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MILITARY INDUSTRIAL COMPLEX, MILITARY EXPENDITURE AND INEQUALITY: A PANEL DATA ANALYSIS

Master's Thesis

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I have written this master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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Abstract

This paper is aimed to reveal the specific role and the quantitative impact of Military Industrial Complex (MIC) on the income inequality in accordance with the defense economy. For decades, there were assertions and discussions about MIC. However, there appear to be no existing researches on the numerical aspect of MIC. This study fills the gap by employing the dynamic panel data analysis for 24 countries for the period from 2001 to 2014 with difference and system GMM. According to the literature, control variables such as indicators of major arms trade and terrorism incidents are selected. In order to see the impact on income inequality fairly, the dependent variables are chosen from the set of Theil's T index based on the household final consumption, Gini coefficient and Human Development Index (HDI). Based on the empirical analysis, a negative relationship between MIC and income inequality is concluded, suggesting that an increase in MIC activity could reduce the income inequality. In addition, the number of terrorism incidents and the trade openness affects negatively while the amount of major arms trade has a positive relationship.

1. Introduction

Military expenditure is an important issue for the international economy. It occupies a significant proportion of government budget, which prevents an opportunity cost including money and any resources from being alternatively employed for purposes that might directly improve the pace of development such as education. Yet, as Coulomb stated in her book Economic Theories Peace and War (2004), although the concept of peace and war itself was shared among economists from Friedrich List (1789 - 1846) and the German historical school to the Marxists, John Maynard Keynes (1883 - 1946) and his successors, the economic analysis of peace and war has been relatively weak than those in the philosophy due to the following historical reason.

The orthodox economic science assumes that minimum government let individuals act on their own rationality. Peace follows automatically. Fundamental hypotheses that are ‘peace is a normal situation’ and ‘economic development is the fundamental condition for a lasting peace’ (Coulomb 2004: 3) have been appealed in the dominant theory. Despite the fact, notable economists from mercantilists to nowadays econometricians have been tackling this issue. However, their thoughts are varied broadly. For example, the marcantilists assume that ‘military and economic conflicts are two interdependent facets of the same reality: the competition between two states on the international scene, to establish their power’. Meanwhile, the classical or neo-classical economists consider that ‘interstate conflicts on economic grounds result from a false comprehension by the ruling class of the real economic interest of their country. Only the military conflict can be legitimated but it is excluded from the economic field of analysis’. (Coulomb 2004: 3) This attitude roots in the nineteen-centuries’ marginalist who established ‘a ‘pure’ economic analysis, outside the historical context’ and aspired ‘to build a theoretical ‘scientific’ system which would definitively guarantee the happiness of humanity. They suggest microeconomic methods of reasoning with little relevance to the analysis of wars and conflicts’. (Coulomb 2004: 56) This is the reason why economic analysis and debate has been relatively weak in defense economics. In the late twentieth century, game theory and econometrics developed the studies of war and military expenditures on the basis of the neo-classical theory.

Specifically, this study contributes to the literature to investigate the relationship between military expenditure and income inequality econometrically, which is less studied even in defense economy, in particular, incorporating the MIC role that is considered descriptively in the past. Therefore, the aims of this paper are (1) clarifying the MIC concept and its role and (2) quantifying the impact of MIC in the relationship of military spending and income inequality. Especially, the importance lies on the second point since this paper tries to fill the gap from the qualitative to the quantitative analysis on the MIC impact in defense economy.

The rest of the paper is organized as follows: Section 2 of the paper presents the literature review including the concept of MIC, frameworks and hypothesis. Section 3 introduces the model and methodology while section 4 discusses the empirical result. Finally, section 5 concludes.

2. Literature review

Based on the above historical thought in defense economy, recent empirical work is briefly categorized into four theoretical frameworks. (Dunne and Nikolaidou 2012) First is the traditional Keynesian framework. The government make good use of military expenditure to boost output through multiplier effects when the effectiveness of aggregate demand is limited. (Dunne 1996) Higher military expenditure leads to an increase in capacity utilization, demand, profits and employment in the economy if aggregate demand is relatively low compared to potential supply. One disadvantage of this theory is that it fails to consider supply side issues such as positive and negative externalities. Smith and Smith (1980) extended this approach for analyzing the relationship of economic growth by including production function. Regarding inequality, it benefits the poor relatively more and improves income distribution. (Tongur & Elveren 2015)

Second is the Neoclassical framework. The state tries to maximize national utility by considering the best trade-off between opportunity costs and security benefits of military expenditure. (Dunne and Nikolaidou 2012) It assumes that defense spending as a pure public good and national interest for protection. Many researchers conducted empirical works within this theory. Aizenman and Glick (2006) employed the Barro (1988) model in economic growth field which explicitly allows for forms of government expenditure, financed by taxes, which can influence output through the production function and has an explicit utility function for the representative agent, which the government maximizes. (Dunne 2005) They consider that output is influenced by security, military expenditure relative to the thread to find the negative relationship: when the threat is low, military expenditure reduces output and vice versa. Dunne (2011) also found that the negative relationship by employing the augmented Solow model with Harrod-neutral technical progress. In the context of income inequality, the state whose military spending is high has fewer funds for social expenditures such as education (opportunity cost). Hence, there may exist a trade-off between social welfare and defense.

Thirdly, the Marxists approach. Baran and Sweezy suggested the underconsumptionist approach in their famous book, Monopoly Capital in 1966, which sees military spending as a crucial device to hinder crisis occurring, by letting the absorption of surplus without increasing wages, unlike other forms of government spending, and so maintaining profits. (Dunne and Skons 2011) Therefore, military expenditure benefits to economic growth when it is assumed that economy disequilibrium exists.

Their view is closely related to the last framework, Institutional approach, which introduces the concept of Military Industrial Complex (MIC). In the 1970s, Marxists shared the idea that the MIC represents only a very temporary solution to capitalist economic stagnation. (Coulomb 2004) The capitalist economy whose nature is overproducing leads to permanent arms economy. Michael Kidron (1970) pointed out that the military expenditure was a key to capitalism's success after 1945. Here, MIC's inefficiency plays a positive role because the primal goal is the prevention of economy's overheating by military spending, where military expenditure is wasteful. Thus, MIC has a motivation to emphasize international conflicts and to try to prevent others from solving friction with non-military ways. (Dunne 1990; Howard and King 2014) Along with this theory, it can be presumed that payment in military-related industries is better than other sectors as long as military expenditure increases. The gap between sectors will rise (Ali 2007) or there may be different impacts on the wage discrepancy between unskilled and skilled labor in R&D personnel. (Lin and Ali 2009)

Compared to traditional Keynesian and neoclassical framework, there are fewer studies in defense economy by institutional approaches in literature, particularly as to inequality. Even those are mostly descriptive than analytic since the concept of MIC is rather polemical. One major criticism is that it is of no use to understand the interactions between the economy and the military sector because it is unsuitable for the study of dynamic effects and difficult to empirically reveal the MIC's real influence on military waste. (Coulomb 2004) Hence, this article is an initial step towards such an integration. That is, the contributions of this study are (1) providing a comprehensive explanation of MIC role, (2) casting a new light on the institutional framework for econometric method; difference and system GMM on panel data in the relationship between inequality and military spending to measure the impact of MIC and (3) using the most recent dataset which is available at the end of 2015.

