Guns and Butter? Military Expenditure and Health Spending on the Eve of the Arab Spring

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Abstract

We examine the validity of the guns versus butter hypothesis in the pre Arab Spring era. Using panel data from 1995-2011—the eve of the Arab uprisings—we find no evidence that increased security needs as measured by the number of domestic terrorist attacks are complemented by increased military spending or more importantly 'crowd out' government expenditure on key public goods such as health care. This suggests that both expenditure decisions were determined by other considerations at the government level.

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1. Introduction

Do security incidents lead to increased military expenditure and lower investment in vital public services such as health care? The Middle East and North Africa (MENA) provides an ideal context in which to examine this relationship. The region has been prone to conflict; high security needs and is home to six of the world's top ten highest military spending countries. In addition, policy-makers and academics are searching for explanations of the 2011 Arab uprisings or awakening and trying to understand how public policy decisions are made in the region. A more nuanced understanding of the policy making process in the region it is argued could help in more effective targeting of external donor funding for development and humanitarian assistance.

The widespread policy and academic view is that in a region renowned for protracted conflicts and terrorism MENA policy-makers have prioritized military and security expenditures, which has led to the subsequent neglect of wider public policy and social welfare such as education and health, thereby increasing poverty and inequalities and creating the social and economic conditions for social unrest. It is argued that over the last forty years, Arab populations had accepted the 'authoritarian bargain' and the associated militarization of societies in return for domestic security at the expense of their social welfare and social mobility. However, the existing evidence is equivocal about the determinants of this relationship. The majority of studies have focused on OCED countries and provide mixed findings. Only a handful of studies have been identified in the MENA region, which find that increased military expenditure crowds-out welfare spending on health and crowds-in spending on education.

In this paper, panel data for 18 MENA countries is collated from the World Development Indicators database of the World Bank. Security needs are estimated using data on casualties resulting from terrorist attacks (number of deaths and serious injuries). This is retrieved from the Global Terrorism Database (GTD) provided by the National Consortium for the Study of Terrorism and Responses to Terrorism (START). Previous studies on the MENA region have not considered security incidents as a potential driver of military expenditure. In contrast to existing studies of the military social welfare expenditure nexus that focus on OECD countries and use simple correlation analysis, we provide an analytical framework based on regression analysis and the Panel Vector Auto Regressive model (PVAR) to systematically explore the trade-off between military and public health expenditures.

Using a panel data from 1995-2011—the eve of the Arab uprisings—we find no evidence that increased security needs as measured by the number of domestic terrorist attacks are complimented by increased military spending and thereby 'crowd out' and reduce government expenditure on key public goods such as health care. We validate these findings with four additional modeling approaches: Generalized methods of moments (GMM), Seemingly Unrelated Regression (SUR), instrumental variable regressions, and Granger causality tests. The results indicate that, in the pre Arab Spring period 1995-2011, military expenditures did not lead to a decline in public health spending in the MENA region, which suggests that both expenditure decisions were determined by other considerations at the government level. Our results show that claims about the 'warfare versus welfare / guns versus butter' hypotheses in the MENA are not so straightforward as many political scientists and regional commentators would like to believe. This relationship and the potential causes of the Arab uprisings require a far more nuanced and evidence-based understanding of decision-making and the political economy of policy-making in the region.

The remainder of the paper unfolds as follows. In Section 2, we review the results from the literature on the guns and butter trade-off. In Section 3, we present some stylized facts on the military spending in the MENA region. In Section 4, we discuss the data and econometric methodology, while in Section 5, we present the empirical findings while results from robustness checks are relegated to the supplemental appendix. Finally, Section 6 provides some concluding remarks.

2. Evidence of 'Guns versus Butter'

Empirical evidence linking military and social expenditures assumes that defense spending is increased at the cost of other forms of public expenditure and concludes that "guns do come at the expense of butter" (Russett, 1969). The guns versus butter nexus defines a potential trade-off between military and social spending (e.g. public health, public education, welfare, etc.). The conclusion of Russett (1969, 1982) confirms what was, at the time, a widely held belief that spending on health and education is negatively affected by military expenditure, particularly during times of conflict. Russett's (1969) analysis is based on US spending between 1939-68 alongside France and the UK, which returned similar results. However, in studying Canada, Russett (1969) returned a positive set of results and so paved the way for an array of literature and analysis over 50 years, which has not lead to a universal consensus for or against the 'gun vs butter' hypothesis. For instance, Yildirim and Sezgin (2002) employ a

SUR model in an effort to elucidate the relationship between military and social expenditures, focusing only on Turkey between 1924 and 1996. In line with the original theory, they also conclude that a trade-off exists between health and military spending; by contrast education spending indicated a positive relationship with military spending. They also propose that there is a sequential funding of health and education once military expenditure has been allocated. This idea was discussed by Deger (1985) who had issued a warning that notoriously elusive endogenous expenditure decisions should be afforded priority when investigating the trade-off.[1]

The military-welfare trade-off has been documented in a number of studies following Russett's (1969) seminal work (e.g. Peroff and Podolak-Warren, 1979; Deger, 1985; Apostolakis, 1992, among others). Russett (1982) utilized time series analysis of the US case from 1941-71 in which he found that no relationship exists between social spending and military spending. Furthermore, Verner (1983) examined 18 Latin American countries in a time series analysis with linear and non-linear regression models and found that only in El Salvador was there a trade-off, in seven countries there was no trade-off, whilst in 10 countries a positive relationship was observed. It is clear then, the extant literature includes numerous analyses using a variety of methodologies in an effort to uncover conclusive evidence on the military-social trade-off. Moreover, the applied methodologies have, necessarily, become more nuanced and complex.

