

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

Bell & Howell Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

UMI[®]



Université d'Ottawa • University of Ottawa

**INTERNATIONAL TRADE POLICY: A GAME-THEORETIC APPROACH
WITH SPECIAL-INTEREST GROUPS AND OPTIMIZING POLITICIANS**

**A thesis
Submitted to
the School of Graduate Studies and Research of the University of Ottawa
in partial fulfillment of the requirements for the degree of**

**Doctor of Philosophy
in
Economics**

by

© Ram Chandra Acharya

January 1999



National Library
of Canada

Acquisitions and
Bibliographic Services

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale
du Canada

Acquisitions et
services bibliographiques

395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-45167-4

CONTENTS

ABSTRACT	viii
ACKNOWLEDGMENTS	x
CHAPTER 1 THE THESIS, ITS OBJECTIVES, AND ITS CONTRIBUTIONS	
1. Background	1
2. The Objectives of the Thesis and Its Contributions	7
CHAPTER 2 THE MODEL AND ITS SOLUTION	
1. Introduction	26
2. The Model	26
2.1. Rent Maximization	28
2.2. Demand for Final Consumption	29
2.3. Market-Clearing Conditions and Payoffs	31
2.4. The Extensive Form of the Game	33
2.5. Equilibrium	35
3. Solving the Model	37
CHAPTER 3 VERTICAL LINKAGES AND THE STRUCTURE OF PROTECTION	
1. Introduction	44
2. Neither Industry is Organized	46
3. Only the Downstream Industry is Organized	48
4. Only the Upstream Industry is Organized	53
5. Both Industries are Organized:	
The Case of the Steel and the Automobile Industries	58
6. Numerical Example	64

6.1. No Industry is Organized	66
6.2. The Downstream Industry is Organized	67
6.3. Only the Upstream Industry is Organized	70
6.4. Both Industries are Organized	71
6.5. Pareto Efficient Frontier in Vertically Related Industries	71
6.6. The Lobbying Decision	77
6.7. A Graphical Illustration of Endogenous Trade Policy	83
7. Conclusions	89
APPENDIX A. Complete Solution to Two Industry Model When $\gamma_1 = 0.4$	91
APPENDIX B. The Endogenous Behavior of Trade Policy and Rental Income at Varying Levels of Revenue Share of Intermediate Input	92
CHAPTER 4 HORIZONTAL LINKAGES AND THE STRUCTURE OF PROTECTION	
1. Introduction	93
2. No Industry is Organized	95
3. Only the Non-traded Good Industry is Organized	99
4. Only the Final Consumption Good Industries are Organized	102
5. Only the Intermediate Input Industry and the Non-traded Final Consumption Good Industry are Organized	104
6. All Three Industries are Organized	106
7. The Numerical Solution to the Model: A Case of Three Industries	109
7.1. No Industry is Organized	112
7.2. Only Industry 3 is Organized	113
7.3. Industries 1 and 3 are Organized	114
7.4. Industries 2 and 3 are Organized	117
7.5. All Industries are Organized	120
7.6. The Pareto-Efficient Frontier	120

7.7. Endogenous Behavior of Trade Policy: A Graphical Illustration	131
8. Conclusions	133
APPENDIX C. Solution to the Model with Three Industries When Goods are Gross Substitutes in Consumption	135
APPENDIX D. Solution to the Model with Three Industries When Goods are Gross Complements in Consumption	136
CHAPTER 5 INTER-INDUSTRY TRADE, MULTIPLE LINKAGES AND THE STRUCTURE OF PROTECTION	
1. Introduction	137
2. No Lobby Group	141
3. One Lobby Group	144
4. Two Lobbies: The Case of Textiles and Apparels	152
5. The Traded and Non-Traded Pure Final Consumption Good Industries are Organized	154
6. Two Lobbies: The Case of the US Sugar Industry	157
7. The Grand Lobby: The Sugar Industry Revisited	161
8. Numerical Example	164
9. Conclusions	171
APPENDIX E. The Signs of Cross Price Effects of Excess Demand Functions of Traded Goods in Case of Three Consumption Goods	173
APPENDIX F. The Derivation of Proposition 3.3	182
SUMMARY AND DIRECTIONS TO FUTURE RESEARCH	185
REFERENCES	188

ABSTRACT

With industry lobby groups and optimizing politicians. I have derived trade policies endogenously for a small open economy using game-theoretic approach. I have extensively studied the effects of linkages among industries on their structure of endogenous protection for vertically related industries, horizontally related industries, and for industries which have multiple linkages both through production and consumption.

In vertically related industries, I have found that the structure of protection of a downstream (upstream) industry depends on the nature of backward (forward) linkages. Among other results, I have shown that in Nash equilibrium, a downstream industry may support the protection of an upstream industry (a case so far considered a puzzle).

In the second model, I have incorporated a non-traded good which is horizontally linked with the traded good and have shown that a non-traded industry can *derive* protection by lobbying in trade policy formulation. Even if only the non-traded good industry is organized, it distorts what otherwise would have been the free trade situation. It is shown that if the traded and the non-traded good industries are producing gross substitutes (complements) the lobby groups representing these two industries reinforce (cancel) each others' efforts to obtain higher profit.

In the third model, I have studied the effects of multiple linkages among industries on the structure of protection. It is shown that there is no one-to-one correspondence between the representation of an industry by a lobby group and its protection through an import tariff or export tax. The net effect of lobbying of an industry depends on how its lobbying activity is neutralized or reinforced by other lobby groups. This model could explain the protection episodes of sugar, sugar user, textile, apparel and wheat industries in the United States.

Besides deriving various theoretical results, given taste and technology parameters, I have solved the three-stage game of endogenous trade policy numerically and computed the Pareto efficient frontier. The frontier may be a single point or a line segment. If the frontier is a single point, the game has a unique truthful Nash equilibrium, whereas if it is a line segment, it has a continuum of truthful Nash equilibria.

Key Words: Lobby groups; Endogenous trade policy; Vertical linkages; Horizontal linkages; Multiple linkages; Backward linkages; Forward linkages; Non-Traded goods; Pareto-efficient frontier; Truthful Nash equilibrium.

JEL Classification: D72, F13

ACKNOWLEDGMENTS

I have been privileged to work under the supervision of Professor Nguyen Van Quyen. He was generous enough to supervise me in the area that I had chosen to work in. Without him, it would have been impossible to write a thesis in international trade in this department. His constructive comments have helped in making this dissertation.

I would also like to thank professors Keith Acheson, Vivek Dehejia, and Stanley Winer of Carleton University, David Gray of University of Ottawa, and the external examiner, Professor Roger Ware of Queen's University. They were members of my thesis committee and have helped in improving it.

My father could not go to school because of the social taboo that if any Acharya attended school, something tragic would happen. However, he was bold enough to challenge that taboo by sending me and my brothers to school. Throughout his life, he contributed towards my education along with my mother. I am constantly inspired by his courageous deeds. After my father's death 17 years ago, my mother single-handedly supported my education. I lost her while I was in the process of completing the thesis. I can never say enough about my mother—a woman full of energy, dedication, and love. Nepal, my home, will never be the same without her.

I am very fortunate to have Sita as my wife. For the last 24 years since we have been married, she has been funding my education in many ways. She took total responsibility in raising our two sons, Sudeep and Sunil, and conducted all household chores after we moved to Canada. Sita, you have been so wonderful and supportive that I do not have enough words to describe how much I owe you. I learnt typing from my son, Sudeep. I still wish I could type as fast as him. Thank you Sudeep for being so helpful and always ready to support your Buba (dad). I am proud of you. Son, Sunil, has always been the one to discuss about English writing. He has a wonderful trick in English composition even at the early age of 15. When in doubt, we follow his advice. Sunil, your smile kept me inspiring even when I had difficult moments during my thesis writing. My friends sometimes asked me how I could write a thesis with two teenagers in the family. Now, I have the answer. It would have been much more difficult without Sita, Sudeep and Sunil.

I would like to thank Dr. Paz Buthedahl who was associated with International Development Research Centre (IDRC) when I began the program. She had been very helpful in encouraging me to start the program. My friend, Troy Joseph, a graduate student at Carleton, has been helpful in several ways. Thank you Troy for your support. I would also like to thank Luce Laviolette, the Administrative Assistant in the department, who has been very supportive throughout my graduate period. Last but not least, I would like to thank IDRC for its financial support.

Ram Acharya

CHAPTER 1

THE THESIS, ITS OBJECTIVES, AND ITS CONTRIBUTIONS

1. Background

Real-world observations are seemingly at odds with the view that the state sets trade policies in pursuit of the single-minded goal of realizing aggregate economic efficiency. For a small open economy with no domestic distortions and no distributional issues, neoclassical trade theory asserts that the level of the optimal tariff is in fact no tariff at all. Yet many governments actively erect tariff walls to protect domestic industries. Two three decades ago, no coherent framework was available to explain the observed structures of protection. The process of tariff formation was treated as a black box, with tariffs determined in a political environment not amenable to economic analysis. However, there is now a growing consensus among trade economists that trade policies are determined jointly by economic and political factors, and therefore they are endogenously determined within the system.

Models of endogenous trade policy formation can be classified into three broad categories: models with incumbent governments; models with competition among political parties; and models with direct democracy.

The models with incumbent governments generally consider political outcomes to be the result of the government's response to demands from different groups in the economy. These types of models can further be divided into demand side and supply side models.

In demand side models, the lobby groups solicit the government to obtain favorable trade policies. Findlay and Wellisz (1982) develop a two-sector model characterized by constant returns to scale and perfect competition. In their model, both sectors use mobile labor and sector-specific capital in their production process. The import industry group lobbies for import tariffs, while the export industry lobbies for free trade. The size of the tariff is increasing in the import-competing industry's lobbying effort, and is decreasing in the export industry's lobbying effort. The Nash equilibrium in the two lobby groups' lobbying strategies determines the level of protection. In this model, both sectors use labor as an input for lobbying activities. Therefore, the total cost of lobbying is the amount of labor used multiplied by the wage rate in the economy.

Feenstra and Bhagwati (1982) allow both labor and capital to be used in lobbying activities, but they focus on a case where only a single industry is politically active. In addition to the standard economic costs of protection, they introduce the costs associated with tariff seeking. In their model, the state seeks to limit the economic costs of socially permissible protection through the "efficient tariff". The revenue thus generated can be used by the state to bribe tariff seekers to accept a lower tariff and to spend less on tariff seeking.

These demand side models implicitly assume certain types of lobbying functions for the government and hence do not explain the supply side of the market.

The supply side model of endogenous trade policy started with the article of Stigler (1971) and was applied in international trade policy formation by Hillman (1982) for declining industries. Later, Long and Vousden (1991) formalized a model under the general equilibrium framework. These researchers distinguish between three groups in a two-good economy: two specific factor owners in two industries and owners of the mobile factor, which is labor. They use the political-support function for the government, which includes the indirect utilities of all three groups, with exogenous weights for each group, reflecting the government's preferences over the three groups. In their model, the tariff is generated by maximizing the political-support function. Under fairly reasonable conditions, they confirm Hillman's result that 'a declining industry will continue to decline'.

These supply side models use political support functions rather than measures of social welfare to study trade policy. They are unable to explain the action taken by different lobby groups. The demand side of protection, made up of different economic actors, is passive in these models. Only the supply side, namely the incumbent government, generates the optimal trade policies.

Grossman and Helpman (1994) combine both demand and supply sides in order to study the endogenous formation of trade policy. The lobby groups make political contribution schedules in order to influence the policy adopted by the government. Moreover, the contributions vary according to the trade policy chosen. The government, on the other

hand, sets trade policy based on the contributions provided by different lobby groups in the economy, as well as on some measure of social welfare.

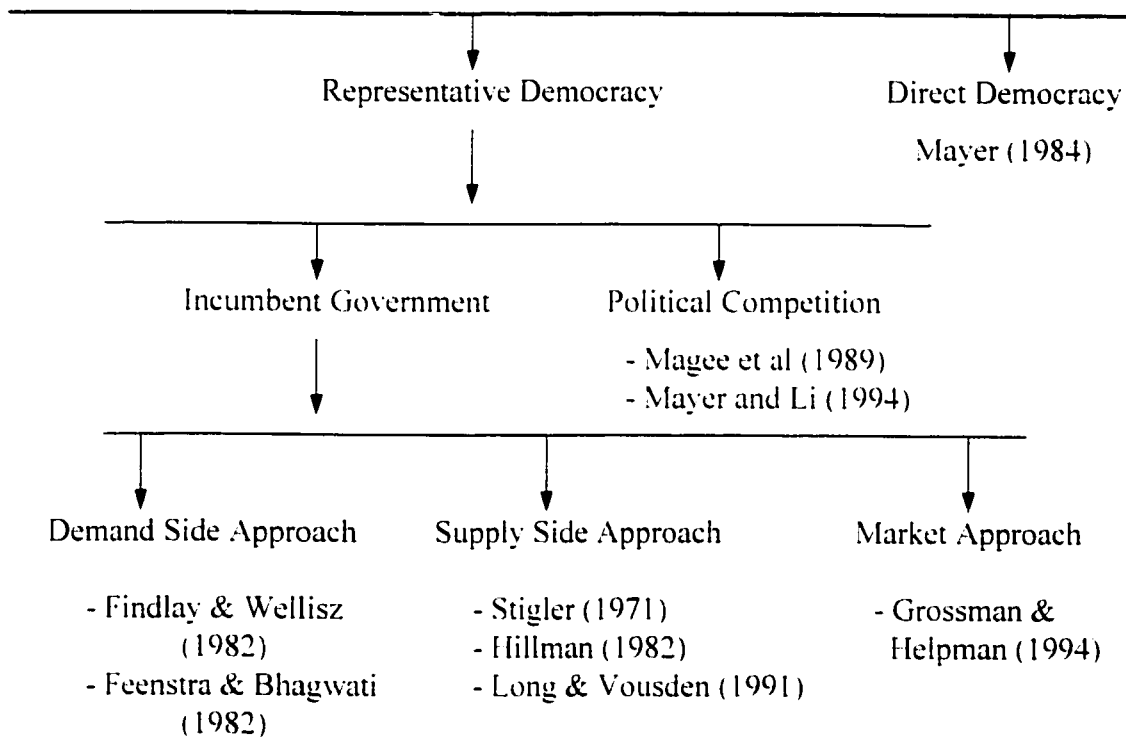
In all the above models with incumbent governments, there are no political parties competing for election. The incumbent government chooses the trade policy with an eye to the prospect of re-election. The government selects a policy that maximizes its objective function, which depends on consumer surplus, producer surplus, and tariff revenues. The model of endogenous trade policy determination with political competition is expounded by Magee et al. (1989). There are two political parties representing protectionist and free trade interests. Before an election, each party commits to the trade policy it would implement if elected to office. After considering the platforms of the two political parties, each lobby group decides how much to contribute to each party. Each party could improve the probability of its election based on the size of political contributions from the various lobbies.

The implication of political competition is that lobbying is intended to affect election outcomes, not policy outcomes, as analyzed by Grossman and Helpman. This model has been criticized by Austen-Smith (1991) for restricting each party's platforms to either pro-export or pro-protection and using probabilistic voting without a rational choice foundation. Mayer and Li (1994) have tackled both criticisms in their research.

In the above two types of models with incumbent governments and political competition, trade policies are determined through representative democracy. They are decided either by the incumbent government, or by the winning party after they have won power. Mayer (1984) develops a direct democracy model, where the tariff level is determined by voting among the population. According to this model, if voting is costless and

preferences are single peaked, the implementation of the median voter's preference will be the outcome of majority voting. Thus the endogenous level of trade policy is determined as if a policy maker maximizes the utility of the median voter. This is a fully specified political economy model. However, trade policy is rarely determined by majority voting. In practice, democracies are of the representative type rather than of the direct type. The outline of the above discussion is presented in the following table.

TABLE 1—THE MODELS OF ENDOGENOUS TRADE POLICY DETERMINATION



Whether trade policies are designed by the incumbent government or whether they are determined by the election platforms is an unsettled issue. A related and more fundamental question is whether different lobby groups contribute to influence the policy of the government or to influence the election outcomes. Since there is little evidence of parties

taking completely opposite stands on trade policy issues, a lobby group may not be sure about which group it should contribute to in an election campaign. Thus it seems reasonable to assume that contributions would be made to influence policy outcomes from the incumbent government, rather than to influence the election of candidates with the favored ideology.

In this thesis, I have used the incumbent-government approach to derive trade policies endogenously. I believe that in a representative democracy, government cares about political contributions and the prospect of re-election. The special-interest groups representing industries provide contribution money to the government to buy economic influence. The incumbent government, on the other hand, chooses trade policies by balancing the contributions from different lobbies and the overall social welfare of society. The government could use political contributions provided by different lobbies to finance campaign for election or for personal use.

Following Olson (1965), who explained how rational individuals driven by self interests might succeed in creating a group, I assume that the specific factor owners in some industries will be able to organize in order to raise the price of their product, and hence their rental income. I do not attempt to explain how lobby groups are formed, but simply assume that they have found some mechanisms to coordinate the efforts of their members and successfully behave as rational unified economic agents.

To derive the trade policy endogenously, I use a three-stage game. In the first stage of the game, different industry interest groups offer contingent political-contribution schedules to the government in an attempt to influence the policy implemented. Based on these

schedules proposed by different lobby groups, the government decides on the trade policies by maximizing its political payoff function, which is a linear combination of contributions from lobby groups and the standard social welfare measure given by the sum of consumer surplus, producer surplus, and tariff revenues. After the trade policies, and hence the domestic price levels, are decided by the government, consumers and producers make their decision about consumption and production, respectively. The lobby groups also pay the government the amounts promised at the beginning of the game. Thus both trade policies and contributions are derived endogenously.

2. The Objectives of the Thesis and Its Contributions

The thesis deals with the structure of protection for a small open economy. A small country can export and import an unlimited amount of goods without affecting international prices. In this sense, the country is a price taker. If perfect competition prevails, and if there are no distortions in the factor and product markets and no distributional issues, then free trade is the optimal policy for such a small open economy. However, if producers lobby for the protection of their industries, their efforts will result in a divergence between the domestic price and the international price of a commodity. By introducing such behavior into a trade model, I can show that for a small economy, the trade policy chosen will be different from free trade.

In the literature on endogenous trade policy determination, most researchers have only followed an industry-by-industry approach. In their analyses, the protection of an industry is determined by the economic structure and the lobbying conditions of the same

industry. These models are unable to account for any possible linkages among industries and the effects of such linkages on the structure of protection of a particular industry. An industry might be related to other industries either in consumption or/and production activities. For example, the steel and automobile industries are related through production, as the former's output is used as an input to the latter's production process. Similarly, the computer and semiconductor industries are also related in production. The sugar and the high fructose corn syrup-industries are related through consumption because the latter product can be used instead of sugar in the beverage industry.

If industries are related either in production, in consumption, or in both, then the direction and the magnitude of protection of an industry depends not only on its own economic structure and lobbying position, but also on how the lobbying activities of various industries cancel or reinforce their efforts to buy economic influence from an optimizing government. There does not exist any model of political economy which includes these linkages, except the two-sector general equilibrium model, where two industries are related through the relative price by its very own construct. In these two-sector models, one industry produces the importable good, and the other the exportable good, thereby highly aggregating several industries into two categories. However, in the real world, I have not seen industries forming a collusion based on their pattern of trade. Needless to say that by aggregating industries into two sectors, such types of model severely restrict their explanatory power.

In order to fill this lacuna in research, the thesis formulates several multi-industry models under the partial equilibrium framework with the help of the theoretical machinery

developed by Bernheim and Whinston (1986), and applied by Grossman and Helpman (1994, 1995) in analyzing the endogenous determination of policy.

Since both Grossman and Helpman's model and my thesis use the same conceptual framework developed by Bernheim and Whinston, I would like to indicate how my approach differs from that of Grossman and Helpman. In their model, the supply of and the demand for the product produced by each non-numeraire industry depends only on its own price. The implication of this structure is that whenever the price of a product produced by a non-numeraire industry rises from the initial equilibrium, then some of the labor previously employed in numeraire industry will be transferred to this non-numeraire industry in order to raise its output. With the rise in its price, the consumption of this non-numeraire good will fall. However, the rise in its price will not affect the level of consumption of other non-numeraire goods. The opposite situation happens if the price of the product produced by a non-numeraire industry falls. Therefore, if there is a change in the price of a non-numeraire good, and hence a change in its level of production and consumption, the only sector that is affected in Grossman and Helpman's model is the numeraire industry.

Therefore, the lobbying activity of a non-numeraire industry does not affect the price and the level of production and consumption of the products produced by other non-numeraire industries. It affects only the level of production and consumption of the numeraire good, which is freely traded by assumption. In that sense, the industry producing the numeraire good is a residual sector. Because of this approach, every organized industry receives import tariff or export subsidy and every unorganized one faces import subsidy or export tax in their model.

In my models, the supply of and the demand for a product depends on its own price and the prices of other products. Hence, whenever, there is a change in the price of a product, it is possible that output of all the numeraire and non-numeraire goods may change in equilibrium. This framework implies that the lobbying efforts of one industry may affect the production and consumption decisions of all other industries. Thus there is potentially a ripple effect all over the economy once an industry is organized.

Moreover, I have built a model where an intermediate good is an input in the production of another good. I have also introduced consumption interdependence between traded and non-traded goods and between traded goods. There is thus a whole range of substitution occurring on all over the industries in my models which is absent in their model. Because of this broader framework, I have been able to derive interesting results that were not possible under Grossman and Helpman's model.

In Grossman and Helpman's model, a lobby group owns both labor and specific capital, and it consumes the product produced by its own industry. Therefore, in their model, the lobby group cares about both net profit and the consumer surplus from the product it is producing. As a result, while making political contribution, the lobby group has to weigh the opposite effects on producer surplus and consumer surplus as a result of a change in the price of a product as well as the net tax revenue transfer that ensures a balanced public budget.

However, in my model, the representative consumer is not a producer. The consumer owns only labor which earn a fixed money wage. And the lobby does not care about the consumer surplus because the lobby members are not the ones who are consuming their product. The lobby's interest is to raise the producer surplus.

In practice, even if the lobby members consume the product they are producing, the fraction of consumption is so negligible that it is not worthwhile for them to worry about the loss of consumer surplus resulting from the higher price of their product. Thus the model where the lobby groups maximize the net payoff — net of contribution — might be more relevant than the one where the lobby groups maximize the net payoff *plus* the consumer surplus and tariff revenues.

Finally, and also importantly, I have solved the game numerically and computed the Pareto efficient frontier. As a byproduct of the numerical exercises, I have been able to obtain several interesting insights — to be explained in the following chapters — which make the model richer and more intuitive.

The rest of the thesis is organized as follows. The theoretical model is formulated in Chapter 2. This model is applied in Chapters 3, 4, and 5 to analyze specific issues such as the effects of vertical linkages, horizontal linkages, and multiple linkages on the structure of protection for the industries involved. In Chapter 3, I study the structure of protection for vertically related industries. There are two traded good industries in the model. One of them produces a final consumption good, and the other produces an intermediate good used as an input by the final good industry. In Chapter 4, I extend the model in Chapter 3 by introducing a non-traded consumption good industry. There are now two consumption goods and one pure intermediate input. Thus the industries are related either vertically or horizontally to each other. The initial model is extended again in Chapter 5 by allowing the intermediate good also to be used as a consumption good. As in Chapter 4, I still have one non-traded consumption good. The main structure of the thesis is presented below in Table 2.

TABLE 2—STRUCTURE OF THE THESIS

	Traded Goods			Non-Traded Goods	Number of Consumption Goods
	Pure Final Consumption Good	Pure Intermediate Good	Consumption cum Intermediate Good	Pure Final Consumption Good	Social Welfare
Chapter 3	1	1	none	none	1
Chapter 4	1	1	none	1	2
Chapter 5	1	none	1	1	3

The central theme of the thesis, which is captured in all the above three models, is that since a good might be related to other goods in production, or in consumption, or in both, the level and structure of protection of an industry is affected not only by its own lobbying activities, but also by the lobbying activities of other industries. As a result, the endogenous protection of an industry cannot and should not be studied in isolation. The interdependence among different industries is fundamentally important for endogenous protection. Thus the thesis formalizes several multi-industry models and analyzes the linkages among them in order to determine their structure of protection.

In the first model, where industries are vertically related, one industry uses the product of the other industry as an input. In this vertically related industrial set-up, I have been able to identify the criterion to evaluate whether the downstream (final good producing) industry will support or oppose the protection of an upstream (input-producing) industry, and vice versa. To my knowledge, this has not been performed in the literature. It seems obvious

(but not shown in any formal model in the literature) why the *using* industry may oppose the protection of an input-producing industry. However, there is no convincing reason why, in some of the cases, the using industry supports the protection of an input-producing industry. Why does the sugar-using industry support the protection of the sugar industry, and the apparel industry support the protection of the textile industry? Why does the automobile industry not oppose the voluntary export restraints (VERs) on the steel industry? All these cases have been characterized as puzzles in the literature. I have developed a tractable model to show that the decision of downstream industries to coalesce with upstream industries for the protection of the latter is the result of Nash equilibrium generated by the rational choice of various economic actors: the government, producers, and consumers. By doing so, I provide a long overdue solution to a puzzle in international trade policy.

Similarly, I have managed to show that the upstream industry may support or oppose the protection of the downstream industry depending upon whether the rents obtained by the specific-factor owners in the upstream industry rise or fall due to lobbying by final-good industries. The main results in Chapter 3 are summarized below.

If none of the industry is organized, then no industry will receive (face) an import tariff (subsidy) or export subsidy (tax) in my model. Since there are no other distortions, if the lobbies are absent, then free trade will be the optimal policy. In the absence of lobby groups, the government maximizes the standard social welfare function, thereby implementing free trade. Therefore, the level of welfare the government receives under free trade defines the participation constraint for the government in the lobbying game. If by accepting the contribution from a lobby group and implementing prices different from their

free trade levels, the payoff of the government falls below the amount it obtains under free trade, the government will stay out of the game.

If there are lobby groups, the optimal policy may differ from free trade levels. Consequently, the payoffs of lobby groups and the government will be different from their free trade levels.

In the model, if only the downstream industry is represented by a lobby group, it will be protected by an import tariff or export subsidy, while the upstream industry may obtain (face) an import tariff (subsidy) or export subsidy (tax). Therefore, the rental income of the downstream-industry lobby group rises, whereas the rental income of the specific-factor owners in the upstream industry may rise or fall. The rental income of the latter group follows the movement of the price of its own product. Thus depending on whether the price of the product of the upstream industry rises above or falls below free trade levels, the upstream industry supports or opposes the protection of the downstream industry.

If only the upstream industry is organized, the prices of the products produced by both the upstream and the downstream industries rise above their free trade levels. The increase in the price of its product necessarily raises the rental income of the upstream-industry lobby above the free trade level. However, even though the price of its product rises, the rental income of the downstream industry may rise or fall from the free trade level. In other words, while the upstream industry is organized, the downstream industry obtains nominal protection, but the effective protection may be positive or negative depending on the relative price changes of the products produced by the downstream and upstream industries.

Thus depending on whether the effective protection is positive or negative, the downstream industry will support or oppose the protection of the upstream industry.

If both vertically related industries are organized, then the downstream industry obtains an import tariff or export tax, whereas the direction of protection of the upstream industry is ambiguous. The protection of the semiconductor and computer industries and the protection of the steel and automobile industries, which are related vertically, can be analyzed using my model.

Considering the formulation of two way backward and forward linkages and their implication for the structure of protection in vertically related industries, I have been able to address what Rodrik (op cit. 1995, p. 1482), writes in his survey article:

Regarding the nature of the industry's output (consumer versus intermediate good) and its market structure, there is again a dearth of theoretical research. It is of course reasonable that intermediate good industries will have a comparatively hard time receiving protection, as long as consumer interests are less well organized and represented than producer interests.

Besides addressing the dearth of theoretical research, my model has also confirmed that an intermediate industry will have a comparatively hard time receiving protection. In a two-industry framework where one industry produces a pure consumption good and the other industry produces a pure intermediate good, I have shown that the price of the final consumption good rises above the free trade level if either of the industries is organized, whereas the price of the intermediate input rises unambiguously only if it is the only industry organized.

I have also solved the game numerically and have derived the Pareto-efficient frontier. If the frontier is reduced to a single point, the game has a unique truthful Nash

equilibrium, whereas if it is a line segment, then I have a continuum of truthful Nash equilibria.

The payoff of the government depends on the number of lobbies and the nature of equilibrium. If there is only one lobby, all the surplus will be extracted by the single lobby, and government's payoff will be equal to that under free trade. Therefore, the contribution the government receives from the single lobby is just sufficient to compensate the loss in social welfare from the free trade level due to price distortion caused by lobbying activities of the single lobby. If there are two lobbies and the equilibrium is unique, the payoff of the government may remain (rise) at (above) free trade level. If the payoff of each lobby is higher when it is the only lobby organized than is the case when both of them are organized, the government payoff rises above the free trade level. However, if the payoff of each lobby is the same when it is the only lobby organized and when both are organized, then the government receives exactly the same level of payoff that it would have received if there were no lobby groups; that is, the payoff under free trade. Finally, if there exists a continuum of truthful Nash equilibria, the payoff of the government remains at the free trade level, and all the surplus is extracted by two lobby groups. In this case, the payoff of each lobby is maximum when both of them are organized.

The summary of all these results is presented in Table 3. In this table, I have shown what happens to the prices of the products produced by both the downstream and upstream industries, their rental income, and the payoff of the government under the following four conditions: (i) when there is no lobby; (ii) when only the downstream industry is represented by a lobby; (iii) when only the upstream industry is represented by a lobby; and (iv) when

both of them are represented by lobbies. The sign ($>$) implies that the domestic price of the product produced by that particular industry is greater than the competitive free trade price:

TABLE 3—STRUCTURE OF PROTECTION AND RENTAL INCOME
IN VERTICALLY RELATED INDUSTRIES

	Level of Nominal Protection		Level of Rental Income		Payoff of the Government	
	Downstream Industry	Upstream Industry	Downstream Industry	Upstream Industry	Unique Equilibrium	Continuum of Equilibrium
No Lobby	0	0	Free Trade Level	Free Trade Level	Social Welfare	
Only Downstream Lobby	> 0	$\neq 0$	\uparrow	\uparrow Constant \downarrow	Constant	
Only Upstream Lobby	> 0	> 0	\uparrow Constant \downarrow	\uparrow	Constant	
Both Lobbies	> 0	$> 0^*, \neq 0$	\uparrow	\uparrow Constant \downarrow	\uparrow Constant	Constant

* the upstream industry will be protected by export subsidy if its product is exported. However, if its product is imported in equilibrium then the result is ambiguous.

the industry under study will be protected by an import tariff or export subsidy. Similarly, the sign ($<$) implies that the industry will face an import subsidy or export tax.

All models of endogenous policy determination in the trade literature have neglected the role of non-traded goods in the formation of trade policy. Since the price of a non-traded good depends on the price of traded goods, it is possible that non-traded good industries engage in lobbying activities for the protection (or for that matter anti-protection) of traded-good industries. I have introduced a non-traded good sector and generated horizontal linkages

between a traded-good industry and a non-traded final consumption good industry. By introducing both tradable and non-tradable sectors and possible linkages among them, I have enriched the analysis of trade policy determination. The basic thrust of my analysis is that since the trade policies do not reflect only markets for traded goods but also markets for non-traded goods, the non-traded good industries have an almost equally important role to play in the formation of international trade policies. This message may sound obvious, but it is an under-stressed fact in international trade policy literature.

In the model of Chapter 4, the traded and the non-traded final consumption goods are related in consumption while the two traded goods are related in production. Therefore, this model captures the horizontal linkages between traded and non-traded final consumption good industries yet maintains the vertical linkages between two traded-good industries.

Even if the traded good industries are not organized, when the non-traded good industry is organized, it distorts what would otherwise have been the free-trade situation. The non-traded industry supports (opposes) the protection of a traded final good industry if it is producing gross substitutes (complements) in consumption. By supporting (opposing) the protection of a traded good industry, which is producing gross substitutes (complements), the non-traded industry derives the endogenous protection. The extent of the *derived* level of endogenous protection of the non-traded industry as a result of the protection of a traded good industry depends on the magnitude of the horizontal linkage between traded and non-traded consumption goods. The magnitude of this horizontal linkage, in turn, depends on the price elasticities of demand and supply of non-traded goods and the cross price elasticity of non-traded consumption good with the traded consumption good.

Similarly, the non-traded good industry gains (loses) by the lobbying activities of the traded-good industries which are producing gross substitutes (complements). We have witnessed that the high fructose corn syrup (the sugar substitutes) producers have benefited from the protection of the sugar industry. The high domestic sugar price has contributed to the use of high fructose corn sweeteners, which increased from less than one-fourth of total caloric sweetener consumption in 1979-81 to almost one half in 1989-91 in the United States. Thus the protection of a traded good has a horizontal linkage inside the economy in the sense that its protection leads to the expansion (contraction) of a non-traded good industry if the two industries are producing gross substitutes (complements) in consumption.

If the non-traded industry is organized, it also affects the structure of protection of another traded good industry which is not directly related with it, but is related with the traded good with which the non-traded good is related. For example, if the non-traded good industry is organized, it also affects the price of traded intermediate input, even though the non-traded good industry and the intermediate input industry are not directly related. Both of them are related, however, with the traded final consumption good: one through production and the other through consumption.

If both the traded and non-traded final consumption good industries are organized, then the prices of their products rise above their free-trade levels only if they are gross substitutes; otherwise, the impact of their lobbying activities on their prices is ambiguous. Moreover, the effect on the price of the pure intermediate good is ambiguous, whether these final consumption goods are gross substitutes or gross complements.

The lobbying activities of the pure intermediate-input industry and the non-traded final good industry raise the prices of all three goods if the traded and non-traded goods are gross substitutes in consumption. However, if they are gross complements in consumption, the net effect is ambiguous for all three industries.

In grand lobbying, i.e., when all three industries are organized, the result again depends on how the consumption goods are related in consumption. I have summarized all these results in Table 4. The traded final good industry is referred to as good 1, the traded pure intermediate input as good 2, and the non-traded final consumption good as good 3. The

TABLE 4—STRUCTURE OF PROTECTION IN HORIZONTALLY RELATED INDUSTRIES

Lobby	Gross Substitutes			Gross Complements		
	Traded Good		Non-Traded Good	Traded Good		Non-Traded Good
	Good 1	Good 2	Good 3	Good 1	Good 2	Good 3
0	0	0	0	0	0	0
01	> 0	≤ 0	> 0	> 0	≤ 0	< 0
02	> 0	> 0	> 0	> 0	> 0	< 0
03	> 0	> 0	> 0	< 0	< 0	> 0
012	> 0	> 0, ≤ 0	> 0	> 0	> 0, ≤ 0	< 0
013	> 0	≤ 0	> 0	≤ 0	≤ 0	≤ 0
023	> 0	> 0	> 0	≤ 0	≤ 0	≤ 0
0123	> 0	> 0, ≤ 0	> 0	≤ 0	≤ 0	≤ 0

lobby group representing each good is also indexed by the same number. For example, the lobby 012 means that industries 1 and 2 are represented by lobby groups, and the three

players in the game are the government (player 0), industry 1 (player 1), and industry 2 (player 2). In Table 4, I have derived theoretical results when the traded and the non-traded final consumption goods are gross substitutes and gross complements in consumption. Again, the positive sign implies that the protection is positive, whereas the negative sign implies that the protection is negative, relative to the free trade level.

I have solved this model numerically and shown that the Pareto efficient frontier will be a point if the traded and the non-traded final consumption goods are gross complements, whereas it is made up of line segments if they are gross substitutes. The government payoff will rise above the free trade level irrespective of the uniqueness of the equilibrium.

In both the vertical- and horizontal-linkages models, each industry is producing either a pure intermediate good or a pure final good. However, in the real world, there are many goods which are used for both purposes. Again, the literature has not been able to accommodate the role of these types of goods in the structure of endogenous protection. To address this issue, I have formulated another model which includes an industry whose product is used both for consumption and production purposes. There are three goods in this model: two traded goods and one non-traded good. Among the traded goods, one is used only for pure consumption, while the other is used both as input in the production of the traded good and for final consumption.

With three consumption goods, there are three possible combinations of interdependence: (i) all goods are gross substitutes; (ii) all goods are gross complements; (iii) one pair of goods is gross complements and the other two pairs of goods are gross substitutes. Furthermore, the last combination consists of three possible relations: (a) two

traded goods being gross complements: (b) traded and non-traded final consumption goods being gross complements: and (c) traded final-cum-intermediate good and non-traded final consumption goods being gross complements.

The effects of an industry on the protection of another industry depend on net effects — net of vertical and horizontal linkages — among all three industries and the level of net output (total domestic production *minus* the level of output used as input by domestic final good industries) of the traded final-cum-intermediate good industry. *Ceteris paribus*, the sign of net output could reverse the direction of protection. Loosely speaking, if the net effects between two traded goods are gross substitutes after the non-traded good market is taken into account, the user industry benefits (loses) if the input industry has positive (negative) net output.

Most of the models in the literature show that an industry represented by a lobby group receives protection, while an industry not represented by a lobby group faces trade taxes, as argued in Grossman and Helpman (*op cit.* 1994). In practice, an organized (unorganized) industry may face (obtain) import subsidy or export tax (import tariff or export subsidy) because of the negative (positive) effects it receives from other industries in the economy. My model has produced interesting results where there may not be a one-to-one correspondence in lobbying activity and the level of protection of an industry. It could happen for instance when the organized efforts of an industry to obtain protection are neutralized by the efforts of other industries or when an industry receives windfall gains by the activities of other industries even if it is not organized. Besides, it is shown that an industry may obtain (face) an import tariff (subsidy) or export subsidy (tax) even if only

industries which are producing gross complements (substitutes) with its product are organized.

With two traded consumption goods, the price of the non-traded good depends on how it is related with two traded consumption goods. Thus whether a non-traded good industry lobbies for the protection of a traded good industry depends on how its lobbying activity would affect both traded good industries.

Through this model, I have been able to explain why the sugar (both a final consumption good and an intermediate input) industry and the sugar-using industry, the textile (both final consumption good and intermediate input) industry and the apparel industry, and the wheat (both final consumption good and intermediate input) industry are protected in the United States.

The results of this model are summarized in Table 5. The level of protection of each industry depends on the nature and magnitude of interdependence among the three industries, the level of net output of consumption-cum-intermediate good, the lobbying status of industries, and, finally, the sign of the cross price effects of excess demand functions. If all goods are gross substitutes, the cross price effects are necessarily positive; however, if a pair of goods or all pairs of goods are gross complements, then the cross price effects on excess demand can take any sign. I have solved the model numerically and shown that the sign

TABLE 5—STRUCTURE OF PROTECTION WITH MULTIPLE LINKAGES

Lobby		Industry 1		Industry 2	
		$D_{1\xi_2}(p) > 0$	$D_{1\xi_2}(p) < 0$	$D_{2\xi_1}(p) > 0$	$D_{2\xi_1}(p) < 0$
0		0	0	0	0
01		> 0	> 0	≤ 0	< 0
02		> 0	< 0	> 0	> 0
03	all substitutes	> 0	x	> 0	x
	all complements	< 0	≤ 0	< 0	≤ 0
	1 & 2 complements	> 0	≤ 0	> 0	≤ 0
	1 & 3 complements	≤ 0	< 0	≤ 0	> 0
	2 & 3 complements	≤ 0	> 0	≤ 0	< 0
012	$y_2(p) > x_{12}(p)$	> 0	≤ 0	> 0	≤ 0
	$y_2(p) < x_{12}(p)$	≤ 0	> 0	≤ 0	< 0
013	all substitutes	> 0	x	≤ 0	≤ 0
	all complements	≤ 0	≤ 0	≤ 0	≤ 0
	1 & 2 complements	> 0	≤ 0	≤ 0	≤ 0
	1 & 3 complements	≤ 0	≤ 0	≤ 0	≤ 0
	2 & 3 complements	≤ 0	> 0	≤ 0	< 0
023		> 0	< 0	> 0	> 0
$D_1 p_2(p) = 0$					
0123	all substitutes				
	$y_2(p) > x_{12}(p)$	> 0	x	> 0	x
	$y_2(p) < x_{12}(p)$	≤ 0	x	≤ 0	x
	all complements				
	$y_2(p) > x_{12}(p)$	≤ 0	≤ 0	≤ 0	≤ 0
	$y_1(p) < x_{12}(p)$	≤ 0	> 0	≤ 0	< 0
	1 & 2 complements				
	$y_2(p) > x_{12}(p)$	> 0	≤ 0	> 0	≤ 0
	$y_2(p) < x_{12}(p)$	≤ 0	≤ 0	≤ 0	≤ 0
	1 & 3 complements				
	$y_2(p) > x_{12}(p)$	> 0	≤ 0	> 0	≤ 0
	$y_2(p) < x_{12}(p)$	≤ 0	≤ 0	≤ 0	≤ 0
	2 & 3 complements				
$y_2(p) > x_{12}(p)$	≤ 0	≤ 0	≤ 0	≤ 0	
$y_2(p) < x_{12}(p)$	≤ 0	> 0	≤ 0	< 0	

x : not relevant

of cross price effects on excess demand depends on the parameters concerning consumption and production and the lobbying status of various industries.

To conclude, I hope that the models I have developed in this thesis will prove useful in furthering the understanding of endogenous trade policy. In his concluding remarks, Rodrik (op cit. 1995, p. 1490) has listed four areas in which he thinks more attention is needed. This author writes:

Third, the theoretical and empirical literature dealing with the determinants of protection across industries, countries and time need to be better integrated.

By investigating the possible linkages among industries as well as the effects of these linkages on the structure of protection, I attempt to fill part of this lacuna. Besides generating several interesting theoretical results, I have also solved the models with two or more lobbies. These numerical solutions represent some contributions to the application of the theoretical machine of a first-price menu auction developed by Bernheim and Whinston (1986) for buying economic influence in the context of trade policy with multiple lobbies.

CHAPTER 2

THE MODEL AND ITS SOLUTION

1. Introduction

In this Chapter, I lay out the detailed framework of the model. The mechanisms for consumer decisions, producers decisions and government best policy responses are outlined in the model. I then solve the model and derive some propositions regarding the Nash equilibrium of the game.

2. The Model

Consider a small open economy in which n commodities are produced. Here n is a positive integer. Each commodity is produced with the help of two primary factors — labor and capital — and, possibly, with other commodities as intermediate inputs. I shall use l and k to

denote labor and capital, respectively. As for the produced commodities, they are indexed by $j, j = 1, \dots, n$.

Let n_1 be a positive integer that I interpret as the number of traded commodities I wish to study in my models. Without any loss of generality, I can assume that these are the first n_1 commodities produced in the small open economy. Each traded commodity I consider can be an intermediate good, a final consumption good, or both.

Associated with n_1 traded goods I consider are n_2 non-traded goods that have some linkages with the n_1 traded goods, where n_2 is a non-negative integer. Such a non-traded good might use a traded good as an intermediate input in its production process or serve as a complement or substitute in consumption for one of the n_1 traded goods. Again, without any loss of generality, I shall assume that these non-traded goods are the next n_2 commodities in the list of the goods produced in my small open economy. The commodities that are endogenous in my model are thus commodities $1, 2, \dots, n_1 + n_2$. Because my model is formalized under the partial-equilibrium framework, I shall assume that $(n_1 + n_2)$ is much smaller than n , the total number of commodities produced in the small open economy.

For each $j = 1, \dots, n$, let p_j be the domestic price of commodity j . Because my model deals only with trade policies — tariffs on imports, subsidies on imported goods, export taxes, and export subsidies — $p_j, j = 1, \dots, n_1$, is both the domestic producers' price and the domestic purchasers' price for the j th traded commodity. Also, to concentrate on trade policies, I shall assume that the n_2 non-traded commodities are neither taxed nor subsidized, i.e., the market-clearing prices for these non-traded commodities are both producers' and purchasers' prices. The domestic prices of the commodities considered in my model are thus

$p_1, \dots, p_{n1}, \dots, p_{n2}$. For each $j > n1 + n2$, because commodity j is exogenous in my model, I shall assume that $p_j = \bar{p}_j = \text{constant}$.

For each $j = 1, \dots, n1$, let p_j^0 be the world price of the j th traded commodity. If commodity j is freely traded, then we must have $p_j = p_j^0$. On the other hand, if the home government intervenes in the market for this commodity, then it derives a wedge, say $\tau_j = p_j - p_j^0$, between the domestic price and the world price of this commodity. If commodity j is imported and τ_j is positive (τ_j is negative), then τ_j is a tariff (τ_j is an import subsidy). On the other hand, if commodity j is exported and τ_j is positive (τ_j is negative), then τ_j is an export subsidy (an export tax).

Because $p_j^0, j = 1, \dots, n1$, are the given world prices of the j th traded commodity, there is a one-to-one correspondence between τ_j and p_j : a choice of the trade tax τ_j implies a choice for the domestic price of commodity j , and vice versa. Hence a vector of trade taxes $(\tau_1, \dots, \tau_{n1})$ can be identified with a vector (p_1, \dots, p_{n1}) of domestic prices of the $n1$ traded commodities, where $p_j = p_j^0 + \tau_j, j = 1, \dots, n1$. For the government, choosing a trade policy is thus equivalent to choosing a domestic price vector (p_1, \dots, p_{n1}) for the $n1$ traded commodities.

