Testing for Efficiency: A Policy Analysis with Probability Distributions

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Klaus Salhofer**)
Erwin Schmid**)
Friedrich Schneider***)
Gerhard Streicher**)

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Institut für Wirtschaft, Politik und Recht
Universität für Bodenkultur Wien

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**) Universität für Bodenkultur Wien (University of Agricultural Sciences Vienna), Department of Economics, Politics, and Law; G.-Mendel Strasse 33; A-1180 Vienna; Austria; phone 00 43 1 476543653; FAX: 00 43 1 476543692; email: salhofer@edv1.boku.ac.at.
***) University of Linz, Department of Economics, A-4040 Linz/Auhof; Austria

Bestelladresse:

Institut für Wirtschaft, Politik und Recht
Universität für Bodenkultur Wien
Gregor Mendel-Str. 33
A – 1180 Wien
Tel: +43/1/47 654 – 3660
Fax: +43/1/47 654 – 3692
e-mail: h365t5@edv1.boku.ac.at

Internetadresse:

http://www.boku.ac.at/wpr/wprpage.html
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Abstract

The study evaluates the efficiency of government intervention using a vertical structured model including imperfectly competitive agricultural input markets, the bread grain market, and the imperfectly competitive food industry. To test for policy efficiency the actually observed bread grain policy is compared to a hypothetical efficient policy. To account for the sensitivity of the results in regard to the model parameter values computer-intensive simulation procedures and surface response functions are utilized.

Keywords: agricultural policy, efficient combination of policy instruments, statistical policy impact analysis

JEL: Q18, D61, H21

1. Introduction

As a rule, governments defend their policy as efficiently meeting stated objectives. The aim of this study is to take this to an empirical test. In particular, it is analyzed if the market interventions into the Austrian bread grain market before the EU accession were designed to efficiently meet the main stated objectives. To do so, the actually observed policy is compared to a hypothetical optimal policy using the same instruments, but at optimal levels.

In the next section, the official objectives relevant to the past bread gain policy in Austria and the policy instruments are reviewed. In Section 3 a vertically-structured model including imperfectly competitive agricultural input markets, the bread grain market, and the imperfectly competitive food industry is developed. Since the results crucially depend on the model parameters a range rather than (one or a few) specific values are derived for each model parameter in Section 4. In Section 5 the simulation model and assumed parameter ranges are used to test for the efficiency of the bread grain policy under uncertainty. Section 6 provides a sensitivity analysis of the results. Section 7 gives a summary and discussion.

2. Objectives and instruments of bread grain policy

Thus, official objectives of farm policy as stated in national agricultural legislation are manifold there also appears to be a high degree of unanimity about the goals of agricultural policy among developed countries. Following Winters (1987, 1990) in analyzing the objectives of agricultural support in OECD countries one may identify four categories of farm policy goals: i) support and stabilization of farm income; ii) self-sufficiency with agricultural (food) products; iii) regional, community and family farm aspects; iv) the environment. There is not much doubt among agricultural policy analysts that farm income support has been the most important goal over the last decades (Josling, 1974; Gardner, 1992).

In general, Austrian agricultural legislation is not different from other developed countries. The overall goals of agricultural policy are stated in paragraph 1 of the "Landwirtschaftsgesetz" (Agricultural Status) (see Gatterbauer et al. 1993, Ortner, 1997) and perfectly fit in the four categories mentioned above.

The particular objectives of bread grain market interventions are stated in the "Marktordnungsgesetz" and can be summarized as (Astl,1989, p. 88; Mannert, 1991, p. 74): i) safeguarding domestic production, ii) stabilizing flour and bread prices; and iii) securing a sufficient supply and quality of bread grain, bread grain products and animal feedstuffs. Utilized policy instruments to meet stated policy objectives can be illustrated by means of Figure 1 with D_{fo} being the domestic demand for bread grain for food production and D being the total domestic demand for bread grain including demand for feeding purposes. Initial domestic supply is represented by S and supply including a fertilizer tax by S_t. World market price is assumed to be perfectly elastic at P_w. Farmers obtain a high floor price (P_D) for a specific contracted quantity (or quota) Q_Q. Since farmers have to pay a co-responsibility levy (CL_{PD}) the net producer price is P_D - CL_{PD}. Quantities, which exceed the quota can be delivered at a reduced price P_E. Again, farmers' net floor price is P_E - CL_{PE}, with CL_{PE} being the co-responsibility levy for bread grain beyond the quota. Food processors have to buy bread grain at the high price P_D, while the price of bread grain for feeding purposes is P_E. Therefore, domestic demand for bread grain in food production is Q_D, domestic demand for feeding purposes is $Q_E - Q_D$, total domestic demand is Q_E, and exports are $Q_X = Q_S - Q_E$.

