

Economic Growth, US Aid or China's increasing Military expenditure? A Data Analysis of factors affecting Military Expenditure in ASEAN Nations embroiled in Territorial Conflicts with China

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Abstract:

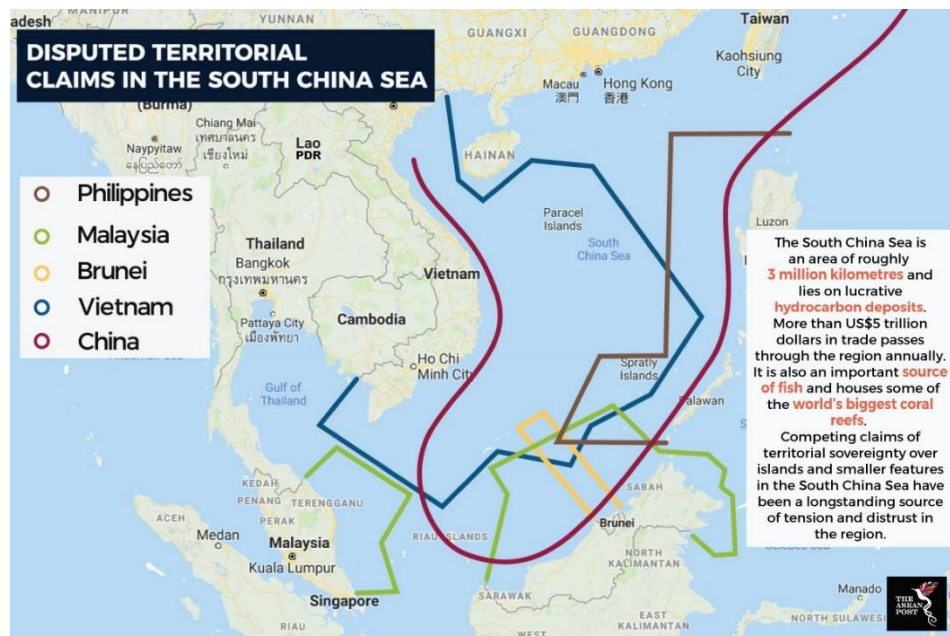
Over the past decade and prior, the Philippines, Vietnam, Malaysia, Indonesia and Brunei, all of whom are members of ASEAN (Association of South East Asian Nations), have been engaged in territorial disputes with China, particularly in regard to the South China Sea. Hence, in this paper, I perform a Data Analysis of how changes to US military aid to these countries, Economic growth in these states as well as pressure from China's increasing Military Budget has affected changes towards Military Spending in these nations. I will first present a data analysis of these individual factors. Following so, I perform a multiple linear regression model to determine which factors, if any, prove the most significant towards changes in military spending in these countries. The results show that, based off data from 2008 to 2018, Individual Economic Growth is the most significant factor in affecting changes towards Vietnam's military expenditure. Further, pressure resulting from China's increasing Military Expenditure is the most significant factor in affecting changes towards Malaysia's military expenditure. Additionally, at significance level $\alpha = 0.1$, Indonesia's individual economic growth is the most significant factor in affecting changes towards its military expenditure. However, at $\alpha = 0.1$, I am inconclusive in determining any significant factor affecting changes towards Brunei and Philippine's military expenditure.

Introduction

Over the past decade and prior, the Philippines, Vietnam, Malaysia, Indonesia and Brunei, all of whom are members of ASEAN (Association of South East Asian Nations), have been engaged in territorial disputes with China, particularly regarding the South China Sea. Hence, in this paper, I aim to perform a data analysis of how changes to US military aid to these countries, economic growth in these states as well as pressure from China's increasing military budget has affected changes towards military spending in these nations. I start off by performing a data analysis of these individual factors. Following so, I perform a multiple linear regression model determining which factors prove the most significant, if any, towards changes in military spending in these respective countries. I shall utilize data made available from the past decade (2008 to 2018). The analysis is done with the programming language R.

Background Information and Brief History

As early as the 1970s, countries surrounding the South China Sea began to lay claim to "islands and various zones in the South China Sea, such as the Spratly Islands, which possess rich natural resources and fishing areas." [1].



[image by Gnanasagaran, ASEAN post]²

“The most provocative of all South China Sea claimant states is the People’s Republic of China”^[3], which most notably lays claim through the Nine-Dash Line, allowing leading scholars to affirm that China “claims virtually the entire South China Sea for itself”^[3]. Following the prescription of the Exclusive Economic Zone (EEZ) in 1982 by the United Nations Convention of the Law of the Sea – which defines a sovereign state’s EEZ as “200 nautical miles from the baselines from which the breadth of the territorial sea is measured”^[4] – matters have only complicated. This complication is attributed to the fact that the territorial claims of some parties, including that of China’s nine-dash line, overlaps the EEZ of other relevant ASEAN claimant states. The United States has defended that “claimant countries, under UN Convention of the Law of the Sea (UNCLOS), should have freedom of navigation through EEZs in the sea”^[1]. However, China’s recent military buildup in the region as well as their aggressive military actions has prompted the US to “challenge China’s assertive territorial claims”^[1] in the form of military aid by “by conducting FONOPs and bolstering support for Southeast Asian partners”^[1]. With this in mind, I aim to investigate how changes to US military aid to these countries, economic growth in these states as well as pressure from china’s increasing military budget has affected changes in military spending in ASEAN nations embroiled in sea claims with China. I shall do so by using data of the past decade made available – 2008 to 2018 – to perform our analysis.

Methods

Data Collection and brief description

I aim to investigate how changes to US military aid to these countries, economic growth in these regions as well as pressure from China’s increasing military budget has affected changes towards military spending in ASEAN nations embroiled in sea claims with China. I shall do so by using data of the past decade made available – 2008 to 2018 – to perform our analysis. Hence, I have 4 data variables to collect: 1) military spending in relevant ASEAN nations, 2) US military aid to these countries, 3) economic growth and 4) China’s (increasing) military budget. All these datasets are filtered to years 2008 to 2018.

Military Spending in relevant ASEAN Nations

I obtained the original Military expenditure (current USD)^[5] dataset from the World Bank Dataset, courtesy of the Stockholm International Peace Research

Institute (SIPRI). The expenditures are reflected in US dollars as a form of standardization. Coding is done in R to select datasets relevant to the study. (Refer to Appendix A and Appendix B for the relevant dataset)

US Military Aid to these countries

I obtained our original entire dataset used on US Foreign Aid from the Foreign Aid Explorer^[6]. The original dataset contains the list of all US foreign aid benefactors as well as their respective amounts from all departments across all sorts of programs or activities. I shall explore foreign aid based on the constant amount made available, to remain consistent with other monetary figures in this study.

US foreign aid is distributed through different departments to serve different purposes. Such includes economic aid, military aid and social assistance. Therefore, in this study, I shall focus on aid solely distributed through the Department of Defense. This would allow me to narrow our focus towards military aid. This is because I am interested in finding out how a variety of identified factors affect military spending in these 5 ASEAN Nations embroiled with territorial conflict with China. Thus, it is within the remit of this paper to focus solely on changes to military aid in its affects towards military spending; other forms of aid would not be relevant. With this, I have the list of foreign aid activities which are distributed through the Department of Defense towards the 5 ASEAN nations engaged with territorial disputes with China.

[1] "DOD - Foreign Military Financing (FMF) Program, Payment Waived"

[2] "1263/MSI - Maritime ISR Improvements"

[3] "President's Emergency Plan for AIDS Relief - PEPFAR Operational Plan Programs"

[4] "DOD - International Military Education & Training (IMET) Program/Deliveries"

[5] "1263/MSI - Maritime MOC/JOC Support"

[6] "1263/MSI - Maritime (MOC/JOC) Support (FIST)"

[7] "Combating Terrorism Fellowship Program (CTFP)"

[8] "Global Train & Equip Program"

[9] "Ministry of Defense Advisors Program"

[10] "Humanitarian Assistance - Typhoon Haiyan"

[11] "Cooperative Threat Reduction Program: Cooperative Biological Engagement [non-ODA]"

[12] "In-Country Counter narcotics Program"

[13] "Cooperative Threat Reduction Program: Proliferation Prevention [non-ODA]"

[14] "CBRN Preparedness Program (CP2)"

[15] "International Counterproliferation Program (ICP)"

[16] "Global Train & Equip Program - Manned ISR Platforms to Conduct Full-Spectrum Counterterrorism Operations"