The post-Cold War era has not as yet provided a rich mine of evidence for the military-social trade-off particularly in direct comparison to the Cold war era; Neuman (1994) suggests the complexity of analysis now required is a significant factor in its paucity.[2] Combining cross-sectional and panel data is recommended by Lin *et al.* (2015) in order to provide an accurate examination of the trade-off. It is proposed that this addresses statistical problems related to heterogeneity across countries. Their findings from 32 OECD countries between 1998 and 2005 suggest that defense expenditures crowd out both health and education spending. However, they remain equivocal about the relationship within non-OECD countries. Similarly, Reeves and Stuckler (2013) examine the relationship between military and health spending in 31 OECD countries including Israel. They assert that Israel practices a sequential

[1] The observation on sequential spending is also attributed to British Prime Minister Thatcher regarding the USSR and has subsequently been adopted by authors such as Reeves and Stuckler (2013) in their assessment of Israeli public spending priorities.

[2] Within the broader literature on the role of military expenditure, mixed evidence is found about the role of military expenditure and economic growth (Dunne, 1996; Dunne *et al.*, 2005; Dunne and Tian, 2015; and d'Agostino *et al.*, 2017).

spending principle which prioritizes military spending over other public spending due to its high security needs and high debt burden.[3] The initial assumption regarding sequential spending is refuted in their analysis of 31 OECD countries which demonstrated a positive correlation between military and health spending over the past 30 years ($r = 0.16, p < 0.01$)[4]. The authors conclude that there is "no inevitable crowding out of public health from defense among high-income countries".[5] Additionally, the analysis shows that if high security needs and debt burdens determined military spending, the consequence would be that, during recessions, health spending should be reduced while violent conflicts should increase military spending. The authors conclude that "in countries with high security needs, defense and health are complementary".[6] It is an interesting omission, however, that Israel is the only Middle East and North Africa (MENA) region country to be included in the analysis despite many neighbouring countries in the region reporting higher numbers of security incidents than Israel as well as the fact that six of the world's top ten military spenders (percentage of GDP) are located in the MENA region (See Table 1).

[Table 1 near here]

Finally, Elbadawi and Keefer (2014) examine the determinants of military expenditures in 140 countries using pooled OLS regression. They find that rising military spending in the MENA region is mainly due to increased security risks in the region. However, as their focus is to understand the nexus of democratization, regional politics, and military expenses, they do not consider trade-offs between military and other types of expenditure.

3. Military spending in the MENA region

Looking at Table 1, in overall military expenditure, the global average is 1.9% of GDP with Saudi Arabia being the only MENA country registered in the top ten spenders. However, as a percentage share of GDP, MENA countries occupy six of the top ten positions worldwide (UN-ESCWA, 2014: 137; SIPRI, 2014). Oman tops the list at 10.84% of GDP while Saudi Arabia spends 8.52% of its GDP. In terms of global priorities, countries tend to spend the most on education followed by health and then the military. In the MENA region, the priority is also education but the trend has been that of high spending on military and health;

[3] Reeves and Stuckler p.1.
[4] *Ibid.*
[5] *Ibid* 3.
[6] *Ibid* 3

underlined by the fact that the MENA countries surpassed the global average on both (UN-ESCWA 2013: 15, 2014: 136-137).

Gaub (2014) states that "had Arab States adjusted their military budgets to European levels in 1990—and maintained them—their economies would have grown by 2-3 per cent a year, and generated output levels over 50 per cent higher than at present." Military expenditure in this regard is clearly seen as a heavy burden across the MENA region. A number of regional commentators have proposed that there is a clear trade-off between military and social expenditure although these assertions are based on limited evidence and simple correlation analysis (UN-ESCWA 2013: 16[7]). To the best of our knowledge, only a handful of rigorous studies exist which examine the trade-offs in the MENA region. Bauwens (2012) examines eight countries: Bahrain, Egypt, Iran, Israel, Jordan, Kuwait, Lebanon, and Tunisia from 1990-2009. By employing the least squares dummy variable (LSDV) regression model, the results highlight a trade-off between military spending and social spending. It is found that a one percentage point increase in defense spending as a share of central government expenditures decreases educational spending by 1.04% and health spending by only 0.16%.