3. The model

The Austrian agribusiness of bread grain is modeled by a log-linear, three-stage, vertically-structured model. The first stage includes four markets of input factors used for bread grain production: land, labor, durable investment goods (e.g. machinery and buildings), and operating inputs (e.g. fertilizer, seeds). Since 95% of farmland is owned by farmers and 86% of labor in the agricultural sector is self-employed, land (A) and labor (B) are assumed to be factors offered solely by farmers in perfectly competitive markets. On the contrary, investment goods (G), and operating inputs (H) are supplied by upstream industries, which are assumed to have some market power to set the prices above marginal cost. Assuming constant elasticity supply functions:

(1a) $Q_i = X_i P_i^{\varepsilon_i}$, ($i = A, B$), and

(1b) $Q_i = X_i \left((1-L_i)P_i\right)^{\varepsilon_i}$, ($i = G, H$), where Q_i denotes the quantity supplied, X_i is the shift parameter, P_i the price, ε_i the supply elasticity of input factor i, and L_i is the Lerner index (defined as the ratio between the profit margin and the price) of input factor industry i.

Export and import of input factors are not considered. Hence, it is assumed that domestic consumption of input factors equals domestic production. This is certainly correct for land and agricultural labor and is also appropriate for important industrially produced input factors (e.g. tractors, fertilizer) before joining the EU.

At the second stage, input factors of the first stage are used to produce bread grain assuming a CES production technology:

$$(2)\quad Q_S = X_{QS}\left(\sum_i \alpha_i Q_i^{\rho}\right)^{\frac{1}{\rho}},\quad (i = A,\ B,\ G,\ H),\quad \text{with } \rho = \frac{\sigma_S - 1}{\sigma_S} \quad \text{and,} \sum_{i=A,B,G,H} \alpha_i = 1,$$

where Q_S denotes the produced quantity of bread grain, X_{QS} the production function efficiency parameter, α_i the distribution parameter of factor i, ρ the substitution parameter, and σ_S the elasticity of substitution between input factors at the farm level.

The first and the second stage are linked by the assumption that bread grain producers maximize their profits. Assuming a perfectly competitive bread grain market factor prices equal the value of marginal product:

$$(3.a)\quad P_i = X_{QS}^{\rho}\alpha_i\left(\frac{Q_S}{Q_i}\right)^{1-\rho}\left(P_E - CL_{PE}\right),\quad (i = A,\ B,\ G), \text{ and}$$

$$(3.b)\quad P_H + T_F = X_{QS}^{\rho}\alpha_H\left(\frac{Q_S}{Q_H}\right)^{1-\rho}\left(P_E - CL_{PE}\right),$$

where P_E is the gross price and CL_{PE} is the co-responsibility levy for bread grain that exceed the quota Q_Q (see Figure 1), and T_F is the fertilizer tax per unit.

The produced quantity of bread grain is used for food production (Q_D), animal feed (Q_E), and exports (Q_X):

(4) $Q_S = Q_D + Q_E + Q_X$.

The third stage aggregates firms which process and distribute bread grain, such as wholesale buyers, mills, exporters, and foodstuffs' producers. Bread grain (D) along with other input factors of labor (J), and capital (K) (a residual of including all other inputs except D and J) are combined to produce food (bread grain products like flour, bread, noodles). Supplies of J and K are again modeled by constant elasticity functions:

(5) $Q_i = X_i P_i^{\varepsilon_i}$, $(i = J, K,)$,

and food production by a CES technology:

(6) $Q_{SF} = X_{QSF}\left(\sum_i \alpha_i Q_i^{\gamma}\right)^{\frac{1}{\gamma}}$ $(i = J, K, D)$, with $\gamma = \frac{\sigma_F - 1}{\sigma_F}$, and $\sum_{i=J,K,D} \alpha_i = 1$,

where Q_{SF} represents the produced quantity of food (bread grain products), X_{QSF} the production function shift parameter, α_i the distribution parameter of factor i, γ the substitution parameter, and σ_F the elasticity of substitution between input factors at the food industry level.

Assuming some market power in the food sector input demand is represented by

(7) $P_i = \left(1 - L_F\right) X_{QSF}^{\gamma} \alpha_i \left(\frac{Q_{SF}}{Q_i}\right)^{1-\gamma} P_F$, $(i = J, K, D)$,

where P_F denotes the price of food, P_D the gross price of bread grain under the quota, and L_F the Lerner index of the downstream sector.

Food demand is modeled by a constant elasticity function:

$$(8) \quad Q_{DF} = X_{QDF} P_F^{\eta_F} ,$$

where Q_{DF} represents the demanded quantity of food, X_{QDF} a shift parameter, and η_F the elasticity of demand.

Import and export of processed bread grain do not play an important role in Austria. According to Astl (1991), the ratio of imports to total consumption of bread and baker's ware is less than 7%. According to Raab (1994), exports of flour and flour products increased but were still only 20,000 t or 4% of domestically processed bread grain in 1993. Given these facts, we assume that domestic demand of bread grain products equals domestic supply:

$$(9) \quad Q_{DF} = Q_{SF}.$$

Bread grain demand for feeding purposes are also modeled by a constant elasticity demand function:

$$(10) \quad Q_E = X_{QDE} P_E^{\eta_E} ,$$

where X_{QDE} and η_E are the shift parameter and the elasticity of animal feedstuffs demand, respectively.

Finally, we define the agricultural share of expenditures for bread grain products (λ) as

$$(11) \quad \lambda = \frac{P_D Q_D}{P_F Q_{DF}} .$$

The model in Equations (1) through (11) is calibrated in order to match the three year averages of prices and quantities over the period 1991 - 1993.

