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The military Expenditure and Economic Growth in the case of the South Korea : The dynamic Computational Equilibrium model in an Endogeneous Growth Perspective

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Abstract

This paper analyses the economic effects of an increase in military expenditure which is required for the military reform and policy in Republic of Korea. The effects of the military expenditure are examined with various scenarios of financial resources in the endogenous growth perspective. We also employ the dynamic Computational General Equilibrium (CGE) model in order to measure the aggregate effect, reflecting the channels of the positive and negative effects and considering the reactions of individual industries and economic agents which it follows in change of military expenditure. The results reveal that the effects of an increase in defense spending vary with financial resources. Raising indirect tax rate is the best for GDP, but corporate income tax rate increase is the best for gross output. The differences between short-term and long-term effects are verified by the dynamic change of each indicator.

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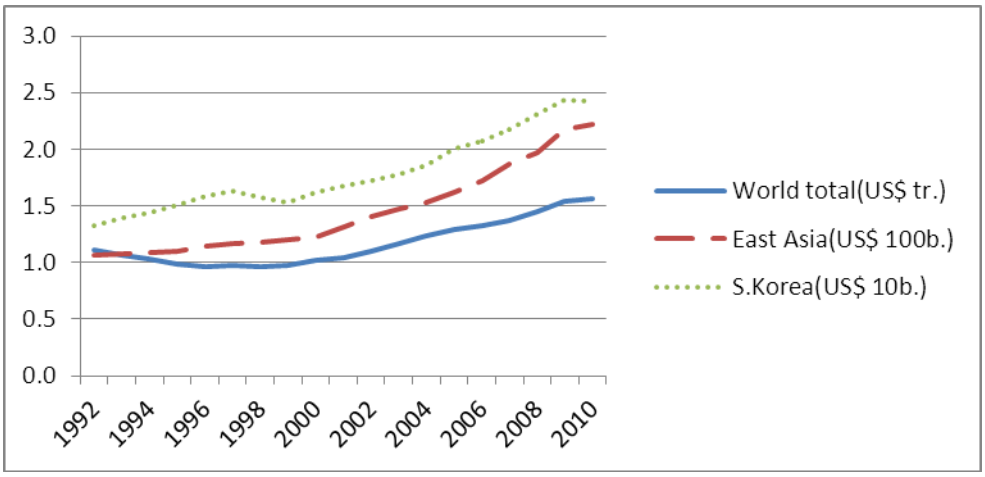
1. Introduction

It is very important but difficult task to balance national security and economic growth. National security is the first priority in each country, but a huge military expenditure can be a large burden for government and the welfare of people. Therefore, the effective budget plan for military spending is required.

Although the military spending was temporarily decreased after the end of Cold War, it has risen since the 1990's. Moreover, this trend is continuing in spite of global economic crisis during the last 10 years. When viewed from this perspective, in most countries, security principle is



< Figure 1. Military expenditure trend[1] >

considered more than economic condition, moving forward with defense policy. In particular, a country such as South Korea facing the military conflicts and tensions prioritizes the security issue.

Therefore, this research focuses on the economic effect by additional military spending and the method of effective military budget procurement in case of South Korea. For this objective, this research analyzes the dynamic changes of the principal economic indicators by using a Computable General Equilibrium (CGE) model with endogenous growth perspective.

2. Literature review

As the national security of country lies in critical situation, defense spending accounts for a significant portion of government budget. Thus, defense spending brings various direct and

[1] Source: SIPRI Military Expenditure Database

indirect ripple effects to the national economy. Military expenditure may influence economic growth through a wide variety of channels. The channels can be broadly divided into three main categories: demand, supply and security (Dunne et al., 2005).

In the demand side, additional defense spending increases total demand and capital utilization, and reduces unemployment, if there is spare capacity in the production sector. In case of developing country, military expenditure influences economic growth through expanding social infrastructure and increasing human capital. However, defense spending can be an opportunity cost of human and capital investment. In addition, additional defense spending brings out tax increase (Deger, 1986) and government spending reduction in other sectors, so it may have different effects on industrial structure through input-output effects.

In the supply side, resources and capital are limited to use, so those used by military sector are opportunity cost in other sectors. Chan (1987) pointed out that non-military investment is cut back, if the level of military expenditure increases. It causes a negative effect on economic growth by reducing productivity in the long-term. However, Yakovlev (2007) argued that military expenditure can result in the development of technology and human resource that can spill over into the private sector. It makes a positive effect across the industries.

In the security side, military expenditures can enhance the incentives to accumulate capital and produce more output, leading to higher economic growth (Thompson, 1974). In many poor countries, war and lack of security are major obstacles to development (Dunne et al., 2005). However, Aizenman and Glick (2003) argued that military expenditure induced by external threats should increase growth, while military expenditure induced by rent seeking and corruption should reduce growth. Therefore, defense spending which is more than basic security needs stimulates an arms race and leads to an unnecessary waste of resources.

As shown above, military spending has an influence on national economy through various paths. Therefore, a model needs to reflect the variety of channels when analyzing the economic effects of defense spending.

For this reason, recent research results have been drawn by CGE models. They are useful for analyzing the economic effects of various types of military expenditure and related changes since they can incorporate economy-wide relationships both within and between countries and provide numerical estimates of the aggregate effects of different policies as well as details on how individual sectors may respond (Ozmemir and Bayar, 2009).

There are recent researches which adopt a CGE model in military sector: Athanassiou et al. (2002) and Ozmemir and Bayar (2009). The former estimated the Greek economic change through the shift of expenditure from military into non-military public spending by a static CGE model. The latter estimated the peace dividend effect of Turkish convergence to EU membership by a multi-region dynamic CGE model.

