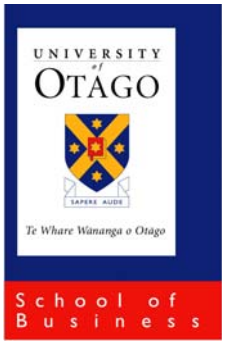

ISSN 0111-1760

University of Otago
Economics Discussion Papers
No. 0401

January 2004

Classroom Tariff Wars: A Tariff Setting Game

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Abstract

This paper outlines a classroom tariff setting game that allows students to explore the consequences of import tariffs imposed by large countries (countries able to influence world prices). Groups of students represent countries, which are organised into trading pairs. Each group's objective is to maximise welfare by choosing an appropriate *ad valorem* tariff. The game is built on a computable general equilibrium model, which allows each nation's utility and terms of trade under alternative tariff regimes to be expressed quantitatively. The exercise encourages students to consider terms of trade improvements and efficiency losses resulting from large-country tariffs and provides a backdrop to discuss the Nash equilibrium of a tariff war. Feedback from students who have participated in trial simulations indicates that the game is a useful supplement to traditional teaching methods.

This Draft January 2004

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* The author would like to thank Paul Hansen and Martin Richardson for useful comments, and a subset of students at the University of Otago for their feedback and patience. The usual disclaimer applies.

1. Introduction

When a large country (a country able to influence world prices) imposes a tariff it experiences a terms of trade improvement and an efficiency loss. As the tariff restricts domestic demand, terms of trade improvements are derived from a decrease in the world price of the imported good. Efficiency losses arise from distortions to producer and consumer prices. A partial equilibrium, supply and demand approach is a simple way of exposing students to these effects in introductory classes, but is of little use when two countries simultaneously impose tariffs; that is, when there is a tariff war. A rigours treatment of a tariff war requires offer curve analysis. Such an approach, however, is commonly omitted from introductory classes and/or not well understood by undergraduates.[1]

This paper outlines a tariff setting game, built on a numerical representation of the standard 2 (countries) × 2 (goods) × 2 (factors) trade model. The game lasts for three rounds. Groups of students represent countries, which are organised into trading pairs and aim to maximise welfare by choosing an appropriate *ad valorem* tariff in each round. Solutions to the computable general equilibrium model under alternative tariff regimes are contained in the appendix and displayed to students after tariff choices are made. The game allows students to explore the effects of large-country tariffs on utility and the terms of trade in an interactive setting and exposes the Nash equilibrium of a tariff war. Although students may choose from a range of possible tariffs they do not have enough information to precisely determine their country's utility under all possible tariff combinations. Instead students are encouraged to use economic intuition and learn from previous rounds to inform their decisions.

2. Particulars

The game is suitable for introductory international trade courses and is best played after students have been exposed to the consequences of tariff imposition by a large country in regular classes, but before retaliation and tariff wars are discussed. Between 25 and 30 minutes are required to introduce, play and discuss the game. The game is best suited to class sizes of fewer than 30 students. The game is built on the

[1] Two prominent undergraduate international trade texts, Krugman and Obstfeld (2003, pp. 212-3) and Yarbrough and Yarbrough (2003, pp.159-62), confine offer curve analyses to appendices.

standard 2 (countries: Alpha and Beta) × 2 (goods: X and Y) × 2 (factors: capital and labour) trade model. Each country is endowed with the same number of capital and labour units and employs identical technologies. Dissimilar but symmetric tastes are the basis for different autarky relative prices. Utility and production functions for each country, which are Cobb-Douglas, and factor endowments are displayed in Table 1.