Based on Equations (1) through (11) welfare levels for different social groups and policy scenarios can be calculated: Welfare of bread grain farmers (U_{BF}) is measured as the sum of Marshallian producer surpluses from supplying land and labor:

$$(12) \quad U_{BF} = \frac{X_A P_A^{\varepsilon_A + 1}}{\varepsilon_A + 1} + \frac{X_B P_B^{\varepsilon_B + 1}}{\varepsilon_B + 1}.$$

Welfare of upstream industries (U_{UI}) is measured as the sum of producer surpluses from supplying investment goods and operating inputs (first term in Equation (13)) and oligopoly rents in these industries (second term),

$$(13) \quad U_{UI} = \left[\sum_{i=G,H} \frac{X_i (1 - L_i)^{\varepsilon_i + 1} P_i^{\varepsilon_i + 1}}{\varepsilon_i + 1} \right] + \left[L_i P_i Q_i \right].$$

Similar, welfare of downstream industry (U_{DI}) is measured as producer surpluses from supplying capital and labor to food industry (first term) and food industries oligopoly rent (second term):

$$(14) \quad U_{DI} = \sum_{i=J,K} \left[\frac{X_i P_i^{\varepsilon_i + 1}}{\varepsilon_i + 1} \right] + \left[L_F P_F Q_{DF} \right].$$

Welfare of food consumers (U_{CS}) is calculated as Marshallian consumer surplus:

$$(15) \quad U_{CS} = -\frac{X_{QDF} P_F^{\eta_F + 1}}{\eta_F + 1}.$$

Similar, welfare of buyers of bread grain for animal feed (U_{BS}) is calculated as

$$(16) \quad U_{BS} = -\frac{X_{QDE} P_E^{\eta_E + 1}}{\eta_E + 1}.$$

This buyers surplus includes the welfare of consumers of the final product (e.g. meat) as well as the welfare of all suppliers of factors necessary to produce this final good (Just, Huth and Schmitz, 1982).

Taxpayers' welfare (U_{TX}) is measured by budget revenues minus expenditures times marginal cost of public funds (MCF):[1]

$$(17) \quad \Delta U_{TX} = MCF \left\{ \begin{bmatrix} -(Q_Q - Q_D)(P_D - CL_{PD} - P_E) - Q_X(P_E - CL_{PE} - P_w) \\ -Q_X AEC - Q_Q ST + CL_{PD} Q_D + CL_{PE}(Q_E - Q_Q + Q_D) \end{bmatrix} + [T_F Q_H] \right\},$$

where CL_{PD} refers to the co-responsibility levy of bread grain under the quota, AEC refers to export cost in addition to the difference between the domestic price and the world market price, like transportation cost and the wholesalers' markup, and ST refers to the premium wholesale buyers get for storing bread grain under the quota. The first term in Equation (17) describes expenditures for exports and revenues from the co-responsibility levy, and the second term describes revenues from fertilizer taxation.

4. Model parameters

To run the model including Equations (1) through (11) and to calculate the welfare of social groups including Equations (12) through (17), 32 parameter values are necessary (ε_A, ε_B, ε_G, ε_H, ε_J, ε_K, α_A, α_B, α_G, α_H, α_J, α_K, α_D, σ_S, σ_F, η_E, η_F, L_G, L_H, L_F, X_A, X_B, X_G, X_H, X_J, X_K, X_{QS}, X_{QSF}, X_{QDF}, X_{QE}, λ, MCF). While 13 values (X_A, X_B, X_G, X_H, X_J, X_K, X_{QS}, X_{QSF}, X_{QDF}, X_{QE}, α_D, α_H, α_K) of these 32 parameters are endogenously derived in the calibration process, 19 specific parameter values (ε_A, ε_B, ε_G, ε_H, ε_J, ε_K, α_A, α_B, α_G, α_J, σ_S, σ_F, η_E, η_F, L_G, L_H, L_F, λ, MCF) have to be assumed.

In contrast to most empirical studies of this kind we do not assume one (or a few) specific value(s) for each parameter, but rather assume each parameter to be in a plausible range. The upper (*a*) and lower (*b*) bounds of these ranges are based on extensive literature and data analysis (described in detail in Salhofer, Schmid, Schneider and Streicher, 2001)) and are presented in Table 1. Two alternative distributions are assumed between the upper and lower bounds: i) a uniform distribution $U(a, b)$; and ii) a symmetric normal distribution $N(\mu, \sigma,)$ with $\mu = (a+b)/2$ and $\sigma = (\mu - a)/1.96$, which is truncated at a and b.

On the base of these parameter ranges, 10,000 independent draws are taken for every single parameter and each alternative distribution. Hence, we derive 10,000 parameter sets including 19 elements for each alternative distribution, separately. These parameter sets are used to derive 10.000 welfare measures for each defined group and each alternative parameter distribution.

