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WATER: *CASUS BELLI OR SOURCE OF COOPERATION?*

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So important is water that there are repeated predictions of water as a *casus belli* all over the globe. For example, the U.N.-sponsored Third World Water Forum stated in August, 2001 that water could cause as much conflict in this century as oil did in the last. Said Crown-Prince Willem-Alexander of The Netherlands: "Water could become the new oil as a major source of conflict."[1] Similarly, former United States Senator Paul Simon recently wrote:[2]

> "Nations go to war over oil, but there are substitutes for oil. How much more intractable might wars be that are fought over water, an ever scarcer commodity for which there is no substitute?"

He went on to say:

> "Last year American intelligence agencies told President Bill Clinton, in a worldwide security forecast, that in 15 years there will be a shortage of water so severe that if steps are not taken soon for conservation and cooperation, there will be regional wars over it."

And these are but two very recent examples of many.[3]

Such forecasts of conflict, however, stem from a narrow way of thinking about water.

Water is usually considered in terms of quantities only. Demands for water are projected, supplies estimated, and a balance struck. Where that balance shows a shortage, alarms are sounded and engineering or political solutions to secure additional sources are sought. Disputes over water are also generally thought of in this way. Two or more parties with claims to the same water sources are seen as playing a zero-sum game. The water that one party gets is simply not available to the others, so that one party's gain is seen as the other parties' loss. Water to have no substitute, so that it can only be traded for other water.

But there is another way of thinking about water problems and water disputes, a way that can lead to dispute resolution and optimal water management. That way involves thinking about

* Thia paper draws on the work of a large number of people involved in the Middle East Water Project discussed below – too many to thank by name. I am greatly indebted to the government of The Netherlands for its support of the project. The views expressed are not necessarily those of any government or person other than myself. I am grateful to Brian Palmer and, especially, to Annette Huber-Lee for assistance but retain responsibility for error.

[1] Reuters inteview reported on Environmental News Network, August 13, 2001.

[2] Paul Simon, "In an Empty Cup, a Threat to Peace", *New York Times,* August 14, 2001.

[3] For example, see Klare (2001, pp. 56-7, 59-60).

the economics of water and shows, in fact, that water can be traded off for other things. Further, it shows that cooperation in water is a far more sensible policy than is autarky (self-sufficiency in water) -- provided, of course, that there is someone with whom to cooperate.

1. Is Water Worth War?

The late Gideon Fishelson of Tel Aviv University once remarked that "Water is a scarce resource. Scarce resources have value." He went on to point out that the possibility of desalinating seawater (together with the costs of conveyance from the seacoast) must put an upper bound on the value of water in dispute to any country that has a seacoast. This implies, for example, that the value of the water in dispute between Israelis and Palestinians lies at most in the range of a few hundred million dollars per year and is most probably far less than that. Such amounts ought not to be a bar to agreement between nations.

Fishelson's remarks were a principal impetus to the creation of the Middle East Water Project (MEWP). That Project, begun in 1993, is a joint endeavor of Israeli, Jordanian, Palestinian, Dutch, and American scholars. Since 1996, it has been supported by the government of The Netherlands and has operated with the consent, if not the commitment of the Israeli, Jordanian, and Palestinian governments.

The MEWP finds that the value of the water in dispute is in fact far less than the Fishelson upper bound. (This corresponds to the finding that, except in years of extreme drought, desalination on the Mediterranean coast is not and will not be efficient.)

To take an example: *In 2010, the loss of an amount of water roughly equivalent to the entire flow of the Banias springs (125 MCMs annually) would be worth no more than $5 million per year to Israel in a year of normal water supply and less than $40 million per year in the event of a reduction of thirty percent in naturally occurring water sources.* At worst, water can be replaced through desalination, so that such water (which has its own costs) can never be worth more than about $75 million per year. These results take into account Israeli policies towards agriculture.

Note that it is *not* suggested that giving up so large an amount of water is an appropriate negotiating outcome, but water is not an issue that should hold up a peace agreement. These are trivial sums compared to the Israeli GDP or to the cost of fighter planes.

2. The WAS Tool: Domestic Results

The owner of water that consumes the water itself does not obtain that water for nothing. Instead, the owner incurs an opportunity cost -- giving up the money that the water would bring if sold. Indeed, the questions of who *owns* water and who *uses* water can be shown to be entirely separate. Water ownership is a property right entitling the owner to the money that the water represents.

The MEWP has built a tool (WAS or "Water Allocation System") that shows how to maximize the net benefits from water (defined as the amount water users are willing to pay for water less the costs of providing the water). This powerful tool permits the user to investigate optimal water management *given the values and restrictions that the user imposes.* For example, the user can specify that, as in Israel, agriculture is to receive water at subsidized prices.

The WAS tool can be used domestically to advise and inform water policy or the analysis of costs and benefits from proposed infrastructure projects or of the value of new water sources. Such uses take into account the *system-wide* effects of decisions or projects.

Here are some examples of such use:

- Israel has a short-term water problem, due to drought. It does *not* have a long-term "crisis" as regards water quantity. Rather the long-term problem is a monetary one. At the worst, that problem can be solved by desalination which can produce unlimited water quantity but at a price too high for unsubsidized agriculture.
- *But desalination (even at 60 cents per cubic meter) will not be necessary or efficient except in extreme drought years.* As a result, since the building of desalination plants requires very substantial capital expenditures, serious consideration should be (and is being) given to securing additional water from Turkey on an interruptible basis.
- Jordan's water problems will not be solved by obtaining a greater share of the Jordan or Yarmouk rivers without the building of substantial new conveyance infrastructure to take such water to Amman. The benefits from repair of Amman's distribution system would far exceed the required expense.

3. The WAS Tool: International Issues

The uses of WAS are not restricted to domestic management, however. The WAS tool can also be used in the resolution of water disputes.

- Water and water disputes can be monetized and analyzed in terms of economics, *taking full account of the social or national value of water that may exceed private value*. This can assist by showing the true size of the water problem, which will often not be very large.
- Further, each party can use its own version of WAS to evaluate the consequences to it of different water agreements.
- Finally, the parties can cooperate by agreeing to trade short-term permits to use water at prices that reflect the scarcity value of the water. WAS generates such prices and shows the gains from cooperation.
- Perhaps most important of all, the WAS tool can be used to guide cooperation in water *and* to estimate what such cooperation would be worth.

Basically, WAS-guided cooperation consists of neighbors trading "water permits" -- short term access to each other's water -- and doing so at efficiency prices generated by the WAS tool. Such prices reflect the values put on water by each participating entity. Since trade in water permits is voluntary, both the buyer and the seller of water permits gain from such transactions. The buyer receives water that it values more highly than the money given up to buy it; the seller receives money that it values more highly than the water it gives up in the sale. The result is a "win-win" situation.

