

# Evaluation of indirect Economic Losses of War: a Perspective of local War's impact on Investment

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**Abstract:** In order to study the indirect impact of local war on economy, this paper divides the impact of local war on investment and economy into short-term impacts and long-term ones. Some tools such as formula of national income accounting, investment Multiplier and learning curve are used to establish a model, which evaluates indirect economic losses caused by war. The results show that local war causes investment changing, and then leads to indirect economic losses. By changing some controllable variables, the losses can be controlled to a certain degree.

**Keyword:** War cost, Investment, Indirect economic losses

## 1. Introduction

It is an important issue to measure the cost of war in the research of defense economics, but the cost of war is defined inconsistently by different scholars. Fang Zhengqi (2004) defined war cost as all kinds of costs and losses that government or groups have paid for and been expected to pay for, which includes the payment of all costs and suffered losses in the preparations for war and the wartime. This definition makes the war cost involving more extensive meaning. Huang Ruixin (2001) pointed that economic cost of war could be divided into direct and indirect costs, which proposed a better quantitative analytical framework. Li Gang (2002) deemed that the economic cost of modern war is the economic cost for the country to pay for the war. He considered war economic cost to be war attrition, and gave a quantitative description of war attrition from the economic point of view. Du Weigong (2003) pointed that economic losses of war is the loss to economic growth and damage it have caused. Mitchell (2003) analyzed the long-term and short-term impacts of the war, which gave us some indications. Hartung (2004) analyzed the hidden cost of war from multi-dimensions. It's very important to put forward dimensions of the hidden costs, and the indirect economic losses caused by investment increment can be partly considered as hidden costs.

Many scholars have done some quantitative analysis on the economic costs of war. Economics and Management research group of Tsinghua University (2001) studied the bearing capacity of Chinese economy from the static point of view. Du Weigong (2003) reviewed some western researches on the economic losses caused by war, based on the "critical theory", he used economic data measuring the chinese economic bearing capacity in 2001. Nordhaus et.al

(2002) forecasted the cost of Iraq war. Glick and Taylor (2005) especially quantitative analyzed indirect economic losses of war. Hartley (2006) and Bilmes, Stiglitz (2006) analyzed the costs and benefits of Iraq war, Bilmes and Stiglitz (2006) updated the estimate in a next research. Moreover, CBO(2002, 2006)and DOD(2003)et.al also estimated the cost of Iraq war. CBO and Stiglitz et.al appointed the same time range of 2003-2016, but the methods they had used were different. CBO divided the war into four phases, namely assets deployment on war seedtime, the war itself, assets redeployment after war, and occupation costs after the war. In addition, there were many researches on economic impact of war. Imai and Weinstein (2000) deemed that driving force behind negative effects of civil war on economic growth is the decrease in private investment, and supported his view by empirical analysis. Meyer (2002) discussed the economic consequences after an attack on Iraq in CSIS Conference Summary. More researches are given by Zhang Yuyan (2003), Wang Yumin (2007), Cui Jianping (2004), Zhang Wenyan (2003), Robert Barro (2003) and David Richardson (2003) et.al.

There are few literatures devoting to the analysis of the war's impact on investment presently. From a cost point of view, the investment is one of the most important components in socio-economic development. The effects on investment caused by war will no doubt lead to economic loss which should contribute to war cost. Analyzing effect on investment caused by war and establishing quantitative analysis platform, will contribute to comprehensive assessment of the cost of war, which is very important for research on defense economics.

## **2. Theoretical analysis of indirect economic impact of local war**

Local war has both direct and indirect impact on economy. It is advantageous to study indirect economic impact of local war from the perspective of investment. Because the nation would reconstruct the country after local war, and investment is one of the most important economic behaviors in reconstruction process, indirect cost of local war can be approximately measured from the perspective of investment. Furthermore, if the investment which is used to develop economy originally transfers to the military department, the benefits of economic development will lose. It can also be considered as a part of hidden cost or opportunity cost of the local war.

Once war breaks out, the government and enterprises will be forced to transfer productive investment to defense department. Meanwhile, War would make domestic investment environment worsen and cool enthusiasm of entrepreneurs, and foreign investments also suffer a strike. When domestic economy goes recovery, investment level will gradually return to normal, and the investment in the period of the economic recovery actually is a part of the war cost.

The war has both short-term and long-term impacts on investment. The outbreak of war will lead a sharp decline of social investment. Government will increase military input and mobilize part of private investments, and a considerable part of private investment will choose to intermit productive investment. Because high-tech local war has the features of “high consumption, short time”, this situation will not last long. However, long-term economic impact of war can not be eliminated. It needs time to reconstruct. Investment will rebound quickly after the war and then gradually returns to normal. It will take a long time from outbreak of war to economic recovery. The impact of the war on investment will be sustained until economic recovery. The devastating characteristic of modern war makes investment play an important role on reconstruction, while this part of investment can be consider as a part of indirect cost of local war.