5. Empirical analysis

As discussed above, the main objective of agricultural policy in Austria, as in most developed countries, was to support farm income. Beside income redistribution, securing a sufficient supply and quality of bread grain products and animal feedstuffs was the most important goal of Austria's bread grain policy in particular (Mannert, 1991). Given this, we may simplify government's decision problem as trying to maximize social welfare given a socially demanded level of farmer's welfare and self-sufficiency.[2] Assuming that the socially demanded transfer level is reflected in the actually observed transfer level, that self-sufficiency is given when domestic supply is greater or equal domestic demand, and that the policy instruments available to government are the actually used instruments, government's decision problem can be formalized as:

$$
(18) \quad \begin{aligned} &\max_{P_{QD}, P_E, CL_{PQD}, CL_{PE}, QQ} \quad W = \left(U_{BF} + U_{UI} + U_{DI} + U_{CS} + U_{BS} + U_{TA}\right) \\ &\text{s.t.} \quad U_{BF} \geq U_{BF}^{A} \\ &\qquad\quad Q_X \geq 0 \end{aligned} ,
$$

where U_{BF}^{A} is the actually observed welfare level of farmers, and Q_x are bread grain exports.

The official goal of introducing a tax on fertilizer was soil protection and hence environmentally motivated. For simplicity, it is assumed that this environmental goal is separable from other goals and optimally met by the current level of fertilizer tax. Hence, government can freely choose the levels of five policy instruments (P_E, CL_{PE}, P_{QD}, CL_{PQD}, Q_Q) to maximize welfare under given constraints.

Utilizing the described simulation model, assumed distributions of parameter values, and welfare measures, the nonlinear optimization problem (18) is solved numerically for 2 times 10,000 alternative parameter sets utilizing GAMS software (Brooke et al. 1988). As a result two alternative distributions of the optimal welfare levels as well as the optimal policy instrument levels and combinations are derived.

Utilizing the same model, parameter sets, and welfare measures, but taking the world market price of bread grain one can simulate a hypothetical nonintervention scenarios. Thus, the social cost of the optimal policy are measured as $SC^*=W^* - W^W$ where W^* and W^W are the welfare level in the optimal situation and in the world market price situation, respectively. Similarly, assuming plugging in the actually observed prices into the simulation model one could calculate the social cost of the actual observed policy $SC^A = W^A - W^W$ where W^A is the actual welfare level. Finally, the relative social cost (RSC) give the share by which the social cost could have been reduced, if the government would have used an optimal combination and levels of policy instruments RSC = $(SC^A - SC^*)/SC^A$. This gives a measure of how close the actual policy is to the optimal policy.

This is illustrated in Figure 2 with the welfare of farmers U_{BF} and non-farmers, as an aggregate of all other groups $(U_{UI} + U_{DI} + U_{CS} + U_{BS} + U_{TA})$, on the axes. Point *E* describes the welfare distribution between these two groups without government intervention. If lump-sum transfers as well as lump-sum taxes would be possible, government could redistribute welfare from non-farmers to farmers along a 45° line through point E. However, here with the assumption of no lump-sum policy instruments the best government can do is described by a concave utility possibility curve. If U_{BF}^{A} is the socially demanded welfare level of farmers and point *A* is the actually observed welfare distribution, distance *AB* are the social cost of the actual policy (Bullock and Salhofer, 1998). The policy derived by the optimization problem (18) would be point *O*. The social cost of this optimal policy are *OB* and $(SC^{A} - SC^{*})/SC^{A} = AO/BO$.

The empirical results for the assumption of normally distributed parameters are summarized in Table 2. At the mean the social cost of the actually policy are measured to be 159 million (about 42% of the value of bread grain production) with a standard deviation of € 23 million. In 95% (9,500 cases) of our 10,000 simulations the social cost are in a range of € 116 million to € 206 million. The 75% probability interval is between € 131 million € 188 million. In the case of the optimal policy the social cost are significantly smaller with a mean of € 91 million, a standard deviation of € 24 million, a 95% probability interval between € 45 million and € 139 million, and a 75% interval between € 62 million and € 121 million. Therefore, by using the same instruments at different levels government could have reduced the social cost on average by € 68 million, about 44% of the actual social cost, and with a 95% (75%) probability between 32% (35%) and 63% (53%).

Assuming a uniform distribution of the parameter values between the upper and lower boundary does not change the mean and median significantly (Table 3), but certainly causes higher standard deviations and hence wider probability intervals.

6. Sensitivity Analysis

To analyze the sensitivity of the RSC with respect to the model parameters, surface response functions are utilized (Zhao, Griffiths, Griffith, Mullen, 2000). The nonlinear relationships between RSC and model parameters are described by its second order approximation, i.e. a quadratic polynomial, comprising a constant, the 19 parameters par_i, (α_A, α_B, α_G, α_J, λ, ε_A, ε_B, ε_G, ε_H, ε_K, ε_J, η_F, η_E, σ_S, σ_F, L_F, L_G, L_H, MCF) and the permutations $par_i\ par_j$ of the products of all 19 parameters.

$$(19)\quad RSC = c_0 + \sum_{i=1}^{19} c_i par_i + \sum_{i=1}^{19}\sum_{j=1}^{i} d_{ij} par_i par_j + e\,,$$

with c_0, c_i, and d_{ij} being regression coefficients, and e an error term.

