A FORMAL MODEL OF ECONOMIC COOPERATION AND CONFLICT DETERRENCE IN ANARCHY

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ABSTRACT

This paper uses a formal model to analyze the relationship between interstate military conflicts and international trade and economic cooperation. The paper studies an infinitely repeated game. In the game, two states set their defense expenditures to deter the other from starting a war and changing the status quo. The solution concept for the game is Markov perfect equilibrium where players make their decisions basing only on the last period conditions of the game. The model shows that a greater offense advantage in war increases defense spending, a higher level of war destruction costs lowers defense expenditures, a higher time discount factor leads to higher defense spending and, a larger pool of resources in the possession of the states reduces defense expenditures. The model also discovers that a higher level of trade and economic cooperation between nations reduces military spending while a higher level of unrealized potential gains from trade and economic cooperation intensifies political economic contest between nations and increases defense spending. The paper applies the insights to understand various well known topics in history. These include: how mercantilism and associated protectionist measures made wars more frequent among the European great powers during the early modern era of colonization; the relationship between competitive protectionisms of the interwar period, the associated Great Depression, the resultant rise of extreme nationalisms and, the final occurrence of World War Two; the link between costs of destruction from nuclear exchanges, gains from international economic arrangements of the Breton Woods system and, the peace after World War II under American leadership.

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INTRODUCTION

How do economic and commercial considerations affect the defense and military decisions of states? Do higher levels of trade and economic integration between nations lead to a more peaceful relationship? These are the questions that the conflict and trade literature try to answer. Most of the works in this literature argue that trade and economic cooperation lead to lesser military conflicts between nations, for instance, Rosecrance (1986) and Polachek (1992, 1997).1 The basic argument is that increased international trade and economic cooperation make military conflicts too costly and therefore pacifies countries participating in trade and economic cooperation.

There are scholar who argues otherwise that trade accentuates conflicts. Barbieri (1987, 2002), for instance, posits that asymmetrical trade relationship mostly benefits the advanced nations and hardly benefits the developing countries or might even impoverish them in the long term. Inequitable economic relationship therefore exacerbates tensions between nations and sparks conflicts.2 Good examples include American use of force to protect her investments in Latin American countries.

This paper uses a formal model to analyze the relationship between conflicts and trade. It models the interactions of two states in anarchy. Anarchy refers to the situation where there are at least two state competing for power and resources and, there is no higher authority to enforce law and order or arbitrate between them. Consequently, they must arm to defend themselves and deter others from attacking them. The model of this paper builds on those of Powell (1993, 1992). The model analyzes how offense-defense advantage in war, destruction costs of war, resources of the contestants under the status quo, time discount factor and, realized gains from trade and unrealized potential gains from trade, affect the attractiveness of wars of conquests and acquisition and the level of military spending required to deter such wars.

THE MODEL

The model uses the Markov perfect equilibrium concept.[3] In a Markov perfect equilibrium, players make decision on their actions based only upon the conditions prevailed in the last period of the game and take no account of history of the game earlier than last period.

THE STRUCTURE OF THE GAME

There are two states alternate in deciding on allocation of resources for either consumption or military purposes. Depending on the rival state's military capacity, the state either attacks the rival or maintains the status quo. If the state attacks the rival, the war will end up in either one of them taking over the other. The probability of victory depends on the military technology and the relative size of the military budgets of the states. If the state decides to maintain the status quo, in the next period the other state

1 See also Polachek, Robst et al. (1999).
2 See also Schneider, Barbieri et al. (2003).
3 Refer to Fudenberg and Tirole (1991, Ch. 13) for the concept of Markov perfect equilibrium. See Powell (1993; 1999, Ch.2) for applications of the concept of Markov perfect equilibrium to the study of war and anarchy.

makes the same decision of allocation of resources either for consumption or military purposes and the decision of either attacking the rival or maintaining the status quo. We will analyze the equilibrium path where none of the states chooses to attack and peace perpetuates infinitely. This is the peaceful Markov perfect equilibrium.

THE PEACEFUL MARKOV PERFECT EQUILIBRIUM

In the peaceful Markov perfect equilibrium, State 2 sets her defense spending so that State 1 is indifferent between staying with the status quo and undertaking the offense to change the status quo. This level of defense for State 2 we denote it as d_2^*.

$$\left\{\left(R_1+g_1-d_1^*\right)\left(\frac{1}{1-\delta}\right)\right\} - \left\{\left(R_1+g_1-a_1^*\right)+P\left(a_1^*,d_2^*\right)\left(R_1+R_2+G-C\right)\left(\frac{\delta}{1-\delta}\right)\right\}=0 \quad 1$$

The first bracket in equation 1 is the payoff to staying at the status quo. The second bracket is the payoff to attacking. For convenience, we denote equation 1 as Y .

