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A QUANTITATIVE ANALYSIS

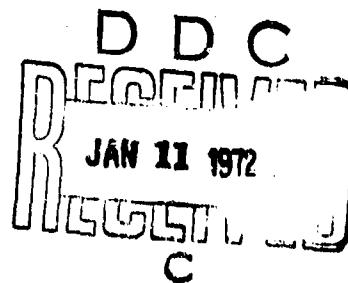
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ABSTRACT

SOVIET AND AMERICAN INFLUENCES ON THE ARAB-ISRAELI ARMS RACE:

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This research examines the extent to which the U.S. and U.S.S.R. have been able to affect the amounts of military spending by Israel and the Arab countries, and thus help to control the Middle East arms race with its grave potential for mutual destruction of Arabs and Israelis.

Yearly quantitative data (1948-64) on the arms budgets of Israel, Egypt, Syria, Lebanon, Jordan, and Iraq, and on such large-scale Soviet and American actions as trade, economic aid, and military aid are used in statistical correlation and multiple regression analyses.

Israeli and Arab arms budgets are found to be relatively independent of U.S. or Soviet aid and trade inputs, when controlling for the past expenditures of each country. A few important exceptions are that Soviet military aid increases Egyptian arms spending, U.S. military aid increases Jordanian arms spending, and U.S. economic aid decreases Israeli arms spending.

Arms spending appears to be caused by outstanding Arab-Israeli conflict issues -- the existence of the State of Israel and the fate of the Palestinians--and by the hostilities, tensions (including enemy arms increases), and violence that stem from these issues.

Population growth and technology relative to available resources were combined for a measure of internal pressure, and the relationship between this dimension and arms spending was investigated. Because such internal pressure was found to be highly associated with other influences on military expenditures, no definite conclusions could be drawn.

The Arab-Israeli arms race is a part of the more general Arab-Israeli conflict, and will probably continue as long as the

larger conflict continues. Unless American and Soviet leaders are aware of how limited their own influence is on this arms race and conflict, they risk an involvement that could trap them into an armed confrontation with each other.

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Introduction to the Problem

Israel and its Arab neighbors, involved in a deeply rooted conflict that has broken out into full-scale war three times since 1948, have engaged in armed violence against each other to this day. They have also spent an increasing amount of their resources on arms over the years and have thereby added to the tension between them and the potential for mutual destruction.

Arms expenditures represent an approximation of military capabilities. They also represent political choices growing out of felt tensions and needs. These choices involve long-term commitments, and are affected by short-term opportunities.

As embodiments of political choices, arms expenditures are subject to influences. What influence have the United States and the Soviet Union--who now vie for political and strategic dominance in the Middle East--on the Arab-Israeli arms race? This question is relevant to all who are concerned about further large-scale armed violence in the Middle East and who wish to see that violence and the arms with which it is waged reduced.

One must be aware that reducing the arms race will not itself remove the deeply rooted conflicts from which the armed violence stems: primarily, the existence of the sovereign Jewish State of Israel and the counter-claim by Arab Palestinians to all of Palestine as their own; and a host of corollary disputed issues, including the territorial boundaries of the State of Israel, the state of belligerency between Israel and the Arab countries around it, the rights of Israel to navigate the Suez Canal and the Straits of Tiran; independence, repatriation, resettlement and compensation of the Palestinian Arab refugees; and possession of the city of Jerusalem. A reduction of arms spending by Israel and the Arab countries would, however, lessen the threat represented by the arms themselves to both sides, and release badly needed resources in each country for economic development and improvement of the living conditions of the people.

Both the United States and the Soviet Union have acted in the Middle East in pursuit of their own interests. Some of these actions whether or not they achieve their objectives have implications for Arab-Israeli military spending. The United States has sought to

keep Israel viable as a progressive democracy, maintain some influence in the Arab countries for the purpose of protecting U.S. economic investments (particularly a three billion dollar investment in oil) maintain a strategic presence for the U.S. and the NATO countries in the Middle East. Both the U.S. and the Soviets wish to have that influence in the Middle East that would enable them to project their military forces into the region, and also be able to use bases in the region to project their military forces, especially their conventional military forces, into other geographical areas. For example, the Soviets would like to have bases in North Africa for possible conventional military attack on Southern Europe. Both the U.S. and the Soviets have been greatly interested in building and maintaining naval strength in the Mediterranean Sea, and having access through the Suez Canal in order to be able to project naval strength to the Persian Gulf, East Africa, South Asia, Southeast Asia, and East Asia. In addition, both countries have sought to maintain control over the flow of oil to Western Europe and Japan. This control is of particular concern to the U.S. in order to secure and guarantee the needed oil supplies for its vital NATO and Japanese alliance partners. The Soviets have been interested in being able to control this flow of oil as a basis for influencing NATO countries and Japan.

In this research it is assumed that the superpowers could acquire and maintain long-term influence in the Middle East only through sustained, continuing large-scale interactions with the Arabs and Israelis. Both the U.S. and Soviet Union have sought to achieve their policy objectives in the Middle East by, among other means, supplying arms, other military assistance, and economic aid, and engaging in trade with the countries of the Middle East as a basis for which they could influence those countries' policies. Both the superpowers have sought to make the recipients of their military aid dependent upon them for necessary follow-up training in the use of the weapons they supply and for spare parts. Even the type of training received tends to tie the recipient country to the donor in that military officers trained one way prefer to continue with the procedures that they have learned rather than have to change to new weapons systems provided by another country.

A general hypothesis in this research is that any unique political influence demonstrated by the U.S. or the Soviet Union is based upon long-standing commitments and support, such as represented by long-term aid and trade agreements.

Economic and military aid to Middle Eastern countries has been used as both a carrot and a stick by the superpowers. Withholding such aid—once established and once a Middle Eastern country became dependent upon it—could be used to influence that country's violent behavior.

The continuation of the arms race and low levels of violence in the Middle East has been of advantage to the Soviets, for the radical Arab countries have become dependent upon them for continuing military assistance to carry on the conflict with Israel. On the other hand, the Soviets have had to be concerned about not letting that violence become so great that they would inadvertently be drawn into the conflict against the U.S.

The U.S. has seen some advantage in the Arab-Israeli conflict, too, for the Israelis represent an anti-Soviet bulwark in the Middle East. The ability of the Israelis to reduce the military and political influence of the Soviets by destroying Soviet-supplied military capabilities to Arab countries could be viewed as an advantage by the U.S. On the other hand the U.S. has also found that the continuing conflict represents the potentially great hazard of drawing the U.S. into direct conflict with the Soviet Union. Thus, Soviets and Americans have conflicting interests in escalating and de-escalating the Arab-Israeli conflict at various times over the years.