- [17] "Global Train & Equip Program - Communications for Maritime Counterterrorism Operations"
- [18] "Southeast Asia Maritime Security Initiative (MSI) - Maritime ISR Improvements"
- [19] "Southeast Asia Maritime Security Initiative (MSI) - Maritime Security and Patrol Vessel Support and Enhancement"
- [20] "Southeast Asia Maritime Security Initiative (MSI) - Maritime and Joint Operations Center Support"
- [21] "Southeast Asia Maritime Security Initiative (MSI) - Maritime ISR Support"
- [22] "Humanitarian and Civic Assistance - Engineering"
- [23] "Southeast Asia Maritime Security Initiative (MSI) - Search and Rescue Operations"
- [24] "Southeast Asia Maritime Security Initiative (MSI) - Participation in Multilateral Engagements"
- [25] "Southeast Asia Maritime Security Initiative (MSI) - Human Rights Training"
- [26] "Ministry of Defense Advisors Program - Indonesia"
- [27] "Southeast Asia Maritime Security Initiative (MSI) - Amphibious and Littoral Security"
- [28] "Humanitarian and Civic Assistance - Medical/Dental"
- [29] "Ministry of Defense Advisors Program - Vietnam"
- [30] "Global Train & Equip Program - Marine Special Operations Group (MARSOG)"
- [31] "Humanitarian Assistance - Malaysian Air Search and Rescue"
- [32] "Cooperative Threat Reduction Program: Cooperative Biological Engagement/Proliferation Prevention [non-ODA]"
- [33] "Humanitarian and Civic Assistance - Medical"
- [34] "Disaster Relief - Indonesia Earthquake"
- [35] "Disaster Relief - Philippines Typhoon Bopha Relief"
- [36] "Humanitarian and Civic Assistance - Medical and Engineering"
- [37] "Global Train & Equip Program - Unspecified Activities"
- [38] "Cooperative Threat Reduction Program: Cooperative Threat Reduction (CTR) Unspecified Activities [non-ODA]"
- [39] "U.S. Army Corps of Engineers: MISSISSIPPI-MEKONG SISTER RIVER PARTNERSHIP FUNDS"
- [40] "Disaster Relief - Philippines Typhoon"
- [41] "Global Emerging Infections Surveillance and Response Program: Implementation and Evaluation of Electronic Disease Surveillance Systems in the Philippines"
- [42] "Humanitarian Assistance"
- [43] "President's Emergency Plan for AIDS Relief - Country Programs"
- [44] "DoD Excess Defense Articles, Grant Authority"

However, I am uninterested in programs which provide military assistance towards activities that provide no contribution towards a nation's military strengthening. These include Natural Disaster relief and/or Search & Rescue Operations. Instead, these programs consume and take up resources that could otherwise be utilized to defend the nation's security interest, including that of territorial claims against China. Hence, I have removed these types of foreign aid activities from our list. They include:

Humanitarian Assistance

Disaster Relief - Philippines Typhoon
 # Disaster Relief - Philippines Typhoon Bopha Relief
 # Southeast Asia Maritime Security Initiative (MSI) - Search and Rescue Operations
 # President's Emergency Plan for AIDS Relief - PEPFAR Operational Plan Programs
 # Humanitarian Assistance - Typhoon Haiyan
 # Humanitarian and Civic Assistance - Medical/Dental
 # Humanitarian and Civic Assistance - Medical
 # Disaster Relief - Indonesia Earthquake
 # Humanitarian Assistance - Malaysian Air Search and Rescue
 # President's Emergency Plan for AIDS Relief - Country Programs

As a result, our study filters and limits US military foreign aid to these selected and relevant activities:

- [1] "DOD - Foreign Military Financing (FMF) Program, Payment Waived"
- [2] "1263/MSI - Maritime ISR Improvements"
- [3] "DOD - International Military Education & Training (IMET) Program/Deliveries"
- [4] "1263/MSI - Maritime MOC/JOC Support"
- [5] "1263/MSI - Maritime (MOC/JOC) Support (FIST)"
- [6] "Combating Terrorism Fellowship Program (CTFP)"
- [7] "Global Train & Equip Program"
- [8] "Ministry of Defense Advisors Program"
- [9] "Cooperative Threat Reduction Program: Cooperative Biological Engagement [non-ODA]"
- [10] "In-Country Counter narcotics Program"
- [11] "Cooperative Threat Reduction Program: Proliferation Prevention [non-ODA]"
- [12] "CBRN Preparedness Program (CP2)"
- [13] "International Counterproliferation Program (ICP)"
- [14] "Global Train & Equip Program - Manned ISR Platforms to Conduct Full-Spectrum Counterterrorism Operations"
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- [25] "Southeast Asia Maritime Security Initiative (MSI) - Amphibious and Littoral Security"
- [26] "Ministry of Defense Advisors Program - Vietnam"
- [27] "Global Train & Equip Program - Marine Special Operations Group (MARSOG)"
- [28] "Cooperative Threat Reduction Program: Cooperative Biological Engagement/Proliferation Prevention [non-ODA]"
- [29] "Humanitarian and Civic Assistance - Medical"
- [30] "Humanitarian and Civic Assistance - Medical and Engineering"
- [31] "Global Train & Equip Program - Unspecified Activities"
- [32] "Cooperative Threat Reduction Program: Cooperative Threat Reduction (CTR) Unspecified Activities [non-ODA]"
- [33] "U.S. Army Corps of Engineers: MISSISSIPPI-MEKONG SISTER RIVER PARTNERSHIP FUNDS"
- [34] "Global Emerging Infections Surveillance and Response Program: Implementation and Evaluation of Electronic Disease Surveillance Systems in the Philippines"
- [35] "DoD Excess Defense Articles, Grant Authority"

(Refer to Appendix C and Appendix D for the relevant dataset)

Economic Growth

I obtained the original GDP growth (annual %) ^[7] dataset from the World Bank Dataset, courtesy of World Bank national accounts data, and OECD National Accounts data files. The growths are reflected in the form of annual GDP growth's based off percentages. Coding is done in R to select datasets relevant to the study. (Refer to Appendix E for the relevant dataset)

China's increasing military budget

Similarly, I obtained this original dataset from the World Bank Dataset, courtesy of the Stockholm International Peace Research Institute (SIPRI) ^[5]. The expenditures are reflected in US dollars as a form of standardization. Coding is done in R to select datasets relevant to the study. It is worth noting that this variable would remain constant amongst all nations in our multiple linear regression of study. (Refer to Appendix A and Appendix B for the relevant dataset)

Data Analysis and results

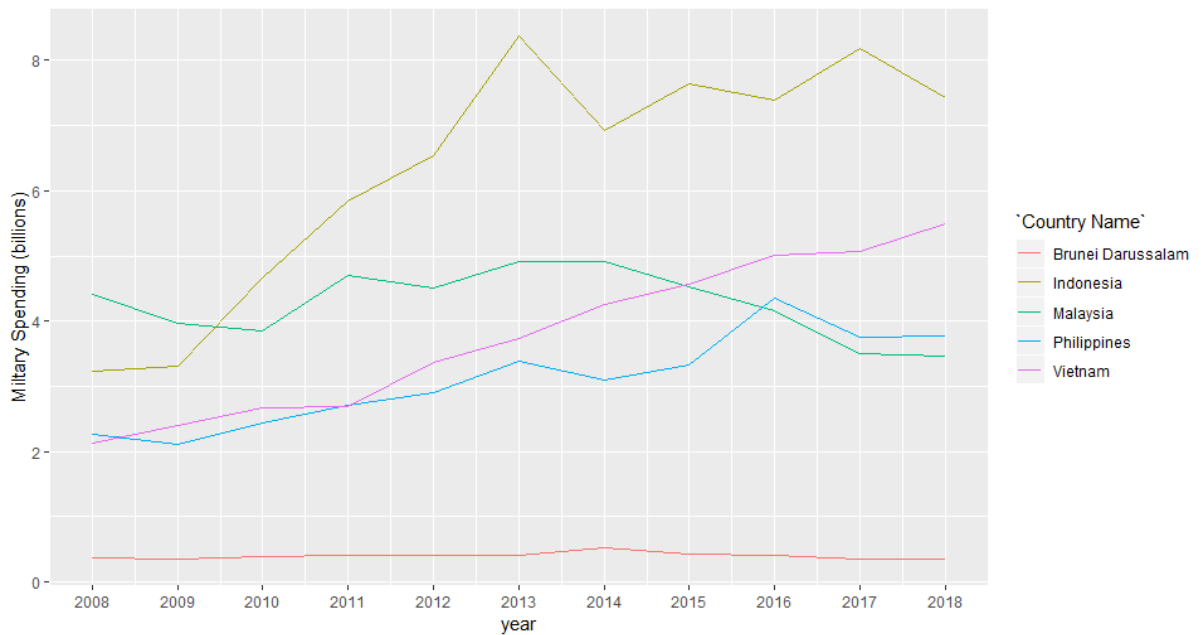
I am ultimately interested in determining how US military aid to these countries, economic growth and pressure from China's increasing military budget has affected changes in military spending in ASEAN nations embroiled in territorial disputes with china. Hence, ultimately, our linear should be as follows:

$$\begin{aligned}
 & \text{Change in Military Expenditure (\%)} \\
 &= B_0 + B_1 (\% \text{ change in US Military Aid}) \\
 &+ B_2 (\text{GDP Growth \%}) \\
 &+ B_3 (\% \text{ change in Chinese Military Expenditure})
 \end{aligned}$$

Before determining how changes in military spending in these ASEAN nations are affected by the respective identified factors, I shall perform a data analysis on each of the individual factors.