### 3. Evaluation model of local war’s indirect economic losses

Assuming that local war lasts short time (no more than one year), and investment increment caused by war manifests in two aspects: the short-term impact on investment increment when war breaks out; and the long-term impact on investment after the end of the war. Correspondingly, gross domestic product increment is changed.

#### (i) Short-term impact of the war on investment increment and economy

When war breaks out, domestic investment will partly transfer to military department, partly fly to foreign countries, and somebody choose to give up any investment. Due to the complexity of this problem, it is impossible to accurately quantify each part of domestic investment, but the total investment increment of wartime can be quantified as follows.

During the war, the country has to ensure defense spending, and it has to endure war economic losses. Therefore, during the war, government, enterprises, and residents transfer part of investment and consumption to the defense department, thus social investment declines. It is assumed that the ratio of  $GDP$  of the year war breaks out to  $GDP$  of the year before war breaks out is  $\eta = GDP_w / GDP_0$ , then

$$GDP_0 = C_0 + (G_0^m + G_0^j) + (I_0^m + I_0^j) + (X_0 - M_0) \quad (1)$$

$$GDP_w = C_w + (G_w^m + G_w^j) + (I_w^m + I_w^j) + (X^j - M^j) \quad (2)$$

Where  $C$  is consumption,  $G$  is government procurement expenditures,  $I$  is total social investment,  $(X - M)$  is net exports, both  $G^m$  and  $I^m$  are civilian expenditure, both  $G^j$  and  $I^j$  are military expenditure.

Thus

$$1 = (c_0 + g_0^m + i_0^m) + (g_0^j + i_0^j) + (x_0 - m_0) \quad (3)$$

The ratio of civilian expenditure before the war to  $GDP_0$  is  $(c_0 + g_0^m + i_0^m)$ , the ratio of military expenditure before the war to  $GDP_0$  is  $(g_0^j + i_0^j)$ .

Government, enterprise, and residents share the costs of war together. Assuming they all transfer part of investment and consumption to defense department, and contribution ratio are the same, i.e.,  $\tau = C_w / C_0 = G_w^m / G_0^m = I_w^m / I_0^m$ , where  $\tau$  is the degree of economic contraction in non-military fields.

Thus the civil investment in wartime is

$$I_w^m = I_0^m \tau$$

The total investment in wartime is

$$I_w = I_w^m + I_w^j = I_0^m \tau + I_w^j$$

The investment increment caused by war is

$$\Delta I = I_0^m (1 - \tau) + I_0^j - I_w^j$$

Thus the  $GDP$  increment is:

$$\Delta GDP_s = [I_0^m (1 - \tau) + I_0^j - I_w^j] \cdot k_i \quad (4)$$

$\Delta GDP_s$  shows the wartime economic losses resulting from short-term impact on investment.

### (ii) Long-term impact of the war on investment increment and economy

Modern warfare, especially the high-tech local war has the features of “high consumption, short time”. The war causes a sharp decline in current investment in a short period of time, and it will take a long time from the outbreak of war to economic recovery. The impact of war will continue until economy develops as usual. It is said that investment must be at a relative high level after the end of war, and it gradually returns to normal level as the economy recovering.

We introduce learning curve, as shown in figure 1. It is assumed accumulated  $GDP$  output value and investment level maintains a certain ratio, i.e.  $dI / I = -bd(\sum GDP) / \sum GDP$ , it means as  $GDP$  accumulated output value grows, investment gradually returns to normal.

$b$  is learning index ( $0 < b < 1$ ),  $c = \ln a$ , and  $c$  is constant, so  $I = a(\sum GDP)^{-b}$ .

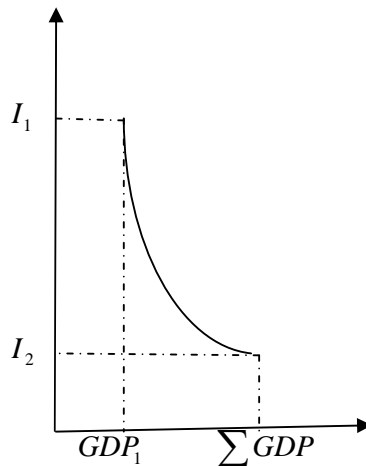


Figure 1 Learning curve of investment after the war

Figure 1 indicates that  $I_1$  is the initial investment value after the end of war and  $I_2$  is the normal investment value after economic recovery, and it is assumed that the normal investment value after economic recovery is equal to the investment value at the time of the year the war breaks out.  $GDP_1$  is the initial  $GDP$  value caused by investment after the end of war, and  $\sum GDP$  is accumulated  $GDP$  output value caused by investment during the period of economic recovery.  $a$  and  $b$  can be evaluated through historical data, thus  $\sum GDP$  can be calculated as follows:

