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Guns and Roses: Military Spending, Financial Aid and Economic Growth in the Case of Saudi Arabia

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Abstract

This study uses a multivariate cointegration approach to investigate empirically the long-run determinants of the Saudi military spending (Guns), financial aid (Roses) donated by Saudi Arabia to Arab States and the output of the economy over the period 1963-2001. The study postulates that the Saudi political regime in reaction to the long perceived military threat posed by Tehran uses the accumulation of arms as a conventional deterrent policy instrument and the financial aid as a political policy instrument to both consolidate the positions of some political regimes in the region and gain their support against this threat. While the financial aid has given Saudi Arabia the role of an anchor of stability and peace in the region, the empirical results suggest the existence of "La Gabelle" notion. The study, also, shows that government expenditure, disaggregated investment and foreign workers do not promote economic growth. Given the rise in unemployment and in the number of poor among Saudi nationals without sound welfare programs, the study calls for the review and the restructuring of both the welfare system and the foreign employment policies in the public and the private sectors.

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1- Introduction:

Over the last three decades Saudi Arabia has played a major role in the political arena of the Arab world. The geographical boundaries of Saudi sketched by Sir Cox right on the Arabian sands of the desert has left it with some tension over boarders with neighbouring countries. The tensed relationship between Saudi Arabia and Iran, however, has a different dimension. It started with the ambition of the Shah of Iran to dominate the Gulf and the relation was further complicated by the wish of the revolutionary religious leaders of Qom to export the revolution to the neighbouring Arab countries.

The perception of the external threat posed by Iran has probably led Saudi Arabia to accumulate arms and to engage in various contracts of military services with allied Western countries. On the other hand, engaging in continuous military spending by the Saudi regime could be necessitated by the ‘‘La Gabelle’’ notion in France in the Seventeenth century where the government used to collect salt taxes via monopolizing the refinement and the sale of it to the public. Therefore, selling oil by Saudi Arabia has some sort of taxability in the wider sense of ‘‘La Gabelle’’, since buying it by Western countries is, probably, conditioned by the Saudi engaging not only in various military contracts including buying traditional arms and military services from these Western countries, but also in contracts tailored to be paid by oil. Exchanging export proceeds with arms is not newly born, but it has its deep roots in human history and one interesting story may be observed in Deaton (1999).

With the collapse of communism by the death of Nasser of Egypt and the weakening of the wave of ‘‘Pan-Arab’’ adhered to by the Ba’ath parties in various Arab countries, the Saudi regime recognized that the political regimes of some Arab countries may be not stable in the long run, and financial aids ‘‘roses’’ may be required not only to consolidate the positions of these regimes, but also to unite the Arab countries against the principle of exporting the ‘‘then impressive’’ revolution of Khomeini across the Arab frontiers. Therefore, we may be able to distinguish between the accumulation of arms as a conventional deterrent policy instrument and the financial aid donated to other Arab regimes to maintain their stability as a peace policy instrument. Since guns and roses may be regarded as independent of each other or complementary or substitutes, the study investigates empirically the nature of the dependency between these two policy instruments as well as the repercussions on the fiscal and monetary policies of the country. This is achieved by postulating three cointegrating relations, which are the military spending (military demand), the financial aid and the output of the economy. Although there exists several approaches proposed in the literature of cointegrating analysis for estimating cointegrated relations and testing formally any restrictions imposed on individual equations as well as across the cointegrated vectors, the study opted for the use of the most recent economic based procedure that allows identification of the long-run parameters and restrictions testing in isolation of the short-run dynamics as well as the structural loading coefficients. The empirical model presented in this study is based on yearly data covering the period 1963-2001. The data used in the construction of the real variables and the sources are given in the Data Appendix. The estimated structural model and the correspondent Vector Error Correction Models (VECM) were repeated for the period 1963-1998 providing three forecast points to check their forecasting performance. Therefore, the study is divided into further three sections. Section two provides the structural model. Section three discusses the econometric results, while section four provides concluding remarks.

2-The Structural Model:

The long-run structural model of the three relations in the context of Saudi Arabia can be written in the form:

$$MS = f(X, G, r, ET)\,;\ f_x > 0,\ f_G > 0,\ f_R > 0,\ f_{ET} > 0 \qquad (1)$$

$$FA = k(r, ET)\,;\ k_R > 0,\ k_{ET} > 0 \qquad (2)$$

$$Y = h(X, r)\,;\ h_x > 0,\ h_R > 0 \qquad (3)$$

where MS is real military spending, X is real exports, G is real government expenditure, r is real interest rate, FA is real financial aid donated by Saudi Arabia to other Arab states, Y is real output and ET is the external military threat facing the Saudi regime. The accumulation of arms over time by the Shia dominated Islamic Republic State of Iran is used as a proxy to ET.

The partial derivatives of military procurements given by Equation (1) are all positive. This implies that a rise in any of its determinants leads to a rise in the demand for military goods and services. The positive association between exports of oil and spending on military goods and services is a reflection of ''La Gabelle'' postulate. The positive partial derivative with respect to government expenditure is merely to reflect the perception of the Saudi authority to the external (and probably internal) threat, which translates into demanding more arms. The partial derivative of military spending with respect to the interest rate is postulated to be positive. This is based on the stylized facts of the Saudi Real Business Cycle, Asseery and Al-Sheikh (2002), where both the oil exports and the long real interest rate are found to be contemporaneously pro-cyclical with respect to oil deflator (price), and that short and long interest rates are both contemporaneously pro-cyclical with respect to output where exports dominates the bulk of it. Therefore, a rise in oil prices, due to a contraction in oil supply or a rise in the demand for oil, raises the proceeds of oil exports and hence raising military spending. Another mechanism is via the impact of the announced government budget where a rise in the appropriated fund for financing military contracts is anticipated to shrink the available money in the economy as a whole and, therefore, raises the domestic interest rates. This is consistent with Barro (1987) who observed that interest rates and military spending move together. The partial derivative with respect to external threat is also positive reflecting the arms race thesis in the Gulf, Asseery (2000).

The supply of financial aid by Saudi Arabia represented by equation (2) shows that its partial derivative is positive with respect to both interest rate and external military threat. The positive partial derivative with respect to interest rate may be rationalized in the way that raising domestic interest rate induces savings and if the government uses any taxing instrument (including the Zakat) to collect the funds for financial aid then the collected funds will be larger the larger are the savings induced by higher domestic interest rate. The positive partial derivative with respect to external military threat implies that the stronger the perception of the threat by the Saudi political regime the higher will be the financial aid directed to some Arab states to rally their support behind its political objectives towards this threat and other military aggressions as happened during Sadam's invasion of Kuwait in 1990. It may also be looked at as playing the role of a political stabilizer for some regimes in the Arab world.

The third equation in the above system is linking real output to real export and real interest rate with positive partial derivatives signaling that a rise in export or real interest rate raises the over all output of the economy. A rise in domestic interest rate, which is tied closely to the interest rate of USA, leads to inflationary pressure in the prices of most sectors of the world economy including the prices of energy and oil and, consequently, resulting in Saudi pumping more oil in the international market.

