ON THE DYNAMICS OF THE ISRAELI-ARAB ARMS RACE

Aamer S. Abu-Qarn and
Suleiman Abu-Bader

Discussion Paper No. 08-09

June 2008

Monaster Center for
Economic Research
Ben-Gurion University of the Negev
P.O. Box 653
Beer Sheva, Israel

Fax: 972-8-6472941
Tel: 972-8-6472286

On the Dynamics of the Israeli-Arab Arms Race

Aamer S. Abu-Qarn* **and Suleiman Abu-Bader**
Ben-Gurion University of the Negev

Abstract

This paper investigates the causal relationships between the military expenditures and military burden of the four major sides of the Israeli-Arab conflict, namely, Egypt, Israel, Jordan and Syria over the period 1960-2004. We utilize both the causality test suggested by Toda and Yamamoto (1995) and the generalized forecast error variance decomposition method of Pesaran and Shin (1998). Our findings suggest weak causality that runs usually from Israel's to Arab's military spending. The strongest links are between Israel and Syria that are still in a state of enmity. No causality was detected between Israel's and Jordan's military spending.

Keywords: Arms race, Middle East, Israeli-Arab conflict, Causality, Generalized Forecast Error Variance Decomposition
JEL Classification: H56, D74, O53

* Corresponding author: Aamer S. Abu-Qarn, Economics Department, Ben-Gurion University, P.O. Box 653, Beer-Sheva, 84105, Israel. Phone: +972-8-6472296, Fax: +972-8-6472941, Email: aamer@bgu.ac.il.

We are indebted to participants at the 2008 Eastern Economic Association Conference and the 2008 International Conference of the Middle East Economic Association for their valuable comments and suggestions. All the remaining errors are ours.

1. Introduction

The Israeli-Arab conflict has been one of the longest conflicts that involved either directly or indirectly not only Israel and its neighboring Arab countries but also the major super powers who acted to maintain their presence and influence in the oil-rich region. The intensity of this international battle field is reflected, at least partially, in the hefty portions of the limited resources of Israel, Egypt, Jordan and Syria that were devoted to military expenditures and accumulation of weapons. Graph 1 demonstrates the exceptionally high military burdens, measured as the shares of military expenditures in GDP, of these countries over the period 1960-2004. For example, Egypt's military burden exceeded 50% in the mid-70s while Israel's topped 20%. Although the 90s, following the initiation of peace talks, have witnessed a drastic decline to levels below 10% for all countries, these levels of military burden remained very high in international standards. In light of the frequent confrontations and the hefty military budgets, many studies have indicated that that Israel and its Arab neighbors are engaged in an arms race.

A typical examination of the existence of arms race is based on the Richardson (1960) model in which the military expenditure, arsenal of weapons, and military personnel of one country change in response to those of the rival country. Thus, the dynamics of military expenditures are shaped by an action-reaction framework. Understanding these patterns of action-reaction among likely rivals is critical in our global world. A country or an international institution that provides foreign aid to a country that is involved in arms race may fuel conflicts by leading to a rise not only in the military expenditures of that country but also in the military expenditures of its rivals. Realizing that the grantee country is involved in an arms race, the granting bodies may restrict the use of their funds to growth-enhancing civilian uses, require

compliance to arms control agreements, and exercise political and economic pressures to try to cease the hostile operations instead of fueling conflict.[1]

Arms races are often examined using Granger causality tests that have been shown to have non-standard asymptotic properties if the variables are integrated or cointegrated.[2] Moreover, the need for pretests for unit roots and cointegration and the inapplicability when the variables have different orders of integration further add to the distortions associated with Granger causality from within VAR or vector error correction (VEC) settings. Examples of using the traditional Granger causality to assess the existence of arms races include, but not limited to, Kollias and Makrydakis (1997), Dunne et al. (2005), and Yildirim and Ocal (2006). Only few studies have addressed the existence and the dynamics of the Israeli-Arab arms race. These include Linden (1991), Chen et al. (1996), Seiglie and Liu (2002), and Sprecher and DeRouen (2002). A brief review of their findings follows in section 3.

In this paper we reassess the dynamics of the Israeli-Arab conflict focusing mainly on whether an arms race exists between Israel and its major adversaries, namely, Egypt, Jordan and Syria.[3] Unlike other studies that have used the traditional Granger causality test or causality from within a VEC, we utilize a causality procedure suggested by Toda and Yamamoto (1995). Their procedure requires the estimation of an augmented VAR that guarantees the asymptotic distribution of the Wald statistic. Also, the procedure does not require pre-testing for integration

[1] Kinsella (1994) and others found that American aid to Israel has contributed to its economy and decreased the likelihood of military intervention in the region. No such evidence was found for the Soviet aid to Arab countries. Moreover, the U.S. provided foreign aid to Egypt after signing the peace treaty with Israel in 1979.

[2] Earlier studies examined arms races in the context of the determinants of military expenditures by including the military expenditures of the adversaries as exogenous explanatory variables. Simultaneous equations were used in more recent studies to allow for simultaneous action-reaction patterns.

[3] Due to lack of data we do not examine Iran, Lebanon, and Saudi Arabia as well as Hamas and Hezbollah.

or cointegration properties of the VAR system, and thus avoids the potential biases of pre-testing.