$$\sum g = e^{(\ln a - \ln I_2)/b}$$

The average annual growth rate of investment is  $\lambda$  at peacetime, and accumulated  $GDP$  output value is  $\sum GDP_0$ . When introducing controllable variable  $t$  to signify the duration of economic recovery (unit: year), thus

$$\sum GDP_0 = I_2 \cdot k_i [(\lambda + 1)^t - 1] / \lambda \quad (5)$$

Therefore

$$\Delta GDP_l = \sum GDP_0 - \sum GDP = I_2 \cdot k_i [(\lambda + 1)^t - 1] / \lambda - e^{(\ln a - \ln I_2)/b} \quad (6)$$

When integrating the short-term and long-term impacts on investment, it can be concluded that the economic losses resulting from war's impacts on investment can be expressed as

$$\Delta GDP = \Delta GDP_s + \Delta GDP_l = [I_0^m (1 - \tau) + I_0^j - I_w^j] \cdot k_i + I_2 \cdot k_i [(\lambda + 1)^t - 1] / \lambda - e^{(\ln a - \ln I_2)/b} \quad (7)$$

#### 4. Result analysis

From equation (7) we can see,  $\tau$ ,  $(I_0^j - I_w^j)$ , and  $b$  are controllable variables.  $\Delta GDP$  and  $\tau$  are negative correlation, and  $(I_0^j - I_w^j)$ ,  $t$ ,  $b$  are positive correlation.

It is assumed that the ratio of military spending to  $GDP$  is  $d_0$ , and the ratio of wartime defense spending to defense spending before the war is  $\mu$ , the ratio of wartime net export value of arms trade to  $GDP$  before the war is  $\alpha$ , i.e.

$$d_0 = \frac{(G_0^j + I_0^j)}{GDP_0}, \mu = \frac{(G_w^j + I_w^j)}{(G_0^j + I_0^j)}, \alpha = \frac{X^j - M^j}{GDP_0}$$

Thus

$$\tau = \frac{\eta - \mu \cdot d_{-1} - \alpha}{c_0 + g_0^m + I_0^m} \quad (8)$$

$\tau$  and  $\eta$  are positive correlation,  $\tau$  and  $\mu$  are negative correlation. Therefore, in order to reduce losses, we can implement as follows.

Firstly, increasing  $\tau$ , namely increasing  $\eta$  or decrease  $\mu$ .  $\eta$  is the reflection of national economic bearing capacity. The stronger national economy's ability is, the smaller wartime  $GDP$  losses are.  $\mu$  denotes the ratio of the wartime defense spending to defense spending before the war, the smaller the value is, the smaller wartime civilian economic contraction is,

and it is the same to the wartime GDP losses.  $\tau$  is the degree of economic contraction in non-military fields. Increasing  $\tau$  means that the transferring of nonproductive investment increases and national economic bearing capacity goes strong. Secondly, decreasing  $(I_0^j - I_w^j)$ . Trying to narrow the gap of military investment between wartime and peacetime. Under normal circumstances, the wartime military investment will be greater than military investment in peacetime, thus the value of  $(I_0^j - I_w^j)$  is negative. The output value has increased at first from the *GDP* value, but considerable part of the investment is unproductive actually. Thirdly, speeding up reconstruction and fostering capacity of rapid recovery in peacetime.

## 5. Conclusions and future works

It is concluded that local war causes investment increment changing, and then causes indirect economic losses, but by changing some controllable variables, the losses can be controlled to a certain degree. It can also be concluded and inspired as follows.

Firstly, we must attach importance to the harmony development of national defense and economy. National economic bearing capability depends on national economic value in wartime. The closer defense spending at wartime and defense spending at peacetime is, the smaller civilian economic contraction at wartime is. Whether defense spending in wartime and peacetime is close, which is conditioned by scale and intensity of war and the national economic strength. Therefore, we must do a good job in economic construction. Only when economy really goes strong, can more input be added in national defense and used to support military demand in wartime. At the same time, the development of national defense should not be neglected for ever.

Secondly, the strategic status of defense investment must be highlighted. Analysis results show that the gap between military investment in peacetime and that in wartime should not be large. It shows importance of defense investment in peacetime. Defense investment contributes to economic growth, and usually defense R&D plays a leading role in civilian R&D.

Moreover, reconstruction costs depend on the effectiveness of reconstruction to a large extent, and they are decided by the reconstruction duration and investment learning index. Learning index reflects the economic recovery capability. Reducing learning index is conducive to the rapid economic recovery. Therefore, the peacetime economic construction process should take into account the economic recoverability.

This paper didn't analyze the indirect economic impact during war preparation. Further research is expected to include this analysis and the application and modification of the theoretical model.

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