The U.S. and the Soviet Union have a great interest in knowing to what extent they are able to control the Middle East conflict systematically, using these large-scale actions of economic and military aid, and trade. There does lie a great danger of being entrapped in a dangerous confrontation with each other over the deeply rooted conflict between the Arabs and Israelis. The superpowers could be manipulated by the Middle Eastern countries in such a way that the proverbial tails could wag the dogs. If it is true, however, that the superpowers do wield political influence, there is the opportunity for superpowers to help reduce tensions

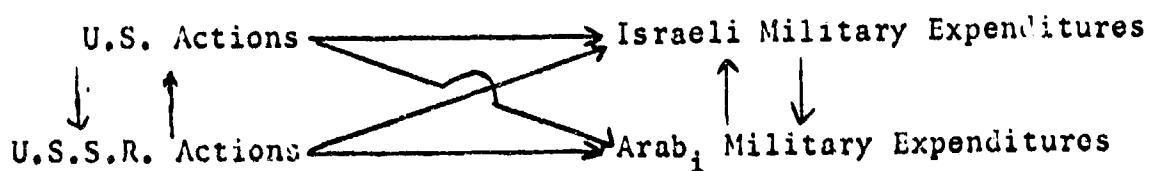
and potential violence by influencing the Arabs and Israelis to acquire fewer arms. Thus, there is danger and opportunity for American and Soviets in the Middle East.

The United States and the Soviet Union have not been the only arms suppliers to the parties in the Arab-Israeli conflict. Britain, France, West Germany and China have supplied considerable amounts of arms at various times since 1948 to countries in the Middle East. Given these various sources of arms supplies and the underlying conflict between the Arabs and the Israelis, it becomes an important question whether the U.S. or the U.S.S.R. could influence the quantity and kind of arms acquired by the belligerents. The pattern of hostile interaction in the Middle East may be so well established that it is relatively unaffected by actions initiated by any outside actor.

The Middle East raises some important theoretical questions: how autonomous is a pattern of interaction among a regional set of nations (a subsystem of the international system)? How much is the regional subsystem affected by interaction with superpower actors, whose actions in the regional subsystem are a part of the larger Cold War system? Put in another way, what is the effect on one subsystem of interaction when penetrated by a larger system of interaction?¹ In Figure 1, the general interactions considered in these questions and in this study are diagrammed.

Figure 1

SYSTEMS OF INTERACTION



Methods and Data

In this study, the approach to investigating these questions of superpower influence on Arab-Israeli arms expenditures is to use statistical methods to analyze systematically the dynamics of the Arab-Israeli arms race in the past and the effects of major

types of Soviet and American actions on that arms race. The statistical methods used include bivariate correlation and multiple regression analysis.

Some comment is required on the variables used to measure the large-scale Soviet and American inputs into the Middle Eastern countries. In this study, the amount of military or economic assistance or trade is correlated in each year with the military expenditures of each Middle Eastern country. An hypothesis is thus made that it is the value of the aid or trade in any year that affects the amount of Arab or Israeli military spending. It can be argued that because aid and trade agreements are made sporadically, influence over the Middle Eastern countries is also sporadic, and occurs not at the time that the aid or trade is actually engaged in, but the time when decisions and agreements to engage in such aid or trade are made. This consideration would hold true for economic aid, military aid, and also trade by the "state" traders such as the U.S.S.R. and most of the Middle Eastern countries. On the other hand, the capability to spend resources for arms by the Middle Eastern countries is dependent upon economic and existing military resources. Therefore it is argued here that the more the resources they actually receive from aid or trade, the more these countries are able to spend for military purposes.

Another note should be made about the data used in this research. This study uses only publicly available data. Data for U.S. Military aid to the Middle Eastern countries comes from Overseas Loans and Grants of the U.S. House of Representatives Appropriations Committee. It is recognized that direct loans and grants do not represent the entire amount of U.S. military assistance to the Middle Eastern countries since 1948. The actual amounts are harder to find and many are classified secrets by the U.S. Government. These types of military assistance would include, for example, direct sales of ammunition and spare parts, or direct sales that were facilitated by U.S. economic assistance. "Third nation" military assistance, at least to Israel, was at times stimulated by the U.S. and frequently compensated for by the U.S. For example, West Germany is alleged to have been com-

pensated by the U.S. for its substantial assistance to Israel during 1958-1963 through the release of "surplus" U.S./NATO stocks.

Similarly, in considering economic aid, one might add to the official data on direct U.S. assistance to Israel such indirect aid as U.S. encouragement and compensation to third countries for their assistance to Israel. An example would be the large German reparation payments to Israel in the 1950's.

One more comment is needed about the potential influence of trade on the actions of the Middle Eastern countries. For the "state traders"--the Soviet Union and most of the Middle Eastern countries--it is more directly apparent how the offering of trade deals could influence the behavior of the governments. For the non-state traders, however, we must make another assumption: that trade influences the behavior of governments through their desire for preferential tariffs, markets, credit terms, etc.

An additional data problem is that much of the data on Soviet aid, both economic and military, is not available. One can only use the data that are available, and use them with the understanding that they represent only a part of the whole of Soviet and American economic and military assistance to the Middle Eastern countries. In using these indicators of Soviet and American inputs, however, and making inferences about the relationships of these indicators to Middle East military expenditures, it is important to articulate the underlying assumptions. One such major assumption, then, is that these commonly known assistances are like the tip of an iceberg: they represent only a fraction of the whole which is submerged beneath the surface and invisible to the observer. It is assumed, however, that the proportion that is visible above the surface is a constant proportion of the total amount over the years. In making this assumption, we still must remain cautious in the kind of inferences we draw from using these quantitative indicators.

The Arab-Israeli Arms Race: Action and Reaction

A pattern of action and reaction in arms spending by Israel and the Arab countries can be clearly demonstrated, and will be shown before the effects of Soviet or American actions on it are

analyzed.

Using annual data from 1948 through 1964² on arms expenditures by Israel, Egypt, Syria, Lebanon, Jordan, and Iraq, expressed in U.S. dollars at 1960 prices and 1960 exchange-rates, one can note an obvious upward trend for each country. Safran has described these trends in great detail, and I shall not repeat that description here.³

When one looks beyond the trend for each country to the relationship between Israeli military expenditures and the military expenditures of each of the above named Arab countries, one finds a very strong relationship. These relationships expressed as product moment correlations are shown in Table I.

