MILITARY EXPENDITURES AND HEALTH OUTCOMES: A GLOBAL PERSPECTIVE

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ABSTRACT

Health has a major contribution in attaining better human capital and wellbeing both at the individual as well as at country levels. Although military spending may boost economic growth through multiplier and spillover effects, yet tradeoffs exist between military expenditures and health outcomes. Grossman (1972) explains health as output which depends on many input variables. By covering a panel of 156 countries ranging from the time period 1970 to 2014, this study incorporates military expenditures, GDP per capita, urbanization, access to the improved drinking water source, number of physicians, and secondary school enrollment as determinants of health (life expectancy and infant mortality). OLS, fixed effects, random effects, and system GMM have been used as estimation techniques. The study reveals that countries with low military expenditures have a comparatively high life expectancy and low infant mortality as compared to countries with high military expenditures. Robustness of results was checked through sensitivity analyses performed on the bases of determinants of health, international geopolitical scenario, and the development status of the country. The evidence of sensitivity analysis suggests that overall results are robust in the life expectancy model but somehow sensitive in case of infant mortality. The study affirms the explicit tradeoff between military expenditures and welfare spending and concludes that hefty defense expenditures lower life expectancy and enhance infant mortality.

Keywords:
Military expenditures
Life expectancy
Infant mortality
Panel data

JEL Classification Codes:
C33, I0, H7, H51, H70

1. Introduction

Maintaining peace and prosperity is a matter of challenge for every state. Defense, education, and health are the foremost components of the state budget. Although it is perplexing to balance the pendulum between state security (defense) and economic development (education and health) yet defense (military expenditures) is the first urgency/priority. According to (Levi, 1988) military expenditures promote security and justice and evoke people to be obedient. The use of any resource in one sector creates an opportunity cost in other sectors of the economy (Apostolakis, 1992). Trade-off situation prevails between military expenditures and health (Arif, Khan, Raza, & Futter, 2019;
Caputo, 1975; B. Russett, 1982; B. M. Russett, 1969; Jülide Yildirim & Sezgin, 2002) as military spending reduces potential resources allocation for social progress. Nevertheless, developed economies experience a progressive impact of military spending on welfare and ambiguous results for emerging economies (Zhang, Liu, Xu, & Wang, 2017). However, a simple descriptive analysis of the data directs that countries with low average military expenditures have a comparatively high life expectancy and low infant mortality as compared to countries with high military expenditures.¹

Health has a major contribution in attaining better human capital and well-being both at the individual as well as at country levels. Policies have achieved health efficiency as life expectancy has been upgraded from 54-71 years in 1960-2015 and infant mortality has been reduced from 102 to 24 per thousand live births during the same period. Nevertheless, huge inequalities in health are observed in descriptive analysis, the average range of life expectancy lies between 39.54-81.49² and average infant mortality ranges between 39.89-147.86 (Majeed & Gillani, 2017). These large health inequalities highlight a great challenge for policymakers and the importance of an effective and balanced budget to achieve the goal of health progress that has been placed at 3rd priority in the global development agenda (Sustainable Development Goals).

Perennial debates on the impact of military expenditures on economic growth and well-being remain uncertain. As there are a number of linkages through which military spending can affect economic growth and development in different ways. On one side, the positive effect has been observed in terms of cumulative employment, extension in technology (Benoit, 1973; P. Dunne & Nikolaidou, 2001; Hussain & kyung Sup, 2009; Thompson, 1974; T.-P. Wang, Shyu, & Chou, 2012; Yakovlev, 2007) and provision of national security (J. P. Dunne, Smith, & Willenbockel, 2005; Singer, Bremer, & Stuckey, 1972; Sobek, 2010). On the other side, its adverse effects in terms of pulling out resources from productive segments of the economy have also been documented (Ali, 2007; Apostolakis, 1992; Caputo, 1975; Mylonidis, 2008; Jülide Yildirim & Sezgin, 2002).

The real challenge for economists and policymakers is to reconnoiter an “adequate” volume of military spending. Every extra money spent above the necessary level is certainly a clear loss for the economy as a whole. Immanuel Kant, an influential philosopher, supports less military expenditures as more military is an insignia of wars (Singer et al., 1972), in this way curtailed resources are devoted to social spending. While, countries with more resources devoted towards military expenditures face fewer threats (Harris, 1970), have the ability to enforced policies (Bates, 2001) provide fewer opportunities for rebels (Hendrix, 2010; Sobek, 2010) and external conflicts (Braithwaite, 2010).

Extensive debates in the fields of sociology, political science, and economics remain uncertain regarding the impact of military expenditures on social well-being. It is a matter of question either military expenditures are a burden or blessing for development indicators. Therefore, predicting the net effect of defense spending on economic development is difficult and a matter of study. The present study will find the impact of military spending on health indicators (life expectancy and infant mortality) for the large panel dataset. This is the first attempt to find the endogeneity issue arises from bread versus butter phenomena by using external instruments. This study will address the

¹ On average, countries with Low military expenditures have high life expectancy (71.67) and low infant mortality (19.71) but countries with high military expenditures have low life expectancy (70.85) and high infant mortality (21.92). (Authors' own calculation)
² The statistics are calculated over the period 1960-2015.
following questions: Do military expenditures help to improve or deteriorate health performance? Either the impact of military expenditures on health outcomes is the same according to different income groups and environmental factors?

The organization of the paper is as follows: Section 2 describes the Literature Review methodology and data is presented in Section 3. Section 4 contains empirical results and the conclusion of the analysis is presented in Section 5.

