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Third Party Intervention based on Matrix Representation for Conflict Resolution

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Abstract

The model of third part intervention is developed and analyzed using the decision support system (Matrix Representation for Conflict Resolution) (MRCRDSS). MRCR is based on the Graph Model for Conflict Resolution (GMCR) framework that provides a suitable and efficient means to model and analyze a strategic conflict. Until now, a little work has been made on modeling third party interventions. In this paper, the equilibrium state of photovoltaic conflict is identified before and after the intervention of a third party. It is clear to see the third party that involves in a conflict and mediation is most effective.

Key words: third party intervention; GMCR; international trade; decision makers; stability analysis; equilibrium state

INTRODUCTION

Disputes happen everywhere; inside of a household, at work among colleagues or employers and employees, between organizations, inside a country on a politic side, economic side, religious side or elsewhere.[1] Not all disputes can be solved by decision maker themselves. One of the best way to solve all those conflicts is to let a third party help, especially when the third party stands for an impartial solution.

When it comes to "third party" we immediately think of a person or group of people besides the two primarily involved in a situation, especially a dispute. It is a phenomenon that more than 70 percent of the conflicts that happened all over the world, attracted an intervention of a third party. Two common types of third-party intervention are mediation and arbitration. Third parties might act as consultants, they help one side or both sides make a concrete analysis of the dispute or conflict and plan a more or less adequate response. The third party can be invited to take part in a conflict or can just intervene because it has an interest in seeing the conflict solved. In other words, when it is about arbitration, the third party listens the two parties and then makes a decision, which can either be advisory or be binding.[2]

Although most research has focused on mediation, not so many studies have been done in the modeling and the analyzing of mediation[3].So this paper is to resolve the conflict between two decision makers by including a third decision maker which is acting as the third party.

In this paper, I will introduce decision support system of Matrix Representation for Conflict Resolution in chapter 2.PV conflict without third party will be modeled and analyzed in chapter 3.In chapter 4,I'll make a new model of third party involved and analyze.

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THE DECISION SUPPORT SYSTEM OF MRCR

Matrix Representation for Conflict Resolution (GMCR)

The Graph Model for Conflict Resolution is used to analyze a strategic conflict means to investigate the interaction of two or more decision makers (DMs) to identify possible outcomes.[4,5]The GMCR technique represents a conflict as moving from state to state via transitions controlled by the decision makers. We use vertices of the graph represent states, arcs of the graph represent transitions. To sum up, a Graph Model has altogether four components, that is:

- N, the set of decision-makers (DMs), where $2 \leq |N| < \infty$. We write N = {1,2,...,n}.
- S, the set of (distinguishable) states, satisfying $2 \leq |S| < \infty$. One particular state, s0, is designated as the status quo state.
- For each $i \in N$, DM i's directed graph Gi = (S, Ai). The arc set $Ai \subseteq S \times S$ has the property that if $(s,t) \in Ai$ then s = t; in other words, Gi contains no loops. The entries of Ai are the state transitions controlled by DM i.
- For each $i \in N$, a complete binary relation i on S that specifies DM i' s preference over
- These logical definition has brought great difficulties for algorithm development. So professor Xu proposed matrix representation. Then we can determine the states' stability by the value of matrix representation. Here are some definitions for Matrix Representation:[7]
- For $i \in N$,reachability matrix J_i is a $|S| \times |S|$ 0-1 matrix defined by

  $J_i(s,q) = \begin{cases} 1 & (s,q) \in A_i \\ 0 & otherwise \end{cases}$,which means DM I can move from state s to state q in one step.
- For $i \in N$,unilateral improvement (UI) matrix J_i^+ is a $|S| \times |S|$ 0-1 matrix defined by

  $J_i^+(s,q) = \begin{cases} 1 & J_i(s,q) = 1, q \, \mathrm{f}_i \, s \\ 0 & otherwise \end{cases}$.
- For $i \in N$, $s \in S$,we define preference matrix as followed:
- $P_i^+(s,q) = \begin{cases} 1 & q \, \mathrm{f}_i \, s \\ 0 & otherwise \end{cases}$, $P_i^-(s,q) = \begin{cases} 1 & s \, \mathrm{f}_i \, q \\ 0 & otherwise \end{cases}$, $P_i^=(s,q) = \begin{cases} 1 & s \sim_i q \\ 0 & otherwise \end{cases}$,

  and $P_i^{-,=}(s,q) = \begin{cases} 1 - P_i^+(s,q) & s \sim_i q \\ 0 & otherwise \end{cases}$.