TABLE I
CORRELATIONS BETWEEN LEVELS OF
ISRAELI AND ARAB MILITARY EXPENDITURES^t
1948-1964

Israeli Military Expenditures _t	Egypt	Syria	Lebanon	Jordan	Iraq
	0.89	0.93	0.90	0.84	0.95

Safran used data representing a variable he named "real defense expenditures." The product moment correlations, however, between "real defense expenditures" and the military expenditure data used in this study for 1948-1964 are as follows: Israel, .95; Egypt, .95; Syria, .97; Jordan, .99; and Iraq, .99.

The correlations between the military expenditures of each Arab country and Israel within the same year are very high. The time lagged correlations between Israel's military expenditures one year and the Arab countries' the previous year, or the Arab countries' one year and the Israeli expenditures the previous year for the years 1949-1964, are not very different from the correlations between the military expenditures within the same year. These lagged correlation coefficients are listed in Table II.

Table II about here

These very high correlations indicate that each Arab country and Israel changed their military spending in the same direction year by year. It is most unlikely, however, that each of these antagonists perceived a military procurement by its opponent, evaluated it, decided what to procure to counter it, and then spent the money for the counter-capability all within the same year. It is more likely that political and military leaders were each year responding in their military spending to common tensions induced by armed hostilities--past, present, and anticipated for the future. Thus, there statistical correlations will not allow one to determine which side "caused" the Arab-Israeli arms race. Influence between Arabs and Israel were mutual and concurrent.

Because of the concurrent influence by the Arabs and Israel on each other's military spending, the use of simple least-squares statistical techniques would result in equations with computed estimates of the parameters representing the amount of change in one country's military expenditures per unit of change in its enemy's military expenditures that would have serially correlated error terms. The error terms would not be independent of the explanatory variables in regression equations of the following form:

$$\hat{\text{Israeli Military Expenditures}}_t = a_1 + b_1 \text{ Egyptian Mil. Exp.}_t + u_1$$

$$\hat{\text{Egyptian Military Expenditures}}_t = a_2 + b_2 \text{ Israeli Mil. Exp.}_t + u_2$$

Since these conditions violate the assumptions of the general linear regression model, these parameters are not estimated here. That task remains for further research.

U.S. and U.S.S.R. Influences

If the underlying conflict issues and hostilities between the Arabs and Israelis were considered the cause of the trends in

military expenditures by Israel and each of the Arab countries, one can control for the trend in each country's military spending, and then estimate the exogenous effects of different U.S. and Soviet actions on the Arab-Israeli arms race. A form of multiple regression equation expressing this is:

$$\hat{\text{Country}}_i \text{ Mil. Exp.}_t = a_1 + b_1 \text{Country}_i \text{ Mil. Exp.}_{t-1} + b_2 \text{Superpower Action}_t + U$$

Including the country's military expenditures from the previous year explicitly controls for the overall trend in expenditures.⁴ The separate effect of actions by the U.S. or the U.S.S.R. can then be estimated. If one does not control for a country's past expenditures, and merely correlates present military expenditures with actions of the U.S. or U.S.S.R., one achieves a high but spurious correlation. The correlation between any two generally increasing series of data will be high, whether or not there is any substantive connection between them.

This multivariate statistical technique can be used to make estimates of the effects of certain U.S. or U.S.S.R. actions toward each of the Middle Eastern countries and to evaluate the strength and consistency of such effects. The large scale aggregated actions to be considered here include the annual amounts of U.S. economic aid, U.S. military aid, U.S. Public Law 480 aid (primarily agricultural products), the proportion of a country's imports coming from the U.S. ("U.S. Export Ratio"), each country's "special" imports⁵ for the U.S., the proportion of a country's imports coming from the U.S.S.R. ("U.S.S.R. Export Ratio"), each country's special imports from the U.S.S.R., the amount of payments U.S. oil companies make to Iraq, and U.S.S.R. economic aid and military aid to Egypt. Empirical data are available for this analysis from 1948 to 1964 except where noted otherwise.

The variables were chosen partly to use what is already known about patterns of interaction in the Middle East from other systematic studies. Pearson has theorized about different subsystems of interaction in the Middle East, including an aid dimension (in which empirically the great powers are prominent), a trade and routine diplomacy dimension, a political conflict dimension (in which empirically the great powers are not prominent), and a dimen-

sion of policy approval or disapproval.⁶ Building on Pearson's work, it is generally hypothesized in this study that if the U.S. and U.S.S.R. have had a systematic influence on the Arab-Israeli arms race, it would have been exercised through large-scale actions such as military aid, economic aid, and trade.

Table III presents the regression analyses for each country's military expenditures first as a function only of its previous year's military expenditures (to demonstrate how strong the habitual pattern of spending in each nation is and to represent the underlying trend in each country's military expenditures), and then as a function of both the previous year's military expenditures and the U.S. or Soviet action for the same year as the military expenditures. In this table one can use the F Ratio of mean squares due to the linear regression divided by the mean squares due to error and deviations or the multiple correlation coefficient R (squared) to determine how well the independent variables in the equation explain the variance in the dependent variable of military expenditures. The product moment correlation coefficient r between

independent variables is given to show the amount of multicollinearity present. The regression coefficient b indicates the change in the military expenditures for a country (in millions of U.S. dollars) for each unit of change in the dependent variable (e.g., per million U.S. dollars of economic aid) while controlling for the other independent variables in the equation.

The standard error of the regression coefficient (SE) is given in Table III so that comparisons can be made with the regression coefficient. With such a comparison, one can evaluate the explanatory power of that variable. The t ratios of the value of a regression coefficient to its standard error are not given because the coefficients were not derived from a random sample, and because the main determinant of a statistical significance level is the sample size. Calculating a precise probability of observing a sample t ratio at least as high as that observed, if the true t ratio were zero --

the statistical significance level -- is thus uninformative since we know that the probability is close to zero and precise computation of it would not yield any important information. As a common bench mark, an asterisk is noted in the table next to a regression coefficient when its t ratio is greater than 2.1. This will be the criterion used in evaluating the influence of variables representing U.S. and Soviet actions on the Arab-Israeli arms race.

