A Game Theoretic Analysis of Turkish Accession to a European Customs Union

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The entrance of additional countries into a European customs union, in this case Turkey, and its impact on agriculture are examined. Results from a trade simulation model are used as components of a Political Preference Function and utilized within a game theoretic framework to identify the optimal strategies for Turkey, the EU, and the U.S. Turkey's best interest, from an agricultural perspective, involves adoption of agreements made in the Uruguay round of GATT as a developing country rather than applying EU protection. Although free trade is not the optimal solution, simulations indicate that the solution does involve the reduction of agricultural protection levels.

Turkey's quest for membership in the European Union (EU) has a long history. Turkey applied for membership in the European Community (EC) in 1959. The resulting negotiations led to the Ankara Agreement, creating an association between Turkey and the EC. The aim of this agreement was to promote continuous commercial and economic relations between the two economies. To achieve this objective, the agreement established three stages: the preparatory stage; the transitional stage; and the final stage. The first stage began in 1964 and ended in 1969. This stage included the provision of concessions from the EC to Turkey. The second stage began in 1970 and covered a 12-year transitional period, during which reciprocal concessions were made. Although the final stage was planned to start in 1995 the outcome of this process is not yet certain (GATT 1994).

While the political and economic conditions necessary for Turkey's accession have not yet been satisfied, the Luxembourg summit reaffirmed Turkey's eligibility to join the EU on the same basis as the other applicant states (Eurecom 1998). To this end, the European Council has specified three areas it considers necessary for Turkish admittance to the Union: 1) intensification of the EU—Turkey Customs Union; 2) implementation of financial cooperation; and 3) approximation of Turkish laws toward the EU laws (Eurecom 1998). The EU—Turkey Customs Union, which came into effect in January of 1996, guarantees the free circulation of industrial goods and processed agricultural products. Although agricultural products are excluded from the treaty, Turkey is progressively adopting many aspects of the Common Agricultural Policy (Republic of Turkey 1996). The future inclusion of agriculture would increase the intensity of the EU—Turkey Customs Union and contribute toward Turkey's meeting the necessary conditions for EU admittance.

International agricultural trade negotiations, such as those between the EU and Turkey, reflect the linkages between domestic farm policies and agricultural protection. The recent agricultural negotiations conducted within the Uruguay round of GATT highlighted several interdependencies between the EU and the United States. As Turkey and various other countries lobby to form agreements with the EU, the potential trade effects will influence the decisions of European and U.S. policy makers alike. EU officials must account for increased production possibilities, shifts in consumer demand and preferences, and the potential interest group coalitions that will result from Turkish accession. U.S. policy makers must consider these changes in EU preferences and market power as they deal with and react to their European counterparts.

Scenarios of this type are examples of the problems that exist in analyzing agricultural trade negotiations as the result of agricultural trade policy

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interdependence (Kennedy et al. 1996). Countries considering the ratification of both bilateral and multilateral trade agreements must consider the results of their choices with respect to the policies of other countries. In addition, countries weighing the prospects of regional trade agreements must consider the reaction of cooperating countries and the rest-of-the-world as they negotiate with prospective partners.

The impact of these interrelationships between countries raises questions as to how agricultural policies are formulated given the reactions of other countries. Policy makers often have some knowledge as to the response their new policies will induce among other nations. Rational countries will formulate agricultural policy based on the expected reactions of other relevant countries. As a result, game theory can provide a useful framework for analyzing agricultural policy decisions given the interdependence of agricultural policy.

In an interdependent world, agricultural policies affect both domestic and international markets. As a result, it is beneficial to know both the desired goal and potential consequences of various agricultural policies. The objective of the research presented here is to examine the effects of liberalized trade combined with Turkish accession to a European Customs Union. Particular emphasis is placed on the impact of these policy changes on trade in agricultural products. The empirical analysis will involve ten agricultural products that each play a significant role in the European Union, Turkey, and the United States in terms of production or consumption: beef and veal, dairy milk, corn, wheat, rice, soybeans, cotton, sugar, tobacco, and pork and poultry.

To accomplish these objectives, this study employs a partial equilibrium trade simulation model, Modele International Simplifie de Simulation (MISS) (Mahé et al. 1988). MISS is a partial equilibrium trade model that simulates, in a comparative static framework, the effects of various policy decisions. Once the model is initialized, simulations are conducted that mirror the effects of the Uruguay Round agricultural agreement. To mirror the policy decisions of the respective governments, consumer, producer, and government budget weights, as components of a Political Preference Function (PPF), are estimated. These weights, when combined with the net gains or losses to producers, consumers, and government, reflect the net gains or losses to the economies as perceived by policymakers. The PPFs resulting from the various scenarios are then evaluated in a game theoretic framework to determine the Nash equilibrium solution to the specified game.

