Federal Budget Deficit, Optimal Policy Choices and Trade Competitiveness:

Some Evidence for U.S. Wheat Trade

by

Jamal B. Othman, Lewell F. Gunter and
Fred C. White

The authors are graduate student, associate professor, and professor, Dept. of Agricultural and Applied Economics, University of Georgia, Athens, GA

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Introduction and Research Issues

Over the past decade there has been considerable emergence of domestic forces that provide the impetus to alter existing agricultural programs. The clearest evidence of these were the unacceptably high budgetary costs of farm programs in the 1980s. In 1986 alone, the actual cost of commodity credit corporation activities to support agriculture was $25.9 billion. Other support programs which include PL 480, export guarantees, and export enhancement program amount to 18.6 billion in the same year. These costs dropped to more manageable levels in 1988 and 1989, mainly as a consequence of the abnormally small harvest in the midwest during the 1988 crop year which gave rise to high market prices (Rausser, 1990). The 1985 Farm Bill has also contributed to cost control in 1988 and 1989 by allowing loans to respond to market conditions. Given current policies, however, changes in market situations have the potential to accelerate program costs once again. The ongoing political concerns over the federal budget deficit provide an added push for restructuring agricultural policies.

Farm interests have pointed out that agriculture has contributed to deficit control through the provisions of the 1985 and 1990 Farm legislation. Outlays for commodity programs have been lower due to cuts in target prices, freezing program yields, and other measures (Schaub and Sumner, 1993). It was estimated that these measures reduced the combined outlays for wheat, feed grains, rice, and cotton programs by $5.6 billion in 1991, $4.9 billion in 1992 and $8.7 billion in 1993.

Undoubtedly the federal budget deficit has had a myriad of effects on agriculture as reflected by some of the consequences of the 1985 and 1990 Farm Bills. However, very little is empirically known about the impacts of the ongoing political debate over the federal budget deficit on policy choices and trade competitiveness. This paper develops a one country trade model that can endogenously determine optimal policy choices and levels for varying assumptions about the power of domestic political interest groups. Specifically, this paper deals with the problem of policy choices and levels in the U.S. wheat sector. The use of trade policy (export subsidies/taxes) is compared with alternative means of price support (deficiency payments and consumer taxes) in the wake of increased taxpayers concerns about the high costs of farm programs and the federal budget deficit. Welfare maximization is used as the criterion for endogenous optimal policy choices. Policy makers in the U.S. are assumed to maximize a criterion function which consists of a weighted sum of the welfare of consumers, producers, and taxpayers. This maximization is subject to a market clearing constraint and other underlying economic behavior in the optimization model. Political concerns over the federal budget deficit and escalating farm program costs are modeled by increasing the relative political weight for taxpayers' welfare. The effects of optimal policy choices on U.S. welfare and wheat trade competitiveness are quantified and examined.

Most trade models with endogenous policies sacrifice details about output supply and demand characteristics in order to develop a tractable optimization model. The model developed in this study, is unique in the sense that it provides a framework to model output supply and demand characteristics more so than many other trade models with endogenous policies. The model can also be generalized to incorporate a number of trading countries with relative ease.

Literature Review and Theoretical Considerations

Agricultural economists have made significant progress in linking policy objectives to endogenous optimal policy choices, such that the influence and distributive effects among three main political interest groups -- consumers, producers, and taxpayers are taken into account (for instance, Sarris and Freebairn (1983), Karp and McCalla (1983), Paarlberg (1986), and Gardner (1988)). Paarlberg (1986) in particular assumes an agricultural policymaker in a country sets policies in only a part of the economy and has no influence over policies in other sectors. The agricultural policy maker maximizes a criterion function which consists of a weighted sum of the welfare of political interest groups, and the weights reflect the influence of the interest groups on the policymaker. The weights are considered as political parameters which reflect the political environment in which policy decisions are made. Paarlberg asserts that when political process is incorporated, the policymaker's ranking of policies cannot be established *a priori*, but only after the political influences on the policymaker have been established. This implies that the political influences determine policies and not vice versa. Paarlberg argues that for a large exporting country, if all the political weights are equal to one, then maximizing the criterion function yields the partial-equilibrium socially optimal export tax formula. If producers are weighted more than consumers and taxpayers, the policymaker's welfare can be increased by subsidizing exports. In modelling policies, political influences can be imposed by the researcher prior to ranking policies or can be determined empirically. In his paper, Paarlberg used a revealed preference approach to establish the levels of political weights for the three interest groups in the wheat sector.