Military Industrial Complex: Definition and characteristics

The first public use of the term was by the Union of Democratic Control, formed by Sir Charles Trevelyan in the United Kingdom on 5th August 1914. Point Four of their pacifist manifesto declared: "4. National armaments should be limited by mutual agreement, and the pressures of the military-industrial complex regulated by the nationalization of armaments firms and control over the arms trade." And the concept has gotten widely known by the speech when 34th president of United States, Dwight D. Eisenhower resigned.

> *"In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist." (January 17th 1961)*

He denounced the danger of the growing reinforcement of the MIC's power in the US, resulting from the unprecedented increase in military staff and armament industries, which was likely to question democratic methods. (Coulomb 2004) Its concept nowadays has been expanded to include academia, entertainment and creative industry.

In 1971, Charles Wolf, Jr. suggested that the military industrial complex is composed of three separate entities: the military, the defense industry, and portions of the government responsible for military affairs in his book, *The Military Industrial Complex: A Reassessment*. It consists of the Department or Ministry of Defense, pressure groups in Parliament or Congress, the armament manufacturers, the army's prescribers, and specialized, notably academic research institutions. Wolf sums up his conception of the MIC succinctly: "The reality of the MIC is complex not simple, pluralistic not monolithic, sometimes effective and potent, sometimes ineffective and impotent, no less motivated by concern for national interests than its critics, nor less motivated by a mixture of other motives than its critics." (Steinbach 2009; Mills 1999) Steinbach (2009) analyzes each link among those sectors based on Wolf's and Seth G. Jones (1972-):

> *"Procurement agencies in many countries, especially the U.S. Department of Defense, often enjoy near or complete monopsonistic status: their decisions as consumers directly affect the price and quantity of goods offered by defense firms. As such, the nature of their demand determines in large part the make up of the market for defense technologies, including what is produced and who gets to sell it. In turn, constrained by procurement decisions, the defense industry plays a critical role in defining the capabilities of a state's military. "… "Thus, a country's ability to respond to international crises in accordance with its foreign policy goals rests in large part on the military's ability to project force beyond its borders, which in turn relies on the production of technologies by the defense industry, which in turn accommodates the policy needs of the procurement bureaucracy."*

As the national government plays a role as a monopolistic buyer and tends to protect the arms industry, no real competitive market for weapon systems is created, and gradually, the interdependence between government and industry increases. This does not suggest that there is no competition between companies. Oppositely, companies are in an intensive competition to gain the small number of very large deals granted by their own or foreign governments. (Skons and Dunne 2011)

Even if the concept of the MIC is rather controversial, many economists acknowledge that the military sector's specificity limits internal competition, favors a rise in costs, sometimes with the pressure of influential networks which are not willing to reach an economic optimum. (Coulomb 2004) Thus, the concept itself is not only interpreted as Marxist suggested.

Relationships between military expenditure and income inequality: three hypothesis

Even the limited existing literature has failed to result in a scholarly consensus on the relationship between military expenditure and income inequality. There are three types of different hypothesis; Inequality-narrowing hypothesis, Inequality-widening hypothesis

and neutrality hypothesis according to Wolde-Rufael (2015). (Abell 1994; Ali 2007; Lin and Ali 2009; Wolde-Rufael 2014, 2015)
The inequality-narrowing hypothesis is that the higher income in the military related sector is enabled by the bigger military spending, which leads to a high-level of aggregate demand and employment that allows the poor gain more relatively. Particularly, it is true in the situation where the military industry is labor-intensive and arms production is home grown. (Ali 2007; Lin and Ali 2009; Wolde-Rufael 2014) It is considered that less military expenditure enables the government to allocate more budget to social welfare such as education and social benefit that improves income dispersion. (Ali 2007; Lin and Ali 2009; Elveren 2012; Wolde-Rufael 2014) In his study, Ali (2012) found that there was a negative and strong military spending's effect on income inequality in Middle Eastern and North African countries over the period 1987-2005 with panel regression. Additionally, a positive trade-off relationship between military expenditure and spendings of education and health over 1988-2005 was shown by GMM panel data analysis of 29 OECD countries according to Lin, Ali and Lu (2015).

The inequality-widening hypothesis is that if the military industry is technology intensive that shifts production towards skilled labor, the difference could be magnified between relatively well-paid skilled workers in the military industry and less skilled labor force in the non-military sector. Hence, it worsens the income inequality. (Ali 2007; Lin and Ali 2009; Wolde-Rufael 2014) The role of MIC accelerates this income dispersion because it favors the higher military expenditure than the appropriate one in this sense. Moreover, higher military expenditure crowds out the spending for other social welfare that benefits the less-off. The military expenditure at the expense of other welfare hinders the income distribution through transfer payments. (Ali 2007; Elveren 2012; Wolde-Rufael 2014) Especially, health and education benefit the human capital which is an important factor of income inequality. Therefore, the higher the military expenditure is, the more exacerbating the income inequality gets. (Ali 2007; Elveren 2012; Wolde-Rufael 2014) It is also explained by the Opportunity Cost Burden Effect model Vadlamannati (2008) postulates. It argues that the military spending drains out the resources from public spending that encourages social and human capital development and reduce income inequality. The figure 1 from the Vadlamannati (2008) paper pictures the mechanism of military sector growth influence on the income inequality and social and human development in an economy at the expense of diminishing returns to social development sectors. After the point P2, the slope of the development spending is sharper than the one before P2, which means the opportunity cost of military spending is abandoned since it substitutes development expenditure to the military sector growth by their funding request. Thus, if the military burden is smaller, the total net effect on economic growth is positive, and the government allocates resources to development spendings that lead to lower income inequality. Or, the diversion to military expenditure is strong enough to decrease the positive net effect and force to increase income inequality.

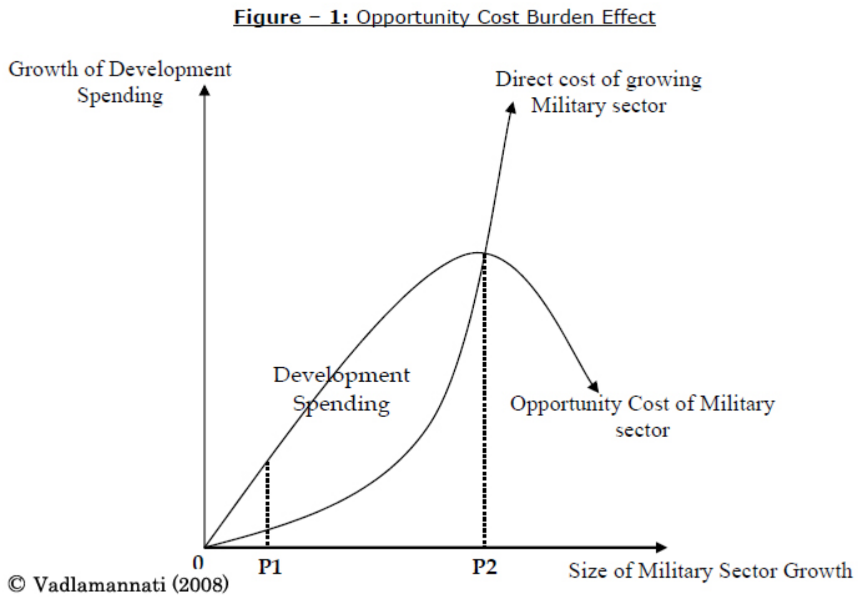

Figure 1: Opportunity Cost Burden Effect (Vadlamannati 2008)

In addition, if the middle-class households are taxed disproportionately in order to fund military spending, the post-tax income might commit to impair the income distribution. (Ali 2007; Ali 2011; Hirnissa, Habibullah, and Baharom 2009; Wolde-Rufael 2014) Many authors discovered the empirical results suggesting the inequality-widening hypothesis. Abell (1994), Kentor, Jorgenson and Kick (2012), Tongur and Elveren (2015) and Vadlamannati (2008) found the positive relationship between military expenditure and income inequality by panel data analysis. Supportively, Ali (2011) found that the high-income inequality results in the lower educational expenditure. Some authors focusing on one country due to the problem of homogeneity in panel data analysis also discovered that a one-way Granger causality from military spending to income inequality;

Elveren (2012) for Turkey, Hirnissa, Habibullah, and Baharom (2009) for Malaysia, Meng, Lucyshyn, and Li (2015) for China, Wolde-Rufael (2014; 2014) for Taiwan and for South Korea.