Theoretical Framework

The foundation of this analysis is based on the model developed by Mahé et al. (1988) with subsequent modifications made by Johnson et al. (1993) and Kennedy et al. (1996). In the model, N commodities are produced, consumed, and traded by K main countries and a politically passive rest-of-the-world. Vectors of supply, demand, and excess demand are used to describe the levels of aggregate production, consumption and trade for each country. The supply sector in country k produces some combination of the N commodities in order to maximize profits given prices, technology and endowments. Aggregate production of the N commodities is described by the vector of supply functions, $S_k\ (P_{Sk};\ X_{Sk})$, where P_{Sk} is the vector of prices observed by the supply sector and X_{Sk} is a vector of exogenous variables, such as technology, input prices, and endowments for the supply sector of country k. Aggregate consumption of the N commodities is described by the vector of demand functions $Q_k\ (P_{Qk};\ X_{Qk})$, where P_{Qk} is the vector of prices observed by the final demand sector and X_{Qk} is a vector of exogenous variables for country k. The aggregate level of trade in the N commodities for country k is described by the vector of excess demand functions $M_k\ (P_{Sk},\ P_{Qk};\ X_{Sk},\ X_{Qk})$ where $M_{ki} > 0$ indicates net imports and $M_{ki} < 0$ indicates net exports of commodity i for i = 1, 2, . . . , N.

Governments intervene in domestic markets through either the use of price (π) or supply/demand shift (σ) instruments. Price instruments, denoted as A^{π}_{Ski} for producers and A^{π}_{Qki} for consumers in country k of commodity i, affect the prices observed by the supply and final demand sectors. With the world price of commodity i represented as P_{Wi} the domestic price functions for country k are:

$$(1) \qquad P_{Ski} = P_{Ski}\ (A^{\pi}_{Ski},\ P_{Wi}) \text{ and } P_{Qki} = P_{Qki}\ (A^{\pi}_{Qki},\ P_{Wi}), \text{ for } i = 1, 2, \ldots, N.$$

Supply/demand shift instruments, shown as A^{σ}_{Ski} and A^{σ}_{Qki} for producers and consumers, respectively, of commodity i in country k, are implicit elements of vectors X_{Sk} and X_{Qk} which shift supply and demand functions by modifying nonprice elements of the producers' or consumers' decision process. Supply/demand shift instruments include policies such as area reduction programs, subsidization schemes, and food stamp/giveaway pro-

grams. In order to make these instruments explicit the vectors X_{Sk} and X_{Qk} are defined as follows,

$$(2) \qquad X_{Sk} = X_{Sk}\,(A^{\sigma}_{Ski};\, X^{o}_{Sk}) \text{ and } X_{Qk} = X_{Qk}\,(A^{\sigma}_{Qki};\, X^{o}_{Qk})$$

where X^{o}_{Sk} and X^{o}_{Qk} signify exogenous non-policy variables.

Through the substitution of the domestic price functions (1) and the function of explicit variables (2), the aggregate supply, demand and excess demand are expressed as functions of world price, policy instruments and exogenous variables in the terms,

$$(3) \qquad S_k\,[P_{Sk}\,(A^{\pi}_{Sk}, P_W), A^{\sigma}_{Sk};\, X^{o}_{Sk}],$$

$$(4) \qquad Q_k\,[P_{Qk}\,(A^{\pi}_{Qk}, P_W), A^{\sigma}_{Qk};\, X^{o}_{Qk}], \text{ and}$$

$$(5) \qquad M_k\,[P_{Sk}\,(A^{\pi}_{Sk}, P_W), P_{Qk}\,(A^{\pi}_{Qk}, P_W), A^{\sigma}_{Sk}, A^{\sigma}_{Qk};\, X^{o}_{Sk}, X^{o}_{Qk}]$$

where $P_{jk}\,(A^{\pi}_{jk}, P_W) = [P_{j1}\,(A^{\pi}_{j1}, P_W), P_{j2}\,(A^{\pi}_{j2}, P_W), \ldots, P_{jN}\,(A^{\pi}_{jN}, P_W)]$ for $j = S, Q$.

Let the main countries be denoted as countries 1, 2, . . . , K and the rest-of-the-world as country K + 1. The vector of excess demand functions for the rest-of-the-world is shown as $M_{K+1}\,(P_W;\, X_{K+1})$ where X_{K+1} is the vector of exogenous variables for the rest-of-the-world. Through the adjustment of world prices, world markets are assumed to clear, i.e., world markets are competitive. Therefore,

$$(6) \qquad \Sigma_k M_k\,[P_{Sk}\,(A^{\pi}_{Sk}, P_W), P_{Qk}\,(A^{\pi}_{Qk}, P_W), A^{\sigma}_{Sk}, A^{\sigma}_{Qk};\, X^{o}_{Sk}, X^{o}_{Qk}] + M_{K+1}\,(P_W;\, X_{K+1}) = 0,$$

where the right-hand side of the equation is an N × 1 vector of zeros. Letting the vector of country k's actions $(A^{\pi}_{Sk}, A^{\pi}_{Qk}, A^{\sigma}_{Sk}, A^{\sigma}_{Qk})$ be represented by A_k, world prices are expressed as functions of actions in the equation

$$(7) \qquad P_W = P_W\,((A_1;\, X^{o}_{S1}, X^{o}_{Q1}), (A_2;\, X^{o}_{S2}; X^{o}_{Q2}), \ldots, (A_K;\, X^{o}_{SK}, X^{o}_{QK}), X_{K+1}).$$

Throughout the process of agricultural policy formulation, the welfare effects of various actions are taken into account by the government. Policymakers behave as though they are using a weighing system to compare the gains and losses of various groups. The product of a weight and a money metric welfare measure (e.g., consumer and producer surplus) is assumed to reveal the relative influence of a group's ability to transfer policy support to itself. This concept is referred to as a Political Preference Function (PPF). The PPF used in this analysis is a weighted, additive function of money metric welfare measures for various societal groups. It is the objective function which, through their policy choices, policymakers behave as though they seek to maximize.