The above system requires testing for cointegration, and just-identifying restrictions has to be imposed to identify the long run relationships exactly. Also, further over-identifying restrictions will be required for the sake of econometrically verifying the postulates of the model. Expressing all variables with the exception of real interest rate in logarithm, which is indicated by lower case letters, and including a deterministic time trend (t), then these equations may be written in the form:

$$ms_t = a_{10} + \beta_{14}x_t + \beta_{15}g_t + \beta_{16}r_t + \beta_{17}et_t + \beta_{18}t + \varepsilon_{1t+1} \quad (4)$$

$$fa_t = a_{20} + \beta_{26}r_t + \beta_{27}et_t + \beta_{28}t + \varepsilon_{2t+1} \quad (5)$$

$$y_t = a_{30} + \beta_{34}x_t + \beta_{36}r_t + \beta_{38}t + \varepsilon_{3t+1} \quad (6)$$

The above system can be represented compactly in the form:

$$\varepsilon_t = \xi_t - A_0 = \beta' Z_{t-1} - A_0 \quad (7)$$

where:

$$Z_t = (ms_t, fa_t, y_t, x_t, g_t, r_t, et_t, t)' \quad (8)$$

$$A_0 = (a_{10}, a_{20}, a_{30})' \quad (9)$$

$$\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t})' \quad (10)$$

Exact-identification of this system suggests the requirement of three, priori, independent restrictions on each of the three cointegrating relations. The study also postulates a number of testable over-identifying restrictions on the β-vector in equation (7). These are unit coefficients on the real export and government expenditure variables in equation (4), a unit coefficient on external threat variable in equation (5), a zero trend in equation (5) and a unit coefficient on the real export variable in equation (6). It may be noted that each β-vector contains eight elements and they are defined as:

$\beta_1 = (\beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}, \beta_{18})$, $\beta_2 = (\beta_{21}, \beta_{22}, \beta_{23}, \beta_{24}, \beta_{25}, \beta_{26}, \beta_{27}, \beta_{28})$ and $\beta_3 = (\beta_{31}, \beta_{32}, \beta_{33}, \beta_{34}, \beta_{35}, \beta_{36}, \beta_{37}, \beta_{38})$.

Therefore, the transposed β-vectors, taking into consideration the just-identifying and over-identifying restrictions, can be written as:

$$\text{Transposed } \beta_1 = (1, 0, 0, -1, -1, -\beta_{16}, -\beta_{17}, \beta_{18}) \quad (11)$$

$$\text{Transposed } \beta_2 = (0, 1, 0, 0, 0, -\beta_{26}, -1, 0) \quad (12)$$

$$\text{Transposed } \beta_3 = (0, 0, 1, -1, 0, -\beta_{36}, 0, \beta_{38}) \quad (13)$$

These transposed β-vectors are in accordance with the previous analysis and to follow this type of modeling strategy Z_t is decomposed to endogenous and exogenous variables in the following manner:

$$Z_t = (H_t, W_t) \quad (14)$$

where H_t contains the three I(1) endogenous variables (ms_t, fa_t, y_t) and W_t contains the exogenous I(1) variables (x_t, g_t, r_t, et_t) in the sense that they have direct influence on H_t, but their changes are not affected by the error correction terms. These exogenous variables resemble in this way the long run forcing variables of the system given that they are themselves are not cointegrated. The estimation of this task can be achieved using full information maximum likelihood (FIML) estimation procedure.

The next task in this framework is to formulate the general Vector Error Correction Model (VECM) embodying the structural equations (4)-(6) and incorporating information about unit roots, the existence of the cointegrating relations and statistically valid restrictions on the coefficients of the individual relations as well as across equation restrictions. Since one of the objectives of the paper is to examine the determinants of economic growth, we shall add the growth of some exogenous macroeconomic aggregates commonly observed in economic growth literature, inter Alia Asseery et al (1999), Greenway and Sapsford (1994), Grier and Tullock (1989), Grimes (1991), Grosman (1988, 1990), Hansen (1994), King and Levien (1993), McKinnon (1973), Oxley (1994), Pagano (1993), Romer (1989), Roubini and Sala-I-Martin (1992), Shaw (1973), Stiglitz (1993) and Wang and Yip (1992), to the estimated error correction models. In particular, these variables are the growth of real private consumption Δpe, the growth of real investment in the oil sector Δio the growth of real investment by the government sector Δig the growth of real investment by the private sector Δip the growth of real outside money Δm0p inflation Δp and the growth of foreign labour Δfe Since the data is in yearly format then it is not implausible to assume that the order of the VAR is one, which will be statistically verified in the next section. This assumption, taking into consideration equation (7), allows ε_t to be embodied in the general VECM as follows:

$$\Delta H_t = \alpha A_0 + \alpha \xi_t + \theta \Delta W_t + u_t \qquad (15)$$

where, α is an 3x3 matrix of error correction coefficients, θ is 3x11 matrix representing the impact effects of the contemporaneous changes of the exogenous variables on the endogenous variables, and u_t is 3x1 vector of serially uncorrelated shocks, $\xi_t = \beta' Z_{t-1}, \alpha A_0 = \prod \mu, \prod = \alpha\beta'$, μ is 3x1 vector of unknown coefficients and Δ refers to first difference. Specifically the estimated error correction models are given by:

$$\Delta ms_t = a_{10} + \gamma_{11}\,\varepsilon_{1\,t-1} + \gamma_{12}\,\varepsilon_{2\,t-1} + \gamma_{13}\,\varepsilon_{3\,t-1} + \theta_{11}\,\Delta x_t + \theta_{12}\,\Delta g_t + \theta_{13}\Delta pe_t + \theta_{14}\,\Delta io_t + \theta_{15}\,\Delta ig_t + \theta_{16}\,\Delta ip_t + \theta_{17}\,\Delta r_t + \theta_{18}\,\Delta m0p_t + \theta_{19}\,\Delta p_t + \theta_{110}\,\Delta fe_t + \theta_{111}\,\Delta et_t + \zeta_{1t} \quad (16)$$

$$\Delta fa_t = a_{20} + \gamma_{21}\,\varepsilon_{1t-1} + \gamma_{22}\,\varepsilon_{2t-1} + \gamma_{23}\,\varepsilon_{3t-1} + \theta_{21}\,\Delta x_t + \theta_{22}\Delta g_t + \theta_{23}\,\Delta pe_t + \theta_{24}\,\Delta io_t + \theta_{25}\,\Delta ig_t + \theta_{26}\,\Delta ipt + \theta_{27}\,\Delta r_t + \theta_{28}\,\Delta\, m0p_t + \theta_{29}\,\Delta p_t + \theta_{210}\,\Delta fe_t + \theta_{211}\,\Delta et_t + \zeta_{2t} \quad (17)$$

$$\Delta y_t = a_{30} + \gamma_{31}\,\varepsilon_{1t-1} + \gamma_{32}\,\varepsilon_{2t-1} + \gamma_{33}\,\varepsilon_{3t-1} + \theta_{31}\,\Delta x_t + \theta_{32}\,\Delta g_t + \theta_{33}\,\Delta pe_t + \theta_{34}\Delta io_t + \theta_{35}\Delta ig_t + \theta_{36}\Delta ip_t + \theta_{37}\Delta r_t + \theta_{38}\Delta m0p_t + \theta_{39}\Delta p_t + \theta_{310}\Delta fe_t + \theta_{311}\Delta et_t + \zeta_{3t} \quad (18)$$

where, γ_{ij}, j = 1, 2, 3 refers to the error correction terms for the estimated long run relations of the military spending, the financial aid and the over all output of the economy, respectively. θ_{ij}, j = 1, 2,..., 11 refers to the order of the coefficients of the impact effect of changes in the exogenous variables in the above individual equations, i = 1, 2, 3 refers to the ordering of the equations in the above system. a_{i0}, refers to the constants and ζ_{it} are the residuals terms which are assumed to be serially uncorrelated and normally distributed. The following section discusses the econometric procedure of estimation used by the study and the main findings.