Generally, trade models with exogenous policies have focussed on the impacts of policy reforms or trade liberalization on trade flows and welfare of trading countries. Alternatively, trade models with endogenous policies have mainly focussed on modeling oligopolistic interactions and optimal policy choices. None of the trade models surveyed has explicitly examined simultaneously the impacts of varying assumptions of political interest group power on policy choices and international trade competitiveness.

Most trade models with endogenous policies incorporate policy instruments into the criterion or objective function by linking all the prices to a common world price. Endogenous policy models can be quite complex in their modeling of oligopolistic interactions and optimal policy choices, but they generally sacrifice details on output supply and demand characteristics in order to develop a tractable optimization model. Very few trade models which explicitly consider output supply and demand characteristics exist in the agricultural trade literature. Muth (1964) developed an output supply model for a homogenous product under assumptions of homogenous degree one production, competitive markets, and constant demand and input substitution elasticities. The Muth model permits analysis of impacts of shifts in factor supplies on equilibrium industry output, and on factor rental rates and demand. The model is not a trade model, however, since it does not include an export sector.

Hertel (1989) extended Muth's model to include policy variables and an export sector. This advancement facilitates analysis of the impacts of both domestic and trade policies, and changes on demand and supply responses, on quantities and prices of inputs, outputs, and exports. While its comprehensiveness is highly appealing, the model treats sectoral and trade policy parameter as exogenous. The optimization model developed in this paper is based heavily on Hertel's model to take advantage of its rigor in modeling exogenous policies and output supply and demand characteristics. The following subsection presents the theoretical framework for Hertel's model. The next section presents the development of the optimization model.

Hertel's Comparative Static Output-Supply Model

Hertel's system of equations for a long-run partial equilibrium model of the farm sector are presented in table 1. The *hat* notation represents the percentage change in the relevant variable. The superscript M denotes a market quantity or price, while F refers to the farm sector. Superscripts D an E refer to domestic and export demands. The first equation explains the price responsiveness of market-level demand, q_o^M, for an aggregate agricultural commodity. The aggregate farm-level demand elasticity, $\in_D = [(1 - \alpha)\in_D^D + \alpha\in_D^E]$ is a weighted sum of the farm-level domestic and export demand elasticities, where α is the quantity share of exports in total demand.

Equation (2) describes the derived demand of a competitive agricultural sector operating under locally constant returns to scale. The variables c_i and σ_{ji} represent cost share of an input and an Allen partial elasticity of substitution, respectively. Equation (3) portrays the assumption of zero profits for the aggregate farm sector. Factor mobility is addressed in equations (4) and (5). Equation 4 depicts non-land factors being supplied to agriculture at an exogenously determined price while equation 5 describes the responsiveness of total farmland supply to a change in rents under the assumptions that $0 < v_L < \infty$. Equations 6-1 through 6-3 incorporate exogenous sectoral *ad valorem* output, input, and trade policy variables into the model. The policy variables - output subsidy (tax), export subsidy (tax), and input subsidy (tax), are represented by $\hat{t}_o$, $\hat{e}_o$, and $\hat{s}_j$, respectively. Positive values of the output and input subsidies, $\hat{t}_o$, and $\hat{s}_j$, represent increases in these subsidies, while a negative value of the export subsidy, $\hat{e}_o$, represents an increase in the export subsidy. Note that the vector $\hat{t}_o$, though not discussed by Hertel, is in fact equivalent to a deficiency payment when it is positive and a consumer tax if it is negative. The last two equations describe the market clearing conditions for output and land. Interested readers are referred to Hertel (1989) for a detailed presentation of the model.

Hertel's system of equation can be written compactly as $QX=B$, where Q is the Jacobian which is the matrix of the coefficients of the endogenous variables while B is a vector of exogenous shifters (policy variables -- input, output, and export policies). Since Q is a square matrix and nonsingular, the solution for X, the matrix of endogenous variables is $Q^{1} B$. Any element x_i in the X matrix can be determined numerically and symbolically using Cramer's Rule. The computer software *Mathematica* is especially effective to obtain numerical as well as symbolic solutions for the endogenous variables. These symbolic solutions provide the most important element for the optimization model used in this study. Symbolic solutions are also important to allow graphical and sensitivity analyses. Table 2 depicts the symbolic results showing the effects of output and trade policies on output prices, production, consumption and trade from Hertel's model.