Both studies estimate economic effects through reducing military expenditure. However, our research, using the dynamic CGE model in an endogenous growth perspective, measures economic effects by increasing military expenditure. In addition, this model reflects various channel effects following the additional military expenditure.

3. CGE Modeling

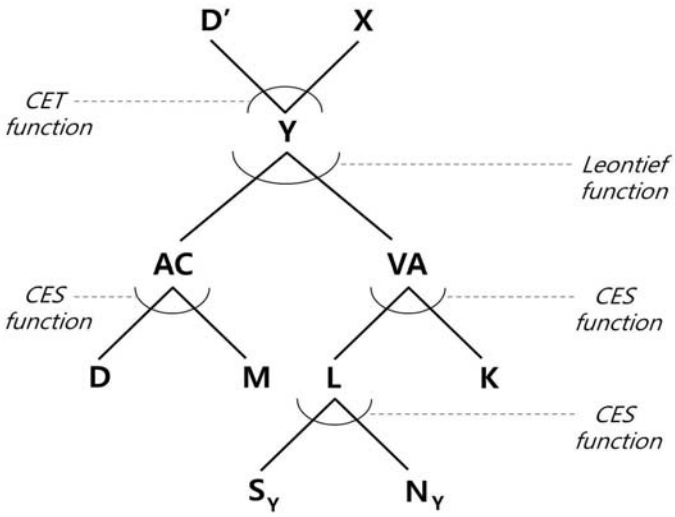
We need to give balanced consideration to both positive and negative paths when analyzing the effect of military expenditure on national economics. That means to describe various effects derived from military expenditure to supply and demand side of CGE structure. The following subsections show the modeling equations which reflect those considerations.

3.1. Supply-side Structure

The supply-side structure is plotted in Figure. 2. The basic structure is similar with general form of other CGE models: Armington composite good (AC) is formed from domestic (D) and imported (M) products through CES function, and output (Y) is supplied for domestic (D') and export (X) uses through CET function. For each elasticity of substitution and transformation for the functions, we adopt the same values with Son & Shin (1997) which was estimated by industry.

Output (Y) is produced with Armington composite and value-added (VA). The production function of this process is supposed as Leontief function (Equation (1)) whose factors are unable to be substituted. The coefficient A_t means technology level or total factor productivity (TFP). Although classic CGE model assumes constant return to scale, real world data tend to show increasing return to scale. Therefore, A_t is set to grow with some ratio. The growth rate is estimated as 1.5% per year by KDI[2] (2005), so we adopt this value. Besides, Park et al. (2003) reported the effect of military R&D investment that 1% point increase in military R&D budget

[2]Korea Development Institute



< Figure 2. Production Structure >

increased TFP growth rate by 0.02%. This value is also adopted with η_M in equation (2).

$$Y_t = A_t \min(AC_t, VA_t) \qquad (1)$$

$$A_{t+1} = A_t(1 + \eta_L + \eta_E) \qquad (2)$$

Labor L in Figure. 2 means human capital, which is artificially compounded with skilled and non-skilled labor forces. Human capital has been regarded as one of main factors for economic growth since Romer (1989). Barro (1998) also verified the positive effect of education to economic growth with cross-country regression. Especially in case of South Korea, poor natural resources drove the government policy to give an emphasis on investment in human resource, which was main growth engine of national economics (Collins 1990, Johnson 2002). This study, therefore, divides the labor force into skilled (S) and non-skilled (N) resources in order to reflect the characteristics of South Korean human resource. Each resource is defined to comprise three kinds of resources (Berthelemy, 1995) as equation (3).

$$\begin{cases} S_t = S_{Yt} + S_{Et} + S_{Mt} \\ N_t = N_{Yt} + N_{Et} + N_{Mt} \end{cases} \qquad (3)$$

Subscripts of S and N in equation (3) mean human resources for production (Y), education (E) and military (M) section. The investment and expenditure to education section are relatively high in South Korea, which means high opportunity cost in production section. There is also another opportunity cost caused by conscription system. South Korea is in conflict with North Korea, so young South Korean men should do their obligatory military service instead of having a job. These circumstances justify the classification in equation (3).

The human resources in education and military section are excluded from production process. Only skilled labor (S_Y) and non-skilled labor (N_Y) in production section form the aggregate labor L_t through CES function (equation (4)). Some other studies used Cobb-Douglas technology instead of CES function, but perfect substitution between skilled and non-skilled labor doesn't accord with real world, as mentioned by Mello (2008).

$$L_t = [\theta S_{Y,t}^{\rho} + (1-\theta) N_{Y,t}^{\rho}]^{1/\rho} \qquad (4)$$

where the elasticity of substitution $\sigma = 1/(1-\rho)$ by industry are estimations by Jeon(2008).

Human resources in education section, S_E and N_E, are supposed to produce educational investment goods I_E defined in equation (5) (Berthelemy, 1995). I_E increases the skilled labor of next period, while non-skilled labor increases with natural growth rate of g_N (equation (6) and (7)).

$$I_{E,t} = [\theta S_{E,t}^{\rho} + (1-\theta) N_{E,t}^{\rho}]^{1/\rho} \qquad (5)$$

$$S_{t+1} = S_t(1-\delta_S) + I_{E,t} \qquad (6)$$

$$N_{t+1} = N_0(1+g_N)^{t+1} \qquad (7)$$

where δ_S is depreciation rate of skilled labor.

If the growth of S_t through the imaginary resource of educational goods I_E were faster than natural growth of N_t, I_E will be the dominant factor to decide the level of L_t in equation (4) and finally economic growth in next period. Therefore, the production of I_E is important for economic development. It is set to be decided by government expenditure to skilled (S_E) and non-skilled (N_E) labor in education section.

