Capital impairment and nuclear deterrence

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Abstract In this paper I describe a single-period model of capital impairment and its application to the case of nuclear deterrence. The paper ends with "The End"

Introduction

It is traditionally believed by the nuclear powers that no matter what happens to their conventional capabilities during a major war, they can always rely on their nuclear weapons as a deterrent. But how does nuclear deterrence actually work?

In this paper, I describe a single-period model of capital impairment and apply it to the case of nuclear deterrence.

The model

There exists a capital stock K. An impairment D occurs ar $t = 0$. After waiting till $t = w$, capital is repaired by $t = T$. The rate of repair is r. The bank interest rate is b.

Therefore, we must have $(K - D)[1 + r(T - w)] \geq K(1 + bT)$

Differentiating with respect to K, we obtain

$$\frac{b}{r} + \frac{w}{T} \leq 1$$

Differentiating with respect to T, we obtain

$$\frac{b}{r} + \frac{D}{K} \leq 1$$

This inequality forms the basis of nuclear deterrence.

The mathematics of nuclear deterrence

The mathematics of deterrence is straight-forward. If the expected impairment $\mathbf{E}[D]$ to capital K is large enough such that

$$\frac{b}{r} + \frac{\mathbf{E}[D]}{K} > \tau$$

where τ is the level of tolerance, then deterrence is **realized**.

High-yield nuclear weapons that exist today easily produce the deterrence required in today's multi-polar world.

The psychology of nuclear deterrence

The psychology of deterrence is not as straight-forward. Nuclear weapons are **not** the weapon of choice against **any** enemy. Use of nuclear weapons against an enemy that does not have them will almost surely be perceived negatively in the international arena. Use of nuclear weapons on an enemy that also has them will almost surely be answered back in kind. And finally, no state produces nuclear weapons without contingent plans to use them in case of a major war. Thus, the psychology of nuclear deterrence works in the mind of the enemy.

Conclusion

Nuclear weapons were and continue to remain a necessary evil in the world because a strategic balance of power is needed to ensure that a multi-polar world remains a multi-polar world. The true cost of a nuclear attack to humanity probably cannot be captured by any model, howsoever complicated.

The End

A commentary on the risk in Ukraine due to possible use of Russian nuclear weapons

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Abstract

In this paper, a provide a commentary on the risk in Ukraine due to possible use of Russian nuclear weapons. The paper ends with "The End"

Introduction

As of this writing, Russia has invaded Ukraine and there exists the possibility of use of Russian nuclear weapons on Ukrainian land. In this paper, a provide a commentary on the risk in Ukraine due to possible use of Russian nuclear weapons.

A commentary on the risk in Ukraine due to possible use of Russian nuclear weapons

In a previous paper, I've described capital impairment and nuclear deterrence.

Recall that the basis of nuclear deterrence is

$$\tau < \frac{b}{r} + \frac{\mathbf{E[D]}}{K} \leq 1$$

Rewriting the in-equation as

$$\tau + \delta = \frac{b}{r} + \frac{\mathbf{E[D]}}{K} = 1 - \epsilon$$

where
$0 \leq \delta$ is a threshold term
and
$0 \leq \epsilon \leq 1$ is an error term
enables the estimation of $\mathbf{E[D]}$
The equation

$$\frac{G}{1 + r_f + p_n} = \mathbf{E[D]}$$

where
G is the GDP
r_f is the **risk-free rate**
p_n is the **nuclear risk premium**
enables the estimation of the **nuclear risk** in Ukraine.

The End