We conduct our causality analysis using two specifications; first, causality in a bivariate VAR system in which we examine causality between Israel's military measures and each of the Arab countries measures separately; second, causality in a quadvariate VAR system in which the military measures of the four countries are present in the system. This specification allows for possible complementary relationships as well as "free riding" among the military measures of the Arab countries that face a common Israeli threat. Additionally, we construct an aggregate measure for the Arab military expenditure and military burden for the case that Israel reacts to the Arab bloc as a group rather than individually.[4]

To gauge the sensitivity of our results we incorporate the likely structural break dates as reported by Abu-Qarn and Abu-Bader (2008) in our causality analysis. Most of the previous studies failed to account for structural breaks when testing for arms races. Furthermore, we examine whether the dynamics of the Israeli-Arab conflict changed following the peace agreement between Egypt and Israel in 1979.

In addition to using the Toda and Yamamoto (1995), we examine the out-of-sample causality using the generalized forecast error variance decomposition method of Pesaran and Shin (1998). Unlike the traditional orthogonalized Cholesky method, this method does not require ordering of the variables in the VAR system, something that is often determined arbitrary given the absence of sound theoretical base.

The remaining of this article is organized as follows. Section 2 briefly describes the major events that shaped the Israeli-Arab conflict and their impact on accumulation of arms. A

[4] See Lebovic (2004) for evidence on Arab "unity in action" against Israel.

brief review of the few studies that addressed the existence and the dynamics of the conflict is provided in section 3. Section 4 lays out the econometric foundations of our empirical investigation. Description of our data and its sources are presented in section 5, followed by a discussion of the causality tests and FEVD results in section 6. Section 7 concludes.

2. The Israeli-Arab Conflict: A Timeline

Several wars and military actions took place in the region since the UN proposed its "Partition Plan" in 1947. The plan called for the establishment of two independent states for Arabs and Jews in Palestine. However, the Arabs rejected this plan and shortly after the withdrawal of the British mandate forces and the declaration of Israel they declared war on Israel. By the end of the "Independence War" or "Al-Nakba" (Arabic for the disaster), hundreds of thousands of Palestinians were expelled or fled their homes and Israel ended up controlling most of Palestine's land.

Following the nationalization of the Suez Canal by Egypt's president Nasser and the blockade of the Tiran Straits to Israeli shipping in 1956, Israel, backed by Britain and France, invaded and subsequently occupied Sinai and Gaza Strip. Soviet warnings of intervention on behalf of Egypt and American economic pressures forced the three parties to withdraw from the occupied lands by early March 1957. The hostile operations reached a peak in 1967 when in a massive and quick assault that lasted for six days, Israel succeeded in seizing Sinai and Gaza Strip from Egypt, the West Bank from Jordan and the Golan Heights from Syria.

On October 6, 1973 Israel was caught by surprise as the Egyptian and Syrian forces coordinated a joint attack and advanced beyond the cease-fire lines into Sinai and the Golan Heights and inflicted heavy casualties on the Israeli Army. Israel counter-attacked and drove the Egyptian and Syrian armies back and advanced deep into Egypt and Syria. A ceasefire ended the

war and paved the way for peace negotiations between Egypt and Israel that culminated in a peace treaty in 1979. According to this agreement, the state of war between the two countries was terminated; Israel pulled out its armed forces and civilians from Sinai; and normal diplomatic relations were established. This dramatic Egyptian move was confronted by a unified Arab front that objected to a separate peace treaty that neglected the Palestinian issue. Moreover, Egypt was suspended from the Arab League, and most Arab countries cut their diplomatic ties with Egypt.

Once the Israel-Egypt peace treaty was finalized, the focus shifted to the Palestinian issue. The articles in the treaty that called for the establishment of an autonomous self-governing authority in the West Bank and Gaza were never materialized. Palestinian forces were stationed in Southern Lebanon under the leadership of the Palestine Liberation Organization (PLO) and initiated attacks on Northern Israel. On June 1982, Israel attacked Palestinian targets in Southern Lebanon with the stated objective of driving PLO forces to the north. However, Israel extended its operations and bombed many Lebanese cities, including Beirut, as well as some Syrian military targets. After a long siege of Beirut, PLO forces were forced out of Lebanon and Israel withdrew from most of the Lebanese territories, however, maintained a “security zone” of approximately 10 miles north of the border that was eventually evacuated in 2000.

The growing frustration among Palestinians in the Occupied Territories over the status quo, their suffering under the occupation, and the lack of progress towards a permanent solution to their nationalistic claims led to many violent incidents and confrontations with the Israeli Army in late 1987. The *Intifada* (Arabic for popular uprising) that began in Gaza and spread to other cities and villages involved hundreds of thousands including children, teenagers and women. This popular resistance included not only stone throwing, burning tires, Molotov

cocktails and the erection of barricades but also massive demonstrations, general strikes, refusal to pay taxes, and boycotts of Israeli products. The Palestinian uprising continued, though to a lower intensity, until the signing of the Oslo Accords in 1993. In the midst of this period Israel suffered a massive missile attack by Iraq when the US backed by a wide international coalition drove Iraq out of Kuwait in 1991. The end of the Gulf War paved the way to direct negotiations between Israel and Arab countries (Egypt, Lebanon, Syria, and a joint Jordanian/Palestinian delegation that excluded the PLO due to Israel's objection) in Madrid in 1991 under the sponsorship of the US and USSR.

