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## The Role of Investment in the Equilibrium of International Political Economy: Game Theory Approach

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Submitted 01/09/23, 1st revision 16/10/23, 2nd revision 14/11/23, accepted 30/11/23

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### **Abstract:**

**Purpose:** The researchers in the international arena, especially in the 'liberal tradition', emphasize on the effect of international economic cooperation such as trade and investment in the expansion of peace and prevention of war. Based on this, the present study has tried to utilize "Game theory" to give a different answer to this main question of, how economic cooperation in the form of international investment could prevent peace or promote peace in addition to maximizing the profit of the investors.

**Design/Methodology/Approach:** In this paper, using game theory and presenting a static game between players, the game modeling between investors and countries has been done.

**Findings:** The results indicated that risks and output inside and outside the country is a direct function of external risk and economic power, of course, this relationship is reversed for the investor. Finally, if the hostility degree ( $\rho$ ) between countries is zero, then the countries will achieve a maximum positive outcome which will increase with the decrease of economic power.

**Practical Implications:** The results confirm that economic cooperation, while reducing conflicts between countries, can also prevent military conflicts and strengthen peace. In addition, convergence and economic interdependence not only reduce the likelihood of war, but also increase the welfare of the parties involved, and this result is a significant reason to strengthen the avoidance of war.

**Originality/Value:** Investors and countries are recommended to use the results of this study and pave the way for world peace by creating international markets.

**Keywords:** Peace, Game theory, Static games of complete information, Nash Equilibrium.

**JEL Classification:** D50, C71, C70, F52.

**Paper type:** Research article.

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## **Introduction**

The issues of peace and war in the international arena have always been considered by states and their scholars. If we take a glance at the political history of countries throughout the world so many disputes and wars can be seen, to such an extent that by just naming some examples at an international and regional level will constitute a very long list.

The world in the 21<sup>st</sup> century, after two world wars, still witnesses numerous military wars and expeditions and in general, political tension in various parts of the world. With these conditions, achieving peace and sustainable security has turned into the main concern and objective in the international arena.

In an effort to achieve this objective, the intellectual approaches of scholars from different sciences have tried to provide new solutions proportionate to the world's revolutions to maintain international peace and stability and avoid war and conflict. In the meantime, "economics" has turned into an important variable in political equations and international relations mainly because of considerable revolutions and changes.

A main part of the world's economy is devoted to trade and mutual investment in line with "globalization" and the global conditions are now inclined toward more interdependency of industries and production of countries. Under the circumstances expanding economic cooperation between countries and their relation with world peace and stability is of utmost importance. In recent decades, and in the era of economic globalization, the assumption that "Liberal economy prevents war" has become very popular (Kazemi, 2005).

In other words, the economic principles of peace become as important as of its political principles, if not more (Egger, 2005). Therefore, one of the issues that needs to be considered is the investigation of the possibility of economic collaborations such as trade and mutual investment despite the political and military conflicts and the effect of such cooperation on the promotion of peace and prevention of war. In this regard, various researchers, especially in the liberal tradition, seek to examine the possibility of establishing trade relations despite differences in other areas as well as to study the side effects of economic cooperation on the peace and stability of countries (Kazemi, 2005).

The interesting point is that "economic grounds for peace and the effect of trade and international investment in preventing war have serious opponents, too". In fact, despite the approach of liberalism, where the liberal economy could prevent war and guarantee the sustainability of peace, realists neither consider liberal economy as a barrier against war, nor do they consider it as triggering war. Marxists consider the liberal economy as inherently prone to war and believes that world peace and security is always threatened due to the presence of capitalism (Qanbarlou, 2016).

Maximization is one of the most important assumptions in neoclassical economics and this maximization is based on the rational decisions that economic firms (influenced by the behavior of other factors) make. One of the most important tools in this situation is game theory (Osborne, 2000). Some thinkers have compared the theory of games to the discovery of double-stranded DNA and this important discovery and theory is referred to as "a theory that can explain everything" (Varoufakis, 2008).

Throughout history, major conflicts between powers have had catastrophic consequences for human societies. Regardless of the petitions against these catastrophes and wars, conflict is a pervasive category that may arise between two companies to access the resources or market share, or between two parties, to gain seats in parliament or similar cases.