Ali (2011) documents the experience of Egypt from 1987 to 2005 using a seemingly unrelated regression estimation (SUR) model. The study finds that higher military expenditure crowds-out (lowers) health spending and crowds-in (increases) spending on education. In a panel study of 16 MENA countries from 1987 to 2005, Ali (2012) further notes that military expenditures were found to reduce income inequalities. Similarly, Yildirim and Sezgin (2002) using SUR estimation methods of Turkish data between 1924-1996 document evidence of a trade-off (crowing out) between military expenditure and health spending. These studies comment that providing explanations and a conceptual framework for the findings is difficult. A variety of pathways could be considered. First, the unstable and conflict-prone environment which has come to dominate the region has provided the opportunity for elites and policy-makers to justify increased security and military spending particularly surrounding the need to curtail internal 'terrorist' threats, predominantly from militant organizations. Second, Ali (2012) argues that across the region the military and security services are so endemic within all aspects of a society and public services, which makes it challenging for researchers to extrapolate where exactly military spending begins and ends. For instance, which government entity deals with security incidents and counter-

[7] "Governments have focused almost exclusively on their own survival instead of the well-being of their own populations" (ESCWA 2013: 16).

terrorism efforts? In many MENA countries this is usually managed by the security services, not the military. This makes analysis of military spending challenging as it is difficult to disaggregate and know how much of it is linked to counter-terrorism rather than traditional defense. Government spending on military and social welfare may also be influenced by the foreign policies of external international powers, which aim to secure regional political stability at the expense of economic development and the social protection and wellbeing of domestic populations (UN-ESCWA 2013; Cammett *et al.*, 2015).

4. Data and econometric model

4.1. Data

In this paper, we contribute to the existing literature by Ali (2011, 2012) and Bauwens (2012) by providing new empirical evidence from the MENA region focusing on the relationship between military expenditure and health. In contrast to Reeves and Stuckler (2013) who use bivariate correlation analysis on OECD countries, we deploy multivariate regression analysis to explore the trade-off between military and health expenditures. We use annual data covering the pre- 'Arab Spring' period 1995-2011. The data spans 18 MENA countries: Algeria, Bahrain, Egypt, Iraq, Iran, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia (KSA), Syria, Tunisia, Turkey, United Arab Emirates (UAE), and Yemen. Data on total health expenditure defined as the percentage of Gross Domestic Product (GDP) and military expenditure defined as the percentage of GDP are taken from the World Development Indicators database provided by the World Bank. Data on casualties resulting from terrorist attacks (number of deaths and serious injuries) is retrieved from the Global Terrorism Database (GTD) provided by the National Consortium for the Study of Terrorism and Responses to Terrorism (START).

Ali (2012) recommends that in the analysis of the 'warfare versus welfare' hypothesis future studies should disaggregate social expenditures (education, health, food subsidies) in order to provide a more in-depth understanding of the relationship to military spending. In this article we therefore focus on health expenditure.

Table 2 presents summary statistics of the variables used in the analysis for the whole panel over the period 1995-2011. The average values of total health expenditure and military expenditure are around 5% of GDP in the MENA region. The average number of deaths and serious injuries caused by terrorist attacks is equal to 347 per country per year.

[Table 2 near here]

Figure 1 plots the data on health and military spending in the MENA region in 2010. The negative relationship between military and health spending suggests that a trade-off exists. Countries with the highest level of military expenditure have the lowest levels of total health expenditure. More specifically, countries in the Gulf Cooperation Council (GCC) seem to have the largest trade-off. Our results from a simple correlation analysis are in line with these patterns.

[Figure 1 near here]

4.2. Econometric model

We use a vector autoregressive model with panel data (PVAR) to take into account the unobserved country heterogeneity in line with Holtz-Eakin *et al.* (1988). The PVAR model, in contrast to the simple correlation test, fully exploits the panel data nature of our dataset by considering simultaneously time series and cross sectional dependencies. In addition to overcoming the inefficiency of the pooled Ordinary Least Squares (OLS), fixed effects (FE), and random effects (RE) models, this model does not suffer from the omitted-variable bias found in these models. Instead, the PVAR model assumes that all variables are endogenous. An additional advantage of the PVAR model is that it captures dynamic features by considering the lagged dependent variable among the covariates.

The first order PVAR model is represented as follows:

$$y_{it} = \alpha + \beta y_{it-1} + u_i + \varepsilon_{it} \qquad (1)$$

In equation (1) y_{it} is a (3x1) vector of three variables [total health expenditure, military expenditure, casualties due to terrorist attacks]; y_{it-1} is a (3x1) vector of the lagged variables [total health expenditure, military expenditure, casualties due to terrorist attacks]; α is a (3x1) vector and β is a (3x3) vector of the parameters to be estimated; u_i is a vector of country fixed effects; ε_{it} a is vector of error terms. All the variables are considered to be endogenous *ex ante*.

In applying the VAR procedure to panel data, we need to impose the restriction that the underlying structure is the same for each cross-sectional unit. Since this constraint is likely to be violated in practice, one way to overcome the restriction on parameters is to allow for 'individual heterogeneity' in the levels of the variables by introducing fixed effects. Since the fixed effects are correlated with the regressors due to lags of the dependent variables, the mean-differencing procedure commonly used to eliminate fixed effects would create biased coefficients. To avoid this problem we use forward mean-differencing, also referred to as the 'Helmert procedure' (see Arellano and Bover, 1995). This procedure removes only the forward mean, i.e. the mean of all the future observations available for each country-year. This transformation preserves the orthogonality between transformed variables and lagged regressors.