After several intensive rounds of negotiations, Israel and PLO signed the "Declaration of Principles On Interim Self-Government Arrangements" in Oslo on August 20, 1993. The Oslo Accords called for the withdrawal of Israel from parts of Gaza Strip and the West Bank and the establishment of the Palestinian Authority (a self-ruled entity that was extended later on to include more cities and villages in the West Bank) and negotiating for a permanent agreement that would begin no later than August 1996. After some progress was made in the Israeli-Palestinian channel, a peace treaty was signed between Israel and Jordan in 1994. Under the terms of the treaty, all the territorial and water disputes were resolved, and the relations between the two countries were normalized.

As the negotiations on a permanent agreement ended in a deadlock, another wave of hostile actions by Palestinians and Israelis erupted in 2000 (*Al-Aqsa Intifada*). In August 2005, despite fierce resistance of settlers, Israel unilaterally withdrew from Gaza Strip and some settlements in the West Bank. On the Lebanese front, following the kidnapping of two Israeli soldiers in Southern Lebanon by Hezbollah in July 2006, Israel raided Lebanon in what later called the Second Lebanon War.

Following a decisive victory for Hamas in the Palestinian Legislative Council elections in January 2007, a unity government headed by Ismail Haniyeh of Hamas was formed, however, Hamas and Fatah reached no agreement on the division of power and responsibilities. The disputes led to Hamas forces violently routing Fatah forces and seizing power in Gaza in June 2007. The Palestinian president Mahmoud Abbas dismissed the Hamas-controlled government and appointed an emergency government in the West Bank. The Hamas government continued to exercise a de facto authority in the Gaza Strip despite the fact that it received neither Arab nor international recognition.

3. Previous Studies

The likely Israeli-Arab arms race received negligible attention in the arms race literature, mainly due to lack of reliable data. The few studies, surveyed below, that examined the issue have conducted the analysis in the context of the determinants of military spending or using the traditional causality tests. Generally speaking, these studies mostly reveal a one-way arms race from Israeli to Arab military spending.

In an attempt to analyze the determinants of the Israeli military spending over the period 1960-1979, McGuire (1982, 1987) estimates a multi-equation model using Full Information Maximum Likelihood (FIML) method. The analysis reveals that the responsiveness of Israel to its Arab adversaries is very modest whereas Arab's responsiveness to changes in Israeli military spending is relatively high. Since McGuire’s studies were conducted on a very short period, their conclusions should be taken with a grain of salt. Furthermore, the detection of first order autocorrelations coefficients that are close to unity is rather problematic and renders their results questionable.

Another study that focused on Israel's determinants of military spending by Mintz and Ward (1989) shows that Israel's spending is driven, among other factors, by the Arab military expenditure. However, they estimate a system of equations in which the latter is exogenous and it has no feedback to Israel's military spending. Despite the impressive fit of Mintz and Ward's regressions, their results indicate severe autocorrelation.[5]

Diverting from the common approach of assessing arms races through determinants of military spending, Linden (1991) applies Granger causality for Israel and an Arab block consisting of all the Middle Eastern countries that are reported by SIPRI over the period 1955-1984. He finds that there is a causal equilibrium relationship with an elasticity close to one that runs from Israel's level of military expenditures to the Arab bloc's military expenditures. However, he finds that disequilibrium behavior dominates Israel military spending as it reacts only to current changes in Arab bloc's level of military expenditures. Thus, he concludes that the arms race system between the two adversaries is rather unstable one.

Chen et al. (1996) use cointegration to investigate the existence of collective action among the Arab neighbors of Israel. They show that up to the late 1970s, Egypt was the only Arab country involved in a fierce arms race with Israel and that the long-run equilibrium relationship disappeared after signing the Camp David Peace Treaty in 1979. The authors find that a long-run equilibrium with a weak Arab response was established between the defense spending of Israel and the minor front line countries (Jordan, Lebanon, and Syria) indicating that these countries did not take the opportunity for complete free riding. Furthermore, they conclude that a collective action among the four Arab countries constituting the front line with Israel may be valid.

[5] See Beenstock (1998).

VEC based on both Engle-Granger and Johansen cointegration procedures is used by Beenstock (1998) to assess causality between Israel's military expenditures and a set of endogenous variables, including military spending by the Arab confrontation states and American military aid, over the period 1960-1994. He detects causality from Arab military spending to Israel's when using the Engle-Granger VEC but fails to do so when using the Johansen-based VEC. The author does not report tests of causality running from Israel's to Arab's military spending.

Seiglie and Liu (2002) apply VEC Granger causality for bivariate, trivariate and quadvariate VARs over the period 1948-1991 for various combinations of Arab countries (Egypt, Iraq, Jordan, and Syria) and Iran with Israel. They find that for most cases, causality runs from Israel's military spending to individual Arab countries and combinations of two or three Arab countries' military spending. Moreover, evidence of causality running from Israel's to Arab military spending is rather weak or nonexistent.

Focusing on military actions rather than military expenditures, Sprecher and DeRouen (2002) conduct VAR-based causality tests over the 1948-1998 period and find that the Israeli military actions are driven by both Arab military actions and domestic political protests while Arab military actions are driven by Israeli military actions and seem to decrease in response to Israeli actions. Thus, they conclude that a bidirectional causality exists between the military actions of the rivals.