In equation 1, a_1^* is optimal military allocation of State 1 should State 1 choose to attack State 2. d_1^* is the optimal peacetime military allocation of State 1.[4] d_2^* is the optimal peacetime military allocation of State 2. P denotes the probability of victory for State 1 when State 1 undertakes the offensive. R_1 is the gross payoff of State 1 (net of gains from trade and other forms of international economic cooperation with State 2) under the status quo. R_2 is the gross payoff of State 2 (net of gains from trade and other forms of international economic cooperation with State 1) under the status quo. C is the destruction caused by war. R_1+R_2+G is the payoff from the unified empire won by war. G refers to the level of potential gains from full economic integration under a political union. δ is the time discount factor.

We use the offence defense version of conflict technology function.[5]

$$P=\frac{\beta a_1}{\beta a_1+d_2} \quad 2$$

is the probability that the attacker, State 1, prevails. β measures the advantage of being on the offense. When β is greater (smaller) than one, offense (defense) has the advantage.

a_1^* in equation 1 is the optimal solution to the following problem:

$$\max_{a_1} A_1=\left(R_1+g_1-a_1^*\right)+P\left(a_1^*,d_2^*\right)\left(R_1+R_2+G-C\right)\left(\frac{\delta}{1-\delta}\right) \quad 3$$

The first order condition is

$$\frac{\partial A_1}{\partial a_1}=-1+\frac{\beta d_2}{\left(\beta a_1+d_2\right)^2}\left(R_1+R_2+G-C\right)\left(\frac{\delta}{1-\delta}\right)=0 \quad 4$$

The second order condition is:

$$\frac{\partial^2 A_1}{\partial a_1^2}=\frac{-2\beta^2 d_2}{\left(\beta a_1+d_2\right)}\left(R_1+R_2+G-C\right)\left(\frac{\delta}{1-\delta}\right)<0 \quad 5$$

Similarly, State 1 chooses d_1^* so that State 2 is indifferent between attacking and staying with the status quo.

$$\left\{\left(R_2+g_2-d_2^*\right)\left(\frac{1}{1-\delta}\right)\right\} - \left\{\left(R_2+g_2-a_2^*\right)+Q\left(a_2^*,d_1^*\right)\left(R_1+R_2+G-C\right)\left(\frac{\delta}{1-\delta}\right)\right\}=0 \quad 6$$

The first bracket is the payoff to staying at the status quo. The second bracket is the payoff to attacking. a_2^* is optimal military allocation of State 2 should State 2 chooses to attack State 1. For convenience, we refer to equation 6 as Z .

$$Q=\frac{\beta a_2}{\beta a_2+d_1} \quad 7$$

[4] The superscript * denotes that the entity is at the optimal value. The subscripts 1 and 2 denote that the entity belongs to either State 1 or 2.
[5] See Hirshleifer (1988, 1995) for alternative forms of conflict technology functions.

denotes the probability of victory for State 2 when State 2 undertakes the offensive.

a_2^* in above equation is the optimal solution to the following problem:

$$\max_{a_2} A_2 = \left(R_2 + g_2 - a_2^*\right) + Q\left(a_2^*, d_1^*\right)\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) \quad 8$$

The first order condition is

$$\frac{\partial A_2}{\partial a_2} = -1 + \frac{\beta d_1}{\left(\beta a_2 + d_1\right)^2}\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) = 0 \quad 9$$

The second order condition is:

$$\frac{\partial^2 A_2}{\partial a_2^2} = \frac{-2\beta^2 d_1}{\left(\beta a_2 + d_1\right)^3}\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) < 0 \quad 10$$