Before conducting the regression analysis, the statistical properties of the panel data used in the analysis are examined. We utilize three tests commonly adopted in the empirical literature to study the stationarity of the variables, which is a necessary step before estimating the relationships among the variables. This is done because using non-stationary variables may lead to spurious correlation. We run the panel versions of the classical Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981), the Phillips-Perron (PP) (Phillips and Perron, 1988), and Im- Pesaran-Shin (2003) tests. The null hypothesis for these tests indicates the presence of non-stationarity. The results of these tests are presented in Table 3. The results show that the health expenditures variable is not stationary in level but becomes stationary when taking the first difference, we conclude that it is integrated of order one, I(1). The military expenditures variable is not stationary when looking at the ADF test, but stationary when using alternative tests. Using all three tests, the terrorist attacks variable is found to be stationary in level and therefore is integrated at order zero, I(0). Given our stationarity tests, we use the first difference of log level (growth rate) for each variable when estimating our model for consistency.

[Table 3 near here]

We explore additional models and methods often used in the literature in the supplemental appendix as a robustness check. We first run a SUR regression since researchers often use SUR to model trade-offs across different spending categories (e.g., Anderson and Blundell 1982; Ali 2011, Kiviet and Schipp 1995; Yildirim and Szegin 2002; Hessami 2014; Zellner

1962). In our case, we are interested in the trade-off between health and military expenditure. We thus run a system of two equations and allow for arbitrary cross-equation correlation to capture the impact of unobserved confounders that cause co-movement in both health and military expenditure. Terrorist attacks are considered an observable confounder. Second, we deploy in the appendix an instrumental variables framework in which the focal outcome is health expenditure and military spending is a potentially endogenous regressor. We introduce terrorism casualties as a plausible instrument for military expenditure, and use it to identify the effect of military spending on health spending. Finally, we use a Granger causality test. Here, we test if past spending of military spending can *predict* current health expenditure.

5. Empirical results

Table 4 presents the PVAR estimation results. The variable *total health expenditure* is regressed on its own lagged value, military expenditure, and casualties due to terrorist attacks variables. We find that military expenditure has a negative but insignificant impact on total health expenditure. Although the result is in line with the simple correlation test, the statistical insignificance of military expenditures suggest that the negative correlation is spurious and therefore the results do not lend support to the 'crowding out' hypothesis stating that governments that increase the military spending do so at the expense of their contribution to the total expenditure on health care in their respective economy. Taken together, our results indicate that, in the pre-Arab Spring period 1995-2011, military expenditures did not crowd out health expenditures in the MENA region, which suggests that both expenditures decisions were governed by other considerations at the government level. These results are also in contrast to those of Lin *et al.* (2015) who also use a regression analysis but for the OECD countries. Our results in Table 4 show that terrorist attacks and security incidents did not have any significant implications on the total health expenditure in the pre Arab Spring period.

[Table 4 near here]

The robustness analyses—outlined in the supplemental appendix—reinforce the main finding: military spending does not crowd-out health spending. In the SUR model, we find no evidence for terror casualties to affect either health or military expenditure. Furthermore, there is a residual positive (rather than negative as the guns-versus-butter trade-off would

suggest) correlation between health and military expenditure due to unobserved factors. In the instrumental variables regression, we find no evidence that changes in or levels of military expenditure affects health expenditure cuts. Lastly, Granger causality tests do not indicate that health and military spending can be predicted by each other, neither in levels nor in differences. Overall, these results lend overwhelming support to our main conclusion.

6. Concluding remarks

Many studies have explored the potential trade-off between military and social expenditures (see Zhang *et al.* 2016 for full review). Given the use of different methodologies, datasets and country contexts and histories, the evidence available is mixed. In this paper we attempted to address the methodological weaknesses found in previous studies and to provide new evidence from the MENA region, which contributes to shedding some light on potential drivers of the 2011 'Arab Spring' and the policy making process in the region.

We note one limitation of our study. A null-result does not prove the absence of a relationship. In other words, military spending might affect health spending via pathways that our models have not captured. It could be the case that if there has been any crowding-out effect of health spending that then it could have occurred in the past, pre-1995. Given that the region has been conflict prone during the last century—such as civil war in Yemen 1994, Gulf war 1990-1991, followed by the Iraqi uprising in 1991, KDPI insurgency in Iran 1989-1996, Grand Mosque Seizure in Saudi Arabia 1979, Dhofar Rebellion in Oman 1962-1975, Lebanon civil war 1975-1990, Iran-Iraq war 1980-1988 and so the list continues—such a hypothesis carries substantial weight. The studies of Ali (2011) and (2012) using data from the MENA from 1987 to 2005 would lend support to this idea. However, empirically testing this hypothesis is difficult due to lack of reliable reporting of government expenditure data pre-1995 from across the 18 MENA countries. We thus consider that our study contributes to the bricolage of evidence from the region and provides additional insights to those of Ali (2011) and (2012) and the guns versus butter evidence base more broadly. The results can help orientate future research to explore the un-modeled pathways in the guns-versus-butter nexus, particularly in the MENA region.

Our main finding is that the apparent trade-off reported between military and health spending is found to be spurious on the eve of the so-called Arab Spring (1995-2010). The analysis and results provide a cautionary note against the reliance on simple correlation analysis to draw important policy conclusions about the relationship between various government

expenditures as reported elsewhere (See for example UN-ESCWA 2013). Academics and policy makers should be careful in assuming that models and results from studies such as those of the OECD can be transplanted onto another region such as that of the MENA without consideration of the historical experiences and political economy factors.