2. Literature Review

In defense economics, the extensive literature links military expenditures with economic growth. Pioneer's work (Benoit, 1973) finds a significant relationship between military expenditures and economic growth. In a similar vein, military expenditures contribute to economic growth through investment, expansion in new technology and infrastructure (P. Dunne & Nikolaidou, 2001; Yakovlev, 2007; Julide Yildirim & Sezgin, 2005). Whereas, using data from 1980 to 2010 for France, (Malizard, 2015) explores the negative impact of military expenditures on private investment (both compete for the same pool of resources). Therefore, no clear consensus has been established on the relationship between military expenditures and economic growth (J. P. Dunne et al., 2005).

Recent literate of military spending deals with demand for military spending (Markowski, Chand, & Wylie, 2017; Skogstad et al., 2016; Yesilyurt & Elhorst, 2017) and corruption (Goel & Saunoris, 2016). The peace dividend describes the relationship between military spending and democracy (Rota, 2011). While this relationship becomes complex as democracy provides chances of more regional conflicts. A negative relationship exists between military spending and democracy (Bove & Brauner, 2016; Eloranta, Andreev, & Osinsky, 2014). Democratic rulers, who wish to be reelected, perceive more incentive to increase social spending than military spending. Military regimes spend more on defense than civilian regimes. Demand for public programs is more than existing resources so a trade off exists among different policy sectors. Caputo (1975) finds an explicit tradeoff between military and welfare spending. Using time-series data for Latin American countries from 1953 to 1987, (Apostolakis, 1992) confirms that military spending reduces potential resources allocation for social progress.

A huge strand of literature confirms that military spending deters development related to saving, investment, and Balance of payment (Deger & Sen, 1983). B. M. Russett (1969) explores the negative relationship between military expenditures and government spending on health and education for the US, France, and the UK. In later work, (B. Russett, 1982) finds no systematic tradeoff between military spending, health, and education for the period 1941-1982. (Scheetz, 1992) examines evolution for public expenditures for four Latin American countries from 1969-1987. He concludes that the growth of defense expenditure faster than health and education expenditures.

Jülide Yildirim and Sezgin (2002) examine the relationship between military and welfare spending (health and education) by using the Seemingly Unrelated Regression model (SUR) for Turkey from time period 1924-1996. Results confirm that military expenditures are positively related to education but negatively with health. Meanwhile in another study, (Hirnissa, Habibullah, & Baharom, 2009) investigate inter-relationship between military spending, education, and health for eight Asian countries. The results of ARDL do not find meaningful relationships except Malaysia and Sri Lanka. Restricted ECM confirms the existence of long run it might be more government funded research and development in military caused continuous imbalance, in result retard development.
Alternatively, (Benoit, 1973) confirms that higher defense spending boosts development in the third world. (Domke, Eichenberg, & Kelleher, 1983) find that the tradeoff between military and welfare is a long-run phenomenon rather than short-run in the case of US, UK, Germany, and France.

A vast literature has analyzed the relationship of health with income (Filmer & Pritchett, 1999; Kabir, 2008; Rajkumar & Swaroop, 2008; Shaw, Horrace, & Vogel, 2005; L. Wang, 2003), inequality (Asafu-Adjaye, 2004; Babones, 2008) and health expenditures (Bokhari, Gai, & Gottret, 2007; Dehn, Reinikka, & Svensson, 2003; Novignon, Olakojo, & Nonvignon, 2012; L. Wang, 2003). Similarly, the bulk of the literature has linked military expenditures with economic growth (Benoit, 1973; Chang, Fang, Wen, & Liu, 2001; Kusi, 1994; Safdari, Keramati, & Mahmoodi, 2011) and welfare spending (Deger, 1985; Eichenberg, 1984; B. Russett, 1982). However, many studies link military expenditures with health expenditures but ignore the direct impact of military expenditures on health indicators. Likewise, mostly literature on military expenditures deal with time series analysis and ignores panel analysis. This study finds the impact of military expenditures on health indicators (life expectancy and infant mortality) by covering a large sample size spanning over 1970-2015. The endogeneity issue arises due to the gun vs. butter phenomenon. In addition, we tackle the endogeneity issue by using appropriate instruments.

3. THEORETICAL FRAMEWORK

The role of military expenditures on the economy can be described in three continuums (J. P. Dunne et al., 2005). First, from the demand side: an additional increment in military spending may boost economic growth through multiplier effects or may suppress growth by crowding out. Second, from the supply-side: military spending results in the development of technology which boosts growth through spillover effects (Yakovlev, 2007) conversely, it causes the opportunity cost of other sectors (Chang et al., 2001). Third, from the security side: the secure milieu provides incentives to accumulate capital which leads to higher growth (Thompson, 1974).

Life expectancy and infant mortality are the most suitable indicators of health particularly for the cross country investigation (Babones, 2008; Saunders, 1996). For the current analysis, life expectancy and infant mortality (proxies of health) are taken as dependent variables and military expenditure is taken as an independent variable. The main focused variable is military expenditures. (Grossman, 1972) considers health as a utility function that depends on the initial stock of health and also on the medical care in which the individual invests over time. Human born with a specific stock of health which depreciates with time and death take place as this stock of health is minimized. Grossman (1972) enlightens the Health Production Function (HPF) of a country that requires an input output association. Health is considered output which ultimately depends on many input variables.

3 See Table 1
This study also incorporates some demographic and infrastructural variables, like, urbanization, the population having access to the improved water source, number of physicians per thousand people, as determinants of health. Urbanization has a dual impact (positive and negative) on health. Positively, urbanization can provide access to jobs, education, health services (Godfrey & Julien, 2005; Gupta, Verhoeven, & Tiongson, 2002). Negatively, more trend of urbanization creates the issue of overcrowdedness which creates social and economic deprivations (Rogers & Wofford, 1989). Access to improved and freshwater has a productive impact on health (Cingolani, Thomsson, & De Crombrugghe, 2015; Majeed & Gillani, 2017; Shafiq & Gillani, 2018). Operative immunization agendas can be a focal point against reducing a cluster of viruses. Effective immunization programs play a vital role in reducing infant mortality and boosting life expectancy (Cingolani et al., 2015; Gupta et al., 2002).