According to the modeling above, an increase in military expenditure decreases government expenditure for educational investment, and this deters the formation of skilled labor. In addition, military section generates opportunity cost in labor by taking skilled and non-skilled labor which can go to production section. These processes are negative effects in economic growth caused by increase in military expenditure. On the other hand, more budget in military section increases TFP growth rate. The budget is also used to buy final goods of other industry, so it may promote industry development. These are positive effects on economic growth caused by an increase in military expenditure. The details of military expenditure are described in section 3.3.

3.2. Demand-side Structure

Berthelemy (1995) proposed that household utility is affected by not only individual consumption (C_t/P_t) but also non-military government expenditure (G_t/P_t) and security (Z_t) attained from military government expenditure. Government expenditures in non-military and military cause increase in the level of welfare and security respectively. This paper accepts his idea and assumes the individual utility and social welfare function, u_t and U_t, as follows.

$$U_t = P_t \cdot u_t = P_t \cdot \left[\left(\frac{C_t}{P_t}\right)^{\beta} \left(\frac{G_t}{P_t}\right)^{\gamma} Z_t^{1-\beta-\gamma} \right] \qquad (8)$$

where P_t is population.

For the definition of security level Z_t, we set up three assumptions. First, security level is proportional to the stock of military asset. Second, military asset of a nation include assets of allied nations. Third, security level is proportional to the ratio of a friendly nations' asset to that of adversary nations. This paper applies these assumptions to South Korean case.

The security of South Korea focuses on suppressing the provocation of North Korea. If we name the military asset of South and North Korea as MA^{SK} and MA^{NK}, the security index can be defined as equation (9). This index also assumes the saturation of military asset deployed to the Korean Peninsula by allied nations, while South and North Korea actively increase their military assets.

$$Z_t = \left[MA_0^{ally\_SK} + MA_0^{SK} \prod_{n=1}^{t} (1 + mn_n^{SK})\right] / \left[MA_0^{ally\_NK} + MA_0^{NK} \prod_{n=1}^{t} (1 + mn_n^{NK})\right] \qquad (9)$$

where $MA_0^{ally\_SK}$: military asset of ROK's allies at initial period

$MA_0^{ally\_NK}$: military asset of North Korea's allies at initial period

mn_n^{SK}: growth rate of military expenditure for South Korea

mn_n^{NK}: growth rate of military expenditure for North Korea

The military expenditure in year 2008 stated in IISS[3] (2010) report is set to be proxy for military asset of allied nations. Military expenditure of North Korea is an estimation by KIDA[4] (2010) based on purchasing power parity (PPP). mn_n^{SK} and mn_n^{NK} in the equation are estimated by regression analysis with time-series data of yearly military expenditure. mn_n^{SK} is used as a factor of policy

[3] International Institute for Strategic Studies

[4] Korea Institute for Defense Analyses

shock in scenarios in section 4.

According to the modeling above, an increase in military expenditure raises security level, and this makes a positive effect on social welfare. But it also reduces the non-military budget, which means negative effect on social welfare.

3.3. Fiscal Balancing

In addition to the model equations in previous sections, we need other constraints to get the general equilibrium solution. They will be described in following paragraphs but the subscript t representing a period in each variable is omitted.

The government is classified with civil (or non-military) government and military government. The former collects taxes and spend it for public services and the latter gets military budget from the former and spend it for national defense.

Civil government collects taxes (τ) which consist of corporation tax (τ_C), indirect tax (τ_I), composite income tax (τ_H) from household and tariff (τ_T). If extra revenue is necessary, it is supplied from investment account as a debt (D_G). These revenues are spent as government consumption (G). It is divided into government expenditure (G_C), transfer payment to household (G_H) and military expenditure (G_M):

$$(\tau_C + \tau_I + \tau_H + \tau_T) + D_G = G_C + G_H + G_M \qquad (10)$$

Military government gets defense budget from civil government and spend it to buy goods from industries and operate physical and human resources. Household gets income with skilled and non-skilled labor ($\omega_S S + \omega_N N$), and income from one's physical capital (rK). Here, adding transfer payment (G_H) and subtracting income tax (τ_H) forms disposable income of household. Household spends some part of it as consumption (C) and save the rest (S_H):

$$(\omega_S S + \omega_N N) + rK + G_H - \tau_H = C + S_H \qquad (11)$$

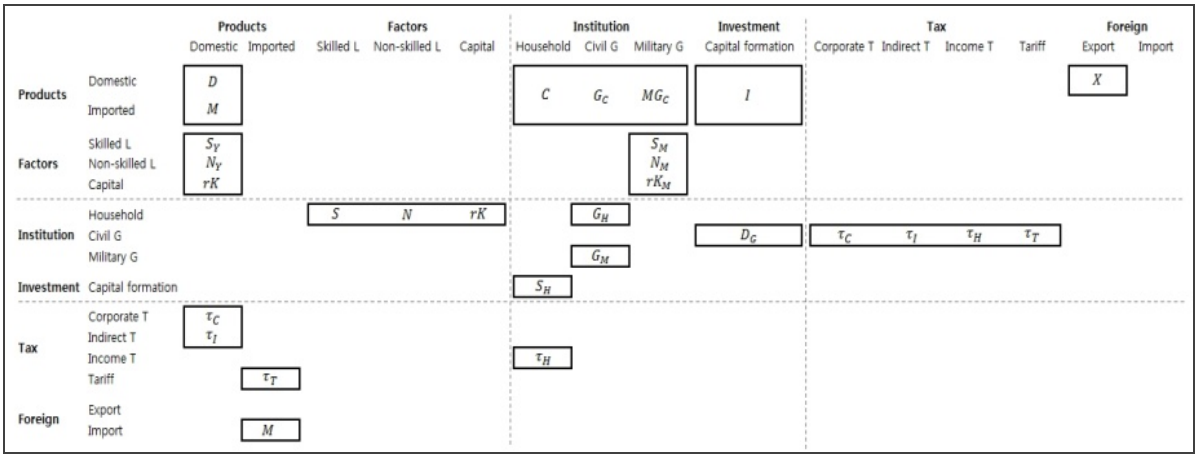
The revenue of investment account is a save from household (S_H), and the expenditure is investment to industry (I) and debt to government (D_G):