We have estimated the gains to Israel and the Palestinians from such cooperation, and find them to exceed the value of changes in water ownership that reflect reasonable differences in negotiating positions.[4]

Figures 1-6 illustrate such findings and more besides. In those Figures, we have arbitrarily varied the fraction of Mountain Aquifer water owned by each of the parties from 80% to 20%.[5]

The two line graphs in Figure 1A show the gains from cooperation in 2010 for Israel and Palestine, respectively, as functions of ownership allocations.[6] Israeli price policies for water are

[4] It is certainly not my intent to leave Jordan out, but analysis of the Jordanian situation is not so far along. Preliminary investigation shows results that are qualitatively similar to those here reported for Israel and Palestine.

[5] We have equally arbitrarily assumed in this Table that Israel owns 100% of the water of the Jordan River. None of these assumptions is intended to convey a political message as to the appropriate allocation of water ownership.

[6] Here and later, the results refer to a year of normal hydrology. Results for drought years are not qualitatively different, although all numbers are larger.

assumed to be the same as in 1995, with large subsidies for agriculture and much higher prices for households and industry.

Starting at the left, we find that Palestine benefits from cooperation by about $68 million per year when it owns only 20% of the aquifer. In the same situation, Israel benefits by about $13 million per year. As Palestinian ownership increases (and Israeli ownership correspondingly decreases), the gains from cooperation fall at first and then rise. At the other extreme (80% Palestinian ownership), Palestine gains about $21 million per year from cooperation, and Israel gains about $51 million per year. In the middle of the Figure, joint gains are about $34 million per year.

It is important to emphasize what these figures mean. As opposed to autarky, each party benefits as a buyer by acquiring cheaper water. Moreover, each party benefits as a seller by tens of million of dollars per year *over and above* any amounts required to compensate its people for increased water expenses.

Why do the gains first decrease and then increase as Palestinian ownership increases? That is because, at the extremes, there are large gains to be made by transferring water from the large owner to the other party. Israel has large benefits at the right-hand side of the diagram because it can obtain badly needed water; it has large gains at the left-hand side because it can there sell relatively little-needed water to the Palestinians. The same phenomenon holds in reverse for Palestine.

One might suppose that the gains would be zero at some intermediate point, but that is not the case. The reason for this is as follows:

It is true that a detailed, non-cooperative water agreement could temporarily reduce gains to cooperation to zero. That would require that the agreement exactly match in its water-*ownership* allocations the optimizing water-*use* allocations of the optimizing cooperative solution. That is very unlikely to happen in practice (and, if it did, would only reach the optimal solution for a very short time, as explained below). In our runs, it does not happen for two reasons.

1. We have not attempted to allocate ownership in the Mountain Aquifer in a way so detailed as to match geographic demands. Instead, we have allocated each common pool in the aquifer by the same percentage split.
2. There are gains from cooperation in these runs that do not depend on the allocation of the Mountain Aquifer. It is always efficient for Gaza to be supplied from the Israeli National Carrier, and it is always efficient for treated wastewater to be exported from Gaza to the Negev for use in agriculture.

There are further results to be read from Figure 1A. The height of the various bars in the figure show the value to the parties *without cooperation* of a change in ownership of 20% of the Mountain Aquifer (about 130 MCM per year). These are calculated by looking at the changes in ownership used in the results, so that, for example, the left-hand-most set of bars show the value to the parties of changes between an Israeli-80%-Palestinian-20% and an Israeli-60%-Palestinian-40% allocation of ownership; the next set of bars examines the value of a change from 60-40 to 40-60.

Note that the value of cooperation generally exceeds the value of such ownership changes. Note also, that a great deal of water is involved.

Further, now look at Figure 1B. This differs from Figure 1A only in the height of the ownership-value bars. In Figure 1B, the height of those bars represents the value of shifts of 20% aquifer ownership *in the presence of cooperation.* That value is about $7 million per year. The lesson is clear:

Ownership is surely a symbolically important issue, and symbols really matter. But cooperation in water reduces the practical importance of ownership allocations – already not very high -- to an issue of very minor proportions.

The same qualitative results hold when we examine Figures 2A and 2B. These differ from Figures 1A and 1B, respectively, in that Israeli Fixed-Price policies (FPP's) are assumed not to be in effect and water sold to users at the efficiency prices generated by WAS.

There are three differences from the Figures 1A and 1B that are worth discussing.

1. While the value to Palestine of ownership changes *without* cooperation remain the same as before (as they must, since Palestine receives exactly the same water as before), the gains to Israel are reduced, but reduced significantly only when Palestine owns the lion's share of the aquifer.
2. The value of ownership changes *with* cooperation is even smaller in Figure 2B than in Figure 2A, about $3-4 million per year.
3. The gains from cooperation are not much different, and the difference is interesting.

One of the issues that might arise in contemplating a cooperative agreement of the type described is as follows: If Israel subsidizes water for agriculture[7], then the demand for water by Israeli farmers will rise. Since this increases water scarcity, it will increase the efficiency prices

[7] For the sake of exposition, I examine Israeli FPP's, but a similar issue would arise if Palestine were to subsidize water for agriculture.

of water and hence the prices to Palestinian consumers. Does not that mean that there will be continual negotiation over Israel's price policy? The answer turns out to be in the negative.[8]

Figure 3 shows the difference to each party made by Israeli FPP's in the context of a cooperative agreement. The negative effects on Palestine are very small at worst. They are about $10 million with Israeli ownership of $80% of the aquifer, and, indeed, with increases in Palestinian ownership, the effects rise toward zero, eventually even becoming positive. This occurs because the use of FPP's also increases the price that Israel must pay to obtain Palestinian water, and, with increasing Palestinian ownership, the amount of such purchases rises.

Of course, the corresponding effect on Israel itself is in the other direction. The effect of FPP's on Israel starts off negative and becomes increasingly so. It must be remembered, however, that this is the price of having the FPP's , particularly of subsidizing agriculture. Presumably, Israel's policy makers would consider that there is an added social gain from doing so – a gain not reflected in the calculations shown.

Figures 4-6 show similar results for 2020. As we should expect, all the monetary figures are greater (for example, total gains from cooperation range from $44 to $120 million per year instead of from $33 to $82 million per year), but the qualitative conclusions are the same. Note particular, that the value of an ownership shift of 20% of the Mountain Aquifer under cooperation is only about $9 million per year in the absence of Israeli FPPs and still only $16 million per year in the presence of such policies.

4. The Real Benefits from Cooperation

But the greatest benefits from cooperation may not be monetary. Beyond pure economics, the parties to a water agreement would have much to gain from an arrangement of trade in water permits. Water quantity allocations that appear adequate at one time may not be so at other times. As populations and economies grow and change, fixed water quantities can become woefully inappropriate and, if not properly readjusted, can produce hardship. *A system of voluntary trade in water permits would be a mechanism for flexibly adjusting water allocations to the benefit of all parties and thereby for avoiding the potentially destabilizing effect of a fixed water quantity arrangement on a peace agreement.* It is not optimal for any party to bind itself to an arrangement whereby it can neither buy nor sell permits to use water.