Education (as a social determinant) ensures improvement in health status. As money has a psychological influence on health (Wilkinson & Pickett, 2006) or income can access towards basic health facilities (Cingolani et al., 2015; Filmer & Pritchett, 1999; Kabir, 2008; Rajkumar & Swaroop, 2008; Shaw et al., 2005; L. Wang, 2003). So, GDP per capita serves as an economic determinant of health.

4. DATA AND METHODOLOGY

4.1 Model Specification

The validity of providing all facilities to its citizens is the core purpose of the state. Hence, the state faces many challenges to balance its budget between national security and economic development. The utilization of resources in one sector creates opportunity
costs for other sectors of the economy (Apostolakis, 1992). So its matter of discussion how military expenditures affect the health sector mainly infant mortality and life expectancy. The econometric modeling of the present study is based on (Grossman, 1972) healthcare theory which considers health outcomes as a function of different factors. In the following set of equations, we move from a mathematically more general model for health toward econometrically more specific models. i.e.

\[ Health\ outcome = f(\text{input variables}) \quad \text{... (1)} \]

\[ Health\ outcome = f(\text{economic factors, social factors, demographic factors}) \quad \text{... (2)} \]

i.e., life expectancy (LEXPECT) has been modeled as follows:

\[ LEXPECT_{it} = \alpha_0 + \alpha_1 MILITEXP_{it} + \alpha_2 PCGDP_{it} + \alpha_3 PHYCIAN_{it} + \alpha_4 IMPWTER_{it} + \alpha_5 SENROL_{it} + \alpha_6 URBNPOP_{it} + u_{it} \quad \text{... (3)} \]

Likewise, infant mortality (INFMORT) has been modeled as the function of the same explanatory variables as in the above model (3)

\[ INFMORT_{it} = \beta_0 + \beta_1 MILITEXP_{it} + \beta_2 PCGDP_{it} + \beta_3 PHYCIAN_{it} + \beta_4 IMPWTER_{it} + \beta_5 SENROL_{it} + \beta_6 URBNPOP_{it} + u_{it} \quad \text{... (4)} \]

Here, the output reflects health indicators which are generally measured through life expectancy and infant mortality. Input variables consist of economic factors: military expenditures (MILITEXP) and GDP per capita (PCGDP), social factors: number of physicians per thousand people (PHYCIAN), the population having access to improved water source (IMPWTER) and secondary school enrollment (SENROL), and demographic factor: urban population growth rate (URBNPOP).

By covering a panel of 156 countries ranging from the period 1970 to 2014, this paper studies life expectancy and infant mortality to measure the insight of individual health. For health variables, the study has taken data from (WDI, 2015). Usually, health indicators do not respond too fast to any organizational changes and changes in health outcomes can be observed over a number of years not yearly that why this study uses five-year interval data for the analysis.

### 4.2 Choice of Instruments and the Estimation Techniques

OLS, fixed effects, random effects, and system GMM have been used as estimation techniques by using life expectancy as health proxy. System GMM technique is used to deal with endogeneity that arises from butter versus gun situation. In this study, endogenous variable military expenditures are instrumented by economic, geographic, and political instruments. The first economic instrument is industrialization as Industrial countries have 55% of world military expenditures (Hewitt, 1992). Correspondingly, industrialized countries spend more on military expenditures i.e. relatively high industrial production (enough domestic surplus), in return a country may be tempted to upsurge military expenditures (Deger & Sen, 1983; Maizels & Nissanke, 1986). Second, the lagged military spending considers as a significant and robust determinant of military expenditures (Goldsmith, 2003; Looney & Frederiksen, 1986; Yakovlev, 2007). The geographical instrument, such as land area has a strong influence on the level of military expenditures (Hewitt, 1992). Subsequently, widely held belief, a larger country has higher military expenditures as compared to a smaller country, even though the main concern involved in defense is indistinguishable.
Finally, the political instrument includes military expenditures of neighboring countries, as the level of military expenditure selected by a government might, to an extent, be motivated by the level selected by its neighbors (Hewitt, 1992; Maizels & Nissanke, 1986; Sun & Yu, 1999). The neighborhood arms race arises as a result of negative externality (Pakistan and India, which creates threat and security pressure for neighbors. Another understanding of the same prodigy is that governments, in the absenteeism of strong gauges of military need, base their decision regarding the level of military expenditures on the behavior of their neighbors (J. P. Dunne & Perlo-Freeman, 2003).

Before proceeding towards estimations, we have applied some diagnostic tests. Results of the link test, VIF test, and Breusch-Pagan test indicate that model is correctly specified, there are no traces of multicollinearity but heteroscedasticity prevails.

5. RESULTS AND DISCUSSION

In this section, we provide the empirical results obtained from panel data for 156 countries over the time period 1970 to 2014. Table 4.1 presents estimation results obtained from OLS, fixed effects, random effects, and system GMM by using life expectancy as health proxy. Columns 1 to 3 direct that military expenditures hurt life expectancy. As, (Apostolakis, 1992) argues that one sector resource usage creates opportunity cost for other sectors. In the same way, an explicit tradeoff exists between military and welfare spending (Apostolakis, 1992; Caputo, 1975). Hefty defense expenditures retard health programs (Dabelko & McCormick, 1977; Peroff & Podolak-Warren, 1979; B. M. Russett, 1969; Stein, 1980). Less attention to the health sector causes a negative influence on life expectancy.