The comparison is mentioned under the following table, where the preference information and the stability (and post-stability) analyze are represented for both GMCR and MRCR.

MRCRDSS

The availability of software that analyzed Graph Models quickly, completely, and reliably resulted in an increase in the number and range of applications of the Graph Model methodology, which in turn provided convincing evidence of the utility of the approach. But the need to justify these models and interpret the results of the analysis created the need to analyze even more Graph Models, typically related to the initial models but distinct from them.

Decision Support System for GMCR is called GMCR II.[8] The DSS GMCR II offers model management and stability analysis and includes some basic coalition analysis and status quo

analysis for simple preference. At present, GMCR II allows for status quo analysis, but does not implement it fully.

Different from GMCR II, MRCRDSS is strongly in stability analysis. I'll show you how to use it by a simple example.



$DM1$ $DM2$

$$P_1(1)=4\ P_1(2)=3\ P_1(3)=2\ P_1(4)=1 P_2(1)=3\ P_2(2)=1\ P_2(3)=2\ P_2(4)=4$$

Figure 2.1 The graph model for chicken game

Step 1: Click on the user bar and login. The user name _welcome_ and password _123_ are provided on the welcome page.



Figure 2.2 Welcome page of MRSC software

Step 2: Setting the number of Decision makers and the amount of options for each Decision Maker. Those information are to be input in the "setting" bar.

Step 3: Input state in the same "setting" bar. Only the states to be considered are counted in.

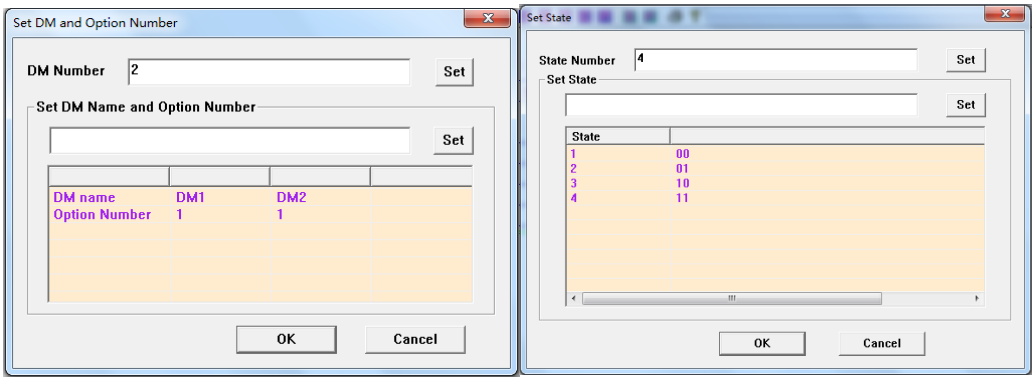


Figure 2.3 DMs and option number, input states

Step 4: under the setting bar, using the direct ranking to get the preferences.