[8] There is, of course, a different an possibly more important issue. If Israeli farmers receive water at subsidized prices, their costs will be less, thus enabling them to compete more effectively in the markets for agricultural outputs. But that would be true of any subsidy to agriculture, not just a water subsidy. It has nothing to do directly with water price policy as such.

Moreover, cooperation in water can assist in bringing about cooperation elsewhere. For example, as already indicated, the WAS model strongly suggests that, even in the presence of current Israeli plans, it would be efficient to have a water treatment plant in Gaza with treated effluent sold to Israel for agricultural use in the Negev where there is no aquifer to pollute. (Indeed, we are informed that since this suggestion arose in model results, there has been discussion of this possibility.) Both parties would gain from such an arrangement. *This means that Israel has an economic interest in assisting with the construction of a Gazan treatment plant.* This would be a serious act of cooperation and a confidence-building measure.

5. Problems and Conclusions

Naturally, there are a number of issues that arise as to such a scheme. Chief among them is that of security. What if one of the partners to such a scheme were to withdraw? Of course, such withdrawal would be contrary to the interest of the withdrawing party, but, as we have sadly seen, people and governments do not always act in their own long-run self-interest.

The main cost of such a withdrawal to the other party would occur if that party had failed to build infrastructure that would be needed without cooperation but not with it. In the case of Israel and the Palestinian authority, that risk would be chiefly Palestinian, since they, but *not* Israel, would need desalination plants in the absence of cooperation but not in its presence. Israel, by contrast, already has a highly developed system of water infrastructure and any decision to build desalination plants does not depend on a decision to cooperate or not cooperate with the Palestinians.

For Israel, at least, therefore, cooperation is clearly a superior policy to autarky. In an atmosphere of trust, cooperation would be likely to benefit Palestine even more.

But, of course, such an atmosphere does not now exist. Cooperation requires a partner, and, at present, that does not appear to be immediately likely. Moreover, as the security issue just mentioned suggests, the Palestinians are likely to be suspicious of Israeli good faith.

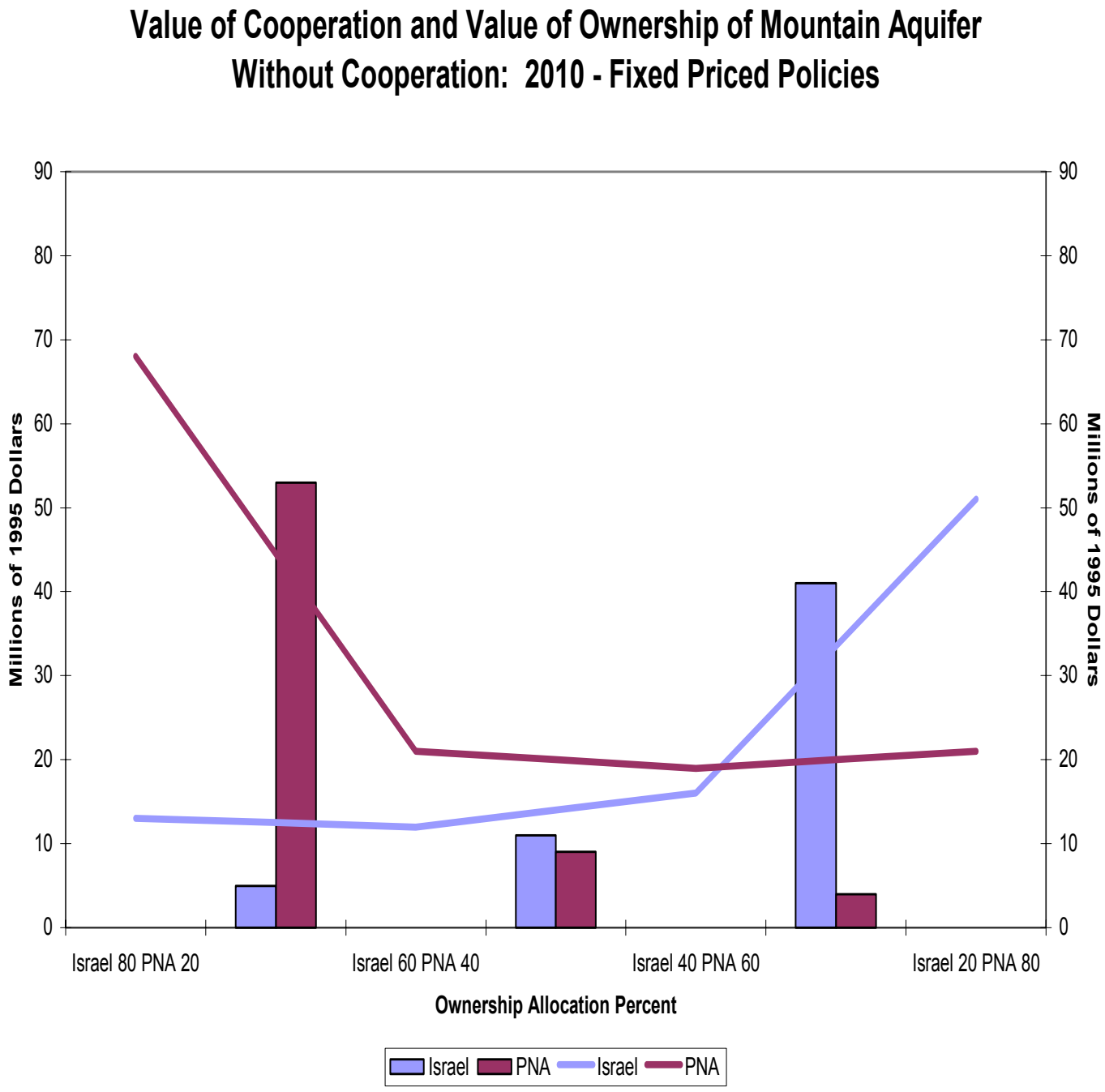
Despite this, I continue to believe that cooperation is both valuable and possible. As already discussed, water is not worth conflict and can become an area for confidence-building measures.

Further, if autarky is truly desired, then one should simply build desalination plants as needed. Autarky in naturally-occurring water is a foolish policy save as a money-saving device -- and the money it saves is not great.

Every country with a seacoast can have as much water as it wants if it chooses to spend the money to do so. Hence, every country with a seacoast can be self-sufficient if it is willing to incur

the costs of acquiring the necessary water. As a result, disputes over water among such countries are merely disputes over costs, not over life and death.