One should note that the statistical analysis here emphasizes single equation regression. Thus, correlations among dependent variables (each country's military expenditures) are not a serious problem, for independent variables exogenous to the Middle East are also included. Moreover, the basic assumption of each of these regression equations should be understood: they indicate what the effects of the independent variables on each dependent variable would be if these independent variables were the only factors affecting each dependent variable.

Another non-statistical criterion of the importance of an explanatory variable should also be noted: the dollar cost/effectiveness of various U.S. or U.S.S.R. actions. For example, where the regression coefficient has a relatively small standard error, one can compare the cost to the United States of effecting a decrease of a million dollars in military expenditures in one of the Middle Eastern countries by giving economic aid as against military aid to that country.

Findings and Implications

Israeli military expenditures appear to be affected only by U.S. economic aid; i.e., Israeli military expenditures have decreased about \$440 thousand per million dollar increase in U.S. economic aid when controlling for previous Israeli military expenditures. These Israeli military expenditures appear to be independent of the other U.S. or Soviet actions entered in Table III.

Egyptian military expenditures appear to be increased by U.S. economic aid (about \$400 thousand per million U.S. dollars in economic aid); Public Law 480 aid (about \$730 thousand per million U.S. dollars of PL 480 aid); by the percentage of Egypt's imports that come from the U.S. (about \$800 thousand for each additional one per cent); and by special imports from the U.S. (about \$850 thousand per million dollars of special imports). In addition, Soviet military aid to Egypt increases Egyptian military expenditures (about \$1.07 million per million dollars of Soviet military aid). Other Soviet or American actions entered into Table III do not seem to influence Egyptian military expenditures systematically.

Lebanese military expenditures are increased by special imports from the U.S. (about \$50 thousand per million dollars of special imports), by the percentage of its imports coming from the Soviet Union (about \$7.07 million for each hundredth of one per cent), and by the amount of imports coming from the U.S.S.R (about \$690 thousand per million dollars of imports). The other U.S. actions listed in Table III do not appear to be systematically related to Lebanese military expenditures.

Jordanian military expenditures are increased by U.S. military aid (about \$840 thousand per million dollars of U.S. military aid).

Other Soviet or U.S. actions entered in Table III do not appear to influence Jordanian military expenditures systematically.

Iraqi and Syrian military expenditures do not appear to be systematically related to any of the U.S. or Soviet actions entered in Table III.

The implications of these findings are, in terms of the variables examined, that United States and the Soviet Union have had some limited influence on the military expenditures of Israel, Egypt, Lebanon and Jordan, but not Iraq or Syria, during the years 1948-1964.⁸

If Soviet military aid to Egypt were not an important operative factor, these findings indicate that the U.S. apparently would have been able to decrease Egyptian military expenditures somewhat by reducing economic aid and exports to Egypt. The Soviets could also reduce Egyptian military expenditures by reducing their military aid to Egypt. The fact is, however, that the Soviets have been increasing their military aid to Egypt since 1955, and this has tended to override any dampening effect of U.S. actions.

U.S. military aid has apparently influenced Jordanian military spending, and that spending could be decreased if the U.S. decreased that aid.

In summary, while there are some Soviet and American actions that have influenced the Arab-Israeli arms race, that influence is limited in the number of countries affected, the actions of the U.S. and U.S.S.R. that are effective, and the magnitude of the effects. Theoretically, as a subsystem of the international system, the Arab-Israeli arms race appears to have a great degree of autonomy only somewhat influenced by the penetration of the outside superpowers. One might thus infer that the Arab-Israeli conflict is so deeply rooted that the parties to it would seek arms from other sources than the U.S. and U.S.S.R. if the superpowers did not supply them; indeed, the Arabs and Israelis have been supplied by other powers since 1948. Another plausible hypothesis (untested here) is that the amount and intensity of armed violence in preceding periods is positively related to arms spending. This analysis suggests that the U.S. and U.S.S.R. can help their clients match their enemy's increases, but only a little in reducing their

clients' military spending, if the U.S. or the U.S.S.R. were so inclined to do the latter.

What else, then, is driving the Arab-Israeli arms race besides the action of the superpowers? Already discussed is the intense hostility and violence of the Arab-Israeli conflict itself, which impels all the actors to acquire more arms in the vain hope of buying more security, but which instead increases threat and tension.

All parties are similarly motivated and respond similarly. Two other impulses behind Arab and Israeli arms spending must be explored: internal pressures in each country and inter-Arab conflicts.

Internal Pressures

The relationship between domestic conditions and international politics and conflict has been discussed by many theorists and practitioners.⁹ In the past four years North Choucri¹⁰ along with Lagerstrom¹¹ and their associates have articulated, operationalized, and tested a theory explicating this relationship in terms of the combination of differential rates of growth in three theoretically fundamental factors: population, technology and resources. A somewhat altered model that is derived from North and Choucri's theoretical work and uses the same three conceptual variables is proposed here.

The faster the growth of the population and technology of a country relative to the growth of the resource base that can satisfy the needs and desires of those people (e.g., goods) and machines (e.g., raw materials, etc.), the more internal pressure generated in that country to expand the activities of that state beyond its own boundaries, either to acquire new resources or to spread out the population. I am hypothesizing that part of this pressure will be demands for strengthening the military capabilities of that country as a means of achieving threat of coercion the desired expansion, to defend what ever expansion has occurred, or to defend the home population and resources from potential attempts at expansion by other countries similarly pressured. Thus, one would expect to see increased military expenditures as this internal pressure increased.

Since a basic part of the Arab-Israeli conflict is concerned with which people should have a given territory, it is probable that each side sees the other as expansionist (e.g., some Arabs talk of driving the Israelis into the sea; Israel holds onto conquered territories). Thus, this pressure-expansion model may be valid if for no other reason that each side in the Arab-Israeli conflict strengthens its own armed capabilities in response to the assumed expansionism of the other side. Increased military spending by one side leads to additional military expenditures by the other side, and assumed expansionism thus becomes a self-fulfilling prophecy in its effect on the Arab-Israeli arms race.

To test this theory in this study, internal pressure is conceptualized as $\left(\frac{\text{Population X Technology}}{\text{Resources}} \right)$. Technology is operationalized as energy consumption, and resources are operationalized as Gross National Product plus economic aid received from the U.S., U.S.S.R., and international organizations. Thus, internal pressure = $\left(\frac{\text{Population X Energy Consumption}}{\text{GNP + Economic Aid received}} \right)$.

