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A GAME THEORY VIEW OF USA AND CHINA FDI OUTFLOW: STATIC COURNOT MODEL OF COMPLETE INFORMATION

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Author's Photos



Author's short biographies

I graduated from the Capital University of Economics and Business, Beijing in 2019 with a Doctor of Philosophy in Applies Economics. I have published several articles, participated, and presented both academic and institutional papers on several workshops, conferences and seminars in different areas. I have an MBA and a Bachelor's Degree in Business Administration from the Institute of Public Administration and Management, University of Sierra Leone.

I am an industry professional with over two decades of successful experience working alongside executive teams in various institutions. I am currently a Program Director at the Keystone Human Services in Delaware, a multinational organization and I'm part of a large team that engages in the day-to-day operational management of my organization in Delaware.

Introduction

- US & China are the major providers of direct investment to the rest of the world
- They are competing to fulfill their driving factors for FDI worldwide
- Due to the common conflict between the two countries economy-wise, this study finds Game theory to be the efficient framework on finding the equilibrium of the battle
- The objective is to establish, examine and analyze best and fair equilibrium on FDI outflows
- This study uses Static Cournot model with complete information to show how the two countries can come into equilibrium

The Literature Review

- Game theory is used in finding out the best outcome from a number of choices by analyzing the strategies (costs and benefits) to each independent player as they contest with each other.

- Game Theory and Cournot Model is an instrument that analyzes strategic conduct by considering in what manner participants anticipate others to act.

- It explores the likely results of a state where two or more rival parties look for the course of action that best benefits them.

- One of the benchmarks of game theory, Cournot (1983) anticipated Nash's definition of equilibrium in the framework of a certain duopoly model.

The Literature Review

- The 2007 United Nations report, for example, pointed out that China is a major capital provider for developing countries in Africa (UNCTAD 2007), followed by the United States.

- China's outward investment, therefore, has substantial implications for the economic development of the world economy in general.

- With the importance of FDI Outflows, four main reasons have been identified as motives for Multinational Corporations (MNCs) seeks to undertake international production activities; resource, efficiency, market and strategic asset seeking (Dunning, 2000; Mallampally and Sauvant, 1999; UNCTAD, 1998).

The Literature Review

- In showing the importance of resolving conflicts, (Azin S. B. *et al*,. 2012) suggested that conflicts like sharing of expenses or profits between main contractors which might be driven from issues such as project delays or suspensions, differing site conditions, contract changes etc. can lead to non compensable consequences that can cause considerable loss for both parties involved in the project if they are not peacefully resolved.
- However, (Romualadas and Algirdas, 2008) recommended the application of theoretical models to be reasonable, coherent and careful, combined with strategic management, industrial organization and other sciences, as well as with economic logic for one to get more accurate results as the application of game theory is limited.

Research Question(s)

- How does China's growth affect the United State economic interests and influence global economic policies?

- Why have the trade disputes between the United States and China overshadowed the benefits they derived from their FDI outflows?

Model Specification (The Cournot Model of Duopoly)

- Cournot model is used to translate an informal statement of the problem into a normal-form representation of the game, and solving for the Nash equilibrium
- Consider q_c and q_u be the quantities of FDI outflow produced by China and USA respectively
- $P(Q) = a - Q$ is the market-clearing price, and

$$Q = q_c + q_u$$

- Assume MC is constant at c, and the TC is $C_i(q_i) = cq_i$

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- Consider the country's payoff $[u_i(s_i, s_j)]$ to be the profit (π) it gains from the quantities of FDI outflow
- A general two-player game payoff function in normal form is

$$\pi_i(q_i, q_j) = q_i[P(Q) - c] = q_i[a - (q_i + q_j) - c]$$

- $\max_{0 \le q_i < \infty} \pi_i\left(q_i, q_j^*\right) = \max_{0 \le q_i < \infty} q_i\left[a - \left(q_i + q_j^*\right) - c\right]$
- The FOC for country $i's$ optimization problem is $q_i = \frac{1}{2}(a - q_j^* - c)$