Methodology

Policy Maker's Behavior and Welfare

Policy makers in the U.S. are assumed to select levels for a set of domestic and trade policy variables which maximize their welfare as represented by a preference or objective function. The preference function for policy makers is expressed as:

$$(9)\ dW^D = (\gamma^C\, d\mu^C + \gamma^P\, d\mu^P + \gamma^T\, d\mu^T)$$

where dW^D represents the change in the preference function, while $d\mu^C$, $d\mu^P$, and $d\mu^T$ represent changes in consumers surplus, producers surplus and taxpayers surplus, respectively. The parameters γ^C, γ^P, and γ^T specify the relative weight (marginal values) attached to the respective domestic political interest group's welfare by the policy makers in the U.S. These weights describe the policy makers' attitude toward the influence and power of the various interest groups within the wheat sector. It is assumed that all political interest groups are welfare maximizers. Consumers of wheat in this study are assumed to be an aggregate of agents who demand wheat for feed and non-feed uses. Consumers' and producers' welfare are represented, respectively, by the standard specification of consumer and producer surplus. The above preference function assumes each interest group may face a different price which is influenced by government intervention. Producer price is affected by production and trade policies. These policy distortions in turn impact market price which is the price faced by consumers. The taxpayer's welfare is expressed as net revenue or expenditure to the government as a result of policies levied on the commodity.

Price dependent Hicksian domestic supply and demand functions are used to estimate the change in producers' and consumers' surpluses respectively. The impacts of policies on prices and quantities from Hertel's model are linear (Table 2). Therefore linear demand and supply functions are used to determine changes in consumer and producer surpluses, respectively. They are shown, respectively:

$$(10)\ p_O^D = \delta_0 + \delta_1\, q_O^D, \quad (\delta_1 < 0),$$

and

(11) $p_O^S = \beta_0 + \beta_1 \, q_O^S, \qquad (\beta_0 > 0, \;\; \beta_1 > 0).$

The welfare measures for consumers and producers in terms of changes (denoted by d) are expressed, respectively, as:

(12) $d\mu^C = (q_0^C \, p_0^D(-\hat{p}_O^D)) \; (1 + 0.5 \; \hat{q}_O^C),$

and

(13) $d\mu^P = (q_0^S \, p_0^S \, \hat{p}_O^S) \; (1 + 0.5 \; \hat{q}_O^S),$

while taxpayers welfare with output and trade policy options is expressed as:

(14) $d\mu^T = -(\hat{t}_O \, p_0^S \, q_1^S) - (\hat{e}_O \, p_0^S \, (q_1^S - q_1^C)),$

as is standard in the literature, taxpayer welfare decreases with tax expenditures and increases with tax revenues.

The variables q_0^C, p_0^D, q_0^S, and p_0^S, are base quantities and prices for domestic demand and farm production in the US, while the subscript 1 denotes the respective new equilibrium levels. Since we are only interested in analyzing welfare changes as a result of policies, $p_{0\alpha}^D$ and $p_{0\alpha}^S$ can conveniently be assigned a value of one while q_0^C and q_0^S, can be either baseline/free trade quantities or ratios. Using the symbolic solutions from Hertel's model (Table 2), the variables $\hat{p}_O^D$, $\hat{p}_O^S$, $\hat{q}_O^D$ and $\hat{q}_O^S$ in equations 12 - 14 are expressed, respectively, as:

(15) $\hat{p}_O^D = (\hat{t}_O)(\frac{\epsilon^S}{\epsilon_D^T - \epsilon^S}) - (\hat{e}_O)(\frac{\epsilon^e}{\epsilon^e - \epsilon^i})$

(16) $\hat{p}_O^S = (\hat{t}_O)(\frac{\epsilon_D^T}{\epsilon_D^T - \epsilon^S}) - (\hat{e}_O)(\frac{\epsilon^e}{\epsilon^e - \epsilon^i})$

(17) $\hat{q}_O^D = \{(\hat{t}_O)(\frac{\epsilon^S}{\epsilon_D^T - \epsilon^S}) + (\hat{e}_O)(\frac{\epsilon^e}{\epsilon^e - \epsilon^i})\}\epsilon_D^D$

(18) $\hat{q}_O^S = \{(\hat{t}_O)(\frac{\epsilon_D^T}{\epsilon_D^T - \epsilon^S}) + (\hat{e}_O)(\frac{\epsilon^e}{\epsilon^e - \epsilon^i})\}\epsilon^S$

Equations 15 through 18 suggest that the policy maker in the US knows with certainty the long-run equilibrium effects of a given level of policies. The equations also imply that the elasticities of demand and supply for wheat are not affected by the levels of policy instruments imposed by the country. The equations also show explicit modeling of changes in output demand and supply as functions of elasticities and policy vectors. These explicit linkages which are not found in the preference functions of most trade models with endogenous policies constitute one of the strengths of our model.