2.1. Rent Maximization

For each $j = 1, \dots, n1 + n2$, the owners of the sector-specific capital used in the production of commodity j — what I call the j th lobby — solve the following rent maximization problem:

$$(1) \quad \max_{l_j, x_{ij}} \left[p_j f_j(\bar{k}_j, l_j, x_{ij}) - \bar{w}l_j - \sum_{i=1}^n p_i x_{ij} \right] = \pi_j(p_1, \dots, p_{n1}, \dots, p_{n2}).$$

In (1), f_j is the production function of industry j and is assumed to be linearly homogenous, strictly concave, and continuously differentiable; \bar{k}_j is its sector-specific capital; l_j is its labor input; and $x_{jj'}$ is the amount of goods j' used as intermediate input by industry j in its production process; \bar{w} is the exogenous wage rate; and p_j is the domestic price of commodity j .

I shall let $l_j(p_1, \dots, p_{n_1+n_2})$ and $x_{jj'}(p_1, \dots, p_{n_1+n_2})$, $j' = 1, \dots, n$, be the input demands by industry j , which are the solution of (1). Note that because \bar{k}_j , \bar{w} , $(p_j)_{j=1, \dots, n}$ are exogenous to my model, I have only expressed the input demands as functions of the domestic prices of the commodities considered endogenous in my model. The output that comes out of the rent maximization problem (1) will be denoted by $y_j(p_1, \dots, p_{n_1+n_2})$. Also, observe that the rent obtained by the owners of the specific factor in industry j is denoted by $\pi_j(p_1, \dots, p_{n_1+n_2})$, part of which will be offered to the home government to buy economic influence, and the rest will be kept as income.

2.2. Demand for Final Consumption

Let J be the subset of $\{1, 2, \dots, n_1+n_2\}$ that consists exactly of the goods for final consumption. I shall assume that the consumption demand for these goods is generated by the utility-maximizing behavior of a representative consumer who has a quasi-linear utility function of the following form:

$$\left(m, (z_i)_{i \in J} \right) \rightarrow m + u \left((z_i)_{i \in J} \right).$$

where m represents the consumption of a good taken as the numeraire and, z_j , $j \in J$, represents the consumption of good j . Furthermore, the sub-utility function u is assumed to be quadratic, i.e.,

$$u\left((z_j)_{j \in J}\right) = \sum_{j \in J} \alpha_j z_j - \frac{1}{2} \left(\sum_{i, i' \in J} \beta_{ii'} z_i z_{i'} \right).$$

where $\alpha_j > 0$ for all $j \in J$ and $\beta = (\beta_{ii'})_{i, i' \in J}$ is a positive definite matrix.

Let \bar{m} be the representative consumer's fixed income expressed in terms of the numeraire. Then the demand for $(z_j)_{j \in J}$ is obtained by solving the following utility-maximization problem.

$$(2) \quad \max_{(z_j)_{j \in J}} \left| \bar{m} - \sum_{i \in J} p_i z_i + \sum_{i \in J} \alpha_i z_i - \frac{1}{2} \sum_{i, i' \in J} \beta_{ii'} z_i z_{i'} \right| = v\left((p_i)_{i \in J}, \bar{m}\right).$$

The following first order condition characterizes the solution of (2)

$$(3) \quad -p_j + \alpha_j - \sum_{i' \in J} \beta_{ji'} z_{i'} = 0, \quad (j \in J).$$

I can express (3) under the following matrix form:

$$(4) \quad \alpha_j - p_j = \beta z_j.$$

In (4), I have let α_j represent the list $(\alpha_i)_{i \in J}$ arranged under the form of a column vector such that for any two indices j and j' in J , if $j < j'$, then α_j appears before $\alpha_{j'}$ in the column vector α_j . Similarly, p_j and z_j represent, respectively, the lists $(p_i)_{i \in J}$ and $(z_i)_{i \in J}$ arranged under the form of column vectors in the same manner as $(\alpha_i)_{i \in J}$. Also, β is the matrix $(\beta_{ii'})$ arranged in the following manner:

(i) if $j_1 < j_2$, then the row $(\beta_{i_1, i'})_{i' \in J}$ appears before the row $(\beta_{i_2, i'})_{i' \in J}$;

(ii) if $j'_1 < j'_2$, then the column $(\beta_{i, i'_1})_{i \in J}$ appears before the column $(\beta_{i, i'_2})_{i \in J}$.

It follows directly from (4) that the vector of consumption demand is given by

$$(5) \quad z_j = (z_i)_{i \in J} = \beta^{-1}(\alpha_j - p_j).$$

The quadratic utility function has featured prominently in the literature of decision making under uncertainty. For me, the attraction is that this utility function allows for complementarities and specific substitution effects among goods — as evident from the explicit form of the demand functions represented by (5). The quadratic utility function is particularly attractive for my model in which market linkages as well as a fine classification of goods are emphasized.

Symbolically, I shall write the consumption demand for good $j \in J$ as $z_j((p_i)_{i \in J})$ or in a more general manner as $z_j(p_1, \dots, p_{n_1 + n_2})$. Now if $j \notin J$, then good j is a pure intermediate good and the representative consumer's demand for this good is obviously zero. Hence if I set $z_j(p_1, \dots, p_{n_1 + n_2}) = 0$ for all j in $(\{1, 2, \dots, n_1 + n_2\} - J)$, I will have defined a system of consumption demand functions for all the endogenous good in my model. Finally, note that v , as defined by (2), is the indirect utility function for the representative consumer. In my extended notation, I shall write this indirect utility function as $v(p_1, \dots, p_{n_1 + n_2}, \bar{m})$.

2.3. Market-Clearing Conditions and Payoffs

Let (p_1, \dots, p_{n_1}) be a trade policy implemented by the home government. Such a domestic price vector for goods $1, \dots, n_1$ can always be maintained by appropriate taxes and subsidies on the markets for the n_1 traded goods. Any excess demand will be met by foreign imports and any excess supply will be exported. However, once (p_1, \dots, p_{n_1}) has been chosen, the prices on the

markets for goods $j = n1 + 1, \dots, n1 + n2$ must adjust to equate supplies and demands. The market-clearing conditions for the non-traded goods are given by

$$(6) \quad y_j(p_1, \dots, p_{n1}, p_{n1+1}, \dots, p_{n1+n2}) = \sum_{i=1}^{n1+n2} x_{ij}(p_1, \dots, p_{n1}, p_{n1+1}, \dots, p_{n1+n2}) \\ = z_j(p_1, \dots, p_{n1}, p_{n1+1}, \dots, p_{n1+n2}), \quad (j = n1 + 1, \dots, n1 + n2).$$

Observe that given (p_1, \dots, p_{n1}) , equation (6) represents a system of $n2$ equations in the $n2$ unknowns p_j , $j = n1 + 1, \dots, n1 + n2$. I shall assume that (6) has a unique solution, which allows me to solve for p_j , $j = n1 + 1, \dots, n1 + n2$, in terms of (p_1, \dots, p_{n1}) . Symbolically, I express the dependence of the prices of the non-traded goods on the trade policy (p_1, \dots, p_{n1}) as follows:

$$(7) \quad (p_{n1+1}, \dots, p_{n1+n2}) = \psi(p_1, \dots, p_{n1}) = \left(\psi_j(p_1, \dots, p_{n1}) \right)_{j=n1+1, \dots, n1+n2}$$

Now if the home government has implemented the trade policy (p_1, \dots, p_{n1}) , then the equilibrium price vector for my model is $(p_1, \dots, p_{n1}, \psi(p_1, \dots, p_{n1}))$, and the rent obtained by lobby j is given by

$$(8) \quad \varphi_j(p_1, \dots, p_{n1}) = \pi_j(p_1, \dots, p_{n1}, \psi(p_1, \dots, p_{n1})), \quad (j = 1, \dots, n1 + n2).$$

while the utility of the representative consumer is

$$(9) \quad \phi(p_1, \dots, p_{n1}) = v(p_1, \dots, p_{n1}, \psi(p_1, \dots, p_{n1}), \bar{m}).$$

The excess demand for the j th traded good is

$$(10) \quad \hat{z}_j(p_1, \dots, p_{n1}) = \sum_{i=1}^{n1+n2} x_{ij}(p_1, \dots, p_{n1}, \psi(p_1, \dots, p_{n1})) - z_j(p_1, \dots, p_{n1}, \psi(p_1, \dots, p_{n1})) \\ - y_j(p_1, \dots, p_{n1}, \psi(p_1, \dots, p_{n1})), \quad (j = 1, \dots, n1).$$

The net revenue that results from the implementation of the trade policy (p_1, \dots, p_{n1}) is given by

$$(11) \quad s(p_1, \dots, p_{n1}) = \sum_{i=1}^{n1} (p_i - p_i^0) \xi_i(p_1, \dots, p_{n1}).$$

2.4. The Extensive Form of the Game

The game of endogenous trade policy I formulate is a three-stage game, the extensive form of which can be described as follows.

In the first stage, each industry lobby announces a contingent political contribution schedule to the home government. By a feasible contingent political contribution schedules for lobby j , I mean a continuous function

$$(12) \quad c_j(p_1, \dots, p_{n1}) = \rightarrow c_j(p_1, \dots, p_{n1}), \quad (j = 1, \dots, n1 + n2).$$

that satisfies the following conditions

$$(13) \quad 0 \leq c_j(p_1, \dots, p_{n1}) \leq \varphi_j(p_1, \dots, p_{n1}), \quad (j = 1, \dots, n1 + n2).$$

Here I interpret $c_j(p_1, \dots, p_{n1})$ as the political contributions lobby promises the government if the trade policy (p_1, \dots, p_{n1}) is implemented. The condition represented by (13) asserts that political contributions are non-negative and that a lobby will not contribute more than the rent it makes under any trade policy implemented by the home government. As specified by (12), lobby j buys economic influences by making political contributions contingent upon the trade policies implemented by the home government. Presumably, the more favorable a trade policy is to the interest of a lobby, the more political contributions it will make to the home government.

I shall assume that all the industry lobbies move simultaneously. In choosing a contingent political contribution schedule, a special-interest group must take into account the

political contribution schedules of other domestic special-interest groups as well as the pressure it intends to exert on its own government. I assume that the domestic interest groups can observe the potential political contribution schedules chosen by each other.

In the second stage, the incumbent government, taking as given the contingent political contribution schedules of all the special-interest groups, chooses a trade policy (p_1, \dots, p_{n1}) . I shall assume that the home government does not behave like a benevolent dictator but has its own self interests to pursue. Its foremost concern is clearly electoral success. Hence it cares about political contributions because they can be used to finance election campaigns. Besides the desire for political success, politicians also have a motive for personal financial gains, and political contributions can certainly be used for this purpose. Therefore, political contributions constitute an important argument in the objective function of the home government. Furthermore, because the home government presumably also cares about the welfare of its citizens as well as budget deficits, its objective function should also depend on the utility of the representative consumer, the producers surplus, and the surplus or deficits of the treasury.

In the third stage, the firms in industries $1, 2, \dots, n1 + n2$ take as given the trade policy (p_1, \dots, p_{n1}) implemented by the home government and make their production decisions. For each $j = 1, 2, \dots, n1 + n2$, the payoff, net of political contributions, obtained by the owners of the specific factor used in the production of commodity j is given by

$$(14) \quad \varphi_j(p_1, \dots, p_{n1}) - c_j(p_1, \dots, p_{n1}), \quad (j = 1, \dots, n1 + n2).$$

As for the home government, I follow Grossman and Helpman *op cit.* and assume that, its payoff is given by

$$(15) \quad \Gamma\left(\left(c_i\right)_{i=1}^{n1+n2} \cdot \left(p_1, \dots, p_{n1}\right)\right) = \sum_{i=1}^{n1+n2} c_i\left(p_1, \dots, p_{n1}\right) + \varepsilon \omega\left(p_1, \dots, p_{n1}\right),$$

where $\omega\left(p_1, \dots, p_{n1}\right) = \phi\left(p_1, \dots, p_{n1}\right) + \sum_{i=1}^{n1+n2} \varphi_i\left(p_1, \dots, p_{n1}\right) + s\left(p_1, \dots, p_{n1}\right)$ is the sum of consumer surplus, producers surplus and tariff revenues. In the right hand side of (15), ε is a non-negative constant representing the weight that the home government assigns to social welfare. This specification assigns a weight of 1 to the political contributions received from the $n1 + n2$ industry lobbies.

2.5. Equilibrium

Before presenting the definition of the equilibrium for the game, let us define the best-response correspondence of the home government. To this end, let $\left(c_i\right)_{i=1, \dots, n1+n2}$ be a combination of feasible political contribution schedules for the $n1 + n2$ industry lobbies and define

$$(16) \quad \mathfrak{R}\left(\left(c_i\right)_{i=1}^{n1+n2}\right) = \arg \max_{\left(p_1, \dots, p_{n1}\right)} \Gamma\left(\left(c_i\right)_{i=1}^{n1+n2} \cdot \left(p_1, \dots, p_{n1}\right)\right).$$

As defined, $\mathfrak{R}\left(\left(c_i\right)_{i=1}^{n1+n2}\right)$ represents the set of trade policies that maximizes the home government's payoff, given that the $n1 + n2$ industry lobbies have announced the

combination of contingent political contribution schedules $(c_j)_{j=1}^{n_1+n_2}$. In choosing (p_1, \dots, p_{n_1}) to maximize the right-hand side of (16), the home government is constrained to choose p_j inside a closed and bounded interval of the half positive real line, say $0 \leq p_j \leq \bar{p}_j$, where \bar{p}_j is a positive constant, $j = 1, \dots, n_1$.

DEFINITION: Let $c^* = (c_j^*)_{j=1}^{n_1+n_2}$ be a combination of feasible contingent contribution schedules for the $n_1 + n_2$ industry lobbies and $p^* = (p_1^*, \dots, p_{n_1}^*)$ be a feasible trade policy for the home government. The combination of strategies (c^*, p^*) is said to be a Nash equilibrium if the following two conditions are satisfied.

$$(a) \ p^* \in \mathfrak{R}(c^*);$$

(b) For each $j = 1, \dots, n_1 + n_2$, the following inequality must hold:

$$\varphi_j(p^*) - c_j(p^*) \geq \sup_{p \in \mathfrak{R}(c^*, c_j)} \left| \varphi_j(p) - c_j(p) \right|,$$

where $c^*_j = (c_1^*, \dots, c_{j-1}^*, c_{j+1}^*, \dots, c_{n_1+n_2}^*)$ and c_j is any feasible contingent political contribution schedule for industry lobby j .

Condition (a) asserts that p^* is the best response for the home government against c^* . If (b) holds for a lobby j , then it is sufficient for c_j^* to be a best response for lobby j against c^*_j . This condition is also necessary if c_j^* is a best response against c^*_j . Indeed, if c_j^* is best against c^*_j , but (b) does not hold for lobby j , then one can find a feasible contingent political contribution schedule \tilde{c}_j and a trade policy $\tilde{p} \in \mathfrak{R}(c^*_j, \tilde{c}_j)$ such that

$$\varphi_j(\bar{p}) - \tilde{c}_j(\bar{p}) > \varphi_j(p^*) - c_j^*(p^*).$$

If lobby j adjust \tilde{c}_j slightly by increasing its contribution at \bar{p} from $\tilde{c}_j(\bar{p})$ to $\tilde{c}_j(\bar{p}) + \textit{epsilon}$, then it can certainly induce the home government to choose \bar{p} definitely as its best-response. In this manner, the j th industry lobby's net payoff is strictly higher at \bar{p} than at p^* , contradicting the hypothesis that c_j^* is the j th lobby's best response to c_{-j}^* , which in turn, implies that the combinations of strategies (c^*, p^*) is not a Nash equilibrium.

3. Solving the Model

The following result, which is the Lemma 2 of Bernheim and Whinston (1986) rewritten in my context, gives a general characterization of the Nash equilibria. For a proof of this lemma, the reader can consult the original article.

LEMMA 3.1: *Let $c^* = (c_j^*)_{j=1}^{n1+n2}$ be a combination of feasible contingent contribution schedules for the $n1 + n2$ industry lobbies and $p^* = (p_1^*, \dots, p_n^*)$ be a feasible trade policy for the home government. The combination of strategies (c^*, p^*) is a Nash equilibrium if and only if the following conditions are satisfied:*

$$(a) \ p^* \in \mathfrak{R}(c^*);$$

$$(b) \ p^* \in \arg \max_p \left[\varphi_j(p) + \sum_{i=1, i \neq j}^{n1+n2} c_i^*(p) + \varepsilon \omega(p) \right], \quad (j=1, \dots, n1+n2);$$

(c) for each $j = 1, \dots, n1 + n2$, one can find a trade policy $p^j = (p_1^j, \dots, p_n^j) \in \mathfrak{R}(c^*)$ such that $c_j^*(p^j) = 0$.

Condition (a) asserts that p^* is a best response for the home government against c^* . Condition (b) is more complicated. It asserts that the trade policy p^* maximizes the joint payoff of the j th lobby and the home government. Here note that the payoff for the home government includes the total political contributions from all the lobbies other than j and social welfare.

Now, if $p^* = (p_1^*, \dots, p_n^*)$ belongs to the interior of the set of feasible trade policies and if each contingent political contribution schedule c_j^* , $j = 1, \dots, n1 + n2$, is differentiable at p^* , then using Lemma 3.1a, I obtain the following first-order condition from (15), which characterizes p^* as a best response for the home government against $(c_j^*)_{j=1}^{n1+n2}$.

$$(17) \quad \sum_{j=1}^{n1+n2} Dc_j^*(p^*) + \varepsilon D\omega(p^*) = 0,$$

where D is the differential operator with respect to (p_1, \dots, p_n) . Next, using Lemma 3.1b, I obtain the following first-order condition, which characterizes the maximization of the joint payoff of lobby j and the home government:

$$(18) \quad D\varphi_j(p^*) + \sum_{i \neq j} Dc_i^*(p^*) + \varepsilon D\omega(p^*) = 0, \quad (j = 1, \dots, n1 + n2).$$

Subtracting (17) from (18), I obtain

$$(19) \quad D\varphi_j(p^*) - Dc_j^*(p^*) = 0, \quad (j = 1, \dots, n1 + n2).$$

Equation (19) asserts that if the home government deviates slightly from p^* , then under c_j^* any increase in rent will be given away as political contributions while any decrease in rent will be equally matched by a decrease in political contributions.

Using (19) in (17), I obtain the following proposition.

PROPOSITION 3.2: Let $\left((c_j^*)_{j=1}^{n_1+n_2}, (p_1^*, \dots, p_{n_1}^*) \right)$ be a Nash equilibrium for the games of endogenous trade policy determination. If $p^* = (p_1^*, \dots, p_{n_1}^*)$ belongs to the interior of the set of feasible trade policies and if each contingent political contribution schedule $c_j^*, j = 1, \dots, n_1 + n_2$, is differentiable at p^* , then p^* satisfies the following first-order condition:

$$(20) \quad \sum_{j=1}^{n_1+n_2} D\varphi_j(p^*) + \varepsilon D\omega(p^*) = 0.$$

Researchers, such as Grossman and Helpman *op cit.*, and Fredriksson (1997), have used first-order condition similar to (20) extensively to study the endogenous determination of policies. Under reasonable hypotheses about supply and demand conditions, equation (20), which does not depend on the strategy chosen by the various lobbies, can be solved and expected to have a unique solution. However, this first-order condition by itself is not sufficient to yield a complete solution for the game. To obtain a complete solution of the game, one must also find the $n_1 + n_2$ equilibrium strategies $c_1^*, \dots, c_{n_1+n_2}^*$, and this seems to be a daunting task. First, it is not simple to find $n_1 + n_2$ non-negative continuous functions, namely $c_1^*, \dots, c_{n_1+n_2}^*$, of $p_1, \dots, p_{n_1+n_2}$ such that (i) $c_j^*, j = 1, \dots, n_1 + n_2$, is a best response for lobby j against $c_1^*, \dots, c_{j-1}^*, c_{j+1}^*, \dots, c_{n_1+n_2}^*$. Second, even if one succeeds in finding such a list of equilibrium political contribution schedules, there remains the problem of their uniqueness. Fortunately, Bernheim and Whinston, *op. cit.*, have demonstrated that in searching for a solution of the game, one can restrict oneself to a class of Nash equilibria with a particularly simple structure that they labeled truthful Nash equilibria.

Let μ_j be a given non-negative number. By a *truthful strategy* relative to μ_j for lobby j , I mean a contingent political contribution schedule of the following form:

$$c_j(\cdot, \mu_j): p \rightarrow c_j(p, \mu_j) = \max \left[\varphi_j(p) - \mu_j, 0 \right].$$

In using a truthful strategy, such as the one just defined, lobby j only aims for a net payoff equal to μ_j . More precisely, if its payoff before political contribution is less than μ_j , it will contribute nothing. On the other hand, if its payoff before contribution is higher than the desired net payoff, then anything in excess of μ_j will be given away as political contribution.

A list $\left(\left(c_j(\cdot, \mu_j) \right)_{j=1}^{n1+n2}, p \right)$ is called a *truthful Nash equilibrium* if (i) it is a Nash equilibrium and (ii) the strategies $\left(c_j(\cdot, \mu_j) \right)_{j=1}^{n1+n2}$ are truthful.

To continue with the characterization of the Nash equilibrium, let us define

$$(21) \quad \mu_0^{\max} = \max_p \left| \varepsilon \omega(p) \right|,$$

$$(22) \quad \mu_{\{0\} \cup L}^{\max} = \max_p \left| \sum_{j \in L} \varphi_j(p) + \varepsilon \omega(p) \right|,$$

where $p = (p_1, \dots, p_{n1})$ represents a feasible trade policy and L is a subset of $\{1, \dots, n1 + n2\}$. As defined, μ_0^{\max} is the maximum payoff obtained by the home government if it does not take into consideration the political contributions made by the $n1 + n2$ industry lobbies in computing its payoff, while $\mu_{\{0\} \cup L}^{\max}$ represents the maximum joint payoff for the coalition constituted by the home government and the all lobbies in L if the lobbies outside L do not offer any political contributions.

To this end, I have the following result:

LEMMA 3.3: Let $\left((c_i^*)_{i=1}^{n1+n2}, p^* \right)$ be a Nash equilibrium. Then the following conditions must hold:

$$(a) \quad \varphi_j(p^*) - c_j^*(p^*) \geq 0. \quad (j = 1, \dots, n1 + n2).$$

$$(b) \quad \sum_{j=1}^{n1+n2} \left| \varphi_j(p^*) - c_j^*(p^*) \right| \leq \mu_{\{0,1, \dots, n1+n2\}}^{\max} - \mu_0^{\max}.$$

$$(c) \quad \sum_{j \in L} \left| \varphi_j(p^*) - c_j^*(p^*) \right| \leq \mu_{\{0,1, \dots, n1+n2\}}^{\max} - \mu_{\{0\} \setminus L}^{\max}$$

where L is any proper subset of $\{1, \dots, n1 + n2\}$ and L is the complement of L in $\{1, \dots, n1 + n2\}$.

In the above lemma, (a) asserts that the net payoff for each lobby cannot be negative. Because the home government can always guarantee itself the payoff level μ_0^{\max} by ignoring all political contributions and because the maximum joint net payoff for all the players in the game (the home government plus the $n1 + n2$ industry lobbies) is $\mu_{\{0,1, \dots, n1+n2\}}^{\max}$, the right-hand side of (b) represents the theoretical maximum joint payoff for all the industry lobbies. The left side of (c) represents joint net payoffs for any group of lobbies L . On the right-hand side of (c), the term $\mu_{\{0\} \setminus L}^{\max}$ represents the maximum joint payoff for the coalition consisting of the home government and all the lobbies outside L . Inequality (c) translates the intuitive condition that it is not possible for the group of lobbies L to obtain a joint payoff strictly greater than $\mu_{\{0,1, \dots, n1+n2\}}^{\max} - \mu_{\{0\} \setminus L}^{\max}$ because if this were the case, the joint payoff for the coalition (the home government + the industry lobbies outside L) will be strictly less than $\mu_{\{0\} \setminus L}^{\max}$, the joint payoff this coalition will obtain by ignoring completely the industry lobbies L .

Lemma 3.3 plays a fundamental role in establishing the existence of a Nash equilibrium and in finding the solution of the game. To this end, let \mathbf{M} be a set of vectors $(\mu_j)_{j=1}^{n1+n2}$ that satisfy the following conditions:

$$(a) \quad \mu_j \geq 0. \quad (j = 1, \dots, n1 + n2).$$

$$(b) \quad \sum_{j=1}^{n1+n2} \mu_j \leq \mu_{\{0,1, \dots, n1+n2\}}^{\max} - \mu_0^{\max}.$$

$$(c) \quad \sum_{j \in L} \mu_j \leq \mu_{\{0,1, \dots, n1+n2\}}^{\max} - \mu_{\{0\} \setminus L}^{\max}.$$

where L is any proper subset of $\{1, \dots, n1 + n2\}$ and L^c is the component of L in $\{1, \dots, n1 + n2\}$.

Because \mathbf{M} contains all the vectors of net payoffs for the $n1 + n2$ lobbies, its Pareto efficient frontier \mathbf{M}^* is of particular importance. The following proposition, which gives a constructive proof of the existence of truthful Nash equilibria, is Theorem 2 of Bernheim and Whinston, *op cit.*, rewritten in my context.

PROPOSITION 3.4: Let $(\mu_j^*)_{j=1}^{n1+n2}$ be an element of \mathbf{M}^* and $p^* = (p_1^*, \dots, p_n^*)$ be a trade policy that maximizes the joint payoff of the home government and the $n1 + n2$ industry lobbies, i.e.,

$$(23) \quad p^* \in \arg \max_p \left| \sum_{j=1}^{n1+n2} \varphi_j(p) + \varepsilon_0(p) \right|.$$

Suppose that for each $j = 1, \dots, n1 + n2$, the j th industry lobby adopts the following truthful contingent political contribution schedule:

$$(24) \quad c_j^*(p) = \max \left[\varphi_j(p) - \mu_j^*, 0 \right]. \quad (j = 1, \dots, n1 + n2).$$

Then the combination of strategies $\left((c_i^)_{i=1}^{n_1+n_2}, (p_i^*)_{i=1}^{n_1+n_2} \right)$ is a truthful Nash equilibrium for the game of endogenous trade policy determination.*

Now recall that under any Nash equilibrium, say \mathbf{E} the vector of net payoffs for the n_1+n_2 lobbies belong to \mathbf{M} . Using Proposition 3.4, one can find a truthful Nash equilibrium that gives each lobby at least the same net payoff as under \mathbf{E} . Because what matters for a lobby is its net payoff, not how the net payoff is obtained, one can, therefore, concentrate on the set of truthful Nash equilibria defined in Proposition 3.4 in searching for a solution of the game. Another attractive property of truthful Nash equilibria is that they are stable. Indeed, according to Theorem 3 of Bernheim and Whinston, op cit., a truthful Nash equilibrium is coalition-proof. Also, I observe that \mathbf{M}^* might contain more than one element and, therefore, there might be more than one truthful Nash equilibria. In the case \mathbf{M}^* has exactly one element, the truthful Nash equilibrium is unique.

CHAPTER 3

VERTICAL LINKAGES AND THE STRUCTURE OF PROTECTION

1. Introduction

In this chapter, I consider only two industries: a final-good industry and an intermediate-good industry. These industries are vertically related through production because the final good industry uses the intermediate product as an input. Thus the final good industry is a downstream industry and the intermediate input industry is an upstream industry.

In practice, we have seen two kinds of conflicting behavior: some downstream industries lobby against protection of upstream industries whereas others coalesce with vertically related upstream industries for the protection of upstream industries. It is

understandable why the downstream, i.e., user industry opposes the protection of an input-producing industry because with the protection of the intermediate input, the cost of production of the user industry rises. If the user industry can pass along the increased input cost to its final consumers, then the protection of an input industry may be less damaging for the user industry. If the user industry is a price taker in its market, like in my model, it will be forced to absorb the cost increase and will be more likely to resist protection.

However, in some cases, we have seen that a downstream industry supports the protection of an upstream industry. It has remained a puzzle why it happens. In this chapter, I will analyze these situations in great detail and show why the conflicting behavior of different downstream industries are consistent with their rent maximizing objectives. I will see that the response of a user industry solely depends on the nature of forward linkages from the upstream industry to the downstream industry.

Similarly, I am interested in knowing whether the intermediate input industry in a small open economy may have an incentive to support or oppose the protection of its user industry. Again, the response of an upstream industry depends on the nature of backward linkages passing from the downstream industry to the upstream industry.

The chapter is organized as follows. Section 2 solves the model when neither industry is organized. In Section 3, I consider the case when only the final-good industry is organized. Similarly, the case when only the intermediate-input industry is organized is analyzed in Section 4. Section 5 addresses the issues when both the upstream and the downstream industries are organized. The model is solved numerically in Section 6. Section 7 concludes the chapter.

For the modeling purpose, let the number of traded goods, $n_1 = 2$ and also assume that there are no non-traded goods, that is, $n_2 = 0$. With this assumption, I have only one non-numeraire final consumption good, $J = \{1\}$. Further, let good 1 be the pure final consumption good and good 2 be the pure intermediate good used in the production of good 1.

2. Neither Industry is Organized

When neither industry is organized, the government solves the following welfare maximization problem:

$$(1) \max_{p_1, p_2} \left[\varepsilon \left(\varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \phi(p_1, p_2) + (p_1 - p_1^w) \xi_1(p_1, p_2) + (p_2 - p_2^w) \xi_2(p_1, p_2) \right) \right] = \mu_0^{\max}.$$

The first-order conditions for an interior solution are

$$(2) \quad D_1 \varphi_1(p_1, p_2) + D_1 \varphi_2(p_1, p_2) + D_1 \phi(p_1, p_2) + \xi_1(p_1, p_2) + (p_1 - p_1^w) D_1 \xi_1(p_1, p_2) + (p_2 - p_2^w) D_1 \xi_2(p_1, p_2) = 0,$$

$$(3) \quad D_2 \varphi_1(p_1, p_2) + D_2 \varphi_2(p_1, p_2) + D_2 \phi(p_1, p_2) + (p_1 - p_1^w) D_2 \xi_1(p_1, p_2) + \xi_2(p_1, p_2) + (p_2 - p_2^w) D_2 \xi_2(p_1, p_2) = 0.$$

By Hotelling's lemma, $D_1 \varphi_1(p_1, p_2) = y_1(p_1, p_2)$ is the domestic supply of good 1. Because p_1 is not present in the problem of rent maximization of industry 2, I have $D_1 \varphi_2(p_1, p_2) = 0$.

Also, by the envelope theorem, $D_1 \phi(p_1, p_2) = -z_1(p_1)$, where $z_1(p_1)$ is the representative consumer's demand for good 1. Hence (2) is reduced to

$$(4) \quad (p_1 - p_1^w) D_1 \xi_1(p_1, p_2) + (p_2 - p_2^w) D_1 \xi_2(p_1, p_2) = 0.$$

Similarly, (3) is reduced to

$$(5) \quad (p_1 - p_1^w) D_2 \xi_1(p_1, p_2) + (p_2 - p_2^w) D_2 \xi_2(p_1, p_2) = 0.$$

Because the excess demand for a good is a decreasing function of its own price. I have $D_1\bar{\xi}_1(p_1, p_2) < 0$ and $D_2\bar{\xi}_2(p_1, p_2) < 0$. Now a rise in the price of good 1, ceteris paribus, will cause its supply to go up. The increase in the production in turn requires an increase in the demand for good 2 to be used as input but has no impact on the supply of good 2. The net impact is a rise in the excess demand for good 2, i.e., $D_1\bar{\xi}_2(p_1, p_2) > 0$. Finally, an increase in the price of good 2, ceteris paribus, causes its demand by industry 1 to drop resulting in a lower output of good 1. However, because good 2 is not a consumption good, the increase in p_2 has no impact on the demand for this good by the representative consumer. The net impact in this case is an increase in the excess demand for good 1, i.e., $D_2\bar{\xi}_1(p_1, p_2) > 0$.

Let us define

$$(6) \quad \Delta(p_1, p_2) = D_1\bar{\xi}_1(p_1, p_2) D_2\bar{\xi}_2(p_1, p_2) - D_2\bar{\xi}_1(p_1, p_2) D_1\bar{\xi}_2(p_1, p_2).$$

Because $D_1\bar{\xi}_1(p_1, p_2) D_2\bar{\xi}_2(p_1, p_2)$ and $D_2\bar{\xi}_1(p_1, p_2) D_1\bar{\xi}_2(p_1, p_2)$ are both positive, one cannot unambiguously determine the sign of $\Delta(p_1, p_2)$ without further restrictions. However, if one makes the reasonable assumption that $D_1\bar{\xi}_1(p_1, p_2) D_2\bar{\xi}_2(p_1, p_2)$, the product of the own effects, is larger than $D_2\bar{\xi}_1(p_1, p_2) D_1\bar{\xi}_2(p_1, p_2)$, the product of the cross effects, then $\Delta(p_1, p_2) > 0$. I state this assumption primarily as follows.

ASSUMPTION 2.1: For all $p_1 > 0$, $p_2 > 0$, the discriminant $\Delta(p_1, p_2)$, as defined by (6), is strictly positive.

Now let $(p_{1,0}^*, p_{2,0}^*)$ be the trade policy implemented when neither industry is organized. As a solution of the maximization problem represented by (1), the trade policy must satisfy the first-order conditions (4) and (5). Furthermore, if Assumption 2.1 is satisfied,

then the only solution of the system (4), (5) is $(p_{1,0}^*, p_{2,0}^*) = (p_1^0, p_2^0)$, i.e., free trade will prevail if neither industry is organized.

3. Only the Downstream Industry is Organized

If only the downstream industry is organized, then according to (23) of Proposition 3.4 in Chapter 2, the trade policy, say $(p_{1,01}^*, p_{2,01}^*)$, implemented by the home government is the solution of the following maximization problem:

$$(7) \quad \max_{p_1, p_2} \left(\phi_1(p_1, p_2) + \varepsilon \left[\phi_1(p_1, p_2) + \phi_2(p_1, p_2) + \phi(p_1, p_2) + (p_1 - p_1^0)\xi_1(p_1, p_2) + (p_2 - p_2^0)\xi_2(p_1, p_2) \right] \right) = \mu_{01}^{\max}.$$

A comparison of (1) and (7) indicates that when industry 1 is organized, its weight increases from 1 to $1 + \varepsilon$ in the objective function that the home government must maximize in choosing the trade policy. If (7) has an interior solution, then the following version of the first-order conditions (4) and (5) must hold:

$$(8) \quad y_1(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) \right] = 0.$$

$$(9) \quad -x_{12}(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0)D_2\xi_1(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) \right] = 0.$$

Observe that in (9), $x_{12}(p_1, p_2)$ denotes the demand for good 2 as intermediate input by industry 1. Using (8) and (9), I obtain the following deviations from their free trade levels of the prices of good 1 and good 2 when only industry 1 is organized.

$$(10) \quad p_{1,01}^i - p_1^0 = - \frac{\left| y_1(p_{1,01}^i, p_{2,01}^i) D_2 \xi_2(p_{1,01}^i, p_{2,01}^i) + x_{12}(p_{1,01}^i, p_{2,01}^i) D_1 \xi_2(p_{1,01}^i, p_{2,01}^i) \right|}{\varepsilon \Delta(p_{1,01}^i, p_{2,01}^i)}$$

$$(11) \quad p_{2,01}^i - p_2^0 = \frac{x_{12}(p_{1,01}^i, p_{2,01}^i) D_1 \xi_1(p_{1,01}^i, p_{2,01}^i) + y_1(p_{1,01}^i, p_{2,01}^i) D_2 \xi_1(p_{1,01}^i, p_{2,01}^i)}{\varepsilon \Delta(p_{1,01}^i, p_{2,01}^i)}$$

Now by Assumption 2.1, the denominators of the expressions on the right side of (10) and (11) are positive. Hence to see which industry is protected, I need only to study the numerators of these expressions. First, I rewrite the numerator of the expression in the right side of (10) as follows

$$(12) \quad \left| -D_2 \xi_2(p_{1,01}^i, p_{2,01}^i) y_1(p_{1,01}^i, p_{2,01}^i) \right| \\ \times \left| 1 + \left(\frac{\eta_{21}(p_{1,01}^i, p_{2,01}^i)}{\eta_{22}(p_{1,01}^i, p_{2,01}^i)} \right) \left(\frac{p_{2,01}^i x_{12}(p_{1,01}^i, p_{2,01}^i)}{p_{1,01}^i y_1(p_{1,01}^i, p_{2,01}^i)} \right) \right| = |A_{1,01}| \times |B_{1,01}|.$$

In (12), I have let $\eta_{21}(p_1, p_2)$ and $\eta_{22}(p_1, p_2)$ denote, respectively, the cross trade elasticity with respect to p_1 and the own price trade elasticity of $\xi_2(p_1, p_2)$, the excess demand for good 2. Observe that $\eta_{21}(p_1, p_2) > 0$ and $\eta_{22}(p_1, p_2) < 0$ if good 2 is imported and $\eta_{21}(p_1, p_2) < 0$ and $\eta_{22}(p_1, p_2) > 0$ if good 2 is exported. In most cases, $|\eta_{21}(p_1, p_2)| < |\eta_{22}(p_1, p_2)|$. Furthermore, for all p_1, p_2 , we always have $p_2 x_{12}(p_1, p_2) < p_1 y_1(p_1, p_2)$ because the cost of any input is always less than the total revenue for any industry. Hence, $B_{1,01} > 0$. Because $D_2 \xi_2(p_1, p_2) < 0$, we also have $A_{1,01} > 0$. I have just shown that if $|\eta_{21}(p_1, p_2)| < |\eta_{22}(p_1, p_2)|$ for all p_1, p_2 , then industry 1 will be protected. Similarly, the numerator of the expression on the right side of (11) can be rewritten as follows:

$$(13) \quad \left| D_{\tilde{\xi}_1} \left(p_{1,01}^*, p_{2,01}^* \right) Y_1 \left(p_{1,01}^*, p_{2,01}^* \right) \right| \\ \times \left| 1 + \left(\frac{\eta_{11} \left(p_{1,01}^*, p_{2,01}^* \right)}{\eta_{12} \left(p_{1,01}^*, p_{2,01}^* \right)} \right) \left(\frac{p_{2,01}^* X_{12} \left(p_{1,01}^*, p_{2,01}^* \right)}{p_{1,01}^* Y_1 \left(p_{1,01}^*, p_{2,01}^* \right)} \right) \right| = \left| A_{2,01} \right| \times \left| B_{2,01} \right|.$$

In (13), $\eta_{11}(p_1, p_2)$ and $\eta_{12}(p_1, p_2)$ denote, respectively the own price trade elasticity and the cross trade elasticity with respect to p_2 of $\tilde{\xi}_1(p_1, p_2)$. As in the case of commodity 2, I expect that $-\eta_{11}(p_1, p_2)/\eta_{12}(p_1, p_2) < -1$ for all p_1, p_2 . In such a case, I shall have $B_{2,01} < B_{1,01}$. Hence without further restrictions on demand and supply conditions of goods 1 and 2, it is not possible to determine the sign of $B_{2,01}$ unambiguously. The following proposition summarizes the results just discussed.

PROPOSITION 3.1: *Suppose that Assumption 2.1 is satisfied and that in absolute values the own-price elasticity of the excess demand for each commodity is at least as large as its cross elasticity. If only industry 1 is organized, then*

(a) $p_{1,01}^* - p_1^0 > 0$ and

(b) $p_{2,01}^* - p_2^0 \not\leq 0$.

That is, if industry 1 is the only one that is organized, then the price of its product will rise above the free trade level while the movement of the price of the good 2, the intermediate input, is ambiguous.

Having discussed the trade policies adopted, I shall now discuss the payoffs of the home government and the owners of the specific factors in industries 1 and 2. First, note that when only industry 1 is organized, the game of endogenous protection is in essence a principal-agent game, with lobby 1 playing the part of the principal and the home

government the part of the agent. Next, recall that under free trade the home government obtains the payoff level μ_0^{\max} while the rent enjoyed by lobby 1 is $\varphi_1(p_1^0, p_2^0)$. Furthermore, it is clear that μ_{01}^{\max} , the joint payoff for the home government and lobby 1 when only industry 1 is organized, exceeds their joint payoff under free trade. Also, to induce the home government into protecting its industry, lobby 1 must design a political contribution schedule so that if the home government participates in the principal-agent game, it will obtain a net payoff (political contribution + weighted social welfare) at least equal to μ_0^{\max} . Hence the following truthful strategy is an optimal contingent political contribution schedule for lobby 1:

$$(14) \quad c_1(p_1, p_2, \mu_{01}^{\max} - \mu_0^{\max}) = \max\left\{\varphi_1(p_1, p_2) - \mu_{01}^{\max} + \mu_0^{\max}, 0\right\}.$$

A best response to (14) for the home government is to implement the trade policy $(p_{1,01}^*, p_{2,01}^*)$ and obtain the same payoff as the one under free trade. The net payoff for lobby 1 is $\mu_{01}^{\max} - \mu_0^{\max}$, which is strictly higher than the rent it obtains under free trade. As for industry 2, which is not organized, given that its import prices do not change with the organization of industry 1, whether its payoff rises or falls depends on whether p_2 goes up or down. I summarize the results just discussed in the following proposition:

PROPOSITION 3.2: Suppose that only industry 1 is organized. Then its net payoff will rise above the free trade level while the net payoff for the home government remains the same as under free trade: the owners of the specific factor in industry 1 extract all the surplus that results from the participation of the home government in the game of political contributions.

As for the owners of the specific factor in industry 2, their income might rise or fall depending on whether the price of their product goes up or down.

Since the rent of industry 2 may rise or fall with the rise in the price of good 1, there is a reason for an upstream industry to support or oppose the protection of a downstream industry. If the protection of a downstream industry leads to the increase in the rent of the upstream industry, the latter will support the cause of the former because of protective backward linkage. On the contrary, if the protection of a downstream industry leads to the contraction of an upstream industry, the two industries will have opposite objectives due to anti-protective backward linkage.

The semiconductor equipment manufacturing industry in the US is a practical example of an upstream industry being supportive to the cause of a downstream industry. This industry produces inputs for semiconductor industry, which in turn produces inputs for computer industry. In 1985, when the semiconductor lobby group in the United States filed a petition to the US government to force the Japanese semiconductor firms to raise the price of semiconductor not just in the US but in all markets, the semiconductor equipment manufacturers in the US publicly opposed the petition because they would be hurt by the efforts to reduce Japanese production investments in the semiconductor industry.¹

This gives an idea how and when an upstream industry may like the downstream industry to be protected and hence extended. Had the American semiconductor industry been using the equipment from the US manufacturing industry, the latter would have been the

¹ An official of the Semiconductor Equipment Manufacturing Institute in the US stated, "I can tell you that American semiconductor production equipment firms are being kept alive today only from Japanese orders. We have 'zero' orders from U. S. semiconductor manufacturers. If it were not for the Japanese manufacturing expansion, many U. S. equipment firms would be out of business (Electronic News of June 24, 1985, 62, quoted from Irwin, 1996, p 43).

supporters for the protection of the former. Since for the US semiconductor equipment industry, the Japanese semiconductor firms were the downstream users, they were supporting the expansion of those Japanese firms.