Table 1: Utility, production and factor endowments

Utility	Production
$U_{\alpha} = X_{\alpha}^{1/4} Y_{\alpha}^{3/4}$	$X_j = 1.75 K_{xj}^{1/4} L_{xj}^{3/4}$
$U_{\beta} = X_{\beta}^{3/4} Y_{\beta}^{1/4}$	$Y_j = 1.75 K_{yj}^{3/4} L_{yj}^{1/4}$
$K_{xj} + K_{yj} = 4000 \quad L_{xj} + L_{yj} = 4000 \quad j = \text{Alpha, Beta}$	

3. Playing the Game

Begin by distributing instruction sheets to students that describe the trade model pertaining to Table 1 (see the appendix). Ask students to determine which country will export which good if the two nations engage in free trade.[2] Display Figure 1, which illustrates Alpha's utility and terms of trade for different *ad valorem* import tariffs levied by Alpha (τ^{α}) when Beta commits to free trade. It is also a good idea to reiterate that the model is symmetric and ask students to consider the following questions: (a) What are the sources of changes in Alpha's utility?[3] (b) Why is welfare unchanged for increases in τ^{α} above 70%?[4] (c) What happens to Beta's utility and terms of trade as τ^{α} increases? Why?[5]

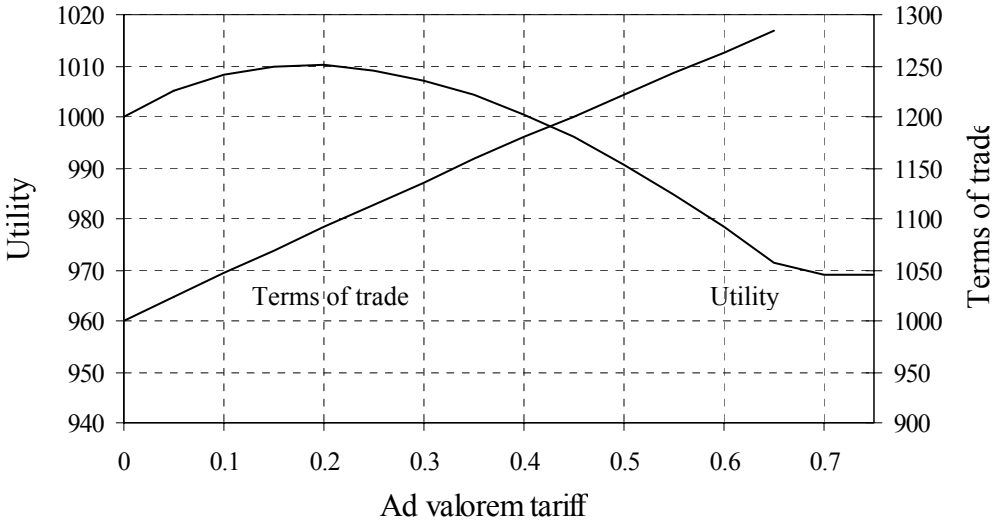
[2] Alpha will export Y and Beta will export X.

[3] As a result of the tariff, Alpha experiences a terms of trade improvement, which increase welfare, and an efficiency loss, which decrease welfare. Additionally, the magnitude of the latter effect rises relative to that of the former as the tariff increases (for all $\tau^{\alpha} < 0.70$).

[4] An *ad valorem* tariff greater than or equal to 0.7 prohibits trade.

[5] Beta experiences greater efficiency losses and a worsening of its terms of trade as τ^{α} increases (for all $\tau^{\alpha} < 0.70$). Beta's utility is, therefore, a decreasing function of τ^{α} (for all $\tau^{\alpha} < 0.70$).

Figure 1: Alpha's utility and terms of trade when Alpha imposes a tariff and Beta commits to free trade



Note: An *ad valorem* tariff greater than or equal to 0.7 prohibits trade.

Set up the game by dividing the class into six groups and create three trading pairs (Alpha 1 and Beta 1, Alpha 2 and Beta 2, and Alpha 3 and Beta 3) by distributing cards displaying each group's country type and number. Students are not to disclose their country details to other groups. The game lasts for three rounds. In each round each group is asked to maximise their country's utility by choosing an *ad valorem* tariff, which, for reporting convenience, must be a multiple of 0.05. It is a good idea to make sure students are aware that their trading partner faces the same incentives as they do – they are not simply choosing a point on Figure 1. Some groups may complain that they don't know how to work out the exact tariff they should choose. Let students know that they do not have enough information to arrive at a precise figure and a certain degree of guesswork is required. They should, however, be able to derive some qualitative conclusions about their decisions. Approach each group and record their chosen tariff.[6]

[6] Some students will immediately recognize the prisoner's dilemma nature of the problem. Although the Nash equilibrium, via dominant strategies, is to levy a positive tariff in every (finite) period, some students may try to cooperate with their trading partner. This is not uncommon in finite period, prisoner's dilemma type economic experiments – see for example Holt and Capra (2003).