It should be noted that this particular operationalization of the theoretical model raises some problems. The particular operational indicators were partially dictated by data availability. However, by using energy consumption as an indicator of "technology," and Gross National Product (plus aid received) as an indicator of the "resources" of a country, it is possible that the expression for "internal pressure" would reduce to $\left(\frac{\text{Population}}{\text{Economic Aid/GNP}} \right)$ if energy consumption were so highly correlated with GNP as to be its equivalent (or multiplied by some constant). Thus, in this expression, internal pressure is seen as primarily a function of population modified only by economic aid received relative to GNP. The resulting emphasis on population growth as being the primary factor generating internal pressures is consistent with North's theory and some of the ideas of the population biologist which North has incorporated into his theory of pressure and expansion.¹²

Table IV presents the results of the regression analysis for Israel, Egypt, Syria, Lebanon and Iraq, covering the years for which data were available.¹³ Table IV includes both levels and annual changes in the level (Δ) of internal pressure and military expenditures. The regression analyses indicate that when controlling

for the change in internal pressure, the level of internal pressure appears to be an important factor influencing the level of military expenditures in Israel, Egypt, and Syria. In Lebanon the change in internal pressure appears to be an important influence on the level of military expenditures when controlling for the level of internal pressure. In Iraq, neither level nor change in internal pressure appear important. Only in Lebanon does the level or change in internal pressure appear to affect the change in military expenditures.

Table IV about here

To test whether internal pressure remains a significant determinant of the level of military expenditures when other factors of previously demonstrated importance--such as previous military expenditures and certain U.S. and U.S.S.R. actions--are taken into account at the same time, further regression analyses have been made of more complicated models for each of the countries listed in Table IV. The results of these analyses appear in Table V

Table V about here

The results of these regression analyses are ambiguous because of the confounding problem of high multicollinearity in these combined models.

One cannot really control one variable by keeping it at a given level while varying another variable with which it is highly correlated, since if they are highly correlated, one must vary with the other. It is simply the case that as operationalized here, internal pressure is highly correlated with the other variables of interest, such as some actions of the U.S. and U.S.S.R. Thus, these regression analyses will not allow one to conclude that the internal pressure theory is falsified. Internal pressure appears to be associated with other actions all of which are part of a more comprehensive process that affects military expenditures.

Inter-Arab Conflict

Another possible contributing factor to the military spending in each Arab country are actual or potential conflicts among the Arab countries themselves. Safran¹⁴ states that Egypt's pan-Arab ambitions lead Syria, Jordan, Iraq and Saudi Arabia to strengthen their armed forces, although because of resource differences and geographic factors this competition does not actually constitute an arms race. The main purpose is to deter potential domestic rebels who might be encouraged by Egypt. Moreover, Safran also notes that there is sporadic mutual stimulation to increase military capacity among Iraq, Syria and Jordan.

Since the same kind of concurrent mutual influence is operative among these Arab states as between each of them and Israel, one cannot calculate the parameters representing reactivity of one Arab country to another using simple least squares procedures because, again, the error terms would not be independent of the explanatory variables. Therefore, although not tested statistically in this research, one might hypothesize inter-Arab conflict as a potential additional factor influencing the military expenditures of the Arab countries. This problem of mutual influence of arms expenditures between Israel and each Arab country, or among the Arab countries, will have to be approached in future statistical research using methods of simultaneous equation estimation.

Conclusion

This research has indicated that the Arab-Israeli arms race is primarily a representation of the basic ongoing pattern of hostile conflict in which each side concurrently influences the other to change its military expenditures. An inference, then, is that until the basic conflict issues underlying the arms race are resolved--including acceptance of the existence of the State of Israel and some satisfactory settlement for the Palestinian Arabs--and the continuing violence spawned by these conflict issues is stopped, the Arab-Israeli arms race will persist.

Finally, this research has demonstrated that the U.S. and U.S.S.R. have had during the 1948-1964 time period but limited influence on the military spending of the parties to this regional conflict, at least as measured by economic aid, military aid, and

trade.

It is possible, but not tested here for lack of data, that the superpowers have had some political influence over the Arabs and Israelis at some discrete points in time, such as when a particular arms deal was being negotiated. Idiosyncratic influence of this sort, however, would be a different phenomenon than the continuous influence being investigated here. Nonetheless, there do appear to be some large-scale actions of the U.S. and U.S.S.R. toward these Middle Eastern countries that affect the arms spending of at least some of them, including Soviet military aid to Egypt. If leaders of the U.S. and U.S.S.R. are concerned about being drawn into armed conflict with each other through their support of opposing parties to the Arab-Israeli conflict, then they would be well-advised to study which of their actions has the effect of escalating the arms race, which of their actions serves to reduce Arab and Israeli military spending, and adjust their military aid, economic aid, and trade policies so as to help reduce the arms race in the Middle East.

It is in the self-interest of both the U.S. and the U.S.S.R. to try to minimize the Arab-Israeli arms race rather than exacerbate it, for tensions arising over concern about relative military capabilities can lead to large-scale violence between Arabs and Israelis. The danger of unintended involvement and confrontation between Americans and Soviets in such violence is real.

Finally, the Arab-Israeli conflict is generated and maintained by conditions and antagonisms largely beyond the control of the superpowers. The influence of the U.S. and U.S.S.R. on the Arab-Israeli arms race has been found to be limited. If the leaders of the U.S. and U.S.S.R. are unaware of how limited their control over this aspect of the Arab-Israeli conflict actually is, they risk an involvement in that conflict that could unintendedly lead to World War III. The risk is not negligible. There is a precedent of big powers becoming entangled in an initially regional conflict-- World War I.

