Straight Versus Gradual Opening of Developed and Developing Economies

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Abstract

Rather than straight opening, a country or financial market should use gradual opening to minimize the costs of such a process. This paper provides a model of three players - one more developed than the other - that allocates their costs of opening to the others. All markets trade many goods such as financial products, and a cooperative game approach is used. The main game theoretic instrument is the Shapley value.

Introduction

How much a market should be opened and to which market should it open initially before total openness is an interesting question that could be answered with a game theoretical approach.

The game could be analyzed non-cooperatively and cooperatively. In such economic situations, non-cooperative games are the most appropriate ones to describe them because cooperative features such as axiomatic approaches are very different from the utility maximization of economic theory. Yet, if we want to analyze them even more realistically than some flawed abstract economic models of simple games that cannot explain real world empirical results, cooperative game theory could be more descriptive. According to Eric Rasmussen, “Cooperative outcomes are neat, fair, beautiful, and efficient.” This implies that cooperation can describe better ethical components than people many times have but are not shown through non-cooperative ways. Sometimes,

the cultural disutility of a payoff is more influential than the maximum monetary payoff of a non-cooperative game.

In futures markets around the world, there are hedgers and speculators, and for every seller, there is a buyer and for every buyer, there is a seller. Currently, China is trying to open its Crude Oil futures products (shfe.com.cn) to foreigner markets since there are only three major players with monopolistic power in China. They are China National Petroleum Corp., PetroChina or CNPC, China Petroleum & Chemical Corp., or Sinopec, and China National Offshore Oil Corp., or CNOOC. If such a small number of players are allowed in the financial markets, the markets would not function adequately, and hence, the suggestion of this paper for opening up developing financial markets.

Literature Review

Free trade is a topic that is relevant these days; furthermore, welfare improvement is an important concern for international economists. Such considerations are dealt in the General Agreement on Tariffs and Trade which existence is criticized for its overall ineffectiveness. However, Kowalczyk and Sjostrom (1994) propose a solution where international side payments are used to ease negotiations among countries that are willing to trade many goods and transfer international income to get rid of trade policies that are distortionary. This paper follows this model in consumer preferences and producer's profits.

For countries to cooperate, they have to achieve an acceptable basis agreed by each party such that it is in each country's own interest to cooperate. An example of such a game is the cooperation of four southern regions of India to share costs for the planning

of an electric power infrastructure (Dermont, 1974). By using a game theoretic application to invest in electric power, a high degree of cooperation can reduce cost and increase welfare. The theory of regional cooperation deals with such results.

Another example of reducing cost through cooperation is the aircraft landing fee game (Littlechild and Thompson, 1977). Through the share of common costs of runway construction for different types of planes, the optimal landing fee for each type is calculated. This model was applied to Birmingham Airport for pricing policy in 1968-1969, and it was the largest numerical application of game theory to date.

In all three games, the Shapley value is calculated, and this paper will do the same to calculate the cost allocation of cooperating through free trade.

Not only trade is relevant to this model, but also political situations such as integration and disintegration (Alesina, Spolaore, and Wacziarg, 2000) can be applied, and the degree of openness for each country can be measured as well. And, another area that can be applied to this model and is not explored extensively up to date is the effect of changes in the structure of financial markets (Cole, 1988).

In the Model section, the cost of each country opening to the rest is calculated. In the following section, the Shapley value of the model is calculated. At last, results are compared and a conclusion is given.

The Model

Calculating the cost of opening

For the sake of intuition, this model has three players but it can be applied for n players as well. There are three countries or financial markets, and one is more or less

developed than the other. The income of a consumer in the developed country is greater than the income in the less developed one.

$U_i (C_{ij}) = \sum^3_{j=1} C_{ij}$ s.t. $\sum^3_{j=1} P_j * C_{ij} = I_i$ for i=1, 2, 3.

Assume $I_1 > I_2 > I_3$ and $I_i > 0$.

Max U_i s.t. their constraints.
C_{ij}

$L = \sum^3_{j=1} C_{ij} + \lambda [I_i - \sum^3_{j=1} P_j * C_{ij}]$

First Order Conditions are:

$dL/dC_{ij} = 1 - \lambda P_j = 0$

$\lambda = 1/P_j \Rightarrow P_j = P_k$ for $k \neq j$

=> Total openness would imply same prices across countries.