This concept is utilized by Gardner (1983 and 1991) in analyzing income redistribution in agriculture. In addition, agricultural economists have estimated PPFs in order to examine policy effects among various agricultural groups (Rausser and Freebairn 1986). The PPF is similar to the political support function used in the Stigler-Peltzman Regulatory Model discussed in Stigler (1971), Peltzman (1976), Hillman (1982), and Magee et al. (1989). It is assumed that competition among groups for political influence and the desire of the political process to appease these groups gives rise to an equilibrium where the gradients of the PPF with regard to policy instruments are zero. Based on this assumption, the weights are estimated empirically at the point where the gradients are zero for the observed level of policy instruments.

This approach presumes a two-level game, one of which has been completed prior to this analysis. The completed level is the non-cooperative game among groups for political influence which determines the PPF weights as parameters. In other words, the game where domestic groups pursue their interests by pressuring the government to adopt favorable policies, and politicians seek power by constructing coalitions among those groups, has been completed. A description of this first-level game can be found in Roe (1995). Effectively, given the weights, the second level of the game occurs where the desire of the policy to appease these groups causes them to behave as though they choose the level of policy instruments to maximize the PPF, conditional on the action of the other countries. This approach is similar to Putnam's (1988) description of trade negotiations as a two-level game.

The application of this method in this particular static analysis presumes a certain degree of independence between the two game levels, i.e., the selection of policy levels in stage two does not affect the weights determined in stage one. The true nature of this two-level game, however, is expected to be dynamic; the outcome of one stage serves as an input into the other. Despite this, the effect of the selection of policy instrument levels on coalition formation and the lobbying process is not instantaneous. As a result, the two-level game, as presented here, is appropriate in a static framework. However, it must be remembered that since political influence does change over time, this two-level game must allow for feedback from one level to the other if it is to be used in a dynamic framework.

In order to use this framework, a number of additional conditions must hold (Bullock 1994; von Cramon-Taubadel 1992), including knowledge of the welfare functions which map instruments to well being, that the observed strategies are Pareto optimal for the given weights, and that the set of feasible welfare outcomes be compact and convex over the domain of policy instruments. These conditions are assumed to hold. Finally, to estimate the PPF weights from observed policy choices, i.e., the outcome of the first level game, the number of policy instruments must equal the number of interest group preference weights so that the resulting matrix of First Order Conditions is of full rank (Bullock 1994). By construction, this is always possible since, in principle, groups can be defined in finer subgroups such that rank is always obtained. If estimation yields the same weight for any subgroups, they can then be aggregated into a larger subgroup.

Let $A_k = (A^{\pi}_{Sk}, A^{\pi}_{Qk}, A^{\sigma}_{Sk}, A^{\sigma}_{Qk})$ represent the actions of country k. A similar function, A_{k+}, exists for the other main countries (denoted by k+). Producers are grouped according to commodities with their welfare defined as the profit obtained through the production and marketing of that commodity. Assuming differentiability, the welfare of the group producing commodity i in country k is expressed as the line integral:

$$(8) \quad \Pi_{ik}(P_{Sk}; X_{Sk}) = \int_0^{Psi} S_k(P_{Sk}; X_{Sk})\, dP_{si},$$

where P_{si} is the domestic producer price of commodity i. The vector,

$$(9) \quad \Pi_k(P_{Sk}; X_{Sk})\,[\Pi_{1k}(P_{Sk}; X_{Sk}), \Pi_{2k}(P_{Sk}; X_{Sk}), \ldots, \Pi_{Nk}(P_{Sk}; X_{Sk})]$$

signifies quasi-rents over the N producer groups. In addition, the utility function is expressed as:

$$(10) \quad U_k(P_{Qk}; X_{Qk}) = \int_{Pqi}^{\infty} Q_k(P_{Qk}; X_{Qk})\, dP_{qi},$$

where P_{qi} is the domestic consumer price of commodity i.

In order to express producer quasi-rents (9) as a function of government policies, equation (1) is substituted for P_{Sk}, equation (2) is substituted for the expression variable X_{Sk}, equation (7) replaces the world price P_W, and non-policy exogenous factors $X^o = (X^o_{S1}, X^o_{S2}, \ldots, X^o_{SK}, X^o_{Q1}, X^o_{Q2}, \ldots, X^o_{QK}, X_{K+1})$ are suppressed, thus obtaining,

$$(11) \quad \Pi_k(A_k, A_{k+}) = \Pi_k\{P_{Sk}[A^{\pi}_{Sk}, P_W(A_k, A_{k+})], A^{\sigma}_{Sk}\}.$$

In the same manner, by substituting equations (1), (2) and (7) into equation (10) and suppressing X^o, consumer utility is expressed as a function of government policies, obtaining

$$(12) \quad U_k(A_k, A_{k+}) = U_k\{P_{Qk}[A^{\pi}_{Qk}, P_W(A_k, A_{k+})], A^{\sigma}_{Qk}\}.$$