$$S_H = I + D_G \qquad (12)$$

3.4 Data and Social Accounting Matrix

The basic data for social accounting matrix (SAM) is based on input-output table in year 2009.

Main six sectors in the SAM are Product, Factor, Institution, Investment, Tax and Foreign as depicted in Figure. 3.



< Figure 3. Structure of social accounting matrix >

Product sector is divided into 28 industries to show the transaction of intermediate goods[5]. Factor sector consists of skilled labor, non-skilled labor and physical capital. Institution sector comprises household, civil government and military government. Tax sector has four kinds of tax in it, while foreign sector has two subsectors of import and export.

4. Scenarios

Previous studies about the effect of military expenditure to national economics mainly focused on the economic benefit or peace dividend caused by decrease of military budget. This study, however, analyzes the effect to South Korean national economics from increase of its military budget. South Korea has been making policy efforts to reform national defense system since mid-2000s. Although the details of these policies have been modified, each version asserts more budget in common than current level.

In this analysis, we adopt the reform plan for defense system proposed in year 2009. That version argued the 7.5% increase in military budget per year from year 2010 to year 2020 in order

[5] It follows the hierarchy of Korea Standard Industry Code (KSIC)

Military budget	Financing	Taxation source	Target tax to increase	Scenario name
Increase with current trend[6]	-	-	-	Baseline scenario
Increase with 7.5% per year from 2010 to 2020[7] (Shock)	Deduction from other budget	Civil government	-	Scenario A
	Increase in tax	Production sector	Indirect tax	Scenario B
			Corporate tax	Scenario C
			Indirect & Corporate tax	Scenario D
		Household	Composite income tax	Scenario E
		Production & Household	Indirect & Corporate & Composite income tax	Scenario F

< Table 1. Scenario classification >

to finance the plan. For the financing, government may choose a way of the following two; one is a decrease in civil government's expenditure instead of the increase in military budget, and the other is an increase in tax to provide additional budget. This paper analyzes the effects of those two methods, but departmentalizes the latter case according to the kinds of tax. The combinations of three kinds of tax (indirect, corporate and composite income tax) are summarized in table 1. Scenario B, C and D means the financing from firms in production sector, while scenario E from household. Scenario F shows the financing from both firms and household.

5. Simulation Results

This chapter describes the main simulation results about gross domestic product (GDP), output by industry and gross output. All presented results except figure 4 are difference values from baseline scenario. The final period in the simulation is year 2040, and the effects of each scenario are compared with each other based on the final period.

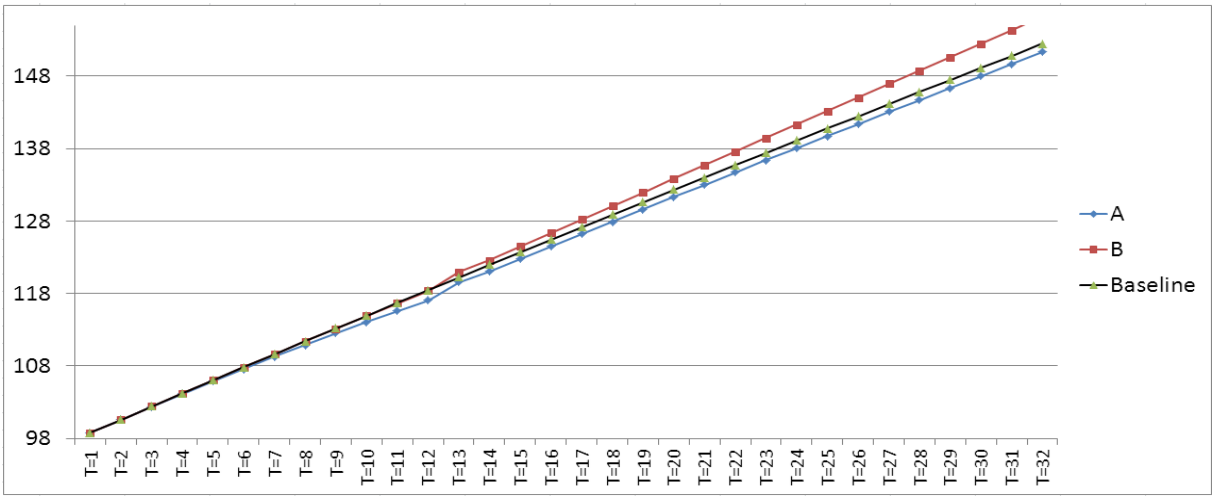
5.1. Gross Domestic Product

[6] This is estimated from regression analysis with data of military budget from 1980 to 2009.

[7] From 2021 to 2040, the same increasing rate with baseline scenario is applied.

Three factors of production, that is, capital stock, skilled and non-skilled labor, grow due to household saving, educational investment goods and natural population growth, respectively. These growths of factors as well as TFP growth raise the national economics for all scenarios as shown in figure 4.