FOOTNOTES

1. Michael Brecher, "The Middle East Subordinate System and Its Impact on Israel's Foreign Policy," International Studies Quarterly, 13, 2 (June, 1969), pp. 117-139.
2. Data were complete for all variables considered in this study only through 1964. Hence the statistical analysis and generalizations reported here strictly apply just to this period. The reader may judge from other evidence or later data how much the relationships reported hold for more recent years.
3. Nadav Safran, From War to War. (New York: Western Publishing Co., 1969.)
4. Controlling for past expenditures when estimating current expenditures is equivalent to estimating the yearly rate of change in expenditures if the regression coefficients of the past expenditures are equal to one.
I.e., where, $Y_t = a + b_1 Y_{t-1} + b_2 X_t + u$,
then, $(Y_t - b_1 Y_{t-1}) = a + b_2 X_t + u$;
when $b_1 = 1$,
then $\Delta Y = (Y_t - Y_{t-1}) = a + b_2 X_t + u$.
It will be noted in the following tables that the estimated value of the regression coefficient of past values of military expenditures is often close to 1.
5. See Appendix for definition of "special" trade.
6. Frederick Pearson, "Interaction in an International Political Subsystem: The 'Middle East', 1963-64," Peace Research Society (International) Papers, XV (1971). (This issue).
7. R. L. Friedheim and J.B. Kadane, "Quantitative Content Analysis of the United Nations Seabed Debates: Methodology and a Continental Shelf Case Study," International Organization, XXIV, 3 (1970), pp. 489-490.
8. It should be noted that Israel and Jordan have paid for most of the military goods they have received from the U.S., and this variable of purchases through long-term credit arrangements has not been included in the analysis for lack of data. This variable might be shown to influence Israeli and

Jordanian arms spending.

9. Quincy Wright, The Study of International Relations (New York: Appleton-Century-Crofts, Inc., 1955).
10. Nazli Choucri and Robert C. North, "The Determinants of International Violence," Peace Research Society (International) Papers, Vol. XII, 1969, pp. 35-37.
_____, "Pressure, Competition, Tension, Threat: Toward a Theory of International Conflict." (Stanford, Calif., September, 1969). (Mimeographed)
_____, "Aspects of International Conflict: Military Preparedness, Alliance, Commitments and External Violence." (Stanford, California, April, 1969). (Dittoed)
Robert C. North, "Steps Toward Developing a Theory (Second Revision)." (Stanford, California, April 24, 1967). (Dittoed)
11. Richard P. Lagerstron, "An Anticipated Gap, Mathematical Model of International Dynamics." (Stanford, California, February 8, 1968). (Dittoed)
12. Paul Ehrlich, The Population Bomb. (New York: Ballantine Books, 1968).
13. Jordan was omitted from analysis because all pertinent data were not available.
14. Safran, Ibid., pp. 247-248.

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- Brecher, Michael. "The Middle East Subordinate System and Its Impact on Israel's Foreign Policy," International Studies Quarterly, 13, 2 (June, 1969), pp. 117-139.
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APPENDIX

DATA SOURCES

Real Defense Expenditures

Source: Safran, Nadav, From War to War, The Arab-Israeli Confrontation, 1948-1967. (New York: Pegasus, 1969). Appendix A, Table A, p. 433.

Explanation: "Real Defense expenditures are the sum of all resources going to defense after price variations have been eliminated." (Safran, p. 199)

Years:

Egypt (UAR)	1951-1964
Iraq	1953-1964
Israel	1951-1964
Jordan	1953-1964
Syria	1953-1964

Military Expenditures

Source: Stockholm International Peace Research Institute, SIPRI Yearbook of World Armaments and Disarmament, 1968/69. (New York: Humanities Press, 1970).

Explanation: Expenditures expressed in millions of U.S. dollars at 1960 prices and 1960 exchange rates.

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	" "
Jordan	" "
Lebanon	" "
Syria	" "

U.S. Economic Aid

Source: U.S. House of Representatives Foreign Affairs Committee, U.S. Overseas Loans and Grants, 1966. U.S. House of Representatives Appropriations Committee, 1964-1968.

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	" "
Jordan	" "
Lebanon	" "

U.S. Military Aid

Source: U.S. House of Representatives Appropriations Committee, Overseas Loans and Grants, 1964

Explanation: Approximate value of equipment and training provided.

Years:

Israel	1948-1964
Jordan	1948-1964

Public Law 480 Aid

Source: U.S. House of Representatives Appropriations Committee, U.S. Overseas Loans and Grants, 1964.

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	1952-1964
Jordan	" "
Lebanon	1948-1964
Syria	1952-1964

Payments of Oil Companies

Source: Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of International Trade Statistics. (New York: United Nations).

Years:

Saudi Arabia	1955-1964
Iraq	" "

Soviet Economic Loans to Egypt (UAR)

Source: United States Congress Joint Economic Hearings. Muller, Jurt, The Foreign Aid Programs of the Soviet Bloc and Communist China. (New York: Walker, 1967).

Years:

1948-1964

DATA SOURCES (continued)

Special Imports from U.S.

Source: Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of International Trade Statistics. (New York: United Nations).

Explanation: Special Trade: "Special imports are the combined total of imports directly for domestic consumption (including transformation and repair) and withdrawals from bonded warehouses or free zones for domestic consumption. Special exports comprise exports of national merchandise, namely, goods wholly or partly produced or manufactured in the country, together with exports of nationalized goods. (Nationalized goods are goods which, having been included in special imports, are then exported without transformation.)"

General Trade: "General imports are the combined total of imports directly for domestic consumption and imports into bonded warehouse or free zone. General exports are the combined total of national exports and re-exports. Re-exports, in the general trade system, consist of the outward movement of nationalized goods plus goods which, after importation, move outward from bonded warehouse or free zone without having been transformed." (Yearbook of International Trade Statistics, 1966, p.6)

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	" "
Jordan	" "
Lebanon	1950-1964
Syria	" "

Special Imports from USSR

Source: Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of International Trade Statistics. (New York: United Nations).

Explanation: Same as Special Imports from U.S.

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	1949-1964
Lebanon	1950-1964
Syria	" "

DATA SOURCES (continued)

USSR Export Ratio

Source: Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of International Trade Statistics. (New York: United Nations).

Explanation: Exports to Country A
Country A's Total Imports

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	" "
Lebanon	" "
Syria	" "

U.S. Export Ratio

Source: Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of International Trade Statistics. (New York: United Nations).