COMPARATIVE STATICS

For comparative statics, we first derive the followings:

$$\frac{\partial Y}{\partial d_1} = \frac{-1}{1-\delta} < 0 \quad 11$$

$$\frac{\partial Y}{\partial d_2} = \frac{\beta a_1^*}{\left(\beta a_1^* + d_2^*\right)^2}\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) > 0 \quad 12$$

$$\frac{\partial Z}{\partial d_1} = \frac{\beta a_2^*}{\left(\beta a_2^* + d_1^*\right)^2}\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) > 0 \quad 13$$

$$\frac{\partial Z}{\partial d_2} = \frac{-1}{1-\delta} < 0 \quad 14$$

The slope of the Y equation is:

$$-\frac{\partial Y / \partial d_2}{\partial Y / \partial d_1} = \frac{\beta a_1^*\left(R_1 + R_2 + G - C\right)\delta}{\left(\beta a_1^* + d_2^*\right)^2} > 0 \quad 15$$

Differentiating the above with respect to d_2 gives:

$$-\frac{2\beta a_1^*\left(R_1 + R_2 + G - C\right)\delta}{\left(\beta a_1^* + d_2^*\right)^3} < 0 \quad 16$$

The slope of the Z equation is:

$$-\frac{\partial Z / \partial d_1}{\partial Z / \partial d_2} = \frac{\beta a_2^*\left(R_1 + R_2 + G - C\right)\delta}{\left(\beta a_2^* + d_1^*\right)^2} > 0 \quad 17$$

Differentiate the above with respect to d_1 gives:

$$-\frac{2\beta a_2^*\left(R_1 + R_2 + G - C\right)\delta}{\left(\beta a_2^* + d_1^*\right)^3} < 0 \quad 18$$

The Jacobian is

$$|J| = \begin{vmatrix} \frac{\partial Y}{\partial d_1} & \frac{\partial Y}{\partial d_2} \\ \frac{\partial Z}{\partial d_1} & \frac{\partial Z}{\partial d_2} \end{vmatrix} = \left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial d_2}\right) - \left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial d_1}\right) \quad 19$$

At the peaceful Markov perfect equilibrium where d_1^* and d_2^* are optimally set at the minimum levels required for maintaining peace, $-\dfrac{\partial Z/\partial d_1}{\partial Z/\partial d_2}$ has a greater slope than $-\dfrac{\partial Y/\partial d_1}{\partial Y/\partial d_2}$ and the Jacobian is negative.6

Proposition 1:
An increase in the offense advantage increases defense expenditures of both countries.

Proof:

$$\frac{\partial Y}{\partial \beta} = -\frac{\left(a_1^* d_2^*\right)}{\left(\beta a_1^* + d_2^*\right)^2}\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) < 0 \tag{20}$$

$$\frac{\partial Z}{\partial \beta} = -\frac{\left(a_2^* d_1^*\right)}{\left(\beta a_2^* + d_1^*\right)^2}\left(R_1 + R_2 + G - C\right)\left(\frac{\delta}{1-\delta}\right) < 0 \tag{21}$$

$$\frac{\partial d_1^*}{\partial \beta} = \frac{\begin{vmatrix} -\dfrac{\partial Y}{\partial \beta} & \dfrac{\partial Y}{\partial d_2} \\ -\dfrac{\partial Z}{\partial \beta} & \dfrac{\partial Z}{\partial d_2} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial \beta}\right)\left(\frac{\partial Z}{\partial d_2}\right) + \left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial \beta}\right)\right\} > 0 \tag{22}$$

$$\frac{\partial d_2^*}{\partial \beta} = \frac{\begin{vmatrix} \dfrac{\partial Y}{\partial d_1} & -\dfrac{\partial Y}{\partial \beta} \\ \dfrac{\partial Z}{\partial d_1} & -\dfrac{\partial Z}{\partial \beta} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial \beta}\right) + \left(\frac{\partial Y}{\partial \beta}\right)\left(\frac{\partial Z}{\partial d_1}\right)\right\} > 0 \tag{23}$$

Q. E. D.

A greater offense advantage in war makes wars of conquests and taking over more attractive. Consequently, deterrence requires higher level of defense spending. A good example was that the gunpowder military revolution which made castles and fortifications less effective ushered in a period of ballooning size of armies and military spending among European nations.7

Proposition 2:
Greater costs of destruction from war lower military expenditures.