3- The Empirical Evidence:

It has become a general practice in the empirical literature of applied economics to start with subjecting all variables to testing for unit roots. In this study we use the conventional Augmented Dickey and Fuller (1979) test, denoted by ADF, to test the log-levels and the first differences of all the variables involved in the estimation of the structural model for unit roots. The results of the estimated ADF test and the computed 95% critical values, given by MacKinnon (1991) using the response surface estimates, are shown in Table 1. It is clear that the series expressed in log-levels and the real interest rate are all of unit roots or non-stationary integrated series of order one, i.e. I(1), while their first differences are stationary or integrated of order zero, i.e. I(0). Also the table shows that the ADF regressions for all series are clear of serial correlations among the residuals as indicated by the reported statistics of the Lagrange Multiplier (LM) of order one.

Table 1
The Results of Testing the Series for Unit Roots Using the Augmented Dickey-Fuller (ADF) test

Variables	Log-Levels		First differences	
	ADF(p)	LM(1)	ADF(p)	LM(1)
ms	- 1.92 (0)	0.363(0.547)	- 6.34 (0)	0.933(0.334)
fa	- 2.18 (0)	0.144(0.704)	- 6.32 (0)	0.349(0.555)
y	- 1.84 (0)	2.51(0.113)	- 4.68 (0)	0.101(0.750)
x	- 2.19 (0)	0.145(0.703)	- 5.71 (0)	1.69(0.194)
g	- 1.91 (0)	0.041(0.840)	- 6.07 (0)	0.066(0.798)
pe	- 1.52 (0)	0.035(0.851)	- 6.07 (0)	0.079(0.778)
io	- 3.10 (0)	0.859(0.354)	- 6.16 (0)	1.57(0.210)
ig	- 1.26 (0)	2.29(0.131)	- 4.63 (0)	1.03(0.310)
ip	- 2.79 (0)	3.45(0.063)	- 5.71 (0)	0.306(0.580)
r	- 2.49 (1)	1.08(0.298)	- 4.54 (1)	2.09(0.149)
m0p	- 1.69 (0)	0.676(0.411)	- 6.78 (0)	0.003(0.954)
p	- 0.033 (0)	1.17(0.280)	- 6.32 (0)	0.349(0.555)
fe	- 2.12 (0)	0.075(0.785)	- 5.94 (0)	0.279(0.597)
et	- 2.30 (1)	1.47(0.226)	- 3.42 (0)	0.732(0.392)
95% Critical Values	- 3.53		- 2.94	

Notes: The definitions of the variables are given in the Data Appendix. Figures under ADF(p) are the calculated t-ratios of the ADF test with a constant and time trend for the log-level of each series and with a constant only for the first difference. (p) is the order of the augmentation of DF test. Figures under LM(1) are the Lagrange Multiplier test of residual serial correlation of order one, while the significance levels are given parenthesis.

The next step in this strategy of modeling and testing is to verify empirically the order (p) of the VAR. To achieve this aim we rely on the Log-Likelihood ratio (LR) test and a number of selection criteria, namely, Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). An unrestricted VAR(3) is chosen initially since it is the maximum order admissible given the limited degrees of freedom. This chosen VAR includes a time trend as the deterministic component but no intercepts are allowed. It is worth noting that the general direction of the conclusion is not very sensitive in this application to the inclusion of the intercepts. Table 2 shows the calculated values of the Maximized Log-Likelihood (LL), AIC and SBC for selecting the order of the VAR. It also shows the calculated test statistics of the LR and the adjusted LR for small sample bias. Under the null the LR statistic is asymptotically distributed as a chi-squared variate with degrees of freedom $m^2(P - p)$, where m^2 is the number of the variables, P is the maximum order of VAR and $p = 0, 1,..., P - 1$. The statistics of this table show that the values of LL and AIC are increasing functions of p, while the value of the SBC drop significantly after one lag. The result of the SBC, therefore, strongly indicates that the length of the VAR is one. The LR test statistics show that all orders are rejected, but on the other hand the Adjusted LR statistics give a strong indication that the order of the VAR is one. Stronger evidence on the order of the VAR can be observed in Table 3, where the segregation between endogenous and exogenous variables is imposed. It is clear in this table that the AIC, SBC, the LR and the adjusted LR statistics are all coincided in choosing an order of one. This result is quite overwhelming given that these criteria seldom coincide in applied work. The results of this table, therefore, suggests that treating x, g, r and et as exogenous I(1) variables is not an implausible assumption. In fact it is consistent with the characteristics of the Saudi economy. The income of the country may be regarded as exogenously determined since it relies heavily on the oil proceeds coming from the west and other developing countries. The exogeneity of government expenditure follows from being under direct control of the government, while the exogeneity of et forces itself naturally. Also the interest rate is tied directly to the interest rate of US to maintain parity. One important conclusion of this table is that the uncertainty surrounding the order of the VAR and, in particular, the risk of over-parameterization has considerably reduced given the limited number of observations.

Table 2
Choice Criteria and the LR Test Statistics for Selecting the Order of the VAR Model

The Variables included in the VAR are: ms, fa, y, x, g, r, et.

Criterion	**Order of VAR**			
	0	**1**	**2**	**3**
LL	- 159.5	110.4	172.8	258.4
AIC	- 166.5	54.4	67.8	104.4
SBC	- 171.9	10.8	- 13.8	- 15.4
LR test, χ^2 (147)	835.7 (0.00)	-	-	-
Adjusted LR test	310.4 (0.00)	-	-	-
LR test, χ^2 (98)	-	296.0 (0.00)	-	-
Adjusted LR test	-	110.0 (0.192)	-	-
LR test, χ^2 (49)	-	-	171.1 (0.000)	-
Adjusted LR test	-	-	63.6 (0.079)	-

Notes: LL is the maximized Log-Likelihood, AIC is the Akaike Information Criterion, SBC is the Schwarz Bayesian Criterion and LR is the Log-Likelihood Ratio test statistic.