Table 1 in the appendix shows the effect of military expenditures on health using infant mortality as a health proxy. Hausman test suggests that the fixed effect as compared to random effect is more appropriate. Its coefficient indicates that with a 1 unit increase in military spending, life expectancy will decrease by 0.273 units. In our model, the problem of endogeneity is likely to arise due to simultaneous linkages (trade-off effect) between military spending and health and there could be the problem of omitted variable bias. In order to avoid endogeneity which causes spurious OLS results, this study practices the system GMM method by using a lag of independent variable and external instruments.

Column 4 reports results of system GMM to indicate that military expenditures have a significantly negative impact on life expectancy as larger military expenditures associating with more security (J. P. Dunne et al., 2005), improves economic growth (Benoit, 1973) through extension in technology (Yakovlev, 2007) and spillover effects promotes health performance (Cingolani et al., 2015). Panel results show an insignificant impact of military expenditures.
## Table 1
### Results of Health and Military Expenditures

| VARIABLES          | OLS          | Fixed Effects | Random Effects | System GMM  |
|--------------------|--------------|---------------|----------------|-------------|
| Military Expenditures | -0.000632   | -0.273***     | -0.261***      | -0.268*     |
|                     | (0.102)      | (0.0788)      | (0.0737)       | (0.143)     |
| Improved water      | 0.148***     | 0.117***      | 0.151***       | -0.112      |
|                     | (0.0192)     | (0.0235)      | (0.0200)       | (0.0952)    |
| Physicians          | 1.496***     | 1.034***      | 1.437***       | 3.255***    |
|                     | (0.219)      | (0.294)       | (0.239)        | (0.883)     |
| Education           | 0.0707***    | 0.0606***     | 0.0560***      | 0.0436      |
|                     | (0.0119)     | (0.0101)      | (0.00926)      | (0.00406)   |
| Urbanization        | -0.138       | 0.485***      | 0.378***       | 1.702***    |
|                     | (0.138)      | (0.105)       | (0.0987)       | (0.435)     |
| Log GDP per Capita  | 2.486***     | 4.276***      | 3.119***       | -0.731      |
|                     | (0.200)      | (0.517)       | (0.296)        | (0.501)     |
| Lag.Life Expectancy |             |               |                | 1.063***    |
|                     |              |               |                | (0.141)     |
| Constant            | 26.51***     | 15.68***      | 21.99***       | -0.519      |
|                     | (1.525)      | (3.461)       | (1.941)        | (4.594)     |
| Observations        | 632          | 632           | 632            | 519         |
| R-squared           | 0.762        | 0.527         | 0.527          | 0.527       |
| Number of coding    |              | 154           | 154            | 134         |
| Functional form test| 0.902        |              |                | AR(1) 0.534 |
| Multicollinearity test | 2.30 |              |                | AR(2) 0.585 |
| Heteroscedasticity test | 0.0000 |              |                | Hansen 0.097 |

*Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Regarding control variables, the population having access to improved water sources and the number of physicians per thousand people have a positive and significant effect on life expectancy. There exists an adverse relationship between urban population growth and life expectancy. Such a relationship is reliable with second fold phenomena of urbanization as explained by (Rogers & Wofford, 1989). Education is fortunate for health as it enables an educated person to enjoy a healthy life. Perfect knowledge about health originates from better education (Chong & Calderón, 2000; Drabo, 2010; Mondal, Hossain, & Ali, 2009). This study finds that the impact of GDP per capita is positive on life expectancy. GDP growth has a positive impact on health performance as indicated by many studies (Bayati, Akbarian, & Kavosi, 2013; Messias, 2003). In short military spending harms life expectancy. All control variables have a significant positive impact on life expectancy except urbanization.

### Sensitivity Analysis

To check the robustness of results, this study includes some other determinants of health in the sensitivity analysis. Based on the determinants of health, the international geopolitical scenario, and the development status of the country, the current study splits sensitivity analyses into three parts. Table 4.2 shows the results of sensitivity analysis for life expectancy in the presence of other determinants of life expectancy. It is observed that the results of military spending are insensitive in the presence of improved sanitation, population growth, and immunization and health expenditures. The original model is represented in column 1. Detailed results are mentioned in the appendix. Many variations have been observed in the case of infant mortality. Infant mortality is sensitive in the presence of population growth and immunization (see appendix, Table 4).
Table 2
Sensitivity Analysis of Life Expectancy (Health determinants)

| Variables          | 1       | 2       | 3       | 4       |
|--------------------|---------|---------|---------|---------|
| Military Expenditures | -0.230*** | -0.274*** | -0.247*** | -0.398*** |
|                    | (0.0802) | (0.0785) | (0.0769) | (0.120) |
| Improved Sanitation | 0.0726*** | 0.465** | 0.0693*** |         |
|                    | (0.0280) | (0.226)  | (0.0135) |         |
| Population Growth  |         |         |         | 0.388*** |
|                    |         |         |         | (0.0806) |

Table 3 represents the sensitivity of life expectancy according to the international geopolitical scenario. Column 1 indicates 96 countries having less than average military expenditures (2.46). Similarly, column 2 represents 64 countries having military expenditures more than average. Column 3 indicates the impact of military expenditures on life expectancy by excluding 20 Organizational for Economic Co-operation and Development (OECD) countries. Columns 4 and 5 represent the impact of the military expenditure before and after the 9/11 incident respectively. The more adverse effect is observed after 9/11\(^4\). Results are sensitive in case of infant mortality.