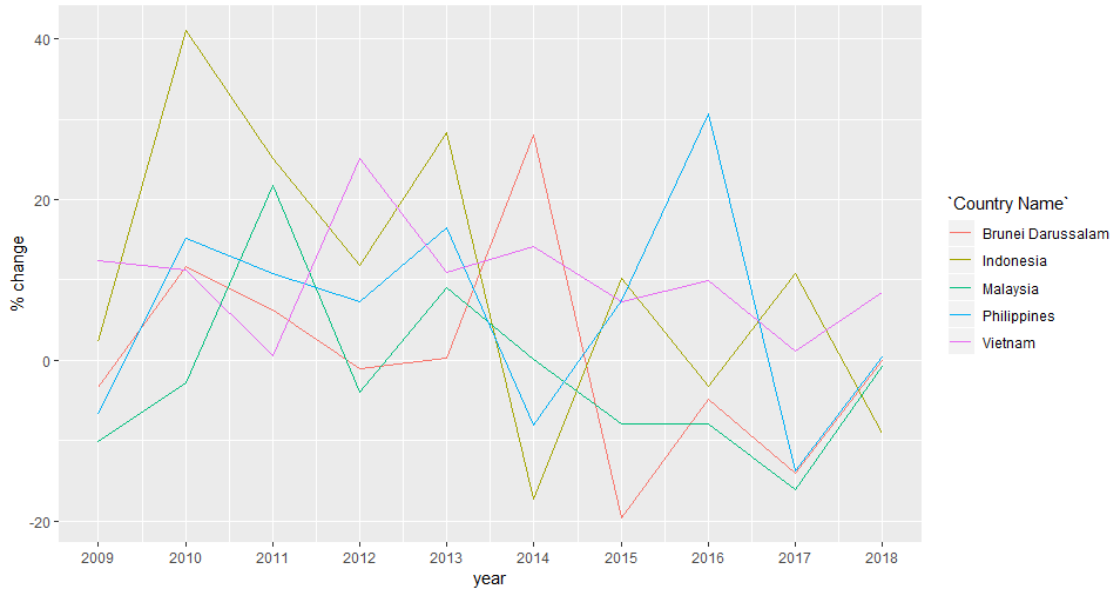
Data Analysis of Factors

Military Spending in relevant ASEAN Nations



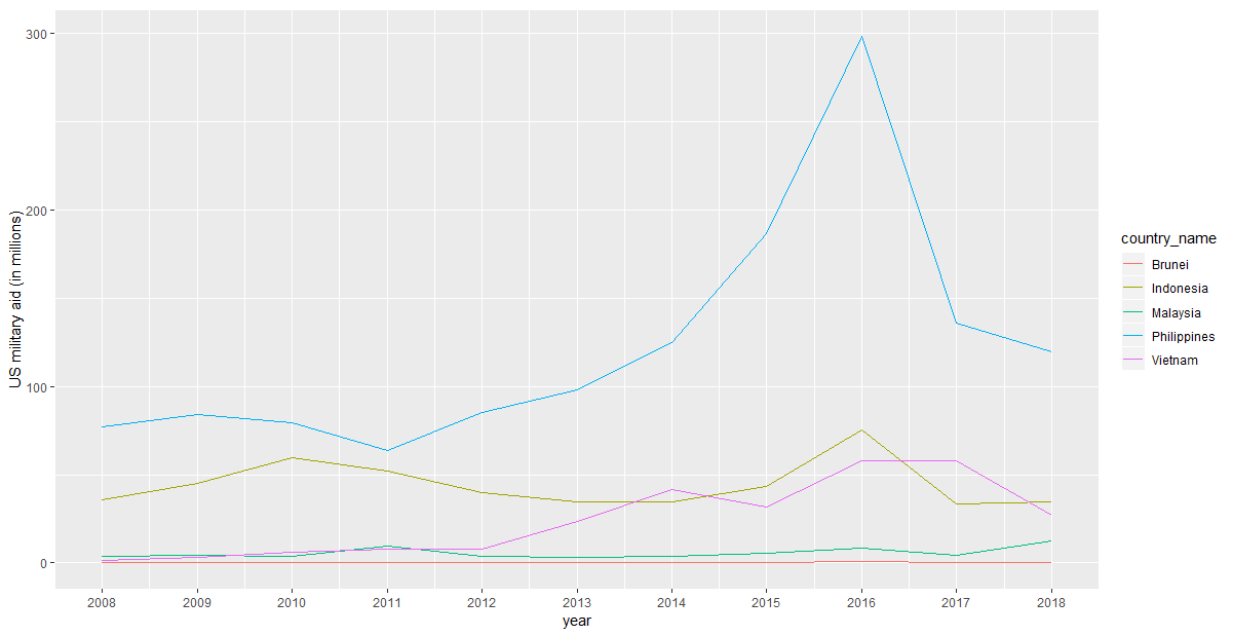
As shown in the graph above, Philippines (US\$ 2.2 to US\$3.7 billion), Indonesia (US\$ 3.2 to US\$7.4 billion) and Vietnam (US\$ 2.1 to US\$5.5 billion) have all increased their military expenditure from 2008 to 2018. Malaysia (US\$ 4.4 to US\$3.4 billion) and Brunei (US\$ 361 million to US\$346 million), on the other hand, have seen a decline in military expenditure within the same timeframe.

The percent changes of military expenditure could be best illustrated from the graph below:



(Refer to Appendix F for R code)

US Military Aid to these countries



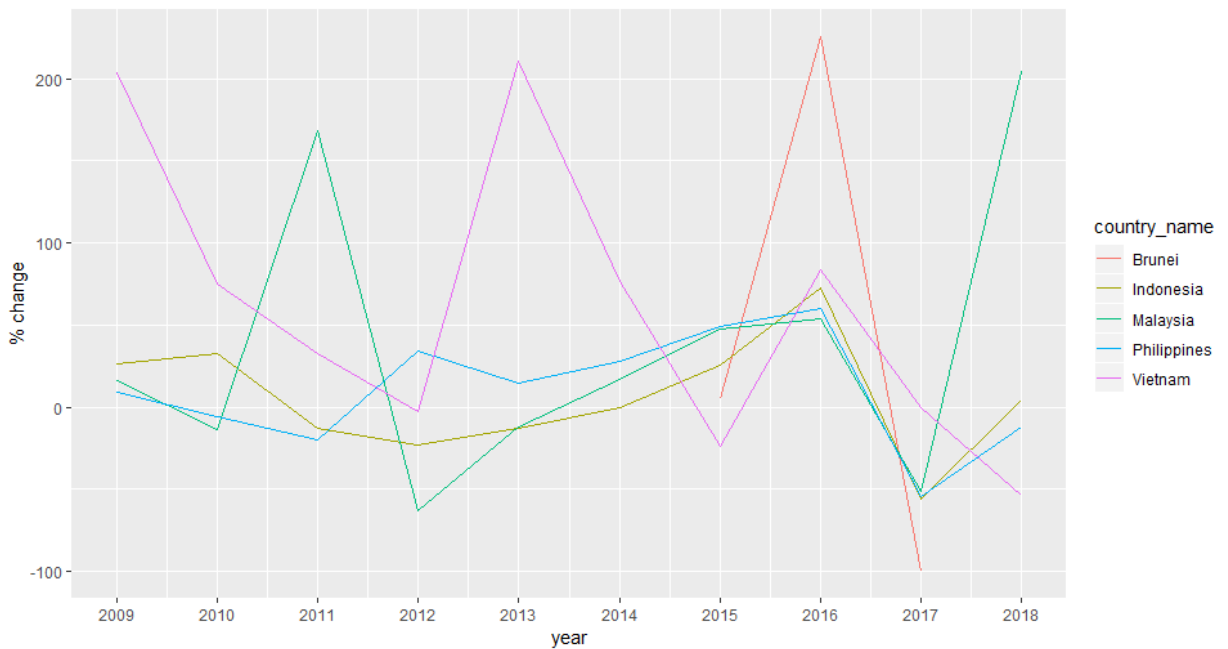
As shown in the figure above, US military foreign aid towards the Philippines, Malaysia and Vietnam has generally increased from 2008 to 2018, while Indonesia and Brunei saw an overall decrease.

It is worth noting that the Philippines saw an exponential growth from 2011 to 2016 before facing sharp declines from 2016 to 2018. Indonesia saw a rather steady decrease, with exceptions from 2008 to 2010, 2014 to 2016 and 2017 to 2018.

Apart from the years 2014 to 2015, and 2017 to 2018, Vietnam saw steady increases from 2008 to 2018. Similarly, aside from years 2011 to 2012 and 2016 to 2017, Malaysia witnessed overall steady increases from years 2008 to 2018.

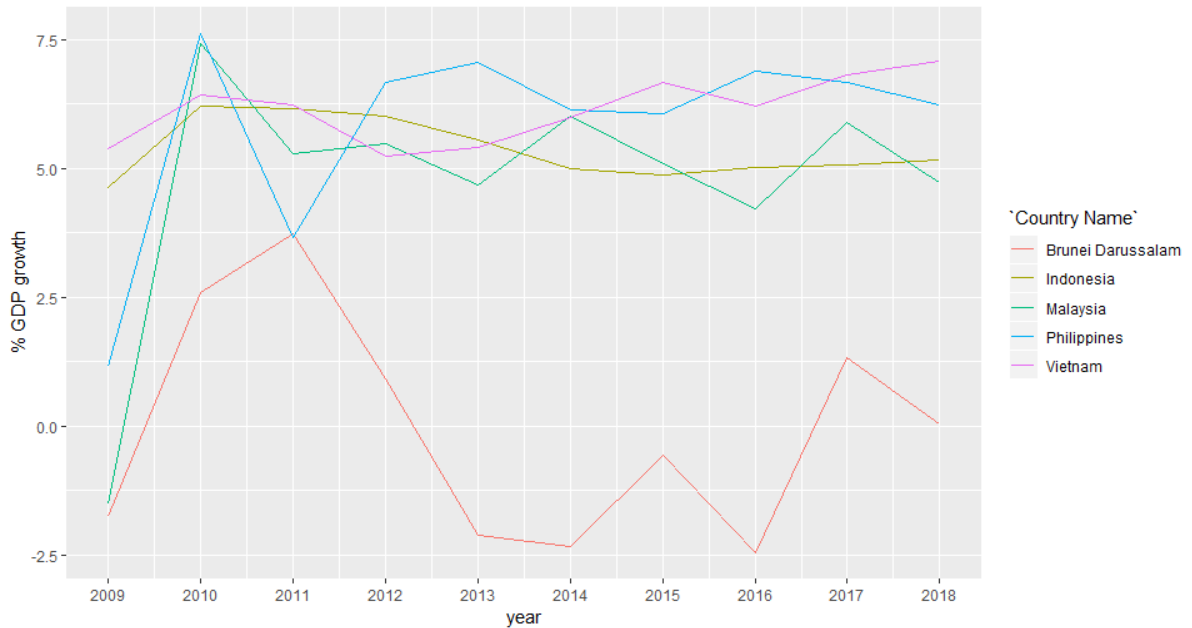
Brunei's foreign aid has remained minimum or non-existent as compared to their ASEAN counterparts in the graph.