Figure 1A


Value of Cooperation and Value of Ownership of Mountain Aquifer
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Ownership Allocation Percent
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Figure 1B

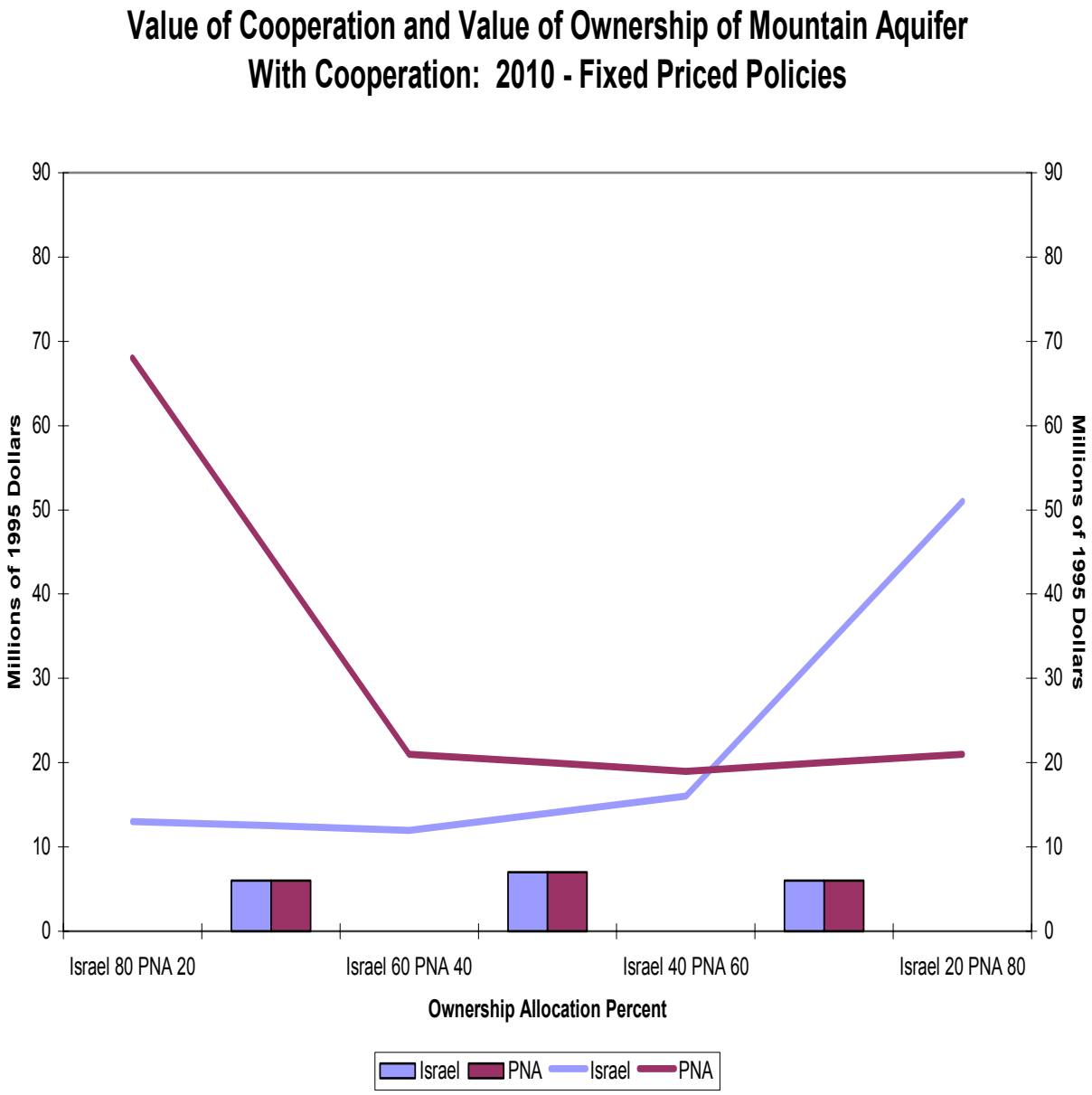