Lastly, the neutrality hypothesis is that as long as the military labor does not occupy a significant part of the whole labor force, and the military expenditure does not fill up a major part of total government expenditure, the impact of military spending is small, so that there is no significant effect on income inequality. It is also the case if the government gives equally ample scope to spending on social welfare.
The empirical evidence from Lin and Ali (2009) suggested no evidence of causality in any direction for a panel data with 58 countries through panel homogeneous non-causality test. Hirnissa, Habibullah, and Baharom (2009) also did not find an effective relationship for a panel data of Indonesia, Philippines, India and South Korea. As to South Korea, their result, that is no one-way or two-way causality, is the opposite result of the one Wolde-Rufael (2014) found, which is not only the positive relationship in a long-run and short-run, but the unidirectional causality from military expenditure to income inequality due to the different methodology and data.

3. Data and Methodology

The panel data analysis over 22 countries by the system GMM with the time period from 2001 to 2014 is employed in this research. As Dunne (2011) pointed out, the interpretation of the sign of a relationship by using Granger causality methods is dubitable unless there is an identified structural model and the evidence of the non-military variables' grandness. The non-military variables are selected from the point of view of the empirical studies on income inequality.

3.1 Data

The 11 variables are utilized in this study for 22 countries, which are selected by the data availability of SIPRI arm producing companies. (Table 1)

Label	Variables	Source	Number of Observation
GINI	Gini coefficient (WIID_ver3_sept15_0, All the Ginis, 1950-2012 (updated in Autumn 2014): Branko L. Milanovic and WB database)	WIID World Bank database	269
THEIL	Theil's T index based on the household final consumption expenditure (PPP) at the current international USD and total population among 137 countries	World Bank database	336
HDI	Human Development Indicator from Human Development Report (2003-2015)	UNDP	312
APCSALE	Top 100 Sales of arm producing company (2002-2014)	SIPRI	336
TIVNET	Net export of Trend Indicator Values (TIVs) expressed in US$ m. at constant (1990) prices. (2000-2014)	SIPRI	336
TERROR	Number of terrorism incidents	Global Terrorism Database	336
HEALTHGOV	Percentage of the health expenditure on the total government expenditure	World Bank database	312
GDP	Real GDP at current price	World Bank database	336
TRADEOPEN	Sum of exports and imports of goods and services measured as a share of gross domestic product	World Bank database	334
UNEMP	Unemployment rate out of total labor force (% modeled ILO estimate)	World Bank database	336
NASA	Dummy variable for countries belong to NATO	NATO	336

Table 1: Dataset

3.1.1 MIC variable

As the measure of MIC variable, the data of The top 100 arms-producing and military services companies in the world (excluding China) from 2002 to 2014 are taken from Stockholm International Peace Research Institute (SIPRI). APCSALE indicates the total sales of arm producing companies, categorized by each country and time. APCSALE are taken into account the numbers of the previous year if they exist. The number in Finland 2010 is an appropriate example. Though the column number in RANK shows zero, but there is 660 in the APCSALE column, which means the only ranked company, Patria

Industries is the 105th in 2010, that is out of the top 100, but in 2011, it is the 98th, so that there is also the 2010's sales figure. Hence, the sales in 2010 is put in 660.

3.1.2 Inequality measure

There are three alternative variables, THEIL, GINI and HDI. THEIL stands for Theil's T based on the household final consumption expenditure (PPP) at the current international USD and total population among 137 countries by World Bank Database (WB) from 2001 to 2014. Theil's T statistic is considered as the family of generalized uncertainty inequality measure with decomposition of within-groups and between-groups' components. The formula of the between-groups component is as following:

$$\text{Theil} = \sum_{i=1}^{n} \frac{y_i}{y} \log\left(\frac{\frac{y_i}{y}}{\frac{N_i}{N}}\right)$$

where n is the number of countries in the sample, y_i is the household final consumption expenditure in country i (i=1,2,…,n) and y is the total household final consumption expenditure of the sample. N and N_i represent the total population and population of country i. Theil statistics measure the deviation of the household final consumption across countries in the sample, not the household income inequality. Ali (2004; 2007) uses the Theil's T statistics taken from the University of Texas Inequality Project (UTIP) with measures computed for 160 countries over period 1987 to 1997. The base data are composed of the employment share and average relative income, capturing the dispersion of industrial pay inequality around the world. On the contrary, this study uses the household final consumption expenditure because of the latest and comprehensive data compared to the UTIP data which covers until 2008. PPP is widely used to compare the income levels in different countries, adjusted by the exchange rate. THEIL, thus, implies the dispersion of income level among 137 countries, which could be the one of alternatives for inequality measures. Germany, Japan and US show the higher level. Brazil, South Africa and Ukraine displays antithetically. Interestingly, Russia exhibits the increasing slope which is similar but weak in Turkey. (Figure 2)