All the previous studies that addressed the existence and the nature of the conflict have applied traditional causality tests from within VAR or VEC settings. As we stated earlier, the traditional Granger causality tests from within VAR and VEC have non-standard asymptotic properties and are subject to pre-testing biases.

4. Econometric Methodologies

Economists often utilize vector autoregressions (VARs) to make inferences on causal relationships among endogenous variables. However Sims et al. (1990) and others have argued that, in general, the traditional Wald test for exact linear restrictions on the parameters in levels VAR does not have the usual asymptotic distributions if the variables are integrated or cointegrated. Proper inferences on VAR levels can be made only if all variables are known to be stationary. Otherwise, one can use VAR in differences if all variables are known to be integrated of order one but not cointegrated, and through the specification of a VEC model if all variables are *I(1)* and cointegrated. However, in most cases the order of integration and cointegration is not known a priori and pretesting for unit roots and cointegration is necessary before conducting causality tests. Consequently, the validity of causality tests is conditional on avoiding biases in testing for unit roots and cointegration among the variables. Econometric studies report that the pre-testing biases might be severe because the power of the unit root test is generally very low and tests for Johansen cointegration are not very reliable in finite samples.[6]

A recent procedure proposed by Toda and Yamamoto (1995) bypasses the need for potentially biased pre-tests for unit roots and cointegration, common to other formulations. The procedure utilizes the Wald test statistic for testing linear restrictions on the coefficients in an augmented VAR. The Modified WALD (MWALD) causality test has an asymptotic chi-squared distribution with p degrees of freedom in the limit when a VAR ($p+d_{max}$) is estimated, where p is the optimal lag order in the unrestricted levels VAR and d_{max} is the maximal order of integration of the variables in the VAR system. The causality procedure is implemented in two steps. In the first step, the correct order of the unrestricted level VAR (p) is to be determined using one of the

[6] See Toda and Yamamoto (1995) and Pesaran et al. (2001).

information criteria methods, and d_{max} is to be determined using one of the unit root tests. The selected $VAR(p)$ is then augmented by the maximal order of integration and a VAR of order $(p+d_{\max})$ is estimated. Testing for causality in a Bivariate system entails estimating the following augmented VAR of order $(p+d_{\max})$:

$$\begin{aligned} Y_{1t} &= \mu_1 + \sum_{k=1}^{p+d_{\max}} \beta_{11,k} Y_{1t-k} + \sum_{k=1}^{p+d_{\max}} \beta_{12,k} Y_{2t-k} + \varepsilon_{1t} \\ Y_{2t} &= \mu_2 + \sum_{k=1}^{p+d_{\max}} \beta_{21,k} Y_{1t-k} + \sum_{k=1}^{p+d_{\max}} \beta_{22,k} Y_{2t-k} + \varepsilon_{1t} \end{aligned} \tag{1}$$

In the above setting, long-run Granger causality from variable Y_2 to variable Y_1 is evaluated by testing the null hypothesis that $\beta_{12,1} = ... = \beta_{12,p} = 0$, and causality from variable Y_1 to Y_2 is examined by testing the null hypothesis that $\beta_{21,1} = ... = \beta_{21,p} = 0$. Toda and Yamamoto (1995) proved that the Wald statistic for testing the above null hypothesis converges in distribution to a χ_p^2 random variable. The application of this procedure ensures that the usual test statistic for Granger causality has the standard asymptotic distribution and valid inference can be carried out (Zapata and Rambaldi, 1997).

FEVD has been used repeatedly by economists to examine the out-of-sample properties of the relationship between the variables in a VAR system. The method enables researchers to shed light not only on the direction but also on the intensity of the causal relationships between variables. Generally speaking, FEVD analysis decomposes the forecast error variance of a variable into proportions attributed to shocks in other variables, as well as its own. Most researchers have used the Cholesky decomposition that requires ordering of the variables. Without a sound theoretical base, ordering is arbitrary and the results may vary greatly depending on the ordering. Furthermore, the orthogonalized FEVD and impulse response

functions are unlikely to be appropriate for analyzing arms races (Smith et al., 2000). As an alternative, Pesaran and Shin (1998) proposed a generalized FEVD that circumvent the need for ordering the variables and produce unique results by utilizing the contemporaneous correlations of the variables under investigation. Unlike the traditional decomposition the generalized FEVD does not impose the restriction that the underlying shocks to the VAR are orthogonalized prior to decomposing the forecast error variances.

5. Data Description and Sources

Raw data were obtained from the following two main sources. (1) Real military expenditures in 2003 constant prices in US dollars as well as the share of military expenditures in GDP for the years 1988-2004 which were obtained from the SIPRI online database available at http://www.sipri.org. (2) Real military expenditures in 1993 constant prices in US dollars and the share of military expenditures in GNP for the period 1963-1987 which were obtained from a database compiled by Beenstock (1998). For the years 1960-1963 we derived the real GNP series using growth rates from the World Development Indicators (WDI) online database (http://devdata.worldbank.org/dataonline), with the exception of Jordan for which the growth rates were taken from the PWT database available at http://pwt.econ.upenn.edu. Military expenditures were converted to real 2000 prices US dollars using the GDP deflator and the GNP/GDP ratio series from the WDI online database. The final product consists of military expenditures in US dollars at 2000 constant prices and the military burden proxied by the share of military expenditures in GDP.