In order to express the budget function let a transpose of an N × 1 vector be denoted by T. Producer receipts are $P_{Sk} \cdot S^T_k$, consumers spend $P_{Qk} \cdot Q^T_k$, and excess demand (supply) is purchased (sold) in the world market at price P_W for a total monetary value of $P_W \cdot M^T_k$. Using equations (3), (4) and (5) the budget is shown as:

$$(13) \quad B_k(P_{Sk}, P_{Qk}, P_W; X) = (P_{Qk} - P_W) \times Q^T_k(P_{Qk}; X_{Qk}) - (P_{Sk} - P_W) \times S^T_k(P_{Sk}; X_{Sk}).$$

Equation 13 allows government expenditures attributed to various policy scenarios to be computed. The difference in expenditures under alternative scenarios versus those in the status quo are used to determine the amount of budget savings available for compensation. Substituting in equation 13 for P_{Sk}, P_{Qk}, P_W, X_{Sk} and X_{Qk} and suppressing X^o as before, the budget of country k, as a function of government policies, is shown as:

$$(14) \quad B_k(A_k, A_{k+}) = B_k\{P_{Sk}[A^{\pi}_{Sk}, P_W(A_k, A_{k+})], P_{Qk}[A^{\pi}_{Qk}, P_W(A_k, A_{k+})], P_W(A_k, A_{k+}), A^{\sigma}_{Sk}, A^{\sigma}_{Qk}\}.$$

Having expressed producer quasi-rents, consumer utility and the budget as functions of government policies, the budget weight is normalized to one and the PPF, as a function of government, is shown as:

$$(15) \quad V_k(A_k m, A_{k+}) = \Pi_k(A_k, A_{k+}) \cdot \lambda_{Sk} + U_k(A_k, A_{k+}) \cdot \lambda_{Qk} + B_k(A_k, A_{k+})$$

where λ_{Sk} is a strictly positive N × 1 vector which represents the relative political weights of the producer groups in country k and λ_{Qk} is a strictly positive scalar representing the relative political weight of the consumer group in country k.

In modeling the policy decision process of interdependent countries, a Nash equilibrium occurs where each country chooses policy that maximizes its PPF given the policy choice of the other. This equilibrium is defined using a best response correspondence. For a given A_{k+}, government k chooses A^*_k, one possible best response to A_{k+}, such that

$$(16) \quad V_k(A^*_k, A_{k+}) \geq V_k(A_k, A_{k+}) \text{ for all } A_k \in A_k,$$

where A_k is the set of all possible actions, which can be employed by government k. Every A_{k+} element of A_{k+} has at least one A_k^* element of A_k that is a best response for country k. A Nash equilibrium is defined as the set of actions (A_k^*, A_{k+}^*) where A_k^* is a best response to A_{k+}^* for country k, and A_{k+}^* is a best response to A_k^* for country k+.

Differentiating equation (15) with respect to A_{Sk} and A_{Qk}, the first order necessary conditions for a maximum are

$$(17)\quad \begin{bmatrix} \dfrac{\partial V_k}{\partial A_{Sk}} \\ \dfrac{\partial V_k}{\partial A_{Qk}} \end{bmatrix} = \begin{bmatrix} \dfrac{\partial \Pi_k}{\partial A_{Sk}} & \dfrac{\partial U_k}{\partial A_{Sk}} \\ \dfrac{\partial \Pi_k}{\partial A_{Qk}} & \dfrac{\partial U_k}{\partial A_{Qk}} \end{bmatrix} \cdot \begin{bmatrix} \lambda_{Sk} \\ \lambda_{Qk} \end{bmatrix} + \begin{bmatrix} \dfrac{\partial B_k}{\partial A_{Sk}} \\ \dfrac{\partial B_k}{\partial A_{Qk}} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}.$$

Under the assumption that V_k is concave in A_k given A_{k+}, and A_k^* which solves equation (16) maximizes V_k. Thus, by definition, A_k^* is a best response to A_{k+}. (A_k^*, A_{k+}^*) is a Nash equilibrium of

$$(18)\quad \begin{bmatrix} \dfrac{\partial V_k}{\partial A_{Sk}} \\ \dfrac{\partial V_k}{\partial A_{Qk}} \end{bmatrix}_{|(A_k^*, A_{k+}^*)} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}.$$

If the matrix

$$(19)\quad \begin{bmatrix} \dfrac{\partial \Pi_k}{\partial A_{Sk}} & \dfrac{\partial U_k}{\partial A_{Sk}} \\ \dfrac{\partial \Pi_k}{\partial A_{Qk}} & \dfrac{\partial U_k}{\partial A_{Qk}} \end{bmatrix}^{-1}$$

exits, then λ_{Sk} and λ_{Qk} can be calculated by rearranging equation 17. Thus,

$$(20)\quad \begin{bmatrix} \lambda_{Sk} \\ \lambda_{Qk} \end{bmatrix} = - \begin{bmatrix} \dfrac{\partial \Pi_k}{\partial A_{Sk}} & \dfrac{\partial U_k}{\partial A_{Sk}} \\ \dfrac{\partial \Pi_k}{\partial A_{Qk}} & \dfrac{\partial U_k}{\partial A_{Qk}} \end{bmatrix}^{-1} \cdot \begin{bmatrix} \dfrac{\partial B_k}{\partial A_{Sk}} \\ \dfrac{\partial B_k}{\partial A_{Qk}} \end{bmatrix}$$

can be solved for λ_{Sk} and λ_{Qk}.