4. Only the Upstream Industry is Organized

If only the upstream industry is organized, then according to (23) of Proposition 3.4, the trade policy, say $(p_{1,02}^*, p_{2,02}^*)$, implemented by the home government is the solution of the following maximization problem:

$$(15) \quad \max_{p_1, p_2} \left(\varphi_2(p_1, p_2) + \varepsilon \left| \begin{array}{l} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \phi(p_1, p_2) \\ + (p_1 - p_1^u) \xi_1(p_1, p_2) + (p_2 - p_2^u) \xi_2(p_1, p_2) \end{array} \right| \right) = \mu_{02}^{\max}.$$

Again, note that when industry 2 is organized, its weight increases from 1 to $1 + \varepsilon$ in the objective function that the home government must maximize in choosing the trade policy. If (15) has an interior solution then the following first-order condition must hold:

$$(16) \quad (p_1 - p_1^u) D_1 \xi_1(p_1, p_2) + (p_2 - p_2^u) D_1 \xi_2(p_1, p_2) = 0.$$

$$(17) \quad y_2(p_1, p_2) + \varepsilon \left| (p_1 - p_1^u) D_2 \xi_1(p_1, p_2) + (p_2 - p_2^u) D_2 \xi_2(p_1, p_2) \right| = 0.$$

Observe that in (17), $y_2(p_1, p_2)$ is the supply of good 2. Using (16) and (17), I obtain the following deviations from their free trade levels of the prices of good 1 and good 2 when only industry 2 is organized.

$$(18) \quad p_{1,02}^* - p_1^u = \frac{y_2(p_{1,02}^*, p_{2,02}^*) D_1 \xi_2(p_{1,02}^*, p_{2,02}^*)}{\varepsilon \Delta(p_{1,02}^*, p_{2,02}^*)} > 0.$$

$$(19) \quad p_{2,02}^* - p_2^0 = - \frac{V_2(p_{1,02}^*, p_{2,02}^*) D_1 \xi_1(p_{1,02}^*, p_{2,02}^*)}{\varepsilon \Delta(p_{1,02}^*, p_{2,02}^*)} > 0.$$

As indicated by (18) and (19), the prices of commodities 1 and 2 both rise above their free trade levels when only industry 2 is organized. While the rise in the price of good 2 is expected, the rise in the price of good 1 is a little surprising. Now when home government raises p_2 to provide protection for industry 2, it causes a jump in the cost of the intermediate input used in the production of good 1. If the price of good 1 were maintained at the free trade level, the income of the owners of the specific factors in industry 1 would certainly fall. Because the rent in industry 1 is a component of welfare, an increase in the price of good 1 above its free trade level, given that $p_{2,02}^*$ has already been chosen, will increase this component. However, an increase of p_1 above its free-trade level will reduce the consumer surplus and possibly have a negative impact on the treasury. What (18) asserts is that the positive impact of a rise in the price of good 1 above its free-trade level dominates the negative impacts of a decline in consumer surplus and possibly a deterioration in the budget surplus. Another way of explaining the result $p_{1,02}^* - p_1^0 > 0$ can be obtained by looking at (16). Indeed, because $p_{2,02}^* - p_2^0 > 0$ when only industry 2 is organized, the second term in the left side of (16) is strictly positive. Hence the first term must be negative. This last result together with the fact $D_1 \xi_1(p_1, p_2) < 0$ then imply that $p_{1,02}^* - p_1^0 > 0$.

As in the case when only industry 1 is organized, the optimal political contribution schedule for industry 2 is the following truthful strategy

$$(20) \quad c_2(p_1, p_2, \mu_{02}^{\max} - \mu_0^{\max}) = \max \left[\varphi_2(p_1, p_2) - \mu_{02}^{\max} + \mu_0^{\max}, 0 \right].$$

In response to (20), the home government will implement the trade policy $(p_{1,02}^*, p_{2,02}^*)$, and obtains the same net payoff as under free trade. The net payoff for the owners of the specific factors in industry 2 rises from the free trade level to $\mu_{02}^{\max} - \mu_0^{\max}$. As for industry 1, the rent enjoyed by the owners of the specific factors in this industry might rise or fall. The nominal protection due to a rise in the price of good 1 might not be sufficient to offset the rise in the cost of the intermediate input. I summarize the results just discussed in the following proposition.

PROPOSITION 4.1: Suppose that Assumption 2.1 is satisfied and that only upstream industry is organized. Then the prices of goods 1 and 2 will both rise above their free trade levels. Furthermore, the net payoff of the owners of the specific factor in industry 2 rises above its free trade level while the net payoff for the home government remains the same as under free trade: the owners of the specific factor in the upstream industry lobby extracts all the surplus that results from the participation of the home government. As for downstream industry, although the price of its product rises, the nominal protection might not be sufficient to offset the rise in the price of the intermediate input and might be induced to oppose the protection granted to the upstream industry.

Thus my model could explain why the user industries may support or oppose the protection of an intermediate input producing industry. As an example of user industries opposing the protection of an input industry, let us take the case of the semiconductor industry and the computer industry. The semiconductor industry produces micro chips which are used as input into computers. When there was an external threat from the Japanese semiconductor manufacturers, the US semiconductor producers formed Semiconductor

Industry Association (SIA) in 1977 to lessen the competition from Japanese imports. In the beginning, the semiconductor *user* industries were organized in the American Electronics Association (AEA), which included many of SIA members as well. After the United States and Japan reached an agreement in 1989 preventing the dumping of semiconductor products in the US market and improving access to the Japanese markets to the US firms, the price of DRAMs increased in the US market. The semiconductor user industries felt that AEA could not address their concern. As a result, IBM, HP and Tandem formed Computer System Policy Project (CSPP) in 1989 in order to counter the SIA influence in the United States. Because of the organized voice of CSPP, in the subsequent agreement in 1991, the antidumping clause was removed. Moreover, it is interesting to note that although there were many other user industries of semiconductor products, the opposing voices came only from the computer industry in which the value of semiconductor products accounted for 15 percent of the total revenue in 1986. Other users such as, the radio and television industry, the telephone and telegraph equipment industry, and the home entertainment equipment industry, where the shares of semiconductor were, respectively, 8.3%, 6.7 % and 5 % of the total revenue (Irwin, op cit.), did not organize to protest the protection given to the semiconductor industry.

The steel industry in the United States is another example of a user industry opposing the protection of an intermediate input-producing industry. In 1989, the US steel industry could not obtain what it wanted from the government mainly because of organized domestic opposition of The Coalition of American Steel-Using Manufacturers (CASUM) (Moore, 1996). This coalition of industrial steel-user groups argued against the extension of voluntary

exports restraints for the US steel industry, which reduced the organized power of the steel industry.

The above two examples show vividly how downstream industries might oppose the protection of an upstream industry. However, there are cases of user industries being in favor of the protection of an input-producing industry. My analysis also answers what Krueger (1996 p. 439) has remarked on her summary to the case studies of seven industries in the United States. She explains:

Perhaps the most intriguing finding arising from the studies and also from discussions with policy makers concerns the reluctance of using industries to oppose protection.... This raises a number of interesting, and unanswered questions. Why, for example, did the auto industry — a major steel user and itself in difficulty — not oppose steel VERs in the early 1980s? Why did it take until the late 1980s for producers of agricultural machinery finally to oppose continued protection for steel, as William Lane's commentary documents? And, to cite another example, why do apparel makers side with textile manufacturers in seeking protection when, as using industries, their interests in textile protection would appear to diverge?

As a possible answer, she quotes policy makers who had the opinion that it is like "gentleman's agreement", that is, the understanding that each industry would not protest others' protection. She further asks (Krueger, op cit. p. 440)

How such tacit understanding came about? If there are not such understanding, the puzzle remains as to why opposition is not more frequently voiced?

In the same vein, while explaining why the automobile industry is not protesting against the protection of inputs such as textiles, steel, glass, electronics, Lane (1996) attributes it to inter-sectoral reciprocal noninterference (IRN). However, this researcher fails to address why that should be the case.

In my model, I have gone one step further and shown why IRN may prevail. This is not due to sympathy nor to gentleman's agreement. It is the Nash equilibrium established through vertical linkages among different lobbying industries. There are economic reasons as shown in my model, for the user groups to be passive or even supportive as in the case of sugar industry which Krueger (1990) refers as a *puzzle* (emphasis added) and Dixit (1996) repeats it.

5. Both Industries are Organized: The Case of the Steel and the Automobile Industries

If both industries are organized, then according to (23) of Proposition 3.4, the trade policy, say $(p_{1,012}^*, p_{2,012}^*)$, implemented by the home government is the solution to the following maximization problem:

$$(21) \quad \max_{p_1, p_2} \left(\varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \varepsilon \left[\begin{array}{l} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) - \phi(p_1, p_2) \\ + (p_1 - p_1^0) \xi_1(p_1, p_2) + (p_2 - p_2^0) \xi_2(p_1, p_2) \end{array} \right] \right) = \mu_{012}^{\max}.$$

The following first-order conditions characterize the interior solution of (21).

$$(22) \quad y_1(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0) D_1 \xi_1(p_1, p_2) + (p_2 - p_2^0) D_1 \xi_2(p_1, p_2) \right] = 0.$$

$$(23) \quad -x_{12}(p_1, p_2) + y_2(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0) D_2 \xi_1(p_1, p_2) + (p_2 - p_2^0) D_2 \xi_2(p_1, p_2) \right] = 0.$$

Using (22) and (23), I obtain the following deviations from their free trade levels of the prices of goods 1 and 2 when both industries are organized.

$$(24) \quad p_{1,012}^* - p_1^0 = \frac{- \left| y_1(p_{1,012}^*, p_{2,012}^*) D_{22} \xi_2(p_{1,012}^*, p_{2,012}^*) + \left[x_{12}(p_{1,012}^*, p_{2,012}^*) - y_2(p_{1,012}^*, p_{2,012}^*) \right] D_{11} \xi_2(p_{1,012}^*, p_{2,012}^*) \right|}{\varepsilon \Delta(p_{1,012}^*, p_{2,012}^*)}$$

$$(25) \quad p_{2,012}^* - p_2^0 = \frac{\left| x_{12}(p_{1,012}^*, p_{2,012}^*) - y_2(p_{1,012}^*, p_{2,012}^*) \right| D_{11} \xi_1(p_{1,012}^*, p_{2,012}^*) + y_1(p_{1,012}^*, p_{2,012}^*) D_{22} \xi_1(p_{1,012}^*, p_{2,012}^*)}{\varepsilon \Delta(p_{1,012}^*, p_{2,012}^*)}$$

The numerator of the expression on the right side of (24) can be rewritten as follows:

$$- \left| y_1(p_{1,012}^*, p_{2,012}^*) D_{22} \xi_2(p_{1,012}^*, p_{2,012}^*) \right| \cdot \left| 1 + \left(\frac{\eta_{21}(p_{1,012}^*, p_{2,012}^*)}{\eta_{22}(p_{1,012}^*, p_{2,012}^*)} \right) \left(\frac{p_{2,012}^* \left(x_{12}(p_{1,012}^*, p_{2,012}^*) - y_2(p_{1,012}^*, p_{2,012}^*) \right)}{p_{1,012}^* y_1(p_{1,012}^*, p_{2,012}^*)} \right) \right| = \left| A_{1,012} \right| \times \left| B_{1,012} \right|.$$

As in Section 2, if I continue to assume that $\left| \eta_{21}(p_1, p_2) \right| < \left| \eta_{22}(p_1, p_2) \right|$ for all p_1, p_2 , then

$-1 < \eta_{21}(p_{1,012}^*, p_{2,012}^*) / \eta_{22}(p_{1,012}^*, p_{2,012}^*) < 0$. In this case, I have $B_{1,012} > 0$, i.e., the price of good 1 rises above its free-trade level when both industries are organized.

The numerator of the expression on the right side of (25) can be rewritten as follows:

$$\left| \frac{y_1(p_{1,012}^*, p_{2,012}^*) D_2 \bar{z}_1(p_{1,012}^*, p_{2,012}^*)}{\left[1 + \left(\frac{\eta_{11}(p_{1,012}^*, p_{2,012}^*)}{\eta_{12}(p_{1,012}^*, p_{2,012}^*)} \right) \left(\frac{p_{2,012}^* (x_{12}(p_{1,012}^*, p_{2,012}^*) - y_2(p_{1,012}^*, p_{2,012}^*))}{p_{1,012}^* y_1(p_{1,012}^*, p_{2,012}^*)} \right) \right]} \right| = [A_{2,012}] \times [B_{2,012}].$$

Again, if I assume that in absolute values the own-price trade elasticity of good 1 dominates its cross price trade elasticity, then $\eta_{11}(p_{1,012}^*, p_{2,012}^*) / \eta_{12}(p_{1,012}^*, p_{2,012}^*) < -1$. It is now not possible to determine unambiguously the sign of $B_{2,012}$. However, if good 2 is exported then $x_{12}(p_{1,012}^*, p_{2,012}^*) - y_2(p_{1,012}^*, p_{2,012}^*) < 0$ and we must have $B_{2,012} < 0$, i.e., the price of good 2 also rises above its free trade level. I summarize the results just discussed in the following proposition:

PROPOSITION 5.1: *Suppose that Assumption 2.1 is satisfied and that in absolute value the own price trade elasticity of the excess demand for each good is at least as large as its cross trade elasticity. If both industries are organized, then the price of final consumption good will rise above its free trade level while the movement of the price of the intermediate good is ambiguous. However, if it is known that good 2 is exported, then its price must rise above the free trade level.*

The above situation, when both upstream and downstream industries are organized, can be the case of the semiconductor and computer industries or the steel and automobile industries in the United States. In both cases, both industries are organized in the United States. Thus Proposition 5.1 necessarily implies that the computer and the automobile industries will be protected and so will be the semiconductor industry and the steel industry if

they are producing exportable goods (although it is not the necessary condition). Thus my model has been able to explain why the automobile and steel industries and computer and semiconductor industries are protected in the United States.

Having discussed the trade policies implemented by the home government, I now determine the strategies chosen by the two lobbies, their net payoffs, and the net payoff of the home government. To this end, let

$$\mathbf{M} = \left\{ (\mu_1, \mu_2) \mid \mu_1 \geq 0, \mu_2 \geq 0, \mu_1 + \mu_2 \leq \mu_{012}^{\max} - \mu_0^{\max}, \mu_1 \leq \mu_{012}^{\max} - \mu_{02}^{\max}, \mu_2 \leq \mu_{012}^{\max} - \mu_{01}^{\max} \right\}.$$

According to Lemma 3.3 of Chapter 2, \mathbf{M} contains all the vectors of net payoffs for the two industry lobbies under Nash equilibrium. A possible depiction of \mathbf{M} is given in Figure 1. In this figure, \mathbf{M} is the rectangle OGMH, where, $OG = \mu_{012}^{\max} - \mu_{02}^{\max}$ and $OH = \mu_{012}^{\max} - \mu_{01}^{\max}$. It is simple to show that \mathbf{M} is always below $H''G''$.

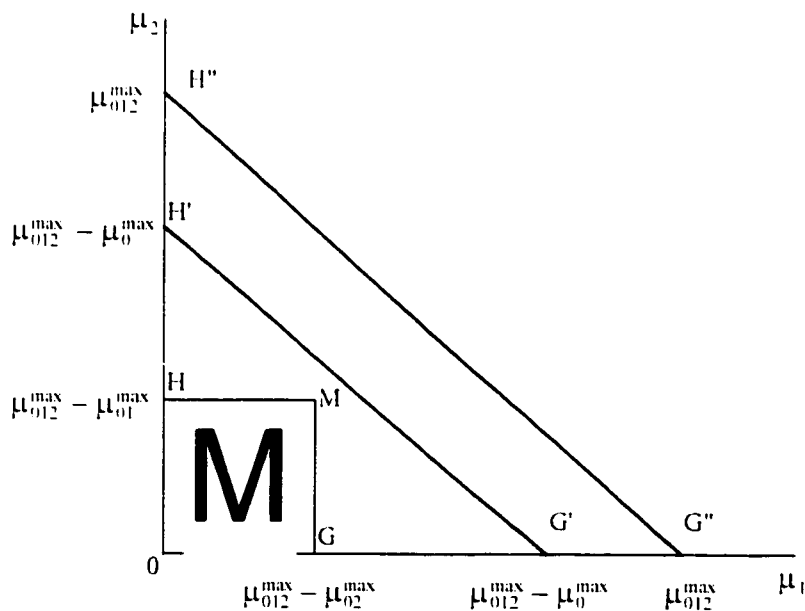


FIGURE 1. UNIQUE TRUTHFUL NASH EQUILIBRIUM

However, depending on the parameters of the model, M can be either below or above $H'G'$. Figure 1 depicts the case where M is below $H'G'$. In Figure 2, the case M is above $H'G'$ is depicted.

According to Proposition 3.4 of Chapter 2, any point on M^* , the Pareto efficient frontier of M , can be supported by a truthful Nash equilibrium. In Figure 1, M^* is reduced to the single point $M = (\mu_{012}^{\max} - \mu_{02}^{\max}, \mu_{012}^{\max} - \mu_{01}^{\max})$ and in such a case there exists a unique truthful Nash equilibrium. Under this truthful Nash equilibrium, the net payoffs for lobby 1, lobby 2, and the home government are given, respectively by $\mu_{012}^{\max} - \mu_{02}^{\max}$, $\mu_{012}^{\max} - \mu_{01}^{\max}$, and $-\mu_{012}^{\max} + \mu_{01}^{\max} + \mu_{02}^{\max}$. For each lobby, its political contribution schedule is given by the following truthful strategy

$$(26) \quad c_j(p_1, p_2, \mu_{012}^{\max} - \mu_{0j'}^{\max}) = \max \left[\varphi_j(p_1, p_2) - \mu_{012}^{\max} + \mu_{0j'}^{\max}, 0 \right], \quad (j \neq j', j, j' = 1, 2).$$

In Figure 2, M^* is equal to the line segment TT' . Because any point on the segment

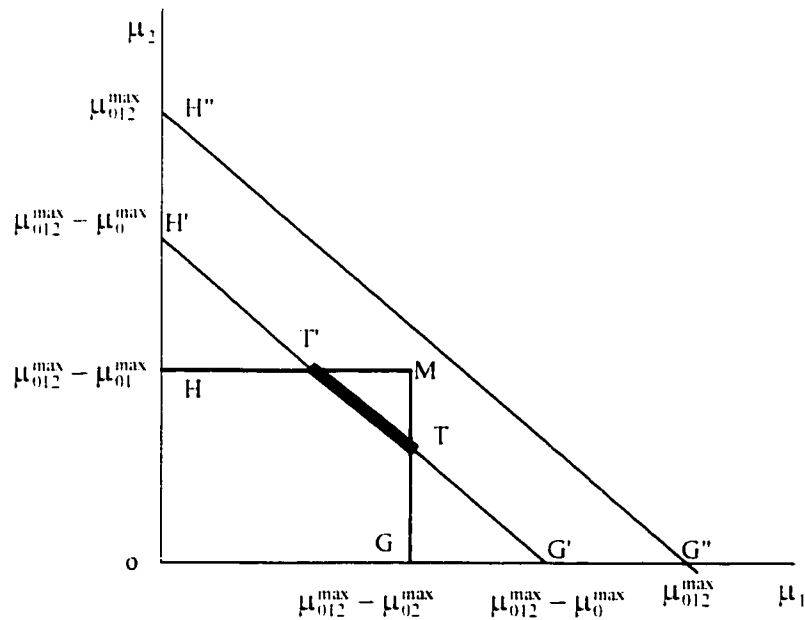


FIGURE 2. A CONTINUUM OF TRUTHFUL NASH EQUILIBRIA

TT' represents a vector of net payoffs for the two lobbies that can be supported by a truthful Nash equilibrium. there exist a continuum of truthful Nash equilibria. In this case, the net payoff for the home government remains the same as the level it obtains under free trade. As for the net payoffs of the two lobbies, say μ_1^* and μ_2^* , they satisfy the following relations:

$$(27) \quad \mu_1^* + \mu_2^* = \mu_{012}^{\max} - \mu_0^{\max}.$$

$$\mu_1^* \leq \mu_{012}^{\max} - \mu_{02}^{\max}.$$

$$\mu_2^* \leq \mu_{012}^{\max} - \mu_{01}^{\max}.$$

I summarize the results just obtained in the following proposition.

PROPOSITION 5.2: (a) *If $(\mu_{012}^{\max} - \mu_{01}^{\max}) + (\mu_{012}^{\max} - \mu_{02}^{\max}) \leq \mu_{012}^{\max} - \mu_0^{\max}$, then there exists a unique truthful Nash equilibrium. Under this truthful Nash equilibrium, the political contribution schedules chosen by the two lobbies are represented by (26). Furthermore, the net payoffs for lobby 1, lobby 2, and the home government are $\mu_{012}^{\max} - \mu_{02}^{\max}$, $\mu_{012}^{\max} - \mu_{01}^{\max}$, and $-\mu_{012}^{\max} + \mu_{01}^{\max} + \mu_{02}^{\max}$. Also, if $(\mu_{012}^{\max} - \mu_{01}^{\max}) + (\mu_{012}^{\max} - \mu_{02}^{\max})$ is strictly less than $\mu_{012}^{\max} - \mu_0^{\max}$, then the net payoff for the home government rises from the free-trade level when both industries are organized.*

(b) *If $(\mu_{012}^{\max} - \mu_{01}^{\max}) + (\mu_{012}^{\max} - \mu_{02}^{\max}) > \mu_{012}^{\max} - \mu_0^{\max}$, then there exists a continuum of truthful Nash equilibria. If I let μ_1^* and μ_2^* denote the net payoffs for lobby 1 and lobby 2, respectively, under a truthful Nash equilibrium, then they satisfy the relations represented by (27). Furthermore, under truthful Nash equilibrium, the net payoff for the home government is equal to the payoff it obtains under free trade, i.e., the two industry lobbies extract all the surplus that results from the participation of the home government in the game of endogenous trade policy determination.*

6. Numerical Example

In this section, I solve a numerical version of theoretical model by assigning numerical values to the parameters. Industry 1 is the final-good producing industry and industry 2 is the intermediate-input industry. The representative consumer maximizes the following quasi-linear utility function:

$$\max_{z_1} \left[\bar{m} - p_1 z_1 + \alpha z_1 - \frac{1}{2} \beta z_1^2 \right] = \phi(p_1, p_2).$$

As a result of this maximization, the consumer has the following linear demand curve:

$$(28) \quad z_1(p_1) = \frac{\alpha - p_1}{\beta}.$$

in which case the indirect utility of the consumer is given by

$$(29) \quad \phi(p_1, p_2) = \bar{m} + \frac{(\alpha - p_1)^2}{2\beta}.$$

On the production side, let us assume the Cobb Douglas technology for both industries. Furthermore, I assume that industry 1 uses good 2 and a specific inputs while industry 2 uses labor and another sector specific factor. More precisely, in its production process

$$y_1 = x_{12}^{\gamma_1} \bar{k}_1^{1-\gamma_1},$$

$$y_2 = l_2^{\gamma_2} \bar{k}_2^{1-\gamma_2}.$$

The rent maximization problem for industry 1 is given by

$$\max_{x_{12}} \left[p_1 (x_{12}^{\gamma_1} \bar{k}_1^{1-\gamma_1}) - p_2 x_{12} \right] = \varphi_1(p_1, p_2).$$

As a solution to the above problem, the industry has the following input demand curve

$$(30) \quad x_{12}(p_1, p_2) = \bar{k}_1 \left(\frac{p_1 \gamma_1}{p_2} \right)^{\frac{1}{1-\gamma_1}}.$$

By substituting the optimal demand for intermediate input into the production function, I obtain the following expression for the optimal output of good 1.

$$(31) \quad y_1(p_1, p_2) = \bar{k}_1 \left(\frac{p_1 \gamma_1}{p_2} \right)^{\frac{\gamma_1}{1-\gamma_1}}.$$

By substituting the input demand given by (30) and the optimal output level given by (31) in its rent maximization problem, I obtain the following expression for the rental income of industry 1 before political contribution:

$$(32) \quad \varphi_1(p_1, p_2) = \bar{k}_1 \left[p_1 \left(\frac{\gamma_1}{p_2} \right)^{\gamma_1} \right]^{\frac{1}{1-\gamma_1}} (1 - \gamma_1).$$

Using (28) and (31), the excess demand expression for good 1 is given as follows:

$$(33) \quad \xi_1(p_1, p_2) = \frac{\alpha - p_1}{\beta} - \bar{k}_1 \left(\frac{p_1 \gamma_1}{p_2} \right)^{\frac{\gamma_1}{1-\gamma_1}}.$$

Similarly, industry 2 solves the following rent maximization problem.

$$\max_{l_2} \left[p_2 \left(l_2^{\gamma_2} \bar{k}_2^{1-\gamma_2} \right) - \bar{w} l_2 \right] = \varphi_2(p_1, p_2).$$

The labor demand and the optimal output level are given by following expressions:

$$l_2(p_2) = \bar{k}_2 \left(\frac{p_2 \gamma_2}{\bar{w}} \right)^{\frac{1}{1-\gamma_2}},$$

$$(34) \quad y_2(p_2) = \bar{k}_2 \left(\frac{p_2 \gamma_2}{\bar{w}} \right)^{\frac{\gamma_2}{1-\gamma_2}}.$$

The rental income of industry 2 is

$$(35) \quad \varphi_2(p_1, p_2) = \bar{k}_2 \left(p_2 \left(\frac{\gamma_2}{\bar{w}} \right)^{\gamma_2} \right)^{\frac{1}{1-\gamma_2}} (1 - \gamma_2).$$

The excess demand function for good 2 is obtained using (30) and (34) and is given by

$$(36) \quad \xi_2(p_1, p_2) = \bar{k}_1 \left(\frac{p_1 \gamma_1}{p_2} \right)^{\frac{1}{1-\gamma_1}} - \bar{k}_2 \left(\frac{p_2 \gamma_2}{\bar{w}} \right)^{\frac{\gamma_2}{1-\gamma_2}}.$$

The treasury balance is given by

$$(37) \quad s(p_1, p_2) = (p_1 - p_1^0)\xi_1 + (p_2 - p_2^0)\xi_2.$$

For the numerical example, I have assigned the following values:

$$\alpha = 1.5, \beta = 0.5, \gamma_1 = (0.05 \text{ through } 0.7), \gamma_2 = 0.7;$$

$$\bar{k}_1 = 2.0, \bar{k}_2 = 1.5, \bar{r} = 0.25, p_1^0 = 0.5, p_2^0 = 0.4 \text{ and } \varepsilon = 1.$$

I have solved the model for several possible values of γ_1 to see how the equilibrium is changed as the share of intermediate input into industry 1 changes. However, in the following tables, I have reported the equilibrium values for only three cases: when the share of intermediate input is 40 percent, 63 percent (to be specific, the model was solved using $\gamma_1 = 0.6294$), and 70 percent of total revenue of the final good industry. The reason to choose those particular three percentage shares is to show three different types of equilibria that may emerge as a solution of the model.

6.1. No Industry is Organized

As a starting point, let us assume that there are no lobby groups in the economy. The home government then maximizes the social welfare function given by (1). In this case, the values for some endogenous variables are listed in Table 1. Since my focus is on the structure of protection and the level of income earned by the owners of the specific factor, I will not report the numerical values of production, consumption, export, import and their elasticities in the text. The detailed listing of the values of all these endogenous variables for four different lobbying situations is given in Appendix A for the case $\gamma_i = 0.4$.

In Table 1, I list some of the variables for three different values of γ_1 . Since no industry is represented by a lobby group, free trade is obtained as the optimal solution of the model. With free trade, the treasury is in balance. The values of different variables in this

TABLE 1—SOLUTION TO THE GAME WHEN NEITHER INDUSTRY IS ORGANIZED

Variables	$\gamma_1 = 0.4$	$\gamma_1 = 0.63$	$\gamma_1 = 0.7$
$p_{1,0}^*$	$p_1^* = 0.500$	$p_1^* = 0.500$	$p_1^* = 0.500$
$p_{2,0}^*$	$p_2^* = 0.400$	$p_2^* = 0.400$	$p_2^* = 0.400$
$\varphi_1(p_{1,0}^*, p_{2,0}^*)$	0.3780	0.2466	0.2197
$\varphi_2(p_{1,0}^*, p_{2,0}^*)$	0.2345	0.2345	0.2345
$s(p_{1,0}^*, p_{2,0}^*)$	0.0000	0.0000	0.0000
$\omega(p_{1,0}^*, p_{2,0}^*) = \mu_0^{\max}$	1.6125	1.4811	1.4542

table helps me to compare their variations as the lobbying status of industries changes. In this sense, these values work as a benchmark for the model. My numerical examples show that Assumption 2.1 holds for all the cases and the absolute value of own trade elasticity of each good is larger than its cross trade elasticity, that is, $\eta_{jj}(p)/\eta_{jj'}(p) < -1$, $j, j' = 1, 2$, $j \neq j'$.

6.2. The Downstream Industry is Organized

Now let us assume that industry 1 is organized. In this case, the objective function for the government is given by (7). The solution of the model is given in Table 2.

Note that the values of all endogenous variables change as we move from Table 1 to Table 2 because of the different equilibrium domestic price vectors. As proved in Proposition 2.1, industry 1 is protected by an import tariff or export tax and this result is confirmed in this numerical exercise. Note that the price of good 2 may go up and down from the free trade level (0.4). In general, industry 2 gets protection if its share in the production of good 1 is very high. The reason might be as follow.

Let us consider two cases: $\gamma_1 = 0.4$ and $\gamma_1 = 0.7$. As the price of good 1 rises because of its lobbying efforts, industry 1 demands for more intermediate input. It is reasonable to assume that the extent of substitution for intermediate input is larger if $\gamma_1 = 0.4$ than if $\gamma_1 = 0.7$. Now when industry 1 maximizes profits, the marginal product of the intermediate input must satisfy the following condition:

$$\frac{p_2}{p_1} = D_1 f_1(x_{12}(p_1, p_2), \bar{k}_1)$$

As more intermediate input is used in industry 1, its value of marginal product falls, and it falls more in the former case than in the latter because the substitution takes place in greater extent in the former case. Thus the price of good 2 rises (falls) less (more) in the former than in the latter case with the given increase in the price of good 1. The price ratio of good 2 over good 1 is also falling as the right side falls due to the use of more intermediate input in industry 1.

TABLE 2—SOLUTION TO THE GAME WHEN ONLY THE DOWNSTREAM INDUSTRY IS ORGANIZED

Variables	$\gamma_1 = 0.4$	$\gamma_1 = 0.63$	$\gamma_1 = 0.7$
$p_{1,01}^*$	1.1850	1.0778	0.9920
$p_{2,01}^*$	0.3956	0.4543	0.4724
$\varphi_1(p_{1,01}^*, p_{2,01}^*)$	1.6041	1.5785	1.4624
$\varphi_2(p_{1,01}^*, p_{2,01}^*)$	0.2261	0.3583	0.4082
μ_{01}^{\max}	2.4161	2.0757	1.9876
$\mu_{01}^{\max} - \mu_0^{\max}$	0.8036	0.5946	0.5334
$c_1^*(p_{1,01}^*, p_{2,01}^*) = \varphi_1(p_{1,01}^*, p_{2,01}^*) - (\mu_{01}^{\max} - \mu_0^{\max})$	0.8005	0.9839	0.9290
Net gain to lobby 1 = $(\mu_{01}^{\max} - \mu_0^{\max}) - \varphi_1(p_{1,0}^*, p_{2,0}^*)$	0.4256	0.3480	0.3137
$\omega(p_{1,01}^*, p_{2,01}^*)$	0.8120	0.4972	0.5252

The rent for industry 1 when it is organized is higher than the free trade level. The rent of industry 2 follows the pattern of its product price. If its price rises above the free trade level, so does its rent, and vice versa. For example, the profit of industry 2 falls below its free

trade level when its share in the total cost of the final good industry is 40 percent, and rises above the free trade level if the share is 63 or 70 percents.

After consumers and producers make their economic decisions, the lobby group pays the government the contributions based on the schedule that it promised and submitted in the first stage of the game. Let us take the case when $\gamma_1 = 0.4$. When neither industry is organized, the payoff of the government is given by $\mu_0^{\max} = 1.6125$. In that case, the profit of industry 1 is given by $\varphi_1(p_{1,0}^*, p_{2,0}^*) = 0.3780$ (Table 1). With industry 1 lobbying for protection, the joint payoff of this lobby and the government is given by $\mu_{01}^{\max} = 2.4161$. Note that $\mu_{01}^{\max} > \mu_0^{\max} + \varphi_1(p_{1,0}^*, p_{2,0}^*)$. The net payoff for lobby 1 is therefore $\mu_{01}^{\max} - \mu_0^{\max} = 0.8036$, which is positive and larger than $\varphi_1(p_{1,0}^*, p_{2,0}^*)$, the profit it obtains if it does not offer any contribution. According to Proposition 3.2, the contribution from lobby group 1 is given by $\varphi_1(p_{1,01}^*, p_{2,01}^*) - (\mu_{01}^{\max} - \mu_0^{\max}) = 1.6041 - (2.4161 - 1.6125) = 0.8005$.

There is a net gain to lobby 1 above its level of payoff in free trade due to its lobbying efforts, which is equal to 0.4256 (= 0.8036 - 0.3780).

Similarly, I could calculate the contribution from lobby 1 and its net gain as the share of the intermediate input in its total cost changes (the entries in the last two rows and the last two columns in Table 2). Note that the amount of contribution is larger than the amount of net gain. And the ratio of net gain to contribution falls as the cost share of intermediate input in the final-good industry increases. The government payoff is exactly the same as in the free trade situation. All the surplus has been extracted by industry 1. Note that for all values of γ_1 ,

$$c_1^*(p_{1,01}^*, p_{2,01}^*) + \varepsilon\omega(p_{1,01}^*, p_{2,01}^*) = \varepsilon\omega(p_{1,0}^*, p_{2,0}^*) \equiv \mu_0^{\max}.$$

6.3. Only the Upstream Industry is Organized

Alternatively, let us take the case when only industry 2 is organized. The home government will maximize the payoff given by (15). Solving the game of endogenous trade policy when only industry 2 contributes, I have the results listed in Table 3.

TABLE 3—SOLUTION TO THE GAME WHEN ONLY THE UPSTREAM INDUSTRY IS ORGANIZED

Variables	$\gamma_1 = 0.4$	$\gamma_1 = 0.63$	$\gamma_1 = 0.7$
$p_{1,02}^*$	0.5879	0.6366	0.6595
$p_{2,02}^*$	0.6838	0.6807	0.6763
$\varphi_1(p_{1,02}^*, p_{2,02}^*)$	0.3446	0.1918	0.1624
$\varphi_2(p_{1,02}^*, p_{2,02}^*)$	1.4355	1.3796	1.3500
μ_{02}^{\max}	2.2119	2.0593	2.0224
$\mu_{02}^{\max} - \mu_0^{\max}$	0.5994	0.5782	0.5682
$c_2^*(p_{1,02}^*, p_{2,02}^*) = \varphi_2(p_{1,02}^*, p_{2,02}^*) - (\mu_{02}^{\max} - \mu_0^{\max})$	0.8361	0.8014	0.7818
Net gain to lobby 2 = $(\mu_{02}^{\max} - \mu_0^{\max}) - \varphi_2(p_{1,02}^*, p_{2,02}^*)$	0.3649	0.3437	0.3337
$\omega(p_{1,02}^*, p_{2,02}^*)$	0.7764	0.6797	0.6724

The prices of both goods rise above the free trade levels. The rent of industry 1 falls whereas the rent of industry 2 rises. However, in certain cases, the rent of specific factor owners in industry 1 may rise from free trade level when intermediate input industry is organized. As listed in Appendix B, when $\gamma_1 = 0.05$, $\varphi_1(p_{1,02}^*, p_{2,02}^*) > \varphi_1(p_{1,0}^*, p_{2,0}^*)$. And the same relation holds if $\gamma_1 = 0.1$.

According to Proposition 3.1, the political contribution of industry 2 is given by $\varphi_2(p_{1,02}^*, p_{2,02}^*) - (\mu_{02}^{\max} - \mu_0^{\max})$. As shown in Table 3, it is positive and the lobby is making net gain by providing contributions to the government. The ratio of net gain to contribution falls slightly when the cost share of the intermediate input rises. As explained in Proposition 3.1,

all the surplus is captured by industry 2. Here too, for any value of γ_1 ,

$$c_2^*(p_{1,02}^*, p_{2,02}^*) + \varepsilon \omega(p_{1,02}^*, p_{2,02}^*) = \varepsilon \omega(p_{1,0}^*, p_{2,0}^*) \equiv \mu_0^{\max}.$$

6.4. Both Industries are Organized

Now, let both industries be organized so that government maximizes the political payoff function given by (21). The prices of both goods and the rents of both industries are higher than those at the free trade levels. The equilibrium values are listed in Table 4.

TABLE 4—SOLUTION TO THE GAME WHEN BOTH INDUSTRIES ARE ORGANIZED

Variables	$\gamma_1 = 0.4$	$\gamma_1 = 0.63$	$\gamma_1 = 0.7$
$p_{1,012}^*$	1.2156	1.4317	1.6033
$p_{2,012}^*$	0.6320	0.6118	0.6662
$\varphi_1(p_{1,012}^*, p_{2,012}^*)$	1.2247	2.0485	3.2480
$\varphi_2(p_{1,012}^*, p_{2,012}^*)$	1.0774	0.9664	1.2842
μ_{012}^{\max}	2.8719	2.6539	2.7149
$\mu_{012}^{\max} - \mu_0^{\max}$	1.2594	1.1728	1.2607
$\mu_{012}^{\max} - \mu_{02}^{\max}$	0.6600	0.5946	0.6925
$c_1^*(p_{1,012}^*, p_{2,012}^*) = \varphi_1(p_{1,012}^*, p_{2,012}^*) - (\mu_{012}^{\max} - \mu_{02}^{\max})$	0.5647	1.4539	2.5555
Net gain to lobby 1 = $(\mu_{012}^{\max} - \mu_{02}^{\max}) - \varphi_1(p_{1,012}^*, p_{2,012}^*)$	0.3154	0.4028	0.5301
$\mu_{012}^{\max} - \mu_{01}^{\max}$	0.4558	0.5782	0.7273
$c_2^*(p_{1,012}^*, p_{2,012}^*) = \varphi_2(p_{1,012}^*, p_{2,012}^*) - (\mu_{012}^{\max} - \mu_{01}^{\max})$	0.6216	0.3882	0.5569
Net gain to lobby 2 = $(\mu_{012}^{\max} - \mu_{01}^{\max}) - \varphi_2(p_{1,012}^*, p_{2,012}^*)$	0.2297	0.2199	0.3191
$(\mu_{01}^{\max} + \mu_{02}^{\max} - \mu_{012}^{\max}) - \mu_0^{\max}$	0.1436	0.0000	-0.1591
$\omega(p_{1,012}^*, p_{2,012}^*)$	0.5698	-0.3610	-1.8173

6.5. Pareto Efficient Frontier in Vertically Related Industries

Based on the values μ_0^{\max} , μ_{01}^{\max} , μ_{02}^{\max} , μ_{012}^{\max} just computed, I can draw the Pareto-efficient frontier of the set of vectors of net payoffs for both industry lobbies under Nash equilibrium. I have drawn it for all the above three cases. Figures 3 and 4 illustrate Proposition 5.2a while Figure

5 depicts Proposition 5.2b. In Figures 3 and 4, the Pareto-efficient frontier M^* of the vectors of net payoff of the two lobby groups is reduced to a single point so that the truthful Nash equilibrium is unique. In Figure 5, the Pareto-efficient frontier is given by a line segment, and, there exist a continuum of truthful Nash equilibria. Figures 3, 4 and 5 correspond to $\gamma_1 = 0.4$, $\gamma_1 = 0.63$ and $\gamma_1 = 0.7$, respectively.

In Figure 3, the payoff of lobby group 1 is measured along the horizontal axis and the payoff of lobby group 2 is measured along the vertical axis. The line $H''G''$ reflects the total maximum payoff of the two industry lobbies and the government given by μ_{012}^{\max} . It intercepts both axes at 2.8719. The line $H'G'$ shows the upper limit of the net payoffs that the two industry lobbies could obtain in the game. This line is represented by $\mu_{012}^{\max} - \mu_0^{\max}$ and intercepts the two axes at 1.2594. Loosely speaking, the expression, $\mu_{012}^{\max} - \mu_0^{\max}$, is the upper

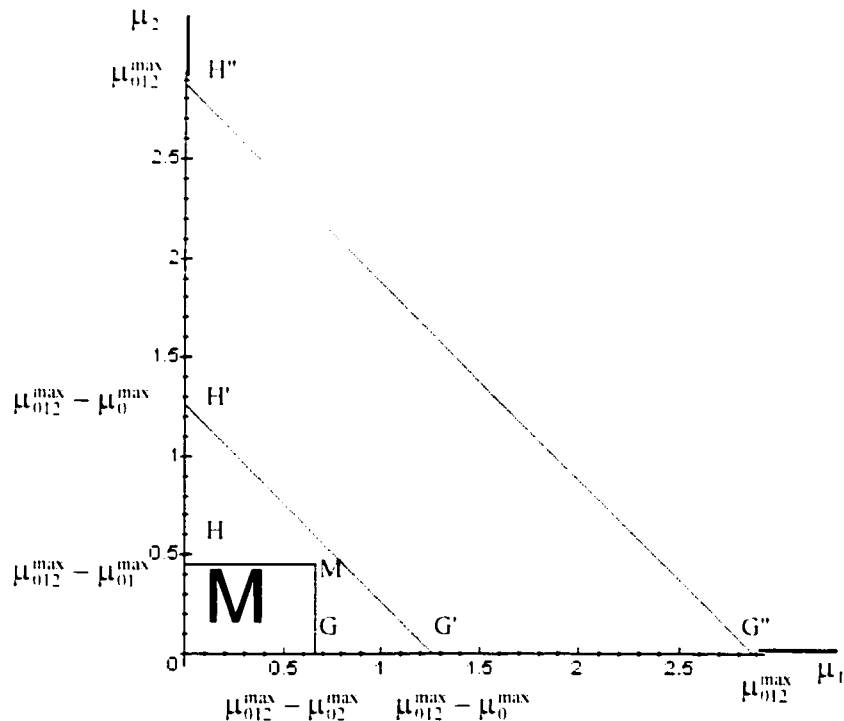


FIGURE 3. ILLUSTRATION OF PROPOSITION 5.2a $\gamma_1 = 0.40$

bound on the sum of the net payoffs that the two lobby groups could obtain by lobbying to the government. Thus $G'G''$ or $H'H''$ measures the payoff to the government when none of the industries are organized, that is, the payoff the government obtains under free trade.

Government will not participate in the game if its net payoff is strictly less than μ_0^{\max} . Thus the line $H'G'$ represents the participation constraint of the government in the lobbying game. The distance OG measures the maximum net payoff that lobby group 1 could obtain by participating at the game provided lobby 2 is already in the game. It is given by $\mu_{012}^{\max} - \mu_{02}^{\max}$ ($= 0.66$). It means that if industry 2 and the government forms a coalition, then the payoff for industry 1 cannot be to the right of point G . Similarly, OH' measures the maximum level of net payoff for industry lobby 2 provided lobby 1 has already formed a coalition with the government. The payoff of industry 2 in this case cannot be above point H . It is given by $\mu_{012}^{\max} - \mu_{01}^{\max}$ ($= 0.4558$).

Point M satisfies all the requirements to be the Pareto-efficient frontier. Thus the truthful Nash equilibrium is uniquely determined by M . At this unique truthful Nash equilibrium, the net payoff of home government rises above free trade level as explained in Proposition 5.2a. More precisely, the net payoff of the government when both industries are present is given by $\mu_{01}^{\max} + \mu_{02}^{\max} - \mu_{012}^{\max} = 1.756$, which is certainly higher than net payoff it obtains under free trade. The government thus benefits from an increasing number of lobbies.

For the case $\gamma_1 = 0.63$, the game also has a unique truthful Nash equilibrium. However, unlike in the previous case, the government gets exactly what it would get under free trade. The global payoff of the two industry lobbies plus that of the government is

represented by the intercepts of H''G'' line (= 2.6539). Similarly, the intercepts of H'G' are 1.1728. Moreover, OG = 0.5946 and OH = 0.5782.

At truthful Nash equilibrium point M, $\mu_{012}^{\max} - \mu_{02}^{\max} + \mu_{012}^{\max} - \mu_{01}^{\max} = \mu_{012}^{\max} - \mu_0^{\max}$. This is one of the conditions mentioned in Proposition 5.2a. This condition can be reduced to $\mu_{01}^{\max} + \mu_{02}^{\max} - \mu_{012}^{\max} = \mu_0^{\max}$. Observe that the left side is the payoff of the government when both industries are represented by lobby groups and the right side is the net payoff of the

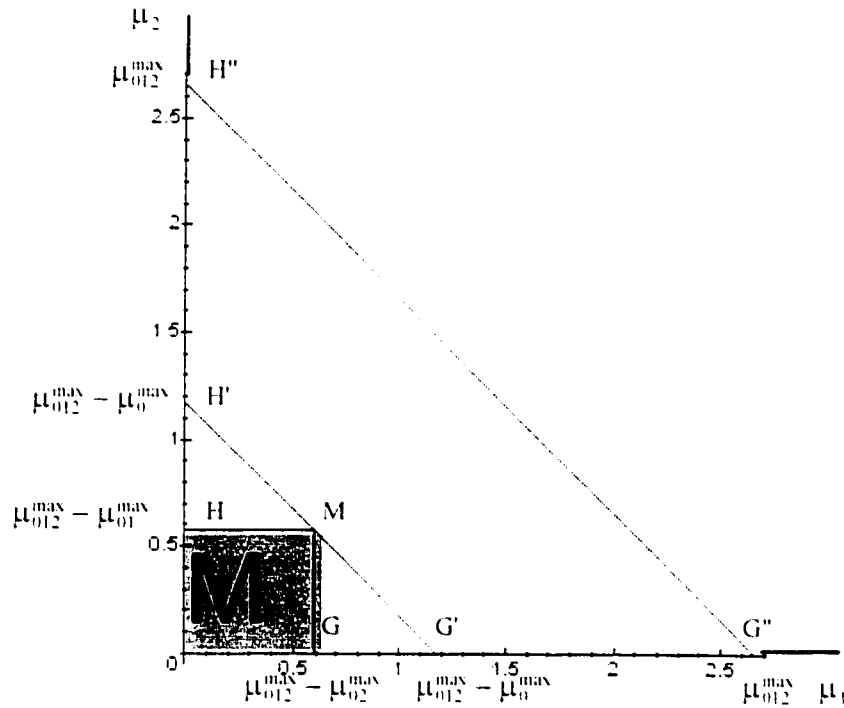


FIGURE 4. ILLUSTRATION OF PROPOSITION 5.2a $\gamma_1 = 0.63$

government when neither of the industry is represented by lobby group. The government is neither better off nor worse off than in free trade. In both cases, the government receives 1.4811, and all the surplus has been extracted by the lobby groups. Although the lobby groups are playing non-cooperatively, the government fails to take advantage of it because of this particular economic relation between upstream and downstream industries.

payoff of lobby 2 cannot exceed OH . And the payoff of the government cannot be smaller than the amount given by $H'H''$ or $G'G''$. At M the first two constraints are satisfied but the payoff to the government falls under the free trade level. If that happens government will simply stay out of the game: no lobbying occurs. Thus in this situation, the participation constraint of the government is binding. The equilibrium should be some where on the line segment TT' and must satisfy all the above constraints. Any points on TT' .

$$\mu_1^* + \mu_2^* = \mu_{012}^{\max} - \mu_0^{\max}$$

$$\mu_1^* \leq \mu_{012}^{\max} - \mu_{02}^{\max}$$

$$\mu_2^* \leq \mu_{012}^{\max} - \mu_{01}^{\max}$$

Lobby 1 would like to attain the point on the South-Eastern part on TT' , whereas lobby 2 would like to attain the point on the North-Western part of TT' . It is not clear how the two lobbies will decide on a point on TT' unless they engage in some sort of non-cooperative bargaining.

