	-1.8
	(1.13)	(1.2)	(1.08)	(1.06)	(1.14)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Refugee control	X	X	X	X	X
Time-varying control		X	X		X
Static control			X		
F-stat	5.66	6.89	3.54	1.52	2.49
N	2259	2209	1877	2259	2209

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each observation is a kibbutz-year. The sample is limited to pre-privatization years and the year of privatization. Dependent variable in the main stage equals one in the income privatization year. **Conflict Intensity, log** is the log transformation of the number of civilian deaths in the year of privatization and five years prior within 20km of the kibbutz, adjusted by the population density at the conflict location. **Rainfall** is the total rainfall surplus in the previous six years at the nearest refugee camp; **Pop** is the population of the nearest refugee camp in 1996; **Dist** is the distance to the nearest refugee camp; Control variables are described in Table 5.4. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

E.2 Robustness Checks for the Main Stage

If the decision of income privatization of the kibbutzim is truly driven by security concerns, one would expect the conflicts closer to the kibbutzim have a larger impact on the privatization than those further away from the kibbutzim have. To test this, I rerun the same regression (as in column 6 in Table 7.4) for conflicts within 5km to 45km. Figure 7.1 shows the effects of conflicts on the income privatization decays as they locate further away from the kibbutz (see Table E.4 in Appendix E.2 for corresponding regression results).

In addition to the spatial decay, one would also expect the conflicts in the more recent years have a larger impact on the privatization than those in the earlier years have. To test this, I rerun the same regression (as in column 6 in Table 7.4), but using conflicts varying from recent one year to recent seven years. Table E.5 in Appendix E.2 shows the conflicts in the recent years have a larger impact on the income privatization decisions.[2] The results once again confirm the theoretical prediction that income privatization is detrimental to the public defense, and thus less likely to be adopted in dangerous environments.

To eliminate reverse causality between conflicts and income privatization, I run a placebo test showing that kibbutz privatization decision is only correlated to conflicts in the past, not conflicts in the future. Specifically, I rerun the same regression (as in column 6 in Table 7.4) for conflicts happens in the next six years, which are instrumented by rainfall in the current year and next five years at the nearest refugee camps. Table E.3 shows while the instrument remains strong across all specifications, the impact of instrumented conflict intensity on privatization decision is not significant and has a much smaller coefficient (-0.52) compared to the coefficient in the main regression (-2.17).

Since nearby kibbutzim face similar threats, I allow error terms to be correlated across kibbutzim within a 100 kilometre radius (Conley, 1999).

[2]The results for conflicts in less than 3 years should be interpreted with cautious, because the instrument variable in the first stage becomes weak due to the smaller sample and large number of zero conflicts in the short time window.

Table E.3: Placebo check: civil conflicts post kibbutz privatization

First Stage, Dependent variable: Conflict Intensity, log					
	(1)	(2)	(3)	(4)	(5)
Refugee Rainfall × Pop. ÷ Dist.	-5.26***	-7.71***	-6.89***	-4.05***	-6.74***
	(1.03)	(1.42)	(1.4)	(.863)	(1.26)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Refugee control	X	X	X	X	X
Time-varying control		X	X		X
Static control			X		
F-stat	26	29.63	24.15	21.96	28.56
N	3286	2602	2232	3286	2602
Main Stage, Dependent variable: Income Privatization					
Conflict Intensity, log	-.451*	-.205	-.27	-.997**	-.81
	(.251)	(.363)	(.418)	(.472)	(.521)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE				X	X
Refugee control	X	X	X	X	X
Time-varying control		X	X		X
Static control			X		
N	3286	2602	2232	3286	2602

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Each observation is a kibbutz-year. The sample is limited to pre-privatization years and the year of privatization. Dependent variable in the main stage equals one in the income privatization year. **Conflict Intensity, log** is the log transformation of the number of civilian deaths in the year of privatization and five years prior within 20km of the kibbutz, adjusted by the population density at the conflict location. **Rainfall** is the total rainfall surplus in the previous six years at the nearest refugee camp; **Pop** is the population of the nearest refugee camp in 1996; **Dist** is the distance to the nearest refugee camp; Control variables are described in Table 5.4. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