Table 3
Choice Criteria and the LR Test Statistics for Selecting the Order of the VAR Model

The Variables Included in the VAR are: ms, fa, y, x, g, r, et.
The I (1) Endogenous Variables are: ms, fa, y.
The I (1) Exogenous Variables are: x, g, r, et.

Criterion	Order of VAR			
	0	1	2	3
LL	16.6	74.6	77.9	84.5
AIC	1.62	50.6	44.9	42.5
SBC	- 10.3	31.6	18.8	9.23
LR test, χ^2 (12)	135.8 (0.00)	-	-	-
Adjusted LR test	83.0 (0.00)	-	-	-
LR test, χ^2 (8)	-	19.8 (0.343)	-	-
Adjusted LR test	-	12.1 (0.841)	-	-
LR test, χ^2 (4)	-	-	13.3 (0.150)	-
Adjusted LR test	-	-	8.12 (0.522)	-

Notes: see notes to Table 2.

After verifying the order of the VAR the following step in this empirical analysis is to test for cointegration. It is known that cointegration analysis depends critically on whether the underlying VECM has restrictions imposed on the coefficients of the intercepts and/or trends. In the preliminary analysis the experimentations with the five known cases in cointegration analysis using unrestricted vector autoregression with various orders of VAR containing all the seven variables indicate that the case of cointegration with unrestricted intercepts and restricted trends in the VAR fits the data well. In this study the Johansen's ML approach is used to test for cointegration. Table 4 reports the maximal eigenvalue and the trace statistics, while Table 5 shows the rank test. In particular, the latter table displays the values of the maximized LL and the selection criteria, AIC, SBC and Hannan-Quinn criterion (HQC). It is obvious that the maximal eigenvalue and the trace statistics while both reject the null hypothesis of no cointegration they do not reject the existence of two but not three cointegrating relations at the 5% level of significance. Table 5 shows that while the value of the AIC slowed significantly after (r = 3) which may be taken as an indication to the possibility of the existence of three cointegrating vectors, the values of HQC lend some support towards this conclusion. Stronger evidence on the existence of three cointegrating vectors using the same statistics, however, can be observed in Tables 6 and 7, where not only segregation between endogenous and exogenous variables is imposed, but also admitting the changes in the exogenous variables in the VAR. The results of these two tables indicate that taking the segregation between the variables into consideration enhances the conclusion of the existence of three cointegrating vectors.

Table 4
Testing for Cointegration with Unrestricted Intercepts and Restricted Trends in the VAR

Order of the VAR = 1.

The Variables Included in the VAR are: ms, fa, y, x, g, r, et.

Test statistics	H_0	H_1	Estimated Statistics	95% Critical Value	90% Critical Value
Maximal Eigen-value	$r = 0$	$r = 1$	67.56	49.32	46.54
	$r \leq 1$	$r = 2$	44.37	43.61	40.76
	$r \leq 2$	$r = 3$	28.73	37.86	35.04
	$r \leq 3$	$r = 4$	18.00	31.79	29.13
	$r \leq 4$	$r = 5$	14.19	25.42	23.10
	$r \leq 5$	$r = 6$	13.27	19.22	17.18
	$r \leq 6$	$r = 7$	5.71	12.39	10.55

Test statistics	H_0	H_1	Estimated Statistics	95% Critical Value	90% Critical Value
Trace	$r = 0$	$r \geq 1$	191.83	147.27	141.82
	$r \leq 1$	$r \geq 2$	124.27	115.85	110.60
	$r \leq 2$	$r \geq 3$	79.90	87.17	82.88
	$r \leq 3$	$r \geq 4$	51.17	63.00	59.16
	$r \leq 4$	$r \geq 5$	33.17	42.34	39.34
	$r \leq 5$	$r \geq 6$	18.98	25.77	23.08
	$r \leq 6$	$r = 7$	5.71	12.39	10.55

Notes: Maximal Eigenvalue and the Trace are, respectively, the LR tests based on the Maximal Eigenvalue and on the Trace of the stochastic matrix. H_0 is the null hypothesis while H_1 is the alternative. r is the number of cointegrating vectors.

Table 5
Testing for the Number of Cointegrating Relations Using Model Selection Criteria with Unrestricted Intercepts and Restricted Trends in the VAR

Order of the VAR = 1.
The Variables Included in the VAR are: ms, fa, y, x, g, r, et.

Rank	LL	AIC	SBC	HQC
r = 0	14.99	7.99	2.35	6.00
r = 1	48.77	27.77	10.85	21.81
r = 2	70.96	37.96	11.28	28.59
r = 3	85.32	42.32	7.69	30.11
r = 4	94.32	43.32	2.24	28.84
r = 5	101.4	44.41	- 1.50	28.23
r = 6	108.1	47.05	- 2.08	29.73
r = 7	110.9	47.90	- 2.84	30.02

Notes: LL is the maximized Log-Likelihood, AIC is the Akaike Information criterion, SBC is the Schwarz Bayesian criterion and HQC is the Hannan-Quinn criterion.

Table 6
Testing for Cointegration with Unrestricted Intercepts and with Trends in the VAR

Order of VAR = 1.

The Variables Included in the VAR are: ms, fa, y, x, g, r, et.

The I (1) Endogenous Variables are: ms, fa, y.

The I (1) Exogenous Variables are: x, g, r, et.

The I (0) Variables included in the VAR are: Δx, Δg, Δpe, Δio, Δig, Δip, Δr, Δm0p, Δp, Δfe, Δet.

Test statistics	H_0	H_1	Estimated Statistics	95% Critical Value	90% Critical Value
Maximal Eigen-value	$r = 0$	$r = 1$	85.60	37.44	34.66
	$r \leq 1$	$r = 2$	39.92	30.55	27.86
	$r \leq 2$	$r = 3$	29.39	23.17	20.73
Trace	$r = 0$	$r \geq 1$	154.9	69.84	65.90
	$r \leq 1$	$r \geq 2$	69.31	45.10	41.57
	$r \leq 2$	$r = 3$	29.39	23.17	20.73

Notes: See notes to Table 4

Table 7
Testing for the Number of Cointegrating Relations Using Model Selection Criteria with Unrestricted Intercepts and Restricted Trends in the VAR

Order of VAR = 1.

The Variables Included in the VAR are: ms, fa, y, x, g, r, et.

The I (1) Endogenous Variables are: ms, fa, y.

The I (1) Exogenous Variables are: x, g, r, et.

The I (0) Variables included in the VAR are: Δx, Δg, Δpe, Δio, Δig, Δip, Δr, Δm0p, Δp, Δfe, Δet.

Rank	Maximized LL	AIC	SBC	HQC
r = 0	81.58	45.58	16.59	35.36
r = 1	124.4	78.38	41.33	65.32
r = 2	144.3	90.34	46.85	75.01
r = 3	159.0	99.04	50.71	82.00

Notes: See notes to Table 5

The ML estimates and their asymptotic t-ratios of the three cointegrating vectors subject to the exact and over-identifying restrictions given by (11-13) above are shown in Table 8. This table also shows the computed maximized values of the log-likelihood function subject to exactly identifying restrictions and subject to over-identifying restrictions, using the modified Newton-Raphson iterative algorithm, and accepting the ML estimates subject to exactly identifying restrictions as the initial values. It is striking that regardless of the limited number of observations and the large number of restrictions the calculated value of the LR test of the restrictions does not reject these restrictions, although it is known by its tendency to over reject the null hypothesis. This test is asymptotically distributed as χ^2 with r degrees of freedom, which equals a total number of eighteen restrictions minus nine just-identifying restrictions.