Alpha's utility and terms of trade under alternative tariffs regimes, based so that both are equal to 1000 when there is free trade, are derived via computer simulation and displayed in Appendix Tables A.1 and A.2, respectively. Beta's utility and terms of trade are derived symmetrically.[7] Use these tables to determine each group's utility and terms of trade and, along with tariff rates, display these figures to the class. If a tariff structure chosen by a trading pair results in zero trade, make this explicit to the class. Students record the results from each round, one at a time, in a results sheet (see the appendix) and are asked to discuss the results in terms of increases/decreases in each nation's terms of trade and efficiency losses. Students can then use the results from the three trading pairs to inform their decisions in subsequent rounds. Begin the next round, if required, by asking groups to choose another tariff.

Three rounds are normally sufficient to portray the key elements of a tariff war - all groups usually derive a lower level of utility in round three than in free trade and, although students do not have perfect information, the results usually provide enough information to tease out the Nash equilibrium, which occurs when each country levies a tariff of 15%. Conclude by summarising the game using the payoff matrix displayed in Figure 2.[8] For clarity a quick guide to the game is presented in Figure 3.

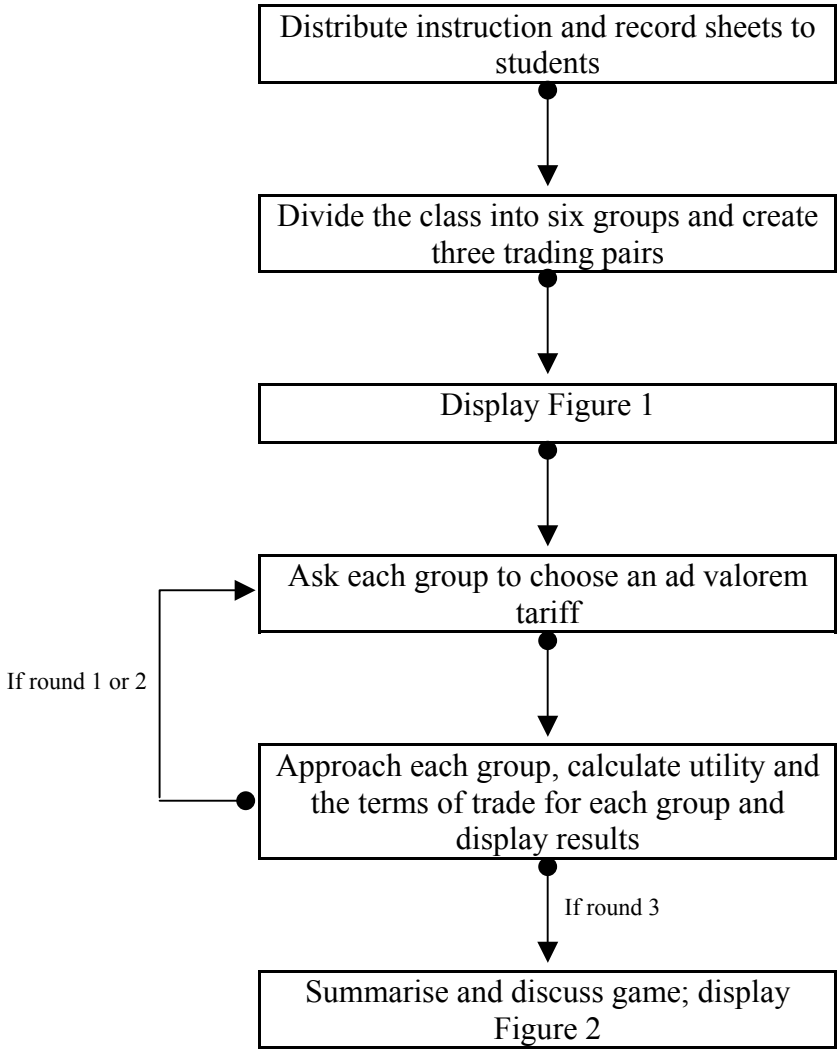
Figure 2: Payoff matrix for tariff setting game