These changes could be reflected as below:



(Refer to Appendix G for R code)

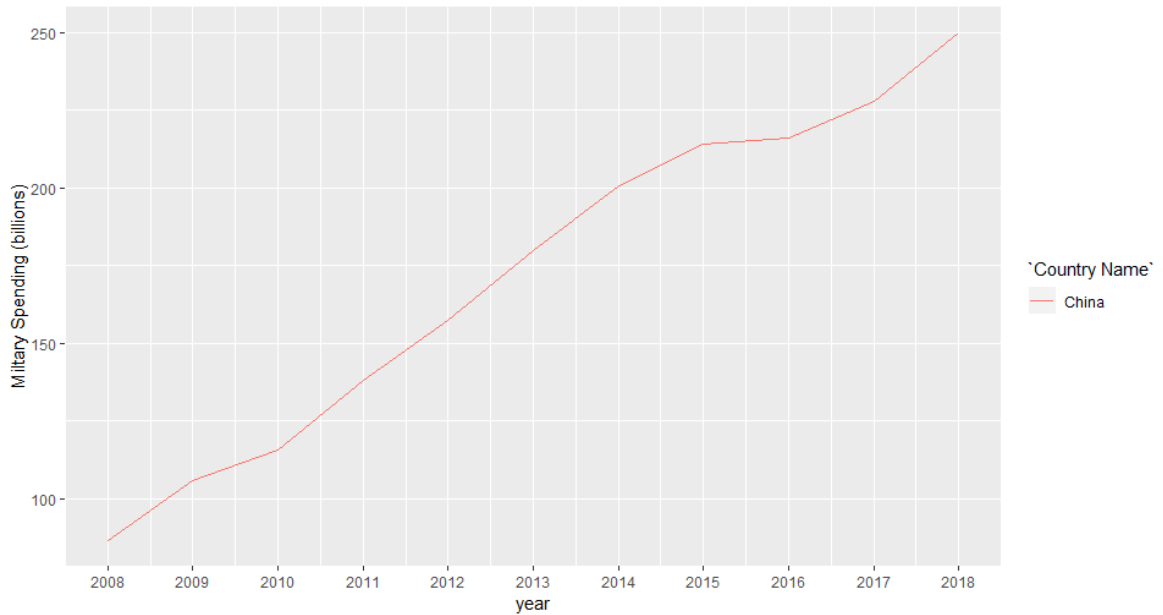
Economic Growth



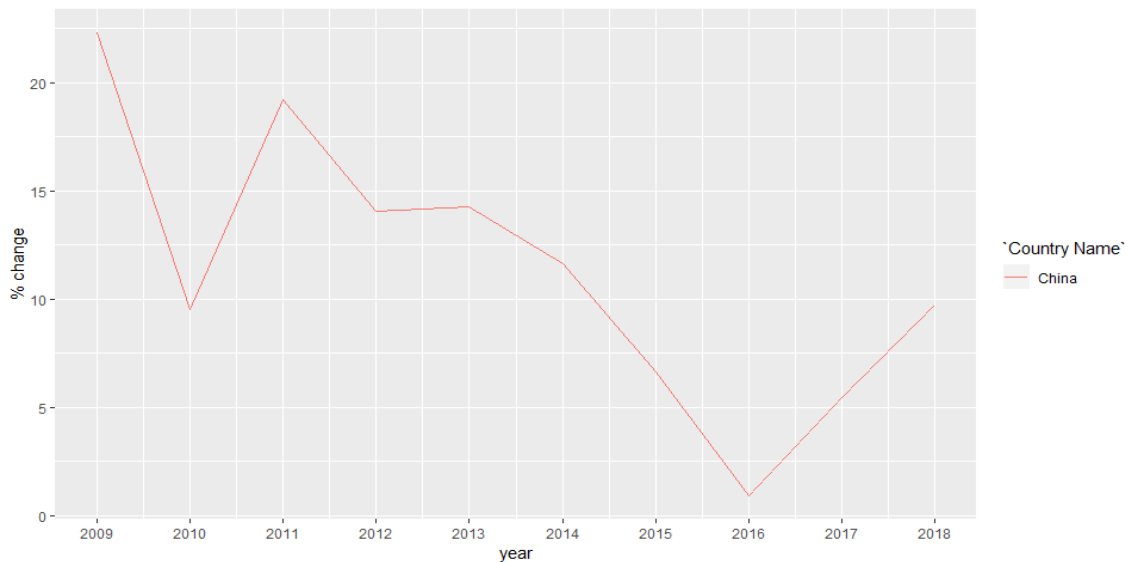
As shown in the figure above, the Philippines, Malaysia, Indonesia and Vietnam experienced prosperous economic growths ranging from 3.65 to 7.63 percent of GDP growth from 2010 to 2018. Brunei, on the other hand, has mostly struggled – in terms of economic growth – having recorded only 3 years of positive GDP growth. It is worth noting that most countries recorded slower growths in 2009 in comparison to its preceding years. This could be attributed to the effects of the 2008 global financial crisis. [8]

(Refer to Appendix H for R code)

China's increasing military budget



As shown above, China's military spending has steadily increased from US\$86 billion in 2008 to US\$250 Billion in 2018, having almost tripled over the past decade (2008 to 2018). These changes could be reflected as illustrated below.



(Refer to Appendix I for R code)

Results

As reiterated from above, I am ultimately interested in determining how US military aid to these countries, Economic growth and pressure from China's increasing Military Budget has affected changes in Military Spending in ASEAN nations embroiled in territorial disputes with china. Hence, ultimately, our multiple linear regression equation should be as follows.

$$\begin{aligned}
 & \text{Change in Military Expenditure (\%)} \\
 & = B_0 + B_1 (\% \text{ change in US Military Aid}) \\
 & + B_2 (\text{GDP Growth \%}) \\
 & + B_3 (\% \text{ change in Chinese defence budget})
 \end{aligned}$$

Given this, I shall perform a multiple linear regression for each of the 5 ASEAN nations involved in territorial disputes with China. (Refer to Appendix J for R Code). Our results could be summarized as follows:

Country	Coefficient estimate				t-value			
	% US Aid Change (B1)	Economic Growth (B2)	% change to China Military Expenditure (B3)	(Intercept) (B0)	% US Aid Change (B1)	Economic Growth (B2)	% change to China Military Expenditure (B3)	(Intercept) (B0)
<i>Multiple Linear Regression test</i>								
Vietnam	-0.04252	-13.34665	-0.33237	98.51991	-1.723	-3.459*	-1.076	3.748**
Philippines	0.1994	2.3729	0.1497	-11.5952	1.551	0.718	0.147	-0.395
Malaysia	0.05788	2.85098	1.26679	-31.90442	2.231.	2.565*	3.082*	-3.574*
Indonesia	0.0213	22.2395	0.1456	-111.3443	0.142	2.443	0.176.	-2.281.
Brunei	0.04878	0.12778	1.01030	-10.82335	0.727	0.053	1.066	-0.938

p-value Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

Vietnam

Coefficients				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)-(B ₀)	98.51991	26.28752	3.748	0.00953 **
% US Aid Change (B ₁)	-0.04252	0.02468	-1.723	0.13566
Economic growth (B ₂)	-13.34665	3.85828	-3.459	0.01348 *
% change to China Military Exp (B ₃)	-0.33237	0.30877	-1.076	0.32309

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.825 on 6 degrees of freedom

Multiple R-squared: 0.6767

Adjusted R-squared: 0.515

F-statistic: 4.185 on 3 and 6 DF

p-value: 0.06431

As shown above, based off data from 2008 to 2018, from a Statistical Multiple Linear Regression analysis, Vietnam's **individual economic growth** is the most and only significant factor, out of those analyzed, in affecting changes towards its military expenditure at significance level $\alpha = 0.05$.

The adj R-squared value suggests 51.5% of variation in changes towards military expenditure in Vietnam from 2008 to 2018 could be explained by the changes in its US military aid received, its economic growth and changes in China's military expenditure.

Philippines

Coefficients				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)-(B ₀)	-11.5952	29.3604	-0.395	0.707
% US Aid Change (B ₁)	0.1994	0.1286	1.551	0.172
Economic growth (B ₂)	2.3729	3.3036	0.718	0.500
% change to China Military Exp (B ₃)	0.1497	1.0213	0.147	0.888

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 12.97 on 6 degrees of freedom

Multiple R-squared: 0.3768

Adjusted R-squared: 0.06514

F-statistic: 1.209 on 3 and 6 DF

p-value: 0.3841

As shown above, based off data from 2008 to 2018, from a Multiple Linear Regression analysis, I am **inconclusive** in determining any significant factors out of those analyzed that affect changes towards Philippine's military expenditure at significance level $\alpha = 0.05$.