Determining the causes of unrest is a rather more complex empirical and policy task than envisioned by UN-ESCWA (2013) and those who claim there was an authoritarian bargain between MENA publics and their governments in order to main the status quo and security in region beset by conflict (Desai *et al.*, 2011). Moreover, the results suggest that support of MENA governments for the military and security apparatus prior to the 'Arab Spring' did not seem to play a role in crowding out health expenditures: a finding that is contrary to that proposed by Lin *et al.* (2013).

Further our results compliment those of Ali and Abdellatif (2013) who find in their study of military expenditure and natural resources in the MENA that the presence of regional conflict had no influence on rates of military spending. Our results further show that internal terrorist incidents and security needs had no effect on military expenditure. There are a number of possible explanations. It could be that this represents the fact that security needs and counter terrorism are not dealt with by the military and so would not be reflected in the expenditure. In many MENA countries, terrorism related threats are typically addressed by the ministries of interior or state security apparatus whose budget is not easy to disentangle from the aggregate national defense budget. Budgetary data on counter terrorism policies are difficult to access in the region given the political sensitivities. It could also be argued that security incidents and the occurrence of regional conflicts have become so normalized and routine in everyday life that their influence on policy making decisions has become negligible when compared to other countries such as those of OECD who are exposed (relatively) far less to terrorism and security incidents. In other words, in the MENA region it could that there has been a policy adaptation in which regional conflicts, high security needs and threats no longer are the main influence on government security and military spending decisions and which consequently could impact social welfare expenditures. To follow the finding of Reeves and Stuckler (2013) that 'in countries with high security needs, defense and health are complementary' we would caveat that this only applies to those countries which do not have a long history and experience of protracted conflict and security incidents.

Policy analysts and commentators on the region should not single out military or security spending and the prioritization as one of the main culprits for the lack of investment in public goods such as health and social protection more broadly. The results allude to the possibility that spending decisions on a vital public policy issue such as health are being made in silo, are determined by political will and not affected by other government priorities and needs. This is a rather simplistic interpretation but lends support for the need for more research insights both ethnographic and quantitative on the political economy of health and public policy in general in the region. Without this we will be unable to fully understand the main drivers of change and transition post 2011. The MENA region has become more unstable and experienced numerous violent conflicts such as in Syria, Yemen and Libya which have affected all countries in the region since 2011. What effects have these protracted conflicts had on government decision making in terms of social spending? Is the 'warfare over welfare' hypothesis a more accurate understanding of the situation since 2011? And have governments hunkered down and diverted government resources to defense and security as a response at the expense of the wellbeing and social welfare of their national populations?

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Table 1. Top 10 military spenders

Absolute Rank	Country	Millions of $	Relative rank	Country	Share of GDP	Change in rank	Country	Percentage change since 2004
1	USA	684489.2	1	Oman	10.84	1	Afghanistan	556.65
2	China	148648.4	2	KSA	8.52	2	Azerbaijan	493.45
3	Russia	73281.6	3	South Sudan	6.5	3	Iraq	284.46
4	France	65263.6	4	Israel	6.14	4	Kazakhstan	247.93
5	UK	60294.2	5	UAE	5.18	5	Ghana	243
6	Japan	59638.4	6	Jordan	4.64	6	Georgia	229.85
7	KSA	52019.2	7	USA	4.5	7	Liberia	189.13
8	India	49261.2	8	Algeria	4.2	8	Algeria	176.21
9	Germany	49080.4	9	Lebanon	4.2	9	Angola	175.12
10	Italy	37025.2	10	Afghanistan	4.08	10	Ecuador	174.71

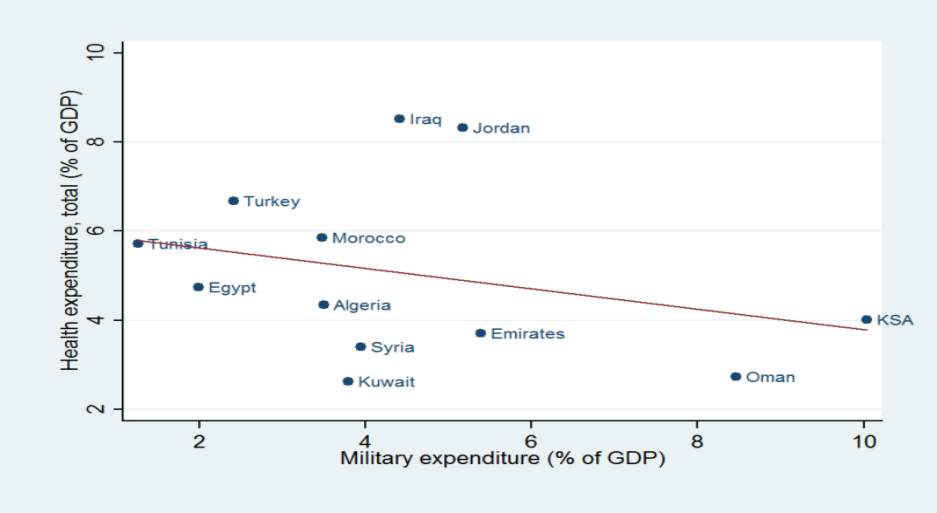
Reproduced from ESCWA (2014: 136) Source: SIPRI, 2014.
Notes: "Millions of $" (expressed in constant 2011 USD) and "share of GDP" are the five-year averages from 2009 to 2013.