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- The equilibrium quantity pair of FDI (q_C^*, q_u^*) is NE if the country's quantity choice of FDI satisfies the following equation

$$(1)\ \boldsymbol{q_1^* = \frac{1}{2}(a - q_2^* - c)}$$

$$(2)\ \boldsymbol{q_2^* = \frac{1}{2}(a - q_1^* - c)}$$

- Solving this pair of simultaneous equations by substitution yields; $(3)\ \boldsymbol{q_1^* = q_2^* = \frac{a-c}{3}}$
- Equations *1*, *2* and *3* fills the theoretical gap of the Cournot model in the construction of the NE using Game theory

Econometrics Methodology (Empirical Model)

- The key assumption is that both countries choose their quantities of FDI outflow simultaneously
- Other factors include exchange rate (*excu*), *GDPu*, and the error term (e)
- Therefore, the econometric model to achieve the objectives of this paper is

$$(4)\ \boldsymbol{fdiu_t} = \propto_0 + \propto_1 \boldsymbol{fdic_t} + \propto_2 \boldsymbol{excu_t} + \propto_3 \boldsymbol{gdpu_t} + \boldsymbol{e_t}$$

- This model was estimated using 0LS, and Eviews 9 statistical software was used for data analysis

Data Type, Description and Sources

- We used annual time series data for the range of 1982 – 2016
- The variables include *FDIu*, *FDIc*, *GDPu*, and *excu*
- All data were obtained from the Word Bank, except for *excu* which was obtained from the Board of Governors of the Federal Reserve System (US)

Results and Discussion of the Findings

- We did pre-estimation tests which involved Graphical Analysis, Descriptive Statistics, Correlation Matrix, Unit Root Test, Cointegration Test
- The Estimated Model is presented below in a standard form

$$\begin{array}{rccccc} LFDIU = & -0.73 & + 0.29LFDIC & + 0.22EXCU & - 0.09DGDPU \\ std & [0.42] & [0.13] & [0.05] & [0.04] \\ t & (-1.7) & (2.3) & (4.1) & (-1.9) \end{array}$$

n = 34 R^2 = 0.6404

- We also did post-estimation tests which involved Serial Correlation Test, Ramsey RESET Test, Stability Test, Multicollinearity Test, and Causality Test

Game Theory Implications of the Results

- Game theory involves the study of the ways in which strategic interactions among rational players produce optimal outcomes with respect to the preferences/utilities of those players.

- The assumptions of static and complete information apply to our case of US and China.

- Section 3 of this paper describes a game between US and China in the Cournot model setting.

- Section 4 we solved the theoretic-game problem between the countries about FDI outflows.

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- This section presents the results of the game in a bi-matrix form and apply Nash equilibrium to the solution of the battle for FDI outflows between US and China.

- Players – involves the two countries, US and China

- Strategies – Supply or Not Supply FDIs

- Payoff – quantities of FDI supplied by each country

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- Empirical estimation of equation *4* is used to construct the bi-matrix
- Our study is on *FDIU* and *FDIC*, then we ignore *EXCU* and *DGDPU* for simplicity
- Estimated equation 4 becomes

$$\boldsymbol{LFDIU = -0.73 + 0.29LFDIC}$$

- For every 1% FDI outflow supplied by China, US supplies 0.3% of FDI outflow

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- If China decides not to supply, then US will supply -0.7
- If US decide not to supply, then China will supply 2.5
- If both countries decide not to supply, then they will all end up with 0

		CHINA	
	XXXXXXXXXXXXX	Supply FDI (%)	Not Supply FDI (%)
US	Supply FDI (%)	**0.3, 1**	**-0.7, 0**
	Not Supply FDI (%)	**0, 2.5**	**0, 0**

- The (Supply-0.3, Supply-1) strategy combination is the Nash equilibrium since it is unique, and no country has incentive to deviate from it

Cont….

- If US and China decide to cooperate and have mutual trust then they can create the maximum total benefit
- Equation *3* shows this possibility

$$q_C^* = q_u^* = \left|\frac{-0.73 - 0.22}{3}\right| = 0.32$$

- Therefore, both countries will jointly supply 32% of the total FDI outflows and enjoy the maximum profit

Conclusion

- The main conclusion is that, in a static situation with complete information, optimal equilibrium is established if US and China produces 0.3% and 1% of FDI outflows respectively.

- This is a conflict solving solution to the battle on FDI outflows between these countries if they decide not to cooperate.

- However, if both countries decide to cooperate then they will monopolize the FDI outflows market by 32% and maximize the total gains.

Thank You!

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