When a continuum of truthful Nash equilibria exist, one cannot calculate the contribution level uniquely because the vector of net payoff of two industry lobbies is not unique. In Table 4, I have calculated the contribution from industry 1 at point T' and that for industry 2 at point T . These are the lower bound contribution levels that each lobby would contribute. The continuum of truthful Nash equilibria is the case where the two lobbies are reinforcing the interests of each other, even though they are playing non-cooperatively. The results are as if they are playing cooperatively.

6.6. *The Lobbying Decision*

This model takes the lobbying decision of an industry as exogenous. However, in hindsight, I could generalize some of my numerical results towards the decision making process of an industry. Before proceeding to this analysis, let us summarize the net payoffs of two industry lobbies in three different situations. The numbers in the following table are taken from Tables 1 through 4. All numbers indicate the net payoffs — net of contribution money to the government but gross of lobbying expenses — of two lobby groups. The values in the first cell are the payoffs under free trade levels. The first entry in each cell is for the payoff of industry 1 and the second one is for the payoff of industry 2.

There are three matrices corresponding to three values of γ_1 . Let us take the first matrix. For each industry “organize” is the dominant strategy. For example, provided industry 2 is not organized, industry 1 receives a net payoff of 0.3780 if it is not organized whereas it receives 0.8036, if it is organized. Similarly, if industry 2 is organized, the net payoff of industry 1 if it is not organized is 0.3436 against 0.6600 if it is organized. Thus, whatever industry 2 does, industry 1 obtains a higher payoff by organizing. The same is true for industry 2. Moreover, each industry is better off if it is the only industry organized than if both of them are organized. However, if both of them are organized, they receive higher payoffs than if none of them is organized. This was the situation which gave me a unique truthful Nash equilibrium and the government was able to extract part of the surplus of the lobbying activities.

In the second matrix ($\gamma_1 = 0.63$), again, “organize” is the dominant strategy. Contrary to the first case, provided an industry is organized, its net payoff remains the same whatever

the other industry does. This is an interesting situation and note that this situation has provided a unique truthful Nash equilibrium when the payoff of the government remains at the free trade level and all the surplus has been extracted by two lobby groups. In this case, one lobby group is not concerned about the lobbying decision of the other industry.

TABLE 5 — NET RENTAL INCOME OF DOWNSTREAM AND UPSTREAM INDUSTRIES

WHEN $\gamma_1 = 0.40$

Downstream Industry	Upstream Industry			
	Not Organized		Organized	
Not Organized	0.3780	0.2345	0.3446	0.5994
Organized	0.8036	0.2261	0.6600	0.4558

NET RENTAL INCOME OF DOWNSTREAM AND UPSTREAM INDUSTRIES

WHEN $\gamma_1 = 0.63$

Downstream Industry	Upstream Industry			
	Not Organized		Organized	
Not Organized	0.2466	0.2345	0.1918	0.5782
Organized	0.5946	0.3583	0.5946	0.5782

NET RENTAL INCOME OF DOWNSTREAM AND UPSTREAM INDUSTRIES

WHEN $\gamma_1 = 0.70$

Downstream Industry	Upstream Industry			
	Not Organized		Organized	
Not Organized	0.2197	0.2345	0.1624	0.5682
Organized	0.5334	0.4082	0.6925	0.7273

In the third matrix, the net payoffs cannot be uniquely determined, but at the upper limit of the net payoff of each lobby, "organize" is the dominant strategy. However, in this case, one organized lobby is better off when the other industry is also organized.

Thus when a lobby group's net payoff is higher when it is the only group organized than when both industries are organized (first matrix in Table 5), the government net payoff due to lobbying activities rises above the free trade level. However, if a lobby group obtains the same level of net payoff whether it is the only industry organized or both of them are organized (second matrix), all surplus is extracted by lobby groups and the government receives exactly the same payoff as under free trade. Similarly, if the payoff of a lobby group is higher when the other industry is also represented by a lobby group than when it is the only organized lobby (third matrix), the payoff of the government remains at the free trade level.

In all three matrices for payoffs, "organize" is the dominant strategy. However, we cannot conclude that they will organize. This would have been the case if the administrative cost of lobbying were zero. Let us suppose that lobbying activity has a positive fixed cost and it is given by λ . Now, whether one industry will be organized depends on whether its net payoff above the level it would have received if it were not organized — net of political contributions — is larger than λ . If it is larger than λ , then an industry will organize whereas if it is less than λ , it will not organize.

For each industry $j = 1, 2$, its net payoffs — net of contributions to the government — depends on whether the other industry $i = 1, 2, i \neq j$ is organized. Therefore there are two cases to consider. The decision rule of industry $j = 1, 2$ when $i = 1, 2, i \neq j$ is not organized is given by the following equation:

$$(38) \quad \varphi_j(p_{1,0j}^*, p_{2,0j}^*) - c_j(p_{1,0j}^*, p_{2,0j}^*) - \varphi_j(p_{1,0}^*, p_{2,0}^*) \leq \lambda.$$

Similarly, the decision rule for industry $j = 1, 2$ when $i = 1, 2, i \neq j$ is organized is given by

$$(39) \quad \varphi_j(p_{1,012}^*, p_{2,012}^*) - c_j(p_{1,012}^*, p_{2,012}^*) - \varphi_j(p_{1,0j}^*, p_{2,0j}^*) \leq \lambda.$$

Under a unique truthful Nash equilibrium, the above two conditions can be written as follows:

$$(38') \quad \left(\mu_{0j}^{\max} - \mu_0^{\max} \right) - \varphi_j(p_{1,0}^*, p_{2,0}^*) \leq \lambda.$$

$$(39') \quad \left(\mu_{012}^{\max} - \mu_{0r}^{\max} \right) - \varphi_j(p_{1,0r}^*, p_{2,0r}^*) \leq \lambda.$$

Now, I have the following conditions:

$$(i) \quad \mu_{0j}^{\max} - \mu_0^{\max} - \varphi_j(p_{1,0}^*, p_{2,0}^*) \leq \mu_{012}^{\max} - \mu_{0r}^{\max} - \varphi_j(p_{1,0r}^*, p_{2,0r}^*) > \lambda;$$

$$(ii) \quad \mu_{0j}^{\max} - \mu_0^{\max} - \varphi_j(p_{1,0}^*, p_{2,0}^*) > \lambda > \mu_{012}^{\max} - \mu_{0r}^{\max} - \varphi_j(p_{1,0r}^*, p_{2,0r}^*);$$

$$(iii) \quad \mu_{0j}^{\max} - \mu_0^{\max} - \varphi_j(p_{1,0}^*, p_{2,0}^*) < \lambda < \mu_{012}^{\max} - \mu_{0r}^{\max} - \varphi_j(p_{1,0r}^*, p_{2,0r}^*);$$

$$(iv) \quad \mu_{0j}^{\max} - \mu_0^{\max} - \varphi_j(p_{1,0}^*, p_{2,0}^*) \leq \mu_{012}^{\max} - \mu_{0r}^{\max} - \varphi_j(p_{1,0r}^*, p_{2,0r}^*) < \lambda.$$

I have not considered the equality sign between two expressions in order to concentrate on the more interesting issues with strict inequalities only.

I have measured these two net payoff vectors — net of political contributions and lobbying administrative cost — in Figure 6. In the horizontal axis I have measured the net payoff of lobby $j = 1, 2$ when $i = 1, 2, i \neq j$ is organized and in the vertical axis the net payoff of lobby $j = 1, 2$ when it is the only industry organized. Condition (i) can be anywhere in the first quadrant like point A. In this case, the net payoff of industry j is positive whatever the other industry does. Therefore in this case, industry j will obviously be organized. The line OA is the 45°-line where the net payoff of lobby j is the same in both situations: when it is the only industry organized, and when both industries are organized. If the net payoff of lobby j is higher when it is the only industry organized than when both industries are

organized, then point A (the coordinates of net payoffs of lobby j in two situations) will remain somewhere to the left of 45° -line. On the other hand, if its payoff is higher if both

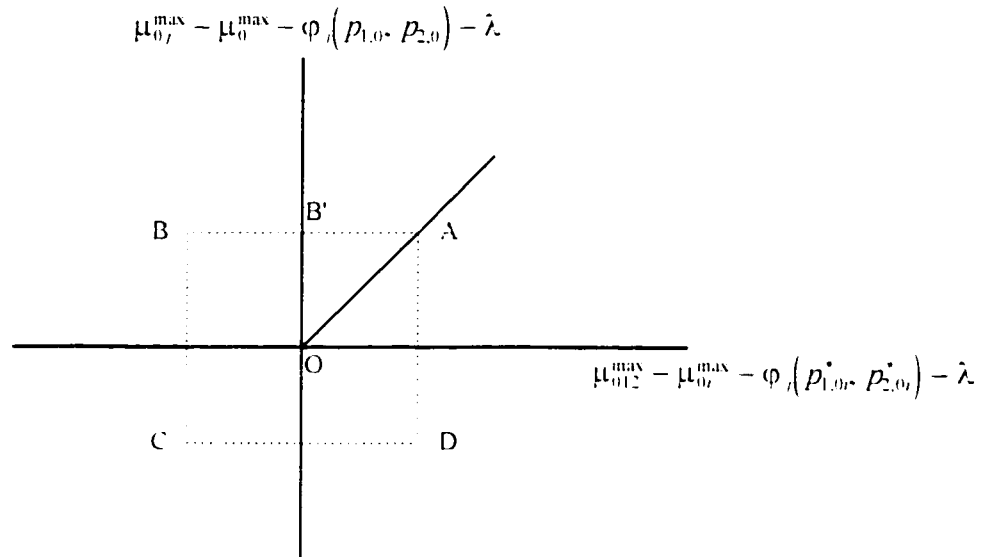


FIGURE 6. LOBBYING DECISION

industries are organized than if it is the only industry organized, then point A remains to the right of this line. All industries whose net payoffs fall under quadrant I, will be organized.

Condition (ii) is given in the second quadrant, let us say, by point B. In this case, industry j 's net payoff is positive only if it is the only industry organized and negative if the other industry is also organized. If it is the only industry organized, it will remain at B' whereas if the other industry is also organized, industry j will be pushed to point B. In this case, industry j will be organized only if industry i does not. Condition (iii) shows the reverse case when the net payoffs of industry j is positive only if both industries are organized and negative if j is the only industry organized. A situation like this is given by point D. In this case, industry j lobbies for the protection of its industry if industry i does the same. Thus in conditions (ii) and (iii), the decision of one industry is influenced by the decision of the other

industry. The last case, where the net payoffs of lobby j is negative in both cases is given by point C. In this case, industry j will not be organized.

From Table 5, I could calculate the additional level of net payoff of an industry when it is organized by subtracting the level of net payoff it would have received if it were not organized. Thus each entry in Table 6 is directly calculated from the two entries in Table 5. The three matrices in Table 5 generate three columns in Table 6.

TABLE 6—NET PAYOFFS OF LOBBY GROUPS BEFORE THE ADMINISTRATIVE COST OF LOBBYING

	$\gamma_1 = 0.40$		$\gamma_1 = 0.63$		$\gamma_1 = 0.70$	
	<u>Lobby 1</u>	<u>Lobby 2</u>	<u>Lobby 1</u>	<u>Lobby 2</u>	<u>Lobby 1</u>	<u>Lobby 2</u>
$\mu_{0j}^{\max} - \mu_{0j}^{\max} - \phi_j(p_{1,0}, p_{2,0})$	0.4256	0.3649	0.3480	0.3437	0.3137	0.3337
$\mu_{012}^{\max} - \mu_{0j}^{\max} - \phi_j(p_{1,0}, p_{2,0})$	0.3154	0.2297	0.4028	0.2199	0.5301	0.3191

In the above table, at $\gamma_1 = 0.40$, the net payoffs of each industry lobby is higher if it is the only one organized (the entries in bold). If $\gamma_1 = 0.63$, industry 1 has higher payoff if both industries are organized than if it is the only industry organized. However, for industry 2 the payoff is higher if it is the only industry organized. The same results hold if $\gamma_1 = 0.70$.

Now whether an industry will be organized depends on the cost of lobbying. If $\lambda = 0.20$, both industries will be organized in all the three cases because the net payoff of each lobby in each case is higher than the value of λ . Next let $\lambda = 0.30$. In the first case when $\gamma_1 = 0.40$, industry 1 will lobby whatever industry 2 does but industry 2 will lobby only if industry 1 does not lobby. Since industry 1 will lobby in this case, industry 2 will stay out. The same

situation happens if $\gamma_1 = 0.63$. However, if $\gamma_1 = 0.70$, each will be organized whatever the other does.

If $\lambda = 0.40$, then at $\gamma_1 = 0.40$, industry 1 will organize only if industry 2 does not organize. Since industry 2 will not organize in this case industry 1 will organize. However, if $\gamma_1 = 0.63$, industry 1 will organize only if industry 2 does the same. Since industry 2 will not organize, none of them will organize. The same situation arises if $\gamma_1 = 0.70$.

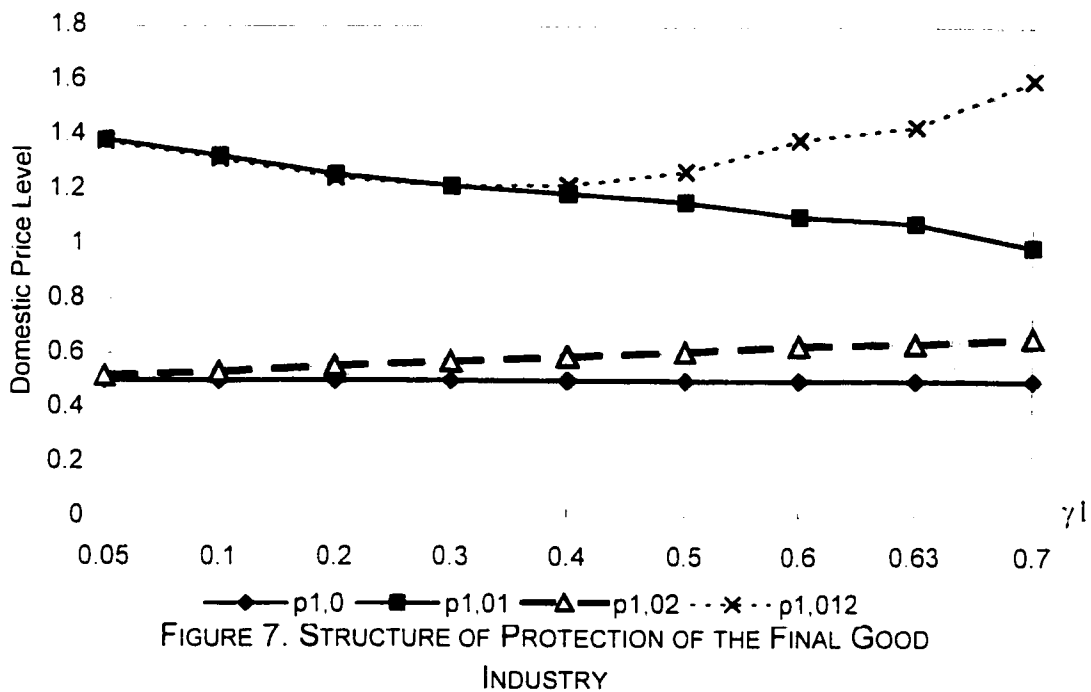
If $\lambda = 0.50$, then no industry will organize. The administrative cost of lobbying is prohibitive for both industries for any value of γ_1 .

6.7. A Graphical Illustration of Endogenous Trade policy

Up to this point, I have studied the payoffs of different lobby groups, the government, and the nature of equilibrium. In what follows, I am going to illustrate what happens to the level and structure of protection of the two industries as the share of intermediate input varies in the total revenue of the final good industry. Note that in a Cobb-Douglas technology, the parameter γ_1 assigned for the intermediate input is the revenue share of the intermediate input in industry 1. In Figure 7, I have shown the movement of the price of good 1 under different lobbying situations at varying shares of intermediate input. Each line is drawn under a given lobbying situation by varying the share of intermediate input in the final good industry. For example, the line designated $p_{1,01}$ shows the movement of prices of good 1 when only industry 1 is organized as the share of intermediate input varies from 0.05 to 0.7. The data for Figures 7 through 10 are given in Appendix B.

In Figure 7, the horizontal line $p_{1,0}$ represents the free trade price of good 1 when neither industry is organized. From Figure 7, I can make the following observations:

- (i) If only industry 1 is organized, the level of protection is always positive at all level of intermediate input shares. However, the level of protection for industry 1 will be smaller as we move to the right, that is, as the share of intermediate input rises. It is because as we move to the right, the share of specific factor into industry 1 falls, and subsequently its power to influence the government also dwindles.



- (ii) If only industry 2 is organized, the relevant line for the movement in the price of good 1 is given by $p_{1,02}$. The level of nominal protection of industry 1 is positive and it rises with the share of the intermediate input. That is, the higher the share of the intermediate input produced by an organized upstream industry, the higher will be the nominal level of protection for downstream industry even if the latter is not organized.

(iii) When both industries are organized, we are on the $p_{1,012}$ line. The level of nominal protection of industry 1 initially falls (however, the protection is positive) as the share of the intermediate input rises. However, after the share of the intermediate input reaches about the 40 percent, the price of good 1 starts rising.

(iv) In this example, we have $p_{1,012} > p_{1,01} > p_{1,02} > p_{1,0} = p_1^0$. Thus the price of good 1 will be always higher than its free trade level, no matter which industry is organized. However, the effective protection may not be positive because the price of the intermediate input will also rise as lobbying occurs. The movement in the price of good 2 is depicted in Figure 8.

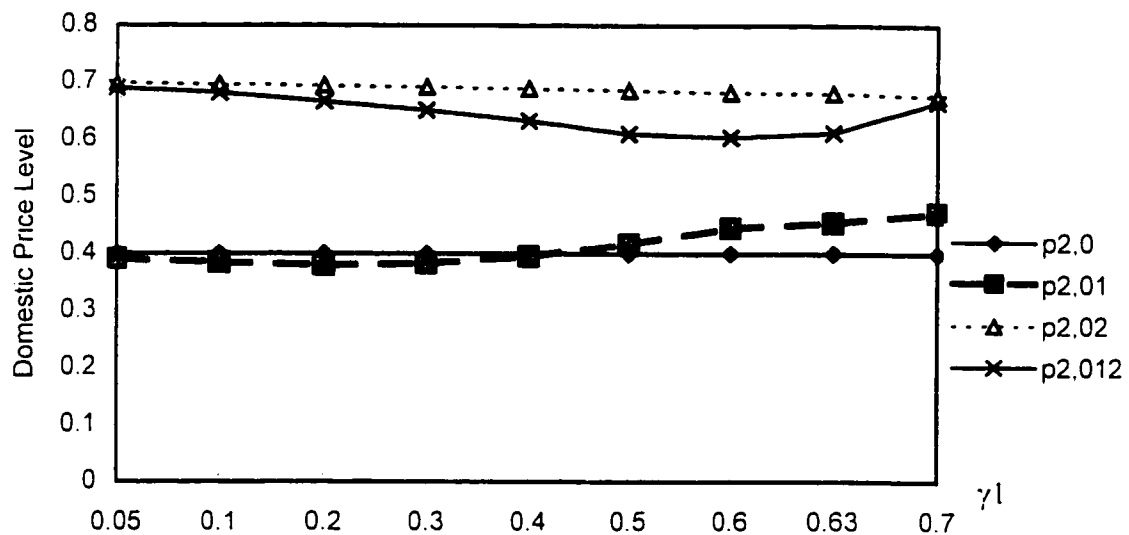


FIGURE 8. STRUCTURE OF PROTECTION OF INTERMEDIATE INPUT INDUSTRY

As the curve $p_{2,01}$ shows, if only industry 1 is organized, the intermediate input industry faces an import tax or export subsidy when the share of the intermediate input is small and obtains an import tariff or export subsidy if the share is relatively large. Thus the linkage from the

downstream industry to the protection of the upstream industry might be positive or negative depending on the share of intermediate input in the final-good industry.

If only industry 2 is organized, its level of protection is positive and falls as its share in the cost of the final good industry rises. At the very end of the graph, it seems that the level of protection for industry 2 will be higher if both industries are organized than if it is the only one organized.

If both industries are organized, the level of protection falls for a while as the share of the intermediate input rises, but when the share rises further the level of protection for the intermediate input starts rising. The trend of the $p_{2,012}$ curve is similar to the trend of $p_{2,01}$.

In this example, we have $p_{2,02}^* > p_{2,012}^* > p_{2,01}^* \lessgtr p_{2,0}^* = p_2^0$.

The above two figures depicted the endogenous protection of traded good industries. However, since industry 1 is using good 2 as an input, the nominal increase in the price of good 1 may not be sufficient to offset the negative effect on the income of the specific factor owners in industry 1 due to the rise in the price of the intermediate input. In order to know whether the downstream industry will support or oppose the protection of an upstream industry, it is not sufficient to look only the change in the price of the product of the downstream industry. For this purpose, one also has to find out whether the owners of the specific factor in the downstream industry lose or gain from the protection of industry 2. In the following figure, I have plotted the net change in the income of specific factor owners in industry 1, relative to the level under free trade. I have normalized the change in income from free trade level; I have only three lines for three respective cases: when only industry 1 is organized, when only industry 2 is organized, and when both industries are organized. Thus

if a line remains above the horizontal axis, it means that relative to the free trade situation, the net change in income is positive whereas if it remains below the horizontal axis, the net change in income is negative. For brevity, I have changed the notation slightly. For example, I have used $\varphi_{1,01}$ to indicate $\varphi_1(p_{1,01}, p_{2,01})$.

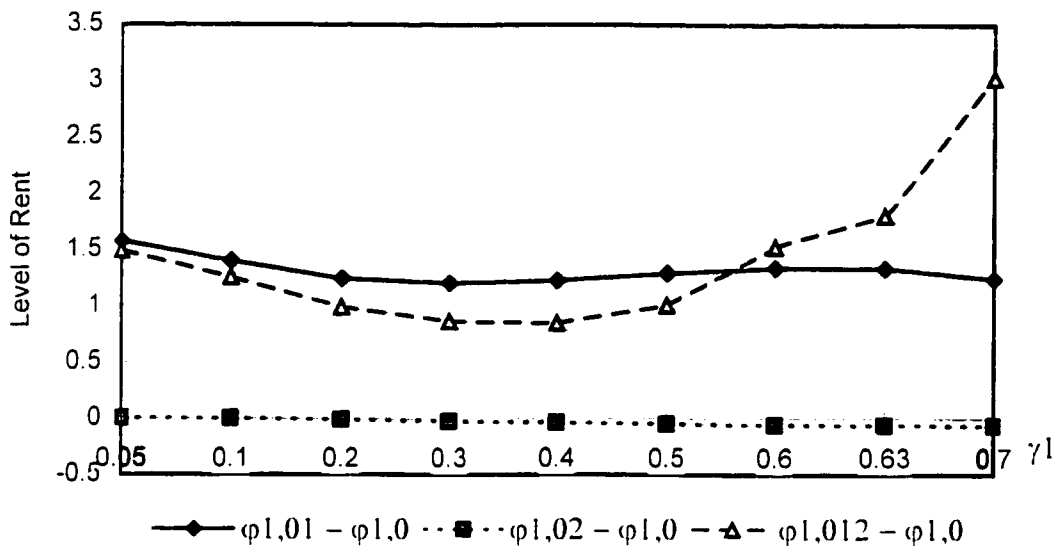


FIGURE 9. CHANGE IN RENTAL INCOME OF THE FINAL GOOD INDUSTRY

In my example, the rental income in industry 1 remains above the free trade level if it is the only industry organized. When industry 2 is organized, in my theoretical discussion, I have shown that the income of specific factor owners in industry 1 may rise or fall, even if the price of good 1 rises. Interestingly, the level of rental income of the owners of the specific factor in the downstream industry rises when the upstream industry is organized and the share of the intermediate input is small. In this example, $\varphi_{1,02} > \varphi_{1,0}$ if the share of intermediate input is 5 or 10 percent (see Appendix B). That is why the line $\varphi_{1,02} - \varphi_{1,0}$ seems to overlap the horizontal axis, but is slightly above the axis at the beginning. Thus it is important to note

that the rent of the downstream industry may also go up if the upstream industry is organized. This solves the puzzle of why the downstream industry are passive or even supportive of the protection of an upstream industry.

The rent of the downstream industry remains always above the free trade level if both upstream and downstream industries are organized.

To summarize, $\varphi_{1,02} \gtrsim \varphi_{1,012} > \varphi_{1,02} \gtrsim \varphi_{1,0} = \varphi_1^0$.

I have shown that if the price of the intermediate input rises above the free trade level, the income of specific factor owners in industry 2 necessarily rises. The endogenous variation of the profit in industry 2 is depicted in Figure 10.

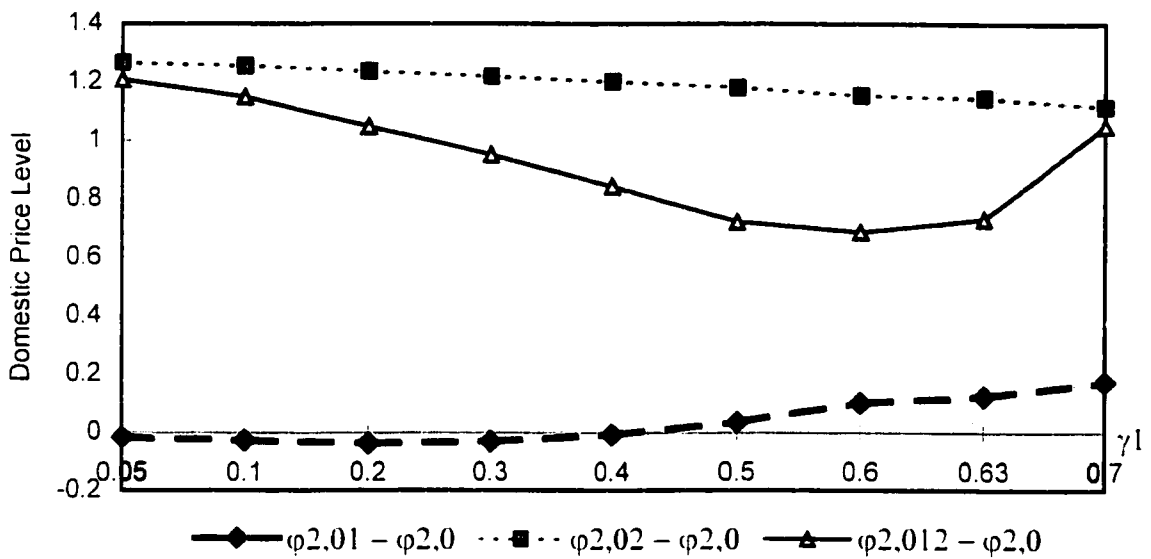


FIGURE 10. CHANGE IN THE RENTAL INCOME IN THE INPUT INDUSTRY

Observe that in Figures 9 and 10, income of the specific factor owners in both industries are high if the share of the intermediate input is larger than about 63 percent and if

both industries are organized. This is the case which gives us a continuum of truthful equilibria as depicted in Figure 5.

7. Conclusions

In this chapter, I have developed a model of vertical linkages between two industries. I have shown that the upstream industry may support the protection of downstream industries. Also, I have discussed situations in which a downstream industry supports or opposes the protection of an upstream industry. The fact that a downstream industry is likely to oppose the protection of an upstream industry is intuitive and obvious. However, by showing that the downstream industry may support the protection of an upstream industry, I have solved a puzzle in the theory of endogenous protection in international trade. Also, I have been able to identify and analyze the economic and political reasons behind the protection of the steel and auto industries, and the semiconductor and computer industries in the United States.

Besides the theoretical analysis, I have solved the three stage game of endogenous trade policy numerically. I also have computed the net payoffs of all industry lobby groups and the government. It is shown that the game may have a unique truthful Nash equilibrium or a continuum of truthful Nash equilibria depending on whether the Pareto efficient frontier is a point or a line segment, respectively. The implication of the unique truthful Nash equilibrium is that, the payoff of the government may rise (remain) above (at) the free trade level. On the other hand, if there exist a continuum of multiple Nash equilibria, the payoff of the government remains at the free trade level.

Moreover, it is shown that when the truthful Nash equilibrium is unique, the level of contributions from lobby groups can be uniquely determined, whereas if there are a

continuum of Nash equilibria, we cannot determine the levels of contributions made by the various lobbies although the policies implemented by the government are always unique.

Although the model takes the lobbying decision of an industry as exogenous, I have motivated my analysis towards the decision making process of an industry. In my numerical example, even though lobbying is the dominant strategy for each industry at zero lobbying cost, once we consider the positive cost of lobbying, one or both of them may opt for not lobbying. Besides, before making a decision on whether to organize, in some cases, an industry does not have to consider what the other industry is going to do whereas in some cases, the decision of one industry depends entirely on the decision of the other industry.

APPENDIX A

COMPLETE SOLUTION TO TWO INDUSTRY MODEL WHEN $\gamma_1 = 0.4$

Variables / Lobby Groups	0	01	02	012
p_1	0.5	1.1850	0.5879	1.2156
p_2	0.4	0.3956	0.6888	0.6320
$\varphi_1(p_1, p_2)$	0.3780	1.6041	0.3446	1.2247
$\varphi_2(p_1, p_2)$	0.2345	0.2261	1.4355	1.0774
$\phi(p_1, p_2)$	1.0000	0.0992	0.8320	0.0809
$s(p_1, p_2)$	0.0000	-1.1174	-1.8356	-1.8132
Total Welfare	1.6125	2.4161	2.2112	2.8719
$z_1(p_1, p_2)$	2.0000	0.6300	1.8243	0.5688
$y_1(p_1, p_2)$	1.2599	2.2561	0.9769	1.6792
$\hat{z}_1(p_1, p_2)$	0.7401	-1.6262	0.8474	-1.1104
$x_{12}(p_1, p_2)$	0.6300	2.7031	0.3335	1.2919
$y_2(p_1, p_2)$	1.9540	1.9046	6.9461	5.6821
$\hat{z}_2(p_1, p_2)$	-1.3241	0.7985	-6.6127	-4.3902
$\eta_{12}(p_1, p_2)/\eta_{11}(p_1, p_2)$	-0.4565	-0.3882	-0.3565	-0.3153
$\eta_{21}(p_1, p_2)/\eta_{22}(p_1, p_2)$	-0.1872	-0.5034	-0.0332	-0.1397
$\Delta(p_1, p_2)$	47.1952	59.4972	74.7369	68.0865

APPENDIX B

THE ENDOGENOUS BEHAVIOR OF TRADE POLICY AND RENTAL INCOME
AT VARYING LEVELS OF REVENUE SHARE OF INTERMEDIATE INPUT

γ_1	p1,0	p1,01	p1,02	p1,012	p2,0	p2,01	p2,02	p2,012
0.05	0.5	1.381	0.5174	1.3756	0.4	0.3911	0.6981	0.6899
0.1	0.5	1.3229	0.5307	1.3138	0.4	0.385	0.6966	0.6813
0.2	0.5	1.2539	0.552	1.2429	0.4	0.3797	0.6939	0.6658
0.3	0.5	1.2134	0.5703	1.2118	0.4	0.3832	0.6914	0.6503
0.4	0.5	1.185	0.5879	1.2156	0.4	0.3956	0.6888	0.6321
0.5	0.5	1.1561	0.6066	1.2675	0.4	0.417	0.6859	0.6098
0.6	0.5	1.1033	0.6288	1.3838	0.4	0.4456	0.6821	0.6031
0.63	0.5	1.0778	0.6366	1.4317	0.4	0.4543	0.6807	0.6118
0.7	0.5	0.992	0.6595	1.6033	0.4	0.4724	0.6763	0.6662

γ_1	$\varphi_{1,0}$	$\varphi_{1,01}$	$\varphi_{1,02}$	$\varphi_{1,012}$	$\varphi_{2,0}$	$\varphi_{2,01}$	$\varphi_{2,02}$	$\varphi_{2,012}$
0.05	0.821	2.3951	0.8265	2.3151	0.2345	0.2176	1.5009	1.4426
0.1	0.7143	2.1146	0.7176	1.967	0.2345	0.2065	1.4898	1.3838
0.2	0.5657	1.8087	0.5578	1.5544	0.2345	0.1971	1.4709	1.2818
0.3	0.4598	1.6618	0.4388	1.3223	0.2345	0.2032	1.4534	1.1845
0.4	0.378	1.6041	0.3446	1.2247	0.2345	0.2261	1.4355	1.0774
0.5	0.3125	1.6024	0.2682	1.3173	0.2345	0.2694	1.4151	0.9563
0.6	0.2598	1.5985	0.2069	1.788	0.2345	0.3359	1.3892	0.9218
0.63	0.2466	1.579	0.1915	2.0485	0.2345	0.3583	1.3796	0.9664
0.7	0.2197	1.4624	0.1624	3.248	0.2345	0.4082	1.35	1.2842

CHAPTER 4

HORIZONTAL LINKAGES AND THE STRUCTURE OF PROTECTION

1. Introduction

In the previous chapter, the effects of vertical linkages between industries on the structure of their protection was studied. Those linkages emanate from the production side only. In this chapter, I incorporate the linkages due to consumption by adding a non-traded consumption good to the model of the preceding chapter. Although the non-traded good is neither taxed nor subsidized, and is not traded internationally, it still can affect the structure of protection

for traded industries if it is organized. Since the prices of traded goods determine the price of a non-traded good, the specific factor owners in a non-traded good industry may have an interest in raising or lowering the price of traded goods in order to increase the price of the non-traded good and consequently their factor income. As mentioned by Krueger (1990), the producers of high fructose corn syrup (HFCS) — a sugar substitute — lobbied for the protection of the sugar industry in the United States. There could also be cases where a non-traded industry lobbies for a lower price of a traded good.

In this chapter, I analyze these issues and study the structure of protection in a model with both traded and non-traded goods. In the model I formulate, there are three goods: one final consumption good (good 1), one traded pure intermediate good (good 2) used in the production of the traded final consumption good and one non-traded final consumption good (good 3). The industries that produce these goods are called industry 1, industry 2 and industry 3, respectively. Section 2 starts with the basic model where there are no lobby groups. Section 3 deals with the case when only industry 3 is organized. Section 4 covers the case when both industries 1 and 3 are organized. Section 5 analyzes the situation when industry 2 and industry 3 are organized. The case of all three industry lobbies is addressed in Section 6. The model is solved numerically in Section 7. The concluding remarks are gathered in Section 8.

Note that using (8) and (9) of Chapter 2, I can write $\varphi_3(p_1, p_2) = \pi_3(p_1, p_2, p_3(p_1, p_2))$, and $\phi(p_1, p_2) = v(p_1, p_2, p_3(p_1, p_2), \bar{m})$, where I have used $p_3(p_1, p_2)$ in place of $\psi_3(p_1, p_2)$ to

denote the price of the non-traded good that clears this market, given the trade policy (p_1, p_2) chosen by the home government.

2. No Industry is Organized

If none of the three industry is organized, the government has only the aggregate social welfare to maximize. Thus the government solves the following welfare maximization problem:

$$(1) \quad \max_{p_1, p_2} \varepsilon \left[\begin{aligned} & \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \pi_3(p_1, p_2, p_3(p_1, p_2)) + v(p_1, p_2, p_3(p_1, p_2), \bar{m}) \\ & + (p_1 - p_1^0)\xi_1(p_1, p_2) + (p_2 - p_2^0)\xi_2(p_1, p_2) \end{aligned} \right] = \mu_0^{\max}.$$

The first-order conditions for an interior solution are

$$(2) \quad \begin{aligned} & D_1\varphi_1(p_1, p_2) + D_1\varphi_2(p_1, p_2) + D_1\pi_3(p_1, p_2, p_3(p_1, p_2)) + D_1\pi_3(p_1, p_2, p_3(p_1, p_2)) D_1p_3(p_1, p_2) \\ & + D_1v(p_1, p_2, p_3(p_1, p_2), \bar{m}) + D_1v(p_1, p_2, p_3(p_1, p_2), \bar{m}) D_1p_3(p_1, p_2) \\ & + \xi_1(p_1, p_2) + (p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) = 0. \end{aligned}$$

$$(3) \quad \begin{aligned} & D_2\varphi_1(p_1, p_2) + D_2\varphi_2(p_1, p_2) + D_2\pi_3(p_1, p_2, p_3(p_1, p_2)) + D_2\pi_3(p_1, p_2, p_3(p_1, p_2)) D_2p_3(p_1, p_2) \\ & + D_2v(p_1, p_2, p_3(p_1, p_2), \bar{m}) + D_2v(p_1, p_2, p_3(p_1, p_2), \bar{m}) D_2p_3(p_1, p_2) \\ & + (p_1 - p_1^0)D_2\xi_1(p_1, p_2) + \xi_2(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) = 0. \end{aligned}$$

Because the profit of industry 2 does not depend on the price of good 1, we have

$D_1\varphi_2(p_1, p_2) = 0$. Furthermore, by Hotelling's lemma, we have $D_1\varphi_1(p_1, p_2) = y_1(p_1, p_2)$, and

$D_1\pi_3(p_1, p_2, p_3(p_1, p_2)) = -x_{31}(p_1, p_2, p_3(p_1, p_2))$, where $y_1(p_1, p_2)$ is the output of good 1 and

$x_{31}(p_1, p_2, p_3(p_1, p_2))$ is the amount of good 1 used as an input into industry 3. Since industry

3 does not use good 1 as an input in my model, this is set to zero. Also,

$D_3\pi_3(p_1, p_2, p_3(p_1, p_2)) = y_3(p_1, p_2, p_3(p_1, p_2))$. By Roy's identity, $D_1v(p_1, p_2, p_3(p_1, p_2), \bar{m}) = -z_1(p_1, p_2, p_3(p_1, p_2))$, and $D_3v(p_1, p_2, p_3(p_1, p_2), \bar{m}) = -z_3(p_1, p_2, p_3(p_1, p_2))$, where $z_1(p_1, p_2, p_3(p_1, p_2))$ and $z_3(p_1, p_2, p_3(p_1, p_2))$ are the representative consumer's demand for good 1 and good 3. Thus (2) can be rewritten as

$$(4) \quad \begin{aligned} & y_1(p_1, p_2) + y_3(p_1, p_2, p_3(p_1, p_2))D_1p_3(p_1, p_2) \\ & - z_1(p_1, p_2, p_3(p_1, p_2)) - z_3(p_1, p_2, p_3(p_1, p_2))D_1p_3(p_1, p_2) \\ & + \xi_1(p_1, p_2) + (p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) = 0. \end{aligned}$$

Similarly, in (3), $D_2\varphi_1(p_1, p_2) = -x_{12}(p_1, p_2)$, $D_2\varphi_2(p_1, p_2) = y_2(p_1, p_2)$. Since good 2 is not used as an input into industry 3, $D_2\pi_3(p_1, p_2, p_3(p_1, p_2)) = -x_{32}(p_1, p_2, p_3(p_1, p_2)) = 0$ in the model. By Hotelling's Lemma, $D_3\pi_3(p_1, p_2, p_3(p_1, p_2)) = y_3(p_1, p_2, p_3(p_1, p_2))$. Also, because good 2 is not used in final consumption, $D_2v(p_1, p_2, p_3(p_1, p_2), \bar{m}) = 0$. And, because the price of good 3 is not related to the price of good 2, we have $D_2p_3(p_1, p_2)$ equal to zero. Hence, (3) can be rewritten as follows:

$$(5) \quad -x_{12}(p_1, p_2) + y_2(p_1, p_2) + (p_1 - p_1^0)D_2\xi_1(p_1, p_2) + \xi_2(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) = 0.$$

Using the three market-clearing conditions $\xi_1(p_1, p_2) = z_1(p_1) - y_1(p_1, p_2)$,

$\xi_2(p_1, p_2) = x_{12}(p_1, p_2) - y_2(p_1, p_2)$ and $z_3(p_1, p_2, p_3(p_1, p_2)) = y_3(p_1, p_2, p_3(p_1, p_2))$ for goods 1,

2, and 3, respectively, I can rewrite (4) and (5) as follows:

$$(6) \quad (p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) = 0.$$

$$(7) \quad (p_1 - p_1^0)D_2\xi_1(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) = 0.$$

Formally, (6) and (7) are exactly the same as the first-order conditions (4) and (5), respectively derived in Chapter 3, when there is no non-traded good. However, some distinction must be kept in mind because while the excess demand for the intermediate input, namely ξ_2 is the same in both models, the excess demand for the traded final good, namely ξ_1 , in the current model is different from that in the model of the preceding chapter. Thus if I make the same assumption that the own price elasticity dominates the cross price elasticity, i.e., $\Delta(p_1, p_2) = D_1 \xi_1(p_1, p_2) D_2 \xi_2(p_1, p_2) - D_1 \xi_2(p_1, p_2) D_2 \xi_1(p_1, p_2) > 0$ then the solution of the system (6), (7) in the two unknowns p_1, p_2 is $p_1 = p_{1,0}^* = p_1^0, p_2 = p_{2,0}^* = p_2^0$. Hence free trade is the policy that maximizes social welfare.

Before continuing, I shall formally state the assumption that guarantees that the system (6), (7) has a unique solution as follows:

$$\Delta(p_1, p_2) = D_1 \xi_1(p_1, p_2) D_2 \xi_2(p_1, p_2) - D_1 \xi_2(p_1, p_2) D_2 \xi_1(p_1, p_2) \text{ is strictly positive.}$$

Thus the presence of non-traded goods does not alter the free trade equilibrium established for the traded good industry if the non-traded industry is not organized. Conditions (6) and (7) will hold as long as none of the industries is organized even if the non-traded good industry uses traded goods as inputs or the traded good industry uses non-traded goods as inputs.

If the non-traded good industry is not organized, then I can use (6) and (7) then proceed exactly as in Chapter 3 to analyze the game when industry 1 or/and industry 2 are organized. Therefore, the expressions for the deviations from their free trade levels of the prices for good 1 and good 2 when only industry 1 is organized, when only industry 2 is organized, and when 1 and 2 are organized are the same as given by the pairs (10) and (11).

(18) and (19), and (24) and (25), respectively derived in Chapter 3. However, since the expression for the excess demand for good 1 in this chapter is different from that in Chapter 3, the magnitude of protection between two models will be different. In this chapter, I will concentrate only on the four other possibilities that are generated by the non-traded industry being organized.