Table 2: Summary Statistics of variables, MENA region, 1995-2011

	N	Average	Standard Deviation	Min	Max
Total health expenditure [a]	303	4.69	2.01	1.12	11.45
Military expenditure [b]	271	4.81	2.74	0.92	14.62
Casualties due to terrorist attacks [c]	306	347	1635	0	15309

Notes: [a, b] Percentage of GDP. [c] Number of deaths and serious injuries.

Figure 1. Health and military expenditures in MENA countries, 2010



Source: World Development Indicators, World Bank.

Table 3. Panel stationarity tests of variables

	Levels			First differences		
Variables	ADF	PP	IPS	ADF	PP	IPS
Total health expenditure	0.764	0.636	0.528	0.000	0.000	0.000
Military expenditure	1.000	0.000	0.051	0.678	0.000	0.000
Casualties due to terrorist attacks	0.002	0.000	0.000	0.000	0.000	0.000

Notes: The null hypothesis for the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP), and Im-Peseran-Shin tests (IPS) is the presence of non-stationarity in all panels. *p*-values are reported.

Table 4. Estimation results (Panel vector autoregressive model)

	Dependent variable: Total health expenditure
Lagged dependent variable	0.082
	(0.101)
Military expenditure	-0.003
	(0.052)
Casualties due to terrorist attacks	-0.001
	(0.001)
Number of observations	215

Notes: Statistical significance: *=10%; **=5%; ***=1%. Robust standard errors are in parentheses. Dependent variables are lagged at order 1.

Supplemental appendix

To probe the robustness of our main findings, we present estimation results under alternative assumptions on the data-generating process. The models presented below are more specific than the PVAR models in the main text. A key concern is that with just 18 countries and 17 years in the sample, it is difficult to find significant results with too flexible estimators. Furthermore, the low number of observations limits us to a few additional tests. Following established practice and the results of our unit root tests, we estimate autoregressive distributed lag models in error correction representation throughout. In these models, the dependent variable is expressed in differences, while its lagged level is being controlled for.

We examine permutations of the following three dimensions:

- Data-generating process: We consider two alternative models that impose some structure upon the fully flexible PVAR model.
- Control variables: We consider two sets of control variables—the empty set (as in the main text) and a set of basic controls, including (logged) terror casualties, infant mortality, and (logged) external resources for health.
- Dependent variables: We consider two dependent variables—(logged) health expenditure (% GDP) and (logged) out-of-pocket health expenditure (% health expenditure).

Table A1 presents the descriptive statistics of all (untransformed) variables.

Table A1. Descriptive statistics

	Observations	Mean	Sd	Min	Max
Health expenditure (% GDP)	303	4.69	2.01	1.12	11.45
Out-of-pocket health expenditure (%)	303	36.78	19.33	10.11	99.61
Military expenditure (% GDP)	271	4.81	2.74	0.92	14.62
Terror casualties	306	347.06	1635.17	0	15309
Infant mortality	306	23.64	15.12	5.60	79.50
External resources for health	303	1.50	4.69	0.00	58.62

A.1. Seemingly-unrelated regression

Our first set of additional robustness tests makes the simplifying assumption that changes in health expenditure and military expenditure are both outcomes of interest that can be individually studied, but unobserved 'third variables' can induce spurious correlation between these two outcomes. Terrorist attacks are assumed to be exogenous. This data-generating process can be conveniently modelled with a seemingly-unrelated regression (SUR) system.

In a SUR system, standard errors are allowed to correlate across equations. A positive correlation would indicate the presence of an unobserved factor that induces increases in both outcomes of interest, while a negative one indicates countervailing effects. For example, it is plausible to argue that a change in government ideology toward a more hawkish stance could decrease health expenses while increasing military expenditure. The SUR framework allows us to detect cross-outcome correlation without the need to measure its sources.

Table A2 presents the results when using health expenditure and military expenditure as our main dependent variables. Consistent with the main analysis, we find no evidence of crowding-out between health spending and military expenses. In fact, the cross-outcome correlation is estimated to be significantly positive ($p<0.01$). This suggests existence of an unmeasured variable that positively relates to both types of spending. For example, spending on police forces is a likely confounder. To avoid future terrorist attacks, the government likely spends on both military and the police force including its counterterrorism units.

Turning to control variables, we do not find evidence for significant relationships between terror casualties and health expenditure and military expenditure respectively. In contrast, external resources for health substitute for domestic health spending as well as military spending ($p<0.01$). A higher lagged level of infant mortality is negatively related to the growth in health expenditure, most likely because states with problems to expedite health spending have weak state capacity to begin with. This interpretation—lack of absorptive capacity—is also consistent with the negative coefficient on the level of external resources for health in both equations. In sum, the models are reasonably specified, explaining about one-third of the variation in health expenditure change.