Each scenario for the financial resources, however, shows difference in level. As listed in table 2, the case without increase in tax (scenario A) results in lowest level of GDP growth.



< Figure 4. GDP growth by scenario >

(% difference from baseline scenario)

Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
-0.719	2.475	1.228	2.319	-0.245	1.783

< Table 2. Effect on GDP >

On the other hand, increasing taxation scenarios show higher growth than baseline except for income tax increase (scenario E). Among those (scenario B, C, D and F), the positive effects of B and D are similar level, but the effect level of C is relatively lower than others.

The annual differences of GDP by scenario are illustrated in figure 5. All scenarios in case of tax increase show temporarily lower level in the duration of policy shock, but the growth rates of scenario B, C, D and F overcome that of baseline scenario after 13th period[8]. Scenario C narrows

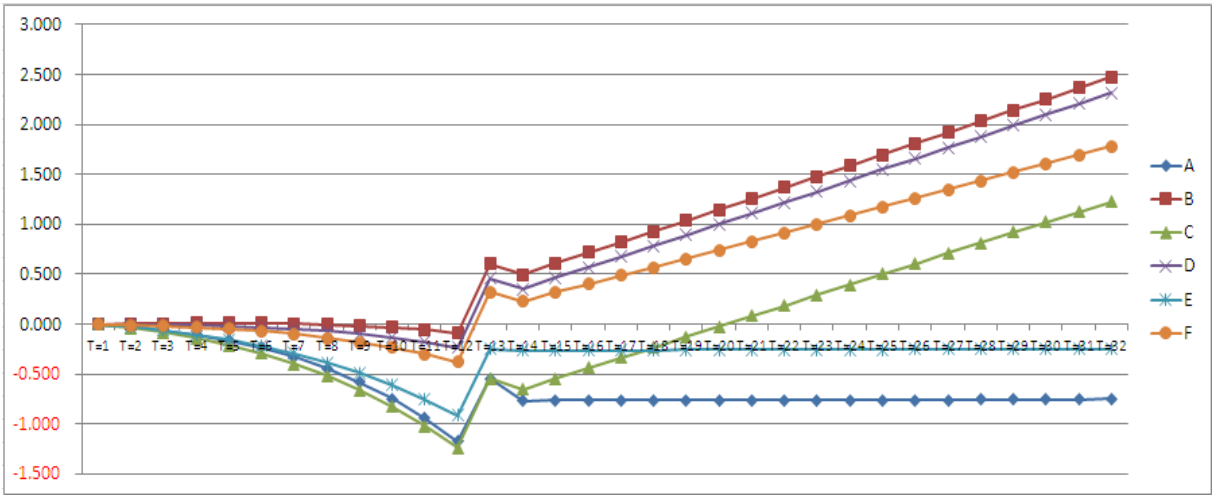
[8] The baseline year of this model is year 2009 (T=1), therefore the duration of policy shock, the increase in military budget, is the periods from 2009 to 2020 (T=2 ~ T=12). Year 2040, the last year of simulation, is a period of T=32.

the gap between baseline scenario and exceeds it from 21st period. But the GDP growth rate of scenario E is nearly same with baseline scenario after 14th period when the difference maintains in same level.

5.2. Output by Industry

Table 3 shows the effects on output by industry for each scenario. Decrease in civil government

(% difference from baseline scenario)



< Figure 5. Dynamic change of GDP >

(% difference with the reference scenario)

#	Industry	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
1	Agriculture, forestry and fisheries	-0.790	1.647	2.016	1.686	-0.224	1.304
2	Mining and quarrying	-0.690	2.241	2.069	2.069	-0.172	1.724
3	Food and kindred prod. and tobacco	-0.753	1.356	1.584	1.388	-0.235	1.066
4	Textile mill prod., apparel, and leather	-0.855	3.434	2.672	3.325	-0.202	2.579
5	Paper and wood products	-0.750	2.063	2.090	2.063	-0.214	1.581
6	Printing and publishing	-0.776	3.017	2.931	3.017	-0.172	2.328
7	Petroleum and coal products	-0.771	1.908	2.252	1.953	-0.217	1.504
8	Chemicals and allied products	-0.769	2.009	2.456	2.067	-0.225	1.591
9	Nonmetallic minerals	-0.726	1.001	1.432	1.060	-0.235	0.805
10	Primary metal products	-0.775	1.879	2.101	1.910	-0.210	1.478
11	Fabricated metal products	-0.771	1.816	2.080	1.857	-0.213	1.431
12	General Machinery and equipment	-0.819	2.626	2.736	2.641	-0.176	2.055

13	Electronic and other electric equip.	-0.570	-0.627	0.323	-0.506	-0.275	-0.414
14	Precision instruments	-0.862	2.585	2.630	2.585	-0.227	1.995
15	Transportation equipment	-0.798	1.889	2.456	1.963	-0.188	1.525
16	Other assembly & processing prod.	-0.851	2.754	2.714	2.754	-0.203	2.106
17	Electric, gas an water services	-0.759	2.097	2.161	2.108	-0.221	1.623
18	Construction	-0.727	0.836	1.217	0.887	-0.240	0.676
19	Wholesale and retail trade	-0.749	1.273	1.691	1.331	-0.231	1.018
20	Eating and drinking places, and hotels and other lodging places	-0.759	1.739	1.906	1.767	-0.241	1.351
21	Transporting and warehousing	-0.796	2.749	2.328	2.696	-0.217	2.078
22	Communications and broadcasting services	-0.747	1.458	1.719	1.494	-0.237	1.150
23	Finance and insurance	-0.767	1.700	1.954	1.733	-0.237	1.330
24	Real estate and business services	-0.743	1.494	1.843	1.540	-0.235	1.184
25	Public administration	-1.055	10.855	10.476	10.814	-0.307	8.346
26	Educational and health services	-0.864	5.099	5.157	5.110	-0.270	3.937
27	Social and personal services	-0.744	1.362	1.671	1.401	-0.242	1.072
28	Others	-0.798	3.733	3.128	3.656	-0.232	2.806

< Table 3. Impact on industry's final output >

expenditure (scenario A) leads the output of all industry to lower level than baseline scenario. The relative loss is 0.76% in average, and the biggest damage appears in "Public Administration" and "Educational & Health Service" industry as 1.055% and 0.864% each.