These weights represent the political influence of various producer and consumer groups relative to the government budget sector in the formulation of agricultural policies. In order to ascertain the changes in welfare resulting from policy changes, Modèle Internationale Simplifié de Simulation (MISS) is used. MISS is a simplified world trade model that simulates, in a comparative static framework, the effects of various policy actions (Mahé et al. 1988).

The MISS model utilizes several identities to simulate the effects of policy changes on the sectors of production, derived demand, and final demand for the regions examined. The model operates on the principle of Walrasian equilibrium. Policy changes undertaken by a country cause adjustments in the world price levels, resulting in changes in supply and demand, and a rebalancing of world trade. The resulting changes in producer welfare, consumer welfare, and government budget expenditures are used as approximations of the partial derivatives in equation 20. When equation 20 is solved for λ_{Sk} and λ_{Qk}, the PPF weights are obtained.

Empirical Analysis

For the purposes of this examination the world is divided into four regions: the European Union, the United States, Turkey, and a politically passive rest-of-the-world. The analysis is conducted using ten commodity groupings: beef and veal, dairy, corn, wheat, rice, soybeans, cotton, sugar, tobacco, and pork and poultry. To initialize the model, protection ratios are calculated for producers and consumers in the U.S., EU, and Turkey for the base year 1992. These protection ratios, combined with production and consumption levels, are used as a base from which all simulations will be conducted. Nominal protection ratios were calculated by the ratio of domestic price to border price. Prices have been calculated in terms of commodity values for all products. Nominal protection ratios for producers and consumers are presented in table 1.

It must be noted that this analysis assumes a politically passive rest-of-the-world. Regardless of fluctuations in world prices, the nominal protection ratios for the rest-of-the-world remain constant at one. As a result, the scenarios analyzed do not reflect any liberalization or policy adjustments on the part of the rest-of-the-world. The quantity and price data, and exchange rates used to initialize the model were gathered from Euromonitor (1995), European Commission (1995), FAO (1994), IMF (1996), Republic of Turkey (1994), USDA (1994b), USDA (1992), USDA (1994c), and USDA (1994d). Supply and demand elasticities are obtained from Gardiner et al. (1989) and are presented in table 2.

The PPF weights represent the political influence of various producer and consumer groups relative to the government budget sector in the formulation of agricultural policies. These weights are derived through the evaluation of incremental changes in the observed policies from their base year levels and have been estimated using 1992

Table 1. Nominal Protection Ratios (1992) and Base and Final Year (2001) GATT Commitments for the U.S., EU, and Turkey

	1992 Nominal Protection Ratios						GATT Commitment					
	Producers			Consumers			Base Year			Final Year		
Product	U.S.	EU	Turkey	U.S.	EU	Turkey	U.S.	EU	Turkey	U.S.	EU	Turkey
Beef & Veal	1.01	1.56	1.37	1.01	1.19	1.70	1.31	2.37	1.37	1.26	1.87	1.35
Dairy	1.59	2.44	1.32	1.23	1.11	1.68	1.59	2.16	1.32	1.50	1.92	1.31
Corn	1.00	1.88	1.47	1.02	1.56	1.21	1.02	1.53	1.47	1.00	1.33	1.45
Wheat	1.20	1.63	1.09	1.17	1.25	1.00	1.05	1.60	1.09	1.02	1.38	1.08
Rice	1.60	1.88	2.00	1.03	1.24	1.25	1.12	2.15	2.00	1.07	1.73	1.97
Soybeans	1.00	2.35	1.43	1.00	1.06	1.07	1.00	2.35	1.43	1.00	2.14	1.41
Cotton	1.18	1.38	1.29	1.18	1.38	1.29	1.38	1.38	1.29	1.32	1.32	1.28
Sugar	1.61	1.64	1.52	1.51	1.46	1.80	2.87	2.40	1.52	2.43	2.12	1.50
Tobacco	1.17	1.13	1.22	1.17	1.13	1.22	1.17	1.13	1.22	1.14	1.11	1.21
Pork & Poultry	1.00	1.41	1.00	1.06	1.17	1.53	1.00	1.41	1.00	1.00	1.34	1.00

Source: European Commission, 1995; Republic of Turkey, 1994; USDA, 1994a; USDA, 1994b; USDA, 1994c, and USDA, 1994d.

data.[1] These changes are used as approximations of the partial derivatives in equation (20). These approximated weights are normalized such that the budget weight is one. When equation (20) is solved for λ_{fi} and λ_{ci}, the PPF weights are obtained.