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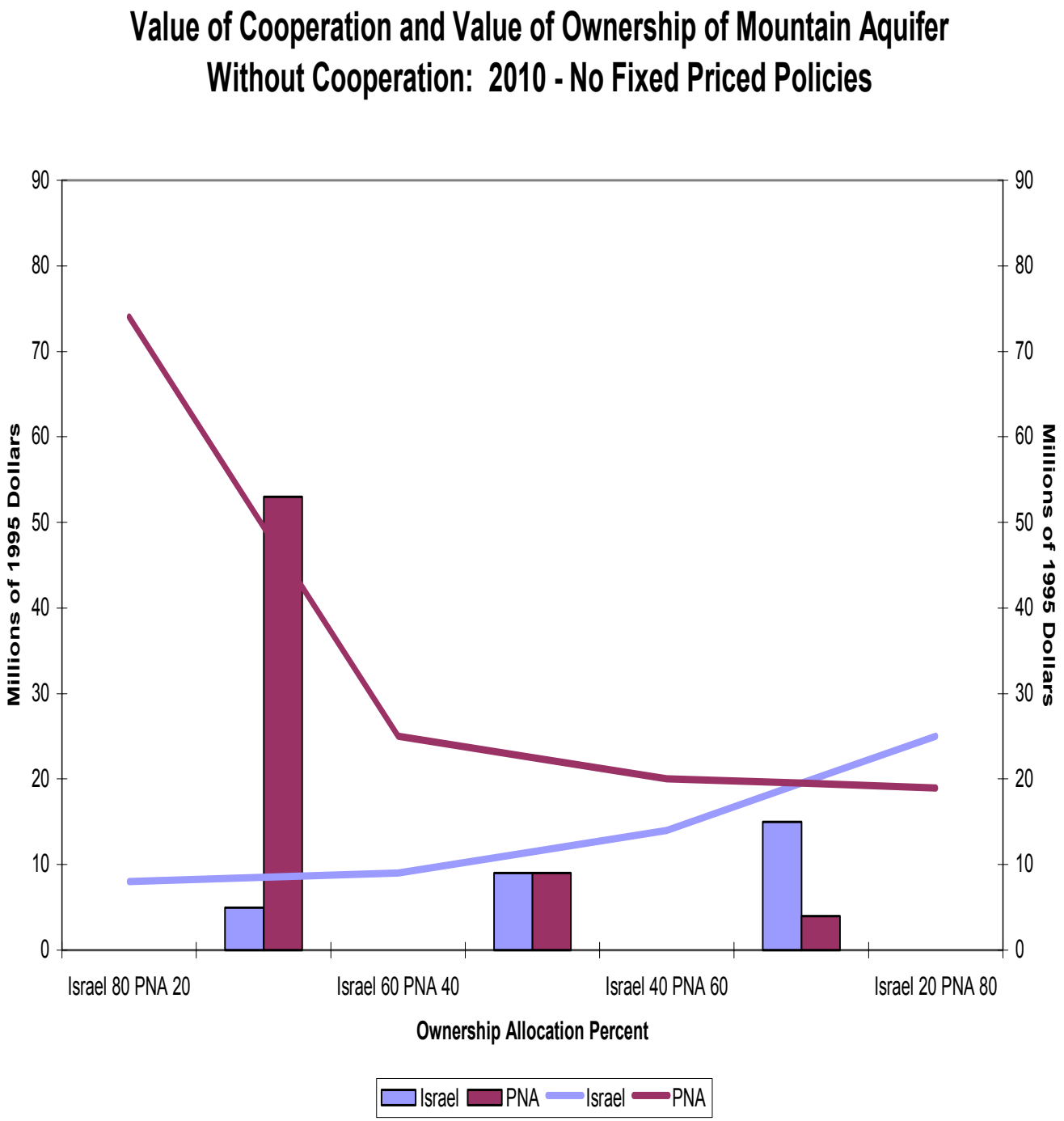
Figure 2A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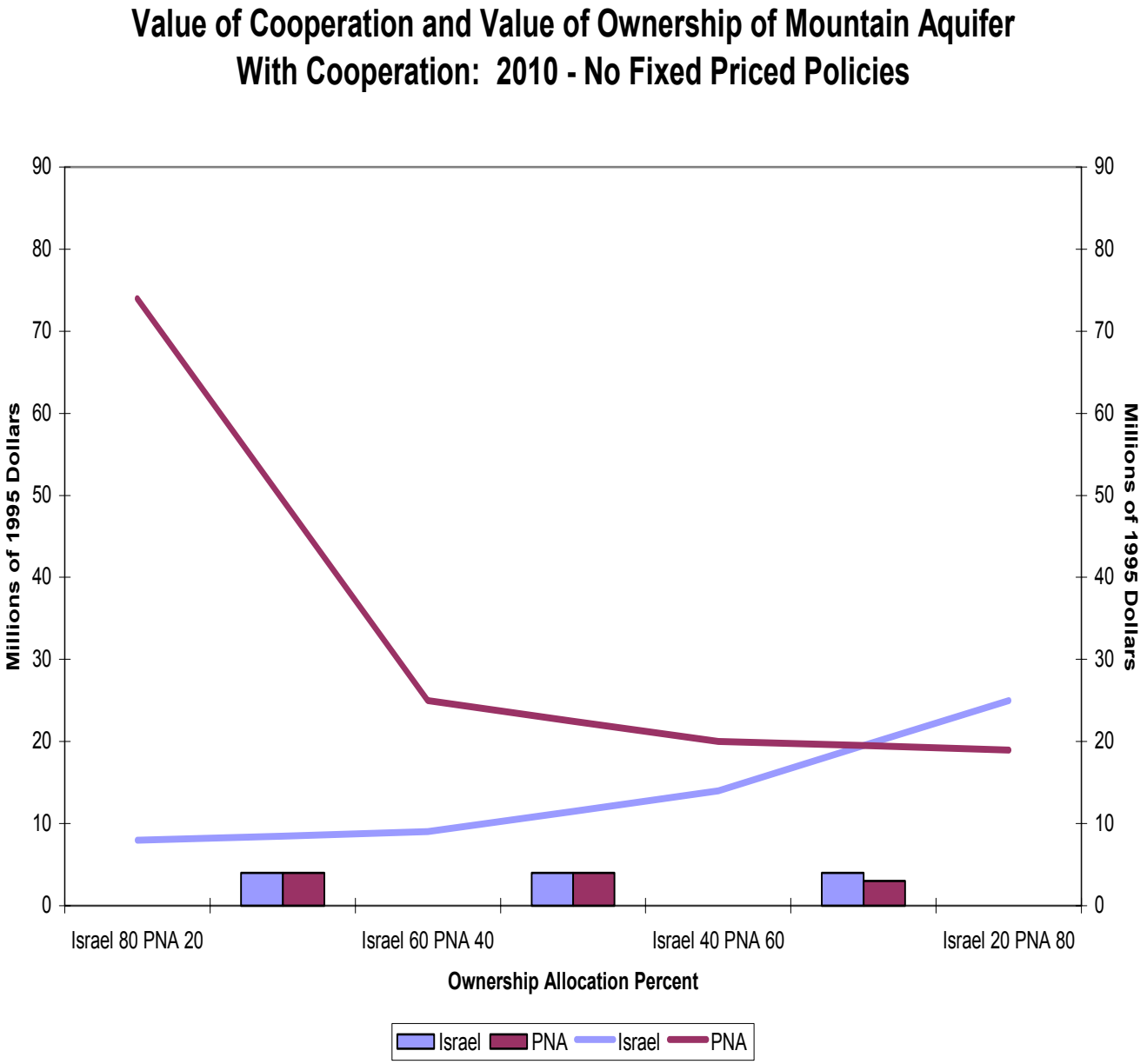
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Figure 3