Proof:

$$\frac{\partial Y}{\partial C} = P\left(a_1^*, d_2^*\right)\left(\frac{\delta}{1-\delta}\right) > 0 \tag{24}$$

$$\frac{\partial Z}{\partial C} = Q\left(a_2^*, d_1^*\right)\left(\frac{\delta}{1-\delta}\right) > 0 \tag{25}$$

$$\frac{\partial d_1^*}{\partial C} = \frac{\begin{vmatrix} -\dfrac{\partial Y}{\partial C} & \dfrac{\partial Y}{\partial d_2} \\ -\dfrac{\partial Z}{\partial C} & \dfrac{\partial Z}{\partial d_2} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial C}\right)\left(\frac{\partial Z}{\partial d_2}\right) + \left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial C}\right)\right\} < 0 \tag{26}$$

6 Refer to Powell (1993; 1999, Ch. 2).
7 Refer to Roberts (1956), Parker (1976, 1988) and Duffy (1980).

$$\frac{\partial d_2^*}{\partial C}=\frac{\begin{vmatrix}\frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial C}\\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial C}\end{vmatrix}}{|J|}=\frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial C}\right)+\left(\frac{\partial Y}{\partial C}\right)\left(\frac{\partial Z}{\partial d_1}\right)\right\}<0 \qquad 27$$

Q. E. D.

A higher level of war destruction costs makes wars less profitable. Consequently, deterrence requires lower levels of defense spending. This agrees with the argument of "nuclear peace".8

Proposition 3:
An increase in the payoffs to a state under the status quo lowers military expenditures of both states.

Proof:

$$\frac{\partial Y}{\partial R_1}=\frac{1}{1-\delta}\left(1-\delta P\left(a_1^*,d_2^*\right)\right)>0 \qquad 28$$

$$\frac{\partial Z}{\partial R_1}=0 \qquad 29$$

$$\frac{\partial d_1^*}{\partial R_1}=\frac{\begin{vmatrix}-\frac{\partial Y}{\partial R_1} & \frac{\partial Y}{\partial d_2}\\ -\frac{\partial Z}{\partial R_1} & \frac{\partial Z}{\partial d_2}\end{vmatrix}}{|J|}=\frac{-1}{|J|}\left(\frac{\partial Y}{\partial R_1}\right)\left(\frac{\partial Z}{\partial d_2}\right)<0 \qquad 30$$

$$\frac{\partial d_2^*}{\partial R_1}=\frac{\begin{vmatrix}\frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial R_1}\\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial R_1}\end{vmatrix}}{|J|}=\frac{1}{|J|}\left(\frac{\partial Y}{\partial R_1}\right)\left(\frac{\partial Z}{\partial d_1}\right)<0 \qquad 31$$

$$\frac{\partial Y}{\partial R_2}=0 \qquad 32$$

$$\frac{\partial Z}{\partial R_2}=\frac{1}{1-\delta}\left(1-\delta Q\left(a_2^*,d_1^*\right)\right)>0 \qquad 33$$

$$\frac{\partial d_1^*}{\partial R_2}=\frac{\begin{vmatrix}-\frac{\partial Y}{\partial R_2} & \frac{\partial Y}{\partial d_2}\\ -\frac{\partial Z}{\partial R_2} & \frac{\partial Z}{\partial d_2}\end{vmatrix}}{|J|}=\frac{1}{|J|}\left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial R_2}\right)<0 \qquad 34$$

$$\frac{\partial d_2^*}{\partial R_2}=\frac{\begin{vmatrix}\frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial R_2}\\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial R_2}\end{vmatrix}}{|J|}=\frac{-1}{|J|}\left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial R_2}\right)<0 \qquad 35$$

8 Refer to Jervis (1989) and, Sagan and Waltz (2002).

Q. E. D.

If a state has a higher payoff under the status quo, then it is more satisfied with the status quo. Consequently, the rival state needs only a lower level of military expenditures to deter it from starting a war to change the status quo. As the rival state saves on military expenditures, it also becomes satisfied with the status quo. Consequently, a lower level of military spending is enough to prevent it from starting a war to change the status quo too.

Proposition 4:
A larger time discount factor increases military expenditures of the states.