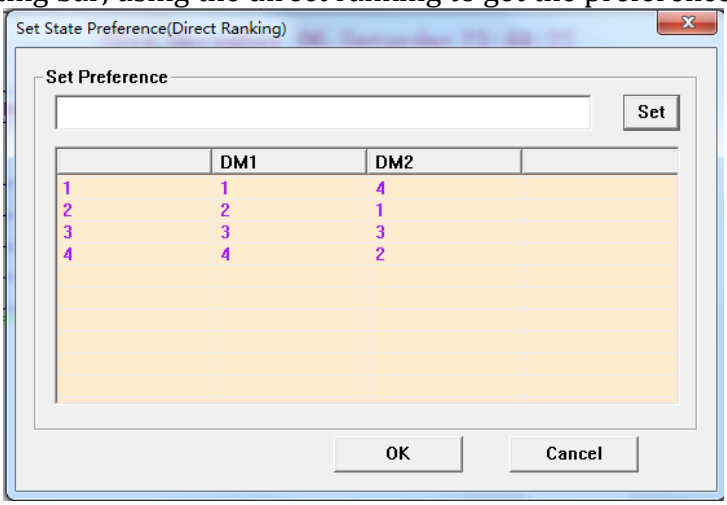
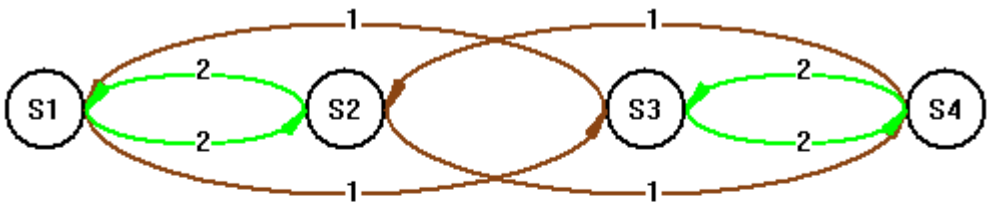


Figure 2.4 Preference (direct ranking)

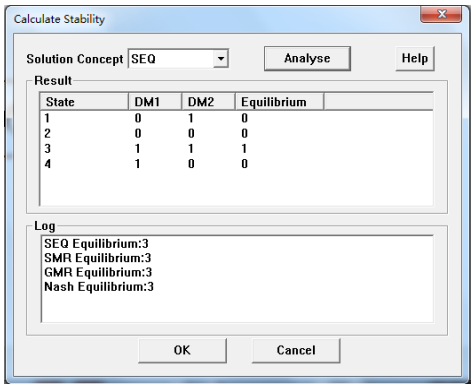
Step 5: the "calculate" bar provides the graph model of the conflict. This is according to the transfer made from one state to another. For each decision maker, it is considered only the transfers with a unique change from "Y" to "N" or vice-versa. The following figure shows the graph obtained.



DM1 DM2

Figure 2.5 Graph model

Step 6: After analyzing these inputs using the MRSC software, a stability tableau is produced defining which states are stable according to different solution concepts or stability definitions. Under "calculate" bar, we use the stability analysis to get the final solution. The solution concepts used are the four ones mentioned before, i.e. NASH, GMR, SMR and SEQ.



State Graph and Equilibrium :

State	DM1		DM2		Equilibrium			
	R	P	R	P	Nash	GMR	SMR	SEQ
1	3	1	2	4				
2	4	2	1	1				
3	1	3	4	3	√	√	√	√
4	2	4	3	2				

Path: =======> DM1; =======> DM2;

FIGURE 2.6 STABILITY ANALYSIS

Photovoltaic conflict without the third party

The solar industry of China has over the past few decades promptly appeared as the most dynamic and fastest-growing in the world. The amount of trade frictions between the European Union and China in the area of solar panels and other related equipment has grown speedily in recent months. In early September 2012, the European Commission initiated an anti-dumping investigation into imports of solar panels and some of their key components (namely, solar cells and solar wafers) manufactured in China and exported to EU. Two months later, in early November, it also launched an anti-subsidy probe about the same set of products. In February 2013, the European Commission opened a new anti-dumping inquiry into imports of solar glass made from China, pointing out that this was "a stand-alone investigation touching a complete different product" from the solar panels cases of late 2012.