Explanation: Exports to Country A
Country A's Total Imports

Years:

Egypt (UAR)	1948-1964
Iraq	" "
Israel	" "
Jordan	" "
Lebanon	" "
Syria	" "

Internal Pressure

Source: Hurwitz, Jacob Coleman, Middle East Politics, The Military Dimensions. (New York: for Council on Foreign Relations by F.A. Praeger, 1969).
Department of Economic and Social Affairs, Statistical Office of the United Nations, Yearbook of International Trade Statistics. (New York: United Nations)

Explanation: Population, Energy Consumption, Gross National Product and Aid (U.S., U.S.S.R., and International Organizations).

$$\left(\frac{\text{Population} \times \text{Energy Consumption}}{\text{GNP} + \text{Aid Received}} \right)$$

Years:

Egypt (UAR)	1952-1964
Iraq	1953-1964
Israel	" "
Lebanon	1957-1964
Syria	1953-1964

TABLE II

NOT REPRODUCIBLE

ARAB ISRAELI MILITARY EXPENDITURES
1949-1964

Bivariate Correlation Coefficients

		<u>Egypt_t</u>	<u>Iraq_t</u>	<u>Jordan_t</u>	<u>Lebanon_t</u>	<u>Syria_t</u>	<u>Sum of Arabs_t</u>
1948-64							
Israel _t	r	.89	.95	.84	.90	.93	.93
		<u>Egypt_{t-1}</u>	<u>Iraq_{t-1}</u>	<u>Jordan_{t-1}</u>	<u>Leb._{t-1}</u>	<u>Syria_{t-1}</u>	<u>Sum of Arabs_{t-1}</u>
1949-64							
Israel _t	r	.89	.94	.84	.92	.93	.94
		<u>Egypt_t</u>	<u>Iraq_t</u>	<u>Jordan_t</u>	<u>Lebanon_t</u>	<u>Syria_t</u>	<u>Sum of Arabs_t</u>
1949-64							
Israel _{t-1}	r	.82	.94	.87	.87	.92	.94

TABLE III
MILITARY EXPENDITURES_t

		Israel	Egypt	Syria	Lebanon	Jordan	Iraq
Country i Mil.Exp. _{t-1}	F	390.86	99.27	76.13	88.27	249.41	808.06
	R	0.97	0.93	0.92	0.93	0.97	0.99
	b	1.15 ^a	0.98 ^a	0.96 ^a	0.91 ^a	0.87 ^a	1.08 ^a
	(SE)	(.308)	(.10)	(.11)	(.10)	(.06)	(.04)
U.S.Econ. Aid _t	F	156.97	72.93		44.61	149.44	450.99
	R	0.98	0.96		0.93	0.98	1.00
	r	.29	0.67		.12	.38	.49
	b	-0.44 ^a	0.40 ^a		-.10	0.15	0.63
	(SE)	(.016)	(.15)		(.10)	(.08)	(.038)
Country i Mil.Exp. _{t-1}	b	1.31 ^a	0.77 ^a		0.92 ^a	0.69 ^a	1.03
	(SE)	(.07)	(.11)		(.10)	(.08)	(.04)
U.S.Mil. Aid _t	F	123.42				124.31	
	R	0.97				0.97	
	r	.63				0.57	
	b	04.97				0.84*	
	(SE)	(50.25)				(.07)	
Country i Mil.Exp. _{t-1}	b	1.03 ^a				0.41	
	(SE)	(.10)				(.044)	
PL 480 Aid _t	F	103.71	73.4 ^a	35.33	41.32	125.32	467.86
	R	0.97	0.96	0.92	0.93	0.97	0.98
	r	.60	0.74	.45	.17	.66	.50
	b	-0.47	0.73 ^a	-0.05	.00	0.20	1.09
	(SE)	(.030)	(.12)	(.083)	(.26)	(.020)	(.060)
Country i Mil.Exp. _{t-1}	b	1.32 ^a	0.51 ^a	0.97 ^a	0.98 ^a	0.82 ^a	1.04
	(SE)	(.070)	(.021)	(.015)	(.010)	(.07)	(.04)
U.S. Export Ratio _t	F	123.31	98.64	43.80	44.32	117.33	378.01
	R	0.97	0.95	0.94	0.93	0.97	0.99
	r	-.54	0.67	-.21	-.72	.73	-.03
	b	-221.63	0.60 ^a	-100.62	-2.06	7.99	-6.69
	(SE)	(200.30)	(.12)	(70.65)	(24.64)	(24.25)	(64.65)
Country i Mil.Exp. _{t-1}	b	1.03 ^a	0.24 ^a	0.92 ^a	0.96 ^a	0.85 ^a	1.03 ^a
	(SE)	(.07)	(.141)	(.011)	(.014)	(.08)	(.04)
Spec. Imports from US _t	F	107.04	57.95	35.30	96.61	116.96	378.01
	R	0.97	0.94	0.92	0.97	0.97	0.99
	r	.72	0.62	.64	.74	.83	.78
	b	0.12	0.85 ^a	-.04	.05 ^a	-0.15	.03
	(SE)	(.10)	(.12)	(.14)	(.01)	(.061)	(.059)
Country i Mil.Exp. _{t-1}	b	1.03 ^a	0.53	0.98 ^a	0.66 ^a	0.90 ^a	1.07 ^a
	(SE)	(.07)	(.031)	(.015)	(.010)	(.010)	(.06)

F Ratio = (Mean Squares linear regression / Error Squares error and deviations). NOT REPRODUCIBLE
R = Multiple correlation coefficient.
r = Product moment correlation between independent variables.
b = Regression coefficient of independent variable.
(SE) = Standard error of regression coefficient.
^a = ratio of regression coefficient to its standard error greater than 2.

Table III

Military Expenditures (continued)

		Israel	Egypt	Syria	Lebanon	Jordan	Iraq
USSR Export Ratio _t	F		49.27	35.17	50.65		388.47
	R		0.94	0.92	0.95		0.99
	r	-.38	.55	.78	.89		.81
	b		-223.15	-30.97	707.34*		73.71
	(SE)		(253.99)	(319.52)	(265.87)		(116.71)
Country i Mil.Exp. _{t-1}	b		1.03*	0.97*	0.44		1.05
	(SE)		(0.12)	(0.18)	(0.22)		(.067)
Spec. Imports from USSR _t	F	94.91	46.55	35.29	45.49		577.74
	R	0.97	0.93	0.92	0.94		0.99
	r	-.36	.75	.89	.89		.84
	b	9.59	-.02	0.12	0.69*		.09
	(SE)	(17.77)	(1.22)	(0.59)	(0.30)		(0.96)
Country i Mil.Exp. _{t-1}	b	1.21*	0.98*	0.91	0.50*		1.07*
	(SE)	(.09)	(0.15)	(0.24)	(0.22)		(.07)
Payment of Oil Cos. _t	F						93.37
	R						0.98
	r						.87
	b						0.26
	(SE)						(0.26)
Country i Mil.Exp. _{t-1}	b						0.97*
	(SE)						(0.17)
USSR Econ Aid _t	F		52.				
	R		0.94				
	r		.66				
	b		0.18				
	(SE)		(0.15)				
Country i Mil.Exp. _{t-1}	b		0.87*				
	(SE)		(0.13)				
USSR Mil. Aid _t	F		80.11				
	R		0.96				
	r		.90				
	b		1.07*				
	(SE)		(0.36)				
Country i Mil.Exp. _{t-1}	b		0.48*				
	(SE)		(0.18)				

F Ratio =

(Mean Squares linear regression

Mean Squares error and deviations)

R =

Multiple correlation coefficient.

r =

Product moment correlation between independent variables.

b =

Regression coefficient of independent variable.