From the budget constraint:

$C_{ij} = I_i/P_j - \sum^3_{k \neq j} P_k/P_j * C_{ik}$

=> $C_{ij} = I_i/P_j - \sum^3_{k \neq j} C_{ik}$

$dC_{ij}/dP_j = -I_i/P_j^2 < 0$

The demand in country i for good j is decreasing in its own prices.

In each country i, there is only one firm, and it produces x_{ij} units of good j with cost function:

$l_{ij} = \theta_i x_{ij}$.

Where l_{ij} is its demand for good j, and $\theta_i > 0$ is a constant cost parameter.

Firm i sells x_{ij} units in market j. It is assumed that it is known where the product comes from and where it is sold to, and that there is no legal access or punishment for reselling across markets is high enough to segment the markets. It is also assumed that in its own country the price charged is equal to its marginal cost to maximize welfare. Φ_{ij} is the monopoly price charged by firm i in market j, and profits are the following:

$\pi_i = \sum_{j=1}^{3} [\Phi_{ij} - \theta_i] x_{ij}$.

The monopoly price includes any tariff, quota, or any costs that is produced, for instance, the lack of free trade agreement or financial market access, thus $\Phi_{ij} > \theta_i$.

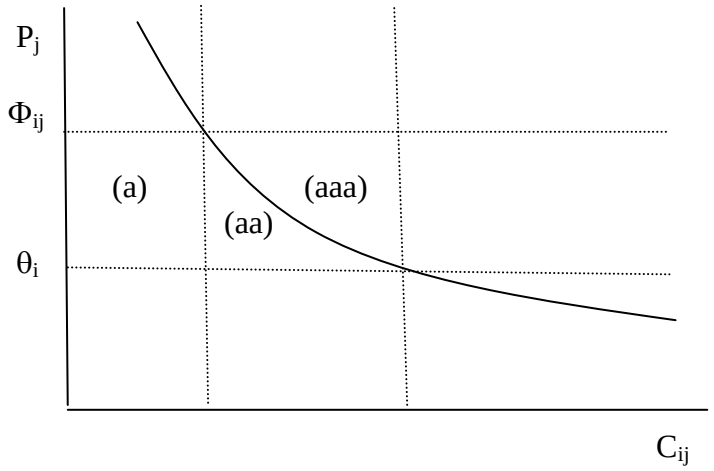

Figure 1

We define the coalition as the agreement by every country to charge at marginal cost in each other's markets.

Proposition 1

The coalition increases welfare by the amount equal to the dead weight losses from their monopoly pricing on each other.

Proof: In Figure 1, area (a) is the monopoly profit and area (aa) is dead weight loss for country j. After prices are reduced to the marginal costs of production $\Phi_{ij}=\theta_j$, area (aa) is gained as welfare. By symmetry, welfare is gained in country i as well when all other conditions are the same.

Proposition 2

The coalition is Pareto-optimal.

Proof: For any product, the coalition equalizes consumer prices across all countries and sets them equal to the costs of producing the good.

From the Proof of proposition 1, we can see that area (a) (the monopoly profit loss) equals to the cost of opening to the other countries, which calculation is:

Area (a) = $[\Phi_{ij}-\theta_j]\ C_{ij}$ when $P_j=\Phi_{ij}$ since $C_{ij}=I_i/P_j-\sum^3_{k\neq j} C_{ik}$.

We know that $I_1>I_2>I_3$ from the utility maximization assumption. We also assume that the goods are not inferior goods. This holds the following inequality for Figure 2:

Area (a) for country 1 > Area (a) for country 2 > Area (a) for country 3

A+B+C > B+C > C and c $\subset$ B and b $\subset$ A

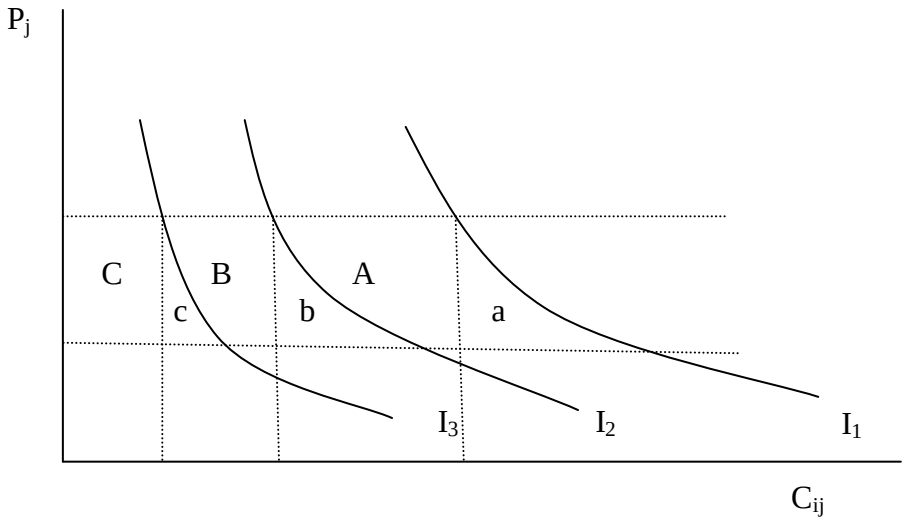

Figure 2

Calculation of the Shapley Value and allocation of costs

In Figure 2, each letter in the area of the square that it is within represents the cost of each country to open. For instance, country 1 opening to country 2 would cost A and for totally opening would cost A+B+C. Country 2 opening to country 3 would cost B and for totally opening would cost B+C. Country 3 totally opening would cost C. And so on for games for n>3 players.

From the differences in costs of opening, we can set up a road map directed towards total openness like in Figure 3.

Total Openness Map

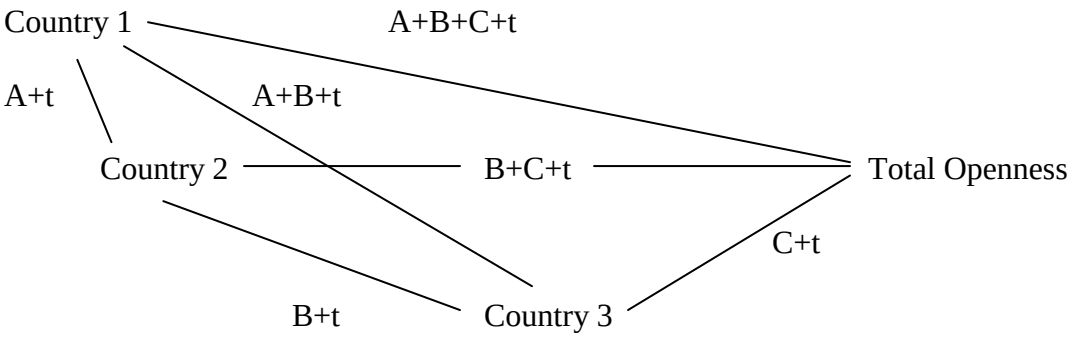

Figure 3 - Each connection shows the cost of opening.

Transaction cost is t. Here, we assume that t is constant for every country; however, as a possible extension in future research, t may vary across countries. For example, the difference in cultural ideologies increases transaction cost between a developed and a less developed country (i.e. a Western and an Asian country).

Transaction cost could be small when two countries are culturally similar (i.e. North America and Europe).

We can notice that $(A+B+C+t)\backslash I_1 < (B+C+t)\backslash I_2 < C+t\backslash I_3$. This shows that the relative costs to open for less developed countries are higher than for the more developed ones. The incentive for rent protection is stronger in less developed countries.

The incentive to cooperate can also be inhibited given the demand curve because of the following conditions: C>c, B+C>b, and A+B+C>a

Theorem 1

In a convex transferable utility game the core is not empty.

Proof: See Shapley (1971)

Theorem 2

The Shapley value is the central point in the core of a convex transferable utility game.

Proof: See Shapley (1971)

The Shapley Value

It is defined as:

$$\varphi_i[v]=\sum_{S \ni i} (S-1)!(n-S)!/n! \; [v(S)-v(S\backslash i)], \quad \text{for all } i \in N \text{ where } N=1,\ldots,n$$

N is the number of players.

v is the characteristic function-sum of the values of the utilities of the players.