On June 6th, 2012, the Commission inflicted interim anti-dumping duties. Those duties were calculated to be of 11.8 percent on all the imports of solar panels, and other solar equipment such as cells and wafers coming from China. If the two disputants had not yet agreed on a mutual concert throughout negotiations, by Aug.6th, 2012, which is two months later, the duty would be lifted up until 47.6 percent. Tensions flared by the time the European officials announced officially that the EU was getting ready to place anti-dumping tariff rates up to 67.9 percent on all Chinese-made solar panels and related supplies. Thus, the EU-China solar dispute is the most significant anti-dumping accusation the European Commission has ever investigated.

Right after the European complaint and as a retaliation gesture over EU attempts to strike Chinese solar panels with punitive import duties, Beijing started the inquiry into whether Europe was exporting its wine to China at invidiously low prices. China then started an anti-dumping investigation into wine imports from the European Union.

Although most countries of the EU had conflict with China,Geman support China.

Decision Maker (DMs):

So the very first thing we should notice about this case is that there are two decision makers which are the European Union (DM1) on one side and China (DM2) on the other side.

Options: Table 3-1 describes the options for each DM.

Table 3.1 Decision makers (DMs) and description of their options

Decision Makers	Options	Description
EU	1. lower the local price	1* EU lows the price of its solar panel on the local market, EU can therefore compete with the Chinese solar panel sold in Europe
	2. implement high anti-dumping tariffs on Chinese solar panels	2* EU advocates for increasing the tariffs on Chinese solar panels, up to 47.6% on imports of solar panels
China	3. investigate into the European wine	3* China, in response to the complaint made by the EU, complained in turn about the exported European wine to China.
	4. get help from Germany	4* For some reasons, Germany is on Chinese side. China could therefore push Germany to convince the majority of the EU countries to be on the Chinese side as well.
	5. reject the high tariffs	5* China has the right to refuse the tariffs imposed by the EU. In fact, those tariffs are too high that China cannot afford to accept them.

States: These are series or combinations of Yes (noted Y) and No (noted N). Nevertheless, all the states are not to be considered; some states reveal cases that would never happen in a real economic event.

Table 3.2 Possible states

EU	1. lower the local price 2. impose high tariffs on Chinese panels	N Y N Y N Y N Y Y Y Y Y Y Y Y Y
China	3. investigate into the European wine 4. use German help to gain support from other EU's countries (get help from Germany) 5. reject the high tariffs	N N N N Y Y Y Y N N Y Y N N Y Y Y Y Y Y Y Y Y Y

Preferences:

The best case scenario for EU would be not to lower its panel's local price and to impose high tariffs on Chinese panels. And the great thing that could happen to China in this case is to reject the high tariffs imposed by the EU.

In this conflict, EU will prefer the following states in a descending order: 1>3>5>7>2>4>6>8. China in turn will prefer the following states in a descending order: 7>8>5>6>3>4>1>2.

Table 3.3 Preferences

DMs	States
European union	1 3 5 7 2 4 6 8
China	7 8 5 6 3 4 1 2
	Most preferred ... Least preferred

Then we input all the information to the MRCRDSS software.