Equation (19) is estimated using the 10,000 parameter sets drawn from the uniform distributions and the implied RSC-values. However, to exclude extreme parameter combinations the lowest and highest 2.5% of RSC-values are omitted, leaving 9,500 observations.

OLS-estimation of the response function exhibits an extremely good fit ($R^2 = 0.993$) as well as medium to high levels of significance for a majority of coefficients. About 57% of the coefficients are significant at the 99% level, 3% at the 95% level, and 12% at the 90% level (Table 4 and Table 5).

The elasticity of the Relative Social Costs with respect to the 19 parameters was calculated performing the following Monte Carlo experiment: First, the 9,500 parameter sets and the estimated response function were used to calculate 9,500 RSC "base"-values.

Second, the parameter sets were slightly changed by increasing all 9,500 values of the first parameter, e.g. α_A, by 1% and calculating 9,500 RSC "new"-values. Third, subtracting the 9,500 new RSC values from the 9,500 base-values and dividing the difference by the base values lead to 9,500 elasticity values, i.e. the percentage change of the RSC with respect to a 1% change in the first parameter. The left block of Table 6 reveals that at the mean (median) of all 9,500 calculated elasticity values a 1% change in the parameter α_A decreases the RSC by 0.007% (0.005%) with a standard deviation of 1.8%, a maximum value of 0.055% and a minimum value of –0.092%. The same procedures lead to elasticities for all other parameters. The fact that the minimum elasticities are negative and the maximum elasticities are positive for all parameters reveals how the effect of a change in one parameter depends on the levels of all other parameters. Only four elasticities are significant different from zero at the 90% level or higher: the agricultural share of expenditures for bread grain products (λ), the Lerner index of the downstream industry (L_F), the elasticity of substitution at the food industry level (σ_F), and the marginal cost of public funds (MCF).

Alternatively to the mean value in the left block of Table 6, the first column represents the percentage change in RSC, when one parameter is changed by 1% and all other parameters are kept unchanged at their mean values. The results in the first columns of the left and the right block do not differ significantly from each other. The second and third columns of the right block, RSC_{min} and RSC_{max}, do not denote percentage changes, but the values of Relative Social Cost, when one parameter is set respectively at the lower and upper bound of its associated range, and all other parameters are set at their mean values. The last column, Δ(RSC), simply indicates the difference in the absolute Relative Social Costs ($\Delta(RSC) = RSC_{max} - RSC_{min}$). This can be interpreted as the „imprecision" in RSC due to the fact that in the model, the parameters used are range estimates rather than point estimates. The higher the absolute value of this last column, the greater the gain in the precision of the estimated RSC associated with a narrower parameter range. The parameters λ, σ_F and L_F exhibit the widest ranges. Hence, additional information on their actual values would be most beneficiary to the simulation model.

7. Discussion

As a rule, governments defend their policy as efficient in common political statements. Utilizing a three-stage vertically structured model including upstream and downstream industries it was shown over a wide range of possible model parameter values that the Austrian bread grain policy was quite inefficient in meeting its two main objectives, namely supporting farm income and self-sufficiency. In fact, the social cost could on average have been reduced by more than 40% by using the same policy instruments, but at efficient levels.

Observing that government was very inefficient in achieving the main explicitly stated objectives desires some rationalization. Five rationales are given below: 1) Uncertainty about demand and supply: Demand, but especially supply of agricultural products are influenced by changes in exogenous factors government can not influence and/or not anticipate. Best known examples are weather, technological progress (a good example might be the rapid adoption of genetically modified seeds in the US in the last years) and changes in consumer preferences (e.g. a drastically change in demand for meat due to the BSE crises). However, in the case of the Austrian bread grain market before EU accession no such extreme exogenous shift in demand or supply appeared and changing weather conditions are controlled to some extent by taking three year averages.

2.) Uncertainty about policy effects: Government can not perfectly anticipate how a change in policy will influences the behavior of individuals and firms. With for example an increase in floor price consumers might substitute bread grain products for meat of soybean products and farmers might increase investments in land or agricultural machinery. The exact magnitudes of these changes are not known and sometimes difficult to anticipate.[3] Given this it is not surprising to observe that the actual observed policy will never exactly match with the ex-post algebraically optimal policy. However, the large estimated difference in social cost between the actual and the optimal policy outcome raises the question if this rational is the only (main) sources of observed inefficiencies. It was quite obvious that a (the) main source of inefficiency was the high level of surplus production and the implied expensive export subsidies. The self-sufficiency rate (domestic supply divided by domestic demand) during the period when the examined bread grain policy was in place (1989 – 1994) was on average 136% with a standard deviation of 8%, and therefore, much higher than actually needed to guarantee self sufficiency.

3.) Policy inertia: The static analysis carried out in this study neglects that government can not only choose the type and levels of policy instruments, but also the point in time at which a policy is changed. Therefore, at each point in time government has to decide if the cost of changing a policy are higher or lower as the cost of having a suboptimal policy in place. Only if the latter is true government will change its policy. The cost of changing a policy can be grouped into compliance and transaction cost. Compliance cost evolve from the fact that economic agents (have to) align to a change in policy. An example are investments in machinery and buildings during a high floor price regime that are no longer used to full capacity after a drastically price drop. Transaction cost include cost of necessary changes in the administration and enforcement of the policy as well as political cost of policy acceptance.