We also constructed an aggregated series for the three Arab countries to which we refer as “Arab” to allow for possible collective action of Arabs against Israel as advised by Olson (1971). For real military expenditures this series is simply the sum of the military expenditures

whereas for military burden, it is defined as this sum divided by the total GDP of these countries. These series are dominated by the figures of Egypt, the largest economy among the front line countries.

6. Results

Our causality analysis is conducted under two specifications. First, causality in a bivariate VAR system in which we examine causality between Israel's military measures and each of the Arab countries measures separately. Second, causality in a quadvariate VAR system in which the military measures of the four countries are present in the system. This specification allows for possible complementary relationships as well as "free riding" among the military measures of the Arab countries that face a common threat.

A necessary step for causality tests based on the Toda and Yamamoto (1995) is to determine the maximal order of integration of the series in the VAR system. The results of the ADF test for the real military expenditures and the military burden for the four countries and the aggregated "Arab" series are reported in Table 1. We determined the optimal lag order based on SIC. All series are found to be integrated of order 1. Thus, the maximum order of integration (d_{max}) in the VAR system is 1 throughout.

Table 2 presents the results of the causality tests for the bivariate specification over the whole period 1960-2004. The optimal lag order of the VAR system is determined using SIC with maximum 4 lags allowed. The reported lags represent the lag order under which no serial correlation of order up to 4 was detected. When real military expenditures are considered, the results indicate that causality runs, in general, from Israel's military expenditures to those of Egypt, Syria, and the aggregated "Arab" measure. While our results show that Egypt reacts to changes in Israel's military expenditures, a bi-directional causality is detected only between

Israel and Syria, and no causality whatsoever is detected in the case of Jordan. It seems that the latter, the smallest economy among the Arab front line countries, does not constitute a factor in the arms race in the region and might have chosen to behave as a free rider as implied by Chen et al. (1996). The causality from Israel's military expenditures to Egypt and Syria's expenditures is a weak one since it is valid only at the 10% significance level. This observation is further validated when the military measure is the military burden. Causality is now detected only from Israel's military burden to Egypt's. Moreover, we still find that Israel reacts to changes in Syria's military burden. Once again, no causality is detected between the military measures of Israel and Jordan. Our findings are partially in line with Chen et al. (1996) who find that Egypt was the only country involved in a fierce arms race with Israel prior to 1979 while Jordan was a free rider and Syria was least responsive to changes in Israel's military spending.

To further investigate the possibility of Arab collective action and/or free riding we apply the Toda and Yamamoto (1995) procedure to a quadvariate VAR in which the military spending of each Arab country responds to other Arab countries spending in addition to Israel's. The results of the causality tests are presented in Table 3. When real military spending is taken as the military measure we detect bidirectional causality between Israel and Syria with the causality from Israel's to Syria's military spending being marginally significant. Turning to causality in military burden, we only find a barely significant causality running from Egypt's to Israel's military burden.

Since many economic series, including defense spending may experience structural breaks that affect causality analysis we carried out the same tests incorporating two endogenously determined structural breaks that have been reported by Abu-Qarn and Abu-Bader

(2008).[7] In general, the breakpoints capture the drastic rise in military expenditures prior to the last major war, 1973, and the sharp decline following the initiation of peace talks in the late 1970s. Thus, these breaks take into account the change in the dynamics in the post-1979 era. The results (Tables 4 and 5) of the causality tests are rather similar to those without structural breaks. The bidirectional causality between Israel's and Syria's military expenditures still holds true, in addition to causality running from Israel's to Egypt's military spending (in the bivariate setting only). Once again, the causality links when military burden is taken are weaker and almost nonexistent. These findings may indicate that the rivals react to the absolute level of the military spending and not to the relative measure.

The peace treaty between Egypt and Israel that was signed in 1979 marked the collapse of the Arab front line bloc when the largest and strongest member ceased to be involved in the confrontation with Israel and left Syria as the major Arab rival of Israel. Table 6 provides us with insights into the possible impact of the peace treaty on the dynamics of the conflict. The analysis complements our causality tests that incorporated two structural breaks. Our causality tests on the post-1979 period reveal rather surprising results; with the exception of Jordan, Arab countries, including Egypt, respond to both Israel's military expenditures and burden. Moreover, Israel responds only to Syrian military burden. One possible explanation might be that despite the "cold" peace, Egypt, the leading Arab country, continues to see in Israel a threat especially since the Palestinians are still under Israeli occupation. Another likely explanation is the short time span (1979-2004) that could undermine the reliability of our analysis.

Our last assessment of the causal relationships between the military expenditures and burden of Israel and its Arab neighbors involves applying the generalized FEVD to gauge the

[7] The authors apply the Bai and Perron (1998) multiple structural breaks test.

strength of the out-of-sample causal relationships. By decomposing the variance of the forecast error of, say Israel's military expenditures, into proportions attributed to shocks in all variables in the system including itself, variance decomposition can provide an indication of Granger causality beyond the sample period. The results of the generalized FEVD for up to ten years ahead are portrayed in tables 7 and 8. Table 7 conveys a relatively strong causality running from Israel's to Egypt's, Syria's, and Arab's military measures. For example a shock to Israel's military expenditures explains 12.34% of the forecast error variance of Syria's military expenditures at period zero and the percentage rises to reach 28.52% after 10 years. Our results indicate that Syria responds with higher intensity than the rest to shocks in Israel's military spending. The other direction of causality emerges from Table 8; Israel responds only to shocks in Syrian military measures. Overall, our FEVD results are in line with our causality findings. Causality runs mainly from Israel's to Arab's military measures and Israel usually responds to changes in Syrian military expenditures.