Data Requirement and Assumptions

Analysis of impacts of optimal policy choices on US welfare and terms of trade is made in relation to the free trade scenario. Since the US and most other countries are imposing distortionary measures in wheat trade, free trade quantities (q_0^C, q_0^S), and prices (p_0^C, p_0^S) have to be calculated. Hertel's equations (6-1) and (6-3), can be rewritten:

(19) $\hat{p}_O^W = \hat{p}_O^M + \hat{e}_O$

and

(20) $\hat{p}_O^M = \hat{p}_O^F + \hat{t}_O$,

where $\hat{p}_O^W$ is the percentage change in world price. Following these relationships, the base quantities and prices are calculated by first parameterizing the wheat demand (10) and supply (11) equations for the major wheat exporting and importing countries -- US, EC-10, Canada, and an aggregate rest-of-the-world (ROW) to reproduce 1986 base period data for each country's supply, demand, prices and trade. A market clearing condition is then imposed by equating total supply with total demand for all countries. The market clearing price is the free trade price assuming there are no shifts in the supply schedules for wheat when all distortions are removed. By plugging the free trade price into the US demand and supply functions, free trade consumption, supply and exports are obtained.

The base data for prices and quantities supplied, consumed and traded, and elasticities came from the USDA publication -- *A Database for Trade Liberalization Studies* The set of prices used to parameterize the supply and demand schedules to reproduce the 1986 base period prices and quantities are producer incentive price and consumer incentive price less marketing margins, respectively. An export demand elasticity for wheat, assuming no retaliation by other countries, was calculated from the trade liberalization database as -13.8. The US trade price of $77.22 was used as the world reference price under policy distortions for the 1986 base year. Although the model has the capability to model output supply for wheat under varying assumptions of input supply and substitution elasticities, in this study we focus only on using one level of output supply elasticity.

Optimization Problem

The policy maker in the US is assumed to select levels for a set of policies that maximize its welfare as given by (9). Note that the maximization problem for the model optimal solutions is of the constrained maximization type, though the preference function (equation 9) seemingly suggests otherwise. The underlying constraints -- technology, factor market clearing and output market clearing are imbedded in the Hertel's equations. The specification of the preference function (9) is actually a direct manifestation of these constraints and other underlying economic behaviors.

It is apparent that the solutions for the optimal policy levels depend not only upon the parameter values for the baseline exogenous variables, but also upon values of the relative influence or political weights of interest groups in the US. The values for the relative political influences were obtained using the revealed preference methodology. This was done by solving for the first order conditions of the maximization problem given the implied policies, the free trade prices and quantities, and other exogenous variables. The implied policies for the US are deduced by solving equations 19 and 20. This implies that all policy distortions the US might employ in the wheat sector are assumed to be characterized by either an output or trade policy or both. Following Paarlberg's argument, it is important to recall that the political influences are assumed to be exogenously determined by the political process, hence the political influences determine policies and not vice versa.

In this study, the *Mathematica* subroutine *MyFindRoot* was used to establish the global maximum for the maximization problem. The maximum of the preference function can also be verified graphically by the peak of a dome on a three dimensional surface.

Results and Discussion

Baseline Prices, Quantities and Political Weights

Table 3 shows the calculated baseline values for US wheat prices and quantities *(b)* in relation to the actual prices and quantities *(a)* in the 1986 base year. The former *(b)* are calculated US terms of trade in wheat when all policy distortions world-wide are removed. Free trade world price for wheat per metric ton increased relative to the observed price ($122.2895 versus $77), which is quite consistent with most studies on wheat trade liberalization. Also shown in table 3 are the implied policy types and levels the US imposed on the wheat sector for the base year. The implied policies are computed by solving equations 19 and 20 given the percentage change in world price and the relevant producer price (+38 percent) and consumer price (-30 percent). Using the revealed preference methodology, the baseline weights for US consumers and taxpayers in relation to producers were derived. These weights are reported in table 3 along with the results of model validation. In general, the results of model validation compare quite satisfactorily with actual prices and quantities.

The results for the influence of each political interest group in 1986 suggest that relative to wheat producers (1) and US taxpayers (0.710), wheat consumers (0.671) were the least influential group with US agricultural policy makers. When these weights were used with the base free trade prices and outputs, optimal policies levels were an output subsidy of 83.3 percent and an export subsidy of 1.59 percent, which are close to the imputed policies for 1986.