Table 3
Sensitivity Analysis of Life Expectancy (International Political Milieu)

| Variable          | 1 - The level of military expenditure | 2 - Incidence of a terrorist event | 3 - Before 9/11 | 4 - After 9/11 | 5 - Excluding OECD |
|-------------------|--------------------------------------|-----------------------------------|-----------------|----------------|-------------------|
| Military Expenditures | -0.446**                             | -0.555**                          | -0.0259**       | -0.196**       | -0.282***         |
|                    | (0.227)                              | (0.0991)                          | (0.0104)        | (0.0787)       | (0.0866)          |

Table 4 shows sensitivity analysis according to the development status of the country. Variation is observed but comparatively high in the case of upper-income countries. Again, results are sensitive in case of infant mortality.

Table 4
Sensitivity Analysis of Life Expectancy (Country’s development status)

| Variable          | 1 - Lower Income countries | 2 - Lower middle-income countries | 3 - Upper-income countries | 4 - Upper middle-income countries |
|-------------------|----------------------------|----------------------------------|---------------------------|----------------------------------|
| Military Expenditures | -1.628***                 | -0.168*                          | -0.348***                 | -0.0762                          |
|                    | (0.479)                   | (0.0975)                         | (0.0964)                  | (0.213)                          |

\(^4\)https://www.nationalpriorities.org/campaigns/how-military-spending-has-changed/
6. CONCLUSION

Growth is powerfully associated with better health is neither astonishing nor new (Bhargava, Jamison, Lau, & Murray, 2001). Foremost components of the state budget are health, military expenditures, and education. This study finds the impact of military spending on health performance by taking life expectancy and infant mortality as proxies of health. To achieve this objective we have used panel data on 156 countries from time period 1970-2014. In the light of careful estimated results obtained from OLS, fixed & random effects, and System GMM, we can address the questions which arose in the first section. The results indicate that the overall impact of military spending on health performance is negative for life expectancy and positive for infant mortality and also significant in panel data analysis. Through sensitivity analysis, we find that overall the results are robust in the case of life expectancy while somehow sensitive in case of infant mortality.

Its duty of the state to keep a balance between gun and butter. For this instance, laws should be developed at the international level in order to save a country from external risks. Strong institutions may play a vital role in controlling internal threats, ultimately resources will deliver to required sectors efficiently.

The recent compilation has certain limitations. So far, many queries remain open. This study shows the overall impact of military spending on life expectancy and infant mortality for a large panel dataset. However, many country-specific variables may affect military spending and health indicators. Particularly results revealed from sensitivity analysis suggest that future analyses should be country-specific. Future work can incorporate the role of aid to discover either it is beneficial for military spending or health at the same time. Future studies can also analyze the impact of military spending by incorporating environment and development level influence to gauge better direction and policy implications for specific-county and region.

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Appendix

**Table 1: Results of Infant Mortality and Military Expenditures**
| VARIABLES        | OLS     | Fixed Effects | Random Effects | System GMM |
|------------------|---------|---------------|----------------|------------|
| Military Expenditures | -0.239  | 0.349         | 0.403*         | 0.560*     |
|                  | (0.276) | (0.253)       | (0.236)        | (0.300)    |
| Improved water   | -0.663***| -0.954***     | -0.961***      | -0.830***  |
|                  | (0.0520)| (0.0753)      | (0.0621)       | (0.184)    |
| Physicians       | -1.769***| 1.541         | -0.422         | 0.0637     |
|                  | (0.593) | (0.944)       | (0.737)        | (1.769)    |
| Education        | -0.406***| -0.382***     | -0.376***      | -0.241***  |
|                  | (0.0322)| (0.0322)      | (0.0294)       | (0.0567)   |
| Urbanization     | 1.891***| -0.617*       | -0.0739        | -1.106     |
|                  | (0.374) | (0.336)       | (0.315)        | (0.707)    |
| Log GDP per Capita| -6.832***| -12.32***     | -7.555***      | 1.400      |
|                  | (0.541) | (1.657)       | (0.874)        | (1.075)    |
| Lag. Infant Mortality | 184.6*** | 249.3***      | 213.8***       | 97.75***   |
|                  | (4.130) | (11.09)       | (5.724)        | (19.31)    |
| Observations     | 632     | 632           | 632            | 519        |
| R-squared        | 0.838   | 0.722         | 154            | 134        |
| Number of coding | 154     | 154           | 154            |            |
| Functional form test | 0.450   |               |                | AR(1) 0.088|
| Multicollinearity test | 2.30   |               |                | AR(2) 0.563|
| Heteroscedasticity test | 0.0000 |               |                | Hansen 0.049|

"Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1"
### Table 2: Correlation Matrix between Health, Military expenditures and Control Variables

| Variable                  | 1     | 2      | 3     | 4      | 5      | 6     | 7      | 8       |
|---------------------------|-------|--------|-------|--------|--------|-------|--------|---------|
| Life Expectancy           | 1     | -0.9567| 1     |        |        |       |        |         |
| Infant Mortality          | -0.9567| 1     | 1     |        |        |       |        |         |
| Military Expenditures     | 0.0408| -0.0186| 1     | 1      |        |       |        |         |
| Improved Water            | 0.8621| -0.8586| 0.0778| 1      | 1      |       |        |         |
| Physicians                | 0.7216| -0.6972| 0.0321| 0.6158| 1      |       |        |         |
| Education                 | 0.6248| -0.6811| -0.0591| 0.5775| -0.4494| 1      |        |         |
| Urbanization              | -0.6790| 0.6724| 0.2697| -0.5852| -0.7054| -0.4524| 1      |         |
| GDP Per Capita            | 0.6077| -0.5851| 0.0679| 0.5258| 0.4422| 0.2790| -0.2830| 1       |