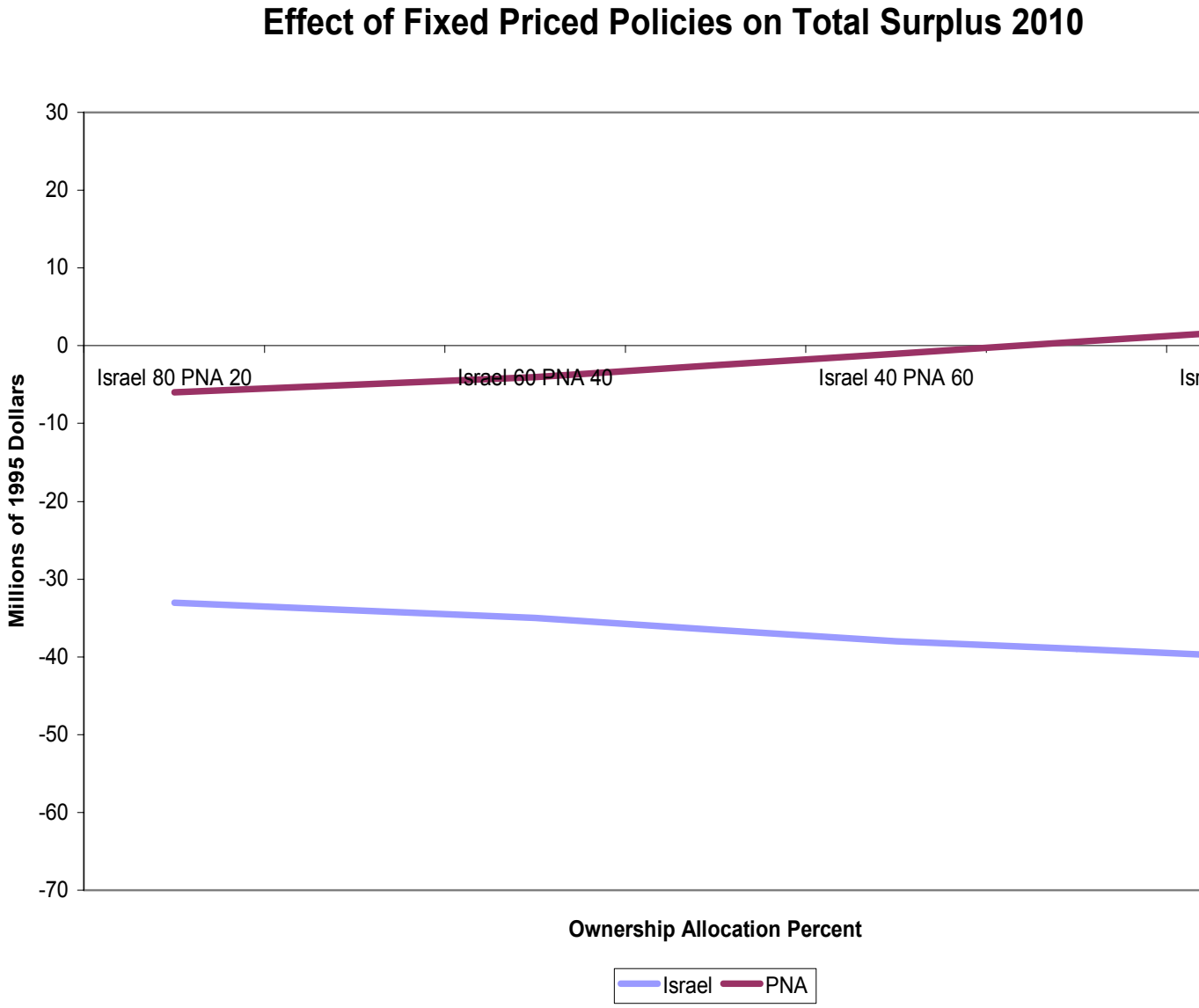
Effect of Fixed Priced Policies on Total Surplus 2010
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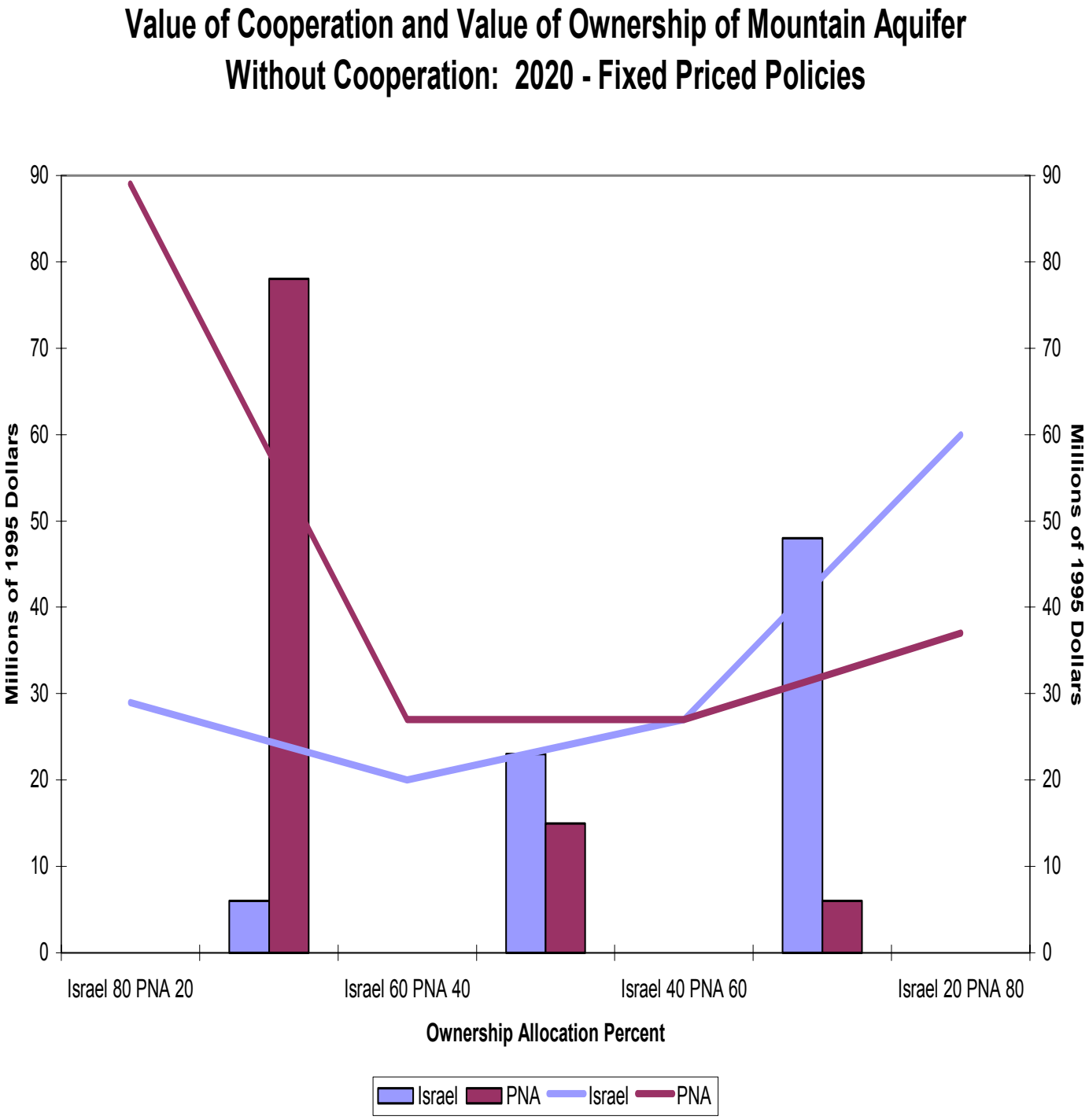
Figure 4A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