The adj R-squared value suggests that 6.514% of variation in changes towards military expenditure in Philippines from 2008 to 2018 could be explained by the changes in its US military aid received, its economic growth and changes in China's military expenditure.

Malaysia

Coefficients				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)-(B ₀)	-31.90422	8.92675	-3.574	0.0117 *
% US Aid Change (B ₁)	0.05788	0.02594	2.231	0.0671 .
Economic growth (B ₂)	2.85098	1.11131	2.565	0.0426 *
% change to China Military Exp (B ₃)	1.26679	0.411	3.082	0.0216 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.782 on 6 degrees of freedom

Multiple R-squared: 0.7331

Adjusted R-squared: 0.5997

F-statistic: 5.494 on 3 and 6 DF

p-value: 0.03716

As shown above, based off data from 2008 to 2018, from a Statistical Multiple Linear Regression analysis, **pressure from China's increasing in military expenditure** is the most significant factor, out of those analyzed, in affecting changes towards Malaysia's military expenditure at significance level $\alpha = 0.05$.

The adj R-squared value suggests that 59.97% of variation in changes towards military expenditure in Malaysia from 2008 to 2018 could be explained by the changes in its US Military aid received, its economic growth and changes in China's military expenditure.

Indonesia

Coefficients				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)-(B ₀)	-111.3443	48.816	-2.281	0.0627 .
% US Aid Change (B ₁)	0.0213	0.1498	0.142	0.8916
Economic growth(B ₂)	22.2395	9.1029	2.443	0.0503 .
% change to China Military Exp (B ₃)	0.1456	0.8277	0.176	0.8662

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 15.21 on 6 degrees of freedom

Multiple R-squared: 0.52

Adjusted R-squared: 0.28

F-statistic: 2.167 on 3 and 6 DF

p-value: 0.1931

As shown above, based off data from 2008 to 2018, from a Statistical Multiple Linear Regression analysis, I am **inconclusive** in determining any significant factors out of those analyzed that affect changes towards Indonesia's military expenditure at significance level $\alpha = 0.05$.

However, at significance level $\alpha = 0.1$, Indonesia's **individual economic growth** is the most and only significant factor, out of those analyzed, in affecting changes towards its military expenditure.

The adj R-squared value suggests that 28% of variation in changes towards military expenditure in Indonesia from 2008 to 2018 could be explained by the changes in its US Military aid received, its economic growth and changes in China's military expenditure.

Brunei

Coefficients				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)-(B ₀)	-10.82335	11.5356	-0.938	0.384
% US Aid Change (B ₁)	0.04878	0.06707	0.727	0.494
Economic growth (B ₂)	0.12778	2.40558	0.053	0.959
% change to China Military Exp (B ₃)	1.0103	0.94776	1.066	0.327

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.87 on 6 degrees of freedom

Multiple R-squared: 0.1621

Adjusted R-squared: -0.2568

F-statistic: 0.387 on 3 and 6 DF

p-value: 0.7667

Based off data from 2008 to 2018, from a Statistical Multiple Linear Regression analysis, I am **inconclusive** in determining any significant factors out of those analyzed that affects changes towards Brunei's military expenditure at significance level $\alpha = 0.05$.

The R-squared value suggests that 16.21% of variation in changes towards military expenditure in Brunei from 2008 to 2018 could be explained by the changes in its US Military aid received, its economic growth and changes in China's military expenditure.

Limitations to our model

Before concluding, I shall explore possible limitations to the model presented. Due to the quantitative nature of our study, it is worth noting that our model does not include categorical factors such as changes in administration, external political pressures or governmental priorities of respective administrations during a certain year. This was not reflected in our model because it is difficult to quantify such figures. Thus, it is worth noting that this specified limitation could potentially explain certain confounding variables in the model.

On top of that, the multiple adj R-squared value for Brunei and the Philippines appears to be rather low. This reflects that the analyzed factors studied were insufficient in explaining the variation in changes to military spending in these countries.

Conclusion and Future Work

Based off data from 2008 to 2018, from a Statistical Multiple Linear Regression analysis, I could conclude that **individual economic growth** is the most significant factor in affecting changes towards **Vietnam's** military expenditure at significance level $\alpha = 0.05$, while **pressure resulting from China's increasing military expenditure** is the most significant factor in affecting changes towards **Malaysia's** military expenditure at significance level $\alpha = 0.05$. At significance level $\alpha = 0.1$, additionally, Indonesia's **individual economic growth** is the most and only significant factor in affecting changes towards its military expenditure. However, based off data from 2008 to 2018, from a Statistical Multiple Linear Regression analysis, I am **inconclusive** in determining any significant factor affecting changes

towards Brunei's, Philippine's and Indonesia's military expenditure at significance level $\alpha = 0.05$.

Should any future work be done, it hopes to provide a military strategical analysis to explain such findings. If anyone wishes to conduct any further statistical and/or policy analysis, it hopes to find any additional possible factors and its significance in affecting changes towards military expenditure in these ASEAN nations embroiled in territorial disputes with China.

**APPENDIX A.
Military Spending 2008 to 2018 (in USD)**

	Country Name	2008	2009	2010	2011	2012
1	Brunei Darussalam	361989035	349759723	390719540	415371529	411261474
2	China	86362099113	105644000000	115712000000	137967000000	157390000000
3	Indonesia	3232202215	3304459138	4663365759	5838026186	6531097955
4	Malaysia	4411795565	3964817705	3854285351	4692483660	4507252007
5	Philippines	2270904919	2115785124	2438189569	2701492158	2898685257
6	Vietnam	2137625597	2401450914	2672286425	2686520590	3360860380

	Country Name	2013	2014	2015	2016
1	Brunei Darussalam	412094280	527785232	424022039	403366489
2	China	179880000000	200772000000	214093000000	216031000000
3	Indonesia	8384028601	6929255301	7639095193	7385408685
4	Malaysia	4915722759	4919244942	4532069852	4169374001
5	Philippines	3377027861	3103128266	3335552977	4357991313
6	Vietnam	3727249276	4255721581	4562632501	5017401787

	Country Name	2017	2018
1	Brunei Darussalam	346706804	346588691
2	China	227829000000	249997000000
3	Indonesia	8178144377	7437197348
4	Malaysia	3494832257	3469828207
5	Philippines	3755351173	3769741011
6	Vietnam	5073853534	5500000000

APPENDIX B.
Changes in Military Spending 2008 to 2018 (%)

	Country Name	2009	2010	2011	2012	2013
1	Brunei Darussalam	-3.378365	11.710844	6.3093822	-0.9894889	0.2025003
2	China	22.326809	9.530120	19.2330960	14.0780042	14.2893449
3	Indonesia	2.235532	41.123420	25.1891121	11.8716797	28.3708905
4	Malaysia	-10.131427	-2.787829	21.7471783	-3.9474118	9.0625230
5	Philippines	-6.830748	15.238052	10.7991024	7.2994141	16.5020539
6	Vietnam	12.341980	11.277995	0.5326587	25.1008607	10.9016399

	Country Name	2014	2015	2016	2017	2018
1	Brunei Darussalam	28.07390385	-19.660117	-4.8713389	-14.046701	-0.03406723
2	China	11.61440961	6.634889	0.9052141	5.461253	9.73010460
3	Indonesia	-17.35172158	10.244101	-3.3208973	10.733809	-9.06008741
4	Malaysia	0.07165138	-7.870620	-8.0028742	-16.178490	-0.71545780
5	Philippines	-8.11067028	7.490013	30.6527386	-13.828392	0.38318222
6	Vietnam	14.17861447	7.211725	9.9672565	1.125119	8.39887204

APPENDIX C.
US Military Aid (in USD)

	country_name	2008	2009	2010	2011	2012
1	Brunei	57162	0	0	94422	0
2	Indonesia	35550418	45018664	59705194	52067564	40004156
3	Malaysia	3514342	4084182	3524282	9450476	3524470
4	Philippines	77358518	84277242	79655918	63790602	85487458
5	Vietnam	1092944	3322494	5802854	7692090	7508021

	country_name	2013	2014	2015	2016	2017	2018
1	Brunei	0	193902	204634	666900	0	0
2	Indonesia	34782876	34648260	43452779	75170966	33291030	34800708
3	Malaysia	3088262	3613863	5321166	8191552	4001470	12172886
4	Philippines	97787714	125049511	186513891	298189443	136154072	119496300
5	Vietnam	23335988	41291273	31600123	57909294	57815250	26823356

APPENDIX D.
Changes in US military Aid (in %)

	country_name	2009	2010	2011	2012	2013
1	Brunei	-100.000000	NA	NA	-100.000000	NA
2	Indonesia	26.633290	32.623203	-12.79224	-23.168758	-13.05184
3	Malaysia	16.214700	-13.708988	168.15323	-62.705900	-12.37656
4	Philippines	8.943713	-5.483478	-19.91731	34.012621	14.38837
5	Vietnam	203.994898	74.653558	32.55701	-2.392965	210.81410

	country_name	2014	2015	2016	2017	2018
1	Brunei	NA	5.534755	225.89892	-100.0000000	NA
2	Indonesia	-0.387018	25.411143	72.99461	-55.7129145	4.534789
3	Malaysia	17.019314	47.243158	53.94280	-51.1512592	204.210353
4	Philippines	27.878550	49.152035	59.87519	-54.3397410	-12.234502
5	Vietnam	76.942468	-23.470214	83.25655	-0.1623988	-53.605051

APPENDIX E.
GDP growth (in %)

	Country Name	2009	2010	2011	2012	2013
1	Brunei Darussalam	- 1.764536	2.59896 6	3.74531 8	0.912841 7	- 2.126029
2	Indonesia	4.628871	6.22385 4	6.16978 4	6.030050 7	5.557264
3	Malaysia	- 1.513529	7.42484 7	5.29391 3	5.473454 2	4.693723
4	Philippines	1.148332	7.63226 5	3.65975 2	6.683818 9	7.064024
5	Vietnam	5.397898	6.42323 8	6.24030 3	5.247367 2	5.421883

	Country Name	2014	2015	2016	2017	2018
1	Brunei Darussalam	-2.349747	-0.5668146	-2.465515	1.328751	0.05234667
2	Indonesia	5.006668	4.8763223	5.033069	5.067406	5.17127033
3	Malaysia	6.006722	5.0915157	4.223410	5.897009	4.72363367
4	Philippines	6.145299	6.0665489	6.884055	6.677554	6.24373774
5	Vietnam	5.983655	6.6792888	6.210812	6.812246	7.07578862

APPENDIX F.