Since the supply of good 3 depends only on its own price, I shall suppress the superfluous variables p_1 and p_2 in $y_3(p_1, p_2, p_3)$ and write $y_3(p_3)$ as the supply function of good 3 from now on. Similarly, the representative consumer's demand for goods 1 and 3 will be written as $z_1(p_1, p_3)$ and $z_3(p_1, p_3)$, respectively. Given p_1 , the equilibrium in the market for the non-traded good is characterized by $y_3(p_3) = z_3(p_1, p_3)$. The demand curve for good 3 in the following figure has been drawn for a given p_1 . If goods 1 and 3 are gross substitutes, (complements) an increase in the price of good 1 will shift this demand curve to the right (left). The intersection of the demand curve for and the supply curve of good 3 determines the

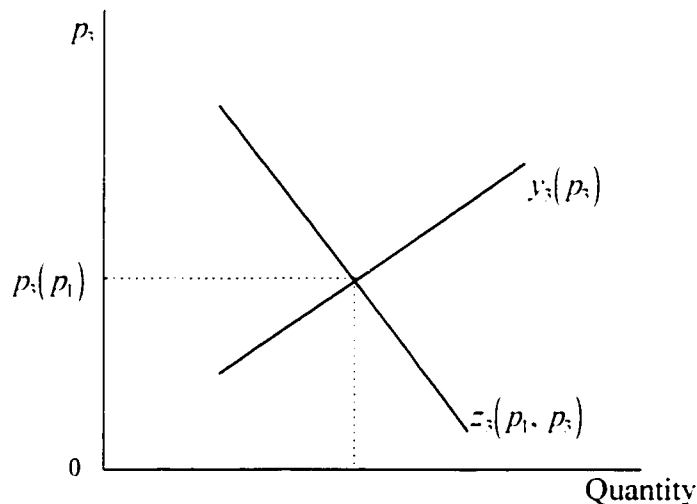


FIGURE 1. NON-TRADED GOOD MARKET EQUILIBRIUM

equilibrium price in this market. Note that the equilibrium price of good 3 depends only on p_1 and will be written as $p_3(p_1)$ instead of as $p_3(p_1, p_2)$. In this manner, the derivative $D_1 p_3(p_1, p_2)$ will be written as $p_3'(p_1)$. The following comparative static result due to a change in p_1 is simple to derive

$$(8) \quad p_3'(p_1) = \frac{\frac{\partial z_3}{\partial p_1}(p_1, p_2)}{y_3'(p_2) - \frac{\partial z_3}{\partial p_2}(p_1, p_2)}.$$

Observe that $\frac{\partial z_3}{\partial p_1}(p_1, p_2)$ is positive (negative) if goods 1 and 2 are gross substitutes (complements). Hence $p_3'(p_1)$ is positive (negative) if these two final consumption goods are gross substitutes (complements). The expression on the right hand side of (8) represents their horizontal linkages. The higher the price elasticities of demand and supply and higher the cross elasticity of demand of the non-traded good, the higher will be the horizontal linkage.

3. Only the Non-traded Good Industry is Organized

According to (23) of Proposition 3.4 in Chapter 2, the home government selects the trade policy $(p_{1,03}^*, p_{2,03}^*)$ by maximizing the following objective function.

$$(9) \quad \max_{p_1, p_2} \left(\begin{array}{c} \pi_3(p_1, p_2, p_3(p_1, p_2)) \\ + \varepsilon \left[\begin{array}{c} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \pi_3(p_1, p_2, p_3(p_1, p_2)) \\ - v(p_1, p_2, p_3(p_1, p_2), \bar{m}) + (p_1 - p_1^v)\xi_1(p_1, p_2) + (p_2 - p_2^v)\xi_2(p_1, p_2) \end{array} \right] \end{array} \right) = \mu_{03}^{\max}.$$

I have the following first-order conditions:

$$(10) \quad y_3(p_3(p_1))p_3'(p_1) + \varepsilon \left[(p_1 - p_1^0)D_1\bar{\xi}_1(p_1, p_2) + (p_2 - p_2^0)D_1\bar{\xi}_2(p_1, p_2) \right] = 0.$$

$$(11) \quad (p_1 - p_1^0)D_2\bar{\xi}_1(p_1, p_2) + (p_2 - p_2^0)D_2\bar{\xi}_2(p_1, p_2) = 0.$$

By solving the system of equations. (10). (11) I obtain

$$(12) \quad p_{1,03}^* - p_1^0 = - \frac{y_3(p_3(p_{1,03}^*))p_3'(p_{1,03}^*)D_2\bar{\xi}_2(p_{1,03}^*, p_{2,03}^*)}{\varepsilon\Delta(p_{1,03}^*, p_{2,03}^*)}.$$

$$(13) \quad p_{2,03}^* - p_2^0 = \frac{y_3(p_3(p_{1,03}^*))p_3'(p_{1,03}^*)D_2\bar{\xi}_1(p_{1,03}^*, p_{2,03}^*)}{\varepsilon\Delta(p_{1,03}^*, p_{2,03}^*)}.$$

We have $D_1\bar{\xi}_1(p_1, p_2) < 0$, $D_2\bar{\xi}_2(p_1, p_2) < 0$, $D_1\bar{\xi}_2(p_1, p_2) > 0$ and $D_2\bar{\xi}_1(p_1, p_2) > 0$, and $\Delta(p_1, p_2) > 0$ by assumption. However, observe that the magnitude of $\Delta(p_1, p_2)$ varies if the trade elasticities are not constant.

The following proposition follows directly from (12) and (13).

PROPOSITION 3.1: *Suppose that Assumption 2.1 is satisfied and that only the industry that produces the non-traded good is organized.*

(a) If the traded final consumption good and the non-traded final consumption good are gross substitutes, then $p_{j,03}^ > p_j^0$, $j = 1, 2$, i.e., the prices of goods 1 and 2 will rise above their free-trade levels due to the lobbying activities of the non-traded consumption good industry.*

(b) If the traded final consumption good and the non-traded final consumption good are gross complements, then $p_{j,03}^ < p_j^0$, $j = 1, 2$, i.e., the prices of goods 1 and 2 will fall below their free-trade levels due to the lobbying activities of the non-traded consumption good industry.*

Thus, even if the traded-good industries are not organized, a non-traded good industry represented by a lobby group distorts what otherwise would have been the free trade situation. It is interesting to note that even though the non-traded good and the intermediate good are not directly related to each other, the lobbying activities of the former affect the payoff of the latter. In this case, the positive (negative) horizontal linkages between industries 1 and 3 spill over into industry 2 with industry 1 acting as a conduit of vertical linkages.

Proposition 3.1 explains why a non-traded good industry lobbies for the protection of a traded good industry which produces gross substitutes and lobbies against the protection for a traded good industry which produces gross complements. To cite an example, the high fructose corn sweetener producers in the United States were lobbying for a higher price of sugar, a substitute good. The high domestic sugar price has contributed to the use of high fructose corn sweeteners increasing from less than one-fourth of total caloric sweetener consumption in 1979-81 to almost one half in 1989-91 in the United States (Orden, 1996). Thus the protection of the sugar industry has contributed to the expansion of the high fructose corn sweetener industry by providing indirect protection.

Hence the protection of a traded good industry has horizontal linkage inside the economy in the sense that its protection leads to the expansion (contraction) of the non-traded good industry that is producing gross substitutes (complements) with its product.

The optimal political contribution for industry 3 when it is the only one organized, can be represented by the following truthful strategy

$$(14) \quad c_3(p_1, p_2, \mu_3^{\max} - \mu_0^{\max}) = \max \left[\varphi_3(p_1, p_2) - \mu_3^{\max} + \mu_0^{\max}, 0 \right].$$

The net payoff of industry 3 rises above the free trade level. This industry extracts all the surplus that results from the cooperation of the government. The payoffs of the specific factor owners in industry 2 rise (fall) above (under) the free trade levels if goods 1 and 3 are gross substitutes (complements). As for the owners of the specific factor in industry 1, the impact on their income of the lobbying activities of the non-traded good industry is ambiguous because the price of their output and the price of the intermediate input both rise or fall together.

4. Only the Final Consumption Good Industries are Organized

The home government chooses $(p_{1,013}^*, p_{2,013}^*)$ as a solution to the following maximization problem:

$$(15) \quad \max_{p_1, p_2} \left(\begin{array}{l} \varphi_1(p_1, p_2) + \pi_3(p_1, p_2, p_3(p_1, p_2)) \\ + \varepsilon \left[\begin{array}{l} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \pi_3(p_1, p_2, p_3(p_1, p_2)) \\ + v(p_1, p_2, p_3(p_1, p_2), \bar{m}) + (p_1 - p_1^0)\xi_1(p_1, p_2) - (p_2 - p_2^0)\xi_2(p_1, p_2) \end{array} \right] \end{array} \right) = \mu_{013}^{\max}.$$

The marginal change in welfare due to changes in policy variables yield the following set of first order conditions.

$$(16) \quad y_1(p_1, p_2) + y_3(p_3(p_1))p_3'(p_1) + \varepsilon \left[(p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) \right] = 0.$$

$$(17) \quad -x_{12}(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0)D_2\xi_1(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) \right] = 0.$$

Solving these conditions simultaneously for the policy variables, I have the following set of price deviations from free trade levels for industries 1 and 2, respectively.

$$(18) \quad p_{1,013}^* - p_1^0 = \frac{- \left[y_1(p_{1,013}^*, p_{2,013}^*) + y_3(p_3(p_{1,013}^*)) \right] p_3'(p_{1,013}^*) \left| D_{2, \xi_2}(p_{1,013}^*, p_{2,013}^*) \right.}{\varepsilon \Delta(p_{1,013}^*, p_{2,013}^*)} \\ - \frac{x_{12}(p_{1,013}^*, p_{2,013}^*) D_{1, \xi_2}(p_{1,013}^*, p_{2,013}^*)}{\varepsilon \Delta(p_{1,013}^*, p_{2,013}^*)}.$$

$$(19) \quad p_{2,013}^* - p_2^0 = \frac{\left[y_1(p_{1,013}^*, p_{2,013}^*) + y_3(p_3(p_{1,013}^*)) \right] p_3'(p_{1,013}^*) \left| D_{2, \xi_1}(p_{1,013}^*, p_{2,013}^*) \right.}{\varepsilon \Delta(p_{1,013}^*, p_{2,013}^*)} \\ + \frac{x_{12}(p_{1,013}^*, p_{2,013}^*) D_{1, \xi_1}(p_{1,013}^*, p_{2,013}^*)}{\varepsilon \Delta(p_{1,013}^*, p_{2,013}^*)}.$$

Now let $\eta_{ij}(p_1, p_2)$ denote the elasticity of $\xi_j(p_1, p_2)$ with respect to p_i , $i, j = 1, 2$. The same argument used to determine the sign of (12) in Chapter 3 can be used to show that if the own price elasticity of the excess demand for good 1 dominates its cross price elasticity, then $-y_1(p_{1,013}^*, p_{2,013}^*) D_{2, \xi_2}(p_{1,013}^*, p_{2,013}^*) - x_{12}(p_{1,013}^*, p_{2,013}^*) D_{1, \xi_2}(p_{1,013}^*, p_{2,013}^*) > 0$. In this case, the expression on the right side of (18) will be positive if $p_3'(p_{1,013}^*) > 0$, i.e., if goods 1 and 3 are gross substitutes. However, if they are gross complements, then the sign of the expression on the right of (18) is not conclusive.

In the same manner that I tried to determine the sign of (13) in Chapter 3, here I cannot determine unambiguously the sign of the expression on the right side of (19) of the current chapter.

Based on the above discussion, I have the following proposition.

PROPOSITION 4.1: *Suppose that Assumption 2.1 is satisfied and that in absolute value the own price elasticity of the excess demand for each good is greater than its cross price elasticity. If industries 1 and 3 are organized, then I have the following results.*

(a) *If the traded and non-traded final consumption goods are gross substitutes, then the lobbying efforts of these industries result in a rise in the prices of both of these goods relative to the levels prevailing under free trade. More precisely, $p_{1,013}^i > p_i^i$ and $p_3(p_{1,013}^i) > p_3(p_i^i)$. On the other hand, if the traded and the non-traded final consumption goods are gross complements, the results are ambiguous.*

(b) *Whether the traded and non-traded final consumption goods are gross substitutes or gross complements, the impact of the lobbying activities of industries 1 and 3 on the industry that produces the intermediate good is ambiguous.*

In order to determine the net payoffs of all lobby groups and the government, let us define

$$\mathbf{M}_{013} = \left\{ (\mu_1, \mu_3) \mid \mu_1 \geq 0, \mu_3 \geq 0, \mu_1 + \mu_3 \leq \mu_{013}^{\max} - \mu_0^{\max}, \mu_1 \leq \mu_{013}^{\max} - \mu_0^{\max}, \mu_3 \leq \mu_{013}^{\max} - \mu_0^{\max} \right\}.$$

As described in Figure 1 and Figure 2 in Chapter 3, I could derive the Pareto-efficient frontier of \mathbf{M}_{013} . Here too, there might be a unique truthful Nash equilibrium or a continuum of truthful Nash equilibria. If the Pareto-efficient frontier of \mathbf{M}_{013} is reduced to a single point, the net payoffs for industries 1 and 3 are uniquely determined. In the case of a continuum of truthful Nash equilibria, these net payoffs are not uniquely determined.

5. Only the Intermediate Input Industry

and the Non-traded Final Consumption Good Industry are Organized

When the intermediate good and the non-traded good industries are represented by lobby groups, the government solves the following problem:

$$(20) \quad \max_{p_1, p_2} \left(\begin{array}{l} \varphi_2(p_1, p_2) + \pi_1(p_1, p_2, p_3(p_1, p_2)) \\ + \varepsilon \left[\begin{array}{l} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \pi_1(p_1, p_2, p_3(p_1, p_2)) \\ + v(p_1, p_2, p_3(p_1, p_2), \bar{m}) + (p_1 - p_1^0)\xi_1(p_1, p_2) + (p_2 - p_2^0)\xi_2(p_1, p_2) \end{array} \right] \end{array} \right) = \mu_{023}^{\max}.$$

The following set of first-order conditions characterize an interior solution:

$$(21) \quad Y_3(p_3(p_1))p_3'(p_1) + \varepsilon \left[(p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) \right] = 0.$$

$$(22) \quad Y_2(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0)D_2\xi_1(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) \right] = 0.$$

The system (21) and (22) yields the following levels of protection for the two industries:

$$(23) \quad p_{1,023}^* - p_1^0 = \frac{-Y_3(p_3(p_{1,023}^*))p_3'(p_{1,023}^*)D_2\xi_2(p_{1,023}^*, p_{2,023}^*) + Y_2(p_{1,023}^*, p_{2,023}^*)D_1\xi_2(p_{1,023}^*, p_{2,023}^*)}{\varepsilon\Delta(p_{1,023}^*, p_{2,023}^*)}$$

$$(24) \quad p_{2,023}^* - p_2^0 = \frac{Y_3(p_3(p_{1,023}^*))p_3'(p_{1,023}^*)D_2\xi_1(p_{1,023}^*, p_{2,023}^*) - Y_2(p_{1,023}^*, p_{2,023}^*)D_1\xi_1(p_{1,023}^*, p_{2,023}^*)}{\varepsilon\Delta(p_{1,023}^*, p_{2,023}^*)}$$

It is clear that $p_{1,023}^* - p_1^0 > 0$ if the traded and non-traded final consumption goods are gross substitutes. If they are gross complements, then the optimal trade policy depends on the relative size of sector 2 and sector 3: sector 2 contributing positively and sector 3 contributing negatively for the protection of sector 1. For industry 2, the right side of (24) is positive if the traded and non-traded final consumption goods are gross substitutes. Otherwise, the sign is ambiguous.

These results can be summarized in the following proposition.

PROPOSITION 5.1: *Suppose that Assumption 2.1 is satisfied and that only industries 2 and 3 are organized.*

(a) If the traded and non-traded final consumption goods are gross substitutes, then $p_{1,023}^ > p_1^0$, $p_{2,023}^* > p_2^0$ and $p_3(p_{1,023}^*) > p_3(p_1^0)$. That is, the lobbying efforts of industries 2 and 3 result in a rise above the free trade levels of the prices of goods 1 and 2. The rise in the price of the traded final consumption good will a fortiori raise the price of the non-traded final consumption good.*

(b) If the traded and the non-traded final consumption goods are gross complements, then the impact on goods 1 and 2 of the lobbying activities of industries 2 and 3 is ambiguous. Similarly, the impact on the price of good 3 will be ambiguous as well.

To determine the net payoffs and political contributions of industries 2 and 3, let

$$\mathbf{M}_{023} = \left\{ (\mu_2, \mu_3) \mid \mu_2 \geq 0, \mu_3 \geq 0, \mu_2 + \mu_3 \leq \mu_{023}^{\max} - \mu_0^{\max}, \mu_2 \leq \mu_{023}^{\max} - \mu_{03}^{\max}, \mu_3 \leq \mu_{023}^{\max} - \mu_{02}^{\max} \right\}.$$

Again, if the Pareto-efficient frontier of \mathbf{M}_{023} is reduced to a single point, there is a unique truthful Nash equilibrium. Otherwise, there exists a continuum of truthful Nash equilibrium and the net payoffs for industries 2 and 3 are not uniquely determined.

6. All Three Industries are Organized

In this case, the government chooses the trade policy by solving the following maximization problem:

$$(25) \quad \max_{p_1, p_2} \left(\begin{array}{l} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \pi_1(p_1, p_2, p_3(p_1, p_2)) \\ + \varepsilon \left[\begin{array}{l} \varphi_1(p_1, p_2) + \varphi_2(p_1, p_2) + \pi_1(p_1, p_2, p_3(p_1, p_2)) \\ + v(p_1, p_2, p_3(p_1, p_2), \bar{m}) + (p_1 - p_1^0)\xi_1(p_1, p_2) + (p_2 - p_2^0)\xi_2(p_1, p_2) \end{array} \right] \end{array} \right) = \mu_{0123}^{\max}.$$

The first-order conditions are

$$(26) \quad y_1(p_1, p_2) + y_3(p_3(p_1))p_3'(p_1) + \varepsilon \left[(p_1 - p_1^0)D_1\xi_1(p_1, p_2) + (p_2 - p_2^0)D_1\xi_2(p_1, p_2) \right] = 0.$$

$$(27) \quad -x_{12}(p_1, p_2) + y_2(p_1, p_2) + \varepsilon \left[(p_1 - p_1^0)D_2\xi_1(p_1, p_2) + (p_2 - p_2^0)D_2\xi_2(p_1, p_2) \right] = 0.$$

The solution to the system of the above two equations is

$$(28) \quad p_{1,0123}^* - p_1^0 = \frac{- \left[y_1(p_{1,0123}^*, p_{2,0123}^*) + y_3(p_3(p_{1,0123}^*))p_3'(p_{1,0123}^*) \right] D_2\xi_2(p_{1,0123}^*, p_{2,0123}^*)}{\varepsilon \Delta(p_{1,0123}^*, p_{2,0123}^*)} - \frac{\xi_2(p_{1,0123}^*, p_{2,0123}^*) D_1\xi_2(p_{1,0123}^*, p_{2,0123}^*)}{\varepsilon \Delta(p_{1,0123}^*, p_{2,0123}^*)}.$$

$$(29) \quad p_{2,0123}^* - p_2^0 = \frac{\left[y_1(p_{1,0123}^*, p_{2,0123}^*) + y_3(p_3(p_{1,0123}^*))p_3'(p_{1,0123}^*) \right] D_2\xi_1(p_{1,0123}^*, p_{2,0123}^*)}{\varepsilon \Delta(p_{1,0123}^*, p_{2,0123}^*)} + \frac{\xi_2(p_{1,0123}^*, p_{2,0123}^*) D_1\xi_1(p_{1,0123}^*, p_{2,0123}^*)}{\varepsilon \Delta(p_{1,0123}^*, p_{2,0123}^*)}.$$

To determine the signs of (28) and (29), I can proceed exactly as in my effort to determine the signs of (24) and (25) of Chapter 3 and obtain the following proposition.

PROPOSITION 6.1: *Suppose that Assumption 2.1 is satisfied and that in absolute value the own price elasticity of the excess demand for each good is at least as large as its cross price elasticity. Also, suppose that industries 1, 2 and 3 are organized.*

(a) If the traded and the non-traded final consumption goods are gross substitutes, then the lobbying efforts of the three industries will result in a rise in the price of the traded final consumption good above its free trade level, i.e., $p_{1,0123}^ > p_1^0$. Furthermore, compared with the situation that prevails under free trade, $p_3(p_{1,0123}^*) > p_3(p_1^0)$, i.e., the price of the non-traded final consumption good rises. On the other hand, if the traded and non-traded final consumption goods are gross complements, the results are ambiguous.*

(b) As for good 2, its price might rise above or fall below the free trade level when all the three industries are organized, irrespective of whether the traded and non-traded final consumption goods are gross substitutes or gross complements. However, if it is known that good 2 is exported and that goods 1 and 3 are gross substitutes, then $p_{2,0123}^ > p_2^0$, i.e., the price of good 2 will rise above its free trade level.*

When there are three industry lobbies, the vector of net payoffs to all three lobbies belong to the following set.

$$\mathbf{M} = \left\{ \begin{array}{l} (\mu_1, \mu_2, \mu_3) \mid \mu_1 \geq 0, \mu_2 \geq 0, \mu_3 \geq 0, \\ \mu_1 + \mu_2 + \mu_3 \leq \mu_{0123}^{\max} - \mu_0^{\max}, \\ \mu_1 + \mu_2 \leq \mu_{0123}^{\max} - \mu_{03}^{\max}, \mu_1 + \mu_3 \leq \mu_{0123}^{\max} - \mu_{02}^{\max}, \mu_2 + \mu_3 \leq \mu_{0123}^{\max} - \mu_{01}^{\max}, \\ \mu_1 \leq \mu_{0123}^{\max} - \mu_{023}^{\max}, \mu_2 \leq \mu_{0123}^{\max} - \mu_{013}^{\max}, \mu_3 \leq \mu_{0123}^{\max} - \mu_{012}^{\max}. \end{array} \right\}.$$

To determine the net payoffs for each industry, it is necessary to study the Pareto-efficient frontier of M , and this exercise will be carried out in the following section in which I completely solve a numerical version of the model in this section.

7. The Numerical Solution to the Model: A Case of Three Industries

Suppose that the representative consumer maximizes the following quasi-linear utility function.

$$\max_{z_1, z_2, z_3} \left| \bar{m} - p_1 z_1 - p_2 z_2 + \alpha_1 z_1 + \alpha_2 z_2 - \frac{1}{2} \left(\beta_{11} z_1^2 + \beta_{22} z_2^2 + 2\beta_{12} z_1 z_2 \right) \right| = v(p_1, p_2, p_3, \bar{m}).$$

As a result of the utility maximization, the consumer has the following linear system of direct demand curves:

$$(30) \quad z_1(p_1, p_2) = \frac{(\alpha_1 \beta_{22} - \alpha_2 \beta_{12}) - \beta_{21} p_1 + \beta_{12} p_2}{(\beta_{11} \beta_{22} - \beta_{12}^2)^2},$$

$$z_2(p_1, p_2) = \frac{(\alpha_2 \beta_{11} - \alpha_1 \beta_{12}) - \beta_{11} p_2 + \beta_{12} p_1}{(\beta_{11} \beta_{22} - \beta_{12}^2)^2}.$$

On the production side, let us assume Cobb Douglas technology for all the three sectors:

$$y_1 = x_1^{1/2} \bar{k}_1^{1/2},$$

$$y_2 = l_2^{1/2} \bar{k}_2^{1/2},$$

$$y_3 = l_3^{1/2} \bar{k}_3^{1/2}.$$

The factor demands in industries 1 and 2, their outputs, and the rental incomes will be as given in Chapter 3. For the non-traded good industry, it maximizes the following objective function

$$\max_{l_3} \left[p_3 \left(l_3^{\gamma_3} \bar{k}_3^{1-\gamma_3} \right) - \bar{w} l_3 \right] = \pi_3(p_1, p_2, p_3).$$

The labor demand and the optimal output level are given by the following expressions:

$$(31) \quad l_3(p_1, p_2, p_3) = \bar{k}_3 \left(\frac{p_3 \gamma_3}{\bar{w}} \right)^{\frac{1}{1-\gamma_3}}.$$

$$y_3(p_1, p_2, p_3) = \bar{k}_3 \left(\frac{p_3 \gamma_3}{\bar{w}} \right)^{\frac{\gamma_3}{1-\gamma_3}}.$$

By substituting these optimal values in the expression for rent, I have the following rental income

$$(32) \quad \pi_3(p_1, p_2, p_3) = \bar{k}_3 \left(p_3 \left(\frac{\gamma_3}{\bar{w}} \right)^{\gamma_3} \right)^{\frac{1}{1-\gamma_3}} (1 - \gamma_3).$$

The excess demand functions for goods 1 and 2 are already given in Chapter 3. The excess demand for good 3 should be zero. Thus using (30), (31), and invoking the market-clearing condition for the non-traded good, I have

$$\frac{(\alpha_3 \beta_1 - \alpha_1 \beta_{13}) - \beta_{13} p_2 + \beta_{13} p_1}{(\beta_{13} \beta_3 - \beta_{13})^2} = \bar{k}_3 \left(\frac{p_3 \gamma_3}{\bar{w}} \right)^{\frac{\gamma_3}{1-\gamma_3}}.$$

Solving this equation for p_3 , I get p_3 as a function only of p_1 and other parameters. Let us assume that the exponent in the preceding expression is 1 which is equivalent to saying $\gamma_3 = 0.5$. Then solving the above equation for p_3 , I obtain

$$(33) \quad p_3(p_1) = \frac{(\alpha_3 \beta_1 - \alpha_1 \beta_{13} + \beta_{13} p_1) \bar{w}}{\beta_{13} \bar{w} + \beta_1^2 \beta_3^2 \gamma_3 \bar{k}_3 + \beta_1^2 \gamma_3 \bar{k}_3 - 2\beta_{13} \beta_3 \beta_{13} \gamma_3 \bar{k}_3}.$$

Substituting this value for p_3 in the consumption demand (30), the factor demand and output supply (31) and rental function (32), I could express all the equations in the model only in terms of the prices of traded goods 1 and 2. Using (23) of Proposition 3.4 in Chapter 2, I

could solve the model for p_1 and p_2 . With the solution for p_1 thus obtained, I could finally calculate the value of p_2 using (33). Thus the model is completely solved. Subsequently, I could calculate the political contributions, the net payoffs for the three lobby groups, and the payoff of the government.

To solve the model numerically, let us assume the following parametric values:

$$\alpha_1 = 1.5, \beta_1 = 0.5, \alpha_2 = 0.75, \beta_2 = 0.25, \beta_{12} = \pm(0.2); \gamma_1 = 0.4, \gamma_2 = 0.7, \gamma_3 = 0.5;$$

$$\bar{k}_1 = 2.0, \bar{k}_2 = 1.5, \bar{k}_3 = 1.0, \bar{w} = 0.25; p_1^0 = 0.5, p_2^0 = 0.4 \text{ and } \varepsilon = 1.$$

With these parameter values, the system of consumption demand (30) becomes

$$(30') \quad z_1 = 2.6471 - 2.9412p_1 + 2.3529p_2,$$

$$z_2 = 0.8824 + 2.3529p_1 - 5.8824p_2.$$

Note that the cross price effects are symmetric, a necessary condition for a well-behaved system of consumer demand functions.

Using the non-traded good market equilibrium, I have

$$(33') \quad p_2 = 0.1119 + 0.2985p_1.$$

In the above expression, I have assumed that good 1 and good 3 are gross substitutes. If I assume that these goods are gross complements, the relevant system of demand functions become

$$z_1 = 6.1765 - 2.9412p_1 - 2.3529p_2,$$

$$(30'') \quad z_2 = 7.9412 - 2.3529p_1 - 5.8824p_2.$$

Similarly, if goods 1 and 3 are gross complements, the equilibrium price of good 3 in terms of the price of good 1 is given by

$$(33'') \quad p_3 = 1.007 - 0.2985 p_1.$$

7.1. No Industry is Organized

As discussed in the analytical part of this chapter, if the non-traded good industry is not organized, the level and the structure of protection of the traded good industries will be as described in Chapter 3 in which there was no non-traded industry. Thus I report only those numerical values when the non-traded good industry is organized. The detailed listing of the values for the complete model is given in Appendix C for the case of gross substitutes and in Appendix D for the case of gross complements. However, for ease of reference, I summarize some results in the following table when none of the industries is organized. Note that the price levels of goods 1 and 2 and the levels of profit for industries 1 and 2 are the same as given in Table 1 in Chapter 3.

TABLE 1—SOLUTION TO THE GAME WHEN NO INDUSTRY IS ORGANIZED

Variables	Gross Substitutes	Gross Complements
$p_{1,0}^*$	0.5	0.5
$p_{2,0}^*$	0.4	0.4
$p_3(p_{1,0}^*)$	0.2612	0.8582
$\varphi_1(p_{1,0}^*, p_{2,0}^*)$	0.3780	0.3780
$\varphi_2(p_{1,0}^*, p_{2,0}^*)$	0.2345	0.2345
$\varphi_3(p_{1,0}^*, p_{2,0}^*)$	0.0682	0.7365
$\omega(p_{1,0}^*, p_{2,0}^*) = \mu_0^{\max}$	1.7039	2.5994

Thus the benchmark price of good 3, when domestic prices of traded goods are equal to the free trade prices, is given by $p_3(p_{1,0}^*)$ in the above table. Since the profits of industry 3 differ according to whether goods 1 and 3 are gross substitutes or whether they are gross

complements, so do utilities of the representative consumer and the payoffs of the government.

7.2. Only Industry 3 is Organized

Let us take the case when only industry 3, the non-traded final consumption good industry, is organized. In this case, government maximizes the objective function given by (9). The values of the endogenous variables are given in Table 2.

TABLE 2—SOLUTION TO THE GAME WHEN ONLY INDUSTRY 3 IS ORGANIZED

Variables	Gross Substitutes	Gross Complements
$p_{1,03}^*$	0.5465	0.3623
$p_{2,03}^*$	0.4069	0.3794
$p_3(p_{1,03}^*)$	0.2751	0.8993
$\varphi_1(p_{1,03}^*, p_{2,03}^*)$	0.4334	0.2289
$\varphi_2(p_{1,03}^*, p_{2,03}^*)$	0.2483	0.1967
$\varphi_3(p_{1,03}^*, p_{2,03}^*)$	0.0757	0.8087
μ_{03}^{\max}	1.7757	3.3722
$\mu_{03}^{\max} - \mu_0^{\max}$	0.0718	0.7728
$c_3^*(p_{1,03}^*, p_{2,03}^*) = \varphi_3(p_{1,03}^*, p_{2,03}^*) - (\mu_{03}^{\max} - \mu_0^{\max})$	0.0039	0.0359
Net gain to lobby 3 = $(\mu_{03}^{\max} - \mu_0^{\max}) - \varphi_3(p_{1,03}^*, p_{2,03}^*)$	0.0036	0.0363

Although neither of the two traded goods industries are organized, the price of both traded goods 1 and 2 rise above the free trade levels if goods 1 and 3 are gross substitutes and fall below the free trade levels if they are gross complements. This is what I have established in Proposition 3.1. By comparing Table 1 with Table 2, I see that the profits of industries 1 and 2 rise if the traded and non-traded final consumption goods are gross substitutes and fall if they are gross complements. Similarly, the price of the non-traded final consumption good has risen above what would have been if free trade prevailed for traded goods. The price of

good 3 rises by about 5 percent in both the gross substitute and gross complement cases due to the lobbying efforts of industry 3. The level of rental income in industry 3 rises by about 10 (11) percent if goods 1 and 3 are gross substitutes (complements).

7.3. Industries 1 and 3 are Organized

Now, let us consider the case when industries 1 and 3 are organized. The government chooses the trade policy by solving the maximization problem represented by (15). The values for some endogenous variables are given in Table 3. If goods 1 and 3 are gross substitutes, we have $\mu_{01}^{\max} + \mu_{03}^{\max} - \mu_{013}^{\max} - \mu_0^{\max} < 0$. This can be rewritten as $\mu_{013}^{\max} - \mu_{03}^{\max} + \mu_{013}^{\max} - \mu_{01}^{\max} > \mu_{013}^{\max} - \mu_0^{\max}$. This is the condition which generates a continuum of truthful Nash equilibria. I have plotted this situation in Figure 2.

TABLE 3—SOLUTION TO THE GAME WHEN INDUSTRIES 1 AND 3 ARE ORGANIZED

Variables	Gross Substitutes	Gross Complements
$\varphi_1(\dot{p}_{1,013}, \dot{p}_{2,013})$	1.7443	0.9986
$\varphi_2(\dot{p}_{1,013}, \dot{p}_{2,013})$	0.2347	0.1834
$\varphi_3(\dot{p}_{1,013}, \dot{p}_{2,013})$	0.2358	0.5593
μ_{01}^{\max}	2.4585	3.3540
μ_{013}^{\max}	2.6721	3.8624
$\mu_{013}^{\max} - \mu_0^{\max}$	0.9683	1.2630
$\mu_{013}^{\max} - \mu_{03}^{\max}$	0.8964	0.4902
$\mu_{013}^{\max} - \mu_{01}^{\max}$	0.2136	0.5084
$\mu_{01}^{\max} + \mu_{03}^{\max} - \mu_{013}^{\max} - \mu_0^{\max}$	- 0.1418	0.2644
$c_1^*(\dot{p}_{1,013}, \dot{p}_{2,013}) = \varphi_1(\dot{p}_{1,013}, \dot{p}_{2,013}) - (\mu_{013}^{\max} - \mu_{03}^{\max})$	0.8479	0.5084
Net gain to lobby 1 = $(\mu_{013}^{\max} - \mu_{03}^{\max}) - \varphi_1(\dot{p}_{1,03}, \dot{p}_{2,03})$	0.4630	0.2613
$c_3^*(\dot{p}_{1,013}, \dot{p}_{2,013}) = \varphi_3(\dot{p}_{1,013}, \dot{p}_{2,013}) - (\mu_{013}^{\max} - \mu_{01}^{\max})$	0.0222	0.0509
Net gain to lobby 3 = $(\mu_{013}^{\max} - \mu_{01}^{\max}) - \varphi_3(\dot{p}_{1,01}, \dot{p}_{2,01})$	0.0200	0.0469

The global payoff for both industry lobbies and the government is 2.6721. The total payoff for the two industry lobbies is 0.9683. The maximum net payoff for industry lobby 1 is less than or equal to 0.8964, which is the difference between the maximum joint payoff for both industry lobbies plus the government and the payoff for the coalition consisting of lobby 3 and the government.

Similarly, the maximum net payoff for industry lobby 3 while it is out of the coalition is less than or equal to 0.2136. The equilibrium should remain to the left of the point given by $\mu_1 = 0.8964$ and below the point given by $\mu_3 = 0.2136$ and below the line with intercepts $\mu_1 = \mu_3 = 0.9683$. It clearly means that point M cannot be an equilibrium point. Here, I have a continuum of truthful Nash equilibria given by the line segment TT' .

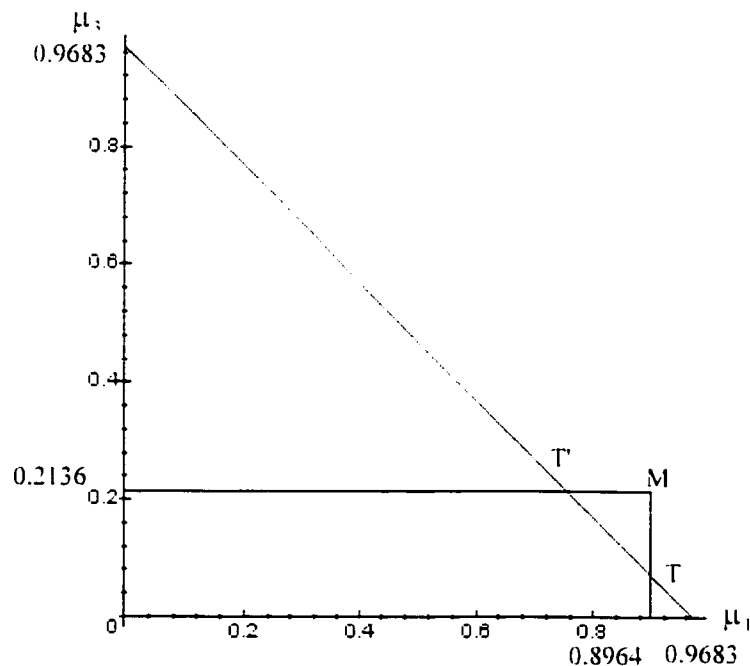


FIGURE 2. INDUSTRIES 1 AND 3 ARE ORGANIZED
THE TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS SUBSTITUTES

On TT' , the payoff of the government is equal to what it would get under free trade. Thus if the non-traded and the traded final consumption goods are gross substitutes and only these industries are organized, the government would neither be worse off nor better off by participating in the game. All surplus would be appropriated by the two industry lobby groups.

On the other hand, if the traded and the non-traded final consumption goods are gross complements, we have $\mu_{01}^{\max} + \mu_{03}^{\max} - \mu_{013}^{\max} - \mu_0^{\max} > 0$. Again, this can be rewritten as $\mu_{013}^{\max} - \mu_{03}^{\max} + \mu_{01}^{\max} - \mu_0^{\max} < \mu_{013}^{\max} - \mu_0^{\max}$, and this is the condition which generates a unique truthful Nash equilibrium. This situation is depicted in Figure 3. In this case, the conditions are $\mu_1^* + \mu_3^* < 1.263$, $\mu_1^* = 0.490$, $\mu_3^* = 0.508$.

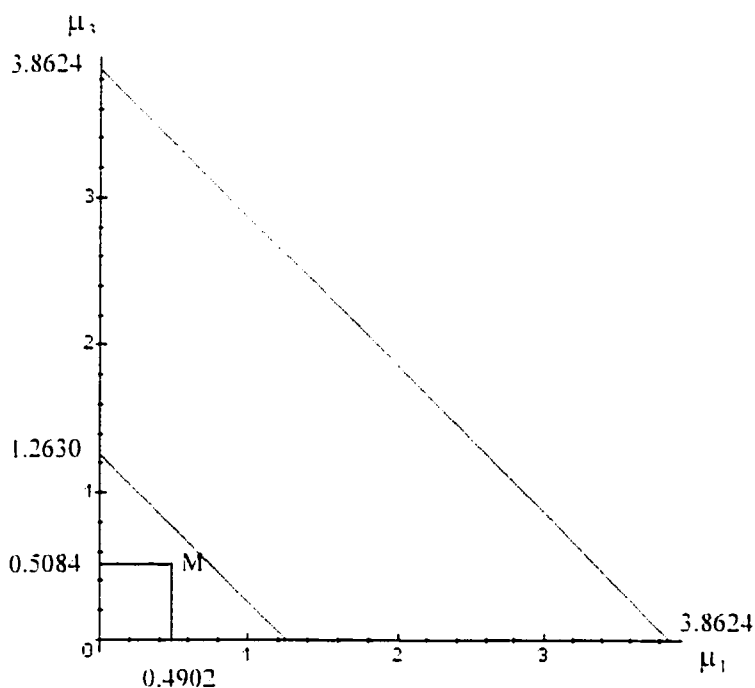


FIGURE 3. INDUSTRIES 1 AND 3 ARE ORGANIZED
THE TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS COMPLEMENTS

Point M is the Pareto efficient frontier, which uniquely determines the net payoffs of the two industry lobbies, the payoff to the government, and the levels of contribution from the two lobby groups. The payoff of the government in this situation ($3.3540 + 3.3722 - 3.8624 = 2.8638$) is higher than under free trade ($= 2.5994$). Thus the government gains from lobbying activities if the goods produced by two organized industries are gross complements.

7.4. Industries 2 and 3 are Organized

Let us take the case when only industries 2 and 3 are organized. The trade policy implemented by the government is the solution to the problem given by (20). The results are as follows.

TABLE 4—SOLUTION TO THE GAME WHEN INDUSTRIES 2 AND 3 ARE ORGANIZED

Variables	Gross Substitutes	Gross Complements
μ_{023}^{\max}	2.3891	3.9368
$\mu_{023}^{\max} - \mu_0^{\max}$	0.6852	1.3374
$\mu_{023}^{\max} - \mu_{03}^{\max}$	0.6134	0.5646
$\mu_{023}^{\max} - \mu_{02}^{\max}$	0.0866	0.7389
$\mu_{02}^{\max} + \mu_{03}^{\max} - \mu_{023}^{\max} - \mu_0^{\max}$	- 0.0149	0.0340
$c_2(p_{1,023}^*, p_{2,023}^*) = \varphi_2(p_{1,023}^*, p_{2,023}^*) - (\mu_{023}^{\max} - \mu_{03}^{\max})$	0.8338	0.8468
Net gain to lobby 2 = $(\mu_{023}^{\max} - \mu_{03}^{\max}) - \varphi_2(p_{1,03}^*, p_{2,03}^*)$	0.3651	0.3679
$c_3(p_{1,023}^*, p_{2,023}^*) = \varphi_3(p_{1,023}^*, p_{2,023}^*) - (\mu_{023}^{\max} - \mu_{02}^{\max})$	0.0056	0.0445
Net gain to lobby 3 = $(\mu_{023}^{\max} - \mu_{02}^{\max}) - \varphi_3(p_{1,02}^*, p_{2,02}^*)$	0.0052	0.0432

Now I could plot these values to obtain the Pareto efficient frontier. If the traded and the non-traded final consumption goods are substitutes, the maximum joint payoff for the two lobby groups and the government is 2.3891 (for the clarity, the line for μ_{023}^{\max} is not drawn in Figure 4). Again, the maximum joint payoff for the government, given that it does not include the

political contribution in its objective function, is 1.7039. The net payoff of lobby 2 when industry 3 and the government form a coalition cannot be more than 0.6134. Similarly, the net payoff of industry lobby 3 when the government and industry 2 form a coalition cannot be more than 0.0866. Figure 4 has been drawn on the basis of these numerical results.

Again, there exist a continuum of truthful Nash equilibria as in the previous case. The government will not be able to increase its payoff from the free trade situation. Observe that in this case we have $\mu_{02}^{\max} + \mu_{03}^{\max} - \mu_{023}^{\max} (= 1.6890) <$ the free trade payoff ($= 1.7039$). But because of the participation constraint the payoff to the government cannot be less than 1.7039.

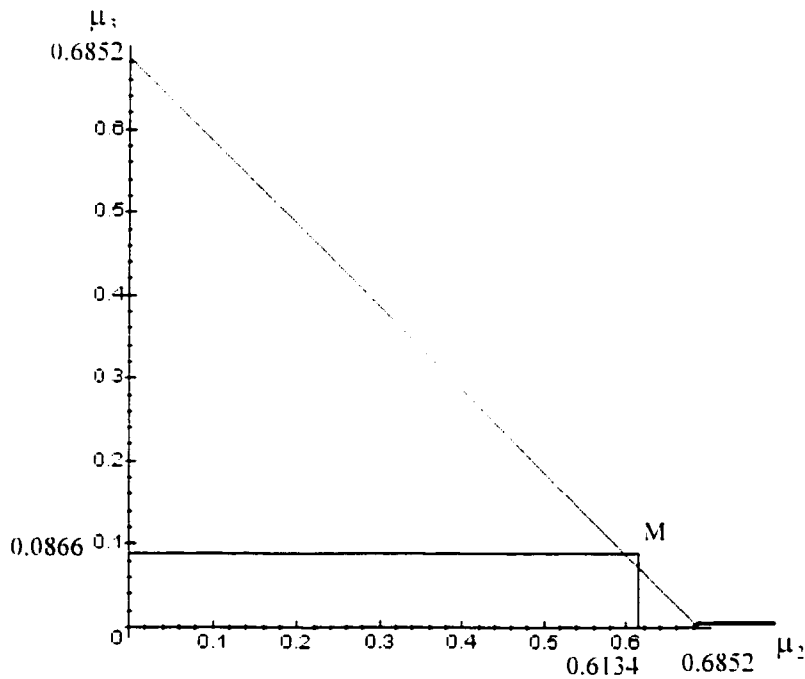


FIGURE 4. INDUSTRIES 2 AND 3 ARE ORGANIZED
THE TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS SUBSTITUTES

Figure 5 depicts the case where the traded and non-traded final consumption goods are gross complements. In this case, there is a unique truthful Nash equilibrium.

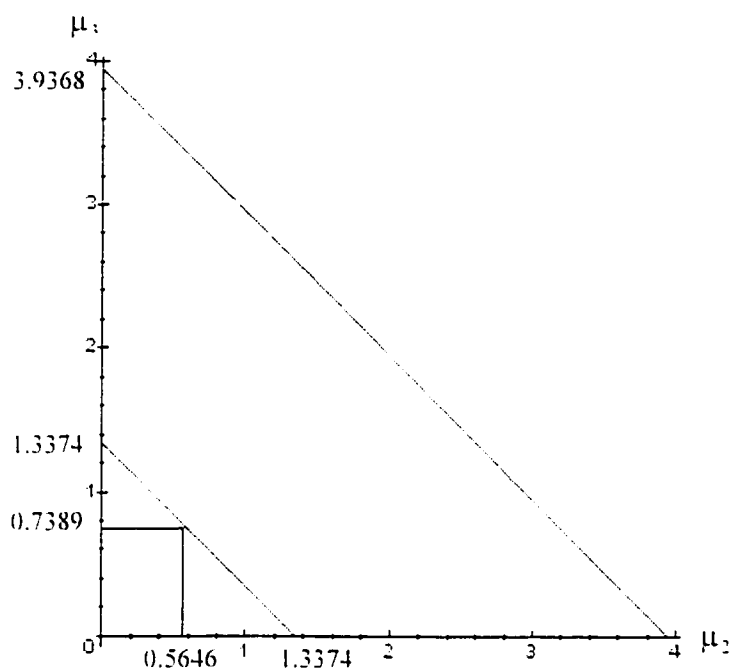


FIGURE 5. INDUSTRIES 2 AND 3 ARE ORGANIZED
THE TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS COMPLEMENTS

For this case, one might wonder why the government's payoff rises above the free trade level when the traded and non-traded final consumption goods are gross complements. The reason might be that if these two consumption goods are gross complements, the lobbying efforts of industry 3 to raise the price of the non-traded final consumption good will result in a lower price of the traded final consumption good, with ensuing deleterious effects on the demand for the intermediate good produced by industry 2. The lobbies for industries 2 and 3 are thus rivalries. The contributions of one lobby diminish the effects of the other's contributions, thereby enhancing the government's position to capture more contributions.