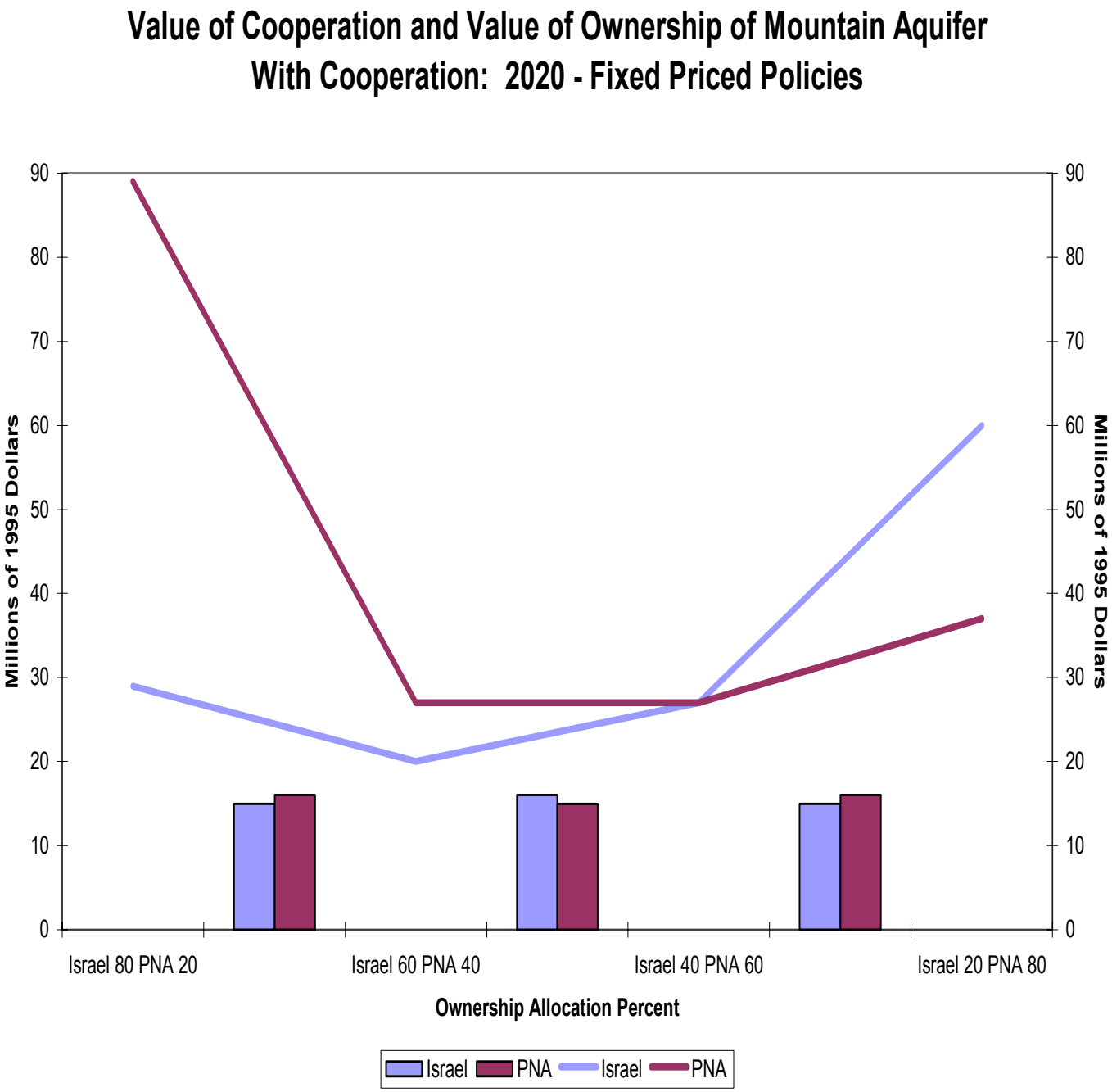
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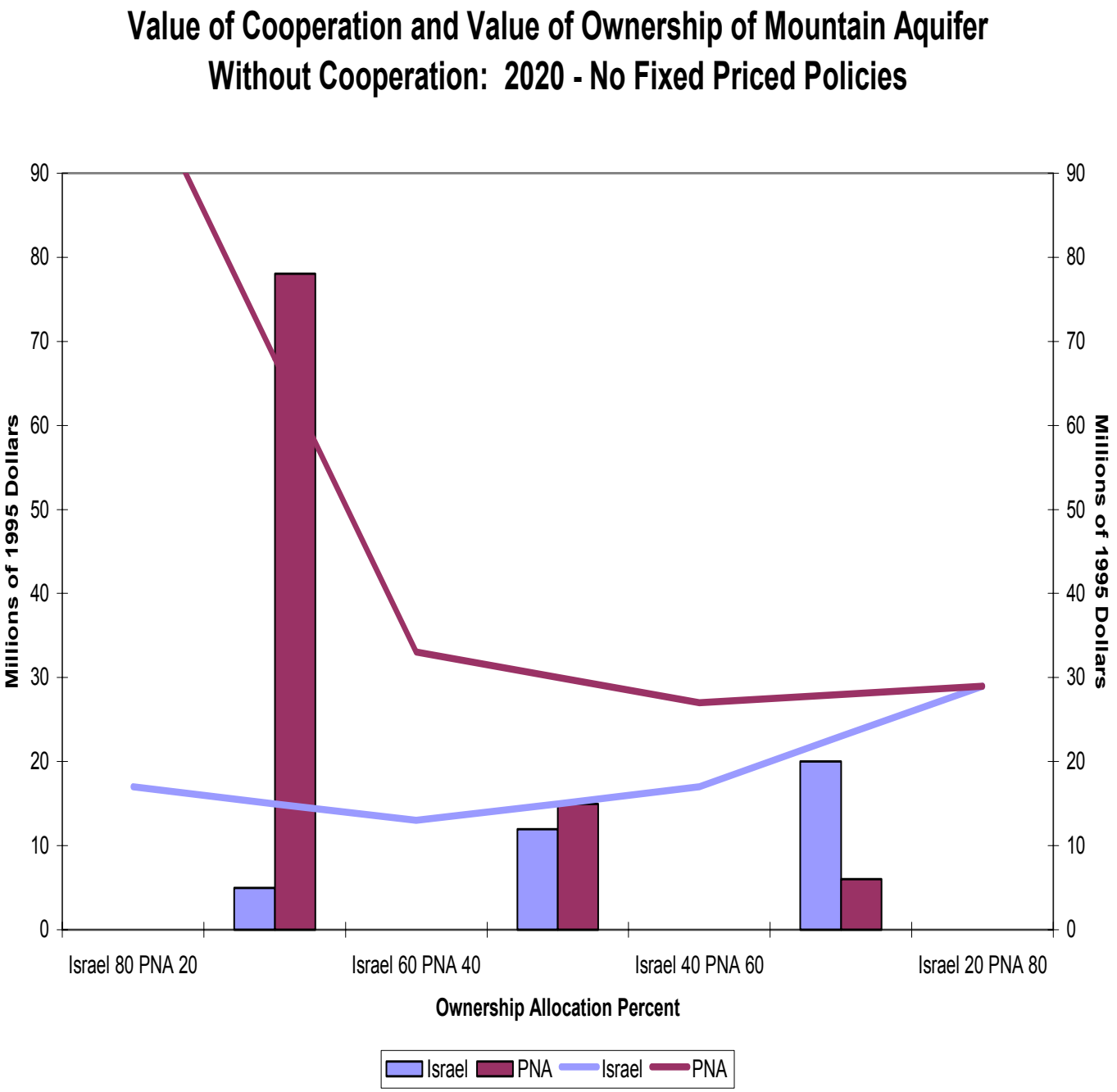
Figure 5A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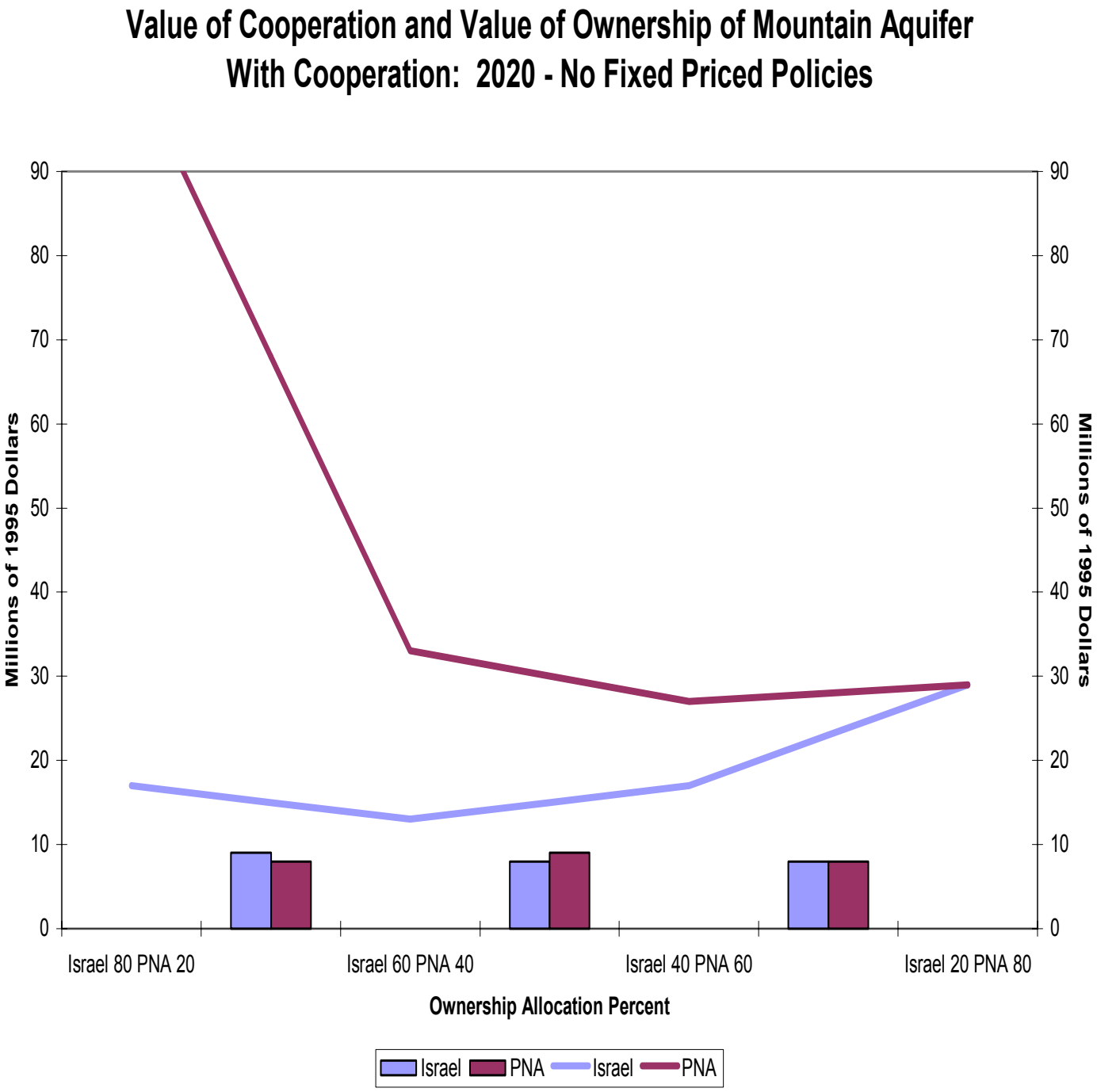