The question is whether, in conflict, as part of history and actions of human societies, balance and optimality can be achieved? This balance is important in so far as trying to destroy or suppress the opposite side for the winning side is not the optimal solution. Accordingly, game theory using mathematical models analyzed cooperation or competition between rational and intelligent. The ultimate goal of this knowledge is to find the optimal solution for players (Salimian and Shahbazi, 2017).

This paper is organized in seven sections. The section on economy and peace is presented in the second section after the introduction. The third section refers to some of the intellectual achievements of the twentieth century. The fourth section includes literature review and the fifth section presents methodology in three subsections. The game modeling is presented in section six and the conclusion and recommendations in section seven.

### **Economy and Peace**

The researchers and scholars, especially in the liberal tradition, believe that political conflicts are not an insolvable barrier to economic cooperation between conflicting countries. Furthermore, they even claim that such cooperation reduces military conflicts and disputes.

This group presents the example of increasing cooperation between China and Taiwan that is happening in the real world. In this case, none of the concerns of pessimists could prevent two countries from cooperation and now China is the greatest trade partner of Taiwan.

The important point is that after the financial crisis of 2001, trade cooperation between the two parties seriously increased which is due to the penetration of the traders and businessmen of Taiwan in their country which meant the Taiwanese officials had no choice but to modify their view of economic cooperation with China.

This new approach facilitated the expansion of trade cooperation and pushed the political disputes to the sidelines (however, the conflicts were not completely resolved). As a conclusion, it can be claimed that the trade relations between Taiwan and China developed while the political conflicts still maintained.

However, the principle of trading is considered as a main step in international relations by all accounts and this barely existed in the past decades. Therefore, it can be concluded that with the presence of political conflicts, economic cooperation is real and possible. This can help peace and stability and reduce conflicts. As investigated, economic cooperation is possible even with the presence of political conflicts and some historical examples have been presented.

Now, with the new advances and developments in industry and transportation, distance has lost its traditional role as a barrier to trade, therefore, countries are not as concerned about trade dependency as in the past.

Thus, it can be concluded that interaction, in its economic context, has extended to a political context and therefore, helps peace and stability. The status of European countries after World War II can be studied; shortly after World War II, the economic cooperation between countries where there was hostility and conflict began to expand and extended to important political issues in Europe until it found its present structure and nature through the integration of the European Union.

As noted in the principles of Liberal theory, these developments could be analyzed in this framework and context. However, it should be noted that this theoretical framework is incapable of analyzing some divergences such as the UK leaving the EU (Brexit) and other theoretical frameworks such as realism that should be used to explain it (Kazemi, 2015).

Moreover, it should be noted that what significantly affects economic cooperation is capital interdependency. In other words, the more two countries cooperate and converge in terms of capital, the less likely initiation of military conflict and serious dispute will be since the risk and sensitivity of capital is much more compared to other aspects of economic cooperation (Gharayan, 2011).

Within the framework of liberal schools, war is an exceptional phenomenon and the principle of cooperation dominates the human community. The human being is inherently a tradesman and sees their profit in cooperation. Likewise, war is the product of some deviations in human nature such as ambition. The individual seeks profit and competes to achieve it; however, individuals have many common interests which lead to fulfillment of their commitments and obligations to society and social cooperation in national and international arenas. If individuals realize that they could have common profitable cooperation beyond the borders as well as within borders, they will avoid conflict and war (Jackson and Sorensen, 2004).

If interdependency is in accordance with liberal or open economic systems, the states will conclude that their development is dependent on trade. This freedom forces them to rely on interdependency and develop it. The countries which have some share in the economy of each other will come to this conclusion that by increasing desirable trade relations it will divert them away from resorting to military practices to promote international status.

The openness or closeness of economic systems or lack of economic freedom also has a reverse effect. If countries are not able to continue trading because of barriers or high tariffs, they try to acquire assets, which they were not able to acquire through trade from non-peaceful ways such as war. In such a situation, the grounds for increasing militarism will be laid in the international arena (Roseckranse, 1996).

In this paper, international economic cooperation and its effect on international relations (peace) will be studied by presenting a theoretical model. It seeks to answer this question as to whether economic cooperation in the form of international investment could prevent war and reduce political tensions or not? The present study tries to provide a scientific response to this question using "Game theory".