7.5. All Industries are Organized

Finally, let all the industries be organized. The political payoff function of the government is given by (25). The optimal trade policy is obtained by solving this function for the domestic price vector. The associated results for all three cases are given in Table 5.

TABLE 5—SOLUTION TO THE GAME WHEN ALL THE THREE INDUSTRIES ARE ORGANIZED

Variables	Gross Substitutes	Gross Complements
μ_{0123}^{\max}	3.1315	4.3075
$\mu_{0123}^{\max} - \mu_0^{\max}$	1.4276	1.7081
$\mu_{0123}^{\max} - \mu_{03}^{\max}$	1.3557	0.9353
$\mu_{0123}^{\max} - \mu_{02}^{\max}$	0.8290	1.1096
$\mu_{0123}^{\max} - \mu_{01}^{\max}$	0.6730	0.9535
$\mu_{0123}^{\max} - \mu_{023}^{\max}$	0.7424	0.3707
$\mu_{0123}^{\max} - \mu_{013}^{\max}$	0.4593	0.4451
$\mu_{0123}^{\max} - \mu_{012}^{\max}$	0.2213	0.5018
$c_1^*(p_{1,0123}^*, p_{2,0123}^*) = \varphi_1(p_{1,0123}^*, p_{2,0123}^*) - (\mu_{0123}^{\max} - \mu_{023}^{\max})$	0.6033	0.3282
Net gain to lobby 1 = $(\mu_{0123}^{\max} - \mu_{023}^{\max}) - \varphi_1(p_{1,023}^*, p_{2,023}^*)$	0.3436	0.1811
$c_2^*(p_{1,0123}^*, p_{2,0123}^*) = \varphi_2(p_{1,0123}^*, p_{2,0123}^*) - (\mu_{0123}^{\max} - \mu_{013}^{\max})$	0.6038	0.7156
Net gain to lobby 2 = $(\mu_{0123}^{\max} - \mu_{013}^{\max}) - \varphi_2(p_{1,013}^*, p_{2,013}^*)$	0.2246	0.2617
$c_3^*(p_{1,0123}^*, p_{2,0123}^*) = \varphi_3(p_{1,0123}^*, p_{2,0123}^*) - (\mu_{0123}^{\max} - \mu_{012}^{\max})$	0.0240	0.0547
Net gain to lobby 3 = $(\mu_{0123}^{\max} - \mu_{012}^{\max}) - \varphi_3(p_{1,012}^*, p_{2,012}^*)$	0.0217	0.0493
$\mu_{012}^{\max} + \mu_{013}^{\max} + \mu_{023}^{\max} - 2\mu_{0123}^{\max}$	1.7084	2.9899
μ_0^{\max}	1.7039	2.5994

7.6. The Pareto-Efficient Frontier

In this section, I derive the Pareto efficient frontier for 3 industry lobbies using the information given in Table 5. First, I derive it for the case when goods 1 and 3 are gross substitutes in consumption and second, I derive it for the case when they are gross complements.

In Figure 6, I have illustrated the net payoffs of the government. In this three dimensional figure, the bigger triangle, abc , shows the maximum payoffs of the coalition of all three industry lobbies and the government, and it is given by μ_{0123}^{\max} ($= 3.1315$).

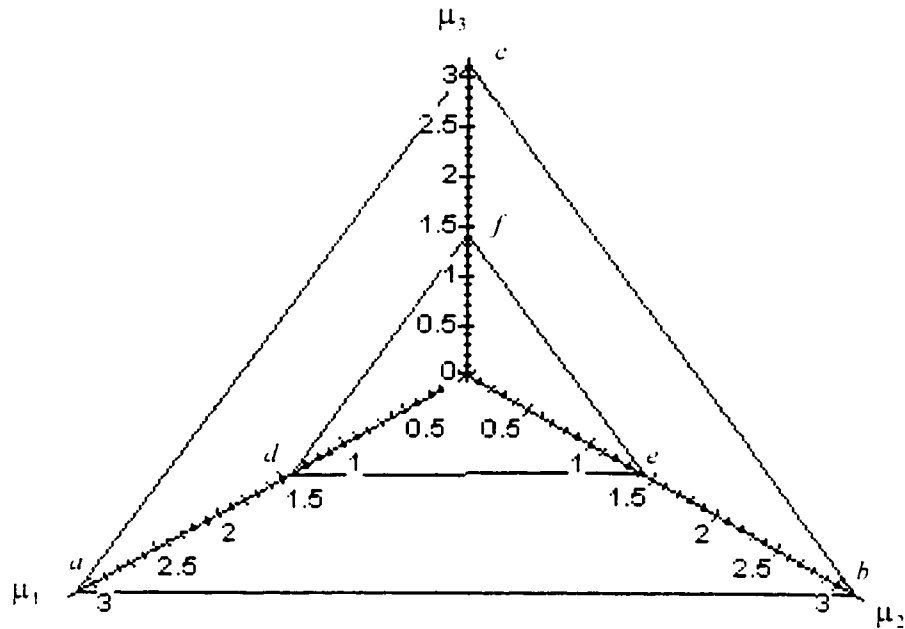


FIGURE 6. TOTAL PAYOFF OF GRAND LOBBIES
WHEN TRADED AND NON-TRADED CONSUMPTION GOODS ARE GROSS SUBSTITUTES

The second triangle, def , is derived for the condition that $\mu_1 + \mu_2 + \mu_3 \leq \mu_{0123}^{\max} - \mu_0^{\max}$ ($= 1.4276$). The payoff to the government at free trade $= \Delta abc - \Delta def$. The respective sides of these two Δ s are parallel. The area between two parallel lines (e.g., between line ab and line de) is equal to the payoff to the government in free trade (e.g., $3.1315 - 1.4276 = 1.7039$). The net payoffs of all industry lobbies should remain inside the triangle def otherwise it violates the participation constraint of the government.

In what follows, I will not draw these two triangles to avoid clutter. However, it should be noted that all the activities I illustrate in Figures 7 through 9, remain inside the triangle def .

In Figure 7, I depict the net payoffs of lobby groups 1 and 2. The line gh represents the constraint that $\mu_1^* + \mu_2^* \leq \mu_{0123}^{\max} - \mu_{03}^{\max}$. This means, the net payoff of industry lobbies 1 and 2 cannot be more than the payoff in grand coalition *minus* the payoff when only industry 3 and the government form the coalition. Thus this line shows the upper limit of the payoffs of lobbies 1 and 2. Their payoffs cannot go to the South of that line. It is given by 1.3557.

The vector on is the maximum payoff that lobby 1 could attain and vector mn shows the maximum payoff that lobby 2 could attain. The vector on is derived for $\mu_1^* \leq \mu_{0123}^{\max} - \mu_{023}^{\max}$ and similarly mn is derived for $\mu_2^* \leq \mu_{0123}^{\max} - \mu_{013}^{\max}$. The vector on is equal to 0.7424 and the vector mn is equal to 0.4593. The kinked point n is the unique Pareto efficient point for industry lobbies 1 and 2.

Since the Pareto-efficient frontier, the kinked point n , is obtainable in the game we have an unique equilibrium between lobbies 1 and 2. The difference between line gh and a parallel line drawn from the kinked point n gives the additional payoff to the government above the free trade level.

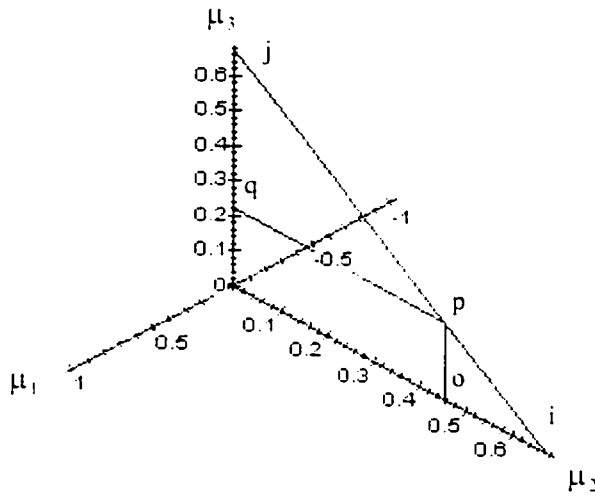


FIGURE 8. NET PAYOFFS OF LOBBIES 2 AND 3
WHEN ALL THREE INDUSTRIES ARE ORGANIZED.

THE TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS SUBSTITUTES

In Figure 9, I illustrate the net payoffs of industry lobbies 1 and 3. I have line kl using $\mu_1^* + \mu_3^* \leq \mu_{0123}^{\max} - \mu_{02}^{\max}$ ($= 0.8290$). In equilibrium, the net payoff of lobbies 1 and 3 should remain to the right of line kl . The vector qr is derived for $\mu_1^* \leq \mu_{0123}^{\max} - \mu_{023}^{\max}$ ($= 0.7424$) and the vector rm is derived using $\mu_3^* \leq \mu_{0123}^{\max} - \mu_{012}^{\max}$ ($= 0.2213$). In this situation, the kinked point r is outside the line kl . It means that there is not a unique equilibrium point for lobby groups 1 and 3. The Pareto efficient frontier has a line segment between the intersections of line kl with vector qr and vector rm .

Every point on TT' satisfies all the constraints of Pareto-efficient frontier for all three lobby groups. Thus the final equilibrium will be anywhere on TT' .

Although there is not a unique equilibrium, the government is able to capture some of the surplus. Following Chapter 3, I have

$$(34) \quad (\mu_{0123}^{\max} - \mu_{023}^{\max}) + (\mu_{0123}^{\max} - \mu_{013}^{\max}) + (\mu_{0123}^{\max} - \mu_{012}^{\max}) < (\mu_{0123}^{\max} - \mu_0^{\max}).$$

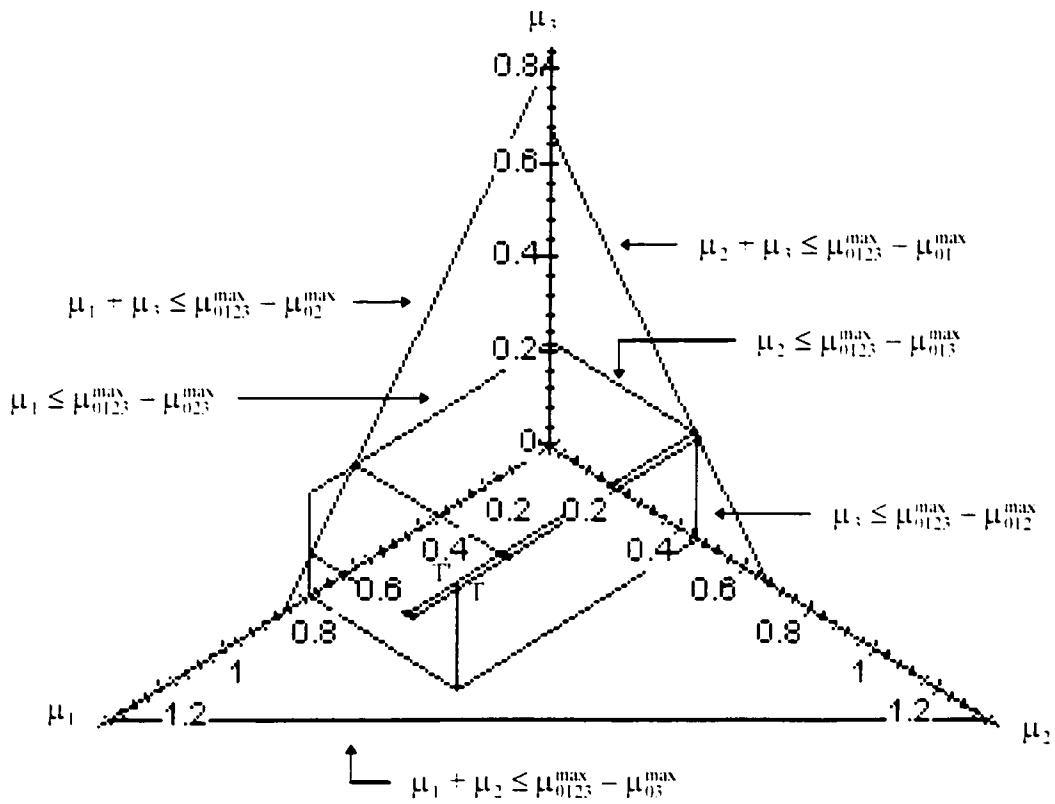


FIGURE 10. PARETO EFFICIENT FRONTIER FOR THREE LOBBIES
TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS SUBSTITUTES

The relation in (34) can be rewritten as

$$(34') \quad \mu_{023}^{\max} + \mu_{013}^{\max} + \mu_{012}^{\max} - 2\mu_{0123}^{\max} > \mu_0^{\max}$$

Using the values from Table 5, the expression in (34') yields

$$1.7084 > 1.7039.$$

In the above expression, the left-hand side is the payoff of the government when all three industries are organized and the right-hand side is the payoff of the government under free trade when there are no lobby group. Thus the payoff of the government is slightly higher in the lobbying situation compared to free trade. When there were only two lobbies and there was a continuum of truthful Nash equilibria, the government was receiving the same payoff as in free trade. However, with three lobbies, the government payoff rises over the free trade level even if there is a continuum of Nash equilibria.

If goods 1 and 3 are net complements, I have a unique truthful Nash equilibrium for all pairs of lobbies as shown in Figures 11 through 13. The payoffs between lobby groups 1 and 2 are shown in Figure 11, and they are derived using the following information:

$$\mu_1^* + \mu_2^* \leq \mu_{0123}^{\max} - \mu_{03}^{\max} (=0.9353),$$

$$\mu_1^* \leq \mu_{0123}^{\max} - \mu_{023}^{\max} (= 0.3707),$$

$$\mu_2^* \leq \mu_{0123}^{\max} - \mu_{013}^{\max} (= 0.4451).$$

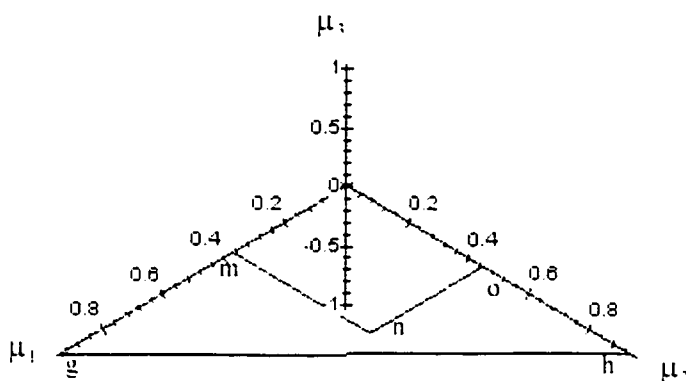


FIGURE 11. NET PAYOFFS OF LOBBIES 1 AND 2
WHEN ALL THREE INDUSTRY LOBBIES ARE ORGANIZED
TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS COMPLEMENTS

The vector of net payoffs of lobby groups 2 and 3 are depicted in Figure 12 by using the following set of payoffs:

$$\mu_2^* + \mu_3^* \leq \mu_{0123}^{\max} - \mu_{01}^{\max} (= 0.9535),$$

$$\mu_2^* \leq \mu_{0123}^{\max} - \mu_{013}^{\max} (= 0.4451),$$

$$\mu_3^* \leq \mu_{0123}^{\max} - \mu_{012}^{\max} (= 0.5018).$$

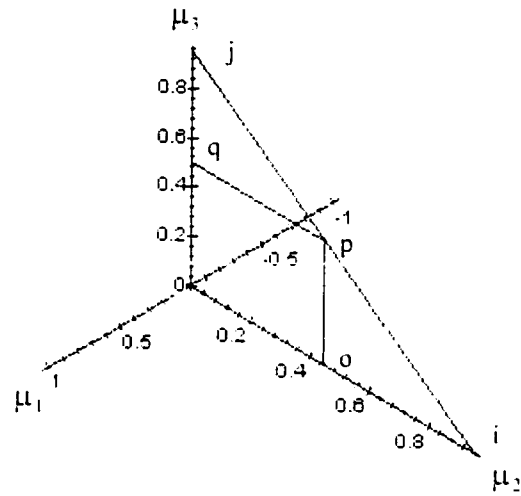


FIGURE 12. NET PAYOFFS OF LOBBIES 2 AND 3
WHEN ALL THREE INDUSTRY LOBBIES ARE ORGANIZED
TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS COMPLEMENTS

In Figure 13, I derive the net payoffs of lobby groups 1 and 3. The following conditions are used while deriving this figure.

$$\mu_1^* + \mu_3^* \leq \mu_{0123}^{\max} - \mu_{02}^{\max} (= 1.1096).$$

$$\mu_1^* \leq \mu_{0123}^{\max} - \mu_{023}^{\max} (= 0.3707).$$

$$\mu_3^* \leq \mu_{0123}^{\max} - \mu_{012}^{\max} (= 0.5018).$$

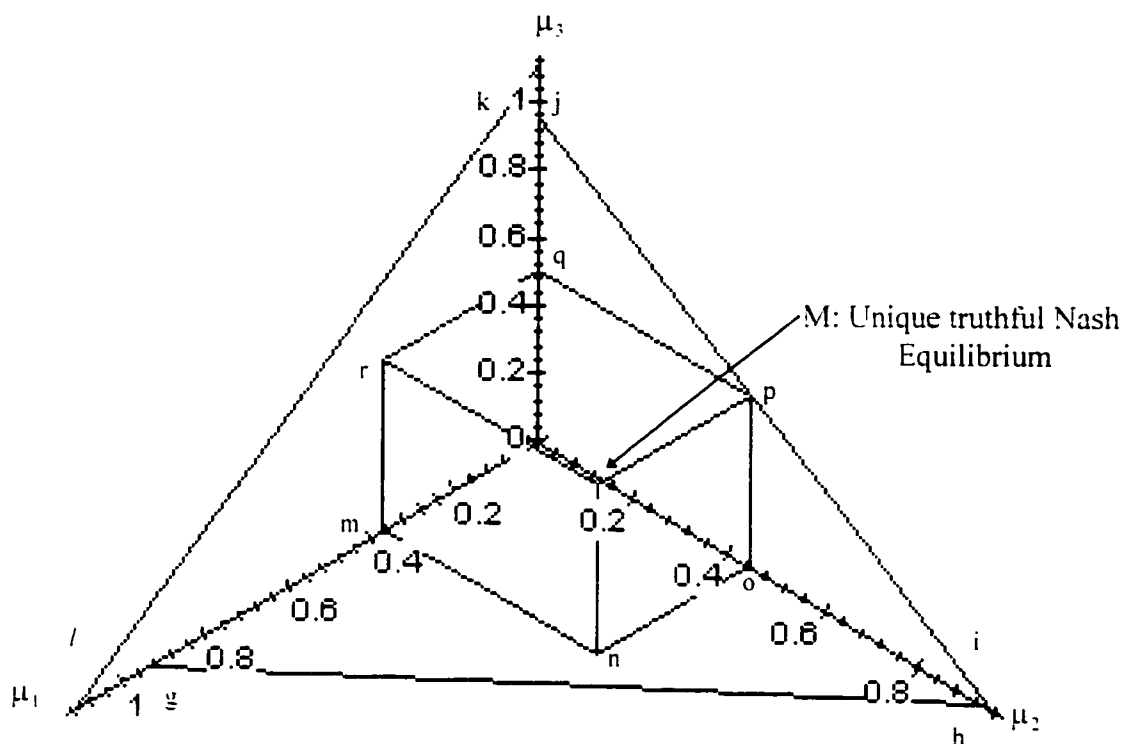


FIGURE 14. PARETO EFFICIENT FRONTIER FOR THREE LOBBIES
TRADED AND NON-TRADED FINAL CONSUMPTION GOODS ARE GROSS COMPLEMENTS

7.7. Endogenous Behavior of Trade Policy: A Graphical Illustration

In the following two figures, I plot the endogenous behavior of protection for both traded and non-traded good producing industries. On the horizontal axes, I have mapped the lobby groups and on the vertical axes I have measured the level of domestic protection of industries 1 and 2 and the resulting market clearing price of non-traded good 3. Thus the position of the line above the horizontal axis shows the import tariff or export subsidy and below the horizontal axis the import subsidy or export tax.

In Figure 15. I have plotted the movement of the prices when goods 1 and 3 are gross substitutes in consumption.

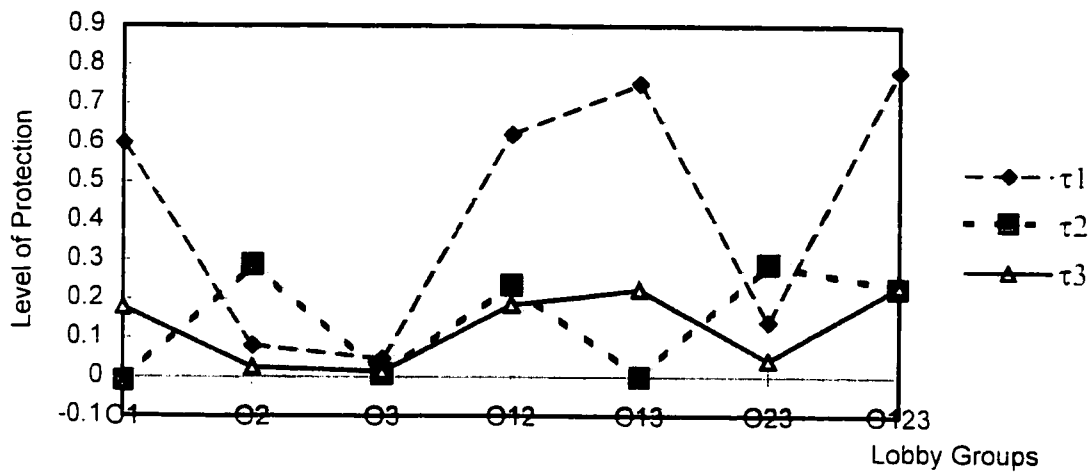


FIGURE 15. ENDOGENOUS PROTECTION
WHEN GOODS ARE GROSS SUBSTITUTES

The protection of industry 1 is maximized when all three industries are organized, followed by when 1 and 3 are organized. The lowest level of protection of industry 1 is obtained when only industry 3 is organized. In my notation, I could rank the level of prices of good 1, 2, and 3 as follows.

$$p_{1,0123}^{\cdot} > p_{1,013}^{\cdot} > p_{1,012}^{\cdot} > p_{1,01}^{\cdot} > p_{1,023}^{\cdot} > p_{1,02}^{\cdot} > p_{1,03}^{\cdot} > p_{1,0}^{\cdot} = p_1^0$$

$$p_{2,023}^{\cdot} > p_{2,02}^{\cdot} > p_{2,012}^{\cdot} > p_{2,0123}^{\cdot} > p_{2,03}^{\cdot} > p_{2,013}^{\cdot} > p_{2,0}^{\cdot} = p_2^0 > p_{2,01}^{\cdot}$$

$$p_{3,0123}^{\cdot} > p_{3,013}^{\cdot} > p_{3,012}^{\cdot} > p_{3,01}^{\cdot} > p_{3,023}^{\cdot} > p_{3,02}^{\cdot} > p_{3,03}^{\cdot} > p_{3,0}^{\cdot}$$

In the above example, industry 1 obtains an import tariff or export subsidy in all the cases. Industry 2 obtains an import tariff or export subsidy in all but one case when only industry 1 is organized.

In Figure 16. I have plotted the endogenous protection for all three industries when goods 1 and 3 are gross complements in consumption.

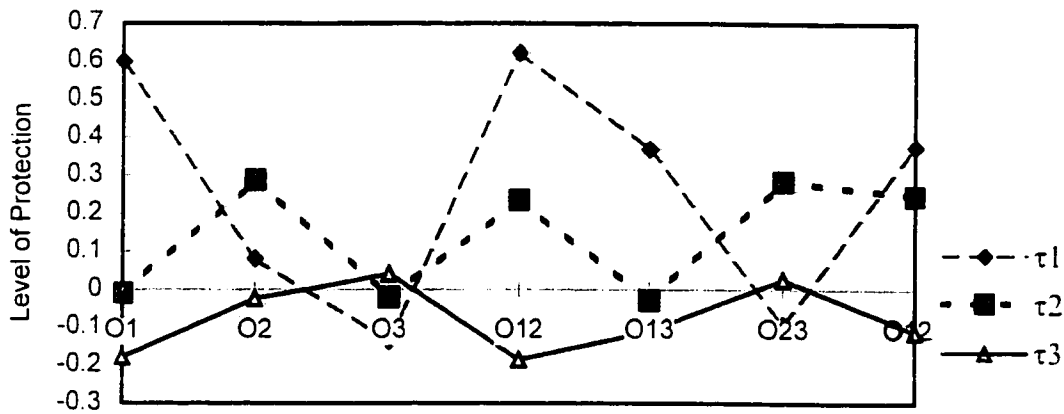


FIGURE 16. ENDOGENOUS PROTECTION
WHEN GOODS ARE GROSS COMPLEMENTS

I can rank the domestic price level as follows.

$$p_{1,012}^* > p_{1,01}^* > p_{1,013}^* > p_{1,0123}^* > p_{1,02}^* > p_{1,0}^* = p_1^0 > p_{1,023}^* > p_{1,03}^*$$

$$p_{2,02}^* > p_{2,023}^* > p_{2,0123}^* > p_{2,01}^* > p_{2,0}^* = p_2^0 > p_{2,01}^* > p_{2,03}^* > p_{2,013}^*$$

$$p_{3,03}^* > p_{3,023}^* > p_{3,0}^* > p_{3,02}^* > p_{3,013}^* > p_{3,0123}^* > p_{3,01}^* > p_{3,012}^*$$

Since goods 1 and 3 are gross complements, good 1 faces an import subsidy or export tax in two cases and so does industry 2 in three out of seven cases.

8. Conclusions

In this chapter, I have studied the structure of protection for a model involving three goods — one traded final consumption good, one traded intermediate good, and one non-traded final consumption good. I have shown that the industry producing the non-traded final consumption good might lobby for a higher (lower) price of the traded final consumption good in the case when these two final consumption goods are gross substitutes (gross complements). Through its lobbying activities, the industry producing the non-traded final

consumption good will exert a positive (negative) impact on the industry producing the traded final consumption good when these two goods are gross substitutes (gross complements) and thus the industry raises the income of the owners of its specific factor.

I have solved the model numerically and computed the Pareto efficient frontier for the case of three industry lobbies. If goods are gross complements, the game has a unique truthful Nash equilibrium, whereas if they are gross substitutes, it has a continuum of truthful Nash equilibria. Unlike the two lobby case, even if the equilibrium is not unique, I have found that the government may receive a payoff higher than the free trade level if there are more than two lobbies. Thus I make the conjecture that the government is better off if there are more than two lobbies.

APPENDIX C

SOLUTION TO THE MODEL WITH THREE INDUSTRIES

WHEN GOODS ARE GROSS SUBSTITUTES IN CONSUMPTION

Variables	0	01	02	03	012	013	023	0123
p_1	0.5	1.0992	0.5808	0.5465	1.1215	1.2517	0.6423	1.2842
p_2	0.4	0.3896	0.6886	0.4069	0.6357	0.4001	0.6905	0.6295
p_3	0.2612	0.4401	0.2853	0.2751	0.4467	0.4856	0.3037	0.4953
$\varphi_1(p_1^*, p_2^*)$	0.3780	1.4298	0.3378	0.4334	1.0668	1.7443	0.3988	1.3457
$\varphi_2(p_1^*, p_2^*)$	0.2345	0.2147	1.4341	0.2483	1.0984	0.2347	1.4472	1.0631
$\varphi_3(p_1^*, p_2^*)$	0.0682	0.1936	0.0814	0.0757	0.1996	0.2358	0.0922	0.2453
Total Welfare	1.7039	2.4585	2.3024	1.7757	2.9102	2.6721	2.3891	3.1315
$y_1(p_1^*, p_2^*)$	1.2599	2.1680	0.9692	1.3217	1.5853	2.3225	1.0346	1.7465
$x_{12}(p_1^*, p_2^*)$	0.6300	2.4467	0.3270	0.7101	1.1187	2.9063	0.3850	1.4152
$y_2(p_1^*, p_2^*)$	1.9540	1.8373	6.9415	2.0338	5.7594	1.9553	6.9858	5.6291
$y_3(p_1^*, p_2^*) = z_3$	0.5224	0.8801	0.5706	0.5502	0.8934	0.9712	0.6074	0.9906
$z_1(p_1^*, p_2^*)$	1.7910	0.4496	1.6101	1.6869	0.3996	0.1081	1.4724	0.0354
$\xi_1(p_1^*, p_2^*)$	0.531	-1.718	0.641	0.365	-1.185	-2.214	0.437	-1.711
$\xi_2(p_1^*, p_2^*)$	-1.324	0.609	-6.614	-1.324	-4.641	0.951	-6.601	-4.204
$\phi(p_1^*, p_2^*)$	1.0232	0.2265	0.8726	0.9348	0.2111	0.1418	0.7669	0.1300
$s(p_1^*, p_2^*)$	0	-1.036	-1.857	0.008	-1.831	-1.665	-1.855	-2.307
$\frac{n_{12}(p_1^*, p_2^*)}{n_{11}(p_1^*, p_2^*)}$	-0.363	-0.309	-0.275	-0.354	-0.243	-0.296	-0.267	-0.236
$\frac{n_{23}(p_1^*, p_2^*)}{n_{22}(p_1^*, p_2^*)}$	-0.187	-0.487	-0.033	-0.199	-0.122	-0.515	-0.038	-0.153
$\omega(p_1^*, p_2^*)$	1.7039	1.0287	0.8684	1.7000	0.7451	0.6920	0.8497	0.4774

APPENDIX D

SOLUTION TO THE MODEL WITH THREE INDUSTRIES
WHEN GOODS ARE GROSS COMPLEMENTS IN CONSUMPTION

Variables	0	01	02	03	012	013	023	0123
p_1	0.5	1.0992	0.5808	0.3623	1.1215	0.8696	0.4100	0.8760
p_2	0.4	0.3896	0.6886	0.3794	0.6357	0.3716	0.6854	0.6463
p_3	0.8582	0.6794	0.8341	0.8993	0.6727	0.7479	0.8851	0.7460
$\varphi_1(p_1^*, p_2^*)$	0.3780	1.4298	0.3378	0.2289	1.0668	0.9986	0.1896	0.6989
$\varphi_2(p_1^*, p_2^*)$	0.2345	0.2147	1.4341	0.1967	1.0984	0.1834	1.4114	1.1607
$\varphi_3(p_1^*, p_2^*)$	0.7365	0.4615	0.6957	0.8087	0.4525	0.5593	0.7834	0.5565
Total Welfare	2.5994	3.3540	3.1980	3.3722	3.8057	3.8624	3.9368	4.3075
$y_1(p_1^*, p_2^*)$	1.2599	2.1680	0.9692	1.0529	1.5853	1.9140	0.7708	1.3298
$x_{12}(p_1^*, p_2^*)$	0.6300	2.4467	0.3270	0.4021	1.1187	1.7918	0.1844	0.7209
$y_2(p_1^*, p_2^*)$	1.9540	1.8373	6.9415	1.7277	5.7594	1.6450	6.8644	5.9864
$y_3(p_1^*, p_2^*) = z_3$	1.7164	1.3587	1.6682	1.7986	1.3454	1.4958	1.7702	1.4919
$z_1(p_1^*, p_2^*)$	2.6866	1.3445	2.5056	2.9948	1.2951	1.8591	2.8882	1.8448
$\bar{z}_1(p_1^*, p_2^*)$	1.4266	-0.823	1.5364	1.9419	-0.290	-0.055	2.1173	0.5150
$\bar{z}_2(p_1^*, p_2^*)$	-1.324	0.609	-6.614	-1.326	-4.641	0.1468	-6.680	-5.265
$\phi(p_1^*, p_2^*)$	1.2504	0.3176	1.0814	1.5693	0.2971	0.5876	1.4545	0.5786
$s(p_1^*, p_2^*)$	0	-0.499	-1.785	-0.240	-1.274	-0.024	-2.097	-1.103
$\frac{u_{12}(p_1^*, p_2^*)}{u_{11}(p_1^*, p_2^*)}$	-0.364	-0.309	-0.275	-0.397	-0.243	-0.333	-0.299	-0.256
$\frac{u_{13}(p_1^*, p_2^*)}{u_{11}(p_1^*, p_2^*)}$	-0.187	-0.487	-0.033	-0.143	-0.122	-0.438	-0.019	-0.079
$\omega(p_1^*, p_2^*)$	2.5994	1.9242	1.7639	2.5635	1.6406	2.3044	1.7420	1.8914

CHAPTER 5

INTER-INDUSTRY TRADE, MULTIPLE LINKAGES AND THE STRUCTURE OF PROTECTION

1. Introduction

In Chapter 3, I studied the structure of protection in a model where there are two traded goods: one traded final consumption good and one traded pure intermediate good which is used as an input in the production of the traded consumption good. There is thus a vertical

linkage between the traded final consumption good and the traded intermediate good. In Chapter 4, I extended the model of Chapter 3 by introducing one more good — a non-traded final consumption good — and studied the linkages between the traded final consumption good and the non-traded final consumption good and their impact on the structure of protection. There are thus vertical linkage between the traded final consumption good and the traded intermediate good and horizontal linkage between the traded final consumption good and the non-traded final consumption good. Furthermore, each good in the model is involved with only one type of linkage. However, we have seen that most of the goods which have an interesting history of lobbying and protection in the United States are used for both production and consumption. For example, sugar is used for final consumption and at the same time it is an input for the candy, bakery, and beverage industries. We could say the same thing for textile, which is used as final consumption and by the apparel industry as input. Each of these goods is involved with vertical as well as horizontal linkages. Thus in order to capture the reasons of protection of these industries, we need a model where a good is used for both production and consumption. Besides, by incorporating such type of good, I will be able to see the net linkage — net of production and consumption — and its effects on trade policy. In the model of this chapter, there are three goods: one traded final consumption good (good 1), one traded good (good 2) used for final consumption as well as input in the production of good 1, one non-traded final consumption good (good 3).

Thus the basic difference between the model in Chapter 4 and the model in this chapter is that good 2 was treated as a pure intermediate input in the former while it is both an intermediate input and a final consumption good in the latter. Of course, by introducing

another commodity which is used for both final consumption and as intermediate input while keeping good 2 as a pure intermediate input. I could obtain a four-sector model. However, all the results that could have been derived in that model could be obtained in this relatively simpler three-sector model.

The production side of the model is represented by the following production functions:

$$y_1 = f_1(\bar{k}_1, l_1, x_{12}).$$

$$y_2 = f_2(\bar{k}_2, l_2).$$

$$y_3 = f_3(\bar{k}_3, l_3).$$

I assume that industry 1 uses labor, a specific factor, and good 2 as an intermediate input. Industries 2 and 3 use labor and sector-specific inputs only. We have inter-industry trade from industry 2 to industry 1. We could obviously assume two-ways trade flows between industries 1 and 2 by assuming that industry 2 also uses good 1 as an input, but it makes the algebra more ambiguous without adding any insight to the model. On the consumption side, goods 1, 2, and 3 may either be gross complements or gross substitutes or independent. Thus goods 1 and 2 are related not only in production, but they might be related in consumption, too. In order to find whether they are gross substitutes or gross complements, we have to look at both the production and consumption sides.

Since there are 3 consumption goods, there are five possible ways of interdependence among them: (i) all goods are gross substitutes, (ii) goods 1 and 2 are gross complements and the other two pairs of goods are gross substitutes, (iii) goods 1 and 3 are gross complements and the other two pairs of goods are gross substitutes (iv) goods 2 and 3 are gross

complements while others are gross substitutes, and (v) all goods are gross complements. Note that if any two pairs of goods are gross complements, it is consistent that the third pair of goods are gross complements as well. However, if two pairs of goods are gross substitutes then it is consistent to have the third pair of goods either gross substitutes or gross complements.

By assuming that a good can be used both as a consumption good and an input into another final consumption good industry, I hope to capture the forces behind the protection of industries like wheat, sugar, and textiles whose products are used at the same time as consumption goods and inputs into other industries.

The policy variables are the tariff or subsidy for industries 1 and 2. Thus the policy that government chooses in the game is denoted by $p = (p_1, p_2)$, the price vector of the traded goods. After this policy has been chosen by the government, the price of the non-traded final consumption good is endogenously determined.

The rest of the chapter is organized in the following way. Section 2 presents the solution of the basic three industry model where there are no lobby groups. In Section 3, I study the structure of protection when any one of these three industries is organized. Section 4 deals with the situation when only two traded good industries are organized. This model can capture the textile and apparel industries in the United States. Section 5 covers the case when both pure final consumption good industries are organized. The case of the sugar industry in the United States is analyzed in Section 6, where there are only two industry lobbies. The case of all industry lobbies is dealt with in Section 7. In Section 8, I solve the

model numerically when two traded goods are gross complements. Section 9 concludes the chapter.

2. No Lobby Group

With three industries in the economy and two traded goods, the government solves the following maximization problem

$$(1) \quad \max_p \left(\varepsilon \left[\sum_i \varphi_i(p) + \phi(p) + \sum_i (p_i - p_i^w) \xi_i(p) \right] \right) = \mu^{\max}.$$

Here I recall that $p = (p_1, p_2)$.

The first-order conditions for an interior solution are

$$(2) \quad \sum_i D_1 \varphi_i(p) + D_1 \phi(p) + \sum_i (p_i - p_i^w) D_1 \xi_i(p) + \xi_i(p) = 0.$$

$$(3) \quad \sum_i D_2 \varphi_i(p) + D_2 \phi(p) + \sum_i (p_i - p_i^w) D_2 \xi_i(p) + \xi_i(p) = 0.$$

In (2), I have $D_1 \varphi_1(p) = y_1(p)$, $D_1 \varphi_2(p) = 0$. The rental income of industry 3 can be written as $\varphi_3(p) = \pi_3(p, p_3(p))$. Therefore, $D_1 \varphi_3(p) = D_1 \pi_3(p, p_3(p)) + D_2 \pi_3(p, p_3(p)) D_1 p_3(p)$, where $D_2 \pi_3(p, p_3(p))$ is the partial derivative of π_3 with respect to p_2 . By Hotelling's lemma, $D_1 \varphi_3(p) = -x_{31}(p, p_3(p)) + y_3(p, p_3(p)) D_1 p_3(p)$. Since industry 3 does not use good 1 as input, $-x_{31}(p, p_3(p)) = 0$. Moreover, because the supply of good 3 depends only on its own price, I will suppress $p = (p_1, p_2)$ and write $y_3(p, p_3(p))$ as $y_3(p_3(p))$. Therefore, $D_1 \varphi_3(p) = y_3(p_3(p)) D_1 p_3(p)$.

Notice that the indirect utility can be written as $\phi(p) = v(p, p_3(p), \bar{m})$. Therefore,

$D_1\phi(p) = D_1v(p, p_3(p), \bar{m}) + D_3v(p, p_3(p), \bar{m})D_1p_3(p)$ where $D_3v(p, p_3(p), \bar{m})$ is the partial derivative of indirect utility v with respect to p_3 . Thus

$$D_1\phi(p) = -z_1(p, p_3(p)) - z_3(p, p_3(p))D_1p_3(p).$$

Using all these results, I can reduce (2) to

$$(4) \quad y_1(p) + y_3(p_3(p))D_1p_3(p) - z_1(p, p_3(p)) - z_3(p, p_3(p))D_1p_3(p) + \sum_{i=1}^2 (p_i - p_i^0)D_1\bar{\xi}_i(p) + \bar{\xi}_1(p) = 0.$$

Similarly, in (3) $D_2\phi_1(p) = -x_{12}(p)$, $D_2\phi_2(p) = y_2(p)$, and $D_2\phi_3(p) = y_3(p, p_3(p))D_2p_3(p)$ and

$D_2\phi(p) = -z_2(p, p_3(p)) - z_3(p, p_3(p))D_2p_3(p)$. Now, the expression in (3) can be written as

$$(5) \quad -x_{12}(p) + y_2(p) + y_3(p, p_3(p))D_2p_3(p) - z_2(p, p_3(p)) - z_3(p, p_3(p))D_2p_3(p) + \sum_{i=1}^2 (p_i - p_i^0)D_2\bar{\xi}_i(p) + \bar{\xi}_2(p) = 0.$$

The market-clearing conditions for goods 1, 2, and 3 are, respectively,

$$\bar{\xi}_1(p) = z_1(p, p_3(p)) - y_1(p),$$

$$\bar{\xi}_2(p) = z_2(p, p_3(p)) + x_{12}(p) - y_2(p),$$

$$0 = z_3(p) - y_3(p).$$

Using the three market-clearing conditions, I can rewrite expressions (4) and (5) as

$$(6) \quad \sum_{i=1}^2 (p_i - p_i^0)D_1\bar{\xi}_i(p) = 0.$$

$$(7) \quad \sum_{i=1}^2 (p_i - p_i^0)D_2\bar{\xi}_i(p) = 0.$$

The determinant of the system (6) and (7) is

$$(8) \Delta(p) = D_1 \xi_1(p) D_2 \xi_2(p) - D_2 \xi_1(p) D_1 \xi_2(p) = D_1 \xi_1(p) D_2 \xi_2(p) \left[1 - \frac{\eta_{12}(p) \eta_{21}(p)}{\eta_{11}(p) \eta_{22}(p)} \right]$$

where $\eta_{ij}(p)$ is the elasticity of the excess demand for good i with respect to the price of good j , $i, j = 1, 2, i \neq j$. Each product $\eta_{ii}(p) \eta_{ii}(p)$ and $\eta_{ii}(p) \eta_{ii}(p)$ is positive if goods i and j have the same trade patterns and negative if they have different trade patterns. Thus $\frac{\eta_{12}(p) \eta_{21}(p)}{\eta_{11}(p) \eta_{22}(p)}$

> 0 in any case.

Now $D_i \xi_i(p) < 0, i = 1, 2$, i.e., the excess demand for each traded good is decreasing in its own price as shown in (E10) of Appendix E. Furthermore, it is reasonable to expect that $|\eta_{ii}(p)| > |\eta_{ij}(p)|, i, j = 1, 2, i \neq j$, i. e., the own price elasticity of the excess demand of a traded good dominates the cross price elasticity. If all these conditions are met, then $\Delta(p_1, p_2) > 0$ for all p_1, p_2 and the unique solution of the system (6), (7) is $p_{1,0}^* = p_1^0, p_{2,0}^* = p_2^0$. That is, when no industry is organized, free trade will be the policy implemented by the government.

Before continuing, I shall state formally the conditions that guarantee that free trade will prevail when no industry is organized as follows:

ASSUMPTION 2.1: For each traded good, the own price trade elasticity is larger than the cross price trade elasticity in absolute value, i.e., $|\eta_{ii}(p)| > |\eta_{ij}(p)|$ for $i, j = 1, 2, i \neq j$.

In this chapter, $D_i \xi_i(p), i, j = 1, 2, i \neq j$, may take any sign. I have discussed this situation in detail in Appendix E. There, I have shown that if all goods are gross substitutes to each other $D_i \xi_i(p), i, j = 1, 2, i \neq j$, is positive and if one pair of goods or all three pairs of goods are gross complements, then $D_i \xi_i(p), i, j = 1, 2, i \neq j$ may take either sign. Moreover, for a case when both traded goods are gross complements, I have solved the model

numerically and shown that $D_i \xi_j(p)$, $i, j = 1, 2, i \neq j$ may be positive or negative depending on the parameter values and the lobbying status of various industries.

3. One Lobby Group

In this section, I assume that only one industry is organized. When only industry j , $j = 1, 2, 3$, is organized, the trade policy implemented is the solution of the following maximization problem:

$$(9) \quad \max \left(\phi(p) - \varepsilon \left| \sum_i \phi_i(p) + \phi(p) - \sum_i (p_i - p^*) \xi_i(p) \right| \right) = \mu^{max}.$$

Let us assume that $j = 1$. The solution of (9) gives the following first-order conditions:

$$(10) \quad y_1(p) + \varepsilon \left| \sum_i (p_i - p^*) D_{1\xi_i}(p) \right| = 0.$$

$$(11) \quad -x_{12}(p) + \varepsilon \left| \sum_i (p_i - p^*) D_{2\xi_i}(p) \right| = 0.$$

In this case, the deviations of the prices of the traded goods from their free trade levels are given by the following expressions:

$$(12) \quad p_{1,01}^* - p_1^* = \frac{-D_{2\xi_2}(p_{01}^*)}{\varepsilon \Delta(p_{01}^*)} \left| y_1(p_{01}^*) + \frac{D_{1\xi_2}(p_{01}^*)}{D_{2\xi_2}(p_{01}^*)} x_{12}(p_{01}^*) \right|.$$

$$(13) \quad p_{2,01}^* - p_2^* = \frac{D_{2\xi_1}(p_{01}^*)}{\varepsilon \Delta(p_{01}^*)} \left| y_1(p_{01}^*) + \frac{D_{1\xi_1}(p_{01}^*)}{D_{2\xi_1}(p_{01}^*)} x_{12}(p_{01}^*) \right|.$$

In (12) and (13), I have let $p_{01}^* = (p_{1,01}^*, p_{2,01}^*)$.