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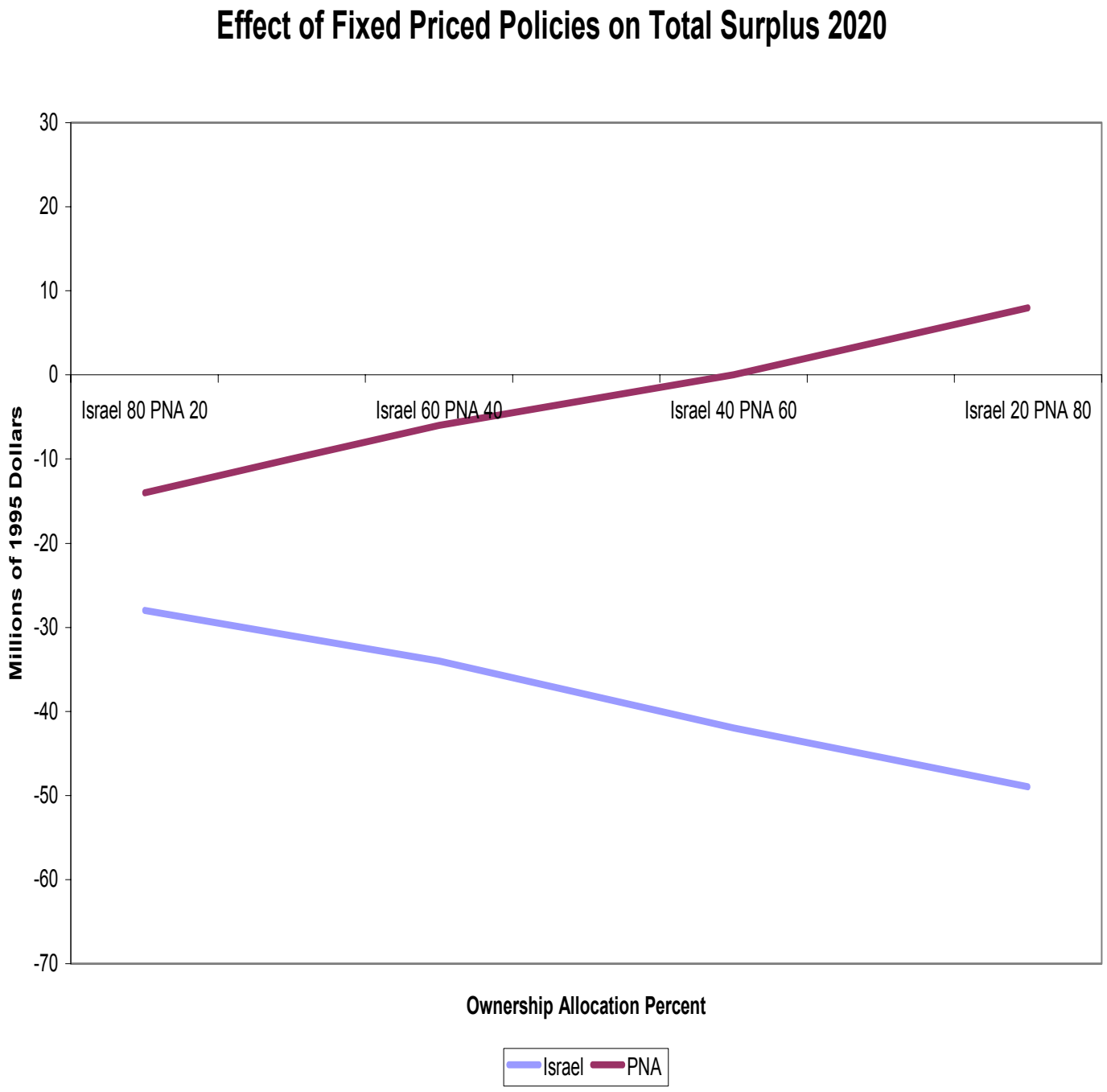
Figure 6


Effect of Fixed Priced Policies on Total Surplus 2020
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