Table 8
Maximum Likelihood Estimates Subject to Over-Identifying Restrictions Order of VAR = 1.

Number of Cointegrating Vectors = 3.

The Variables Included in the VAR are: ms, fa, y, x, g, r, et.

The I(1) Endogenous Variables are: ms, fa, y.

The I(1) Exogenous Variables are: x, g, r, et.

The I(0) Variables included in the VAR are: Δx, Δg, Δpe, Δio, Δig, Δip, Δr, Δm0p, Δp, Δfe, Δet.

β-Vector and Statistics	Vector 1	Vector 2	Vector 3
β_{i1}	1.00	0.00	0.00
β_{i2}	0.00	1.00	0.00
β_{i3}	0.00	0.00	1.00
β_{i4}	- 1.00	0.00	- 1.00
β_{i5}	- 1.00	0.00	0.00
β_{i6}	- 0.130	- 0.334	- 0.071
	(- 3.71)	(- 4.56)	(- 3.23)
β_{i7}	- 0.367	- 1.00	0.00
	(- 11.1)		
β_{i8}	0.037	0.00	- 0.017
	(9.25)		(- 8.50)
LR = 11.8			
(0.223)			
LL = 159.04			
LL* = 153.12			

Notes: i relates to the i^{th} cointegrating vector. Numbers in parenthesis under the coefficients are the calculated t-ratios based on the asymptotic standard errors. LR is the log-likelihood ratio test statistic for testing the over-identifying restrictions and it is asymptotically distributed as a χ^2 with (9) degrees of freedom. The number in parenthesis under LR test statistic is the significance level. LL is the maximized value of the log-likelihood function subject to exactly identifying restrictions. LL* is the maximized value of the log-likelihood function subject to over-identifying restrictions.

Finally, using OLS the estimated ECM's, given by equations (16-18), that are associated with the cointegrated relations subject to the over-identifying restrictions are reported in Table 9 along with the t-values calculated from the Newey-West asymptotically heteroscedasticity and autocorrelation consistent standard errors. The Newey-West correction utilizes estimated autocovariances, the appropriate number of which depends on the generally unknown true degree of autocorrelation. The study, therefore, uses the Parzen window, which weights past autocovariances quadratically, and imposes a window size of one-third the sample size.

Table 9
The Estimated Error Correction Models of the Jointly Determined Variables Using OLS
Dependent Variables:

Independent Variables:	Δms_t	Δfa_t	Δy_t
Intercept	- 9.29	0.288	- 0.024
	(- 15.9)	(0.121)	(- 0.136)
$\varepsilon_{1\ t-1}$	- 1.06	0.598	- 0.016
	(- 15.2)	(2.23)	(- 0.993)
$\varepsilon_{2\ t-1}$	0.040	- 0.557	0.012
	(1.12)	(- 10.2)	(1.43)
$\varepsilon_{3\ t-1}$	1.09	- 0.089	- 0.126
	(11.0)	(- 0.228)	(- 3.36)
Δx_t	0.165	0.881	0.383
	(1.22)	(5.01)	(11.7)
Δg_t	0.547	0.168	0.004
	(2.39)	(0.536)	(0.072)
Δpe_t	- 0.207	0.845	0.168
	(- 0.914)	(1.77)	(2.79)
Δio_t	- 0.041	- 0.116	- 0.013
	(- 1.17)	(- 0.766)	(- 1.24)
Δig_t	0.038	- 0.017	- 0.037
	(0.389)	(- 0.072)	(- 2.17)
Δip_t	- 0.240	- 0.316	0.073
	(- 1.02)	(- 0.727)	(1.36)
Δr_t	- 0.077	0.043	0.004
	(- 3.73)	(0.845)	(0.757)
$\Delta m0p_t$	- 0.054	0.781	0.125
	(- 0.158)	(1.19)	(2.09)

Independent Variables:	Δms_t	Δfa_t	Δy_t
Δp_t	- 0.941	0.559	- 0.117
	(- 7.85)	(1.69)	(- 3.61)
Δfe_t	0.481	- 0.451	- 0.091
	(3.16)	(- 0.449)	(- 3.29)
Δet_t	0.519	0.837	0.088
	(9.67)	(2.45)	(4.73)

Notes: See equations 4-6. Numbers in parenthesis under the estimated coefficients are the calculated t-ratios based on Newey-West adjusted standard error's Parzen weights, with one-third of the sample size as the truncation lag. Diagnostic tests and the forecasting performance are reported in Table 10. The cointegrating vectors ε_1, ε_2, and ε_3 are as defined in Table (8) and they are as follows:

ε_1 = ms - x - g - 0.13 r - 0.367 et + 0.037t

ε_2 = fa - 0.334 r - et

ε_3 = y - x - 0.0.071 r - 0.017t

The first equation in this estimated system reported in the aforementioned table, which is the error correction equation of the military spending, shows that the coefficient of the error correction term associated with the long run military spending, $\varepsilon_{1\ t-1}$, is statistically significant and bares the expected theoretical sign. This suggests that if actual military spending in the previous period is higher than its equilibrium value then change in military spending in the next period is expected to fall, which brings actual military spending closer to its long run equilibrium path. This implies that the government corrects its decisions in the light of the error made in the previous period in adjusting military spending relative to the long-run desired level. While the error correction term associated with the long run foreign aid, ε_{1t-2}, in this equation is not statistically significant implying that decisions regarding military spending are conducted independently from foreign aid, the error correction term of the long run output relation, $\varepsilon_{1\ t-3}$, is highly significant and posses the required positive sign. The Wald test of restricting these two significant error correction terms to equal one in absolute value, which is distributed as a χ^2 with two degrees of freedom, reported in Table 10, does not permit rejection of this restriction. It may, therefore, be inferred that in the long run when all growth rates equal zero the elasticity of the military spending ratio (MS/Y) with respect to government expenditure is not different than one, i.e. the relation between military spending ratio and government expenditure is one to one. The magnitude of the coefficient of $\varepsilon_{1\ t-1}$ suggests that adjustment is completed within a year. The result of this equation also shows that some variables have significant predictive power to explain the growth of military spending in the short run. While inflation and the growth of interest rate reduce the growth of military spending, there is clear evidence that the growth of external threat, foreign labour recruitment and government expenditure contribute to the rise in military spending.