7. Summary

This article examines the dynamics of the Israeli-Arab conflict over the period 1960-2004 to determine whether an arms race exists between Israel and its Arab adversaries. To do so we apply two methodologies; first, a causality procedure developed by Toda and Yamamoto (1995) that avoids the shortcomings that the traditional Granger causality tests suffer from; second, the Generalized FEVD proposed by Pesaran and Shin (1998) that overcomes the need for ordering in the VAR system that is necessary in the traditional Cholesky decomposition.

Our analysis included both bivariate (Israel with each Arab country separately) and quadvariate (Israel with all Arab countries simultaneously) VARs to accommodate collective action and/or free riding among Arab countries.

We find that in most cases, Arabs respond to changes in both the military expenditures and military burden of Israel. A bidirectional causality is often detected between Israel and Syria, countries that are still in a state of enmity. In almost all of our tests, Jordan was not found to be actively involved in an arms race with Israel and might have been acting as a free rider. The results hold intact also when we incorporate the possibility of structural breaks in the defense series and when examining the nature of the conflict after signing the peace treaty between Egypt and Israel in 1979. Our results are consistent with the previous studies that addressed the nature of the Israeli-Arab arms race.

As we indicated earlier, arms races analysis, in general, and in the Middle East, in particular, can serve countries (the U.S., for example) and international institutions (potentially the U.N. and the E.U.) in weighting the effects of their intervention (foreign aid, exercising political and economic pressure, and other measures) not only on one country but all the countries that are involved in the conflict.

References

Abu-Qarn, A. S. & Abu-Bader, S. (2008). Structural Breaks in Military Expenditures: Evidence for Egypt, Israel, Jordan and Syria. Peace Economics, Peace Science and Public Policy 14.

Bai, J. & Perron, P. (1998). Estimating and Testing Linear Models with Multiple Structural Changes. Econometrica 66, 47-78.

Beenstock, M. (1998). Country Survey XI: Defence and the Israeli Economy. Defence and Peace Economics 9, 171-222.

Chen, B., Feng, Y. & Masroori, C. (1996). Collective Action in the Middle East? A Study of Free-Ride in Defense Spending. Journal of Peace Research 33, 323-339.

Dunne, J. P., Nikolaidou, E. & Smith, R. P. (2005). Is There an Arms Race between Greece and Turkey? Peace Economics, Peace Science and Public Policy 11, 1-37.

Kinsella, D. (1994). The Impact of Superpower Arms Transfers on Conflict in the Middle East. Defence and Peace Economics 5, 19-36.

Kollias, C. & Makrydakis, S. (1997). Is There a Greek-Turkish Arms Race?: Evidence from Cointegration and Causality Tests. Defence and Peace Economics 8, 355-379.

Lebovic, J. H. (2004). Unity in Action: Explaining Alignment Behavior in the Middle East. Journal of Peace Research 41, 167-189.

Linden, M. (1991). The Dynamics and the Instability of the Middle East Military Expenditures in Years 1955-1984. Defence Economics 2, 199-208.

McGuire, M. C. (1982). U.S. Assistance, Israeli Allocation, and the Arms Race in the Middle East: An Analysis of Three Interdependent Resource Allocation Processes. Journal of Conflict Resolution 26, 199-235.

McGuire, M. C. (1987). Foreign Assistance, Investment, and Defense: A Methodological Study with an Application to Israel, 1960-1979. Economic Development and Cultural Change 35, 847-873.

Mintz, A. & Ward, M. D. (1989). The Political Economy of Military Spending in Israel. The American Political Science Review 83, 521-533.

Morris, B. (2001). Righteous Victims : A History of the Zionist-Arab Conflict, 1881-2001. New York: Vintage Books.

Olson, M. (1971). The Logic of Collective Action: Public Goods and the Theory of Groups. Cambridge, MA: Harvard University Press.

Pesaran, M. H. & Shin, Y. (1998). Generalized Impulse Response Analysis in Linear Multivariate Models. Economics Letters 58, 17-29.

Pesaran, M. H., Shin, Y. & Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. Journal of Applied Econometrics 16, 289-326.

Richardson, L. F. Arms and Insecurity: A Mathematical Study of Causes and Origins of War. Pittsburgh: Boxwood Press.

Sachar, H. M. (1998). A History of Israel from the Rise of Zionism to Our Time. (2nd ed.). New York: Knopf.

Seiglie, C. & Liu, P. C. (2002). Arms Races in the Developing World: Some Policy Implications. Journal of Policy Modeling 24, 693-705.

Sims, C. A., Stock, J. H. & Watson, M. W. (1990). Inference in Linear Time Series Models with Some Unit Roots. Econometrica 58, 113-144.

Smith, R. P., Dunne, J. P. & Nikolaidou, E. (2000). The Econometrics of Arms Races. Defence and Peace Economics 11, 31-43.