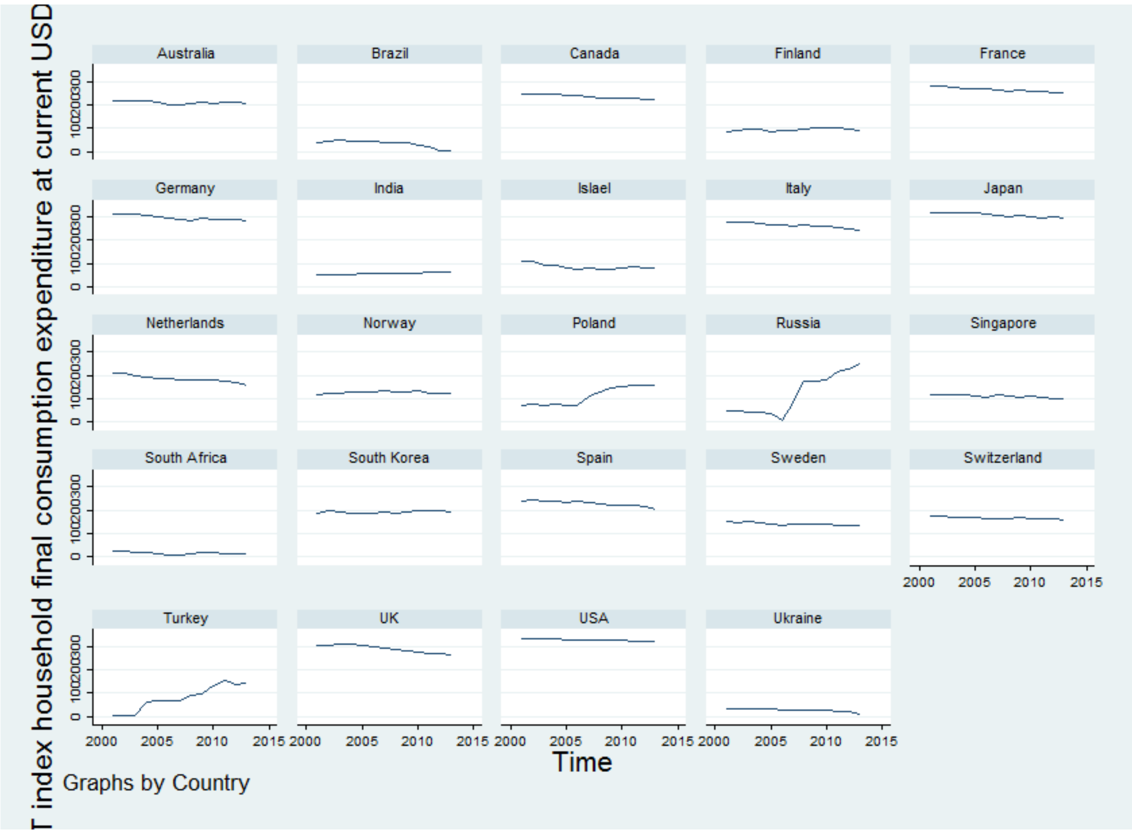

Figure 2: Time trends of Theil's T in sample countries

GINI stands for the Gini coefficient that is known as the statistical dispersion intended to represent the nation's household income distribution, developed by Corrado Gini in 1912. If the coefficient expresses zero, it means the perfect equality, where everybody has the same income. The larger the value gets, the bigger the inequality becomes. The data in this paper is taken from the World Income Inequality Database (WIID), Milanovic's dataset which is updated in 2014 and WB. The Gini coefficients of each country are shown in the figure 3. The highest average Gini coefficient in the sample is South Africa, 66.6 and the second is Brazil, 54.6. Not surprisingly, the lowest is Sweden, 25.4. Though there are some missing values, it is assumed that no dramatic improvement happened during the sample period from 2001-2014. Wolde-Rufael (2014) used Gini coefficient of South Korea from 1965 to 2011 and found the negative relationship between military expenditure and income inequality by the Granger causality method.

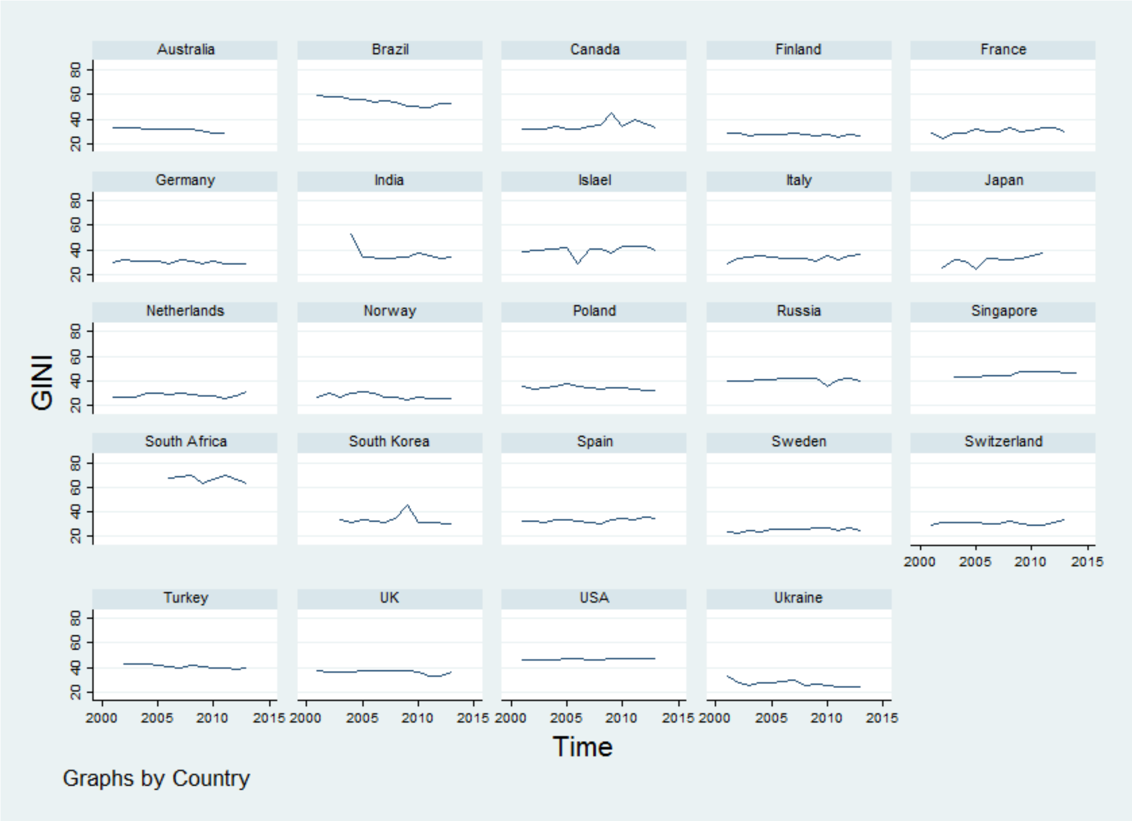

Figure 3: Time trends of Gini coefficients in sample countries

The last alternative variable is HDI, that is Human Development Index, created by United Nations Development Programme (UNDP). HDI literally expresses the human development outcomes where different countries have the same Gross National Income (GNI). For example, the Malaysia's GNI is higher than Chile's, but the life expectancy and the expected years of schooling in Malaysia are 7 years and 2.5 years shorter than the ones in Chile respectively. Chile has the much higher HDI value than Malaysia in this case. (UNDP) Overall, HDI implies that the income levels, taking into account the values which are considered as the living standard. Norway has the highest average HDI over the sample period while India has the opposite. (Figure 4)

Comparing those three indicators, Gini and HDI shows similar tendency which is that the developed countries, particularly Northern countries, having the rich social welfare system such as Norway and Sweden are categorized as less inequality countries, but the developing countries such as Brazil and South Africa is contrary. It is taken as granted since HDI partially includes Gini. Due to the base data's difference, Theil's T which is a relative comparison between groups comparison, not an absolute measure presents somewhat oppositely. Thus, using three measures as comparison would serve to check the model stability.