Table 10
Diagnostic Statistics for the Estimated Error Correction Models and the Multivariate Dynamic Forecasting Performance Equations:

Diagnostic and Forecasting Statistics	Δms_t	Δf_t	Δy_t
Diagnostic Statistics: 1963-2001			
R^2	0.906	0.738	0.936
DW	2.29	2.17	1.64
Serial Correlation: χ^2 (1)	1.80	0.535	1.63
	(0.179)	(0.464)	(0.201)
Normality: χ^2 (2)	0.349	0.514	0.520
	(0.177)	(0.773)	(0.771)
Heteroscedasticity: χ^2 (1)	0.119	0.364	1.83
	(0.730)	(0.546)	(0.176)
Wald test: χ^2 (2)	1.05		
	(0.593)		
Wald test: χ^2 (1)		0.025	
		(0.874)	
PT-test	5.22	3.07	4.95
Forecasting Performance:			
Mean 1963-1998	- 0.00	- 0.00	- 0.00
1999-2001	- 0.026	- 0.069	- 0.012
Mean Absolute 1963-1998	0.072	0.181	0.016
1999-2001	0.026	0.266	0.012
Mean Sum Squares 1963-1998	0.009	0.052	0.0004
1999-2001	0.001	0.095	0.0003
Root Mean Sum Squares 1963-1998	0.092	0.228	0.019
1999-2001	0.029	0.309	0.016

Notes: The estimated parameters of the error correction models are given in Table 9.

The second equation in Table 9 is the estimated equation of change in foreign aid. The result shows that the error correction term of the long-run foreign aid, $\varepsilon_{1\ t-2}$, is statistically significant and bears the expected negative sign. This substantiates the existence of foreign aid equation in an error correction format. The magnitude of the coefficient suggests reasonable speed of convergence to equilibrium once the equation is shocked. The result also shows that the error correction term associated with the long run equation of military spending, $\varepsilon_{1\ t-1}$, has a significant impact on the growth of foreign aid. This implies that military spending in the long run is not endogenous with respect to foreign aid. The endogeneity of the output of the economy with respect to foreign aid in the long run is, however, obvious since its associated error correction term, ε_{3t-1}, is not significantly different from zero. Given that the two significant error correction terms are equal in absolute value as shown by the insignificance of the value of the Wald test reported in Table 10, the ratio of guns to roses may be retrieved in the following equation:

$$log\ (MS/FA) = X + g - 0.204r - 0.633et - 0.037t \qquad (19)$$

The above equation shows the unit elasticities of the guns to roses ratio with respect to real exports and real government expenditure implying that a rise in any of these two determinants result in an equal rise in the ratio via the rise in military spending, while a rise in interest rate or the intensity of the external threat reduces the ratio of guns to roses via the rise in foreign aid, ceteris paribus. The existence of "La Gabelle" notion seems to be confirmed in the above equation. Returning back to the estimated error correction equation of foreign aid we observe that the growth of export, private expenditure and external threat are all have significant positive influences on the growth of foreign aid. Also this equation indicates that military spending and foreign aid are substitutes reflecting the peaceful nature of the Saudi regime.

The third equation shown in Table 9 is the estimated error correction equation of the output of the economy. The result shows that non of the two error correction terms associated with military spending and foreign aid are statistically significant implying their endogeneity with respect to the whole economy. The error correction term of the long-run output is statistically significant and has the expected negative sign, but its magnitude is quite small suggesting that it will take the economy a longer time to return to equilibrium after being shocked. Other variables found to exert significant positive influence on the growth of output are the growth of real exports, private expenditure and external threat. The growth of real outside money seems to contribute positively to economic growth but inflation seems to reduce real output with the same magnitude. It is striking that the growth of government investment is negative while the growth of government expenditure, investment by the oil sector and by the private sector have no influence on economic growth. This suggests, taking into consideration the low value of the coefficient of the growth of the private expenditure, that the government should switches its expenditures to programs that have direct benefits on the welfare of the people. The results also show that while recruiting more foreigners raises military spending due to the need for more money allocated for contracting military personnel, it has a significant negative impact on economic growth. This latter result is consistent with the law of diminishing returns being in operation. This is not a surprising result since the economy is over-saturated with foreign workers to the extent that the ratio of Saudi nationals to foreigners is highly likely to be at least one to one. This result calls for restructuring the foreign employment policies in the public and the private sectors.

The diagnostic statistics reported in Table 10 indicate the goodness of fit as shown by the high values of the coefficients of determination (R^2) and there is no evidence of serial correlation as demonstrated by both the calculated values of DW statistic and the Lagrange Multiplier test of residual serial correlation. Also the calculated normality statistics strongly reject non-normality among the residuals and heteroscedasticity is rejected for the three estimated equations. The calculated statistics of the Pesaran and Timmmermann (1992) test, denoted by PT, shown in the table exceed the critical value of the normal distribution suggesting that the fitted and the actual values come from the same statistical distribution. The statistics of the multivariate dynamic forecasting performance of the three equations over the period 1999-2001 shown in the same table do not point to serious problems of misspecification since the calculated forecasting statistics over the forecasting period are reasonably comparable with those reported for the period 1963-1998. It is worth noting that refitting these models over the period 1963-1998 to produce the three forecast points did not show any serious econometric divergence from the estimated models over the whole period.

3- Concluding Remarks:

The study postulates that the Saudi regime has long perceived the external threat posed by the Iranian regimes whether under the Shah of Iran who played the role of the policeman of the Gulf or under the militant leaders of Qom. Also the Saudi regime has recognized that the principle of exporting the revolution is not limited to itself but also may creep upon other regimes in Arab countries in the region. The official financial aid donated by the Saudi political regime to other Arab states is looked at as a political instrument not only to consolidate the position of these regimes for the sake of long-run stability in the region, but also to gain their support against the external military threat. This policy instrument is, however, conducted along side the accumulation of arms as a deterrent policy instrument by Saudi Arabia. To examine the relationship between these guns-and-roses instruments and their link to macroeconomic aggregates the study uses a multivariate cointegrated system comprising three long-run cointegrated relations for military spending, financial aid donated by Saudi Arabia to other Arab states and output. The empirical results over the period 1963-2001 demonstrate that financial aid is endogenous with respect to the growth of military spending in the short run which is consistent with the Saudi regime playing the anchor of stability of these regimes in the region. This, however, does not rule out the need of the Saudi regime in the long run for the support of these regimes against the external military threat as the one-to-one relation between financial aid and external threat is found. It is also documented that the guns-and-roses policy instruments are substitutes and that both have no influence on the economic growth suggesting that they are conducted endogenously. The study finds that a rise in export or in government expenditure raises the ratio of guns to roses via the rise in military spending, while a rise in interest rate or external threat reduces this ratio via the rise in roses, ceteris paribus. In particular, the one to one relation between military spending and exports found in the cointegrating vector of military spending establishes ‘‘La Gabelle’’ notion. Military spending instrument, however, seems to shrink real money in circulation and this is found to result in a pressure on the real interest rate upwardly. This implies that savings are induced and this will shrink real money in circulation even further which has its adverse effects on prices and in turn on wages and job offers for Saudi nationals. The results demonstrate that the law of diminishing returns with respect to foreign workers is operating on the whole economy. Given the reluctance of firms in the private sector to employ Saudi nationals due to the easy access to recruit the very low wage Asian workers, and that employment in the government sector has been halted, then the number of Saudi nationals falling down in the poverty trap without sound welfare programs will be on the rise resulting in resentment and aggressive behaviour. It is also demonstrated that neither the disaggregated investment variables nor government expenditure has any positive impact on economic growth. Therefore, the study calls for redirecting government expenditure to the programs that have direct bearing on the welfare of the Saudi nationals. Also the study calls for reforming and restructuring the foreign recruitment policies in the public and the private sectors.