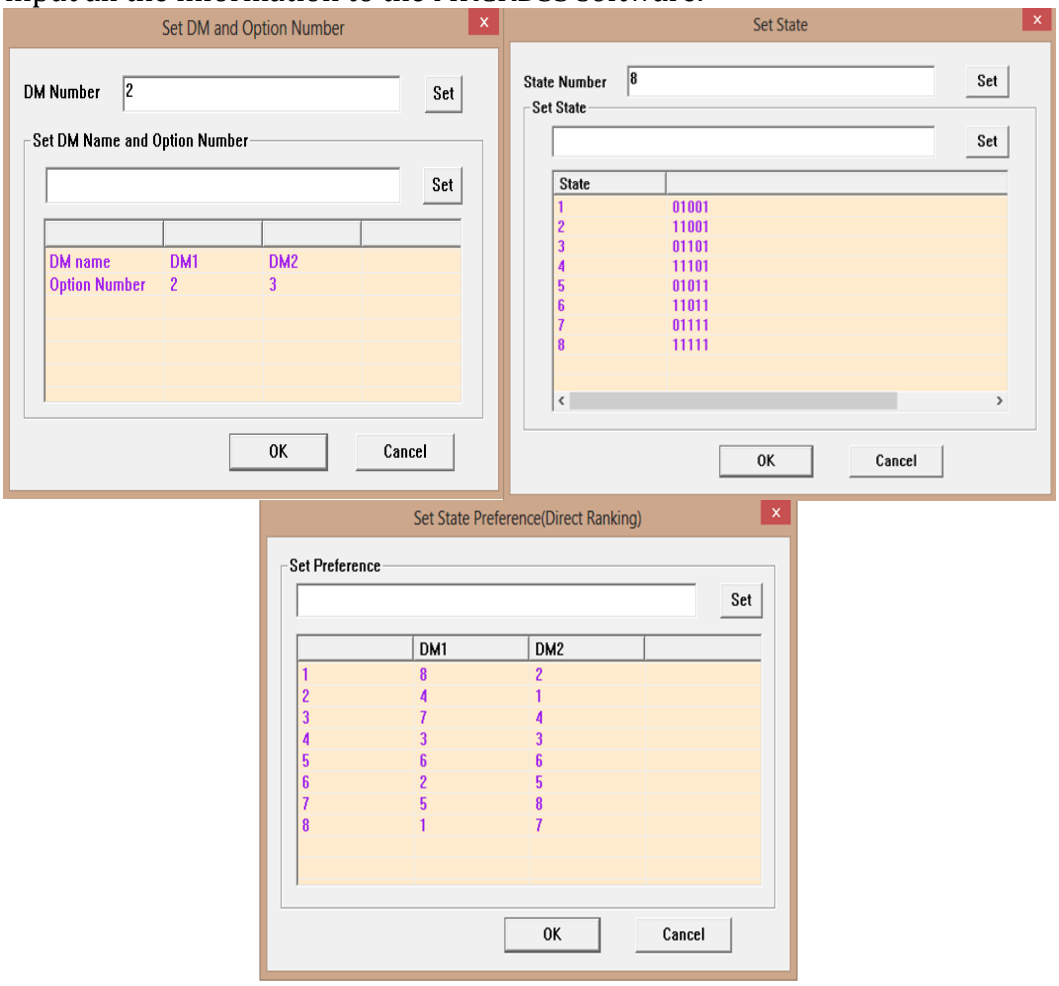


Figure 3.1 DMs and option number, input States, Preference

The graph model and the solution we got are shown in the following pictures:

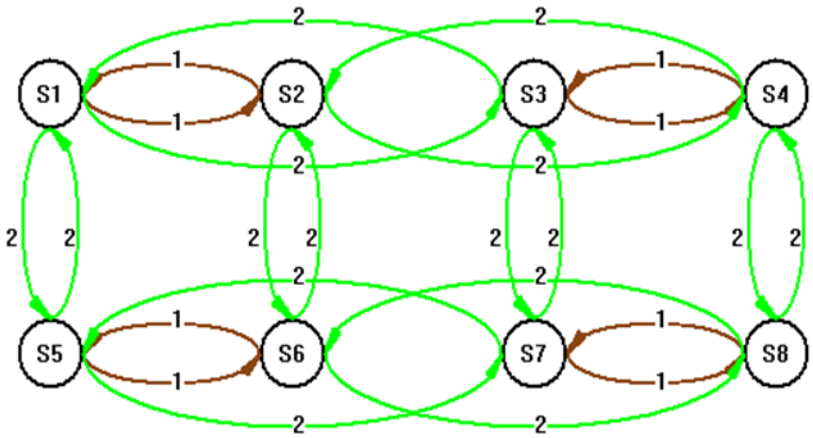


Figure 3.2 Graph model for the PV conflict

State Graph and Equilibrium :