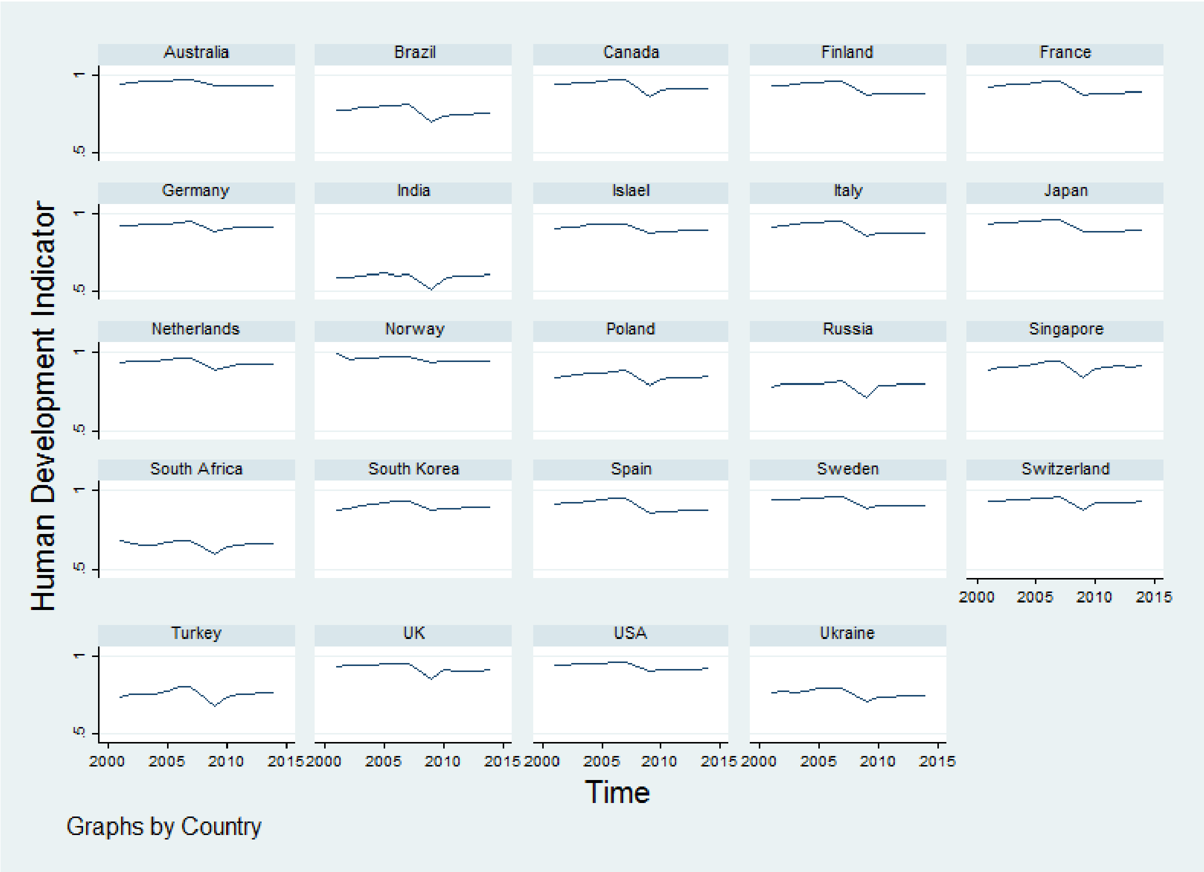

Figure 4: Time trends of HDI in sample countries

3.1.3 Indicators of military activities

TIVNET is created to measure arms trade, based on the international transfer of major weapons by SIPRI. There is another alternative measure such as observations categorized as 93 in HS code without re-import and re-export regardless of the sizes, but it includes all arms and ammunitions, which is not necessarily for the military purpose. Russia and US are the bigger exporters. On the other hand, the importer is India. (Table 2; Figure 5)

	Mean	Standard deviation	Min	Max
Australia	-764.07	353.86	-1440.00	-279.00
Brazil	-210.36	145.36	-630.00	-35.00
Canada	-36.71	162.13	-408.00	148.00
Finland	-43.07	71.11	-183.00	34.00
France	1652.71	442.79	808.00	2334.00
Germany	1603.50	757.64	790.00	3175.00
India	-2706.96	1338.95	-5555.00	-1142.00
Israel	100.93	460.24	-723.00	640.00
Italy	319.71	328.88	-202.00	861.00
Japan	-439.79	104.37	-688.00	-273.00
Netherlands	328.71	296.46	-11.00	970.00
Norway	-160.93	256.57	-525.00	109.00
Poland	-215.21	226.57	-852.00	45.00
Russia	6190.57	1247.81	5094.00	8545.00
Singapore	-618.93	429.45	-1491.00	-65.00
South Africa	-119.07	257.61	-755.00	93.00
South Korea	-849.36	467.24	-1501.00	56.00
Spain	270.64	490.15	-266.00	1255.00
Sweden	392.21	162.90	96.00	749.00
Switzerland	192.25	111.26	46.00	443.00
Turkey	-674.79	348.50	-1346.00	-215.00
UK	607.21	406.15	-18.00	1453.00
USA	6559.64	1350.47	4450.00	9613.00
Ukraine	524.79	307.22	198.00	1450.00
Total	495.99	2033.09	-5555.00	9613.00

*Note: Unit is million USD at 1990 prices

Table 2: Mean, standard deviation, min and max of TIVNET

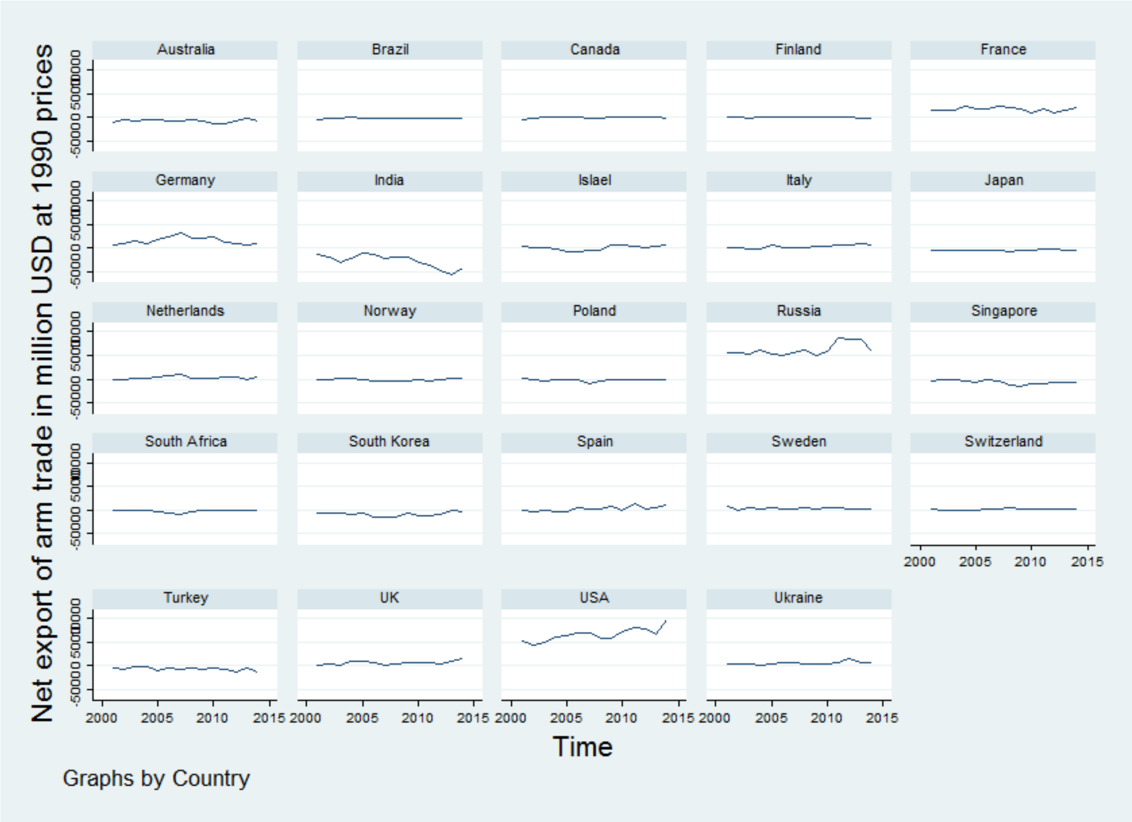

Figure 5: Time trends of TIVNET in sample countries

3.1.4 Potential determinants in income inequality

In accordance with the existing literature, this study also concerns a large number of possible determinants in income inequality. A brief overview is provided below.