Sprecher, C. & DeRouen, K., Jr (2002). Israeli Military Actions and Internalization-Externalization Processes. Journal of Conflict Resolution 46, 244-259.

Toda, H. Y. & Yamamoto, T. (1995). Statistical Inference in Vector Autoregressions with Possibly Integrated Processes. Journal of Econometrics 66, 225-250.

Yildirim, J. & Ocal, N. (2006). Arms Race and Economic Growth: The Case of India and Pakistan. Defence and Peace Economics 17, 37-45.

Zapata, H. O. & Rambaldi, A. N. (1997). Monte Carlo Evidence on Cointegration and Causation. Oxford Bulletin of Economics and Statistics 59, 285-298.

Graph 1 – Military Burden, 1960-2004

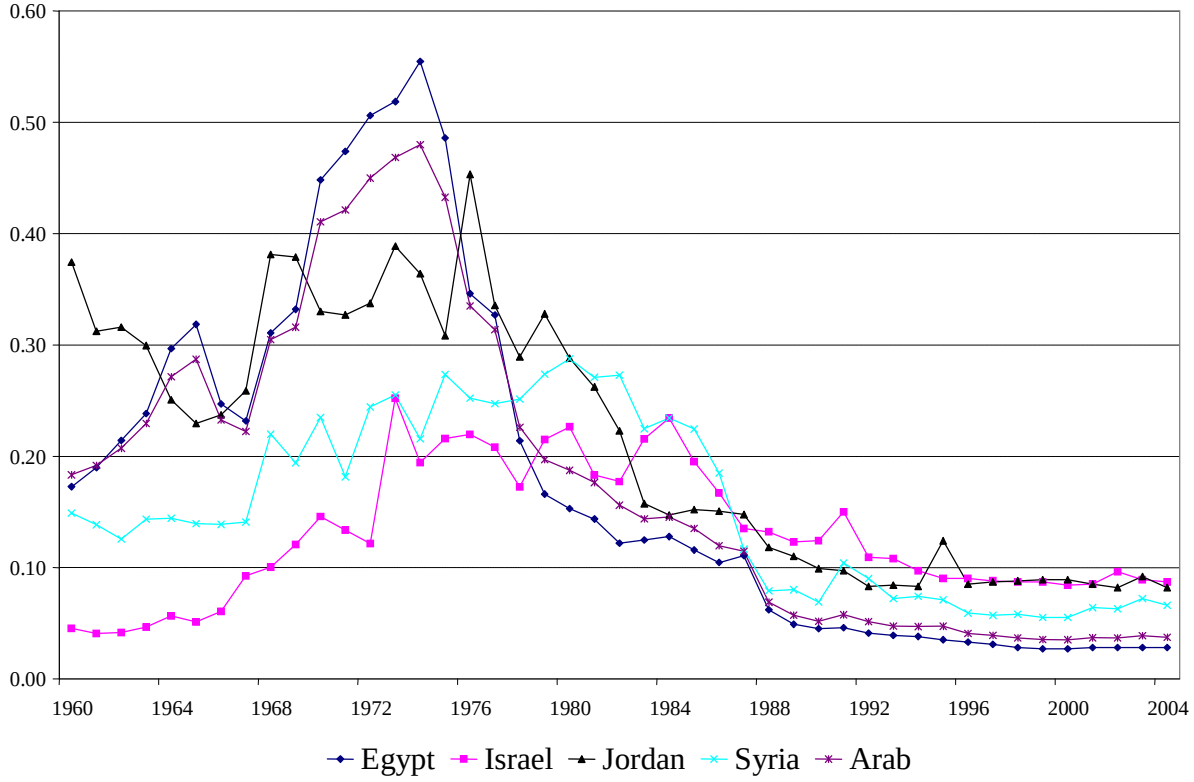

Table 1 - ADF Unit Root Test

Real Military Expenditures

	Levels		First differences	
	ADF	**Lag**	**ADF**	**lag**
Egypt	-2.83	3	-5.09***	0
Israel	-1.96	0	-7.85***	0
Jordan	-2.38	0	-7.65***	0
Syria	-1.32	0	-5.04***	0
Arab	-2.41	2	-3.04**	1
	Military Burden			
Egypt	-2.66	2	-3.03**	1
Israel	-1.83	0	-8.30***	0
Jordan	-2.33	0	-6.07***	1
Syria	-1.70	0	-7.96***	0
Arab	-2.71	2	-4.40***	0

Notes:

Optimal lag length based on SIC with 8 maximum lags allowed.
*, **, *** denote significance at the 10%, 5%, 1%, respectively.

Table 2 – Causality Test (Bivariate)

$Arab_i$	Lag	Israel → $Arab_i$	$Arab_i$ → Israel
	Real Military Expenditures		
Egypt	1	2.64*	0.06
Jordan	1	1.03	0.15
Syria	1	3.65*	4.47**
Arab	1	3.12*	0.01
	Military Burden		
Egypt	2	6.12**	0.50
Jordan	1	0.76	1.14
Syria	1	0.04	7.10***
Arab	2	4.31	0.43

Notes:

→ indicates the direction of causality.
Lags are based on SIC with maximum 4 lags allowed.
*, **, *** denote significance at the 10%, 5%, 1%, respectively.