### **Conflicting Propositions and Game Theory**

Since Plato, - if we imagine him as a symbolic founder of rationality, human beings had some basic beliefs in the theory of rational thinking that lasted until the second half of the 20th century without facing any serious challenge. Some of them include, "Every proposition is either true or false", "every correct proposition can be proved anyway, although it may be difficult to prove", "resolving any conflict is equal to defeat of one or both of parties".

Some of the intellectual achievements of the twentieth century, and specifically the second half of the twentieth century, include challenging these type of conclusions by logicians and in particular, mathematicians. In the first case it was proved that there are many propositions that are neither true nor false. This has led to changes in some mathematical disciplines that yielded interesting achievements.

Concerning the second case, it was proved that there are many correct and true propositions that cannot be proved; rather, the dimension of unverifiable correct options is wider than verifiable and provable propositions. This subject did not only show the limitations and confinement of human rationality; it also opened up a new and wider range of rationality to humanity. The origin of game theory is in the third area of logicians' achievements in the twentieth century; i.e., the possibility of cooperation and balance in conflict (Tabibian, 2010).

Throughout history, major conflicts between powers have had catastrophic consequences for human societies. Regardless of the petitions against these catastrophes and wars, conflict is a pervasive category that may arise between two

companies to access the resources or market share, or between two parties, to gain seats in parliament or similar cases. The question is whether, in conflict, as part of history and actions of human societies, balance and optimality can be achieved? This balance is important in so far as trying to destroy or suppress the opposite side for the winning side is not the optimal solution (Tabibian, 2010).

Accordingly, game theory using mathematical models analyzed cooperation or competition between rational and intelligent. The ultimate goal of this knowledge is to find the optimal solution for players (Myerson, 1991).

Game theory has applications in studying a wide range of subjects including the manner of decision makers' interaction in a competitive environment such that the results of each agent's decision is effective on the results achieved by the other agents. In fact, the main structure of game theory in most analyses includes a multidimensional matrix such that each dimension includes a set of options and the arrays of this matrix include the results achieved for agents in respect to various arrangements of the expected options.

One of the main conditions for applying this theory in analysis of competitive environments is the faithfulness of interacting agents in respecting the logic of the game (Abduli, 2012).

### **Literature Review**

The review of related literature in economy and peace and in game theory confirms the innovation of the present study. Most of the studies in the field of peace and economy, some of which have been presented here, mostly utilize game theory to achieve equilibrium in a certain field (mostly oil and gas) and have not dealt with peace and economy from a macro perspective. Studies in the field of economics and peace can be divided into two categories of studies.

The first category is studies that examine a particular aspect of peace (the issue of cooperation or non-cooperation) between countries. The following researches about the first category of mentioned studies such as Popescu and Hurduzeu (2015), Nazari Adli and Khakestari (2016), Salimian and Shahbazi (2017) and Attar *et al.* (2018) which have been done by game theory approach.

The second category is studies that examine peace at the international level and have direct relation to this research. Yared, (2010) in his study, presented a dynamic theory on war and peace.

The results showed that over a long-term period, if the countries are patient enough, the temporary wars could create sustainability (peace) if the war costs are high and the scores are low.

Horner *et al.* (2015) studied the relation between mediation and peace and designing the mechanism for conflict resolution in international relations. They showed that uninterrupted communication helps conflict reduction since it enables the conflicting parties to disclose themselves.

Kimbrough *et al.* (2017) studied the theories, applications and the conflict of interest and war in economy. They examined the main models of conflict and conflict of interest and showed that in recent empirical literature, the results confirm the theory of conflicts with both laboratory and field data.

Anderson and Mukherjee (2019) investigated seeking no war, achieving no peace. Their model survey “no war, no peace” situations in a game theoretical framework where two countries are engaged in a standoff over a military sector. They suggested two different pathways. The first is idealistic and based on mutual trust whereas the second is based on deterrence meaning that both countries impose a threat of using armed force against the other country in their respective military doctrines.

Salimian and Almasifard (2020) studied the economic grounds of peace using game theory. Presenting a static game between players, they modeled the behavior of investors and countries concerning the possible strategies for each player. To this end, they first considered a state where two countries are indifferent.

Then, in the second state, two competing countries (enemies) were considered and in the third state, three countries were assumed, one of which was the competitor and the other was an indifferent country.