State	DM1		DM2		Equilibrium			
	R	P	R	P	Nash	GMR	SMR	SEQ
1	2	8	3,5	2				
2	1	4	4,6	1				
3	4	7	1,7	4				
4	3	3	2,8	3				
5	6	6	1,7	6				
6	5	2	2,8	5				
7	8	5	3,5	8	√	√	√	√
8	7	1	4,6	7				

Path: =======> DM1; =======> DM2;

Figure 3.3 Stability analysis result

The solution we got clearly shows that the case reveals a conflict. That is because the state 7 is the equilibrium state and it represent a case where EU does not decrease the European price of their solar panel but does charge the Chinese solar panels with a high anti-dumping tariff rate (about 47.6%). State 7 is also when China does charge the European wine and does use help from Germany to get as much support as possible from countries of the EU itself, China does also reject the high tariff rate imposed by the EU. So it is necessary to let third party intervene in the conflict in order to partially resolve it.

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Photovoltaic conflict involves the third party in

I choose the European Commission and China Council for the Promotion of International Trade (CCPIT) as a third party in this study. Those two organizations will work together in order to resolve the photovoltaic conflict and make sure there is a win-win agreement.

Table 4.1 Third party and the description of its options

THIRD PARTY	OPTIONS	DESCRIPTION
European Commission & the CCPIT	6. adjust the tariff rates	6* the two organizations acting as one same party can negotiate and try to decide of a new tariff rate lower than the one imposed by the EU.
	7. establish quotas	7* the third party can also determine a fixed amount of Chinese panels that are to be exported to Europe.

The following table shows the 24 states to be considered in this paper:

Table 4.2 Possible states under third party

1. lower the local price 2. impose high tariffs on Chinese panels	N Y N Y N Y N Y N Y N Y N Y N Y N Y N Y N Y N Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y
3. investigate the European wine 4. get help from Germany 5. reject the high tariffs	N N Y Y N N Y Y N N Y Y N N Y Y N N Y Y N N Y Y N N N N Y Y Y Y N N N N Y Y Y Y N N N N Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y
6. adjust the tariff rate 7. establish quotas	Y Y Y Y Y Y Y Y N N N N N N N N Y Y Y Y Y Y Y Y N N N N N N N N Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y
States number	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

To be fair, each side has an organization in the third party,but we still don't know which side the third party prefer.So the preferences for the third party are uncertain.

If the third party consider two sides' interest, new preferences are to be made as it shown in table 3.5.

Table 4.3 All the Decision makers and their preferences

DMs	**States**
EU	9 11 13 15 10 12 14 16 17 19 21 23 18 20 22 24 1 3 5 7 2 4 6 8
China	7 8 5 6 3 4 1 2 23 24 21 22 19 20 17 18 15 16 13 14 11 12 9 10
Third Party	17 18 19 20 21 22 23 24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
	Most preferred Least preferred

This is the graph model:

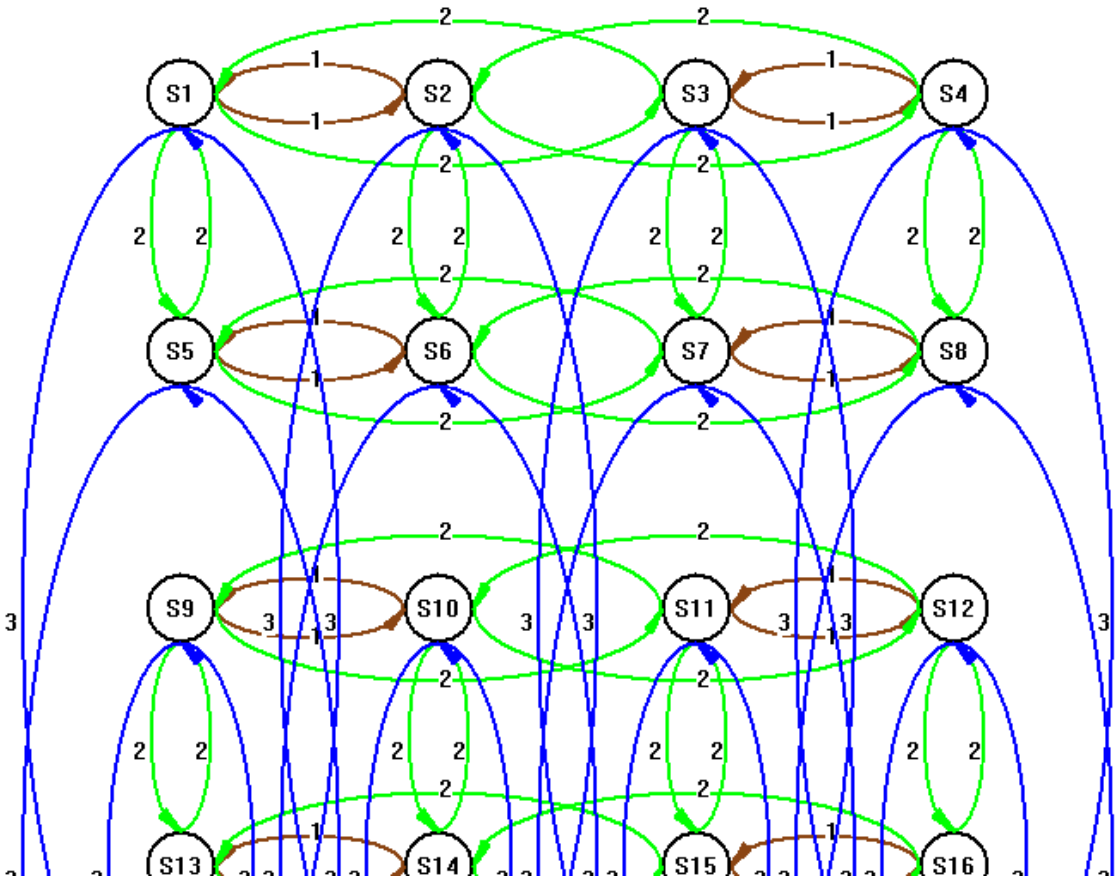

Figure 4.1 Graph model for the PV conflict including third party

And this is the analysis result table:

Table 4.4 Stability analysis with the Third Party→ equilibrium state

State	DM1		DM2		DM3		Equilibrium			
	R	P	R	P	R	P	Nash	GMR	SMR	SEQ
1	2	8	3,5	18	17	16				
2	1	4	4,6	17	18	15				
3	4	7	1,7	20	19	14				
4	3	3	2,8	19	20	13				
5	6	6	1,7	22	21	12				
6	5	2	2,8	21	22	11				
7	8	5	3,5	24	23	10				
8	7	1	4,6	23	24	9				
9	10	24	11,13	2	17	8				
10	9	20	12,14	1	18	7				
11	12	23	9,15	4	19	6				
12	11	19	10,16	3	20	5				
13	14	22	9,15	6	21	4				
14	13	18	10,16	5	22	3				
15	16	21	11,13	8	23	2				
16	15	17	12,14	7	24	1				
17	18	16	19,21	10	1,9	24		√	√	
18	17	12	20,22	9	2,10	23		√	√	
19	20	15	17,23	12	3,11	22		√	√	
20	19	11	18,24	11	4,12	21		√	√	
21	22	14	17,23	14	5,13	20		√	√	
22	21	10	18,24	13	6,14	19		√	√	
22	21	10	18,24	13	6,14	19		√	√	
23	24	13	19,21	16	7,15	18	√	√	√	√
24	23	9	20,22	15	8,16	17		√	√	

So we can see the 23rd state is equilibrium.That is to say EU agree to low the tariffs and China cut down the quantity of PV production.

If the third party prefer EU,they may establish quotas and not adjust the tariff rate.So the preference and the result will be shown in the table followed.