Table 3 – Causality Test (Quadvariate)

$Arab_i$	Lag	Israel → $Arab_i$	$Arab_i$ → Israel
	Real Military Expenditures		
Egypt	1	0.83	0.00
Jordan	1	0.42	2.16
Syria	1	3.52*	6.87***
	Military Burden		
Egypt	4	2.11	7.85*
Jordan	4	2.75	2.62
Syria	4	6.06	4.17

Notes:

→ indicates the direction of causality.
Lags are based on SIC with maximum 4 lags allowed.
*, **, *** denote significance at the 10%, 5%, 1%, respectively.

Table 4 – Causality Test (Bivariate) with 2 Breaks allowed

$Arab_i$	Lag	Israel → $Arab_i$	$Arab_i$ → Israel
	Real Military Expenditures		
Egypt	**1**	5.51**	0.28
Jordan	**1**	1.24	0.43
Syria	**1**	3.38*	4.34**
Arab	**1**	0.75	0.86
	Military Burden		
Egypt	**2**	3.70	2.25
Jordan	**1**	0.84	1.49
Syria	**1**	0.06	3.36*
Arab	**2**	2.38	2.08

Notes:

→ indicates the direction of causality.
Lags are based on SIC with maximum 4 lags allowed.
*, **, *** denote significance at the 10%, 5%, 1%, respectively.
Break points based on Abu-Qarn and Abu-Bader (2008); Military expenditures – Egypt: 1969, 1977; Israel: 1972, 1982; Jordan: 1975, 1983; Syria: 1974, 1986; Arab: 1968, 1987. Military burden - Egypt: 1969, 1977; Israel: 1972, 1986; Jordan: 1981, 1989; Syria: 1967, 1986; Arab: 1969, 1977.

Table 5 – Causality Test (Quadvariate) with 2 Breaks allowed

$Arab_i$	Lag	Israel → $Arab_i$	$Arab_i$ → Israel
		Real Military Expenditures	
Egypt	1	0.93	0.95
Jordan	1	0.62	0.00
Syria	1	3.57*	8.21***
		Military Burden	
Egypt	4	9.05*	2.02
Jordan	4	5.06	0.63
Syria	4	5.05	1.33

Notes:

→ indicates the direction of causality.
Lags are based on SIC with maximum 4 lags allowed.
*, **, *** denote significance at the 10%, 5%, 1%, respectively.
Break points based on Abu-Qarn and Abu-Bader (2008); Military expenditures – Egypt: 1969, 1977; Israel: 1972, 1982; Jordan: 1975, 1983; Syria: 1974, 1986; Arab: 1968, 1987. Military burden - Egypt: 1969, 1977; Israel: 1972, 1986; Jordan: 1981, 1989; Syria: 1967, 1986; Arab: 1969, 1977.

Table 6 – Causality Test (Bivariate) Post-1979

$Arab_i$	Lag	Israel → $Arab_i$	$Arab_i$ → Israel
		Real Military Expenditures	
Egypt	**1**	5.79**	1.66
Jordan	**1**	1.22	1.74
Syria	**1**	2.58*	0.56
Arab	**1**	5.35**	1.72
		Military Burden	
Egypt	**1**	5.89**	0.87
Jordan	**2**	5.52*	0.48
Syria	**2**	0.93	8.66**
Arab	**1**	6.64***	0.05

Notes:

→ indicates the direction of causality.
Lags are based on SIC with maximum 4 lags allowed.
*, **, *** denote significance at the 10%, 5%, 1%, respectively.

Table 7 – Generalized FEVD for Arab Countries (%)

	Explained by own shock after … years				Explained by a shock to Israel's military measure after … years			
	0	**1**	**5**	**10**	**0**	**1**	**5**	**10**
Real Military Expenditures								
Egypt	100	92.60	92.60	92.60	4.16	13.51	13.51	13.51
Jordan	100	99.32	99.22	99.21	0.15	0.71	0.82	0.82
Syria	100	95.32	85.17	85.09	12.34	21.98	28.48	28.52
Arab	100	90.36	90.35	90.35	7.19	20.19	20.21	20.21
Military Burden								
Egypt	100	91.57	92.02	92.03	2.66	13.46	13.08	13.08
Jordan	100	98.56	98.16	98.16	6.68	6.82	7.03	7.03
Syria	100	100	100	100	16.98	17.04	17.05	17.05
Arab	100	93.73	94.22	94.22	5.93	14.61	14.20	14.22

Table 8 – Generalized FEVD for Israel (%)

$Arab_i$	Explained By a shock to $Arab_i$ military measure after … years				Explained by Own shock after … years			
	0	**1**	**5**	**10**	**0**	**1**	**5**	**10**
Real Military Expenditures								
Egypt	4.16	4.32	4.32	4.32	100	99.97	99.97	99.97
Jordan	0.15	0.33	0.36	0.36	100	99.87	99.85	99.85
Syria	12.34	13.87	14.33	14.31	100	93.50	92.85	92.83
Arab	7.19	7.02	7.02	7.02	100	99.96	99.96	99.96
Military Burden								
Egypt	2.66	2.50	3.93	3.94	100	99.94	98.14	98.13
Jordan	6.68	6.27	6.28	6.28	100	99.34	99.15	99.15
Syria	16.98	18.72	20.55	20.55	100	90.41	87.04	87.03
Arab	5.93	5.43	6.11	6.12	100	99.65	98.52	98.51