In order to determine whether industry 1 will be protected let us rewrite the expression on the right-hand side in (12) as follow

$$(14) \quad \left| \frac{-D_{2\xi_2}(\dot{p}_{b1})}{\varepsilon\Delta(\dot{p}_{b1})} y_1(\dot{p}_{b1}) \right| \times \left| 1 + \left(\frac{\eta_{21}(\dot{p}_{b1})}{\eta_{22}(\dot{p}_{b1})} \right) \left(\frac{p_{2,01} x_{12}(\dot{p}_{b1})}{p_{1,01} y_1(\dot{p}_{b1})} \right) \right| = [A_{1,01}] \times [B_{1,01}].$$

Given Assumption 2.1, we have $A_{1,01} > 0$ and $B_{1,01} > 0$. Therefore, I can conclude that the price of good 1 rises above the free trade level.

Similarly, for industry 2, the right side of expression (13) can be rewritten as

$$(15) \quad \left| \frac{D_{2\xi_1}(\dot{p}_{b1})}{\varepsilon\Delta(\dot{p}_{b1})} y_1(\dot{p}_{b1}) \right| \left| 1 + \left(\frac{\eta_{11}(\dot{p}_{b1})}{\eta_{12}(\dot{p}_{b1})} \right) \left(\frac{p_{2,01} x_{12}(\dot{p}_{b1})}{p_{1,01} y_1(\dot{p}_{b1})} \right) \right| = [A_{2,01}] \times [B_{2,01}].$$

According to Lemma E2 in Appendix E, if goods 1, 2, and 3 are gross substitutes of each other, then $D_{2\xi_1}(p) > 0$. And, if a pair or all pairs of goods are gross complements, $D_{2\xi_1}(p)$ may take any sign. If $D_{2\xi_1}(p) > 0$, then $A_{2,01} > 0$ and the sign of $B_{2,01}$ is ambiguous. But if

$D_{2\xi_1}(p) < 0$, then $A_{2,01} < 0$ and $B_{2,01} > 0$ because in this case $\frac{\eta_{11}(\dot{p}_{b1})}{\eta_{12}(\dot{p}_{b1})} > 0$.

PROPOSITION 3.1: *Suppose that Assumption 2.1 holds and that only the traded final consumption good industry is organized.*

(a) *The lobbying activities by the industry producing the traded final consumption good will result in a rise in the price of this good above its free trade level, i.e., $p_{1,01}^* > p_1^0$.*

(b) *The impact on industry 2 of the lobbying activities of the industry producing the traded final consumption good is ambiguous, i.e., $p_{2,01}^*$ might be higher or lower than p_2^0 if $D_{2\xi_1}(p) > 0$. However, if $D_{2\xi_1}(p) < 0$, then the price of good 2 will fall below the free trade level.*

As in Chapter 3, if only the industry that produces the traded final consumption good is organized, it will be protected. The upstream industry, namely industry 2, whose output can be used as intermediate input and as final consumption, might or might not be protected. The

net effect depends on the horizontal linkages among the three goods in consumption and the vertical linkages between industry 1 and industry 2.

Suppose now only industry 2 is organized. Then the deviations from their free trade levels of the prices of goods 1 and 2 are given by

$$(16) \quad p_{1,02}^* - p_1^0 = \frac{D_{1\xi_2}(p_{02}^*)}{\varepsilon\Delta(p_{02}^*)} Y_2(p_{02}^*).$$

$$(17) \quad p_{2,02}^* - p_2^0 = -\frac{D_{1\xi_1}(p_{02}^*)}{\varepsilon\Delta(p_{02}^*)} Y_2(p_{02}^*).$$

In (16) and (17), I have let $p_{02}^* = (p_{1,02}^*, p_{2,02}^*)$

Note the difference between the expression in (16) and the expression in (18) in Chapter 3 where goods 1 and 2 are related only vertically. In that chapter, if the upstream industry is organized, the price of the good produced by the downstream industry necessarily rises above free trade level. However, in current chapter, where goods 1 and 2 have multiple linkages (vertical as well as horizontal), the price of good 1 may rise or fall from free trade level if industry 2 is represented by a lobby group. The price of good 1 rises above free trade level if goods 1, 2, and 3 are gross substitutes in consumption. If one pair of goods or all pairs of goods are gross complements, the result depends on the sign of $D_{1\xi_2}(p_{02}^*)$. The price of good 1 rises above free trade level if $D_{1\xi_2}(p_{02}^*) > 0$ and falls below free trade level if $D_{1\xi_2}(p_{02}^*) < 0$. As we will see in the numerical example in Section 8, the price of good 1 falls below free trade level when industry 2 is organized. The price of good 2 rises above free trade level, whatever the nature of their interdependence. I summarize these results in the following proposition.

PROPOSITION 3.2: *Suppose that Assumption 2.1 holds and that only industry 2 is organized.*

(a) *If goods 1, 2, and 3 are gross substitutes in consumption, then $p_{1,02}^* > p_1^0$, i.e., the lobbying activities of industry 2, the upstream industry, will result in a rise of the price of good 1 above its free trade level. If a pair or all pairs of goods are gross complements, the result depends on the horizontal and the vertical linkages among three goods. If $D_{1\bar{2}2}(p_{02}^*) > 0$, then $p_{1,02}^* > p_1^0$ whereas if $D_{1\bar{2}2}(p_{02}^*) < 0$, I have $p_{1,02}^* < p_1^0$.*

(b) *Irrespective of the nature of interdependence among the three goods, we always have $p_{2,02}^* > p_2^0$, i.e., if industry 2 is organized, it always manages to raise the price of its product above the free trade level.*

As an example of the case of industry 2 organized, let us consider the wheat industry in the United States. Wheat is a final consumption good and it is also used by millers, bakers, and livestock producers. It is also related to other final consumption goods, especially cereals. The wheat farmers are organized whereas the user industries generally are not. The wheat industry thus plays the role of industry 2, and wheat-using industry as industry 1. In the mid-eighties because the users like millers were counter-subsidized while the other users were very passive in opposing the export enhancement program, the wheat industry was able to obtain a protection rate of 48 percent (Gardner, 1996), which is the ratio of net gain to wheat farmers to the market value of wheat.

Using the wheat market in the mid 80s, I could also explain how the treasury can be an instrument for the determination of trade policy. Traditionally, US wheat producers were supported by The Commodity Credit Corporation (CCC), which used to buy wheat at support price. By 1985, the CCC had so much wheat surplus in stock that the US had to find a way to sell it in the foreign markets. Subsequently, a plan called the Export Enhancement Program

(EEP) was devised so that the wheat exporters would receive export subsidy in kind from the stock of wheat. About this program, Gardner (op cit. p. 305), observes:

Politically, the EPP was given the breath of life by a conjunction of interests represented by three individuals: Senator Zorinsky's strong desire, as the ranking democrat on the agriculture committee and representative of Nebraska, for a substantial export subsidy program, budget director David Stockman's need for Democratic votes on key economic legislation; and Senator Dole's brokering savvy, with interests in supporting both the administration (as majority leader) and Kansas wheat growers. Stockman agreed that the administration would implement an export subsidy program, in exchange for Zorinsky's vote on the budget resolution containing the Regan administrator's fiscal proposals, with the subsidies to take the form of unwanted (CCC) surplus commodities with a zero budget score.

He further explains that the American Bakers Association did not take a position on this issue. And, the Millers National Association testified in favor of EPP. The users, bakers, and millers, did not oppose the export subsidy on their raw material because of the following three reasons:

- (i) 30 million bushels of CCC wheat was given free of charge to flour mills, who then sold 1 million tons of flour (requiring 50 million bushels of wheat) to Egypt. The largest flour sale in history won the hearts of the millers.
- (ii) the subsidy was given in kind out of the existing stocks which would place additional wheat on the market and would not raise the domestic price of wheat as a cash subsidy would.

(iii) although the export enhancement would increase the price of wheat but because of price non-sensitivity of wheat product, millers and bakers would be able to pass the incidence to the consumers who were not organized.

Finally, suppose that only industry 3 is organized. I have the following deviations from the free trade levels of the prices of good 1 and good 2.

$$(18) \quad p_{1,03}^* - p_1^* = \frac{-D_{2,\xi_2}(p_{03}^*)}{\varepsilon\Delta(p_{03}^*)} V_3(p_{03}^*) \left| D_{1,p_3}(p_{03}^*) - \frac{D_{1,\xi_2}(p_{03}^*)}{D_{2,\xi_2}(p_{03}^*)} D_{2,p_3}(p_{03}^*) \right| = |A_{1,03}| \times |B_{1,03}|.$$

$$(19) \quad p_{2,03}^* - p_2^* = \frac{D_{1,\xi_1}(p_{03}^*)}{\varepsilon\Delta(p_{03}^*)} V_3(p_{03}^*) \left| D_{1,p_3}(p_{03}^*) - \frac{D_{1,\xi_1}(p_{03}^*)}{D_{2,\xi_1}(p_{03}^*)} D_{2,p_3}(p_{03}^*) \right| = |A_{2,03}| \times |B_{2,03}|.$$

In (18) and (19), I have let $p_{03}^* = (p_{1,03}^*, p_{2,03}^*)$.

If only the non-traded final consumption good industry is organized, then based on Appendix F, I have the following results:

If all goods are gross substitutes, $|A_{1,03}| \times |B_{1,03}| > 0$ and $|A_{2,03}| \times |B_{2,03}| > 0$.

If all goods are gross complements, and

(i) if $D_{i,\xi_i}(p) > 0$, then $|A_{1,03}| \times |B_{1,03}| < 0$ and $|A_{2,03}| \times |B_{2,03}| < 0$;

(ii) if $D_{i,\xi_i}(p) < 0$, the sign of $|A_{j,03}| \times |B_{j,03}|, j = 1, 2$, is ambiguous.

Note that $D_{i,\xi_j}(p) = D_{j,\xi_i}(p)$, where $i, j = 1, 2, i \neq j$.

If goods 1 and 2 are gross complements and the other two pairs of goods are gross substitutes, then

(i) if $D_{i,\xi_i}(p) > 0$, $|A_{1,03}| \times |B_{1,03}| > 0$ and $|A_{2,03}| \times |B_{2,03}| > 0$;

(ii) if $D_{i,\xi_i}(p) < 0$, the sign of $|A_{j,03}| \times |B_{j,03}|, j = 1, 2$, is ambiguous.

If goods 1 and 3 are gross complements, and goods 1 and 2 and goods 2 and 3 are gross substitutes, then

(i) if $D_{i\bar{i}}(p) < 0$, $|A_{1,03}| \times |B_{1,03}| < 0$ and $|A_{2,03}| \times |B_{2,03}| > 0$:

(ii) if $D_{i\bar{i}}(p) > 0$, then the sign of $|A_{j,03}| \times |B_{j,03}|$, $j = 1, 2$, is ambiguous.

If goods 2 and 3 are gross complements, and the other remaining two pairs of goods are gross substitutes, then

(i) if $D_{i\bar{i}}(p) < 0$, $|A_{1,03}| \times |B_{1,03}| > 0$ and $|A_{2,03}| \times |B_{2,03}| < 0$:

(ii) if $D_{i\bar{i}}(p) > 0$, then the sign of $|A_{j,03}| \times |B_{j,03}|$, $j = 1, 2$, is ambiguous.

I can summarize the above results in the following proposition.

PROPOSITION 3.3: (a) *Suppose that Assumption 2.1 is satisfied and that only industry 3 is organized.*

(a) *If goods 1, 2, and 3 are gross substitutes of each other then the prices of both goods 1 and 2 will rise above their free trade levels, i.e., $p_{1,03}^* > p_1^0$ and $p_{2,03}^* > p_2^0$. As a result, the price of good 3 also rises.*

(b) *If all goods are gross complements of each other, then the prices of both traded goods 1 and 2 fall below their free trade levels if $D_{i\bar{i}}(p_{03}^*) > 0$, $i, j = 1, 2, i \neq j$. However, if $D_{i\bar{i}}(p_{03}^*) < 0$, $i, j = 1, 2, i \neq j$, the signs of the deviations of the prices of good 1 and good 2 from their free trade levels are ambiguous.*

(c) *If goods 1 and 2 are gross complements, and the other two pairs of goods are gross substitutes, the prices of both goods 1 and 2 rise above their free trade levels if $D_{i\bar{i}}(p_{03}^*) > 0$, $i, j = 1, 2, i \neq j$. However, the direction of protection of these industries is ambiguous if $D_{i\bar{i}}(p_{03}^*) < 0$, $i, j = 1, 2, i \neq j$.*

(d) If goods 1 and 3 are gross complements, and goods 1 and 2 and goods 2 and 3 are gross substitutes, then the price of good 1 falls below free trade level whereas the price of good 2 rises above free trade level if $D_{i\bar{z}_j}(p_{0i}^*) < 0, i, j = 1, 2, i \neq j$. However, if $D_{i\bar{z}_j}(p_{0i}^*) > 0, i, j = 1, 2, i \neq j$, the impact on the prices of both goods is ambiguous.

(e) Finally, if goods 2 and 3 are gross complements and the other two pairs of goods are gross substitutes, the price of good 1 rises above free trade level whereas the price of good 2 falls below free trade level if $D_{i\bar{z}_j}(p_{0i}^*) < 0, i, j = 1, 2, i \neq j$. The direction of the deviations in the prices of good 1 and 2 from their free trade levels is ambiguous if $D_{i\bar{z}_j}(p_{0i}^*) > 0, i, j = 1, 2, i \neq j$.

According to Proposition 3.1 of Chapter 4, where there are only one traded final consumption good and one non-traded final consumption good, the traded good industry will be protected by an import tariff or export subsidy if its product is a gross substitute for the product of the organized non-traded good industry. Furthermore, if the traded final consumption good industry is producing a gross complement for the non-traded good industry, which is represented by lobby group, then the traded good industry will face an import subsidy or export tax. These results do not necessarily hold in the present context where a non-traded good industry is linked with two traded good industries. It is possible that when only the non-traded final consumption good industry is organized, the traded pure final consumption good industry will face an import subsidy or export tax even if its product is a gross substitute for the product of the organized non-traded good industry. Similarly, a traded pure final consumption good industry which produces a gross complement for the product of the organized non-traded good industry, may be protected in equilibrium. Thus the net effect

depends on (i) how the traded goods are related to each other and (ii) how each traded good is related to the non-traded good in consumption and production.

With this discussion, my analysis of one lobby is complete. In what follows, I analyze the situations when there are two and three lobbies.

4. Two Lobbies: The Case of Textiles and Apparels

Let us now consider the case when only the traded good industries are organized. In this case, the government solves the following problem

$$(20) \quad \max_p \left(\sum_1 \varphi_1(p) + \varepsilon \left[\sum_1 \varphi_1(p) + \phi(p) + \sum_1 (p - p^*) \xi_1(p) \right] \right) = \mu_{012}^{\max}$$

and the deviations from the free trade levels of prices of goods 1 and 2 are given by

$$(21) \quad p_{1,012}^* - p_1^* = \frac{-D_{2\xi_2}(p_{012}^*)}{\varepsilon \Delta(p_{012}^*)} \left| y_1(p_{012}^*) - \frac{D_{1\xi_2}(p_{012}^*)}{D_{2\xi_2}(p_{012}^*)} (y_2(p_{012}^*) - x_{12}(p_{012}^*)) \right|$$

$$(22) \quad p_{2,012}^* - p_2^* = \frac{D_{2\xi_1}(p_{012}^*)}{\varepsilon \Delta(p_{012}^*)} \left| y_1(p_{012}^*) - \frac{D_{1\xi_1}(p_{012}^*)}{D_{2\xi_1}(p_{012}^*)} (y_2(p_{012}^*) - x_{12}(p_{012}^*)) \right|$$

In (21) and (22), I have let $p_{012}^* = (p_{1,012}^*, p_{2,012}^*)$

An example of two traded good industries lobbying for protection can be found in the textile and apparel industries in the United States. Textile is used for final consumption and also as input into the apparel industry. In my model, the apparel industry and the textile industry play the roles of industry 1 and industry 2, respectively. Both the textile and the apparel industries are organized in the United States and have been protected since the mid-

1950s. The protection started with a focus on one country — Japan — and one commodity — cotton textile. By 1985, there were over 100 different commodity categories, and over 60 countries subject to quota. They are covered under the Multi-Fiber Arrangement (MFA).

Now if $D_{1\xi_2}(p) > 0$ and if the output of industry 2 is larger than the demand for the intermediate input by industry 1, i.e., if $y_2(p) > x_{12}(p)$, then (21) is positive. Similarly, if $D_{1\xi_2}(p) < 0$ and the domestic supply of good 2 is less than the demand for good 2 by industry 1, then again (21) is positive. On the other hand, if these two set of conditions are not met simultaneously, then the sign of (21) is ambiguous. If all goods are substitutes, we have $D_{1\xi_2}(p) > 0$. In this case, if $y_2(p) > x_{12}(p)$, then (21) is positive. The same situation emerges if a pair of goods or all pairs of goods are gross complements and $D_{1\xi_2}(p) > 0$. However, if $D_{1\xi_2}(p) < 0$, then for (21) to be positive, we need $y_2(p) < x_{12}(p)$. One cannot derive the conditions when (21) will be unambiguously negative.

The expression in (22) is positive if $D_{2\xi_1}(p) > 0$ and $y_2(p) > x_{12}(p)$. On the other hand, (22) is negative if $D_{2\xi_1}(p) < 0$ and $y_2(p) < x_{12}(p)$. In all other cases, the sign of (22) is ambiguous. I summarize the results just discussed as follows:

PROPOSITION 4.1: *Suppose that Assumption 2.1 holds and that both of the traded goods industries are organized.*

(a) If (i) goods 1, 2, and 3 are gross substitutes and (ii) the output of good 2 is always larger than the demand for good 2, as intermediate input, by industry 1, then $p_{1,02}^ > p_1^0$ and $p_{2,02}^* > p_2^0$, i.e., the prices of both traded goods rise above their free trade levels. The same results hold if all pairs of goods or a pair of goods are gross complements but $D_{i\xi_j}(p_{0i}^*) > 0$, $i, j = 1, 2, i \neq j$.*

(b) If a pair of goods or all pairs of goods are gross complements and $D_{i\xi_j}(p_{ii}) < 0$, $i, j = 1, 2, i \neq j$, industry 1 will be protected by import tariff or export subsidy if $y_2(p) < x_{12}(p)$, i.e., the level of output of industry 2 is not sufficient even to cover the demand for intermediate input by industry 1. In this case, industry 2 faces import subsidy.

(c) On the other hand, if $D_{i\xi_j}(p_{ii})$, $i, j = 1, 2, i \neq j$ and $y_2(p) - x_{12}(p)$ take opposite signs, then the outcome of the lobbying activities of industries 1 and 2 on the prices of their own products is ambiguous.

Thus if the output of the textile industry is larger (smaller) than the input required by the apparel industry and the nature of interdependence between goods is such that $D_{i\xi_j}(p_{ii})$ is positive (negative) then the apparel industry is protected by an import tariff or export subsidy. However, the textile industry receives protection in the form of an import tariff or export subsidy only if $y_2(p) > x_{12}(p)$ and $D_{2\xi_1}(p) > 0$. If both these conditions are reversed, the textile industry faces an import subsidy. Note that when $y_2(p) < x_{12}(p)$, textile is imported not only for final consumption but also for use as input in the apparel industry.

5. The Traded and Non-Trade Pure Final Consumption Good Industries are Organized

The government maximizes the following payoff function

$$(23) \quad \max_p \quad \varphi_1(p) + \varphi_2(p) + \varepsilon \left[\sum_i \varphi_i(p) + \phi(p) + \sum_i (p_i - p_i^0) \xi_i(p) \right] = \mu_{11}^{\max},$$

and the set of trade policies for two traded good industries satisfies the following first-order conditions:

$$(24) \quad p_{1,013}^* - p_1^0 = \frac{-D_{2,\xi_2}(p_{013}^*)}{\varepsilon\Delta(p_{013}^*)} \left| \begin{array}{l} \left\{ y_1(p_{013}^*) + \frac{D_{1,\xi_2}(p_{013}^*)}{D_{2,\xi_2}(p_{013}^*)} x_{12}(p_{013}^*) \right\} \\ + \left\{ D_1 p_3(p) - \frac{D_{1,\xi_2}(p_{013}^*)}{D_{2,\xi_2}(p_{013}^*)} D_2 p_3(p_{013}^*) \right\} y_3(p_{013}^*) \end{array} \right|$$

$$(25) \quad p_{2,013}^* - p_2^0 = \frac{D_{2,\xi_1}(p_{013}^*)}{\varepsilon\Delta(p_{013}^*)} \left| \begin{array}{l} \left\{ y_1(p_{013}^*) + \frac{D_{1,\xi_1}(p_{013}^*)}{D_{2,\xi_1}(p_{013}^*)} x_{12}(p_{013}^*) \right\} \\ + \left\{ D_1 p_3(p) - \frac{D_{1,\xi_1}(p_{013}^*)}{D_{2,\xi_1}(p_{013}^*)} D_2 p_3(p_{013}^*) \right\} y_3(p_{013}^*) \end{array} \right|$$

The sign of expression (24) depends on the sum of expressions inside the first and the second pairs of curly brackets on the right hand side. Since the expression inside the first pair of curly brackets is always positive, the sum of two components will be unambiguously determined (positive) only if the expression inside the second pair of curly brackets is positive. Whenever the expression inside the second pair of curly brackets is negative or ambiguous in sign, the sign of the whole expression in (24) is ambiguous. From Appendix F, the expression inside the second pair of curly brackets is positive in one of the following three situations: (i) all goods are gross substitutes, or (ii) goods 1 and 2 are gross complements and $D_{1,\xi_2}(p_{013}^*) > 0$, or (iii) goods 2 and 3 are gross complements and $D_{1,\xi_2}(p_{013}^*) < 0$. Thus only in these three cases, is the sign of (24) positive. In all the other cases, the sign of (24) is ambiguous.

In (25), the expression $\frac{D_{2,\xi_1}(p_{013}^*)}{\varepsilon\Delta(p_{013}^*)} \left| y_1(p_{013}^*) + \frac{D_{1,\xi_1}(p_{013}^*)}{D_{2,\xi_1}(p_{013}^*)} x_{12}(p_{013}^*) \right|$ is negative if $D_{2,\xi_1}(p_{013}^*) < 0$ and ambiguous if $D_{2,\xi_1}(p_{013}^*) > 0$. Therefore, the sign of (25) is unambiguously determined

(negative) if $\frac{D_2 \bar{\xi}_1(p_{013}^*)}{\varepsilon \Delta(p_{013}^*)} \left| \left(D_1 P_3(p) - \frac{D_1 \bar{\xi}_1(p_{013}^*)}{D_2 \bar{\xi}_1(p_{013}^*)} D_2 P_3(p_{013}^*) \right) Y_3(p_{013}^*) \right|$. the remaining component in

(25). is negative. This expression is negative (Appendix F) (i) if all goods are gross complements and $D_2 \bar{\xi}_1(p_{013}^*) > 0$. or (ii) if goods 2 and 3 are gross complements and $D_2 \bar{\xi}_1(p_{013}^*) < 0$. However, note that if $D_2 \bar{\xi}_1(p_{013}^*) > 0$, the first part is ambiguous in sign. Therefore, we have only one case when the sign of (25) will definitely be negative. I can derive the following proposition from (24) and (25).

PROPOSITION 5.1: *Suppose that Assumption 2.1 holds and that the own price elasticity is at least as large as the cross price elasticity for the traded goods. If only industries 1 and 3 are organized, then*

(a) the price of good 1 rises above the free trade level in either of the following cases:

(i) all three goods are gross substitutes for each other;

(ii) goods 1 and 2 are gross complements and $D_1 \bar{\xi}_2(p_{013}^) > 0$;*

(iii) goods 2 and 3 are gross complements and $D_1 \bar{\xi}_2(p_{013}^) < 0$.*

(b) The price of good 2, the consumption cum intermediate input good, falls below free trade level if goods 2 and 3 are gross complements and $D_2 \bar{\xi}_1(p_{013}^) < 0$.*

(c) In all the other cases, the effects of lobby groups 1 and 3 on the prices of both traded goods are ambiguous.

Here I have only been able to show when the pure consumption good receives an import tariff or export subsidy and the consumption cum intermediate input good faces an import subsidy or export tax. Among the various possibilities, there is only one case when the

impact on both industries 1 and 2 is unambiguous: that is, when goods 2 and 3 are gross complements and $D_i \xi_j(p_{0i}) < 0$, $i, j = 1, 2$, $i \neq j$. In this case, the price of good 1 rises above and the price of good 2 falls below their free trade levels. Note that even if all the goods are gross substitutes, I cannot unambiguously determine the impact of the lobbying activities of industries 1 and 3 on industry 2.

6. Two Lobbies: The Case of the US Sugar Industry

Let us take the case of the sugar industry in United States. The price of sugar in the US is more than double the price in the international market. This sort of protection for the sugar industry has been a puzzle for policy analysts. Sugar is a final good and at the same time it is also used as input by other sweetener user industries. In the United States, over 70 percent of the sugar is purchased by industrial users — bakers, candy makers, soft drink manufactures, confectioneries, and so on. If these downstream firms benefit from lower sugar prices, they could form a pressure group to countervail the price-raising efforts of the sugar industry. Moreover, the sugar industry has consumption interdependence with the non-traded high-fructose corn syrup (HFCS) industry.

Before the replacement of sugar by corn-sweeteners happened, the sugar producers might have believed that the demand for sugar is price inelastic. They were right until the time the production of corn-sweetener started. However, the very high price of sugar in the seventies made it feasible to introduce the rather costly technology of corn-sweetener, thereby making the demand for sugar more price elastic. After its introduction, this sweetener began to replace sugar in the soft-drink industry. Therefore, the corn-sweetener producers

want a higher domestic price of sugar so that the demand and hence the price of syrup would increase.

It is interesting to note that the corn syrup producers in the US supported the quota and tariff on sugar but vehemently opposed the deficiency payment to the sugar producers if the international price falls below a defined floor level because deficiency payment would not increase the price of sugar, the event that the corn syrup producers would not like to see happen (Orden, op. cit.).

Now, let the industry that uses sugar as input be industry 1 and the sugar industry be industry 2 and HFCS be industry 3¹. In the United States, it seems to be the case that the sugar industry and HFCS are both organized. The downstream sugar-using industries have been passive in the past. However, during the North American Free Trade (NAFTA) negotiations between the US and Mexico, the sugar producers were opposed by the sweetener users through their organization, Sweetener Users Association (SUA), which represents 16 food-processing industries. But as in many policy decisions, the sweetener users were not very effective (Orden, op. cit.). Thus I will evaluate both cases: the case industry 1 is organized and the case it is not unorganized.

During the NAFTA negotiations, sugar and corn were two main agricultural items on the agenda: sugar for the US and corn for Mexico. The corn market was highly protected and politically very sensitive in Mexico while the sugar industry was highly protected in the

¹ It could be argued that the sugar industry has no specific capital as an input, therefore, the present model could not resemble the situation of sugar industry in the United States. However, the sugar industry has an interesting structure which allows me to generalize my results. The producers would not consider growing the raw materials sugar cane and sugar beet without a mill nearby, and no refinery mills would be established unless it was anticipated that there would be a source of supply in the area. For this reason, it is possible that the growers, processors and the refiners are the same and in the short run at least some of the investment is sector specific. The land or the processing machine or the refinery cannot be used for other purposes in the short run.

United States. The National Corn Growers Association (NCGA) in the US wanted the corn market to be liberalized in Mexico. Mexico wanted a more liberal US sugar market. Sugar producers in the US were lobbying for protection of their industry. The NCGA had supported sugar protection because a higher price of sugar was a good thing for corn producers. Thus both groups have the same interests in their domestic market. However, in the Mexican market, they have opposite interests. NCGA wanted lower price of corn in Mexico whereas the sugar industry in the US wanted higher price of corn in Mexico because otherwise the sugar producers in US feared that it would be a repetition of what happened in the United States: a replacement of sugar in soft drinks by high-fructose corn sweeteners in Mexico and a subsequent export of surplus sugar to the US protected market under NAFTA. Since I do not consider foreign lobbying, my analysis will focus only on their common interests in the domestic market.

Let us first take the case when the sugar industry and HFCS are organized. Then the government solves the following problem:

$$(26) \quad \max_p \left(\varphi_2(p) + \varphi_3(p) + \varepsilon \left[\sum_1 \varphi_1(p) + \phi(p) + \sum_1 (p_i - p_i^*) \xi_i(p) \right] \right) = \mu_{23}^{max}$$

In this respect, the price deviations of the traded goods from their free trade levels are given by the following two expressions:

$$(27) \quad p_{123}^* - p_1^0 = \frac{-D_2 \xi_2(p_{123}^*)}{\varepsilon \Delta(p_{123}^*)} \left| - \frac{D_1 \xi_2(p_{123}^*)}{D_2 \xi_2(p_{123}^*)} Y_2(p_{123}^*) + \left\{ D_1 p_3(p_{123}^*) - \frac{D_1 \xi_2(p_{123}^*)}{D_2 \xi_2(p_{123}^*)} D_2 p_3(p_{123}^*) \right\} Y_3(p_{123}^*) \right|$$

$$(28) \quad p_{2,023}^* - p_2^0 = \frac{D_2 \xi_1(p_{023}^*)}{\varepsilon \Delta(p_{023}^*)} \left| - \frac{D_1 \xi_1(p_{023}^*)}{D_2 \xi_1(p_{023}^*)} y_2(p_{023}^*) + \left\{ D_1 p_3(p_{023}^*) - \frac{D_1 \xi_1(p_{023}^*)}{D_2 \xi_1(p_{023}^*)} D_2 p_3(p_{023}^*) \right\} y_3(p_{023}^*) \right|.$$

In (27) and (28), I have let $p_{023}^* = (p_{1,023}^*, p_{2,023}^*)$. Observe that the output of industry 1 does not appear as an explanatory variable because industry 1 is not organized. But the output of industry 2 is the explanatory variable for the endogenous deviations of the prices from their free-trade levels. The variable related to industry 3 also appear in (27) and (28). The role of the sector producing the non-traded final consumption good is captured by the expressions inside the curly brackets.

Since HFCS and sugar are gross substitutes, $D_2 p_3(p_{023}^*) > 0$. Because good 1, especially candies and confectioneries, and good 3 are not related in consumption, $D_1 p_3(p) = 0$. Thus the expression for price deviation of sugar industry in (28) takes the following form

$$(28') \quad p_{2,023}^* - p_2^0 = - \frac{D_1 \xi_1(p_{023}^*)}{\varepsilon \Delta(p_{023}^*)} \left| y_2(p_{023}^*) - D_2 p_3(p_{023}^*) y_3(p_{023}^*) \right|.$$

Whatever the nature of interdependence between goods 1, 2, and 3, the expression on the right side of (28') is positive. Hence I have proved that $p_{2,023}^* - p_2^0 > 0$. The larger are HFCS and the sugar industries and the larger is the magnitude of the horizontal linkage between them, the larger will be the magnitude of protection for the sugar industry. Thus it is not surprising that sugar industry was obtaining 52.5 percent of domestic price subsidy equivalent and 83.7 percent of tariff equivalent of boarder protection from international prices in 1991 (Orden, op cit.).

Let us next look at sugar-using industries. When all but the sugar-using industries are organized, (27) takes the following form

$$(27') \quad p_{1,023}^* - p_1^0 = \frac{D_1 \bar{\xi}_2(p_{023}^*)}{\varepsilon \Delta(p_{023}^*)} \left[V_2(p_{023}^*) + D_2 p_3(p_{023}^*) V_3(p_{023}^*) \right]$$

Now, when $D_1 p_3(p) = 0$, that is, when $\tilde{\beta}_{31} = 0$, the expression (E12) in Appendix E can be written as $D_1 \bar{\xi}_2(p) = D_1 x_{12}(p) - \tilde{\beta}_{21}$. Thus $D_1 \bar{\xi}_2(p) > 0$ if $D_1 x_{12}(p) > \tilde{\beta}_{21}$. This condition is necessarily fulfilled if goods 1 and 2 are gross substitutes in consumption. Furthermore, the positive sign of $D_1 \bar{\xi}_2(p)$ implies that (27') is positive. If this is the case, then the sugar-using industries must also be protected in the United States even if they are not organized. It explains why sugar-containing products also have 120 percent of tariff equivalent of border protection (Orden, *op cit.*). I summarize the results just discussed in the following proposition.

PROPOSITION 6.1: *Suppose that only industries 2 and 3 are organized. If goods 1 and 3 are independent in consumption, then the lobbying activities of industries 2 and 3 will result in a rise of the price of good 2 above its free trade level, i.e., $p_{2,023}^* > p_2^0$. Furthermore, if goods 1 and 2 are gross substitutes, then $p_{1,023}^* > p_1^0$, i.e., the price of good 1 also rises above its free trade level.*

7. The Grand Lobby: The Sugar Industry Revisited

Finally, let us consider the case when all three industries are organized. In this grand lobbying scenario, the government solves the following problem:

$$(29) \quad \max_p \left(\sum_{j=1}^i \varphi_j(p) + \varepsilon \left| \sum_{j=1}^i \varphi_j(p) + \phi(p) + \sum_{j=1}^i (p_j - p_j^0) \xi_j(p) \right| \right) = \mu_{0123}^{\max}.$$

The deviations from their free trade levels of the prices of goods 1 and 2 are given by

$$(30) \quad p_{1,0123}^i - p_1^0 = \frac{-D_{2, \xi_2}(p_{0123}^i)}{\varepsilon \Delta(p_{0123}^i)} \left| \begin{array}{l} y_1(p_{0123}^i) + \frac{D_{1, \xi_2}(p_{0123}^i)}{D_{2, \xi_2}(p_{0123}^i)} [x_{12}(p_{0123}^i) - y_2(p_{0123}^i)] \\ + \left\{ D_1 p_3(p_{0123}^i) - \frac{D_{1, \xi_2}(p_{0123}^i)}{D_{2, \xi_2}(p_{0123}^i)} D_2 p_3(p_{0123}^i) \right\} y_3(p_{0123}^i) \end{array} \right|.$$

$$(31) \quad p_{2,0123}^i - p_2^0 = \frac{D_{2, \xi_1}(p_{0123}^i)}{\varepsilon \Delta(p_{0123}^i)} \left| \begin{array}{l} y_1(p_{0123}^i) + \frac{D_{1, \xi_1}(p_{0123}^i)}{D_{2, \xi_1}(p_{0123}^i)} [x_{12}(p_{0123}^i) - y_2(p_{0123}^i)] \\ + \left\{ D_1 p_3(p_{0123}^i) - \frac{D_{1, \xi_1}(p_{0123}^i)}{D_{2, \xi_1}(p_{0123}^i)} D_2 p_3(p_{0123}^i) \right\} y_3(p_{0123}^i) \end{array} \right|.$$

In (30) and (31), I have let $p_{0123}^i = (p_{1,0123}^i, p_{2,0123}^i)$. Now, the above two equations assume the following forms when one considers industries 1, 2, and 3 as the sugar-using industry, the sugar industry, and the HFCS industry.

$$(32) \quad p_{1,0123}^i - p_1^0 = \frac{D_{1, \xi_2}(p_{0123}^i)}{\varepsilon \Delta(p_{0123}^i)} \left| \begin{array}{l} \frac{D_{2, \xi_2}(p_{0123}^i)}{D_{1, \xi_2}(p_{0123}^i)} y_1(p_{0123}^i) + [y_2(p_{0123}^i) - x_{12}(p_{0123}^i)] + D_2 p_3(p_{0123}^i) y_3(p_{0123}^i) \end{array} \right|.$$

$$(33) \quad p_{2,0123}^i - p_2^0 = -\frac{D_{1, \xi_1}(p_{0123}^i)}{\varepsilon \Delta(p_{0123}^i)} \left| \begin{array}{l} \frac{D_{2, \xi_1}(p_{0123}^i)}{D_{1, \xi_1}(p_{0123}^i)} y_1(p_{0123}^i) + [y_2(p_{0123}^i) - x_{12}(p_{0123}^i)] + D_2 p_3(p_{0123}^i) y_3(p_{0123}^i) \end{array} \right|.$$

The expression in (32) is positive if the following three conditions are satisfied: (i) $D_{1, \xi_2}(p_{0123}^i) > 0$; (ii) $y_2(p_{0123}^i) > x_{12}(p_{0123}^i)$; and (iii) $D_2 p_3(p_{0123}^i) > 0$. Interestingly, (32) is also positive if all of these inequalities are reversed. Similarly, (33) is positive if the above conditions are

satisfied and negative if all of the conditions are reversed. Therefore, I have the following results:

PROPOSITION 7.1: *Suppose that the sugar industry, the sugar-using industry, and the industry producing the sugar substitute (HFCS), are all organized. Then I have the following results.*

(a) The price of sugar and the price of sugar-using products will rise above their free-trade levels if

(a1) all the three goods are gross substitutes and the domestic sugar production exceeds its use as input in the sugar-using industry or

(a2) goods 2 and 3 are gross substitutes, $D_1 \bar{\xi}_2(p_{0123}^) > 0$, and the domestic sugar production is more than what is required as input by the sugar-using industry.*

(b) If either all three goods are gross complements or goods 2 and 3 are gross complements, $D_1 \bar{\xi}_2(p_{0123}^) < 0$ and the output of the sugar industry is not enough even to cover the input demand by the sugar-using industry, then the sugar-using industry will again obtain protection. However, in this case, the sugar industry faces an import subsidy.*

Note that now there are conditions to be met for the protection of the sugar industry. In the previous case, when the sugar-using industry is not organized, the sugar industry obtains a positive level of protection in equilibrium. In the present case, the sugar industry may face an import tariff or export subsidy if the conditions derived in Proposition 7.1(a1) and 7.1(a2) are not met. However, Proposition 7.1(b) is not relevant in the present context because for this situation to arise, goods 2 and 3 must be gross complements. In my example, good 2 (sugar) and good 3 (HFCS) are gross substitutes.

With this discussion, the analysis of various lobbying situations is complete. In this chapter, I have not said anything about the price of the non-traded good and its level of derived protection. Since the various combinations of goods may have different natures of interdependence, I can unambiguously say something about the price of good 3 only in two situations. If all goods are gross substitutes for each other, the price of good 3 rises (falls) if the prices of both traded goods rise (fall). Similarly, if all goods are gross complements, the price of good 3 rises (falls) if the prices of both traded goods fall (rise) due to lobbying activities. On the other hand, if a pair of goods is gross complements and the other two pairs are gross substitutes, I cannot decide the direction of movement of the price of non-traded good due to the lobbying activities by various industries until I specify the functional forms of the demand curves for all three goods and solve the model numerically. In what follows, I solve the game numerically for the case when the two traded goods are gross complements and the other two pairs of goods are gross substitutes.

8. Numerical Example

As described in Condition 2 in Appendix E, when a pair of goods or all pairs of goods are gross complements in consumption, then the cross price response of excess demand function is ambiguous unless we know the value of the parameters involved. We have the condition that $D_i \bar{x}_j(p^*)$, $i, j = 1, 2, i \neq j$ is positive (negative) if $D_1 x_{12}(p) - \beta_{12}$ is greater (smaller) than

$-\frac{\tilde{\beta}_{13} \tilde{\beta}_{23}}{\tilde{\beta}_{33} + y_3'(p_3(p))}$. Thus the main purpose of this exercise is to show that

$D_i \bar{x}_j(p^*)$, $i, j = 1, 2, i \neq j$, may take either positive or negative sign, and, therefore, the

qualitative results must be derived for each case. I have shown this by solving the game numerically.

For the numerical example, I have used the following parameter values on the production side:

$$\gamma_1 = 0.3, \gamma_2 = 0.7, \gamma_3 = 0.5;$$

$$\bar{k}_1 = 2.0, \bar{k}_2 = 1.5, \bar{k}_3 = 1.0,$$

$$\bar{w} = 0.25$$

$$p_1^0 = 0.5, p_2^0 = 0.4 \text{ and } \varepsilon = 1.$$

On the consumption side, with three consumption goods, there are five possible ways of interdependence. The game can be solved for all the five cases; however, I will only solve the case when goods 1 and 2 are gross complements and the other two pairs of goods are gross substitutes. Let us suppose that the parameters in the direct demand functions are given as follows:

$$\alpha_1 = 2.0, \beta_{11} = 0.5, \beta_{12} = -0.24, \beta_{13} = 0.2,$$

$$\alpha_2 = 3.0, \beta_{22} = 0.6, \beta_{23} = 0.18,$$

$$\alpha_3 = 3.5, \beta_{33} = 0.4.$$

Substituting these parameter values into the direct demand functions and solving for the inverse demand functions, as given by equations (E1) through (E3) in Appendix E, I obtain

$$z_1 = 6.079 - 5.258p_1 - 3.343p_2 + 4.134p_3,$$

$$z_2 = 6.611 - 3.343p_1 - 4.053p_2 + 3.495p_3,$$

$$z_3 = 2.736 - 4.134p_1 + 3.495p_2 - 6.140p_3.$$

For the numerical exercise, I have assumed the Cobb Douglas production technology for all three industries. By setting the market clearing condition for non-traded goods as shown in (E4), I solve for the price of the non-traded good in terms of the prices of the traded goods. Thereafter, I replace the price of the non-traded good by its expression as a function of the prices of traded goods in all equations in the system. Once every variable is expressed in terms of the prices of the traded goods, I solve the game by choosing the optimal price vector for the government. I have obtained the solutions for all the eight possible combinations of lobbying situations. The results are presented in Table 1.

TABLE 1—SOLUTION TO THE GAME WITH THREE INDUSTRIES
WHEN GOODS 1 & 2 ARE GROSS COMPLEMENTS IN CONSUMPTION

Variables/Lobbies	0	01	02	03	012	013	023	0123
p_1	0.5	0.954	0.448	0.723	0.853	1.352	0.698	1.265
p_2	0.4	0.333	0.644	0.441	0.553	0.375	0.681	0.585
p_3	0.762	0.964	0.840	0.893	1.006	1.184	0.983	1.229
$\varphi_1(p^*)$	0.460	1.252	0.320	0.747	0.858	1.959	0.589	1.471
$\varphi_2(p^*)$	0.234	0.128	1.146	0.325	0.689	0.189	1.382	0.830
$\varphi_3(p^*)$	0.580	0.929	0.705	0.797	1.013	1.401	0.966	1.511
Total Welfare	15.082	15.861	15.598	15.761	16.131	17.002	16.421	17.368
$y_2(p^*) - x_{12}(p^*)$	1.461	-0.334	5.718	1.730	3.489	-0.561	6.392	3.656
$\xi_1(p^*)$	3.948	2.057	4.023	3.015	2.471	0.539	2.990	0.895
$\xi_2(p^*)$	4.519	5.773	-0.277	3.795	1.550	5.270	-1.439	0.655
$y_3(p_3(p^*))$	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
$D_{1,x_{12}}(p^*)$	1.407	2.410	0.680	1.434	1.115	2.366	0.759	1.218
$D_{1,x_{12}}(p^*) - \beta_{12}$	-1.936	-0.933	-2.663	-1.909	-2.228	-0.977	-2.584	-2.125
$\frac{\beta_{13}\beta_{23}}{\beta_{33} + y_3(p_3(p^*))}$	1.775	1.775	1.775	1.775	1.775	1.775	1.775	1.775
$D_{i,\xi_j}(p^*)$	-0.161	0.842	-0.888	-0.134	-0.453	0.798	-0.809	-0.350

Observe that in this example, when only industry 2 is organized, the price of good 1 falls below the free trade level as explained in Proposition 3.2 (a), which was not possible if goods 1 and 2 were related only vertically. The vertical linkage between these two goods is given by $D_{1,x_{12}}(p^*)$, and the magnitude of this linkage changes as the prices of goods 1 and 2 change. The horizontal linkage between goods 1 and 2 is given by $\tilde{\beta}_{12} = 3.340$. The difference between these two linkages is the net linkage. From (E12), we have

$$(34) \quad D_{i,\xi_i}(p) = \left| D_{1,x_{12}}(p) - \tilde{\beta}_{12} \right| + \frac{\tilde{\beta}_{13}\tilde{\beta}_{23}}{\tilde{\beta}_{13} + y_i(p_i(p))}$$

Thus, the value for $D_{i,\xi_i}(p^*)$ depends on the net linkage between goods 1 and 2 and the horizontal linkages between goods 1 and 3 and goods 2 and 3. Using the information in the last four rows in Table 1, I have illustrated the movements of different components in (34) in Figure 1.