4.) Path dependency: Since smaller reforms are usually easier realized than large ones, today's policy (type as well as level of instruments) clearly depends to some extent on yesterday's policy (Koester, 1997). The floor price policy observed in many agricultural markets of developed countries were born and breed from food shortage after World War II.

High producer prices have stimulated investments and production and a supply shift. The same is true for the case of bread grain in Austria. From the end of the 70's supply exceeded demand and production surplus and expenses for export subsidies increased. However, at that time producers were used to and consumers were no longer aware of the high prices of agricultural products and government tried to tame the increasing surplus production by minor adjustments like the introduction of the co-responsibility levy in 1979 or the change to a two-price plan (a higher floor price for a certain amount of bread grain under a quota and a lower floor price for the rest) rather than a radical change in the support system.

5.) Implicit policy objectives: From a political economy point of view government does not act like a benevolent dictator, but rather tries to maximize its probability to stay in power. Hence, instead of (or in addition to) following the explicit (official) objectives, it also has implicit (not officially mentioned) policy objectives. For example, Salhofer, Hofreither and Sinabell (2000) discuss that beside farmers upstream and downstream industries had considerable formal (institutionalized) and informal influence in the agricultural policy decision-making process in Austria. Moreover, they confirm that upstream and downstream industries clearly benefited from the existing policy. Therefore, from a political economy point of view one could argue that though support of upstream and downstream industries never was an explicit official goal of farm policy, following political pressure from this group it was an implicit (not officially mentioned) policy objective.

The results derived in this study are based on computer intensive simulation and sensitivity-analysis techniques. Therefore, ranges of parameter values, rather than a few specific values are assumed. This has several advantages: First, instead of producing one (or a few) specific but highly uncertain number(s) about the effect of a policy, we are able to give a plausible range as well as a mean. Second, the results of the sensitivity analysis clearly reveal how a change in one parameter influences the results as well as what parameters are especially sensitive to the results. Hence, this gives a hint in which direction additional research effort (time) is invested efficiently.

Footnotes:

[1] In multiplying budget expenditures times marginal cost of public funds it is taken into account that raising money to support the agricultural sector causes distortions in other sectors. Given the small share of the cost of agricultural programmes in the total budget the marginal cost of public funds (MCF) might be a good measure of these additional cost.

[2] Note, that equally one could describe government's decision problem as minimizing social cost, given a certain amount of wealth transfers to farmers and self-sufficiency.

[3] An alternative way to think about this problem is in terms of information cost. The degree to which government can anticipate the effects of a policy change depends on how much information it has about individuals and firms. Clearly there is a trade off between the cost of collecting this information (e.g. by doing surveys) and the cost of implementing a suboptimal policy.

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Table 1: Summary of parameter ranges

Parameter	Range	Parameter	Range
ε_A	0.1 – 0.4	α_A	0.06 – 0.1
ε_B	0.2 – 1.0	α_B	0.29 – 0.39
ε_G	1.0 – 5.0	α_G	0.11 – 0.19
ε_H	1.0 – 5.0	α_J	0.27 – 0.37
ε_J	0.2 – 1.4	λ	0.07 – 0.10
ε_K	1.0 – 5.0	L_G	0 – 0.2
σ_S	0.1 – 0.9	L_H	0 – 0.2
σ_F	0.5 – 1.5	L_F	0 – 0.2
η_E	-0.1 – -0.6	MCF	0.1 – 0.4
η_F	-0.5 – -1.5		

Table 2: Social cost of actual and optimal policy given a normal distribution of parameter values

				95% Probability interval		75% Probability interval	
	Mean	Median	Std. Dev.	from	to	from	to
Social cost of actual policy	159.3	158.6	23.2	116.3	206.2	131.4	188.4
Social cost of optimal policy	91.2	91.1	24.0	45.0	138.7	61.7	120.9
Percentage improvement	0.44	0.42	0.08	0.32	0.63	0.35	0.53

Table 3: Social cost of actual and optimal policy given a uniform distribution of parameter values

				95% Probability interval		75% Probability interval	
	Mean	Median	Std. Dev.	from	to	from	to
Social cost of actual policy	158.9	157.2	30.4	104.3	221.5	122.2	197.5
Social cost of optimal policy	90.2	89.3	31.6	31.4	152.8	51.5	129.7
Percentage improvement	0.45	0.43	0.11	0.30	0.72	0.33	0.59