The PPF weights, shown in table 3, are consistent with the protection ratios presented earlier. There are a few weights, however, that may contradict standard perceptions regarding political influence. Among these, tobacco producers have the lowest weight among U.S. producers. This may not be surprising given the relatively low protection ratio for tobacco (table 1) and the recent health concerns regarding tobacco usage in the United States. On the other end of the spectrum, soybeans have the third highest weight among EU producers. While soybean producers may be a very small group relative to other EU agricultural producers, this result is not surprising given the relatively high nominal protection ratio for EU soybeans (table 1) and the relatively high PPF weight previously estimated for EU oilmeals (Kennedy et al. 1996). Finally, while rice does not have a large share of total agricultural production in Turkey, its role in domestic agricultural consumption contributes to its having its country's largest weight. Additionally, it may be the small number of rice producers and their ability to organize that allows the rice sector to garner political support.

[1] This analysis involves the grouping of producers according to commodities. Differing levels of diversification exist between and within Europe and the United States. Although producers do not organize solely on the basis of product lines, the political preference function, estimated with respect to commodities, reflects the preferences of the polity. In turn, the resulting commodity weights may be used to determine the relative political influence of producers based on the respective product mix.

It is also interesting to note that all weights for Turkey are larger than one. Remember that the political preference function is normalized such that the budget weight is one. One reason for interest group weightings exceeding that for the budget sector in Turkey is that public agricultural enterprises administer the purchasing and support payments of these products, mostly crops, and pay high prices, usually over world prices. Conversely, because of the low income of the population, these high prices are not transferred to the consumers. While this has a negative impact on the budget, the resulting budget pressure is viewed by the Turkish polity as an acceptable tradeoff given the large number of low-income consumers that benefit from lower food prices.

To find a Nash equilibrium for the countries involved, a game-theoretic framework is used. The normal-form representation of a game is specified by the following: the players in the game, the actions available to each player, and the payoffs corresponding with each action combination. In this case there are three players: the U.S., the EU, and Turkey (TUR). Let A_k denote the set of actions available to player k, for k = US, EU, TUR. Let $(A_{US}, A_{EU}, A_{TUR})$ denote combination of actions, and let P_k denote player k's payoff function where $P_k(A_{US}, A_{EU}, A_{TUR})$ is player k's payoff resulting from actions $(A_{US}, A_{EU}, A_{TUR})$. The normal-form representation of a three-player game specifies the player's action spaces (A_1, A_2, A_3) and their payoff functions (P_1, P_2, P_3). This game is denoted by $G = \{A_1, A_2, A_3; P_1, P_2, P_3\}$.

In the normal-form game, $G = \{A_1, A_2, A_3; P_1, P_2, P_3\}$ let A_{k1} and A_{k2} be feasible strategies for player k, i.e., they are members of A_k. Action A_{k1} is strictly dominated by A_{k2} if, for all combinations

Table 2. Direct Price Elasticities for the U.S., EU, and Turkey

	Supply			Demand		
Product	U.S.	EU	Turkey	U.S.	EU	Turkey
Beef & Veal	0.65	0.60	0.21	−0.70	−0.73	−0.28
Dairy	0.50	0.60	0.60	−0.17	−0.14	−0.09
Corn	0.48	0.65	0.40	−0.21	−0.41	−0.40
Wheat	0.60	0.70	0.30	−0.35	−0.35	−0.11
Rice	0.40	0.43	0.15	−0.25	−0.41	−0.07
Soybeans	0.60	0.53	0.20	−0.42	−0.20	−0.42
Cotton	0.74	0.38	0.45	−0.20	−0.49	−0.30
Sugar	0.50	0.90	0.10	−0.24	−0.36	−0.10
Tobacco	0.25	0.20	0.10	−0.20	−0.40	−0.10
Pork & Poultry	1.09	1.93	0.50	−0.60	−0.60	−0.40

Source: Gardiner et al., 1989.

of actions available to the other players, k's payoff from playing A_{k1} is strictly less than k's payoff from playing A_{k2}, such that $P_k\ (A_{k1}, A_{-k}) < P_k\ (A_{k2}, A_{-k})$ for all $A_{-k} \in A_{-k}$. Rational players will not play strictly dominated strategies, a concept which is useful in the identification of solutions to bimatrix games. If a unique solution to a three-player, normal-form, noncooperative game between the U.S., EU, and Turkey is to be found, it must be self-enforcing. Each player's predicted action must be that player's best response to the predicted action of the other player. This is the concept of Nash equilibrium. In the three player normal-form game $G = \{A_1, A_2, A_3; P_1, P_2, P_3\}$ the actions (A_1^*, A_2^*, A_3^*) are a Nash equilibrium if, for each player k = 1, 2, and 3, A_k^* is player k's best response to the actions specified for the other player's −k, such that $P_k\ (A_k^*, A_{-k}^*) \geq P_k\ (A_k, A_{-k}^*)$ for all $A_k \in A_k$.

This analysis incorporates game theory to identify optimal strategies for the countries involved. The U.S. and EU choose among four strategies: status-quo (ST); base year reductions until the final year according to the Uruguay round of GATT (GT); 50% reduction from their base year protections (50); and a 100% reduction from their base year protections (FT). The status-quo scenario presented here uses the base period protection levels adopted by these countries in the Uruguay round agreement. As a result, the U.S. and EU base protection levels are different, and generally higher, than those actually employed in 1992. The protection levels for all scenarios are calculated as percentage reductions from this GATT base scenario. The GT scenario simulates the final protection reductions to occur by the year 2001, ranging from fifteen to thirty-six percent. These protection ratios are presented in table 1.