Table 4.5 All the decision makers and their preferences

DMs	States
EU	9 11 13 15 10 12 14 16 17 19 21 23 18 20 22 24 1 3 5 7 2 4 6 8
China	7 8 5 6 3 4 1 2 23 24 21 22 19 20 17 18 15 16 13 14 11 12 9 10
Third Party	10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 1 2 3 4 5 6 7 8 9
	Most preferred Least preferred

Table 4.6 Stability analysis with the third party→ equilibrium state

State	R	P	R	P	R	P	Nash	GMR	SMR	SEQ
1	2	8	3,5	18	17	8				
2	1	4	4,6	17	18	7				
3	4	7	1,7	20	19	6				
4	3	3	2,8	19	20	5				
5	6	6	1,7	22	21	4				
6	5	2	2,8	21	22	3				
7	8	5	3,5	24	23	2				
8	7	1	4,6	23	24	1				
9	10	24	11,13	2	17	24				
10	9	20	12,14	1	18	23				
11	12	23	9,15	4	19	22				
12	11	19	10,16	3	20	21				
13	14	22	9,15	6	21	20				
14	13	18	10,16	5	22	19				
15	16	21	11,13	8	23	18	√	√	√	√
16	15	17	12,14	7	24	17		√	√	
17	18	16	19,21	10	1,9	16				
18	17	12	20,22	9	2,10	15				
19	20	15	17,23	12	3,11	14				
20	19	11	18,24	11	4,12	13				
21	22	14	17,23	14	5,13	12				
22	21	10	18,24	13	6,14	11				
23	24	13	19,21	16	7,15	10				
24	23	9	20,22	15	8,16	9				

If the third party prefer EU, the tariffs will still be so high,but the amount of export PV production will be decrease.The conflit still can't be work out.

If the third party prefer China,new preference will be made as this:

Table 4.7 All the decision makers and their preferences

DMs	**States**
EU	9 11 13 15 10 12 14 16 17 19 21 23 18 20 22 24 1 3 5 7 2 4 6 8
China	7 8 5 6 3 4 1 2 23 24 21 22 19 20 17 18 15 16 13 14 11 12 9 10
Third Party	1 2 3 4 5 6 7 8 17 18 19 20 21 22 23 24 9 10 11 12 13 14 15 16
	Most preferred Least preferred

Here is the result:

Table 4.8 Stability analysis with the third party→ equilibrium state

State	R	P	R	P	R	P	Nash	GMR	SMR	SEQ
1	2	8	3,5	18	17	24		√	√	
2	1	4	4,6	17	18	23				
3	4	7	1,7	20	19	22		√	√	
4	3	3	2,8	19	20	21				
5	6	6	1,7	22	21	20		√	√	
6	5	2	2,8	21	22	19				
7	8	5	3,5	24	23	18	√	√	√	√
8	7	1	4,6	23	24	17				
9	10	24	11,13	2	17	8				
10	9	20	12,14	1	18	7				
11	12	23	9,15	4	19	6				
12	11	19	10,16	3	20	5				
13	14	22	9,15	6	21	4				
14	13	18	10,16	5	22	3				
15	16	21	11,13	8	23	2				
16	15	17	12,14	7	24	1				
17	18	16	19,21	10	1,9	16				
18	17	12	20,22	9	2,10	15				
19	20	15	17,23	12	3,11	14				
20	19	11	18,24	11	4,12	13				
21	22	14	17,23	14	5,13	12				
22	21	10	18,24	13	6,14	11				
23	24	13	19,21	16	7,15	10				
24	23	9	20,22	15	8,16	9				

Although there will be an appropriate tariff rate which two sides can all accept, the amount is still very large.This situation will still affect EU's market.So EU can't agree with it.

CONCLUSION

In this paper, the conflict between countries has been analyzed using a graph model, Graph Model for Conflict Resolution. This graph model helps to resolve the conflict between decision makers. In international trade, two nations can enter a dispute because of the law of protectionism. The conflict can be ended and the decision makers can choose the reasonable state and can create peace within each other. In another word, the decision makers can keep and strengthen their partnership if the conflict has been resolved. Case about the intervention of a third party in international trade's conflict has been introduced and analyzed how the graph model can be applied to resolve a conflict.

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