TERROR represents the incidents of terrorism which occurred in each year based on the Global Terrorism Database by the University of Maryland. Aizenman and Glick (2006) found that when the threat is low, military spending decreases output and vice versa. This relationship is prone to remain in the countries where more corruption exists. (Dunne 2005)

HEALTHGOV is the health expenditure shares out of the government spending by WB. As the inequality-widening hypothesis suggests, there may exist the expenditure trade-off between on military and on social welfare. It is selected to capture the crowd-out effect which is caused by that trade-off.

Trade openness is the other important factor in defense economy. It is considered that a more open economy will represent bigger arms trade. Positive and negative effects are found in the economic growth theory in relation with military spending, and its impact is

also disputable. (Edwards 1998; Frankel and Romer 1999; Dollar and Kraay 2004; Yanikkaya 2003; Yakovlev 2007; Rodriguez and Rodrik 2000; Dunne and Tian 2013)
Other important determinants introduced to this paper along with the research of income inequality are the real GDP and the unemployment rate, which are named LNRGDP and LNUNEMP respectively. (Hasman et al. 2015) It is worth that taking into account only the military-related variables, but also other variables related to the existing literature in the income inequality study.
NATO indicates the dummy variable for countries belonging to NATO at the date when this research is carried out. It may be assumed to be less important compared to other indicators, so it is treated separately in the empirical results.

3.1.5 Outliers
Note that in terms of outliers, variables are treated by the logarithm transformation in order to reduce variation except for those which dramatically drop their observation, taken logarithm and for dummy variables. For example, TIVNET drops almost half of its observation since it contains negative values. It is precarious that to eliminate outliers outside of inner fence or outer fence or to reduce volatility with transformation by binning or taking logarithm because they may carry the important information, especially, in this study, it is considered to be left due to the limited number of observations over all. Hence, in the empirical part, both results with and without logarithm transformation are reported. The variable names attached LN in front hereinafter means the ones taken by logarithm.

3.2 Methodology
It is employed that dynamic panel method with the significant lagged effects of the dependent variable. There are two common transformations, "the first-difference" and "(forward) orthogonal deviations". (Arellano and Bover 1995) The latter transformation is chosen in this paper by reason of the unbalanced panel data.
Firstly, the regression specification is as follows:

$$Dependent\ variable_{it} = \propto\ + \beta Dependent\ variable_{it-1} + \gamma X_{it} + \delta_t + \varepsilon_{it}$$

where

$$\varepsilon_{it} = \mu_i + \nu_{it}$$

The subscripts i and t denote countries and years. Dependent variable as income inequality is applied by (1) Gini coefficient, (2) Theil's T based on PPP(THEIL) and (3) HDI. The income inequality is considered to be sticky, which is closely examined below, so that the right-hand side includes the first lag of the dependent variable. X is the set of independent variables which is listed in Table 1, excluding the above three variables. δ are year dummies that is introduced to eliminate universal time-related shocks from the errors, μ_i are the unobserved country specific fixed-effects, and ν_{it} are the identically and independently distributed (i.i.d) error terms. It is obvious that the estimation by Ordinary Least Square (OLS) is biased and inconsistent because its basic assumption is violated due to the correlations between the dependent variable and μ_i and also between the first lag of dependent variable and μ_i. Hence, the first differencing specification is necessary to deal with this problem:

$$\Delta Dependent\ variable_{it} = \propto\ + \beta \Delta Dependent\ variable_{it-1} + \gamma \Delta X_{it} + \delta_t + \Delta \upsilon_{it}$$

Δ means the first difference operator. Although this transformation diminishes μ_i, it still biased downwards since the lagged dependent variable is endogenous by the correlation between $Dependent\ variable_{it-1}$ in $\Delta Dependent\ variable_{it-1}$ and υ_{it-1} in $\Delta \upsilon_{it}$. To be precise, not only the lagged dependent variable, but any predetermined explanatory variables that are not strictly exogenous would be potential endogenous because of the corresponding correlation with υ_{it-1}. In addition to that, if the target panel is unbalanced, the first-differencing amplifies the gaps. Hence, orthogonal deviations are considered, which subtract the mean of all future accessible observations of a variable. It diminishes data loss because it is possible to calculate for all observations but for the last of each, that are usable as instruments by no lagged observations entering the formula. The specific transformation is in such a way when ω is a variable.

$$\omega_{i,t+1}^{\perp} \equiv \sqrt{\frac{T_{it}}{(T_{it}+1)}}\left(\omega_{it} - \frac{1}{T_{it}}\sum_{s>t}\omega_{is}\right)$$

where T_{it} is the number of available future observations. Note that as long as the ω_{it} are independently distributed before transformation, they go on consequently. Moreover, this feature lasts when ω_{it} is i.i.d. (Roodman 2009)

In order to cope with the endogeneity problem, a generalized method of moment (GMM) is suggested by Arellano and Bond (1991), which includes OLS and the two stage least squares (2SLS) as special cases. 2SLS is the simplest way to deal with, but it cannot be a good estimator under heteroscedasticity, which feasible GMM regards it by modelling well-structured error term in an efficient and better-behaved way. GMM estimator is based on a matrix of instruments structured with the exogenous variables and with subsets of the lagged values of the levels of dependent variables, and of the levels of the endogenous variables. (difference GMM) According to Bond et al., (2001), when it is considered that there is a strong persistence in the examined time series, which means it is close to a random walk or when the cross-section variability overwhelms time variability much, the difference GMM estimator becomes weak or the regressors become poor instruments for transformed variables because past levels carry little information of future changes. To overcome this problem, the augmented version of difference GMM, called as system GMM is proposed. (Arellano and Bover 1995; Blundell and Bond 1998) The advantage of system GMM is that it obtains efficiency by using a lagged endogenous variable among the exogenous ones to control for the dynamics of adjustment. It allows fewer time span and lots of individuals as well as some endogenous variables and fixed effects, coping with heteroscedasticity and autocorrelation. (Roodman 2009; Tongur and Elveren 2015)

The Im-Pesaran-Shin (2003) and the Fisher-type (Choi 2001) Augmented-Dickey Fuller unit root test is applied in order to check the stationarity in our unbalanced panel data. The null hypothesis is that all panels contain unit roots and the alternative ones are that some panels are stationary and at least one panel is stationary (N is finite) respectively. Table 3 shows the results conducted on each three income inequality variable as a dependent variable. In the Fisher-type test, the inverse chi-squared p-value (P) is for the finite number of panels and the others, where Z, L*, and Pm stand for the inverse normal, the inverse logit t, and the modified inverse chi-squared p-value respectively, are valid for the finite and infinite number of panels. Although the Im-Pesaran-Shin test is not available for GINI and LNGINI due to the insufficient time period, at the five percent significant level, the null hypothesis can be hold. For LNTHEILT, the values of P and Pm are rejected by the five percent significant level, but together with Im-Pesaran-Shin test and the values Z and L* in Fisher-type test, it can be judged as carrying unit roots in itself. It is appropriate to stick to the assumption that all panels contain unit roots for THEILT, LNTHEILT, HDI and LNHDI. Therefore, difference GMM is applied for GINI and LNGINI while system GMM is suitable and a proper methodology to be conducted for THEILT, LNTHEILT, HDI and LNHDI. (Table 3)