Table E.4: Robust check - conflicts within different ranges over space

First Stage, Dependent variable:	Conflict Intensity, log								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	5km	10km	15km	20km	25km	30km	35km	40km	45km
Refugee Rainfall × Pop ÷ Dist	-.63***	-.874***	-2.56***	-4.16***	-7.37***	-13.7***	-17.6***	-21***	-23.6***
	(.133)	(.271)	(.697)	(.844)	(1.08)	(1.77)	(2.15)	(2.53)	(2.91)
Year FE	X	X	X	X	X	X	X	X	X
Locality FE	X	X	X	X	X	X	X	X	X
Refugee control	X	X	X	X	X	X	X	X	X
Time-varying control	X	X	X	X	X	X	X	X	X
F-stat	22.363	10.392	13.491	24.276	46.188	60.08	66.69	69.179	66.015
N	2209	2209	2209	2209	2209	2209	2209	2209	2209
Main Stage, Dependent variable:	Privatization Decision								
Conflict Intensity, log	-14.4***	-10.4***	-3.54***	-2.18***	-1.23***	-.661***	-.515***	-.431***	-.384***
	(5.11)	(3.68)	(1.26)	(.774)	(.437)	(.235)	(.183)	(.153)	(.136)
Year FE	X	X	X	X	X	X	X	X	X
Locality FE	X	X	X	X	X	X	X	X	X
Refugee control	X	X	X	X	X	X	X	X	X
Time-varying control	X	X	X	X	X	X	X	X	X
N	2209	2209	2209	2209	2209	2209	2209	2209	2209
SD: Conflict Intensity	.0045	.0072	.0136	.0314	.0256	.0528	.0547	.0592	.0526
Impact of one SD. increase	-.065	-.075	-.048	-.068	-.031	-.035	-.028	-.026	-.02

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The table replicates regression 6 in Table 7.4, but using conflicts within 5 to 45 km of each kibbutzim in the year of income privatization and prior five years. To compare the impact of conflicts in various distance, **Impact of one SD. increase** shows the effect of one standard deviation increase in the conflict intensity on the income privatization possibility. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

Table E.5: Robust check - conflicts within different ranges over time

First Stage, Dependent variable: Conflict Intensity, log							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	1 year	2 year	3 year	4 year	5 year	6 year	7 year
Refugee Rainfall × Pop. ÷ Dist.	-1.9*	-2**	-2**	-2.7***	-3.7***	-4***	-3.7***
	(1.14)	(.862)	(.911)	(.861)	(.807)	(.851)	(.95)
Year FE	X	X	X	X	X	X	X
Subdistrict FE	X	X	X	X	X	X	X
Kibbutz FE	X	X	X	X	X	X	X
Refugee control	X	X	X	X	X	X	X
Time-varying control	X	X	X	X	X	X	X
F-stat	2.79	5.32	5.03	9.53	21.51	22.33	15.56
N	2859	2859	2859	2641	2425	2209	1988
Main Stage, Dependent variable: Income Privatization							
Conflict Intensity, log	-5.6**	-4.72**	-4.36**	-2.74**	-1.98**	-2.2***	-2.63***
	(2.44)	(2.01)	(1.82)	(1.13)	(.799)	(.82)	(.953)
Year FE	X	X	X	X	X	X	X
Subdistrict FE	X	X	X	X	X	X	X
Kibbutz FE	X	X	X	X	X	X	X
Refugee control	X	X	X	X	X	X	X
Time-varying control	X	X	X	X	X	X	X
N	2859	2859	2859	2641	2425	2209	1988
SD: Conflict Intensity	.0124	.0219	.036	.0415	.0397	.0301	.0201
Impact of one SD. increase	-.069	-.103	-.157	-.114	-.079	-.066	-.053

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The table replicates regression 6 in Table 7.4, but using conflicts over the recent one year to recent seven years within 20km of each kibbutzim. To illustrate, column 4 uses conflicts in the year of privatization and prior three years. To compare the impact of conflicts in various distance, **Impact of one SD. increase** shows the effect of one standard deviation increase in the conflict intensity on the income privatization possibility. Robust standard errors correct for spatial correlation within a radius of 100km (Conley 1999).

Table E.6: Placebo check - spatial correlation

First Stage, Dependent variable: Conflict Intensity, log					
	(1)	(2)	(3)	(4)	(5)
Refugee Rainfall × Pop. ÷ Dist.	-4.02***	-4.02***	-4.02***	-4.02***	-4.02***
	(.784)	(.851)	(.919)	(.945)	(.956)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE	X	X	X	X	X
Refugee control	X	X	X	X	X
Time-varying control	X	X	X	X	X
F-stat	26.32	22.33	19.14	18.08	17.66
N	2209	2209	2209	2209	2209
First Stage, Dependent variable: Income Privatization					
Conflict Intensity, log	-2.2***	-2.2***	-2.2***	-2.2***	-2.2***
	(.745)	(.82)	(.826)	(.804)	(.796)
Year FE	X	X	X	X	X
Subdistrict FE	X	X	X	X	X
Kibbutz FE	X	X	X	X	X
Refugee control	X	X	X	X	X
Time-varying control	X	X	X	X	X
N	2209	2209	2209	2209	2209

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The table replicates regression 5 in Table 7.4. Robust standard errors correct for spatial correlation within a radius of 50km, 100km, 200km, 300km, and 500km correspondingly (Conley 1999).