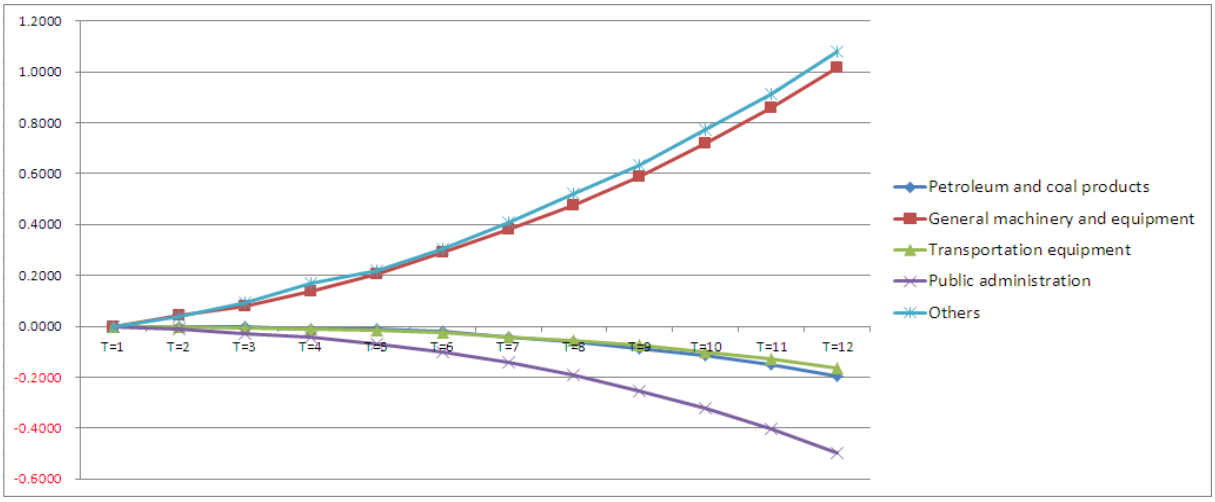
Tax increase scenarios (B, C, D and F) cause positive effect to all industries except "Electronic and Other Electric Equipment" industry, while scenario E causes negative effect. The amount of positive effect in scenario F which represents the tax increase from both production sector and household is relatively smaller than those of other positive scenarios. This makes us to infer that the increasing income tax from household is undesirable for output, as examined in GDP.

The level of positive effect is different by industry. For example of scenario B, "Electronic and Other Electric Equipment" industry grows only 0.557% more than baseline scenario, while "Public Administration" industry does 10.870%. In the other perspective, each industry has its own best scenario. "Agriculture, Forestry and Fisheries" industry sees its highest growth in scenario C, while "Textile Mill Products, Apparel and Leather" industry prefers scenario B.

As results listed in Table 3, increasing taxes (Scenario B, C, D, E and F) is better for the final output level than decreasing government expenditure (Scenario A). However, each scenario can be separated into short-term and long-term effects through dynamic changes in the final output.

Figure 6 depicts the dynamic change of output level for top five industries with the high proportion of military expenditure in scenario B. Intuitively speaking, output level of all industries during the periods of increased defense spending is expected to rise due to the increased demand from military sector, but actually only two industries ("Petroleum and coal products",

(% difference with the reference scenario)



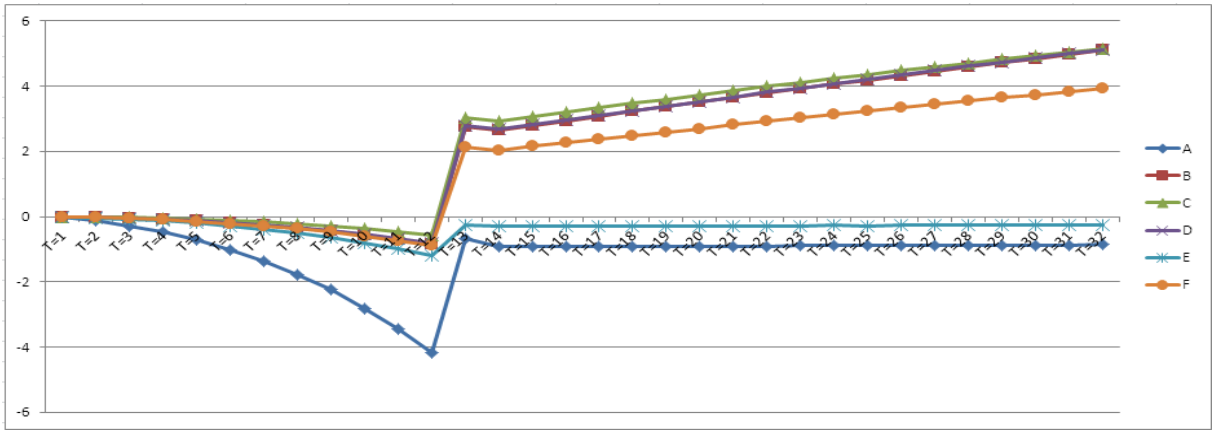
< Figure 6. Dynamic change of output level in big 5 military spending industries >

"General machinery and equipment") show an increase in output level. The outputs of the other industries are reduced due to the increased tax and the decreased demand for intermediate goods in other industries.