Table 4: Values of the coefficients of the surface response function

Const.	$Par_{i\backslash j}$	1	α_A	α_B	α_G	α_J	λ	ε_A	ε_B	ε_G	ε_H	ε_K	ε_J	η_F	η_E	σ_S	σ_F	L_F	L_G	L_H	MCF
	α_A	0.305	-0.445	-0.030	-0.155	0.053	-0.105	0.080	-0.114	0.048	0.011	-0.002	0.045	0.003	0.119	-0.051	-1.334	-0.010	-0.294	-0.205	-0.738
	α_B	-0.388		-0.392	0.233	0.068	0.026	-0.050	0.023	-0.100	0.020	0.002	-0.003	0.035	0.005	0.045	0.049	-0.332	0.096	-0.033	-0.061
	α_G	-0.162			-0.041	0.077	0.002	0.004	0.027	0.046	-0.007	-0.010	0.020	-0.001	0.030	-0.026	-0.008	0.034	0.888	0.005	-0.115
	α_J	0.036				-0.002	0.015	0.072	-0.181	0.009	-0.020	-0.002	0.127	-0.026	0.003	0.001	0.001	-0.016	-0.017	-0.262	0.192
	λ	-48.461					-3.706	2.371	0.837	10.275	8.301	0.186	-2.188	-2.788	0.171	0.062	0.165	0.054	0.825	0.139	111.352
	ε_A	-0.020						0.038	-0.036	0.030	0.015	0.011	-0.019	0.009	-0.009	-0.001	0.000	0.000	0.000	-0.013	-0.013
	ε_B	-0.105							0.097	-0.031	-0.016	0.053	0.044	-0.014	0.026	-0.016	0.001	0.000	-0.003	-0.001	-0.017
	ε_G	-0.021								-0.001	0.001	-0.001	0.006	0.002	0.000	-0.001	-0.002	0.000	0.000	0.000	0.001
	ε_H	-0.073									-0.003	-0.010	-0.001	0.015	0.006	-0.002	-0.003	-0.004	0.000	0.000	0.003
7.058	ε_K	-0.042										-0.002	0.000	-0.003	0.029	-0.003	0.000	-0.001	-0.015	0.001	0.001
	ε_J	-0.109											-0.009	0.000	0.001	0.079	-0.002	0.000	-0.001	-0.034	0.005
	η_F	1.994												0.117	-0.041	-0.006	-1.429	-0.110	-0.003	0.052	0.141
	η_E	0.493													-0.046	0.024	0.003	-0.182	-0.093	0.013	-0.028
	σ_S	-0.052														0.054	0.047	0.003	0.004	0.010	-0.010
	σ_F	-1.886															-0.296	0.091	0.044	0.391	0.196
	L_F	-4.096																-0.303	0.138	0.065	0.754
	L_G	-0.278																	0.003	0.031	0.030
	L_H	-0.579																		-0.023	0.047
	MCF	1.162																			0.043

Table 5: Significance of the coefficients of the surface response function

Const.	$Par_{i\backslash j}$	1	α_A	α_B	α_G	α_J	λ	ε_A	ε_B	ε_G	ε_H	ε_K	ε_J	η_F	η_E	σ_S	σ_F	L_F	L_G	L_H	MCF
	α_A	+	+++		+		+++	+++	+++	+			+++		+++		+				+
	α_B	+++		+++	+++	+		+++	++	+++	+		+	+++	++	+++	+		+		
	α_G	+			+	+			+++	+++			+++		+++	+++			+		
	α_J							+	+++		++		+++	+++	+			+			++
	λ	+++					+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++		+++
	ε_A							+++	+++	++		+++	+++	+++	+					+++	+
	ε_B	+++							+++	+++	+++	+++	+++	+++	+++	+++	+		+++	+++	+++
	ε_G	+++								+		+	+++	+++		+++	+++			+++	+++
	ε_H	+++									+++	+++		+++	+++	+++	+++	+++		+++	+++
+++	ε_K	+++										+++		+++	+++	+++	+	+++	+++	+++	+++
	ε_J	+++											+++			+++	+++		++	+++	+++
	η_F	+++												+++	+++		+++	+++	+	+++	+++
	η_E	+++													+++	+++		+++	+++	+++	+++
	σ_S	+++														+++	+++			+++	+++
	σ_F	+++															+++	+++	+++	+++	+++
	L_F	+++																+++	+++	+++	+++
	L_G	+++																		+	+
	L_H	+++																		+	++
	MCF	+++																			+++

+++ represents a 99% significance level, ++ represents a 95% significance level, + represents a 90% significance level,

Table 6: Sensitivity Analysis

	Monte Carlo-results (n=9500)					Evaluation at parameter means			
Par.	**Mean**	**Median**	**S.E.**	**Min**	**Max**	**Avg.**	**RSC_{min}**	**RSC_{max}**	**Δ(RSC)**
α_A	-0.007	-0.005	0.018	-0.092	0.055	-0.006	0.418	0.417	-0.001
α_B	-0.035	-0.033	0.055	-0.245	0.168	-0.036	0.420	0.415	-0.004
α_G	-0.001	-0.002	0.018	-0.064	0.087	-0.002	0.418	0.417	0.000
α_J	0.015	0.015	0.021	-0.059	0.105	0.015	0.417	0.419	0.002
λ	-1.106***	-1.187	0.277	-1.588	0.118	-1.232	0.494	0.364	-0.130
ε_A	0.000	0.000	0.005	-0.028	0.027	0.000	0.418	0.417	0.000
ε_B	-0.016	-0.012	0.032	-0.153	0.094	-0.015	0.419	0.411	-0.008
ε_G	-0.019	-0.023	0.015	-0.049	0.059	-0.029	0.431	0.415	-0.016
ε_H	-0.054	-0.064	0.034	-0.129	0.136	-0.078	0.453	0.409	-0.044
ε_K	-0.016	-0.018	0.024	-0.080	0.102	-0.023	0.428	0.415	-0.013
ε_J	-0.011	-0.011	0.014	-0.061	0.055	-0.015	0.424	0.415	-0.009
η_F	-0.109	-0.098	0.078	-0.366	0.225	-0.132	0.388	0.466	0.079
η_E	-0.176	-0.158	0.108	-0.539	0.076	-0.177	0.374	0.448	0.074
σ_S	0.005	0.005	0.012	-0.069	0.073	0.007	0.414	0.419	0.005
σ_F	-0.538***	-0.543	0.138	-1.028	0.123	-0.644	0.603	0.332	-0.271
L_F	-1.023**	-1.058	0.417	-2.116	0.604	-1.124	0.478	0.372	-0.106
L_G	-0.007	-0.012	0.032	-0.088	0.125	-0.013	0.419	0.417	-0.001
L_H	-0.019	-0.029	0.074	-0.225	0.317	-0.031	0.420	0.417	-0.003
MCF	0.107**	0.101	0.054	-0.068	0.287	0.118	0.389	0.448	0.059