### Variable Definition / Description

| Variable                  | Definition / Description                                                                 | Source and Observation | Mean    | Standard deviation | Minimum | Maximum |
|---------------------------|-----------------------------------------------------------------------------------------|------------------------|---------|--------------------|---------|---------|
| Life expectancy           | Life expectancy at birth, total (years)                                                  | WDI, 156 (1970-2015)   | 64.30   | 10.14              | 39.54   | 78.86   |
| Infant mortality          | Mortality rate, infant (per 1,000 live births)                                           | WDI, 156 (1970-2015)   | 50.20   | 37.71              | 5.31    | 147.86  |
| Military expenditures     | Tax revenue (% of GDP)                                                                    | WDI, 156 (1970-2015)   | 2.46    | 1.98               | 0.086   | 13.68   |
| Improved Water            | Improved water source (% of population with access)                                      | WDI, 156 (1970-2015)   | 82.46   | 18.09              | 33.79   | 100     |
| Physicians                | Physicians (per 1,000 people)                                                             | WDI, 156 (1970-2015)   | 1.35    | 1.26               | .021    | 4.32    |
| Education                 | Total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age. | WDI, 156 (1970-2015)   | 91.69   | 20.75              | 26.90   | 142.60  |
| Urbanization              | Urban population growth (annual %)                                                        | WDI, 156 (1970-2015)   | 2.91    | 1.87               | -0.10   | 8.57    |
| GDP per capita            | GDP per capita (constant 2005 US$)                                                       | WDI, 156 (1970-2015)   | 8209.17 | 12541.93           | 167.08  | 56382.94|

### Instrumental Variables

| Variable                  | Definition / Description                                                                 |
|---------------------------|-----------------------------------------------------------------------------------------|
| Industrial countries dummy| 1 = industrial country                                                                  |
|                           | 0 = non-industrial country                                                              |
| Land area                 | sq. km WDI                                                                              |
| Lagged military spending & Neighboring countries military spending | Author’s own calculations |
### Table 4: Sensitivity Analysis of Infant Mortality (Determinants)

**Dependent Variable: Infant Mortality**

| Variables           | 1          | 2       | 3       | 4       |
|---------------------|------------|---------|---------|---------|
| Military Expenditures| 0.756***   | 0.487   | 0.199   | 0.998** |
|                     | (0.288)    | (0.321) | (0.361) | (0.425) |
| Improved Sanitation | -0.230*    |         |         |         |
|                     | (0.120)    |         |         |         |
| Population Growth   | 7.745***   |         |         |         |
|                     | (2.625)    |         |         |         |
| Immunization        | -0.418**   |         |         |         |
|                     | (0.186)    |         |         |         |
| Health Expenditures |           |         |         |         |
|                     | 2.338      |         |         | (1.496) |

### Table 5: Sensitivity Analysis of Infant Mortality (Environment)

**Dependent Variable: Infant Mortality**

| Variable          | Less than average | More than average | Excluding OECD | Before 9/11 | After 9/11 |
|-------------------|-------------------|-------------------|----------------|-------------|------------|
| Military Expenditures | 1.982**           | 0.389             | 0.446*         | 0.0596      | 0.395*     |
|                    | (0.875)           | (0.255)           | (0.270)        | (0.0390)    | (0.234)    |

### Table 6: Sensitivity Analysis of Infant Mortality (Development level)

**Dependent Variable: Infant Mortality**

| Variable          | Lower Income countries | Lower middle Income countries | Upper Income countries | Upper middle Income countries |
|-------------------|------------------------|--------------------------------|------------------------|-------------------------------|
| Military Expenditures | 3.209*                | 0.480                          | 0.169                  | 0.191                         |
|                    | (1.832)                | (0.382)                        | (0.187)                | (0.473)                        |
### Table 7: Sensitivity Analysis for Life Expectancy and Infant Mortality (Detailed table of Determinants)

| VARIABLES          | (1) Dependent Variable: Life Expectancy | (2)  | (3)  | (4)  | (5) Dependent Variable: Infant Mortality | (6)  | (7)  | (8)  |
|--------------------|-----------------------------------------|------|------|------|-----------------------------------------|------|------|------|
| Military Expenditures | -0.230***                              | -0.274*** | -0.247*** | -0.398*** | 0.756***                              | 0.487 | 0.199 | 0.998*** |
|                    | (0.0802)                               | (0.0785) | (0.0769) | (0.120) | (0.288)                               | (0.321) | (0.361) | (0.425) |
| Improved water     | 0.0848***                              | 0.117*** | 0.0748*** | 0.143*** | -0.683***                              | -0.841*** | -0.565** | -1.451*** |
|                    | (0.0267)                               | (0.0234) | (0.0243) | (0.0220) | (0.194)                               | (0.231) | (0.229) | (0.377) |
| Physicians         | 0.0619***                              | 0.0588*** | 0.0467*** | 0.0354*** | 2.153                                 | -0.875 | -0.00592 | 1.410 |
|                    | (0.0101)                               | (0.0101) | (0.0102) | (0.00878) | (2.024)                               | (2.003) | (1.950) | (3.216) |
| Education          | 0.978***                               | 0.992*** | 1.074*** | 0.906*** | -0.283***                              | -0.174** | -0.0987 | -0.325*** |
|                    | (0.299)                                | (0.294) | (0.287) | (0.277) | (0.0550)                              | (0.0749) | (0.0926) | (0.122) |
| Urbanization       | 0.547***                               | 0.146    | 0.486*** | 0.200*** | -0.944*                               | -7.907*** | -0.414 | 0.143 |
|                    | (0.107)                                | (0.195) | (0.102) | (0.0866) | (0.565)                               | (2.413) | (0.864) | (0.823) |
| Log GDP per Capita | 3.723***                               | 4.272*** | 4.018*** | 3.918*** | 3.138**                               | 0.642    | 0.727 | 0.575 |
|                    | (0.556)                                | (0.515) | (0.506) | (0.449) | (1.503)                               | (1.408) | (1.201) | (2.623) |
| Improved Sanitation| 0.0726***                              |         |         |         | -0.230*                               |         |       |       |
|                    | (0.0280)                               |         |         |         | (0.120)                               |         |       |       |
| Population Growth  | 0.465**                                |         |         |         | 7.745***                              |         |       |       |
|                    | (0.226)                                |         |         |         | (2.625)                               |         |       |       |
| Immunization       | 0.0693***                              |         |         |         | -0.418**                              |         |       |       |
|                    | (0.0135)                               |         |         |         | (0.186)                               |         |       |       |
| Health Expenditures| 0.388***                               |         |         |         | 2.338                                 |         |       |       |
|                    | (0.0806)                               |         |         |         | (1.496)                               |         |       |       |
| Constant           | 17.52***                               | 16.02*** | 16.66*** | 17.57*** | 87.28***                              | 102.2*** | 102.9*** | 154.5*** |
|                    | (3.518)                                | (3.453) | (3.377) | (2.971) | (20.50)                               | (23.75) | (20.90) | (39.19) |
| Observations       | 624                                   | 632     | 632     | 507     | 518                                   | 519     | 519     | 431    |

"Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1"
Table 8: Sensitivity Analysis for Life Expectancy and Infant mortality (Detailed table of Environment)

| VARIABLES         | (1) Less than average | (2) More than average | (3) Excluding OECD | (4) Before 9/11 | (5) After 9/11 | (6) Less than average | (7) More than average | (8) Excluding OECD | (9) Before 9/11 | (10) After 9/11 |
|-------------------|------------------------|------------------------|--------------------|-----------------|--------------|---------------------|----------------------|-------------------|----------------|---------------|
| Military          |                        |                        |                    |                 |              |                     |                      |                   |                 |               |
| Expenditures      | -0.446**               | -0.255**               | -0.282***          | -0.0259**       | -0.196**     | 1.982***            | 0.389                | 0.446*            | 0.0596         | 0.395*        |
|                   | (0.227)                | (0.0991)               | (0.0866)           | (0.0104)        | (0.0787)     | (0.875)             | (0.255)              | (0.270)           | (0.0390)       | (0.234)       |
| Improved water    | 0.140***               | 0.190***               | 0.128***           | 0.149***        | 0.210***     | -1.059***           | -0.878***            | -0.930***         | -1.202***       | -1.100***     |
|                   | (0.0217)               | (0.0500)               | (0.0263)           | (0.0202)        | (0.0284)     | (0.0799)            | (0.104)              | (0.0718)          | (0.0762)       | (0.0844)      |
| Physicians        | 0.0422***              | 0.0922***              | 0.0629***          | 0.0175**        | 0.0163       | -0.350***           | -0.328***            | -0.364***         | -0.100***       | -0.144***     |
|                   | (0.00985)              | (0.0198)               | (0.0111)           | (0.00814)       | (0.00996)    | (0.0372)            | (0.0497)             | (0.0335)          | (0.0304)       | (0.0296)      |
| Education         | 1.264***               | 0.979*                 | 0.463              | 0.812***        | 0.618***     | -0.0879             | -0.0536              | -0.465            | -0.231         | 0.367         |
|                   | (0.283)                | (0.518)                | (0.428)            | (0.188)         | (0.161)      | (1.033)             | (1.042)              | (0.964)           | (0.546)        | (0.478)       |
| Urbanization      | 0.523***               | 0.380**                | 0.503***           | -0.0241         | 0.0145       | -0.891              | 0.342                | -0.0679          | 0.374*         | -0.0305       |
|                   | (0.149)                | (0.152)                | (0.118)            | (0.0541)        | (0.0721)     | (0.569)             | (0.383)              | (0.367)           | (0.203)        | (0.214)       |
| Log GDP per Capita| 3.816***               | 2.270**                | 3.637***           | 3.809***        | 3.864***     | -7.525***           | -8.075***            | -9.227***         | -6.498***       | -11.24***     |
|                   | (0.347)                | (0.989)                | (0.580)            | (0.361)         | (0.444)      | (1.152)             | (1.425)              | (1.184)           | (1.323)        | (1.320)       |
| Constant          | 18.43***               | 23.59***               | 20.72***           | 21.76***        | 17.04***     | 218.9***            | 202.8***             | 221.5***          | 198.7***        | 230.4***      |
|                   | (2.511)                | (5.920)                | (3.573)            | (2.921)         | (3.004)      | (8.386)             | (8.987)              | (7.143)           | (10.82)        | (8.927)       |
| Observations      | 386                    | 235                    | 491                | 719             | 589          | 386                 | 235                  | 491               | 722            | 589           |

"Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1"
Table 9: Sensitivity Analysis for Life Expectancy and Infant Mortality (Detailed table of Development level)