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DATA APPENDIX

OBS.	NMS_t	$IRANMS_t$	$ICPI_t$	NFA_t	NPO_t
1963	.54100	14.4870	.65921	.16188	4.6700
1964	.53100	16.6060.	68436	.17181	4.6900
1965	.56100	22.8260	.69910	.21553	4.7300
1966	1.0500	31.3650	.69639	.28966	4.9700
1967	1.5970	40.0300	.70751	.40355	5.1000
1968	1.2240	45.7340	.71240	.39810	5.2400
1969	1.3960	42.1600	.73800	.42402	5.3280
1970	1.6650	45.1200	.75030	.77400	5.8410
1971	1.9250	73.2150	.78177	.95679	6.3080
1972	2.6570	131.8750	.83179	1.5189	7.7650
1973	3.9830	253.9500	.91347	4.1254	10.1330
1974	5.9320	315.0000	1.0436	7.6077	18.2530
1975	16.7900	453.0000	1.1780	9.4951	28.3820
1976	31.5350	547.0000	1.3106	10.6888	40.2190
1977	31.6700	564.0000	1.6683	10.8781	50.8840
1978	38.6850	585.0000	1.8638	18.5776	61.3350
1979	52.3880	386.2250	2.0593	14.2439	74.5590
1980	64.0760	363.8000	2.4844	18.9040	88.5200
1981	75.7250	345.9000	3.0858	18.6539	102.8740
1982	87.6950	341.3250	3.6625	13.2077	117.4450
1983	84.3110	340.1250	4.3855	11.2598	127.8160
1984	77.8170	362.6250	4.9354	11.2557	129.9980
1985	71.9920	454.5000	5.1521	9.5285	130.9810
1986	62.4180	469.3730	6.1015	13.0270	123.6860
1987	60.7260	645.0000	7.8448	10.8156	122.9670
1988	52.1530	703.0000	10.0940	7.6698	126.8120
1989	48.9460	811.0000	12.3499	4.3817	130.0450

OBS.	NMS_t	$IRANMS_t$	$ICPI_t$	NFA_t	NPO_t
1990	50.0000	1011.0	13.2919	16.5904	139.0080
1991	100.0000	1235.0	15.5686	7.0032	148.4500
1992	54.0000	1482.0	19.5865	3.5952	156.3650
1993	61.6360	2255.0	23.7394	3.0372	162.7600
1994	53.5490	4023.0	31.2047	2.3481	168.3980
1995	49.5010	4457.0	46.6997	2.5541	172.9390
1996	50.0250	6499.0	60.2132	5.7095	236.6070
1997	66.0000	8540.0	70.6600	7.6692	247.8340
1998	78.0000	10624.0	83.2843	5.8449	252.2120
1999	69.0000	12933.0	100.0000	7.4330	262.2270
2000	75.0000	21936.0	114.4764	10.6160	271.9360
2001	115.0000*	32163.0	136.2681	10.5848	281.5090

* The figure of this year is underestimated in SIPRI.

OBS.	NGO_t	NO_t	PE_t	G_t	IG_t
1963	1.4800	5.5300	2.8400	1.4300	.57000
1964	1.6100	6.2900	2.9100	1.6500	.80000
1965	1.7500	7.2700	3.6400	1.9200	1.1000
1966	2.0300	7.6500	4.0000	2.6700	1.0200
1967	2.0600	8.5900	4.5900	2.7500	1.1200
1968	2.1500	9.0900	5.3600	3.0300	1.2400
1969	2.2580	9.5660	5.1600	3.4210	1.2100
1970	2.4120	14.3290	6.4120	3.7980	1.2000
1971	2.8760	18.6740	6.9200	4.2850	1.4400
1972	3.6370	28.6840	7.9000	5.3350	1.9900
1973	5.2970	83.4100	9.8300	9.8640	3.4200
1974	9.8710	111.1010	18.0400	15.9110	7.3700
1975	18.9410	116.5700	23.9000	28.8830	17.4910

OBS.	NGO_t	NO_t	PE_t	G_t	IG_t
1976	27.4750	136.2490	34.4000	41.0330	27.3520
1977	38.9990	133.9350	54.6100	47.0340	40.4840
1978	45.9030	140.3840	68.6100	71.9040	49.0310
1979	56.3250	252.7050	102.4000	77.5630	61.5980
1980	68.7330	360.7410	114.9100	81.9150	66.8740
1981	81.4180	337.8840	126.5100	128.5260	73.8810
1982	87.9920	206.3600	151.3000	126.8540	66.4110
1983	82.5940	157.9890	157.3700	121.3250	50.0260
1984	84.8710	132.5550	159.4000	121.0550	46.3140
1985	82.0920	96.9580	158.6000	114.3880	32.7750
1986	76.6990	67.4610	140.1500	106.3670	25.1840
1987	78.5900	70.4430	135.5400	107.7070	27.4020
1988	80.9810	69.1150	139.4000	97.4170	24.0290
1989	83.2890	90.7490	145.0300	96.5640	26.2850
1990	99.5250	146.4600	155.8700	120.1260	42.4910
1991	119.0620	167.5250	168.7500	165.0000	45.2010
1992	109.4090	186.5240	183.9200	148.9650	32.2890
1993	113.4410	158.3640	193.9100	127.7790	30.0290
1994	115.6160	157.7220	185.8300	119.5610	23.9690
1995	123.0110	175.2010	193.5220	122.8490	25.1680
1996	116.7410	228.5250	259.4860	144.7840	12.9140
1997	130.5650	230.4030	261.4280	161.7950	16.1020
1998	129.2490	155.1730	251.4180	155.1920	12.4370
1999	130.2550	201.4740	252.2170	154.0940	12.9580
2000	133.2680	291.8030	258.1260	183.8040	16.3530
2001	138.4240	270.3930	255.7840	188.6950	16.7890

OBS.	IP_t	IO_t	$M0_t$	$EXPORT_t$
1963	.49000	.15000	.84600	5.5300
1964	.70000	.21000	.97800	6.2900
1965	.95000	.28000	1.1040	7.2700
1966	.88000	.26000	1.2410	7.6500
1967	.99000	.28000	1.3740	8.5900
1968	1.0700	.32000	1.4530	9.0900
1969	1.0630	.32700	1.5280	10.3020
1970	1.1530	.57700	1.6420	15.1890
1971	1.2890	.67100	1.9510	19.8620
1972	1.6700	2.0400	2.4880	30.0120
1973	2.3480	2.6320	3.3740	85.6820
1974	6.6710	3.6590	5.0520	114.4610
1975	10.6270	5.4220	8.5590	120.2840
1976	16.5220	7.3160	13.6080	140.3210
1977	18.3530	8.0530	17.9700	140.7640
1978	19.3970	8.2220	21.0100	147.2380
1979	23.2080	12.2640	25.1990	258.4880
1980	28.6950	10.8110	26.1440	368.4250
1981	35.8350	12.6040	30.4210	354.9200
1982	34.1670	14.8820	35.2810	219.4450
1983	41.3220	11.8820	34.6550	167.1750
1984	40.6220	9.5540	34.7500	145.5300
1985	35.2330	8.3020	36.8680	113.1630
1986	32.0290	8.9270	38.6040	85.9890
1987	31.0450	6.7530	39.3960	99.0450
1988	31.6440	1.2470	35.9450	103.0790
1989	32.5910	1.5340	33.8770	118.2050
1990	27.0750	4.2340	44.7760	181.1320