R code for Military Spending (ASEAN nations relevant to study)

```
> library(data.table)
> library(ggplot2)
> library(bit64)
> library(dplyr)
> data<-fread("./project/volume/data/raw/API_MS.MIL.XPND.CD_DS2_en_csv_v2_512127.csv")
> colnames(data) <- as.character(unlist(data[1,]))
> data <- data[-1, ]
> data<-data[Country Name`%like% "Philippine|Indonesia|Vietnam|Malaysia|Brunei"]
> data<-data[,.(Country Name`, `2008`, `2009`, `2010`, `2011`, `2012`, `2013`, `2014`, `2015`, `2016`, `2017`, `2018`)]
>
> melted<-melt(data, id.vars = NULL)
> melted$variable<-as.numeric(paste(melted$variable))
> ggplot(melted, aes(variable, (value/1000000000)))+ geom_line(aes(color=`Country Name`))+scale_x_continuous(breaks=c(2008,2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("year")+ylab("Military Spending (billions)")
>
>
> data$change_2009<-(((data$`2009`)-(data$`2008`))/(data$`2008`)*100)
> data$change_2010<-(((data$`2010`)-(data$`2009`))/(data$`2009`)*100)
> data$change_2011<-(((data$`2011`)-(data$`2010`))/(data$`2010`)*100)
> data$change_2012<-(((data$`2012`)-(data$`2011`))/(data$`2011`)*100)
> data$change_2013<-(((data$`2013`)-(data$`2012`))/(data$`2012`)*100)
> data$change_2014<-(((data$`2014`)-(data$`2013`))/(data$`2013`)*100)
> data$change_2015<-(((data$`2015`)-(data$`2014`))/(data$`2014`)*100)
> data$change_2016<-(((data$`2016`)-(data$`2015`))/(data$`2015`)*100)
> data$change_2017<-(((data$`2017`)-(data$`2016`))/(data$`2016`)*100)
> data$change_2018<-(((data$`2018`)-(data$`2017`))/(data$`2017`)*100)
> change_data<-data[,.(Country Name`, change_2009, change_2010, change_2011, change_2012, change_2013, change_2014, change_2015, change_2016, change_2017, change_2018)]
> setnames(change_data, "change_2009", "2009")
> setnames(change_data, "change_2010", "2010")
> setnames(change_data, "change_2011", "2011")
> setnames(change_data, "change_2012", "2012")
> setnames(change_data, "change_2013", "2013")
> setnames(change_data, "change_2014", "2014")
> setnames(change_data, "change_2015", "2015")
> setnames(change_data, "change_2016", "2016")
> setnames(change_data, "change_2017", "2017")
> setnames(change_data, "change_2018", "2018")
> melted_change<-melt(change_data, id.vars = NULL)
> melted_change$variable<-as.numeric(paste(melted_change$variable))
```



```

> ggplot(melted_change, aes(variable, value))+ geom_line(aes(color=`Country Name`))+scale
_x_continuous(breaks=c(2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("ye
ar")+ylab("% change")
>
>
>
> colnames(melted_change) <- c("country_name", "year", 'military_spending_change')
> fwrite(melted_change, "./project/volume/data/interim/change_military.csv")

```

APPENDIX G. R code for US Military Aid

```

> library(data.table)
> library(ggplot2)
> library(bit64)
> library(dplyr)
> data<-fread("./project/volume/data/raw/us_foreign_aid_complete.csv")
> data<-data[country_name%like% "Philippine|Indonesia|Vietnam|Malaysia|Brunei"]
> data<-data[implementing_agency_name%like%"Defense"]
> data<-data[order(-fiscal_year)]
> data$fiscal_year<-as.integer(data$fiscal_year)
> data<-data[,.(country_name, implementing_agency_name, fiscal_year, constant_amount, act
ivity_name, transaction_type_name)]
> data<-data[fiscal_year>=2008]
> data$fiscal_year<-as.character(data$fiscal_year)
> unique(data$activity_name)
[1] "DOD - Foreign Military Financing (FMF) Program, Payment Waived"
[2] "1263/MSI - Maritime ISR Improvements"
[3] "President's Emergency Plan for AIDS Relief - PEPFAR Operational Plan Programs"
[4] "DOD - International Military Education & Training (IMET) Program/Deliveries"
[5] "1263/MSI - Maritime MOC/JOC Support"
[6] "1263/MSI - Maritime (MOC/JOC) Support (FIST)"
[7] "Combating Terrorism Fellowship Program (CTFP)"
[8] "Global Train & Equip Program"
[9] "Ministry of Defense Advisors Program"
[10] "Humanitarian Assistance - Typhoon Haiyan"
[11] "Cooperative Threat Reduction Program: Cooperative Biological Engagement [non-ODA
]"
[12] "In-Country Counternarcotics Program"
[13] "Cooperative Threat Reduction Program: Proliferation Prevention [non-ODA]"
[14] "CBRN Preparedness Program (CP2)"
[15] "International Counterproliferation Program (ICP)"
[16] "Global Train & Equip Program - Manned ISR Platforms to Conduct Full-Spectrum Count
erTerrorism Operations"
[17] "Global Train & Equip Program - Communications for Maritime CounterTerrorism Oper
ations"

```

[18] "Southeast Asia Maritime Security Initiative (MSI) - Maritime ISR Improvements"
 [19] "Southeast Asia Maritime Security Initiative (MSI) - Maritime Security and Patrol Vessel Support and Enhancement"
 [20] "Southeast Asia Maritime Security Initiative (MSI) - Maritime and Joint Operations Center Support"
 [21] "Southeast Asia Maritime Security Initiative (MSI) - Maritime ISR Support"
 [22] "Humanitarian and Civic Assistance - Engineering"
 [23] "Southeast Asia Maritime Security Initiative (MSI) - Search and Rescue Operations"
 [24] "Southeast Asia Maritime Security Initiative (MSI) - Participation in Multilateral Engagements"
 [25] "Southeast Asia Maritime Security Initiative (MSI) - Human Rights Training"
 [26] "Ministry of Defense Advisors Program - Indonesia"
 [27] "Southeast Asia Maritime Security Initiative (MSI) - Amphibious and Littoral Security"
 [28] "Humanitarian and Civic Assistance - Medical/Dental"
 [29] "Ministry of Defense Advisors Program - Vietnam"
 [30] "Global Train & Equip Program - Marine Special Operations Group (MARSOG)"
 [31] "Humanitarian Assistance - Malaysian Air Search and Resue"
 [32] "Cooperative Threat Reduction Program: Cooperative Biological Engagement/Proliferation Prevention [non-ODA]"
 [33] "Humanitarian and Civic Assistance - Medical"
 [34] "Disaster Relief - Indonesia Earthquake"
 [35] "Disaster Relief - Philippines Typhoon Bopha Relief"
 [36] "Humanitarian and Civic Assistance - Medical and Engineering"
 [37] "Global Train & Equip Program - Unspecified Activities"
 [38] "Cooperative Threat Reduction Program: Cooperative Threat Reduction (CTR) Unspecified Activities [non-ODA]"
 [39] "U.S. Army Corps of Engineers: MISSISSIPPI-MEKONG SISTER RIVER PARTNERSHIP FUNDS"
 [40] "Disaster Relief - Philippines Typhoon"
 [41] "Global Emerging Infections Surveillance and Response Program: Implementation and Evaluation of Electronic Disease Surveillance Systems in the Philippines"
 [42] "Humanitarian Assistance"
 [43] "President's Emergency Plan for AIDS Relief - Country Programs"
 [44] "DoD Excess Defense Articles, Grant Authority"

>

> # Humanitarian Assistance
 > # Disaster Relief - Philippines Typhoon
 > # Disaster Relief - Philippines Typhoon Bopha Relief
 > # Southeast Asia Maritime Security Initiative (MSI) - Search and Rescue Operations"
 > # "President's Emergency Plan for AIDS Relief - PEPFAR Operational Plan Programs"
 > # "Humanitarian Assistance - Typhoon Haiyan"
 > # "Humanitarian and Civic Assistance - Medical/Dental"
 > # "Humanitarian and Civic Assistance - Medical"
 > # "Disaster Relief - Indonesia Earthquake"
 > # "Humanitarian Assistance - Malaysian Air Search and Resue"
 > # "President's Emergency Plan for AIDS Relief - Country Programs"
 > data<-data[!activity_name %like% "President's Emergency Plan for AIDS Relief - PEPFAR Operational Plan Programs|Humanitarian Assistance - Typhoon Haiyan