To model its choice to join or to not join the Customs Union, Turkey chooses between two strategies: the application of its agreed upon Uruguay Round protection reductions without joining a European Customs Union (GT_{TUR}); and joining a European Customs Union and setting agricultural protection levels equal to those of the EU (CU_{TUR}). It is important to note that Turkey's choice of the

Table 3. 1992 Political Preference Function Weights

	United States		European Union		Turkey	
	Rank	Weight	Rank	Weight	Rank	Weight
Beef & Veal	8	0.96	4	1.21	8	1.10
Dairy	1	1.13	1	1.32	4	1.18
Corn	5	1.07	5	1.17	3	1.22
Wheat	6	1.06	2	1.25	11	1.02
Rice	1	1.13	6	1.07	1	1.77
Soybeans	10	0.86	3	1.22	4	1.18
Cotton	4	1.08	11	0.84	6	1.14
Sugar	1	1.13	8	1.02	7	1.13
Tobacco	11	0.83	10	0.91	10	1.07
Pork & Poultry	7	0.97	7	1.06	9	1.09
Consumers	9	0.94	9	1.00	2	1.24

Source: Calculated.

strategy CU_{TUR} involves setting Turkish agricultural protection within any set of scenarios to the corresponding EU level: ST_{EU}; GT_{EU}; 50_{EU}; or FT_{EU}.

Each country k chooses some action $A_k \in A_k$ to maximize its PPF given the action choices of the other countries. The games are presented in the following manner. If the players' action spaces are specified as A_{US}, A_{EU}, and A_{TUR} and their payoff functions as P_{US}, P_{EU}, and P_{TUR}, then this game is denoted by $G = \{A_{US}, A_{EU}, A_{TUR}; P_{US}, P_{EU}, P_{TUR}\}$. This simulation will determine the Nash equilibrium between the U.S. and EU when their actions are ST, GT, 50, and FT, while the actions available to Turkey are GT and CU. Thus, the action space is $A_k = \{ST_k, GT_k, 50_k, FT_k\}$ for k = US, EU and $A_k = \{GT_k, CU_k\}$ for k = TUR.

Two separate games will be analyzed. The first incorporates the weights approximated previously. The second game utilizes PPFs with weights of one, to reflect the outcome if policymakers view all groups equally. It is hypothesized that the first game will better reflect the process occurring between the three countries.

As can be seen from table 4, both the U.S. and the EU have strictly dominant strategies by choosing the 50% reduction from their protection levels. As a result the unique Nash equilibrium occurs at $\{50_{US}, 50_{EU}, GT_{TUR}\}$. At this action, PPF values are 749, 725, and −88 for the U.S., EU, and Turkey, respectively, relative to the base period actions.

The Nash equilibrium is identified in the following manner. Suppose Turkey chooses GT_{TUR}. When the U.S. chooses ST_{US}, the best response for the EU is to choose action 50_{EU} since the EU's PPF is higher than that for each of its other available actions. It is obvious that the EU is better off choosing the action 50_{EU}. Regardless of the action chosen by the U.S., the EU, as a rational agent, will choose 50_{EU}. On the other hand, regardless of the strategy chosen by the EU, the U.S. will respond by choosing action 50_{US} since its PPF is highest at this point. Thus, the U.S. and EU have strictly

Table 4. Non-Cooperative Game Between the United States, European Union, and Turkey, 1992 Political Preference Function Weights

GT_{TUR}	EU Actions			
U.S. Actions	ST_{EU}	GT_{EU}	50_{EU}	FT_{EU}
	2	−2	54	204
ST_{US}	1	259	1038	−1489
	15	−19	−57	−153
	274	288	356	571
GT_{US}	35	304	1066	−1521
	6	−27	−66	−162
	618	664	**749**	1089
50_{US}	−36	−49	**725**	−1962
	−15	−48	**−88**	−184
	211	346	331	719
FT_{US}	−809	−1318	371	−2467
	−47	−86	−121	−218
CU_{TUR}	EU Actions			
U.S. Actions	ST_{EU}	GT_{EU}	50_{EU}	FT_{EU}
	−53	−32	43	254
ST_{US}	−69	221	995	−1509
	−835	−562	−348	37
	218	258	344	620
GT_{US}	−40	268	1024	−1545
	−845	−572	−358	27
	560	632	733	1133
50_{US}	−438	−88	679	−1980
	−878	−604	−389	−5
	152	310	310	754
FT_{US}	−886	−1360	328	−2489
	−928	−652	−435	−51

Note: The unique Nash equilibrium occurs at $\{50_{US}, 50_{EU}, GT_{TUR}\}$.
These numbers represent changes in PPF for the U.S., EU, and Turkey, respectively, measured in million U.S. dollars.