		Beta	
		$\tau^{\beta} = 0$	$\tau^{\beta} = 0.15$
Alpha	$\tau^{\alpha} = 0$	1000.00 *1000.00*	985.62 *1009.77*
	$\tau^{\alpha} = 0.15$	1009.77 *985.62*	990.78 *990.78*

[7] For example, if τ^{α} = 0.15 and τ^{β} = 0.05, Alpha's and Beta's utility are 1002.68 and 988.95, respectively, and the two countries terms of trade are 1044.77 and 957.14, respectively.

[8] For simplicity, each player can only choose between two alternatives – to commit to free trade or to impose a tariff of 15% – in the payoff matrix summarising the game.

Figure 3: A quick guide to the tariff setting game



One problem encounter when playing the game relates to the intangible nature of utility. Students sometimes choose a different objective to that stipulated, such as minimising the utility of their trading partner. Various incentives can be offered to moderate such behaviour. Rolling a dice after the completion of each round and awarding a prize (such as a chocolate) to each member of the group that attained the highest utility in the round if a six is rolled is one such method.

4. Discussion

At the beginning of the game students only know payoffs under zero-positive tariff combinations. Restricting the availability of information is a useful learning tool as it forces students to think carefully about the channels through which tariffs operate.

The nine outcomes (three trading pairs × three rounds) usually provide a broad range of results and provide a backdrop for discussion.[9] You may ask the class, why is Alpha's utility higher in simulation 1 than simulation 2 when Alpha's terms of trade is higher in the latter?[10] Questions can also be asked as the results are displayed. For example, you may wish to reveal tariffs chosen by a trading pair and ask, which nation will experience an improvement in its terms of trade? Which nation will have the highest utility?[11]

The game can also be used to demonstrate one benefit from setting the rules for world trade via a governing body such as the World Trade Organisation. Playing another round in which each group openly displays its country details and inter-group discussions are allowed prior to tariff selection accomplishes this. Ask groups who chose a zero tariff why they did so without a binding contract. Ask students who chose a positive tariff what would be required for them to commit to free trade.

5. Summary

A simple form of the tariff setting game involves students choosing a zero or a positive tariff.[12] The binary variant of the game, however, is much less thought provoking than when tariffs are a multiple choice. While a degree of guesswork is involved in initial rounds, the game described in this paper requires students to consider terms of trade movements and efficiency losses associated with import tariffs in an interactive setting. Comments from students who have participated in trial simulations indicate that the numerical nature of the game assists understanding of the channels through which large-country tariffs affect welfare.

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[9] First round solutions can range from autarky to free trade as students acquire an appreciation for the parameterisation of the game. The range of solutions is usually narrower in subsequent rounds.

[10] Efficiency losses outweigh terms of trade improvements as τ^{α} increase. Hence, a higher terms of trade is not necessarily associated with higher utility.

[11] Providing trade is not prohibited, both nations will experience similar efficiency losses but the country that chooses the highest tariff will experience a terms of trade improvement. Hence, the country that sets the highest tariff will also gain the highest level of utility. However, this is not to say that choosing a higher tariff than ones trading partner is a dominant strategy.

[12] Holt and Capra (2003) outline how such a game can be played using playing cards.

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Table A.1: Alpha's utility under alternative tariff regimes

τ^{β}	τ^{α}														
	0.00	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**
0.00	1000.00	1004.92	1008.11	1009.77	1010.09	1009.20	1007.24	1004.32	1000.53	995.97	990.71	984.81	978.34	971.35	968.91
0.05	994.52	998.88	1001.53	1002.68	1002.49	1001.11	998.67	995.28	991.04	986.03	980.33	974.00	968.91	968.91	968.91
0.10	989.75	993.58	995.72	996.37	995.70	993.85	990.96	987.12	982.44	977.01	970.89	968.91	968.91	968.91	968.91
0.15	985.62	988.95	990.60	990.78	989.65	987.35	984.02	979.76	974.66	968.91	968.91	968.91	968.91	968.91	968.91
0.20	982.08	984.92	986.11	985.83	984.26	981.53	977.78	973.12	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.25	979.05	981.43	982.17	981.46	979.47	976.34	972.19	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.30	976.51	978.45	978.76	977.63	975.24	971.71	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.35	974.39	975.91	975.81	974.28	971.50	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.40	972.68	973.78	973.29	971.38	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.45	971.32	972.03	971.16	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.50	970.29	970.63	969.38	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.55	969.57	969.54	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.60	969.12	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.65	968.92	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91
0.70	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91	968.91