	Im-Pesaran-Shin test			Fisher-type test	
Dependent variable	1 lagged value	2 lagged value		1 lagged value	2 lagged value
GINI	N/A*	N/A*	P	0.0011	N/A**
			Z	0.0204	N/A**
			L*	0.0005	N/A**
			Pm	0.0001	N/A**
LNGINI	N/A*	N/A*	P	0.0012	N/A**
			Z	0.0170	N/A**
			L*	0.0005	N/A**
			Pm	0.0002	N/A**
THEILT	0.9509	0.9932	P	0.1869	0.9852
			Z	0.9706	0.9998
			L*	0.9242	0.9999
			Pm	0.1925	0.9724
LNTHEILT	0.7515	0.8328	P	0.0051	0.001
			Z	0.7912	0.9652
			L*	0.4003	0.6378
			Pm	0.0016	0.0001
HDI	1.0000	1.0000	P	1.0000	1.0000
			Z	1.0000	1.0000
			L*	1.0000	1.0000
			Pm	1.0000	1.0000
LNHDI	1.0000	1.0000	P	1.0000	1.0000
			Z	1.0000	1.0000

	L*	1.0000	1.0000
	Pm	1.0000	1.0000

N/A: Insufficient number of time periods

N/A: Insufficient number of observations

Table 3: Im-Pesaran-Shin and Fisher-type ADF unit root tests

4. Empirical Result

The empirical results based on the difference GMM and system GMM analysis of the unbalanced panel data with regard to the relationship between MIC and income inequality by Stata are shown at Table 4. AR (1) is used to capture the stickiness by Arellano-Bond test. LNRGDP, TIVNET and LNAPCSALE are treated as exogenous variables while LNHELTHGOV, TERROR, LNUNEMP, LNTRADEOPEN are considered not strictly exogenous. All of the results are significant either or both Sargan and Hansen test at the ten percent significant level.

Although the two-step efficient difference GMM performs better than one-step for the estimated coefficient with lower bias and standard errors which are also exact in the difference GMM according to Windmeijer (2005), one-step estimations are reported as well for the comparison. To make the results robust to the heteroscedasticity and arbitral autocorrelation patterns within individuals in one-step GMM and to conduct Windmeijer correction in two-step GMM, syntax **robust** are added. Additionally, **small** for small-sample corrections and **orthogonal** for the orthogonal transformation are added. (Roodman 2009) It is indicated that (1) to (8) for Gini coefficient, (9) to (16) for Theil's T of PPP and (17) to (24) are for HDI with each logarithm as dependent variables. The even number results are run with NATO variable.

At the ten percent significant level, AR (1) is rejected and AR (2) is not for (1), (2), (5), (6), (9), (10), (13), (14), (17), (18) and (19). Others are violated. Looking at the even number's results, none of the NATO coefficient is significant. Thence, it is worth to note that the effectiveness of NATO is not highly imperative in this study.

The significant coefficients of LNAPCSALE, TERROR, TIVNET and LNTRADEOPEN are stable by Wald test. Taking a close look at the above results, LNAPCSALE is negatively significant at the five percent level for GINI and LNGINI and at the ten percent level for THEILT on the one-step GMM. The MIC activity impacts negatively on the income inequality measured as Gini coefficient, that is, the inequality-narrowing hypothesis is supported. When the dependent variable is taken as Theil's T index, it suggests the inequality-narrowing hypothesis too. Yet, the statement on Gini coefficient is plausible because not only the one conducted on the logarithm of Theil's T on the one-step system GMM is not significant, but the significance level on the Theil's T one-step is weaker. This inequality-narrowing finding matches Ali (2013) and Lin, Ali and Lu (2013) who found by panel data GMM regression.

The coefficient of TERROR has weak but significantly positive effect on models for HDI both on the one- and two-step GMM. The more terrorism incidents happen, the better HDI gets. It seems counterintuitive, but if one takes into account the income-narrowing hypothesis, which is explained as a higher aggregate demand and employment that allows the poor gain more relatively in the labor-intensive surroundings and home-based arms production, the frequency of terrorism induces more arms productions, which results in conversing income inequality. TIVNET has positive and significant impact on Theil's T while LNTRADEOPEN is the opposite. Literally, as the arms trade increases, the income inequality increases, but as the country is more open to trade, the income inequality decreases. The explanation to the former realization is similar in accordance with the income-narrowing hypothesis which is home grown in particular. The more trade reduces the sales of home-based arms producing industry. The latter is explained along with the existing literature because it is not the military related, but the general transaction, which is trade reduces inequality. The first lags of dependent variable fairly describe the current occurrence in the Theil's T and HDI models.

	Difference GMM							
	One-step		Two-step		One-step		Two-step	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L.gini	-0.0547	-0.0547	-0.2620	-0.2620				
	(0.0984)	(0.0988)	(0.5993)	(0.6015)				
L.lngini					-0.0220	-0.0220	-0.0857	-0.0857
					(0.0996)	(0.0999)	(.)	(.)
nato		0.0000		0.0000		0.0000		0.0000
		(.)		(.)		(.)		(.)
lnhealthgov	-1.9419	-1.9419	15.2575	15.2575	-0.0658	-0.0658	0.8179**	0.8179**
	(3.5152)	(3.5280)	(11.6548)	(11.6973)	(0.1151)	(0.1155)	(0.3104)	(0.3115)
terror	0.0024	0.0024	0.0114	0.0114	0.0001	0.0001	0.0003	0.0003
	(0.0076)	(0.0076)	(0.0222)	(0.0223)	(0.0002)	(0.0002)	(.)	(.)
lnrgdp	-2.2725	-2.2725	-11.3568	-11.3568	-0.0729	-0.0729	-0.0760	-0.0760
	(2.6953)	(2.7051)	(7.5813)	(7.6089)	(0.0790)	(0.0793)	(.)	(.)
tivnet	0.0005	0.0005	0.0017	0.0017	0.0000	0.0000	0.0000	0.0000
	(0.0003)	(0.0003)	(.)	(.)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
lnapcsale	-1.2436**	-1.2436**	9.5466	9.5466	-0.0369**	-0.0369**	0.1189	0.1189
	(0.5421)	(0.5441)	(8.8114)	(8.8435)	(0.0150)	(0.0150)	(.)	(.)
lnunemp	0.5561	0.5561	-3.3041	-3.3041	0.0189	0.0189	-0.0266	-0.0266
	(1.3079)	(1.3127)	(3.9041)	(3.9183)	(0.0392)	(0.0394)	(.)	(.)
lntradeopen	-6.6151	-6.6151	18.2059	18.2059	-0.1986	-0.1986	0.0413	0.0413
	(5.6482)	(5.6688)	(15.3700)	(15.4260)	(0.1554)	(0.1560)	(0.6870)	(0.6895)
Observations	160	160	160	160	160	160	160	160
Number of countries	23	23	23	23	23	23	23	23
Arellano-Bond test for AR(1)	-2.30	-2.30	(.)	(.)	-2.62	-2.62	(.)	(.)
p value	0.021	0.021	(.)	(.)	0.009	0.009	(.)	(.)