(SE) =

Standard Error of regression coefficient.

* =

t ratio of regression coefficient to its standard error greater than 2.1.

TABLE IV

INTERNAL PRESSURE MODEL

Level of Military Expenditures of each country

		Israel	Egypt	Syria	Lebanon	Iraq
Country _i Pressure _t	F	20.04	12.70	18.77	115.75	2.93
	R	0.91	0.66	0.91	0.99	0.65
	r	0.45	0.36	0.50	0.91	-0.23
	b	126.95 ^a	4.59 ^a	157.25 ^a	-9.61	-11.31
	(SE)	(20.12)	(0.91)	(31.71)	(5.60)	(6.25)

Country _i Δ Pressure _t	b	-16.55	-4.35	0.01	338.20 ^a	0.06
	(SE)	(43.24)	(3.90)	(0.01)	(48.81)	(0.05)

Δ Military Expenditures of Each Country

		Israel	Egypt	Syria	Lebanon	Iraq
Country _i Pressure _t	F	0.86	0.63	0.40	3.82	0.27
	R	0.42	0.39	0.30	0.81	0.25
	r	0.45	0.36	0.50	0.91	-0.23
	b	15.06	0.84	-22.05	-51.10 ^a	-0.36
	(SE)	(12.32)	(0.68)	(36.05)	(20.61)	(1.70)

Country _i Δ Pressure _t	b	-2.75	-1.69	0.01	496.56 ^a	0.01
	(SE)	(26.49)	(2.23)	(0.10)	(179.68)	(0.11)

Years considered:

Israel	1954-64
Egypt	1953-64
Syria	1954-64
Lebanon	1950-64
Iraq	1954-64

NOT REPRODUCIBLE

Internal Pressure = $\frac{\text{Population} \times \text{Energy Consumption}}{\text{GNP} + \text{AED Received}}$

Ratio = $\frac{\text{Mean Squares linear regression}}{\text{Mean Squares error and deviations}}$

• Multiple correlation and coefficient

• Product moment correlation between independent variables.

• Regression coefficient of independent variables.

(SE) • Standard Error of regression coefficient.

• t ratio of regression coefficient to its standard error greater than 2.1.

TABLE V

U.S. AND U.S.S.R. ACTIONS WITH INTERNAL PRESSURE
AS DETERMINANTS OF MILITARY EXPENDITURES

Israel Military Expenditures_t, 1954-64

IV ₁ Isr. Mil. Exp. t-1	F	30.35		
	R	0.99		
	b	1.32 ^a		
	(SE)	(0.34)		
IV ₂ U.S. Econ. Aid _t	b	-0.66 ^a		
	(SE)	(0.35)		
IV ₃ Isr. Pressure _t	b	-12.57		
	(SE)	(36.02)		
	r	IV ₂	IV ₃	7 Degrees of Freedom
	IV ₁	0.14	0.97	
	IV ₂		0.27	

Egyptian Military Expenditures_t, 1953-64

IV ₁ Egy. Mil. Exp. t-1	F	34.56			
	R	0.93			
	b	0.47 ^a			
	(SE)	(0.22)			
IV ₂ USSR Mil. Aid to Egy. t	b	0.85 ^a			
	(SE)	(0.32)			
IV ₃ US Export Ratio _t	b	508.10 ^a			
	(SE)	(200.06)			
IV ₄ Egy. Pressure _t	b	-0.96			
	(SE)	(1.22)			
	r	IV ₂	IV ₃	IV ₄	NOT REPRODUCIBLE
	IV ₁	0.94	0.60	0.70	
	IV ₂		0.45	0.61	7 Degrees of Freedom
	IV ₃			0.99	

Domestic Pressure = $\left(\frac{\text{Population} \times \text{Energy Consumption}}{\text{GNP} + \text{Aid Received}} \right)$.

F Ratio = $\left(\frac{\text{Mean Squares linear regression}}{\text{Mean Squares error and deviations}} \right)$.

R = Multiple correlation and coefficient.

r = Product moment correlation between independent variables.

b = Regression coefficient of independent variables.

(SE) = Standard Error of regression coefficient.

t = ratio of regression coefficient to its standard error greater than 2.1.

Table V (continued)

Syrian Military Expenditures_t, 1953-64

IV ₁ Svr. Mil. Exp. _{t-1}	F	18.26
	R	0.91
	b	0.22
	(SE)	(0.44)

IV ₂ Syr. Pressure _t	b	128.82
	(SE)	(82.32)

r IV₁, IV₂ 0.94 8 Degrees of Freedom

Lebanese Military Expenditures_t, 1958-64

Leb. Mil. Exp. _{t-1}	F	2.65
	R	0.85
	b	-0.19
	(SE)	(0.62)

USSR Export Ratio _t	b	56.26
	(SE)	(742.48)

Leb. Pressure _t	b	35.22
	(SE)	(29.64)

<u>r</u>	IV ₂	IV ₃	3 Degrees of Freedom
IV ₁	0.54	0.85	
IV ₂		0.78	

Iraqi Military Expenditures_t, 1954-64

IV ₁ Iraqi Mil. Exp. _{t-1}	F	125.00
	R	0.98
	b	1.17*
	(SE)	(0.09)

IV ₂ Iraqi Pressure _t	b	1.49	9 Degrees of Freedom
	(SE)	(1.80)	

r IV₁, IV₂ -0.62

ERRATA

Pages should read:

p. 3, line 29: "...Israel..."

p. 4, line 4: "...oil), and maintain..."

p. 5, line 9: delete "violent behavior"; insert "military spending."

line 17: "... has also seen..." delete "to"

p.15, line 7: "... that the United States ..."

p.16, line 15: "... North and Choucri .. "

line 21: "... and that uses ..."

line 31: "... achieving by threat or coercion ..."

line 32: "... defend whatever expansion ..."

p.17, line:16: "Internal Pressure"

p.18: No new paragraph at bottom. "... combined models.

One cannot ..."

p.21, Friedheim and Kadane page reference: pp. 489-490.