Concerning the obtained equilibrium in three states, the overall result showed that the investor achieves the best consequence (Nash equilibrium) by constituting portfolio and investing in various markets and inside the country by interaction and peace.

According to studies in the field of economics and peace mentioned, most studies in the fields of economy and peace have used game theories to achieve equilibrium in a certain field (mostly oil and gas) and have not considered it from the view of peace.

Therefore, this paper, theoretically and by presenting a model, deals with this issue on how economy could provide the grounds for international peace and utilize game theory.

The above presented research about peace and economy is not based on financial markets and this research is presented for the first time about the role financial markets on peace using important variables such as risk in local and foreign markets, returns in local and foreign markets, economic power of countries and the degree of hostility between countries by modeling. Therefore, this is the innovation of this research.

## **Methodology**

The research methodology will be presented here in three subsections:

### ***Game theory:***

The modeling of game theory in international economy, work economy, major economy and general tax becomes general and is now moving towards development economy and economic history. Many of those who make models utilize game theory as it allows them to think as an economist when the pricing theory is not sufficient and responding (Gibbons, 1997). The present study has used game theory to achieve the research objectives.

Game theory tries to model the situations where individuals' interests are in conflict. The main aim of game theory is to present an attitude and approach based on which the players can wisely behave and before taking any action, think deeply about it and select the action which is to their benefit. Game theory is especially useful when the number of competing players (agents) is limited since in this case; any player significantly influences the earnings of other players (Abduli, 2012; Mas-Colell *et al.*, 1995).

Games have various dimensions; therefore, various classifications could be presented. The main classification is to classify games into cooperative and non-cooperative games. The game theorists differentiate the non-cooperative games into static and dynamic non-cooperative games. Static and dynamic games are classified into games of complete and incomplete information. Therefore; the non-cooperative games can be divided into four groups of dynamic games of complete information, static games of incomplete information, dynamic games of incomplete information and equilibrium concept (Shy, 2014; Mas-Colell *et al.*, 1995).

### ***Equilibrium Concept:***

Although the games might have many consequences, it is almost impossible to estimate the final result of a game. In order to forecast the result of a game, it is necessary to expand the methods and algorithms that confine the set of all consequences to a smaller set, called equilibrium consequences. Moreover, some features should be specified that are beneficial in emergence of equilibrium. Assume that  $a = (a^1, a^2, \dots, a^i, \dots, a^N)$  is a list of behaviors that N players take (play).

Now, consider certain players represented by  $i$  ( $i$  could be any player from 1 to N), subtract the behavior of  $i$  player from  $a$  consequence. Now the list showing the behavior adopted by all players except player  $i$  is shown as by  $a^{-i}$ . In other words,  $a^{-i} = (a^1, \dots, a^{i-1}, a^{i+1}, \dots, a^N)$ . It can be said that a consequence is the collection of the behavior of player  $i$  and other players. In other words, the consequence  $a$  can be expressed as  $a = (a^i, a^{-i})$  (Shy, 2014).



**Nash equilibrium:**

In 1951, John Nash presented a new concept of equilibrium (previously used by Cournot in studying bilateral monopoly) which turned into a new concept of equilibrium and was generally used in game analysis.

Consequence  $\hat{a} = (\hat{a}^1, \hat{a}^2, \dots, \hat{a}^N)$  is called Nash equilibrium (NE) (in respect to any  $i = 1, 2, \dots, N, \hat{a}^i \in A^i$ ) if the deviation from related consequence is not to the benefit of any player assuming that other players are not deviated from the played strategy in Nash consequence. In other words, for any player  $i$ , ( $i=1, 2, \dots, N$ ), and for all behaviors  $a^i \in A^i, \pi^i(\hat{a}^i, \hat{a}^{-i}) \geq \pi^i(a^i, \hat{a}^{-i})$ , if:

$$\begin{cases} \pi^i(\hat{a}^i, \hat{a}^{-i}) > \pi^i(a^i, \hat{a}^{-i}) & \text{for some } a^i \in A^i \\ \pi^i(\hat{a}^i, \hat{a}^{-i}) = \pi^i(a^i, \hat{a}^{-i}) & \text{for some } a^i \in A^i \end{cases}$$

Then this equilibrium is called weak Nash Equilibrium. In sum, equilibrium in the consequence of dominant behaviors is also Nash equilibrium; however, Nash equilibrium is not always equilibrium in the dominant behaviors (Souri, 2007).