| VARIABLES          | Lower Income countries | Lower middle Income countries | Upper Income countries | Upper middle Income countries | Lower Income countries | Lower middle Income countries | Upper Income countries | Upper middle Income countries |
|--------------------|------------------------|-------------------------------|------------------------|-----------------------------|------------------------|-------------------------------|------------------------|-----------------------------|
| Military Expenditures | -1.628***              | -0.168*                      | -0.348***              | -0.0762                     | -0.238                 | -0.640                        | -0.460***              | 1.793**                     |
|                           | (0.479)                | (0.0975)                     | (0.0964)               | (0.213)                     | (1.602)                | (0.599)                       | (0.134)                | (0.699)                     |
| Improved water          | 0.117**                | 0.146***                     | 0.196***               | 0.144***                    | -0.422***              | -0.339***                     | -1.490***              | -1.254***                   |
|                           | (0.0555)               | (0.0367)                     | (0.0619)               | (0.0458)                    | (0.143)                | (0.0961)                      | (0.0855)               | (0.119)                     |
| Physicians             | 0.0634***              | 0.0544***                    | 0.0233                 | 0.0241                      | -0.416***              | -0.533***                     | 0.0923*                | -0.116                      |
|                           | (0.0233)               | (0.0173)                     | (0.0245)               | (0.0276)                    | (0.0660)               | (0.0728)                      | (0.0533)               | (0.104)                     |
| Education              | 0.20.35*               | 1.018*                       | 1.284***               | 1.621***                    | -24.35                 | -3.227*                       | 0.589*                 | -2.089**                    |
|                           | (11.97)                | (0.599)                      | (0.198)                | (0.584)                     | (35.36)                | (1.805)                       | (0.313)                | (0.881)                     |
| Urbanization           | 1.100**                | 0.806***                     | 0.0274                 | 0.745***                    | 0.313                  | 2.858**                       | 0.520***               | 0.170                       |
|                           | (0.452)                | (0.256)                      | (0.0730)               | (0.234)                     | (1.668)                | (1.161)                       | (0.169)                | (0.838)                     |
| Log GDP per Capita      | 1.658                  | 3.488***                     | 5.057***               | 2.749***                    | -10.58**               | -13.04***                     | -2.759***              | -5.078**                    |
|                           | (1.945)                | (0.925)                      | (0.499)                | (0.813)                     | (5.276)                | (2.650)                       | (0.477)                | (1.957)                     |
| Constant               | 27.73***               | 20.94***                     | 2.289                  | 27.61***                    | 2.030***               | 213.5***                      | 171.1***               | 191.3***                    |
|                           | (10.89)                | (5.109)                      | (5.861)                | (5.761)                     | (32.01)                | (18.16)                       | (7.878)                | (17.84)                     |
| Observations           | 96                     | 168                           | 206                    | 164                         | 96                     | 168                           | 206                    | 164                         |

"Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1”

Table 10: List of Countries

|    | Afghanistan | 33  | Croatia | 65  | Iran, Islamic Rep. | 97  | Montenegro | 129 | Spain   |
|----|-------------|-----|---------|-----|--------------------|-----|------------|-----|---------|
| 1  | Afghanistan | 33  | Croatia | 65  | Iran, Islamic Rep. | 97  | Montenegro | 129 | Spain   |
| 2  | Albania     | 34  | Cuba    | 66  | Iraq               | 98  | Morocco    | 130 | Sri Lanka|
| 3  | Algeria     | 35  | Cyprus  | 67  | Ireland            | 99  | Mozambique | 131 | Sudan   |
| 4  | Angola      | 36  | Czech Republic | 68  | Israel             | 100 | Namibia    | 132 | Swaziland|
| 5  | Argentina   | 37  | Denmark | 69  | Italy              | 101 | Nepal      | 133 | Sweden   |
| 6  | Armenia     | 38  | Djibouti| 70  | Jamaica            | 102 | Netherlands | 134 | Switzerland|
| 7  | Australia   | 39  | Dominican Republic | 71  | Japan              | 103 | New Zealand | 135 | Syrian Arab Republic |
| 8  | Austria     | 40  | Ecuador | 72  | Jordan             | 104 | Nicaragua | 136 | Tajikistan|
| 9  | Azerbaijan  | 41  | Egypt, Arab Rep. | 73  | Kazakhstan         | 105 | Niger      | 137 | Tanzania |
|   | Country             |   | Country            |   | Country       |   | Country     |
|---|---------------------|---|-------------------|---|---------------|---|------------|
| 10| Bahrain             | 42| El Salvador       | 74| Kenya         | 106| Nigeria    |
| 11| Bangladesh          | 43| Equatorial Guinea | 75| Korea, Rep.   | 107| Norway     |
| 12| Belarus             | 44| Estonia           | 76| Kuwait        | 108| Oman       |
| 13| Belgium             | 45| Ethiopia          | 77| Kyrgyz Republic | 109| Pakistan  |
| 14| Belize              | 46| Fiji              | 78| Lao PDR       | 110| Panama     |
| 15| Benin               | 47| Finland           | 79| Latvia        | 111| Papua New Guinea |
| 16| Bolivia             | 48| France            | 80| Lebanon       | 112| Paraguay   |
| 17| Botswana            | 49| Gabon             | 81| Lesotho       | 113| Peru       |
| 18| Bulgaria            | 50| Gambia, The       | 82| Liberia       | 114| Philippines |
| 19| Burkina Faso        | 51| Georgia           | 83| Libya         | 115| Poland     |
| 20| Burundi             | 52| Germany           | 84| Lithuania     | 116| Portugal   |
| 21| Cabo Verde          | 53| Ghana             | 85| Luxembourg    | 117| Qatar      |
| 22| Cambodia            | 54| Greece            | 86| Macedonia, FYR | 118| Romania    |
| 23| Cameroon            | 55| Guatemala         | 87| Madagascar    | 119| Russian Federation |
| 24| Canada              | 56| Guinea            | 88| Malawi        | 120| Rwanda     |
| 25| Central African Republic | 57| Guinea-Bissau     | 89| Malaysia      | 121| Saudi Arabia |
| 26| Chad                | 58| Guyana            | 90| Mali          | 122| Senegal    |
| 27| Chile               | 59| Haiti             | 91| Malta         | 123| Serbia     |
| 28| China               | 60| Honduras          | 92| Mauritania    | 124| Seychelles |
| 29| Colombia            | 61| Hungary           | 93| Mauritius     | 125| Sierra Leone |
| 30| Congo, Dem. Rep.    | 62| Iceland           | 94| Mexico        | 126| Slovak Republic |
| 31| Congo, Rep.         | 63| India             | 95| Moldova       | 127| Slovenia   |
| 32| Cote d’Ivoire       | 64| Indonesia         | 96| Mongolia      | 128| South Africa |