Impacts of Increased Taxpayers Political Influenceon Policy Choices and Trade Competitiveness

Increased taxpayers' concerns about the federal budget deficit and escalating farm program costs were modeled by increasing the weight of taxpayers and solving for optimal policies. The first scenario in table 4 shows optimal policies and welfare changes, relative to free trade, for the base set of revealed weights. Three additional weight scenarios are modeled and the results presented in table 4. The first two of these increase taxpayers' weight while holding the weights for consumers and producers constant. The last scenario shows optimal policies when weights for all three groups are equal.

The first scenario uses the revealed weights from the 1986 data.The first two rows show the optimal policy levels for these weights assuming that either a trade policy (row 1) or an output policy would be in effect. The third row assumes a combination of these two policy instruments would be used. As seen from the table, the sole policy of a trade subsidy yields a lower deadweight loss than either an output subsidy or a combination of these two policies. The highest benefit for producers, who have the highest weight, occurs with an output subsidy. By combining both subsidy types, taxpayer losses and producer gains are slightly smaller than under the sole output subsidy, while consumer welfare is lower than with a lone output subsidy.

The second scenario increases taxpayers' political weight to 0.85. With the increase in taxpayer weights, optimal output and trade subsidies are smaller. The highest gains to producers occur with a trade subsidy of 28.5 percent. Consumers benefit most from an output subsidy of 22.11 percent. Taxpayers are harmed the least by a combination of a 41.8 percent export subsidy and a 19.5 percent consumer tax. Total deadweight loss is least for the option with the output subsidy only.

In the third scenario, taxpayer weight is increased to a level on par with producers, while consumer weight remains at the original level. This set of weights results in policies which are strongly anti-consumer. With these weights, producers suffer welfare losses under two of the three policy sets due to the heavy use of consumer taxes which increase taxpayer welfare.

The final scenario in table 4 sets the weights of all three groups equal. When only a single policy is used, the optimal strategy is either an export tax of 6.5 percent or a consumer tax of 6.5 percent. Taxpayers benefit and producers lose under all three policy sets, while consumer gain under both solutions with export taxes. Total welfare is enhanced slightly, relative to free trade, under each policy combination.

While the type of policy choices given the set of weights can be quite predictable, determination of the levels of the policy choice intuitively can be difficult. Figures 1 and 2 depict three dimensional graphs for the relationship between optimal policy choices and varying assumptions about consumers and taxpayers political weights. The graphs were plotted using symbolic solutions for optimal policy choices under the assumption that the US has either of the two policy options, but not both at the same time. It can be clearly seen from the figures, as taxpayers' weight increases, export and output subsidies are both discouraged.

Concluding Remarks

In general, the results suggest that if reducing the deficit is more important politically to policymakers than reducing consumer costs, while maintaining price supports for producers, then combinations of trade subsidies and consumer taxes represent optimal policy choices for the US wheat sector. The actual solution depends on how strong the taxpayers are relative to producers and consumers. As taxpayer weight increases, subsidies (expenditures) became generally less desirable and consumption or trade taxes (revenues) became more desirable. When taxpayer weights reach a level equal to producer weights, optimal policies may result in welfare losses to producers, as output subsidies are replaced with output taxes.

References

Gardner, B.L. *The Economics of Agricultural Policies* New York: Macmillan Publishing Co., 1987

________. "Export Policy, Deficiency Payments, and a Consumption Tax.". *The Journal of Agricultural Economics Research.* Vol. 40, No. 1, Winter 1988.

Gardiner, W.H. and P.M. Dixit. "The Price Elasticity of Export Demand for U.S. Agricultural Products: Methods and Estimates. "Unpublished manuscript, Economic Research Service, U.S.D.A.

Hertel, T.W. "Negotiating Reductions in Agricultural Support: Implications of Technology and Factor Mobility. "*Amer. J. Agr. Econ.* August, 1989.

Harwood, J.L., and K.W. Bailey. *The World Wheat Market - Government Intervention and Multilateral Policy Reform.* Commodity Economics Division, Economic Research Service, U.S.D.A. Staff Report No. AGES 9007. January 1990.

Karp, L.S., and A.F. McCalla. "Dynamic Games and International Trade: An Application to the World Corn Market." *Amer. J. Agr. Econ.* 65(1983):641-50.

Muth, R.F. "The Derived Demand Curve for a Productive Factor and the Industry Supply Curve." *Oxford Econ. Papers.* 16(1964): 221-34.

Paarlberg, P.L., and P.C. Abbott. "Oligopolistic Behavior by Public Agencies in International Trade: The World Wheat Market." *Amer. J. Agr. Econ.* August 1986.

Rausser, G.C. "The Political Economy of Agriculture in the United States". A chapter in *The Political Economy of Agricultural Trade and Policy - Toward a New Order for Europe and North America* Colorado: Westview Press, 1990.