S is the non-empty subset of N taken in some suitable order-coalition containing the player i.

The idea of this value is that player i receives the average of his marginal contributions to different coalitions that might form.

The Shapley value satisfies the properties of Efficiency, Anonymity, Dummy, and Additivity.

Proof: See Osborne and Rubinstein (1998)

Results

S	c(S)	Σ_S c(i)	v(S)
Country 1	A+B+C+t	A+B+C+t	0
Country 2	B+C+t	B+C+t	0
Country 3	C+t	C+t	0
Countries 1, 2	A+B+C+2t	A+2B+2C+2t	B+C
Countries 1, 3	A+B+C+2t	A+B+2C+2t	C
Countries 2, 3	B+C+2t	B+2C+2t	C
Countries 1, 2, 3	A+B+C+3t	A+2B+3C+3t	B+2C

Table 1

To calculate the Shapley Value:

Orders	1	2	3	Totals
Countries 1,2,3	0	B+C	C	B+2C
Countries 1,3,2	0	B+C	C	B+2C
Countries 2,1,3	B+C	0	C	B+2C
Countries 2,3,1	B+C	0	C	B+2C
Countries 3,1,2	C	B+C	0	B+2C
Countries 3,2,1	B+C	C	0	B+2C
Totals	3B+4C	3B+4C	4C	6(B+2C)

The Shapley Values is: (1/2B+2/3C, 1/2B+2/3C, 2/3C)

Table 2

The Cost Allocation for each country would be:

Country 1: A+B+C+t -1/2B-2/3C= A+1/2B+1/3C+t

Country 2: B+C+t-1/2B-2/3C=1/2B+1/3C+t

Country 3: C+t-2/3C=1/3C+t

Conclusions

Without cooperation, each country opening directly to the rest would cost A+B+C+t, B+C+t, and C+t to Countries 1, 2, and 3 respectively as shown in Table 1. However, if these three players form a coalition to gradually allocate the cost of opening, the costs are reduced by the Shapley value lowering them to A+1/2B+1/3C+t, 1/2B+1/3C+t, and 1/3C+t for each country respectively as derived from Table 2.

Summarizing, opening without coordination reduces the monopoly prices of each country's products equal to their marginal costs losing monopoly power to perfect competition gaining the dead weight loss as a welfare increase (a, b, and c areas in figure 2). However, if a coalition is form and the opening is gradual-the higher developed country opens to the next developed one and vice versa and so on until total openness, we would still have a welfare increase but with lower cost of opening. This approach could allow an incentive from the rent protecting parties with monopoly interests to efficiently minimize their costs when opening up their markets, a compromise for rent protection.

A good extension of this paper would be the consideration of having different transaction costs to form different coalitions.

References

Alesina Alberto, Enrico Spolaore and Romain Wacziarg. "Economic Integration and Political Disintegration." *The American Economic Review* 90 (2000): 1276—1296.

Cole, Harold. "Financial Structure and International Trade." *International Economic Review* 29 (1998): 237—259.

Gately, Dermot. "Sharing the Gains from Regional Cooperation: A Game Theoretic Application to Planning Investment in Electric Power." *International Economic Review* 15 (1974): 195—208.

Kowalczyk, Carsten, and Tomas Sjostrom. “Bringing GATT into the Core,” *Economica* 61 (1994): 301—317.

Littlechild, S.C. and G. F. Thompson. “Aircraft Landing Fees: A Game Theory Approach,” *The Bell Journal of Economics* 8 (1977): 186—204.

Mas-Colell, Andreu, Michael D. Whinston and Jerry R. Green. *Microeconomic Theory.* Oxford: Oxford University Press, 1995.

Myerson, Roger B. *Game Theory: Analysis of Conflict.* Cambridge: Harvard University Press, 1997.

Osborne, Martin J., and Ariel Rubinstein. *A course In Game Theory.* Cambridge: The MIT Press, 1998.

Rasmusen, Eric. *Games and Information: An Introduction to Game Theory.* Cambridge: Blackwell, 1997.

The Shanghai Futures Exchange. Accessed 2012. http://www.shfe.com.cn.

Shapley, Lloyd S. “Cores of convex games.” *International Journal of Game Theory* 1 (1971): 11—26.