Proof:

$$\frac{\partial Y}{\partial \delta}=\left[\left(R_1+g_1-d_1^*\right)-P\left(a_1^*,d_2^*\right)\left(R_1+R_2+G-C\right)\right]\left(\frac{1}{1-\delta}\right)^2<0 \quad 36$$

$$\frac{\partial Z}{\partial \delta}=\left[\left(R_2+g_2-d_2^*\right)-Q\left(a_2^*,d_1^*\right)\left(R_1+R_2+G-C\right)\right]\left(\frac{1}{1-\delta}\right)^2<0 \quad 37$$

We therefore have

$$\frac{\partial d_1^*}{\partial \delta}=\frac{\begin{vmatrix}-\frac{\partial Y}{\partial \delta} & \frac{\partial Y}{\partial d_2}\\ -\frac{\partial Z}{\partial \delta} & \frac{\partial Z}{\partial d_2}\end{vmatrix}}{|J|}=\frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial \delta}\right)\left(\frac{\partial Z}{\partial d_2}\right)+\left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial \delta}\right)\right\}>0 \quad 38$$

$$\frac{\partial d_2^*}{\partial \delta}=\frac{\begin{vmatrix}\frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial \delta}\\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial \delta}\end{vmatrix}}{|J|}=\frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial \delta}\right)+\left(\frac{\partial Y}{\partial \delta}\right)\left(\frac{\partial Z}{\partial d_1}\right)\right\}>0 \quad 39$$

Q. E. D.

As states become more patient, they care more about the future and therefore the potential gains from wars of conquests becomes more attractive. Consequently, deterrence involves greater defense expenditures.9

Proposition 5:
A higher level of realized gains from trade and economic cooperation accruing to either state lowers military expenditures of both states.

Proof:

$$\frac{\partial Z}{\partial g_1}=0 \quad 40$$

$$\frac{\partial Y}{\partial g_2}=0 \quad 41$$

$$\frac{\partial Y}{\partial g_1}=\frac{\left(r_1+g_1-d_1^*\right)}{1-\delta_1}-\left(r_1+g_1-a_1^*\right)>0 \quad 42$$

$$\frac{\partial Z}{\partial g_2}=\frac{\left(r_2+g_2-d_2^*\right)}{1-\delta_2}-\left(r_2+g_2-a_2^*\right)>0 \quad 43$$

9 Powell (1993; 1999, Ch. 2) has similar findings.

$$\frac{\partial d_1^*}{\partial g_1} = \frac{\begin{vmatrix} -\frac{\partial Y}{\partial g_1} & \frac{\partial Y}{\partial d_2} \\ -\frac{\partial Z}{\partial g_1} & \frac{\partial Z}{\partial d_2} \end{vmatrix}}{|J|} = \frac{-1}{|J|}\left(\frac{\partial Y}{\partial g_1}\right)\left(\frac{\partial Z}{\partial d_2}\right) < 0 \qquad 44$$

$$\frac{\partial d_2^*}{\partial g_1} = \frac{\begin{vmatrix} \frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial g_1} \\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial g_1} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left(\frac{\partial Y}{\partial g_1}\right)\left(\frac{\partial Z}{\partial d_1}\right) < 0 \qquad 45$$

$$\frac{\partial d_1^*}{\partial g_2} = \frac{\begin{vmatrix} -\frac{\partial Y}{\partial g_2} & \frac{\partial Y}{\partial d_2} \\ -\frac{\partial Z}{\partial g_2} & \frac{\partial Z}{\partial d_2} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial g_2}\right) < 0 \qquad 46$$

$$\frac{\partial d_2^*}{\partial g_2} = \frac{\begin{vmatrix} \frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial g_2} \\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial g_2} \end{vmatrix}}{|J|} = \frac{-1}{|J|}\left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial g_2}\right) < 0 \qquad 47$$

Q. E. D.

Higher levels of realized gains from international trade and other forms of economic cooperation make wars less attractive and lower the levels of defense spending required for deterrence.10

Proposition 6:
A higher level of unrealized potential gains from full economic integration increases military expenditures of both states.

Proof:

$$\frac{\partial Y}{\partial G} = -P\left(a_1^*, d_2^*\right)\left(\frac{\delta}{1-\delta}\right) < 0 \qquad 48$$

$$\frac{\partial Z}{\partial G} = Q\left(a_2^*, d_1^*\right)\left(\frac{\delta}{1-\delta}\right) < 0 \qquad 49$$

$$\frac{\partial d_1^*}{\partial G} = \frac{\begin{vmatrix} -\frac{\partial Y}{\partial G} & \frac{\partial Y}{\partial d_2} \\ -\frac{\partial Z}{\partial G} & \frac{\partial Z}{\partial d_2} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial G}\right)\left(\frac{\partial Z}{\partial d_2}\right) + \left(\frac{\partial Y}{\partial d_2}\right)\left(\frac{\partial Z}{\partial G}\right)\right\} > 0 \qquad 50$$

$$\frac{\partial d_2^*}{\partial G} = \frac{\begin{vmatrix} \frac{\partial Y}{\partial d_1} & -\frac{\partial Y}{\partial G} \\ \frac{\partial Z}{\partial d_1} & -\frac{\partial Z}{\partial G} \end{vmatrix}}{|J|} = \frac{1}{|J|}\left\{-\left(\frac{\partial Y}{\partial d_1}\right)\left(\frac{\partial Z}{\partial G}\right) + \left(\frac{\partial Y}{\partial G}\right)\left(\frac{\partial Z}{\partial d_1}\right)\right\} > 0 \qquad 51$$