+ |Humanitarian and Civic Assistance - Medical/Dental|Humanitarian and Civic Assistance - Medical
 + |Disaster Relief - Indonesia Earthquake|Humanitarian Assistance - Malaysian Air Search and Rescue|
 + President's Emergency Plan for AIDS Relief - Country Programs|Humanitarian Assistance|
 + Disaster Relief - Philippines Typhoon|Disaster Relief - Philippines Typhoon Bopha Relief|
 + Southeast Asia Maritime Security Initiative (MSI) - Search and Rescue Operations
 + |President's Emergency Plan for AIDS Relief - Country Programs|Humanitarian Assistance"]

> unique(data\$activity_name) #list all the items included in our newly filtered dataset

[1] "DOD - Foreign Military Financing (FMF) Program, Payment Waived"
 [2] "1263/MSI - Maritime ISR Improvements"
 [3] "DOD - International Military Education & Training (IMET) Program/Deliveries"
 [4] "1263/MSI - Maritime MOC/JOC Support"
 [5] "1263/MSI - Maritime (MOC/JOC) Support (FIST)"
 [6] "Combating Terrorism Fellowship Program (CTFP)"
 [7] "Global Train & Equip Program"
 [8] "Ministry of Defense Advisors Program"
 [9] "Cooperative Threat Reduction Program: Cooperative Biological Engagement [non-ODA]"
 "
 [10] "In-Country Counternarcotics Program"
 [11] "Cooperative Threat Reduction Program: Proliferation Prevention [non-ODA]"
 [12] "CBRN Preparedness Program (CP2)"
 [13] "International Counterproliferation Program (ICP)"
 [14] "Global Train & Equip Program - Manned ISR Platforms to Conduct Full-Spectrum CounterTerrorism Operations"
 [15] "Global Train & Equip Program - Communications for Maritime CounterTerrorism Operations"
 [16] "Southeast Asia Maritime Security Initiative (MSI) - Maritime ISR Improvements"
 [17] "Southeast Asia Maritime Security Initiative (MSI) - Maritime Security and Patrol Vessel Support and Enhancement"
 [18] "Southeast Asia Maritime Security Initiative (MSI) - Maritime and Joint Operations Center Support"
 [19] "Southeast Asia Maritime Security Initiative (MSI) - Maritime ISR Support"
 [20] "Humanitarian and Civic Assistance - Engineering"
 [21] "Southeast Asia Maritime Security Initiative (MSI) - Search and Rescue Operations"
 [22] "Southeast Asia Maritime Security Initiative (MSI) - Participation in Multilateral Engagements"
 [23] "Southeast Asia Maritime Security Initiative (MSI) - Human Rights Training"
 [24] "Ministry of Defense Advisors Program - Indonesia"
 [25] "Southeast Asia Maritime Security Initiative (MSI) - Amphibious and Littoral Security"
 [26] "Ministry of Defense Advisors Program - Vietnam"
 [27] "Global Train & Equip Program - Marine Special Operations Group (MARSOG)"
 [28] "Cooperative Threat Reduction Program: Cooperative Biological Engagement/Proliferation Prevention [non-ODA]"
 [29] "Humanitarian and Civic Assistance - Medical"
 [30] "Humanitarian and Civic Assistance - Medical and Engineering"

```

[31] "Global Train & Equip Program - Unspecified Activities"
[32] "Cooperative Threat Reduction Program: Cooperative Threat Reduction (CTR) Unspecified Activities [non-ODA]"
[33] "U.S. Army Corps of Engineers: MISSISSIPPI-MEKONG SISTER RIVER PARTNERSHIP FUNDING"
[34] "Global Emerging Infections Surveillance and Response Program: Implementation and Evaluation of Electronic Disease Surveillance Systems in the Philippines"
[35] "DoD Excess Defense Articles, Grant Authority"
> data<-data[,.(country_name, constant_amount, fiscal_year)]
>
> data1<-dcast(data, country_name~fiscal_year, sum, value.var = "constant_amount")
> melted<-melt(data1, id.vars = NULL)
> melted$variable<-as.numeric(paste(melted$variable))
> ggplot(melted, aes(variable, (value/1000000)))+ geom_line(aes(color=country_name))+scale_x_continuous(breaks=c(2008,2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("year")+ylab("US military aid (in millions)")
>
> data1$aids_change_2009<-(((data1$`2009`)-(data1$`2008`))/(data1$`2008`)*100)
> data1$aids_change_2010<-(((data1$`2010`)-(data1$`2009`))/(data1$`2009`)*100)
  NAs produced by integer64 overflow
> data1$aids_change_2011<-(((data1$`2011`)-(data1$`2010`))/(data1$`2010`)*100)
  NAs produced by integer64 overflow
> data1$aids_change_2012<-(((data1$`2012`)-(data1$`2011`))/(data1$`2011`)*100)
> data1$aids_change_2013<-(((data1$`2013`)-(data1$`2012`))/(data1$`2012`)*100)
Warning message:
In `/.integer64`(((data1$`2013`)-(data1$`2012`)), (data1$`2012`)):
  NAs produced by integer64 overflow
> data1$aids_change_2014<-(((data1$`2014`)-(data1$`2013`))/(data1$`2013`)*100)
  NAs produced by integer64 overflow
> data1$aids_change_2015<-(((data1$`2015`)-(data1$`2014`))/(data1$`2014`)*100)
> data1$aids_change_2016<-(((data1$`2016`)-(data1$`2015`))/(data1$`2015`)*100)
> data1$aids_change_2017<-(((data1$`2017`)-(data1$`2016`))/(data1$`2016`)*100)
> data1$aids_change_2018<-(((data1$`2018`)-(data1$`2017`))/(data1$`2017`)*100)
  NAs produced by integer64 overflow
> aids_change_data<-data1[,.(country_name, aids_change_2009,aids_change_2010,aids_change_2011, aids_change_2012, aids_change_2013, aids_change_2014, aids_change_2015,aids_change_2016, aids_change_2017, aids_change_2018)]
> setnames(aids_change_data,"aids_change_2009","2009")
> setnames(aids_change_data,"aids_change_2010","2010")
> setnames(aids_change_data,"aids_change_2011","2011")
> setnames(aids_change_data,"aids_change_2012","2012")
> setnames(aids_change_data,"aids_change_2013","2013")
> setnames(aids_change_data,"aids_change_2014","2014")
> setnames(aids_change_data,"aids_change_2015","2015")
> setnames(aids_change_data,"aids_change_2016","2016")
> setnames(aids_change_data,"aids_change_2017","2017")
> setnames(aids_change_data,"aids_change_2018","2018")
> melted_change<-melt(aids_change_data, id.vars = NULL)
> melted_change$variable<-as.numeric(paste(melted_change$variable))

```

```

> ggplot(melted_change, aes(variable, value))+ geom_line(aes(color=country_name))+scale_x_continuous(breaks=c(2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("year")+ylab("% change")
> colnames(melted_change) <- c("country_name", "year", 'aid_change')
> melted_change$country_name[melted_change$country_name == "Brunei"] <- "Brunei Darussalam"
> fwrite(melted_change, "./project/volume/data/interim/change_aid.csv")

```

APPENDIX H. R code for Economic Growth

```

> library(data.table)
> library(ggplot2)
> library(bit64)
> library(dplyr)
> data<-fread("./project/volume/data/raw/API_NY.GDP.MKTP.KD.ZG_DS2_en_csv_v2_511423.csv")
> colnames(data) <- as.character(unlist(data[1,]))
> data <- data[-1, ]
> data<-data[`Country Name`%like% "Philippine|Indonesia|Vietnam|Malaysia|Brunei"]
> data<-data[.(`Country Name`,`2009`,`2010`,`2011`,`2012`,`2013`,`2014`,`2015`,`2016`,`2017`,`2018`)]
>
> melted<-melt(data, id.vars = NULL)
> melted$variable<-as.numeric(paste(melted$variable))
> ggplot(melted, aes(variable, value))+ geom_line(aes(color=`Country Name`))+scale_x_continuous(breaks=c(2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("year")+ylab("% GDP growth")
>
> colnames(melted) <- c("country_name", "year", 'economic_growth')
>
>
> fwrite(melted, "./project/volume/data/interim/change_economy.csv")

```

APPENDIX I. R code increase in Chinese Military Budget

```

> library(data.table)
> library(ggplot2)
> library(bit64)
> library(dplyr)
> data<-fread("./project/volume/data/raw/API_MS.MIL.XPND.CD_DS2_en_csv_v2_512127.csv")
> colnames(data) <- as.character(unlist(data[1,]))
> data <- data[-1, ]