Roningen, V., J. Wainio, and J. Sullivan. *A Database for Trade Liberalization Studies* Agriculture and Trade Analysis Division., Economic Research Service, U.S.D.A, 1989.

Sarris, A.H., and J. Freebairn. "Endogenous Price Policies and International Wheat Prices." *Amer. J. Agr. Econ.* 65(1983): 214-24.

Scaub J.D., and D.A. Summer. "The Deficit and Agriculture." *Choices.* First Quarter 1993

Table 1. Hertel's Equations for a Long-Run Partial Equilibrium Model of the Farm Sector

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Commodity demand

(1) $\hat{q}_O^M = (1-\alpha)\epsilon_D^D \hat{p}_O^M + \alpha\epsilon_D^E \hat{p}_O^E$

Derived factor demands under constant returns to scale technology

(2) $\hat{q}_j^F = \sum_{i=1}^{N} c_i \sigma_{ji} \hat{p}_i^F + \hat{q}_O^F$

Zero profits

(3) $\hat{p}_O^F = \sum_{i=1}^{N} c_i \hat{p}_i^F$

Nonland inverse factor supplies

(4) $\hat{p}_j^M = 0 \quad (j \neq L)$

Land supply

(5) $\hat{q}_L^M = v_L \hat{p}_L^M$

Ad valorem - output subsidy

(6-1) $\hat{p}_O^F = \hat{p}_O^M - \hat{t}_O$

Ad valorem - input subsidy

(6-2) $\hat{p}_j^F = \hat{p}_j^M - \hat{s}_j, \quad j = 1, \ldots, N$

Ad valorem - export subsidy

(6-3) $\hat{p}_O^E = \hat{p}_O^M + \hat{e}_O$

Commodity market clearing

(7) $\hat{q}_O^M = \hat{q}_O^F$

Land market clearing

(8) $\hat{q}_L^M = \hat{q}_L^F$

Table 2. Supply, Total Demand, and Import Supply Elasticities and Effects of Output and Trade Policies on Output Prices, Production, Consumption, and Trade

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Supply elasticity:

$$\epsilon^S = -[1_N^T \sum_{NN}^{-1} 1_N]^{-1}$$

Total demand elasticity:

$$\epsilon_D^T = \{(1 - \alpha)\, \epsilon_D^D + \alpha \epsilon_D^E\}, \quad \alpha = \frac{q_O^E}{q_O^M}$$

Import supply elasticity:

$$\epsilon^i = \{q_a^S\, \epsilon_a^S - q_a^C\, \epsilon_a^D\} \,/ q^{\exp}$$

Effect of Output Subsidy/Deficiency Payment or Consumer Tax on Output Prices

Consumer price:

$$\hat{p}_O^D = \hat{t}_O\{\epsilon^S \,/\, (\epsilon_D^T - \epsilon^S)\}$$

Producer price:

$$\hat{p}_O^S = \hat{t}_O\, \{\, \epsilon_D^T \,/\, (\, \epsilon_D^T - \epsilon^S\,)\}$$

Effect of Export Subsidy or Tax

Consumer and producer price:

$$\hat{p}_O^D = \hat{p}_O^S = -(\hat{e}_O)\{\epsilon^e \,/\, (\epsilon^e - \epsilon^i)\}$$

Effect of Output and Export Subsidy/Tax on Consumption and Trade

Consumption:

$$\hat{q}_O^C = \hat{p}_O^D\, \epsilon_D^D$$

Production:

$$\hat{q}_O^S = \hat{p}_O^S\, \epsilon^S$$

Trade:

$$\hat{q}^{\exp} = \hat{q}^{imp} = (q_O^S/q^{\exp})\hat{q}_O^S - (q_O^C/q^{\exp})\hat{q}_O^C$$

Table 3. Prices, Quantities and Elasticities for US wheat and Results of Model Validation

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a. Actual Prices and Quantities for 1986 Base Year

Supply: 56.925 bill. mt.
Domestic Consumption: 30.173 bill. mt.
Export: 26.752 bill. mt.

Producer Incentive Price: $168.00/mt
Consumer Incentive Price less Marketing Margin $86.00/mt
World Reference Price -- US Trade Price: $77.22/mt

b. Calculated Free Trade (Baseline) Prices and Quantities *for 1986 Base Year*

Supply: 47.0491bill. mt.
Domestic Consumption: 26.6751
*Export:*20.374

World Price: 122.2895

c. Calculated Baseline Policies and Political Weights for 1986 Base Year.