In all scenarios, the final output level of "Educational and health services" industry with 50.9% share of government spending is decreased compared with reference scenario during the period of increased defense spending (figure 7). However, in the scenario B, C, D and F, the output levels are higher than the level of reference scenario since the end of additional military expenditure (T=12), because of the increased demand from expanded government spending.

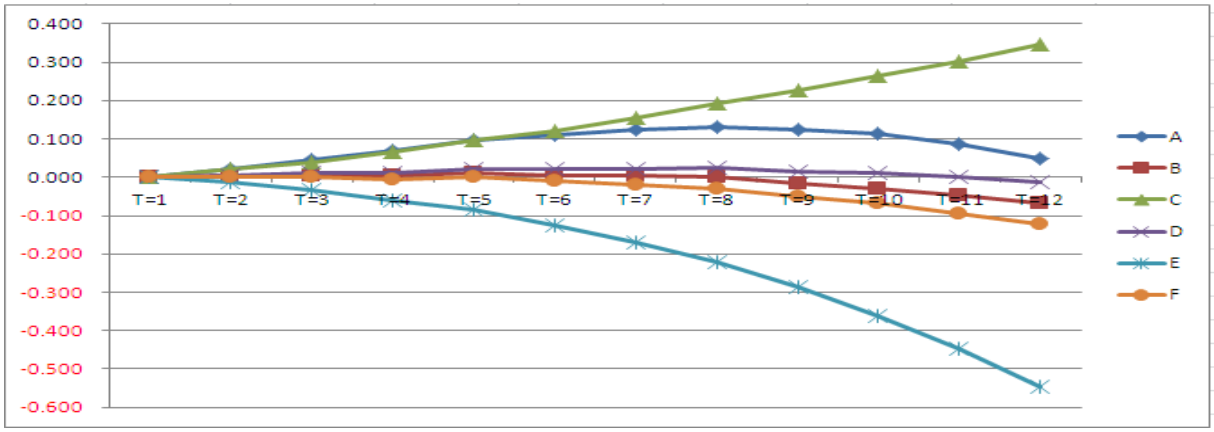
From figure 7, we can certify that each industry has a different dynamic change even in the same scenario. In addition, it has a different dynamic change by scenario even in the same industry (figure 8). Figure 8 shows that scenario A, C and D result in the increase in the output level compared with reference during the policy shock for "Primary metal product" industry, while the outputs in scenario B, E and F are decreased relatively.

(% difference with the reference scenario)



< Figure 7. Dynamic change of output level in Educational and health services >

(% difference with the reference scenario)



< Figure 8. Dynamic change of output level in Primary metal products >

5.3. Gross Output

The simulation results for gross output are presented in figure 9. The scenario C exhibits the best result for gross output in the final year (T=32). In contrast, the scenario A represents the worst result, the same as GDP case. In case of scenario B, D and F, the final output levels are less than that of reference scenario until the period of increased military spending, but the output levels catch up from the 16th period. The table 4 lists the impacts on gross output in each scenario at final period (T=32).

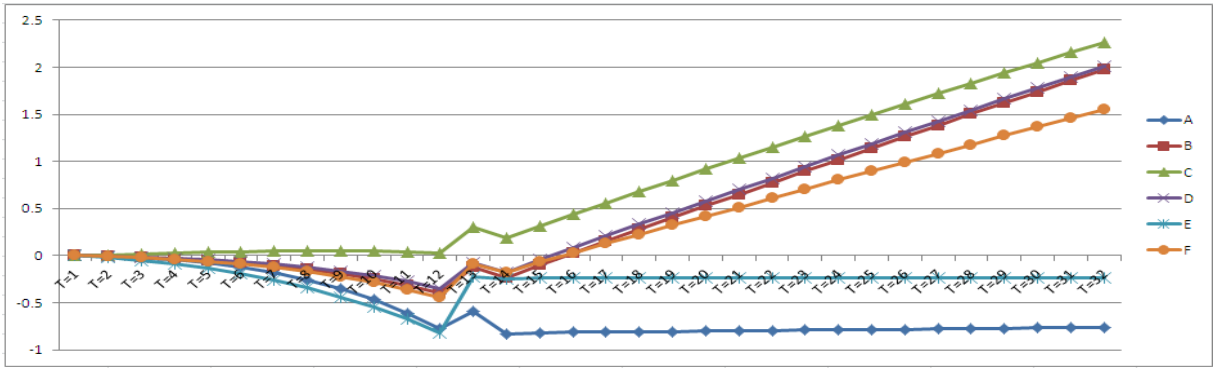
The gaps between the scenarios and reference scenario are reduced because the increase rate of input factors in other scenarios is higher than that in reference scenario after 12th period. At first, the level of skilled labor for production sector is higher than the reference level just after T=12, because the demand for skilled labor from military government decrease, which means the availability of extra skilled labor into the production sector. For another reason, the budget of

(% difference with the reference scenario)

Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
-0.760	1.972	2.263	2.011	-0.233	1.548

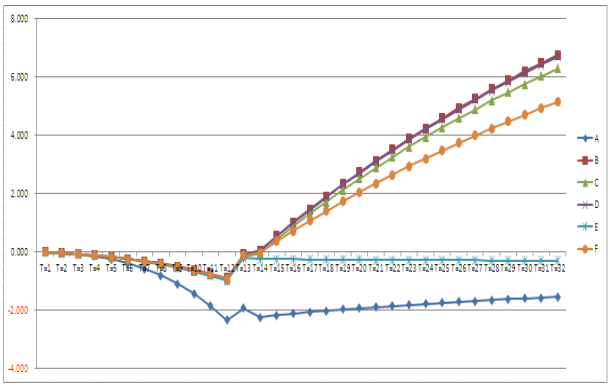
< Table 4. Impacts on gross output >

(% difference with the reference scenario)