Arellano-Bond test for AR(2)	-0.50	-0.50	-1.63	-1.63	-0.31	-0.31	(.)	(.)
p value	0.618	0.618	0.102	0.102	0.757	0.757	(.)	(.)
Sargan test for over identification (*p*-value)	0.097	0.087	0.097	0.087	0.097	0.087	0.097	0.087
Hansen test for over identification (*p*-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Diff-in-Hansen Tests for Exogeneity of GMM Instruments (*p*-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* p<0.10, ** p<0.05, *** p<0.01

	System GMM							
	One-step		Two-step		One-step		Two-step	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
L.theilt	0.9805***	0.9706***	0.7643***	0.7337***				
	(0.0516)	(0.0504)	(0.2702)	(0.2340)				
L.lntheilt					0.9045***	0.8895***	0.8028***	0.7504***
					(0.1711)	(0.1766)	(0.1870)	(0.2000)
nato		3.6324		20.5006		0.0742		0.2412
		(2.5156)		(167.4649)		(0.0810)		(0.2948)
lnhealthgov	-6.3602	-7.2303	24.2465	20.0057	0.2467	0.2327	0.3242	0.3575
	(5.9130)	(6.2052)	(49.8469)	(40.0554)	(0.2628)	(0.2462)	(0.3748)	(0.3413)
terror	-0.0028	-0.0038	0.0424	0.0432	0.0003	0.0003	0.0003	0.0005
	(0.0141)	(0.0146)	(0.0568)	(0.0430)	(0.0004)	(0.0004)	(0.0008)	(0.0007)
lnrgdp	-0.2584	-0.4465	-21.0318	-23.2223	-0.0155	-0.0311	-0.0323	-0.1735
	(3.8565)	(3.8364)	(31.0610)	(20.3836)	(0.0745)	(0.0777)	(0.4136)	(0.3888)
tivnet	0.0019***	0.0019***	0.0015	0.0015	-0.0000	0.0000	0.0000	0.0000
	(0.0005)	(0.0006)	(0.0011)	(0.0011)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
lnapcsale	-1.2237*	-1.1318*	16.4569	16.7866	0.0218	0.0232	0.0750	0.1124
	(0.6750)	(0.6051)	(18.2123)	(.)	(0.0281)	(0.0280)	(0.1104)	(0.0919)
lnunemp	-2.6766	-3.7956	12.4825	9.6090	-0.0300	-0.0663	-0.0512	-0.0997
	(2.6431)	(2.7010)	(19.7634)	(30.0692)	(0.0786)	(0.1138)	(0.2584)	(0.2631)
lntradeopen	-5.3763*	-5.7719	28.3918	27.7133	-0.0259	-0.0447	0.2611	0.1815
	(3.1136)	(3.7381)	(32.8232)	(29.8534)	(0.0803)	(0.0943)	(0.2555)	(0.3524)
Observations	238	238	238	238	238	238	238	238
Number of countries	24	24	24	24	24	24	24	24
Arellano-Bond test for AR(1)	-2.29	-2.29	-0.89	-0.88	-1.29	-1.30	-1.00	-1.00
p value	0.022	0.022	0.373	0.381	0.196	0.193	0.319	0.318

Arellano-Bond test for AR(2)	-1.26	-1.27	-1.04	-1.06	-1.15	-1.22	-1.45	-1.31
p value	0.206	0.205	0.299	0.288	0.249	0.221	0.146	0.191
Sargan test for over identification (*p*-value)	0.000	0.000	0.000	0.000	0.010	0.013	0.010	0.013
Hansen test for over identification (*p*-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Diff-in-Hansen Tests for Exogeneity of GMM Instruments (*p*-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

	System GMM							
	One-step		Two-step		One-step		Two-step	
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
L.hdi	0.9728***	0.9646***	0.6762***	0.7055*				
	(0.0426)	(0.0401)	(0.1249)	(0.3714)				
L.lnhdi					0.9089***	0.8980***	0.8247***	0.6611
					(0.0584)	(0.0558)	(0.2012)	(0.4880)
nato		0.0026		0.0174		0.0054		0.0207
		(0.0030)		(0.0211)		(0.0055)		(0.0542)
lnhealthgov	0.0018	0.0021	0.0502	0.0497	0.0198	0.0201	0.0328	0.0629
	(0.0096)	(0.0092)	(0.0375)	(0.0606)	(0.0212)	(0.0209)	(0.0478)	(0.1110)
terror	0.0000***	0.0000***	0.0001**	0.0001	0.0001***	0.0001***	0.0001	0.0001
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
lnrgdp	0.0013	0.0007	-0.0173	-0.0140	0.0000	-0.0012	0.0114	-0.0210
	(0.0020)	(0.0023)	(0.0200)	(0.0269)	(0.0049)	(0.0054)	(0.0485)	(0.0801)
tivnet	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
lnapcsale	-0.0013	-0.0013	0.0061	0.0050	-0.0007	-0.0006	-0.0035	0.0091
	(0.0008)	(0.0008)	(.)	(0.0082)	(0.0015)	(0.0015)	(0.0120)	(0.0250)
lnunemp	-0.0039	-0.0049	-0.0129	-0.0195	-0.0081	-0.0095	-0.0114	-0.0090
	(0.0032)	(0.0034)	(0.0196)	(0.0330)	(0.0065)	(0.0072)	(0.0421)	(0.0362)
lntradeopen	0.0029	0.0027	0.0049	0.0167	0.0048	0.0045	0.0185	0.0279
	(0.0030)	(0.0030)	(0.0397)	(0.0462)	(0.0053)	(0.0056)	(0.0693)	(0.0413)
Observations	197	197	197	197	197	197	197	197
Number of countries	24	24	24	24	24	24	24	24
Arellano-Bond test for AR(1)	-1.83	-1.75	-1.83	-1.61	-0.93	-1.55	-1.20	-0.85
p value	0.068	0.080	0.067	0.107	0.355	0.122	0.228	0.393

Arellano-Bond test for AR(2)	0.32	0.27	0.57	0.94	0.16	0.24	0.31	0.54
p value	0.746	0.789	0.566	0.348	0.874	0.807	0.756	0.589
Sargan test for over identification (*p*-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen test for over identification (*p*-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Diff-in-Hansen Tests for Exogeneity of GMM Instruments (*p*-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 4: difference and system GMM analysis on the dataset

5. Discussion

Regarding the effectiveness of LNAPCSALE, it is only significant on the one-step GMM. This is still debatable because the one-step GMM causes downward biasness compared to the two-step GMM. Additionally, not many explanatory variables show significance. It may be due to the limitation of available countries. Generally speaking, panels whose N is equal to around 20 for the GMM estimation is considered troublesome. (Roodman 2009) Even though this research is done on as many as available of variables that are taken from the latest data sources, there would be a possibility that another different result is led with more available panels.

6. Conclusion

This research is conducted by the difference and system GMM for unbalanced panel data of 22 countries with 10 variables in order to investigate the relationship between military expenditure and income inequality from the MIC point of view. The result suggests that the negative relationship exists significantly in the difference GMM model where Gini coefficient is a dependent variable, and also negative, but a relatively weak relationship can be observed by the Theil's T one-step system GMM. By judging the significance level and variable specification, the income-narrowing hypothesis can be supported in this research. Not to be argued, although it was a debated matter that the existence of MIC so far, this paper put the discussion forward in terms of quantitative aspects.

It is possible that the result will change because of the lack of a more comprehensive dataset. The longer time periods and many numbers of countries allow the future study to examine the relationship deeply, but this study opens the way to the MIC approach in defense economy, which is relatively abandoned and suggests some hints to important findings.

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