Table A2. SUR results using health expenditure

	(1)		(2)		(3)	
	b	se	b	se	b	se
Δ.Health expenditure						
L.Health expenditure	-0.252***	(0.025)	-0.283***	(0.053)	-0.334***	(0.059)
Δ.Terror casualties			0.017	(0.012)	0.015	(0.010)
L.Terror casualties			0.021	(0.019)	0.018	(0.017)
Δ.Infant mortality					-0.062	(0.040)
L.Infant mortality					-0.007**	(0.003)
Δ.External resources					-0.010***	(0.001)
L.External resources					-0.008***	(0.001)
Δ.Military expenditure						
L.Military expenditure	-0.337***	(0.047)	-0.341***	(0.049)	-0.355***	(0.049)
Δ.Terror			-0.002	(0.007)	-0.002	(0.006)
L.Terror			0.002	(0.010)	0.001	(0.009)
Δ.Infant mortality					-0.045	(0.051)
L.Infant mortality					-0.005	(0.005)
Δ.External resources					-0.011***	(0.002)
L.External resources					-0.007*	(0.004)
Cross-outcome correlation	**0.46*** **		**0.47*** **		**0.43*** **	
Observations	287		287		285	
Within R-squared	0.29		0.31		0.36	

Notes: SUR system of equation estimation using maximum likelihood. Both equations include two-way fixed effects. Standard errors clustered on countries.

Significance levels: * p<.1 ** p<.05 *** p<.01.

Table A3 repeats the analysis from Table A2 but using out-of-pocket health expenditure as the first outcome of interest. The main conclusions from the analysis are unaffected. Conditional on observed control variables, both outcomes are not significantly correlated with each other (the point estimate is close to zero). The coefficients of terror casualties are not significant. In terms of additional controls, we find that an increase in the growth of external resources for health positively relates to an increase in the out-of-pocket share of health expenditure ($p<0.01$). This can again be taken as suggestive evidence that governments reduce public health expenditure when external resources are ready to fill the gap.

Table A3. SUR results with out-of-pocket health expenditure

	(1)		(2)		(3)	
	b	se	b	se	b	se

Δ.Out-of-pocket expenditure						
L.Out-of-pocket expenditure	-0.087***	(0.020)	-0.087***	(0.021)	-0.130***	(0.016)
Δ.Terror casualties			-0.195	(0.388)	-0.166	(0.373)
L.Terror casualties			-0.034	(0.343)	0.037	(0.328)
Δ.Infant mortality					-0.783	(1.269)
L.Infant mortality					-0.231	(0.141)
Δ.External resources					0.191***	(0.027)
L.External resources					0.211***	(0.051)
Δ.Military expenditure						
L.Military expenditure	-0.298***	(0.051)	-0.297***	(0.051)	-0.312***	(0.054)
Δ.Terror casualties			-0.006	(0.006)	-0.005	(0.006)
L.Terror casualties			-0.005	(0.006)	-0.004	(0.006)
Δ.Infant mortality					-0.026	(0.051)
L.Infant mortality					-0.004	(0.005)
Δ.External resources					-0.012***	(0.002)
L.External resources					-0.008**	(0.004)
Cross-outcome correlation	**-0.05**		**-0.04**		**-0.01**	
Observations	287		287		287	
Within R-squared	0.10		0.10		0.14	

Notes: SUR system of equation estimation using maximum likelihood. Both equations include two-way fixed effects. Standard errors clustered on countries.

Significance levels: * p<.1 ** p<.05 *** p<.01.

A.2. A direct test of the crowding-out hypothesis

In a second set of analyses, we consider health expenditure as our unique outcome of interest and military expenditure to be a (potentially endogenous) regressor. This setup allows us to directly assess whether there is a significant negative correlation between the two variables (equivalent to a crowding-effect). We are not concerned about reverse causality as a source of endogeneity (a negative correlation is evidence of crowding-out). However, we must beware of endogeneity due to omitted variables. A standard solution to this is an instrumental-variable design, in which we try to find a variable that correlates with military expenditure but affects health expenditure only through its effect on the former.

Terror casualties are not an implausible instrument. Assuming that casualties are never significant enough to directly cause increases in public health spending, they are theoretically strongly related to military spending because governments can use terrorism as a pretext to reallocate scarce public resource to the military (Daoud 2011, 2017, 2018). Our approach in this set of analyses hence is to instrument military spending with terror casualties and study whether (predicted) military spending is negatively related to health expenditure.

Table A4 shows the results for health expenditure as a percentage of GDP. We find that there never is a significantly negative relationship between military spending and health expenditure (in fact, in the last two models, it is positive). Yet, we caution against over-interpretation of these findings because the instruments are weak, considering conventional levels of statistical significance. Neither are any of the control variables significant.

Table A5 repeats the analysis using out-of-pocket health expenditure as outcome of interest. The results are similar, at the exception of the first model in which the coefficient on the level of military expenditure is negatively related to the change in health spending. This is not evidence of crowding-out though.