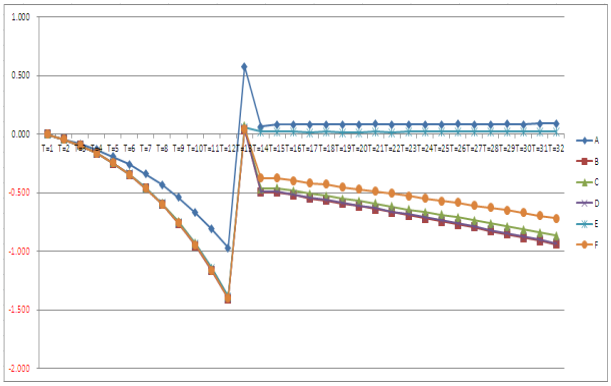


< Figure 9. Dynamic change of gross output level >

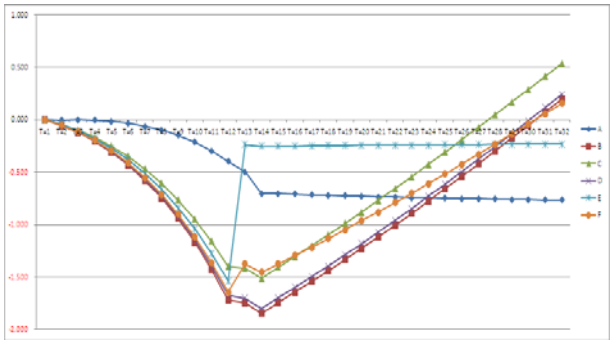
(% difference with the reference scenario)



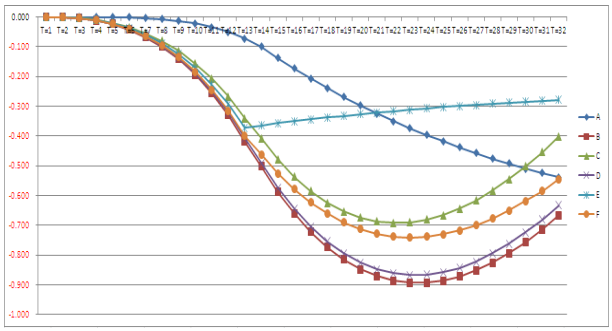
(a) Skilled labor for production sector



(b) Non-skilled labor for production sector



(c) Capital investment



(d) Capital stock

< Figure 10. Dynamic change of factors for production sector >

educational investment increases after 12th period, which leads to an increase in skilled labor.

Secondly, the capital stock also increases faster because of more physical investment after 12th period. For non-skilled labor, the gap against reference does not change. The reasons are like followings: the demand for non-skilled labor from the military government decreases, but that for educational investment of civil government increases. Here, the magnitude of increase is greater than that of decrease, which keeps the lower capacity of non-skilled labor for production sector. Finally, the faster increase rate in both skilled labor and capital stock after 12th period overwhelms the static gap in non-skilled labor available for production sector, which narrows the difference in gross output. (Figure. 9 and 10)

6. Conclusions and Policy implications

It may not be appropriate to comprehend national defense policy only with evaluation of partial economic profit and loss it will lead, especially considering the importance and the ripple effect of national security. Nonetheless, economic interpretations of military spending are still important issues, considering the fact that a sizable proportion of the government budget is allocated to national defense. The results of research work on what the economic effects of military expenditure are depending on how the increase is financed, moreover, are all the more meaningful in that those provide policy implication for facing problem of military reform.

This paper evaluated the economic effect of additional military expenditure which is required for implementing military reform with various scenarios of financial resources. As a valuation basis for policy scenarios, we used GDP, output by industry and gross output.

Based on the long-term effects, it was more effective policy response to raise tax rate in order to free up more resources for the supplementary defense budget than otherwise. Raising indirect tax rate is the best for GDP, but corporate tax rate increase is the best for total output. As respects output by industry, raising indirect tax rate or corporate tax rate is proper, which measures is the best depends on industry. The aggregate income tax increase, on the other hand, led to results that were relatively not better than raising tax rate related to the production sector.

Also, differences between short-term and long-term effects were verified by dynamic change of each indicator. In case of an increased taxation, both GDP and gross output fell during the defense budget's shock. And then, from that point on, gap of each indicator between baseline scenario and tax-and-spend scenarios except an aggregate income tax has narrowed. As a result, two pointers of those scenarios were higher than those of baseline at the last simulation period. Output by industry varies with the scenarios. Furthermore, the effect on output by industry is

dependent on industry even for the same scenario.

In conclusion, the economic effect of military spending varies with measures to fund for additional military expenditure. Also, the best policy varies with economic indicators. Short-term and long-term effects are quite distinct from each other. Thus, we cannot consistently conclude what the effects of military spending would be. Decision makers should reason the key factors as consideration when promoting the policies associated with military reform.

Our results were drawn from applying the specific scenarios based on the economic structure and production technology of the Republic of Korea in 2009. Therefore, these results may not be applicable to cases of other nations, and different degrees or periods of a change in national defense expenditure. Also, although our CGE model has many advantages compared with other models and methodologies, we should make more positive and negative channels through which military spending may influence state economy reflected into the model with balance. We leave these issues for future research.

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