Note: τ^{α} and τ^{β} denote *ad valorem* tariffs levied by Alpha and Beta, respectively; Beta's utility is derived symmetrically; and utility is 968.91 in each nation in autarky.

Table A.2: Alpha's terms of trade under alternative tariff regimes

τ^{β}	τ^{α}														
	0.00	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**
0.00	1000.00	1023.30	1046.35	1069.13	1091.67	1113.97	1136.04	1157.87	1179.47	1200.85	1222.01	1242.95	1263.68	1284.20	-
0.05	977.23	1000.00	1022.51	1044.77	1066.79	1088.56	1110.11	1131.41	1152.50	1173.36	1194.00	1214.42	-	-	-
0.10	955.71	977.98	1000.00	1021.77	1043.29	1064.57	1085.62	1106.44	1127.04	1147.41	1167.57	-	-	-	-
0.15	935.34	957.14	978.70	1000.00	1021.06	1041.88	1062.47	1082.84	1102.97	-	-	-	-	-	-
0.20	916.02	937.39	958.51	979.37	1000.00	1020.39	1040.55	1060.48	-	-	-	-	-	-	-
0.25	897.69	918.64	939.34	959.80	980.02	1000.00	1019.75	-	-	-	-	-	-	-	-
0.30	880.25	900.82	921.13	941.20	961.03	980.63	-	-	-	-	-	-	-	-	-
0.35	863.66	883.85	903.80	923.50	942.97	-	-	-	-	-	-	-	-	-	-
0.40	847.84	867.68	887.28	906.64	-	-	-	-	-	-	-	-	-	-	-
0.45	832.74	852.26	871.53	-	-	-	-	-	-	-	-	-	-	-	-
0.50	818.32	837.52	856.48	-	-	-	-	-	-	-	-	-	-	-	-
0.55	804.53	823.44	-	-	-	-	-	-	-	-	-	-	-	-	-
0.60	791.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.65	778.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: τ^{α} and τ^{β} denote *ad valorem* tariffs levied by Alpha and Beta, respectively; and Beta's terms of trade are derived symmetrically.

A Tariff Setting Game: Student Instruction and Results Sheet

Consider two countries, Alpha and Beta, which produce two goods, X and Y, under conditions of increasing opportunity costs. The two countries are identical in every aspect except for tastes. Residents of Alpha prefer to consume large amounts of Y whereas residents of Beta prefer to consume large amounts of X. Preferences are symmetric (i.e. Alpha's liking for good Y matches Beta's liking for good X etc.). If there is free trade, which country will export X? Which country will export Y?

You will be divided into six groups and assigned a country type and number. Do not disclose your country details to other groups. Your group will trade with the group of opposite number and similar type – there will be three trading pairs (Alpha 1 and Beta 1, Alpha 2 and Beta 2, and Alpha 3 and Beta 3).

Figure 1 at the front of the class displays Alpha's utility and terms of trade for various *ad valorem* import tariffs levied by Alpha when Beta commits to free trade. (*Note:* the game is symmetric so the diagram can also be interpreted to display Beta's utility and terms of trade when Beta chooses a positive tariff and Alpha commits to free trade). Your objective is to maximise your county's utility by choosing an *ad valorem* import tariff. Your chosen tariff must be a multiple of 0.05. Use the diagram at the front of the class to assist your decision but remember that your trading partner will not necessarily choose a zero tariff. The game will last for three rounds. Record your outcomes in the table below.

Results from the tariff setting game

Round	Your tariff	Partner's tariff	Your utility	Your terms of trade
0	0	0	1000.000	1000.00
1				
2				
3				