Table 5. Non-Cooperative Game Between the United States, European Union, and Turkey, Political Preference Function Weights Equal to One

GT_{TUR}	EU Actions			
U.S. Actions	ST_{EU}	GT_{EU}	50_{EU}	FT_{EU}
	2	−133	−269	−602
ST_{US}	1	3647	6859	9721
	5	−11	−36	−91
	673	562	455	219
GT_{US}	−127	3563	6781	9682
	1	−15	−41	−96
	1654	1586	1522	1469
50_{US}	−996	2834	6136	9051
	−13	−30	−54	−110
	2238	2271	2155	2235
FT_{US}	−2195	1009	5289	8307
	−34	−48	−75	−131
CU_{TUR}	EUActions			
U.S. Actions	ST_{EU}	GT_{EU}	50_{EU}	FT_{EU}
	−28	−146	−271	569
ST_{US}	26	3670	6850	9693
	−361	−242	−138	−64
	641	550	451	253
GT_{US}	−104	3589	6772	9599
	−366	−247	−144	−70
	1618	1569	1514	1499
50_{US}	−970	2860	6126	9023
	−390	−271	−166	−94
	2199	2248	2141	**2259**
FT_{US}	−2168	1030	5293	**8283**
	−425	−298	−198	**−127**

Note: The unique Nash equilibrium occurs at $\{FT_{US}, FT_{EU}, CU_{TUR}\}$.
These numbers represent changes in PPF for the U.S., EU, and Turkey, respectively, measured in million U.S. dollars.

dominant strategies of 50_{US} and 50_{EU}, respectively. The same result occurs when Turkey chooses CU_{TUR}. Thus, since 50_{US} and 50_{EU} are strictly dominant strategies, the iterative elimination of strictly dominated strategies narrows the game solutions to Turkey's choice between GT_{TUR} and CU_{TUR} at $\{50_{US}, 50_{EU}\}$. As a rational agent, Turkey compares its payoff from GT_{TUR} (−88) to that from CU_{TUR} (−389) and chooses GT_{TUR} in order to maximize its PPF. Thus, the Nash equilibrium solution to this game occurs at $\{50_{US}, 50_{EU}, GT_{TUR}\}$.

Now consider the scenario in which all weights are equal to one. The PPF results for this scenario can be seen in table 5. As can be seen from these results, the unique Nash equilibrium occurs at free trade in this $\{FT_{US}, FT_{EU}, CU_{TUR}\}$. It must be remembered that, since Turkey chooses to join the European Customs Union in this game, Turkey effectively chooses free trade since the EU's optimal strategy involves the adoption of free trade. This outcome is consistent with theory in terms of gains from trade.

Conclusions

According to the results of this analysis, it is in the best interest of Turkey, from an agricultural standpoint, to adopt agreements made in the Uruguay Round of GATT as a developing country rather than joining the European Customs Union and applying EU protection. Conversely, the Turkish agricultural sector can benefit by joining the European Customs Union, provided that the EU adopts free trade. The losses suffered by Turkey under most scenarios can be partly attributed to the relatively high weight of the Turkish Consumer sector. In instances where the terms-of-trade favors the Turkish Producers the negative effects felt by Consumers dominate gains to producers due to the Turkish PPF weights.

Results show that producer surpluses in the U.S. and EU will decrease due to the fact that these countries decrease their protection levels. Since these decreases in protection increase world prices, the consumer surplus in Turkey will decrease as well. The Uruguay Round of GATT has eliminated quotas in many products by replacing them with tariff equivalents. However, these tariff equivalents were higher than those previously utilized in the U.S., while the EU also employed higher protection bases for protection reduction.

The Nash equilibrium occurred at the level of a 50% reduction for both the U.S. and EU using the estimated weights. When all sectors are weighted equally, the Nash equilibrium occurred at free trade. Several key results are related to Turkey's accession into a European customs union and the Nash equilibrium. The results show that Turkey's accession into this customs union is not in Turkey's best interest from an agricultural standpoint. Turkey can apply its GATT commitments and be better off remaining outside this customs union.

Among the significant products of this analysis is the result that the Nash equilibrium for the U.S. and EU occurred at 50% reduction from their base period protections with the estimated weights when Turkey is not in the EU. If Turkey were to join the customs union, the Nash equilibrium would again be a 50% reduction from the base level protection for the U.S. and EU. When weights are equal to one, the Nash equilibrium occurs at free trade levels for the U.S. and EU, with Turkey choosing to join the European Customs Union. This result is consistent with theory and, based on observable behavior, suggests that the countries involved weight the sectors analyzed in a manner consistent with the weights used in this analysis.

Free trade is not an optimal solution using the estimated weights. Both the U.S. and EU benefit from reducing protection levels to a point between the existing protection levels and free trade. Although free trade is not the optimal solution in agriculture, simulations indicate that there exists an optimum with freer trade. Future negotiations can identify areas of further protection reductions. This seems likely since the Nash equilibrium occurs at a level of protection that is less than GATT commitments for the U.S. and EU.

The results have several implications. Turkey's loss in agriculture, from joining this European customs union, may be compensated for by the potential gains in the manufacturing and service sectors as well as EU funding for various sectors in the form of structural payments. Turkish policymakers should evaluate these gains and losses, deciding whether it is in the country's best interest to join customs unions of this type. Comparisons can be made in a similar framework to include the manufacturing and services sectors. The framework and results of this study can contribute to future analyses that consider various welfare aspects of trade liberalization and integration.

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