Finally, it should be said that if game theory seeks to provide a single answer to a game, that answer should be Nash equilibrium. Therefore, when the players are to select the strategy in a game without the possibility of negotiation about their choices, any player should have an opinion on the selection of the opponent/s.

Nash equilibrium will be achieved, first, when each player selects the strategy which yields most profit, based on his opinion of the choice of other player; and secondly, when the player's opinion is true, i.e., the other player/ opponent selects the same strategy as formed in the mind of the first player. The strategies that players choose in this way constitute their Nash equilibrium strategy (Abdoli, 2007).

**Game Modelling:**

Assume that states/countries and investors enter the game simultaneously. The states prefer, as much as is possible, that there is not an outflow of capital from their borders and that it be invested within the same economy. On the other hand, the investors are looking for markets with higher returns or lower risk. Therefore, one of them will enter a game in the following way:

Assume that the utility function of the investors is defined as follows:

$$U_I = \frac{R^2}{Y_f} \frac{1}{1+R_f Y} \quad (1)$$

Where  $U_I$  is the investor's utility function,  $R$ , the return in the local market,  $R_f$ , the return in the foreign market,  $Y$ , the risk of local market and  $Y_f$  is the risk of foreign

market. This function indicates that an increase in the return of capital in the local market leads to increased utility of investors. Moreover, increased risk in the foreign market leads to decreased utility of the investor; however, the effects of returns for the investor in this function are more than the effects of foreign risk. The expression  $\frac{1}{1+R_f Y}$  is the probability of no investment in foreign market.

This provability decreases with an increase in the risk of local market and increased return of foreign market. In other words, in the case of an increase in the risk of local market or the return on investment in the foreign market, this probability would decrease so that the capital remains in the country (there is no outflow). On the other hand, the utility function of the countries is defined as follows:

$$U_G = \frac{1}{K} \frac{R^2}{Y^2} - \rho \frac{R_f}{Y_f} \quad 0 < K \leq 1 \quad \text{and} \quad 0 \leq \rho \leq 1 \quad (2)$$

In this function,  $U_G$  is the utility of countries,  $R$  is the return in the local market,  $R_f$  is the return in the foreign market,  $Y$  is the risk in the local market and  $Y_f$  is the risk in the foreign market. This function shows that the risk and local return is more important for countries than the risk and return in other markets (foreign). The important point in this function is about  $K$  and  $\rho$  that is defined as follows:

$K$  is the economic power of countries and in the 0-1 range. If  $K = 1$ , then the country is in the highest economic stage and the importance of the capital will be  $\frac{R^2}{Y^2}$ . The lower stage is *the*  $K$  value, then, the country is economically in a lower economic phase and the significance of the capital for it will be  $\frac{R^2}{Y^2}$ . In other words, the significance of keeping the capital inside the country will be more for it. Moreover, the comparison of  $\frac{R^2}{Y^2}$  and  $\frac{R_f}{Y_f}$  indicates that the priority of countries is to preserve capital in the local market.

$\rho$ , is called the degree hostility and in the range of 0-1. If  $\rho = 0$ , then the countries are friends and the local and foreign markets are considered as being the same. If  $\rho = 1$ , the countries are absolute enemies. The closer  $\rho$  is to zero, the closer the relations of the countries with each other will be and the closer  $\rho$  is to 1, the more the degree of hostility between countries will be.

Now, it is assumed that,

$$\frac{R}{Y} = 1 \quad \text{and} \quad \frac{R_f}{Y_f} = 1 \quad (3)$$

These two assumptions are completely logical concerning the financial theories since according to the financial theories, higher return in the market occurs where more risk is tolerated. This condition is established for every market (local and foreign).  $\frac{R}{Y} = 1$  shows that if this relation is constant, in order to achieve higher return, more risk should be tolerated and vice versa.

Also, assume that:

$$R_f = a R \quad , \quad a \geq 1 \quad (4)$$

This assumption is logical since the investor will invest in the foreign market when the return on foreign investment is at least equal to domestic market (lower return in local market than foreign market).