Policies: 67.1 Percent in Output Subsidy and 7.2 Percent in Export Subsidy
Political Weights: Consumers -- 0.670, Producers -- 1.0, Taxpayers -- 0.710

d. US Supply and Demand Elasticities

Supply : 0.6
Domestic Demand: -0.35
Export Demand: -13.8
Export Supply (faced by ROW): 1.84
Total Demand: -6.18

d. Model Validation

Supply: Overforecast by 2.9859 bill. mt.
Domestic Demand: Overforecast by 0.54650 bill. mt.
Export: Underforecast by 3.532 bill. mt.

Table 4. Optimal Policy Choices Under Increasing Taxpayer Weights

Weights[1]		Optimal Policies[2]		Changes in Welfare[3]			Change in Total Welfare (Deadweight Loss)
Taxpayer	Consumer	Trade Subsidy (Tax)	Output Subsidy (Tax)	Taxpayers	Producers	Consumers	
0.71	0.67	55.7	n.a.	-2648	3247	-1466	-868
		n.a	84.86	-7149	5483	248	-1417
		1.59	83.26	-7093	5478	197	-1418
0.85	0.67	28.5	n.a	-1041	1558	-785	-268
		n.a.	22.11	-1426	1230	64	-132
		41.8	-19.5	-253	1165	-1175	-263
1.0	0.67	13.6	n.a.	-414	715	-383	-82
		n.a.	-9.2	505	-472	-27	6
		64.9	-73.2	2099	-534	-1846	-281
1.0	1.0	-6.5	n.a.	144	-323	188	9.5
		n.a.	-6.5	358	-332	-19	7
		-6.5	0.2	144	-323	188	9.5

[1] Producer weight=1.0 for all scenarios

[2] Taxes in parentheses

[3] Unweghted welfare changes from free trade base

Figure 1. Relationship Between Optimal Output Subsidy (Tax) and Consumer and Taxpayer Weights