OBS.	IP_t	IO_t	$M0_t$	$EXPORT_t$
1991	36.8040	4.5050	44.6200	197.2780
1992	54.6910	7.0000	43.7720	207.8650
1993	60.4210	8.0000	42.6230	179.4030
1994	51.6540	8.1540	44.9650	181.8920
1995	53.6190	14.7680	43.0870	209.3710
1996	81.3980	8.5360	43.0380	237.8120
1997	83.8460	9.2930	45.8230	243.3840
1998	89.0560	11.4660	45.0190	163.0990
1999	92.0910	13.1470	55.0600	210.2310
2000	92.9530	14.0180	51.0190	308.4730
2001	95.4290	14.3910	49.2030	292.9130

OBS.	DNS_t	$D1_t$	$D2_t$	$D3_t$	FE_t
1963	-	11.4340	9.8056	10.6536	1.3614
1964	4.0000	10.4572	9.5425	9.8664	1.4080
1965	4.5000	11.3813	9.3670	10.5204	1.4437
1966	4.5000	7.3596	10.3949	7.7310	1.4800
1967	4.5000	10.4779	9.6836	9.9121	1.5418
1968	5.5000	12.0207	10.3333	11.2055	1.5598
1969	6.0000	13.3511	10.9530	12.3336	1.6065
1970	5.5000	13.7517	13.5817	14.1837	1.5340
1971	4.4935	14.2857	14.5675	15.1704	1.5343
1972	4.4255	15.6208	18.0725	18.2538	1.1660
1973	7.3825	18.4246	45.5646	38.9743	1.1863
1974	7.7113	29.7730	64.4038	54.3913	1.6588
1975	5.9909	41.9226	66.8134	59.0781	1.5537
1976	5.2534	51.1348	69.0040	64.0116	1.6780
1977	5.9986	59.2790	68.2373	66.1083	1.5855
1978	9.4639	63.5514	69.8803	68.5750	1.5794

OBS.	DNS_t	$D1_t$	$D2_t$	$D3_t$	FE_t
1979	11.9885	69.4259	115.9906	96.4490	1.5636
1980	12.9898	74.0988	160.2396	120.6230	1.8430
1981	12.0167	78.1041	165.3930	119.5129	2.0587
1982	8.5129	81.0414	157.9395	105.6993	2.1288
1983	8.5081	80.3738	132.7481	94.7223	2.8238
1984	8.0198	81.0414	126.7241	91.5156	3.0827
1985	7.5277	79.8398	114.3474	85.1021	3.4103
1986	5.5221	77.5701	56.7367	69.5617	3.6098
1987	6.0110	76.2350	66.9230	71.6584	4.1022
1988	6.5000	77.0360	54.3270	68.4517	4.9398
1989	7.0000	77.9706	72.9471	74.7418	4.9748
1990	6.5000	81.8425	96.2771	85.4721	3.8304
1991	3.5000	89.9866	89.0481	89.0489	4.7481
1992	3.0000	88.9186	92.7721	90.0356	5.9093
1993	3.0000	91.5888	81.6000	87.0755	6.1988
1994	4.7500	93.5915	81.1619	88.0622	6.2837
1995	5.2500	97.1963	89.8148	93.7356	6.4234
1996	5.0000	100.0000	106.7920	101.9992	6.6222
1997	5.0000	102.0000	108.7890	103.9984	6.6383
1998	4.5000	100.0000	70.8672	90.0041	7.0887
1999	5.0000	100.0000	100.0000	100.0000	7.6891
2000	6.0000	99.0000	136.0000	112.0000	7.3885
2001	3.3000	100.0000	127.0000	109.0000	7.6548

Notes:

Apart from IRANMS and ICPI, all variables belong to the Saudi economy. The variables given in the Data Appendix above are defined as follows:

- NMS_t is the military spending in nominal terms.
- $IRANMS_t$ is the Iranian military spending in nominal terms.
- $ICPI_t$ is the Iranian consumer price index.
- $NFAR_t$ is the nominal financial aid donated by Saudi to other Arab states.
- NPO_t is the nominal private (non-oil) output.
- NGO_t is the nominal government output.
- NOO_t is the nominal oil output.
- PE_t is the private expenditure.
- GE_t is the government expenditure.
- IG_t is the nominal investment by the government sector.
- IP_t is the nominal investment by the private sector.
- IO_t is the investment by the oil sector.
- $M0_t$ is outside money or money in circulation.
- $EXPORT_t$ is the nominal export.
- $DSNR_t$ is the nominal discount rate of the USA adjusted for the Saudi exchange rate expectations.
- $D1_t$ is private (non-oil) output deflator.
- $D2_t$ is the oil output deflator.
- $D3_t$ is the output deflator.
- FE_t is the number of foreign workers

The following constructions of the variables have come out from long trials. Our guide is that the results should satisfy the tests of serial correlation, normality and heteroscedasticity. Also they should have statistically valid restrictions, reasonable predictive power and relatively better out-of-sample forecasting performance. It is worth noting that the procedure of estimation is quite sensitive to any changes in the construction of the variables. The variables are constructed as follows:

$ms_t = \log((NMS_t/D1_t)*100)$

$fa_t = \log((NFAR_t/D1_t)*100)$

y_t = log(((NPO$_t$/D1$_t$)*100) + ((NGO$_t$/D1$_t$)*100) + ((NOO$_t$/D2$_t$)*100))
et_t = log((IRANMS$_t$/ICPI$_t$)*100)
g_t = log((GE$_t$/D3$_t$)*100)
pe_t = log((PE$_t$/D1$_t$)*100)
ig_t = log((IG$_t$/D3$_t$)*100)
ip_t = log((IP$_t$/D3$_t$)*100)
io_t = log((IO$_t$/D2$_t$)*100)
x_t = log((EXPORT$_t$/D2$_t$)*100)
r_t = DNSR$_t$ - log(D1$_t$/D1$_{t-1}$)
fe_t = log(FE$_t$)
p_t = log(D1$_t$)
$m0p_t$ = log((m0$_t$/D1$_t$)*100)
Δ is the first difference of the variable.

Data has been compiled from various issues of the IFS, SIPRI, the annual economic reports of the Saudi Arabian Monetary Agency (SAMA), the Gulf Co-operation council (GCC) and the Arab League.