10 Refer to Barbieri (1996).

Higher levels of potential gains from full economic integration under political unification make war of conquests and taking over more lucrative. Consequently, deterrence requires higher level of defense spending.

APPLICATIONS

The model argues that trade and other forms of economic integration reduce military conflicts. This mechanism works at both the international and regional level. Therefore, regional economic cooperation and integration should be encouraged. This includes organizations such as the European Union and Association of Southeast Asian Nations. Another insight from the model is that arms race, by reducing the payoffs for staying with the status quo, pushes the contestants towards the directions of war. The model therefore agrees with those who try to limit arms race military spending. Above all, the insights from the model are useful for explaining the relationship between gains or unrealized gains from trade and military expenditures and wars. The following three cases are among the best well known ones.

MERCANTILISM AND EUROPEAN GREAT POWER WARS

In the early modern era Europe, states practicing mercantilism were constantly at war with each other. The gunpowder military revolutions intensified contests among the European nations. Mercantilism emerged as a school of thought and was popular among European states. It preached measures to increase state power. These measures included promotion of commerce and industries, protectionist measures to increase exports and restrict imports, encouragement of science and technological research, and acquisition of overseas colonies. Mercantilist restrictions of trade among nations resulted in huge unrealized gains from full economic cooperation. Acquisition of extra territories through war became more profitable. Consequently, European nations, especially the great powers, were constantly at wars with each other to acquire more power and territories.11 The early modern era Europe was well known for its warring environment and was named the European competitive state system.

PROTECTIONISM, GREAT DEPRESSION AND EXTREMISMS

After World War One the world economy was in danger. There was no powerful world leader to maintain and ensure the smooth functioning of multilateralism. The once mighty British Empire was in debts and in decline. France was in no better situation. Germany was impoverished. America emerged from the war as a victor and a big creditor with a booming economy. Yet, America was not ready to shoulder the world economic and political leadership thrust upon her. She instead retreated back into her traditional isolationism.

Without an effective leadership and having no formal institutional framework, the international economic regime unraveled and led to disastrous consequences. The Great Depression aggravated the economic woes. To restore their failing economies, nations after nations resorted to protectionism. Britain relied upon her empire and adopted the imperial preference system. France clinched on to her colonies economically. Germany relied on the Balkans. America had the Americas. Japan tightened the control over her empires and enlarged her sphere of influence in China. The fight for sphere of influence, resources and market and declining economic conditions led to the rise of extreme nationalisms such as Nazism and Fascism and ultimately, the outbreak of the World War Two.12

BRETTON WOODS, NUDES AND PAX AMERICA

The Bretton Woods system was established with the Great Depression and World War Two in mind. The costs, sufferings and destructions of World War Two were enormous. To avoid the collapse of the international economic system from triggering another great war, the allied victors set up the Bretton Woods system to manage international finance and trade and, post war reconstruction. Trade and economic exchanges and cooperation expanded in the free world. Partly because of it, there was no major war in the free world, though there was regional war due to reasons other than economics.13

Pax America got help from another source too, the nuclear peace. Cold War was a long and bitter confrontation between the free world under American leadership and the Communist world under Soviet Union hegemony. Despite the animosity between the two superpowers, an all out war was averted. An important reason was that the great destruction costs of a nuclear exchange deterred both sides from starting a war. For instance, both America and Soviet Union showed great restraints during the Cuban missiles crisis.14

CONCLUSIONS

In sum, the model illustrates that there exists a relationship between trade and conflict. Specifically, higher levels of realized gains from trade reduce attractiveness of conflicts and the amount of defense spending required to deter them and, higher levels of unrealized potential gains from economic cooperation make conflicts more lucrative and raise the amount of military expenditures necessary for conflict deterrence. Given that these topics are salient, there should therefore be more researches along this line.

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