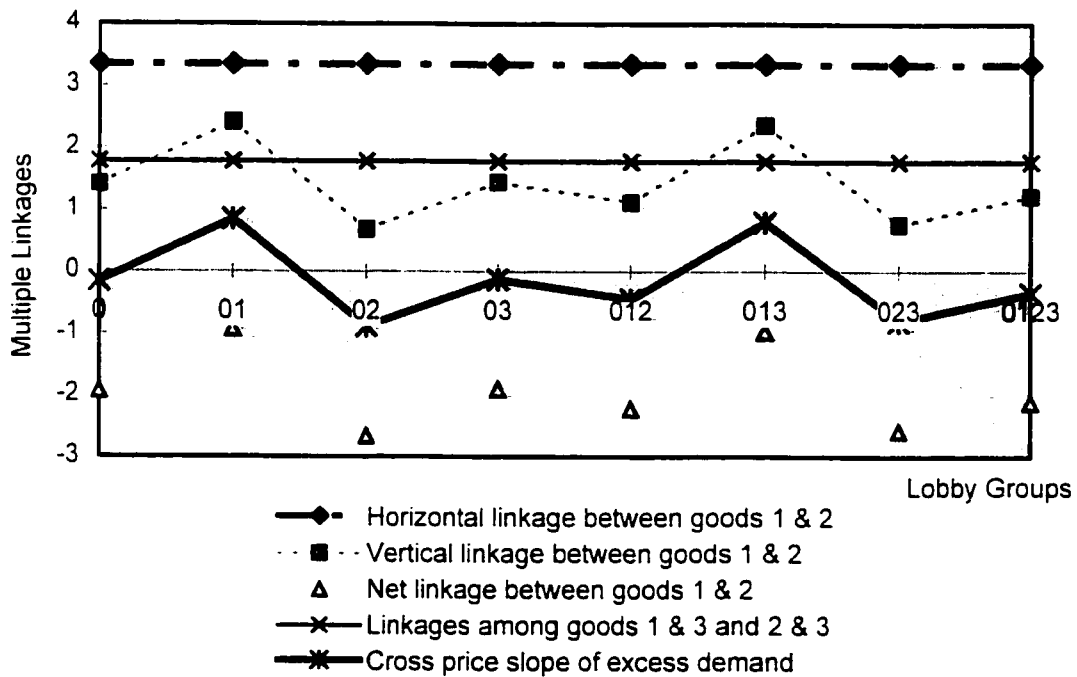


FIGURE 1. MULTIPLE LINKAGES AND THE STRUCTURE OF PROTECTION

In Figure 1, $\frac{\tilde{\beta}_{13}\tilde{\beta}_{23}}{\tilde{\beta}_{33} + y_3'(p_3(p^*))}$ is referred to as "the linkages between goods 1 and 3 and goods 2 and 3". Since $\tilde{\beta}_{12}$ and $\frac{\tilde{\beta}_{13}\tilde{\beta}_{23}}{\tilde{\beta}_{33} + y_3'(p_3(p^*))}$ are constant, the movements of $D_{1,x_{12}}(p^*)$ - $\tilde{\beta}_{12}$ and hence the movement of $D_{i,\xi_j}(p^*)$ are exactly given by the movement of $D_{1,x_{12}}(p^*)$. As described in Appendix E, the cross price effect on excess demand, i.e., $D_{i,\xi_j}(p^*)$, $i, j = 1, 2, i \neq j$, is negative in some cases and positive in other cases.

While solving the game, I have used the following production function for industry 1:

$$y_1 = x_{12}^{\gamma_1} \bar{k}_1^{1-\gamma_1}.$$

Then the demand curve for intermediate input of this industry is given by

$$x_{12}(p_1, p_2) = \bar{k}_1 \left(\frac{p_1 \gamma_1}{p_2} \right)^{\frac{1}{1-\gamma_1}}.$$

Thus

$$(35) \quad D_{1,x_{12}}(p_1, p_2) = \frac{1}{1-\gamma_1} \bar{k}_1 \left(\frac{\gamma_1}{p_2} \right)^{\frac{1}{1-\gamma_1}} (p_1)^{\frac{\gamma_1}{1-\gamma_1}}$$

In Figure 1, I have plotted $D_{1,x_{12}}(p_1, p_2)$, while both prices p_1 and p_2 are changing. However, I would like to see the movement in $D_{1,x_{12}}(p_1, p_2)$ while only one price is changing and the other price is given.

Since the value of production parameters are $\gamma_1 = 0.3$, $\bar{k}_1 = 2.0$, given the value of p_2 , I can derive the curve for $D_{1,x_{12}}(p_1, p_2)$ as p_1 changes by using (35). By substituting the values of $D_{1,x_{12}}(p_1, p_2)$ into (34), I could derive the curve for $D_{i,\xi_j}(p)$. Since all other components that define $D_{i,\xi_j}(p)$ except $D_{1,x_{12}}(p_1, p_2)$ have constant values, the shape of $D_{i,\xi_j}(p)$ resembles the shape of $D_{1,x_{12}}(p_1, p_2)$ as shown in Figure 2.

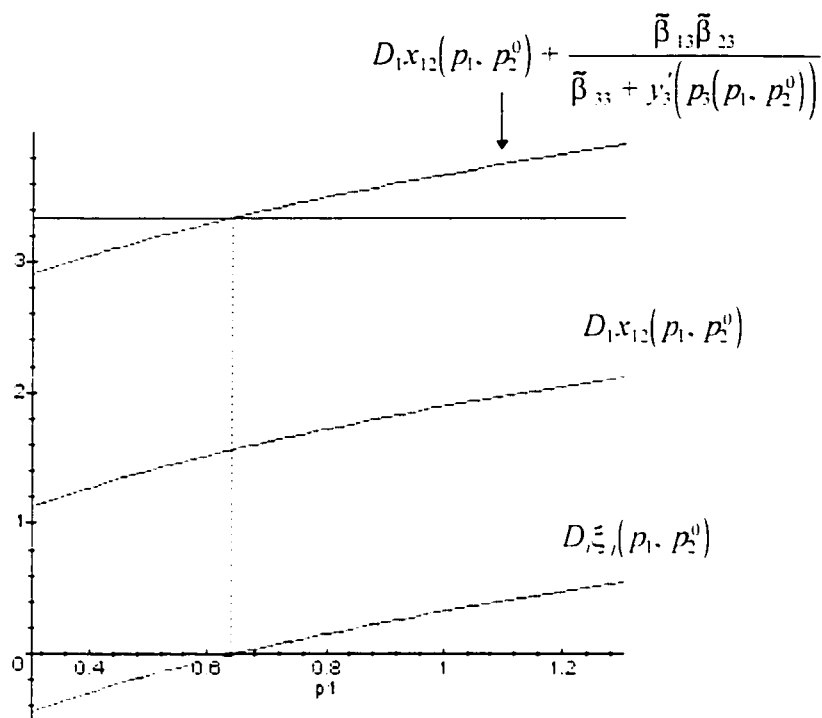


FIGURE 2. THE CROSS PRICE EFFECT OF EXCESS DEMAND FUNCTION WHEN $p_2 = p_2^0$

In Figure 2, I have used $p_2 = 0.4$, the price of good 2 under free trade, and varied the value of p_1 . The value of cross price effect on excess demand function is negative for certain range of values of p_1 , however, if the value of p_1 rises above that value, then the value of cross price effect on excess demand function becomes positive. Note that when the price of good 2 is at the free trade level as given in this particular case, p_1 is equal to 0.5 if none of the industry is organized. Under free trade, $D_{i_2} \xi_j(p_1^0, p_2^0)$ is negative (-0.161) as given in Table 1 and illustrated in Figure 1. This negative value of $D_{i_2} \xi_j(p_1^0, p_2^0)$ is also confirmed in Figure 2.

In Table 1, the value of $D_{i_2} \xi_j(p)$ is negative in six out of eight cases. It is positive in two cases, when only industry 1 is organized and when industries 1 and 3 are organized. In Figure 3, I illustrate the case when only industry 1 is organized. In this case, we have $p_{1,01}^* =$

0.954 and $p_{2,01}^* = 0.448$. Thus Figure 3 is drawn for $p_{2,01}^* = 0.448$. Note that at $p_{1,01}^* = 0.954$, the value of $D_{i,\xi_j}(p^*)$ is positive and equal to 0.842.

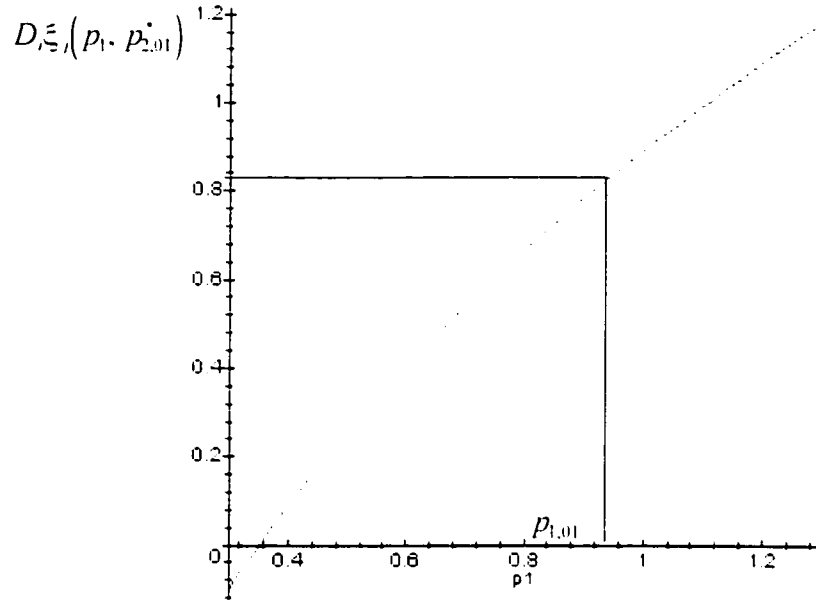


FIGURE 3. THE CROSS PRICE EFFECT OF EXCESS DEMAND FUNCTION WHEN $p_2 = p_{2,01}^*$

Similarly, I could plot the cross price effect on excess demand functions for different lobbying situations and obtain respective curves for $D_{i,\xi_j}(p^*)$. Since the values of p_2 changes as the lobbying situations change, I will have eight different curves for $D_{i,\xi_j}(p^*)$ for eight lobbying situations.

I could repeat the above procedure when (i) all the goods are gross complements; (ii) goods 1 and 3 are gross complements and the other two pairs of goods are gross substitutes; (iii) goods 2 and 3 are gross complements and the other two pairs of goods are gross substitutes. In each case, the value of $D_{i,\xi_j}(p^*)$ may take any sign. Thus in my theoretical analysis, I have covered both cases: when $D_{i,\xi_j}(p^*) > 0$ and when $D_{i,\xi_j}(p^*) < 0$, and derived the results for each case.

9. Conclusions

I have developed a model of inter-industry trade and multiple linkages yet incorporating traded and non-traded goods. I have shown how production and consumption linkages among industries affect the structure of protection of a traded good industry. Unlike in the previous two chapters, the effect of one industry on the protection of another does not depend only on consumption or production, it depends on the net effects of production cum consumption. For example, take the case of industry 1 and 2 which are related both through production and consumption. When industry 1 (2) is organized, the price of the product of industry 2 (1) may fall if their production effect is smaller than the consumption effects, that is, if the two goods are sufficiently complement in consumption to offset the positive effects of the production linkage.

Furthermore, I have shown how consumption interdependence of two traded goods with a non-traded good affects the structure of protection of traded good industries. Even if a traded good is a substitute (complement) with a non-traded good, the lobbying efforts of a non-traded industry does not necessarily raise (lower) the price of the traded good. The final result depends on how all industries are related in production and consumption.

My model has been able to capture the behavior of some of the industries which have a long and interesting history of protection in the United States. I have explained how wheat farmers were able to obtain protection under the export enhancement program. I have demonstrated in the present lobbying situation, how the sugar industry and sugar-using industries in the United States might be protected by an import tariff or export subsidy.

In my model, even if an industry is organized, it may face an import subsidy or export tax and may obtain protection even if it is not organized. In the complex interdependence of many industries, it is rather naïve to conclude that every organized industry is protected and every unorganized one is taxed as is the case with all models in the endogenous trade literature. In the world of multiple linkages, in some cases, one industry may lobby just to cancel the negative effects of rival industries, whereas in other cases, one may gain from the lobbying efforts of others. My model has been able to identify these various linkages and integrate them in a comprehensive system to study the pattern of trade protection. I have found that the protection of an industry depends on not only whether it is organized or not, but also on the pattern of trade, the level of net output of an industry available for final consumption, and the nature of interdependence with other industries.

Finally, by solving the game numerically, I have shown that the cross price effect of excess demand function, might be negative if a pair or a pairs of goods are gross complements in consumption.

APPENDIX E

THE SIGNS OF CROSS PRICE EFFECTS OF EXCESS DEMAND FUNCTIONS OF TRADED GOODS

IN CASE OF THREE CONSUMPTION GOODS

Recall that in Section 2.2 of Chapter 2, I have derived the demand for final consumption goods by maximizing a quasi-linear utility function under the budget constraint. In the present context of three final consumption goods, the sub-utility function u takes the following form:

$$u(\bar{z}_1, \bar{z}_2, \bar{z}_3) = \sum_{i=1}^3 \alpha_i \bar{z}_i - \frac{1}{2} \sum_{i,j=1}^3 \beta_{ij} \bar{z}_i \bar{z}_j$$

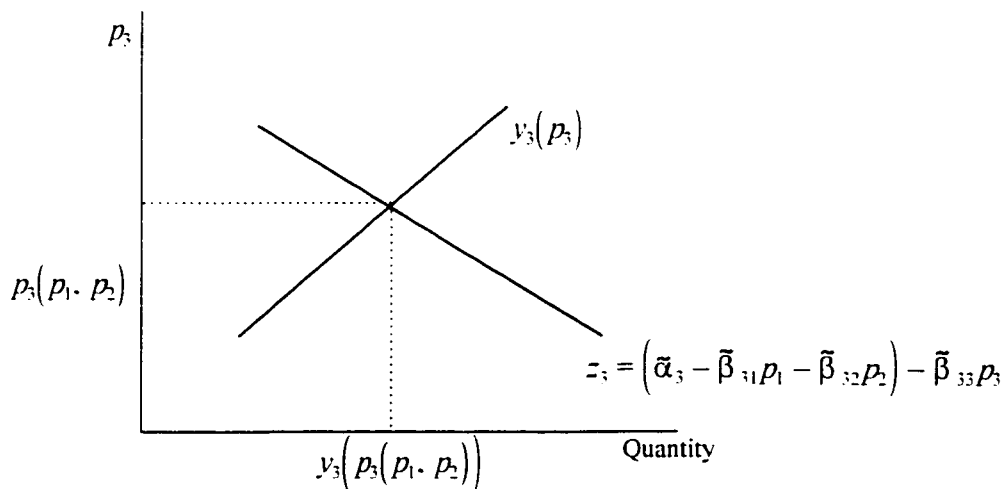
where $\beta = (\beta_{ij})_{i,j=1,2,3}$ is a positive definite matrix.

Let $\tilde{\beta} = (\tilde{\beta}_{ij})_{i,j=1,2,3}$ be the inverse of β . Then the demand for the final consumption goods is given by

$$\bar{z}_j = \tilde{\alpha}_j - \sum_{i=1}^3 \tilde{\beta}_{ij} p_i, \quad j = 1, 2, 3.$$

where $\tilde{\alpha}_j = \sum_{i=1}^3 \tilde{\beta}_{ij} \alpha_i$.

Let $p = (p_1, p_2)$ be the trade policy implemented by the government. Then the equilibrium



price of the non-traded final consumption good under the trade policy p is determined by the following market-clearing condition:

$$y_3(p_3) = \bar{\alpha}_3 - \bar{\beta}_{31}p_1 - \bar{\beta}_{32}p_2 - \bar{\beta}_{33}p_3.$$

Thus given $p = (p_1, p_2)$, the demand for the final consumption goods by the representative consumer is determined by the following four equations:

$$(E1) \quad z_1 = \bar{\alpha}_1 - \bar{\beta}_{11}p_1 - \bar{\beta}_{12}p_2 - \bar{\beta}_{13}p_3.$$

$$(E2) \quad z_2 = \bar{\alpha}_2 - \bar{\beta}_{21}p_1 - \bar{\beta}_{22}p_2 - \bar{\beta}_{23}p_3.$$

$$(E3) \quad z_3 = \bar{\alpha}_3 - \bar{\beta}_{31}p_1 - \bar{\beta}_{32}p_2 - \bar{\beta}_{33}p_3.$$

$$(E4) \quad y_3(p_3) = \bar{\alpha}_3 - \bar{\beta}_{31}p_1 - \bar{\beta}_{32}p_2 - \bar{\beta}_{33}p_3.$$

Observe that when (p_1, p_2) is given, equation (E4) can be used to determine p_3 . Once p_3 is found, equations (E1), (E2) and (E3) can then be used to determine the demand for goods 1, 2, and 3, respectively, by the representative consumer.

Let us now carry out a comparative exercise for the demand for the final consumption goods by the representative consumer when the government changes the price of good 1. It follows from equation (E4) that

$$y_3'(p_3)dp_3 = -\bar{\beta}_{31}dp_1 - \bar{\beta}_{33}dp_3, \text{ i.e.,}$$

$$(E5) \quad dp_3 = -\frac{\bar{\beta}_{31}dp_1}{\bar{\beta}_{33} + y_3'(p_3)}.$$

The variation of the demand for good 1 by the representative consumer can be found by using (E1) and (E5):

$$(E6) \quad dz_1 = -\bar{\beta}_{11}dp_1 - \bar{\beta}_{13}dp_3 = \left(-\bar{\beta}_{11} + \frac{\bar{\beta}_{13}^2}{\bar{\beta}_{33} + y_3'(p_3(p_1, p_2))} \right) dp_1.$$

Now in (E6), if $\tilde{\beta}_{13} > 0$, then an increase in p_3 , ceteris paribus, reduces the representative consumer's demand for good 1, i.e., good 1 and good 3 are gross complements in consumption. On the other hand, if $\tilde{\beta}_{13} < 0$, then an increase in the price of good 3, ceteris paribus, will increase the representative consumer's demand for good 1, i.e., goods 1 and 3 are gross substitutes in consumption. The coefficient $\tilde{\beta}_{13}$ thus represents the horizontal linkage between goods 1 and 3 in consumption.

In deriving the second equality in (E6), I have also used the fact that $\tilde{\beta}$ is symmetric, i.e., $\tilde{\beta}_{ij} = \tilde{\beta}_{ji}$. Now because $\tilde{\beta}$ is positive definite, $\tilde{\beta}_{jj} > 0$, $j = 1, 2, 3$. Furthermore, because the supply curve of good 3 is upward-sloping, I must have $y_3'(p_3(p_1, p_2)) > 0$. Thus $\tilde{\beta}_{33} + y_3'(p_3(p_1, p_2)) > 0$. I can rewrite (E6) in the following way:

$$(E6') \quad dz_1 = \left(\frac{-\tilde{\beta}_{11}\tilde{\beta}_{33} - \tilde{\beta}_{11}y_3'(p_3(p_1, p_2)) + \tilde{\beta}_{13}^2}{\tilde{\beta}_{33} + y_3'(p_3(p_1, p_2))} \right) dp_1.$$

Intuitively, I expect that $|\tilde{\beta}_{13}|$ is smaller than both of $\tilde{\beta}_{11}$ and $\tilde{\beta}_{33}$, i.e., the own-price effect dominates the cross-price effect and this is what I will assume. With this assumption, I have $-\tilde{\beta}_{11}\tilde{\beta}_{33} + \tilde{\beta}_{13}^2 < 0$. Hence, the coefficient of dp_1 is negative.

Using (E5) in (E2), I can express the variation of the representative consumer's demand for good 2 as follows:

$$(E7) \quad dz_2 = \left(\frac{-\tilde{\beta}_{21}\tilde{\beta}_{33} - \tilde{\beta}_{21}y_3'(p_3(p_1, p_2)) + \tilde{\beta}_{21}\tilde{\beta}_{23}}{\tilde{\beta}_{33} + y_3'(p_3(p_1, p_2))} \right) dp_1.$$

The sign of the coefficient of dp_1 in (E7) depends on the nature of the horizontal linkages between each pair of the three goods 1, 2, and 3 in consumption. For example, if all those goods are gross substitutes in consumption, then $\tilde{\beta}_{21} < 0$, $\tilde{\beta}_{31} < 0$, $\tilde{\beta}_{23} < 0$. In this case, the coefficient of dp_1 is positive, i.e., an increase in the price of good 1 will result in an increase in the representative consumer's demand for good 2 after the market for the non-traded final consumption good has adjusted. However, if all the three goods are gross complements of each other, then $\tilde{\beta}_{21} > 0$, $\tilde{\beta}_{31} > 0$, $\tilde{\beta}_{23} > 0$ and the sign of the coefficient of dp_1 becomes ambiguous. However, since I have assumed $|\tilde{\beta}_{31}|$ and $|\tilde{\beta}_{23}|$ smaller than $\tilde{\beta}_{21}$, if all three goods are gross complements, the sign of the coefficient of dp_1 will be unambiguously negative if the following condition is fulfilled.

$$\text{CONDITION 1: } |\tilde{\beta}_{21}| \geq \min \left\{ |\tilde{\beta}_{31}|, |\tilde{\beta}_{23}| \right\}.$$

The parameters $\tilde{\beta}_{21}$, $\tilde{\beta}_{31}$, and $\tilde{\beta}_{23}$ represent the horizontal linkages among the three consumption goods 1, 2, and 3. Condition 1 stipulates that $\tilde{\beta}_{21}$, the linkage between the two traded goods, is not strictly the weakest among the three linkages.

If Condition 1 is satisfied, I have $dz_2/dp_1 < 0$ in (E7). Of course, Condition 1 is a sufficient (but not a necessarily) condition for the coefficient of dp_1 to be negative. However, if all goods are gross complements and Condition 1 is not satisfied, then the sign of dz_2/dp_1 is ambiguous.

In what follows, I will see what happens if some of the goods are gross substitutes and some of them are gross complements.

(i) Suppose goods 1 and 2 are gross complements, goods 1 and 3 are gross substitutes, and goods 2 and 3 are gross substitutes. In this case, in (E7) $-\tilde{\beta}_{21}\tilde{\beta}_{33} < 0$, $-\tilde{\beta}_{21}y'_3(p_3(p_1, p_2)) < 0$, and $\tilde{\beta}_{31}\tilde{\beta}_{23} > 0$. Now if Condition 1 is satisfied, then $dz_2/dp_1 < 0$. Without Condition 1, the sign is ambiguous.

(ii) If only goods 1 and 3 are gross complements, then $-\tilde{\beta}_{21}\tilde{\beta}_{33} > 0$, $-\tilde{\beta}_{21}y'_3(p_3(p_1, p_2)) > 0$ and $\tilde{\beta}_{31}\tilde{\beta}_{23} < 0$. If Condition 1 is satisfied then the coefficient of dp_1 is positive. Thus goods 1 and 2 will remain gross substitutes even after the market for good 3 adjusts.

(iii) Suppose that only goods 2 and 3 are gross substitutes. Like in case (ii), if Condition 1 is satisfied, I have the positive coefficient between quantity demanded of good 1 and the price of good 2. As in other cases, without Condition 1, I cannot sign the coefficient.

Similarly, the variations of the representative consumer's demand for goods 1 and 2 due to a change in the price of good 2 are given by

$$(E8) \quad dz_1 = \left(\frac{-\tilde{\beta}_{12}\tilde{\beta}_{33} - \tilde{\beta}_{12}y'_3(p_3(p_1, p_2)) + \tilde{\beta}_{32}\tilde{\beta}_{13}}{\tilde{\beta}_{33} + y'_3(p_3(p_1, p_2))} \right) dp_2.$$

$$(E9) \quad dz_2 = \left(\frac{-\tilde{\beta}_{22}\tilde{\beta}_{33} - \tilde{\beta}_{22}y'_3(p_3(p_1, p_2)) + \tilde{\beta}_{23}^2}{y'_3(p_3(p_1, p_2))} \right) dp_2.$$

Since I have assumed $-\tilde{\beta}_{22}\tilde{\beta}_{33} + \tilde{\beta}_{23}^2$ to be negative, the sign of the coefficient of dp_2 in (E9) is negative. As in the case of good 1, the sign of the coefficient of dp_2 in (E8) depends on the nature of the linkages between each possible pairs of the three goods in consumption. Since

$\tilde{\beta}$ is symmetric, i.e., $\tilde{\beta}_{ij} = \tilde{\beta}_{ji}$, the sign of the coefficient in (E8) depends on the same criteria used for the coefficient in (E7). I can summarize the results just discussed as follows:

LEMMA E1: (a) If any two of the three goods 1, 2, and 3 are gross substitutes, then

$$dz/dp_i > 0, i, j = 1, 2, i \neq j.$$

(b) If each pair among the three goods 1, 2, and 3 are gross complements, and if Condition 1 is satisfied, then $dz/dp_i < 0, i, j = 1, 2, i \neq j$.

(c) Suppose that Condition 1 holds. If (i) goods 1 and 2 are gross complements, (ii) goods 1 and 3 are gross substitutes, and (iii) goods 2 and 3 are gross substitutes, then $dz/dp_i < 0, i, j = 1, 2, i \neq j$.

(d) Suppose that Condition 1 holds. If (i) goods 1 and 3 are gross complements, (ii) goods 1 and 2 are gross substitutes, and (iii) goods 2 and 3 are gross substitutes, then $dz/dp_i > 0, i, j = 1, 2, i \neq j$.

(e) Suppose that Condition 1 holds. If (i) goods 2 and 3 are gross complements, (ii) goods 1 and 2 are gross substitutes, and (iii) goods 1 and 3 are gross substitutes, then $dz/dp_i > 0, i, j = 1, 2, i \neq j$.

Let us now determine the signs of the first partial derivatives of the excess demands for good 1 and good 2. I have

$$\bar{z}_1(p_1, p_2) = z_1(p_1, p_2, p_3(p_1, p_2)) - y_1(p_1, p_2).$$

Thus

$$D_1 \bar{z}_1(p_1, p_2) = D_1 z_1(p_1, p_2, p_3(p_1, p_2)) + D_3 z_1(p_1, p_2, p_3(p_1, p_2)) D_1 p_3(p_1, p_2) - D_1 y_1(p_1, p_2).$$

Using (E6'), I can rewrite the preceding expression as

$$(E10) \quad D_1 \xi_1(p_1, p_2) = \frac{-\tilde{\beta}_{11} \tilde{\beta}_{33} - \tilde{\beta}_{11} y_3'(p_3(p_1, p_2)) + \tilde{\beta}_{13}^2}{\tilde{\beta}_{33} + y_3'(p_3(p_1, p_2))} - D_1 y_1(p_1, p_2).$$

Recall that I have assumed $|\tilde{\beta}_{13}|$ is smaller than $\tilde{\beta}_{11}$ and $\tilde{\beta}_{33}$. This assumption ensures that $D_1 \xi_1(p_1, p_2) < 0$, i.e., the excess demand for good 1 is decreasing in its own price. Similarly, the excess demand for good 2 is

$$\xi_2(p_1, p_2) = z_2(p_1, p_2, p_3(p_1, p_2)) + x_{12}(p_1, p_2) - y_2(p_1, p_2).$$

Hence

$$(E11) \quad \begin{aligned} D_1 \xi_2(p_1, p_2) &= D_1 z_2(p_1, p_2, p_3(p_1, p_2)) + D_1 z_2(p_1, p_2, p_3(p_1, p_2)) D_1 p_3(p_1, p_2) \\ &\quad + D_1 x_{12}(p_1, p_2) - D_1 y_2(p_1, p_2) \\ &= \left[\frac{-\tilde{\beta}_{21} \tilde{\beta}_{33} - \tilde{\beta}_{21} y_3'(p_3(p_1, p_2)) + \tilde{\beta}_{31} \tilde{\beta}_{23}}{\tilde{\beta}_{33} + y_3'(p_3(p_1, p_2))} \right] + D_1 x_{12}(p_1, p_2). \end{aligned}$$

In (E11), the second equality is obtained by using (E7) and the fact that the supply of good 2 depends only on its own price, not the price of good 1. To determine the sign of $D_1 \xi_2(p_1, p_2)$, first note that $D_1 x_{12}(p_1, p_2) > 0$ because industry 1 uses more of good 2 as intermediate input when p_1 , the price of its product, goes up. The sign of $D_1 \xi_2(p_1, p_2)$ thus depends on how the three goods are related in consumption.

From (E11), I have

$$(E12) \quad D_1 \xi_2(p_1, p_2) = \frac{D_1 x_{12}(p_1, p_2) - \tilde{\beta}_{21} \left| \tilde{\beta}_{33} + y_3'(p_3(p_1, p_2)) \right| + \tilde{\beta}_{31} \tilde{\beta}_{23}}{\tilde{\beta}_{33} + y_3'(p_3(p_1, p_2))}.$$

Since the denominator on the right hand side of expression (E12) is positive, the sign of the expression on the left hand side depends on the sign of the expression of the numerator on the right hand side. For $D_1\bar{\xi}_2(p_1, p_2)$ to be positive, the following condition must be satisfied:

$$\text{CONDITION 2: } \left| D_1x_{12}(p_1, p_2) - \bar{\beta}_{21} \right| > - \frac{\bar{\beta}_{31}\bar{\beta}_{23}}{\bar{\beta}_{33} + y_3'(p_3(p_1, p_2))}$$

If all goods are gross substitutes, the left side of Condition 2 is positive whereas the right side is negative. Therefore, Condition 2 is always satisfied, hence $D_1\bar{\xi}_2(p_1, p_2) > 0$. If all goods are gross complements, the left side of Condition 2 may take any sign whereas the right hand side will be negative. I have the same situation, if goods 1 and 2 are gross complements and the other two pairs of goods are gross substitutes. If goods 1 and 3 are gross complements, and the other two pairs of goods are gross substitutes, then both sides of Condition 2 take positive signs. The same result emerges if goods 2 and 3 are gross complements and the other two pairs are gross substitutes.

To continue, I next study the variations in the excess demand for good 1 and good 2 when p_2 changes. I have

$$\begin{aligned} (E13) \quad D_2\bar{\xi}_1(p_1, p_2) &= D_2z_1(p_1, p_2, p_3(p_1, p_2)) + D_3z_1(p_1, p_2, p_3(p_1, p_2))D_2p_3(p_1, p_2) \\ &\quad - D_1y_2(p_1, p_2) \\ &= \frac{-\bar{\beta}_{12}\bar{\beta}_{33} - \bar{\beta}_{12}y_3'(p_3(p_1, p_2)) + \bar{\beta}_{13}\bar{\beta}_{23}}{\bar{\beta}_{33} + y_3'(p_3(p_1, p_2))} - D_2y_1(p_1, p_2). \end{aligned}$$

Now because $y_1(p_1, p_2)$, the supply of good 1, is decreasing in p_2 , the price of the intermediate input, I have $D_2y_1(p_1, p_2) < 0$. Moreover, since $D_1\bar{\xi}_2(p_1, p_2) = D_2\bar{\xi}_1(p_1, p_2)$, the same argument

used to determine the sign of $D_{1\xi_2}(p_1, p_2)$ can be used to determine the sign of $D_{2\xi_1}(p_1, p_2)$. I summarize the results just discussed in the following lemma.

LEMMA E2: (a) *If goods 1, 2, and 3 are gross substitutes of each other in consumption, then*

$$D_{i\xi_j}(p_1, p_2) > 0, i, j = 1, 2, i \neq j.$$

(b) *If Condition 2 holds then $D_{i\xi_j}(p_1, p_2) > 0, i, j = 1, 2, i \neq j$. Otherwise,*

$$D_{i\xi_j}(p_1, p_2) < 0, i, j = 1, 2, i \neq j.$$

Conditions 1 and 2 are related. From (E11), it is obvious that if Condition 1 holds and all pair of goods are gross complements, then $D_{i\xi_j}(p_1, p_2), i, j = 1, 2, i \neq j$ may take any sign. Similarly, if Condition 1 holds and goods 1 and 2 are gross complements and the other pairs of goods are gross substitutes, then again $D_{i\xi_j}(p_1, p_2), i, j = 1, 2, i \neq j$ may take any sign. However, if goods 1 and 3 are gross complements and the other pairs of goods are gross substitutes, then $D_{i\xi_j}(p_1, p_2), i, j = 1, 2, i \neq j$ is positive. Moreover, if goods 2 and 3 are gross complements and the other two pairs of goods are gross substitutes, then $D_{i\xi_j}(p_1, p_2), i, j = 1, 2, i \neq j$ is positive.

If Condition 1 does not hold, then $D_{i\xi_j}(p_1, p_2), i, j = 1, 2, i \neq j$ may take any sign whichever pair of goods are gross complements.

APPENDIX F

THE DERIVATION OF PROPOSITION 3.3

In (18), $A_{1,03} > 0$ in all the cases whatever the nature of interdependence among goods. If goods 1, 2, and 3 are gross substitutes of each other, then $D_1\xi_2(p) > 0$, $D_2\xi_1(p) > 0$, $D_1p_3(p) > 0$, $D_2p_3(p) > 0$ and hence $B_{1,03} > 0$. In this case, the whole expression in (18) becomes positive.

Now, if all goods are gross complements, $D_1p_3(p) < 0$, $D_2p_3(p) < 0$. In this case, $B_{1,03} < 0$ if $D_1\xi_2(p) > 0$. However, if $D_1\xi_2(p) < 0$, then $B_{1,03}$ may take any sign.

If only goods 1 and 2 are gross complements and the other two pairs of goods are gross substitutes, I have $D_1p_3(p) > 0$, $D_2p_3(p) > 0$. In this case, $B_{1,03} > 0$ if $D_1\xi_2(p) > 0$. If $D_1\xi_2(p) < 0$, then $B_{1,03}$ may take any sign.

Let goods 1 and 3 be gross complements and the other two pairs of goods be gross substitutes. Then $D_1p_3(p) < 0$, $D_2p_3(p) > 0$. In this case, $B_{1,03} < 0$ if $D_1\xi_2(p) < 0$. However, if $D_1\xi_2(p) > 0$, then $B_{1,03}$ may take any sign.

If goods 2 and 3 are gross complements and the other remaining two pairs are gross substitutes, then $D_1p_3(p) > 0$, $D_2p_3(p) < 0$. In this case, $B_{1,03} > 0$ if $D_1\xi_2(p) < 0$. However, if $D_1\xi_2(p) > 0$, the sign of $B_{1,03}$ is ambiguous.

Next, let us analyze equation (19). If all goods are gross substitutes, then $A_{2,03} > 0$ and $B_{2,03} > 0$.

If all goods are gross complements and $D_2\xi_1(p) > 0$, then $A_{2,03} > 0$ and $B_{2,03} < 0$. However, if all goods are gross complements and $D_2\xi_1(p) < 0$, $A_{2,03} < 0$. But the sign of $B_{2,03}$ is ambiguous.

Let goods 1 and 2 be gross complements and the other two pairs of goods be gross substitutes. If $D_{2,\xi_1}(p) > 0$, I have $A_{2,03} > 0$ and $B_{2,03} > 0$. On the other hand, if $D_{2,\xi_1}(p) < 0$, $A_{2,03} < 0$ and $B_{2,03}$ may take any sign.

If goods 1 and 3 are gross complements and the other two pairs of goods are gross substitutes, then if $D_{2,\xi_1}(p) < 0$, I have $A_{2,03} < 0$ and $B_{2,03} < 0$. However, if $D_{2,\xi_1}(p) > 0$, then $A_{2,03} > 0$ and the sign of $B_{2,03}$ cannot be determined.

If goods 2 and 3 are gross complements and the other two pairs are gross substitutes, then if $D_{2,\xi_1}(p) < 0$, I have $A_{2,03} < 0$ and $B_{2,03} > 0$. If $D_{2,\xi_1}(p) > 0$, then $A_{2,03} > 0$ and the sign of $B_{2,03}$ is ambiguous.

Form the above discussion, for any $j = 1, 2$, it can be summarized that

If all goods are gross substitutes, $|A_{1,03}| \times |B_{1,03}| > 0$ and $|A_{2,03}| \times |B_{2,03}| > 0$.

If all goods are gross complements, then

(i) if $D_{j,\xi_1}(p) > 0$, then $|A_{1,03}| \times |B_{1,03}| < 0$ and $|A_{2,03}| \times |B_{2,03}| < 0$;

(ii) if $D_{j,\xi_1}(p) < 0$, the sign of $|A_{1,03}| \times |B_{1,03}|, j = 1, 2$, is ambiguous.

If goods 1 and 2 are gross complements and the other two pairs of goods are gross substitutes, then

(i) if $D_{j,\xi_1}(p) > 0$, $|A_{1,03}| \times |B_{1,03}| > 0$ and $|A_{2,03}| \times |B_{2,03}| > 0$;

(ii) if $D_{j,\xi_1}(p) < 0$, the sign of $|A_{1,03}| \times |B_{1,03}|, j = 1, 2$, is ambiguous.

If goods 1 and 3 are gross complements, and goods 1 and 2 and goods 2 and 3 are gross substitutes, then

(i) if $D_{j,\xi_1}(p) < 0$, $|A_{1,03}| \times |B_{1,03}| < 0$ and $|A_{2,03}| \times |B_{2,03}| > 0$;

(ii) if $D_i \xi_j(p) > 0$, then the sign of $|A_{i,0j}| \times |B_{i,0j}|$, $j = 1, 2$, is ambiguous.

If goods 2 and 3 are gross complements, and the other remaining two pairs of goods are gross substitutes, then

(i) if $D_i \xi_j(p) < 0$, $|A_{1,03}| \times |B_{1,03}| > 0$ and $|A_{2,03}| \times |B_{2,03}| < 0$:

(ii) if $D_i \xi_j(p) > 0$, then the sign of $|A_{i,0j}| \times |B_{i,0j}|$, $j = 1, 2$, is ambiguous.

SUMMARY AND DIRECTIONS TO FUTURE RESEARCH

In the thesis, I have extensively studied the effects of linkages among industries on their structure of protection in a small open economy. I have derived trade policies endogenously for vertically related industries, horizontally related industries, and for industries which have multiple linkages both through production and consumption. I have also incorporated a non-traded good to study the protection of traded-good industries.

Besides generating some theoretical results, I have also solved the game of endogenous trade policy numerically and computed the Pareto efficient frontier. The frontier may be a single point or a line segment. If the frontier is a single point, I have a unique truthful Nash equilibrium, whereas if it is a line segment, I have a continuum of truthful Nash equilibria.

In my models, if the government does not accept any contribution from any lobby group and hence maximizes a standard social welfare function, the optimal policy is free trade. Therefore, the level of payoff that government receives under free trade sets the participation constraint for the government. If by accepting the contribution from a lobby group the payoff of the government falls below its free-trade level, the participation constraint is binding, and the government is better off by not accepting the contribution from that lobby group.

I have found that with only one lobby in the economy, all of the surplus generated through lobbying activities is extracted by the single lobby. In this case, social welfare *plus* the contribution from the single lobby add up exactly to what the government would have

received had there been no lobby group. That is, the payoff of the government would remain at the free-trade level. With two lobbies, the government may be able to obtain part of the surplus, i.e., the payoff of the government may rise above the free-trade level. It could happen only if the Pareto efficient frontier is a point and hence there is a unique truthful Nash equilibrium. However, if the Pareto frontier is a line segment, i.e., if there exist a continuum of truthful Nash equilibria, all of the surplus will be extracted by the two lobbies.

With three lobbies, the government may always receive more than what it obtains under free trade, that is, government may receive part of the surplus generated by lobbying activities. Therefore, the conjecture is that the government's payoff is non-decreasing in the number of lobbies. Thus there is a potential area for research to study whether an agent's payoff is non-decreasing in number of principals in a common-agency problem.

In the thesis, I have taken the lobbying decision as exogenous. There is a potential area for research to endogenize the lobbying decisions.

I have considered lobbying for tariff making only and derived the contributions endogenously. This model could potentially be extended to study the problems of revenue seeking (the downstream lobbying) along with tariff making (upstream lobbying).

Throughout my analysis, I have assumed that all industries are perfectly competitive so that in the third stage of the game there is no strategic decision to be taken by consumers and producers. Once the trade policy has been decided, at the third stage, the producers and consumers behave as atoms in the system. The framework of this thesis could be used to study the endogenous level of trade protection when the market structure is imperfect. The model could also be extended to include several governments. In such a set up, one would be

able to analyze the direct interaction and retaliation between two governments who accept contributions from their respective domestic lobbies.

Finally, I have used the quasi-linear (transfer) utility function to study the endogenous protection of industries. An alternative research strategy would be to consider a non-transferable utility to capture the income effect on trade policy determination.

REFERENCES

- Austen-Smith, D.** "Rational Consumers and Irrational Voters." *Economics and Politics*, 1991, 3, pp. 73-92.
- Bernheim, B. Douglas and Whinston, Michael D.** "Menu Auctions, Resource Allocation, and Economic Influence." *Quarterly Journal of Economics*, February 1986, 101(1), pp. 1-31.
- Dixit, Avinash.** *The making of Economic Policy: A Transaction-Cost Politics Perspective*. Munich Lecture in Economics. Cambridge, MA: MIT Press, 1996.
- Feenstra, Robert C. and Bhagwati, Jagdish N.** "Tariff Seeking and the Efficient Tariff." in Jagdish N. Bhagwati, ed., *Import Competition and Response*. Chicago: University of Chicago Press, 1982, pp. 245-258.
- Findlay, Ronald and Wellisz, Stanislaw.** "Endogenous Tariffs, the Political Economy of Trade Restrictions, and Welfare." in Jagdish Bhagwati, ed., *Import Competition and Response*. Chicago: University of Chicago Press, 1982, pp. 223-238
- Fredriksson, Per G.** "The Political Economy of Pollution Taxes in a Small Open Economy." *Journal of Environment Economics and Management*, 1997, 33, pp. 44-58.
- Gardner, Bruce.** "The Political Economy of U.S. Export Subsidies for Wheat." in Anne O. Krueger, ed., *The Political Economy of American Trade Policy*. A NBER Project Report. Chicago: University of Chicago Press, 1996, pp. 291-331.
- Grossman Gene M. and Helpman, Elhanan.** "Protection for Sale." *American Economic Review*, September 1994, 84(4), pp. 833-50.
- _____. "Trade War and Trade Talks." *Journal of Political Economy*, August 1995, 103(4), pp. 675-708.
- Hillman, Arye L.** "Declining Industries and Political-Support Protectionist Motives." *American Economic Review*, December 1982, 72(5), pp. 1180-1187.
- Irwin, Douglas A.** "Trade Politics and Semiconductor Industry." in Anne O. Krueger, ed., *The Political Economy of American Trade Policy*. A NBER Project Report. Chicago: University of Chicago Press, 1996, pp. 11-66.
- Krueger, Anne O.** "The Political Economy of Controls: American Sugar." in Maurice Scott and Deepak Lal eds., *Public Policy and Economic Development: Essays in Honor of Ian Little*. New York: Oxford University Press, 1990, pp. 170-216.

- _____. "Conclusions." in Anne O. Krueger, ed., *The Political Economy of American Trade Policy*. A NBER Project Report. Chicago: University of Chicago Press. 1996. pp. 423-43.
- Lane, William C.** "Comment on The Waning Influence of Big Steel?." in Anne O. Krueger, ed., *The Political Economy of American Trade Policy*. A NBER Project Report. Chicago: University of Chicago Press. 1996. pp. 125-27.
- Long, Ngo Van and Vousden, Neil.** "Protectionist Responses and Declining Industries." *Journal of International Economics*, February 1991. 30(1-2). pp. 87-103.
- Magee, Stephen P.; Brock, William A. and Young, Leslie.** *Black Hole Tariffs and Endogenous Policy Theory: Political Economy in General Equilibrium*. Cambridge NY: Cambridge University Press. 1989.
- Mayer, Wolfgang.** "Endogenous Tariff Protection." *American Economic Review*, December 1984. 74(5). pp. 970-985.
- Mayer, Wolfgang. and Li, J.** "Interest Groups, Electoral Competition, and Probabilistic Voting for Trade Policies." *Economics and Politics*, 1994, 6, pp. 59-77.
- Moore, Michael O.** "Steel Protection in the 1980s: The Waning Influence of Big Steel." in Anne O. Krueger, ed., *The Political Economy of American Trade Policy*. A NBER Project Report. Chicago: University of Chicago Press. 1996. pp. 73-125.
- Olson, Mancur.** *The Logic of Collective Action*. Cambridge, MA: Harvard University Press. 1965.
- Orden, David.** "Agricultural Interest Groups and the North American Free Trade Agreement." in Anne O. Krueger, ed., *The Political Economy of American Trade Policy*. A NBER Project Report. Chicago: University of Chicago Press. 1996. pp. 335-82.
- Rodrik, Dani.** "Political Economy of Trade Policy." in Gene M Grossman and Kenneth Rogoff, eds., *Handbook of International Economics Vol. III*. Amsterdam: North Holland Press. 1995. pp. 1457-1494.
- Stigler, George J.** "The Theory of Economic Regulation." *Bell Journal of Economics and Management Science*. 1971. 1. pp. 1-21.