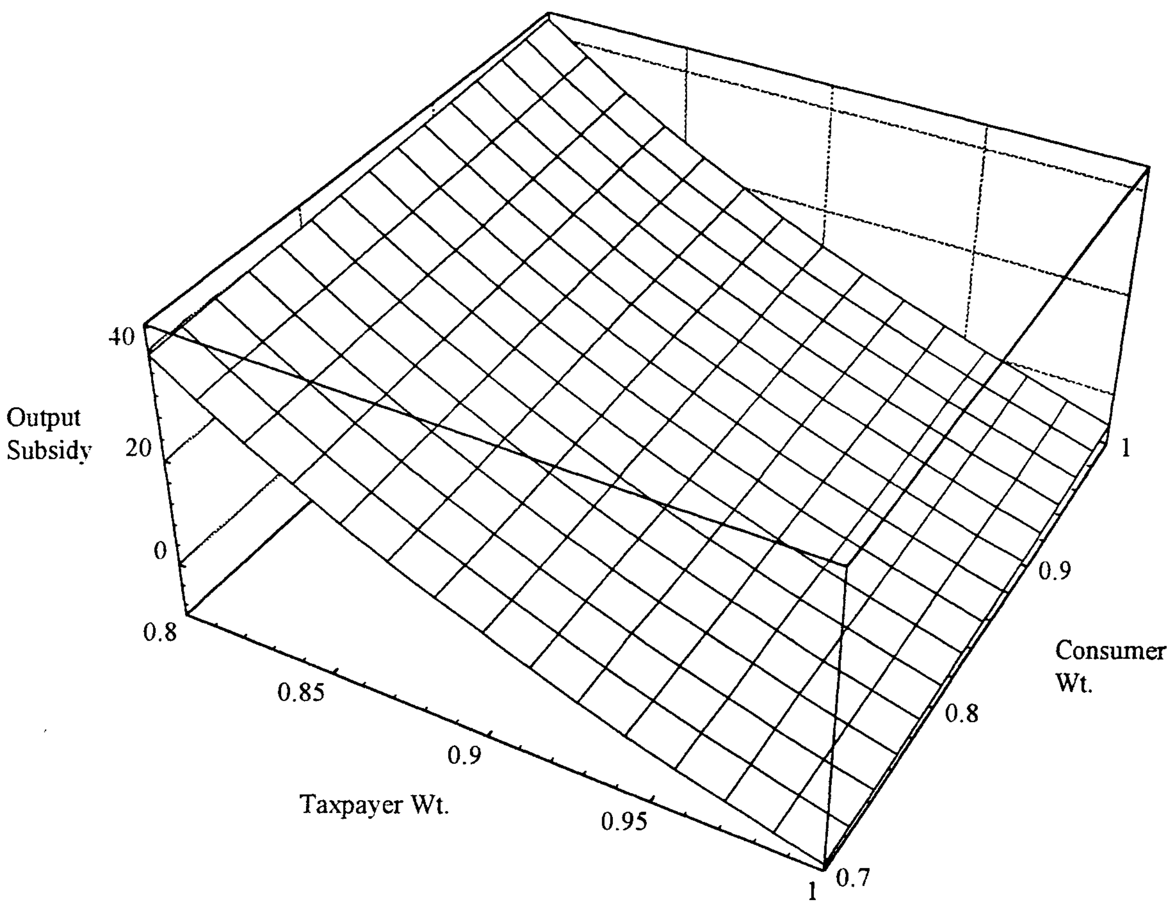
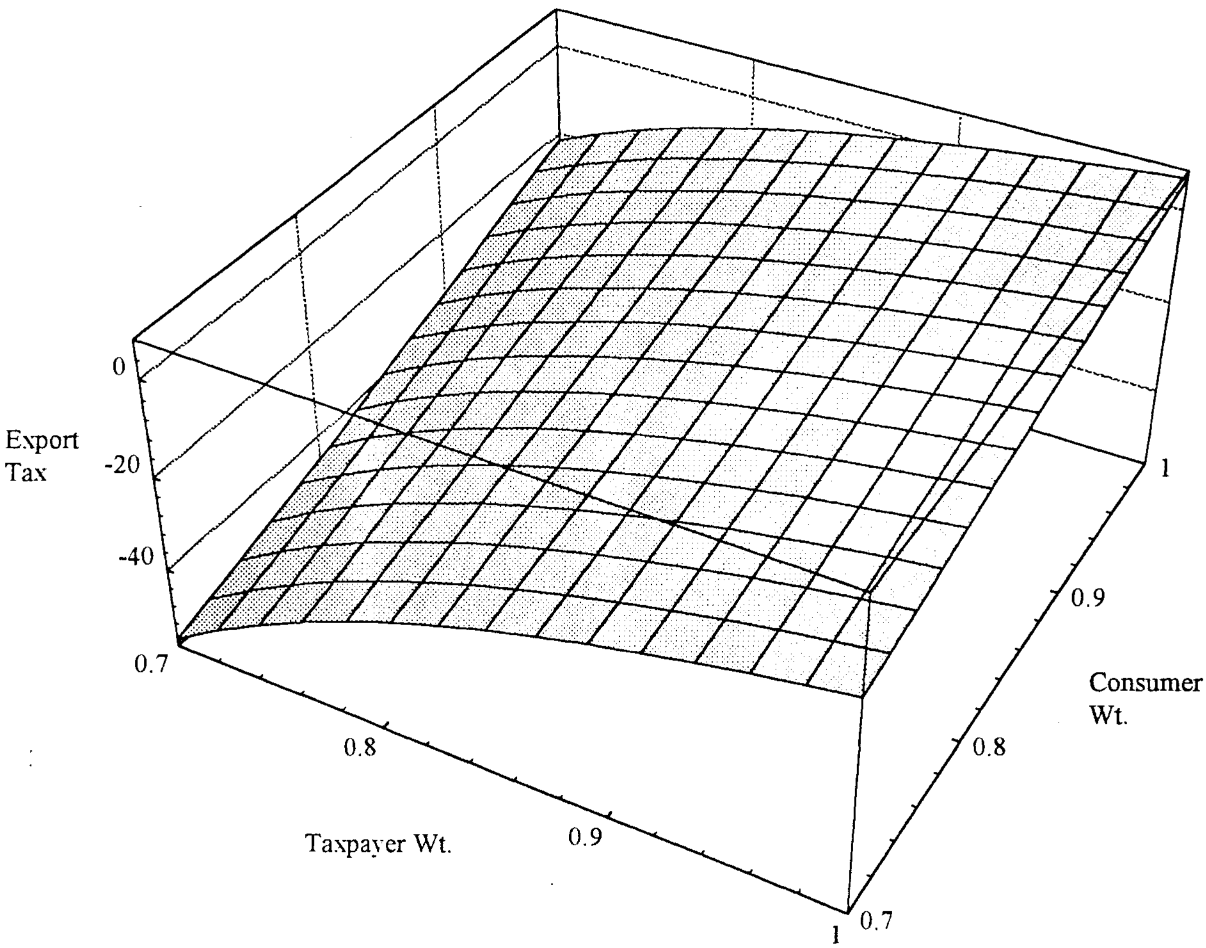


Figure 2. Relationship Between Optimal Export Tax (Subsidy) and Consumer and Taxpayer Weights



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