Table A4. IV design using health expenditure

	(1)		(2)		(3)		(4)	
	b	se	b	se	b	se	b	se
Δ.Health expenditure								
L.Health expenditure	-0.291***	(0.081)	-0.329***	(0.087)	-0.291***	(0.081)	-0.329***	(0.087)
Δ.Military expenditure	-1.018	(0.871)	-1.084	(1.452)	-0.994	(0.983)	-0.959	(0.913)
L.Military expenditure	0.801	(4.698)	1.036	(4.178)	0.196***	(0.053)	0.200***	(0.050)
L.Infant mortality			0.005	(0.048)			-0.004	(0.005)
L.External resources			0.002	(0.013)			-0.000	(0.004)
L.Military expenditure								
L.Terror casualties	-0.003	(0.016)	-0.001	(0.012)				
Δ.Terror casualties	-0.000	(0.006)	-0.000	(0.008)				
L.Infant mortality			-0.011	(0.014)				
L.External resources			-0.002	(0.007)				
Δ.Military expenditure								
Δ.Terror casualties	-0.006	(0.005)	-0.006	(0.005)	-0.007	(0.005)	-0.007	(0.005)
L.Terror casualties	-0.004	(0.005)	-0.004	(0.005)	-0.003	(0.003)	-0.004	(0.004)
L.Infant mortality			0.001	(0.002)			0.001	(0.002)
L.External resources			0	0			0.001	(0.003)
Cross-equation correlation	-1.05		-1.05		1.35*		1.32***	
Observations	260		259		253		252	
Within-R2	0.42		0.43		0.40		0.40	

Notes: Recursive system of equations, estimated using maximum likelihood. Military expenditure is modelled using terrorist casualties in levels and differences as instruments. Models 1-2 instrument both level and difference in military expenditure. Models 3-4 only instrument the difference. All equations include two-way fixed effects. Standard errors clustered on countries.
Significance levels: * p<.1 ** p<.05 *** p<.01.

Table A5. IV design using out-of-pocket expenditure

	(2)		(3)		(4)	
	b	se	b	se	b	se
Δ.Out-of-pocket expenditure						
L.Out-of-pocket expenditure	-0.210***	(0.029)	-0.210***	(0.031)	-0.210***	(0.029)
Δ.Military expenditure	-35.534	(38.769)	-32.953	(26.375)	-35.112	(27.453)
L.Military expenditure	-7.754**	(3.480)	-0.181	(1.234)	-0.385	(1.267)
L.Infant mortality	-0.143	(0.121)			-0.061	(0.136)
L.External resources	-0.015	(0.278)			-0.003	(0.259)
L.Military expenditure						
L.Terror casualties	-0.001	(0.017)				
Δ.Terror casualties	-0.001	(0.006)				
L.Infant mortality	-0.011	(0.014)				
L.External resources	-0.002	(0.007)				
Δ.Military expenditure						
Δ.Terror casualties	-0.006	(0.006)	-0.006	(0.005)	-0.006	(0.005)
L.Terror casualties	-0.007*	(0.004)	-0.007	(0.004)	-0.007	(0.004)

L.Infant mortality	0.001	(0.002)		0.001	(0.002)
L.External resources	0.001	(0.003)		0.001	(0.003)
Cross-equation correlation	-0.12		1.25**	1.31*	
Observations	259		253	252	
Within-R2	0.19		0.22	0.23	

Notes: Recursive system of equations, estimated using maximum likelihood. Military expenditure is modelled using terrorist casualties in levels and differences as instruments. Models 1 (equivalent to A4) dropped due to non-convergence. All equations include two-way fixed effects. Standard errors clustered on countries.
Significance levels: * p<.1 ** p<.05 *** p<.01.

A.3. Granger causality test

A final test to demonstrate that health expenditure and military expenditure are not related to each other in our sample is a Granger causality test. For instance, if past realizations of military spending could predict current health expenditure (controlling for past health spending), but past realizations of health spending would not predict current military expenditure (controlling for its past realizations), then military spending Granger-causes health spending.

We do not find evidence for variable to Granger-cause the other, neither in levels, nor in changes (Table A6). This is additional supportive evidence for our main finding that there is no crowding-out between the two variables.

Table A6: Granger tests

	(1) Health expenditure		(2) Military expenditure		(3) Health expenditure		(4) Military expenditure	
	b	se	b	se	b	se	b	se
Levels								
L.Health	0.608***	(0.078)	0.035	(0.094)				
L2.Health	0.092	(0.095)	0.138	(0.116)				
L3.Health	0.043	(0.073)	-0.038	(0.089)				
L.Military	0.100	(0.067)	0.775***	(0.084)				
L2.Military	-0.098	(0.080)	-0.233**	(0.099)				
L3.Military	0.031	(0.060)	0.071	(0.074)				
Differences								
L.Health					-0.346***	(0.084)	-0.006	(0.103)
L2.Health					-0.222***	(0.082)	0.091	(0.102)
L3.Health					-0.072	(0.083)	-0.023	(0.106)
L.Military					0.132**	(0.065)	-0.068	(0.086)
L2.Military					0.016	(0.065)	-0.296***	(0.083)
L3.Military					-0.044	(0.063)	-0.205***	(0.078)
N	222		216		204		198	

Notes: Fixed-effects regressions with two-way fixed effects. Standard errors clustered on countries.
Significance levels: * p<.1 ** p<.05 *** p<.01.