```

```

> data<-data[Country Name=="China"]
> data<-data[,c(Country Name,`2008`,`2009`,`2010`,`2011`,`2012`,`2013`,`2014`,`2015`,`2016`,`2017`,`2018`)]
>
> melted<-melt(data, id.vars = NULL)
> melted$variable<-as.numeric(paste(melted$variable))
> ggplot(melted, aes(variable, (value/1000000000)))+ geom_line(aes(color=`Country Name`))
+scale_x_continuous(breaks=c(2008,2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("year")+ylab("Military Spending (billions)")
>
>
> data$change_2009<-(((data$`2009`)-(data$`2008`))/(data$`2008`)*100)
> data$change_2010<-(((data$`2010`)-(data$`2009`))/(data$`2009`)*100)
> data$change_2011<-(((data$`2011`)-(data$`2010`))/(data$`2010`)*100)
> data$change_2012<-(((data$`2012`)-(data$`2011`))/(data$`2011`)*100)
> data$change_2013<-(((data$`2013`)-(data$`2012`))/(data$`2012`)*100)
> data$change_2014<-(((data$`2014`)-(data$`2013`))/(data$`2013`)*100)
> data$change_2015<-(((data$`2015`)-(data$`2014`))/(data$`2014`)*100)
> data$change_2016<-(((data$`2016`)-(data$`2015`))/(data$`2015`)*100)
> data$change_2017<-(((data$`2017`)-(data$`2016`))/(data$`2016`)*100)
> data$change_2018<-(((data$`2018`)-(data$`2017`))/(data$`2017`)*100)
> change_data<-data[,c(Country Name,change_2009, change_2010, change_2011, change_2012, change_2013,change_2014, change_2015, change_2016, change_2017, change_2018)]
> setnames(change_data,"change_2009","2009")
> setnames(change_data,"change_2010","2010")
> setnames(change_data,"change_2011","2011")
> setnames(change_data,"change_2012","2012")
> setnames(change_data,"change_2013","2013")
> setnames(change_data,"change_2014","2014")
> setnames(change_data,"change_2015","2015")
> setnames(change_data,"change_2016","2016")
> setnames(change_data,"change_2017","2017")
> setnames(change_data,"change_2018","2018")
> melted_change<-melt(change_data, id.vars = NULL)
> melted_change$variable<-as.numeric(paste(melted_change$variable))
> ggplot(melted_change, aes(variable, value))+ geom_line(aes(color=`Country Name`))+scale_x_continuous(breaks=c(2009,2010,2011,2012,2013,2014,2015,2016,2017,2018))+xlab("year")+ylab("% change")
>
> colnames(melted_change) <- c("country_name", "year", 'china_change_military')
> fwrite(melted_change, "./project/volume/data/interim/china_change_military.csv")

```

APPENDIX J.

R code for Multiple Linear Regression

> **library(data.table)**

data.table 1.12.2 using 4 threads (see ?getDTthreads). Latest news: r-datatable.com

```
> library(ggplot2)
Registered S3 methods overwritten by 'ggplot2':
  method      from
[.quosures   rlang
c.quosures   rlang
print.quosures rlang
> library(bit64)
Loading required package: bit
Attaching package bit
package:bit (c) 2008-2012 Jens Oehlschlaegel (GPL-2)
creators: bit bitwhich
coercion: as.logical as.integer as.bit as.bitwhich which
operator: ! & | xor != ==
querying: print length any all min max range sum summary
bit access: length<- [ [<- [[ [[<-
for more help type ?bit
```

Attaching package: 'bit'

The following object is masked from 'package:data.table':

setattr

The following object is masked from 'package:base':

xor

```
Attaching package bit64
package:bit64 (c) 2011-2012 Jens Oehlschlaegel
creators: integer64 seq :
coercion: as.integer64 as.vector as.logical as.integer as.double as.character as.bin
logical operator: ! & | xor != == < <= >= >
arithmetic operator: + - * / %/% %% % ^
math: sign abs sqrt log log2 log10
math: floor ceiling trunc round
querying: is.integer64 is.vector [is.atomic] [length] format print str
values: is.na is.nan is.finite is.infinite
aggregation: any all min max range sum prod
cumulation: diff cummin cummax cumsum cumprod
access: length<- [ [<- [[ [[<-
combine: c rep cbind rbind as.data.frame
WARNING don't use as subscripts
WARNING semantics differ from integer
for more help type ?bit64
```

Attaching package: 'bit64'

The following object is masked from 'package:bit':

still.identical

The following objects are masked from 'package:base':

%in%, :, is.double, match, order, rank

```
> library(dplyr)
```

Attaching package: 'dplyr'

The following objects are masked from 'package:data.table':

between, first, last

The following objects are masked from 'package:stats':

filter, lag

The following objects are masked from 'package:base':

intersect, setdiff, setequal, union

```
> change_aid<-fread("./project/volume/data/interim/change_aid.csv")
> change_economy<-fread("./project/volume/data/interim/change_economy.csv")
> change_military<-fread("./project/volume/data/interim/change_military.csv")
> change_china<-fread("./project/volume/data/interim/china_change_military.csv")
>
> merged<-merge(change_aid, change_economy, by.x=c("country_name","year"),by.y=c("country_name","year"))
> merged<-merge(merged, change_military, by.x=c("country_name","year"),by.y=c("country_name","year"))
> merged<-merge(merged, change_china[,.(year, china_change_military)], by.x="year", by.y="year", all.x = T, all.y=T)
>
>
> #Vietnam#
> vietnam<-merged[country_name=="Vietnam"]
> summary(lm(formula = military_spending_change ~ aid_change+economic_growth+china_change_military, data = vietnam))
```

Call:

```
lm(formula = military_spending_change ~ aid_change + economic_growth +
    china_change_military, data = vietnam)
```

Residuals:

```
    Min     1Q  Median     3Q     Max
-6.9234 -1.7495  0.1192  2.4788  5.2720
```

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	98.51991	26.28752	3.748	0.00953 **
aid_change	-0.04252	0.02468	-1.723	0.13566
economic_growth	-13.34665	3.85828	-3.459	0.01348 *
china_change_military	-0.33237	0.30877	-1.076	0.32309

 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.825 on 6 degrees of freedom
 Multiple R-squared: 0.6767, Adjusted R-squared: 0.515
 F-statistic: 4.185 on 3 and 6 DF, p-value: 0.06431

```
> #Philippines#
> Philippines<-merged[country_name=="Philippines"]
> summary(lm(formula = military_spending_change ~ aid_change+economic_growth+china_
change_military, data = Philippines))
```

Call:
 lm(formula = military_spending_change ~ aid_change + economic_growth + china_change_military, data = Philippines)

Residuals:

Min	1Q	Median	3Q	Max
-18.395	-6.042	-2.471	7.874	14.802

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-11.5952	29.3604	-0.395	0.707
aid_change	0.1994	0.1286	1.551	0.172
economic_growth	2.3729	3.3036	0.718	0.500
china_change_military	0.1497	1.0213	0.147	0.888

Residual standard error: 12.97 on 6 degrees of freedom
 Multiple R-squared: 0.3768, Adjusted R-squared: 0.06514
 F-statistic: 1.209 on 3 and 6 DF, p-value: 0.3841

```
> #Malaysia#
> Malaysia<-merged[country_name=="Malaysia"]
> summary(lm(formula = military_spending_change ~ aid_change+economic_growth+china_
change_military, data = Malaysia))
```

Call:
 lm(formula = military_spending_change ~ aid_change + economic_growth + china_change_military, data = Malaysia)

Residuals:

Min	1Q	Median	3Q	Max
-6.423	-3.282	-1.737	3.135	10.200

Coefficients:

```
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  -31.90422  8.92675 -3.574 0.0117 *
aid_change    0.05788  0.02594  2.231 0.0671 .
economic_growth  2.85098  1.11131  2.565 0.0426 *
china_change_military 1.26679  0.41100  3.082 0.0216 *
```

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.782 on 6 degrees of freedom
Multiple R-squared: 0.7331, Adjusted R-squared: 0.5997
F-statistic: 5.494 on 3 and 6 DF, p-value: 0.03716

```
> #indonesia#
> indonesia<-merged[country_name=="Indonesia"]
> summary(lm(formula = military_spending_change ~ aid_change+economic_growth+china_
change_military, data = indonesia))
```

Call:

```
lm(formula = military_spending_change ~ aid_change + economic_growth +
  china_change_military, data = indonesia)
```

Residuals:

```
   Min    1Q  Median    3Q   Max
-19.036 -10.733  1.806 11.169 14.322
```

Coefficients:

```
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  -111.3443  48.8160 -2.281 0.0627 .
aid_change    0.0213  0.1498  0.142 0.8916
economic_growth 22.2395  9.1029  2.443 0.0503 .
china_change_military 0.1456  0.8277  0.176 0.8662
```

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 15.21 on 6 degrees of freedom
Multiple R-squared: 0.52, Adjusted R-squared: 0.28
F-statistic: 2.167 on 3 and 6 DF, p-value: 0.1931

```
> #brunei#
> Brunei<-merged[country_name=="Brunei Darussalam"]
> Brunei[is.na(Brunei)] <- 0
> summary(lm(formula = military_spending_change ~ aid_change+economic_growth+china_
change_military, data = Brunei))
```

Call:

```
lm(formula = military_spending_change ~ aid_change + economic_growth +
  china_change_military, data = Brunei)
```

Residuals:

Min	1Q	Median	3Q	Max
-15.7375	-5.2576	-2.9580	0.8071	27.4635

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-10.82335	11.53560	-0.938	0.384
aid_change	0.04878	0.06707	0.727	0.494
economic_growth	0.12778	2.40558	0.053	0.959
china_change_military	1.01030	0.94776	1.066	0.327

Residual standard error: 14.87 on 6 degrees of freedom
Multiple R-squared: 0.1621, Adjusted R-squared: -0.2568
F-statistic: 0.387 on 3 and 6 DF, p-value: 0.7667

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