Moreover,

$$Y = b Y_f \quad , \quad b \geq 1 \quad (5)$$

This assumption is logical since the investor will invest in the foreign market when the return on foreign investment is at most equal to the domestic market (lower risk in foreign market than domestic market).

Now, Equations (1) and (2) will be equal to following equations according to Equations (3), (4) and (5):

$$U_I = \frac{R^2}{Y_f} \frac{1}{1+R_f R} \quad (6)$$

And,

$$U_G = \frac{1}{K} \frac{R^2}{b^2 Y_f^2} - \rho \quad 0 < K \leq 1 \quad , \quad 0 \leq \rho \leq 1 \quad (7)$$

Now, by differentiating the utility functions, we will have:

$$\frac{\partial U_I}{\partial R} = 0 \Rightarrow R = -\frac{2}{R_f} \quad (8)$$

$$\frac{\partial U_G}{\partial Y_f} = 0 \Rightarrow Y_f = -\frac{R_f^2}{8Kb^2} \quad (9)$$

Now, by replacing Eq. 8 and 9 with each other, we will have:

$$R = Y = 4Kb^2 \quad (10)$$

These relations show that the more  $b$  (the lower risk in foreign market) and  $K$  are (economic power in local market), the more the risk and return inside the country will be and vice versa.

$$R_f = Y_f = -\frac{1}{8Kb^2} \quad (11)$$

These relations show that the more  $b$  (the lower risk in foreign market) and  $K$  are (economic power in local market), the more the risk and return outside the country will be and vice versa.

Now, it is possible to obtain the utility of investor and countries with equations 10 and 11. Therefore, we have:

$$U_I = -256 b^6 K^3$$
$$U_G = \frac{1}{K} - \rho$$

As long as  $b$  and  $K$  are always positive, the outcome of investors will be negative. This consequence shows that an increase in  $b$  (lower risk in foreign countries) and  $K$  (economic power) would lead to a decrease in the utility of the investor. Moreover, this equation shows that the utility of investors will be under risk ( $b$ ) and not in range ( $a$ ).

On the other hand, the utility of countries shows that if the hostility degree between countries ( $\rho$ ) is zero, then the countries will achieve the maximum positive outcome. The obtained positive outcome depends on the economic power of countries ( $K$ ). It means that the less the economic power of countries is, the higher this utility will be. This outcome leads the weak countries (economically) towards more pace.

These results confirm the results of Salimian *et al.* (2019) and Salimian and Almasifard (2020).

### **Conclusion and Recommendation**

One of the topics and fields of thought is the study of the possibility of economic cooperation such as trade and mutual investment, while there are political differences and the effect of this cooperation on the spread of peace and the prevention of war. Today, investors pay attention to the international concept of investment more than at any other time.

Since the formation of international markets and the creation of investment opportunities, investors no longer limit themselves to the local and domestic markets. On the other hand, countries intend to make sure that local capital be utilized in the fulfillment of local objectives and avoid capital outflow as much as possible. Many thinkers believe unlike politics, it can be a factor of connection and

convergence; where the economic cooperation of governments, based on absolute achievements, despite the possibility of differences in the benefit of the parties, causes the benefit of all parties to the cooperation

In this paper, by using game theory and presenting a dynamic game between players, the game modeling between investors and countries has been studied. The results indicated that the higher  $b$  (less risk in foreign markets) and  $K$  are (local economic power), the more local risk and return will be and vice versa. The higher  $b$  (less risk in foreign markets) and  $K$  are (local economic power), the higher risk and return in foreign countries will be and vice versa.

Moreover, an increase in  $b$  (less risk in foreign markets) and  $K$  (economic power) would lead to a decrease in investor's utility and in the end, if the hostility between countries ( $\rho$ ) is zero, then, the countries will achieve the maximum positive outcome.

These results clearly show the relationship between two very important categories and the basis of financial sciences (risk and return) and their mutual effects on each other in the domestic and foreign economies on the consequences of both players (governments and investors).

These results confirm that economic cooperation, while reducing conflicts between countries, can also prevent military conflicts and strengthen peace. In addition, convergence and economic interdependence not only reduce the likelihood of war, but also increase the welfare of the parties involved, and this result is a significant reason to strengthen the avoidance of war.

Finally, investors and countries are recommended to use the results of this study and pave the way for world peace by creating international markets.

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