*, **, *** indicate a significance level of 90%, 95%, and 99%, respectively.

Figure 1: Bread grain market and policy

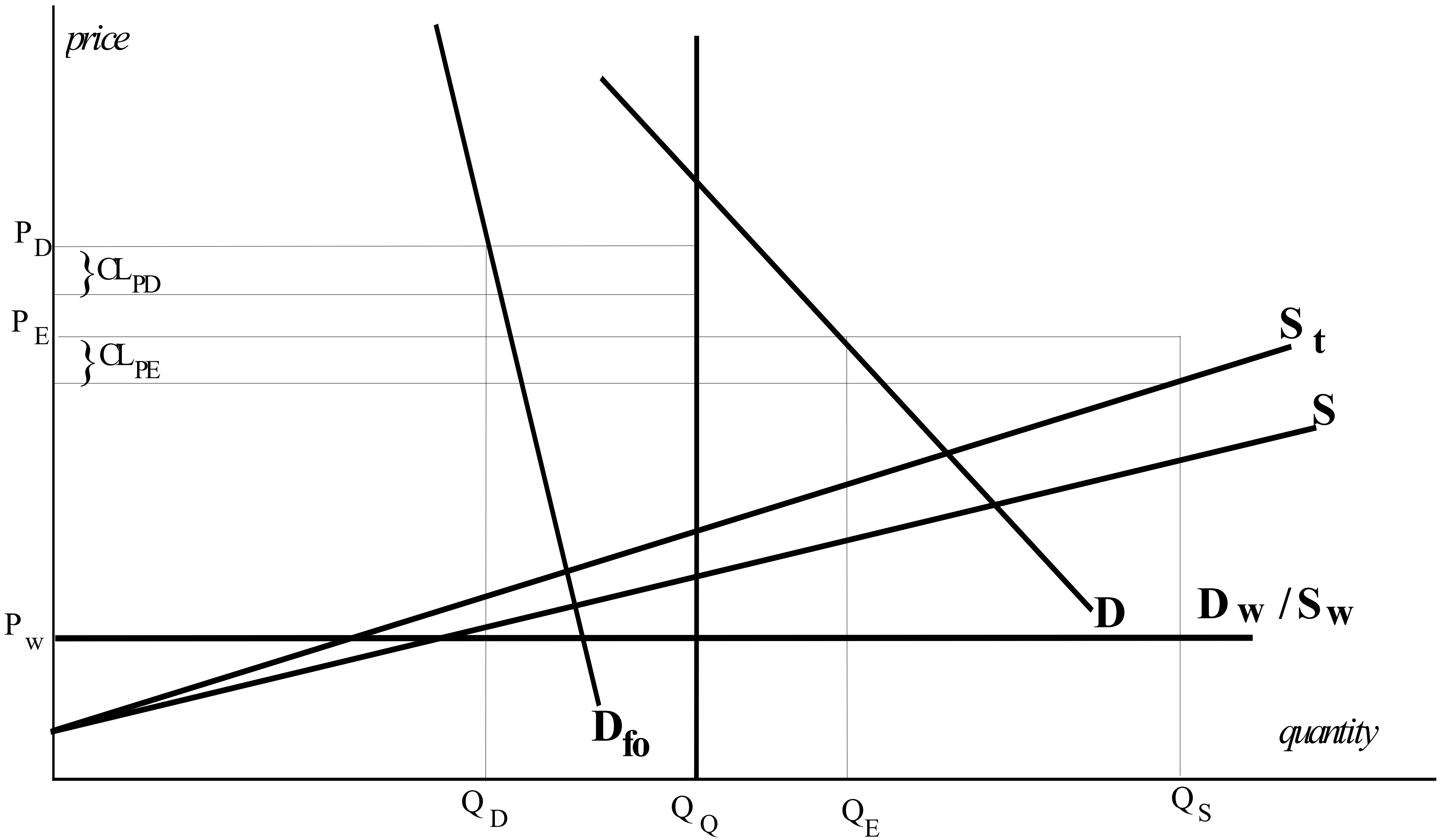

Figure 2: Social cost of actual and optimal policy