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Sugar and Sugar Beet Policy Reforms in Turkey

Yasar Akcay and Meral Uzunoz
Department of Agricultural Economics, Faculty of Agriculture,
Gaziosmanpasa University, 60240-Tokat, Turkey

Abstract: The translog cost function is applied to analyze input demand in Turkey sugar beet production from 1975 to 2003. Sugar and sugar beet production became an important issue after the sugar act changed in 2001. Although the political aspects of sugar beet production have been studied extensively, few studies are available on the quantitative aspects of sugar beet production in Turkey. The main goal of the study was to estimate input substitution and the elasticity of demand for the factors of sugar beet production. The computed factor demand elasticities show that the demand for the four factor inputs (labor, land, energy and fertilizer) considered in the analysis is inelastic with respect to changes in factor prices. Sugar beet production has a feature of traditional labor-intensive farming in Turkey. Current sugar and sugar beet policy may induce the farmers to adopt more efficient production and management techniques, enabling them to remain viable in a liberalized market setting.

Key words: Sugar and sugar beet, translog cost function, factor demand, Turkey

INTRODUCTION

Sugar beet is very important crop in agriculture production pattern in Turkey. The value of sugar beet production represents 2.5% of the total value of total crop production. Sugar production has a share of 10 % in Europe and 8% in the world (Anonymous, 2005a). Sugar is also one of the most important commercial products in terms of added value in Turkey's economy. Turkey started sugar production in 1923 and sugar production became a monopoly under the control of the government after enacting the sugar monopoly act in 1929 (Kıymaz, 2002). The Sugar Factories Corporation of Turkey was established in 1935 to unify Sugar Factories and to balance sugar production and consumption. The sugar act (No. 6747) was enacted in 1956 and all laws related to the sugar sector were unified under one law that applied until 2001 when a new sugar act was passed (Yavuz, 2004). However sugar and sugar beet production became an important issue after sugar law changed in 2001.

The sugar support price has been determined at the level of 10% above production cost for sugar beet containing 16% sugar with additional sugar content and an early harvest premium having been further paid. Also sugar beet farmers have received early payments of up to 40% before the harvest (Ozcelik and Fidan, 2002). Sugar production is protected from low world prices using a high level of tariff. This tariff was declared as 150% above the world price and was reduced by 10% until 2004 (Yucel and Unal, 2002).

Although the political aspects of sugar beet and sugar production have been studied extensively, few studies (Akcay and Esengun, 1997, 1999, 2000) are available on the quantitative aspects of sugar beet and sugar production in Turkey. In recent years, many studies have been made on the political evaluation of sugar beet production (Gunes and Gulcubuk, 2002; Ozcelik and Fidan, 2002; Konyalı and Gaytancıoglu, 2002; Oguz *et al*., 2002; Yucel and Unal, 2002; Yavuz *et al*., 2002; Yavuz, 2004; Gunes *et al*., 2004; Koc and Fuller, 1998). However, there is still a need for further study, especially in the quantitative study related to the production structure and input usage in the sugar beet farming having a share of 12.5% (500 000) in the total farms. The specific objective of the study was to estimate input substitution and the elasticity of demand for the factors of sugar beet production. Besides, the study is expected to provide meaningful parameters that would be of valuable use for the policy planners.

MATERIALS AND METHODS

The translog cost function is applied to analyze input demand in Turkey sugar beet production from 1975 to 2003. In this study, secondary data were used to carry out to the study. The data required for estimating the cost function are the total cost of inputs, the quantity of sugar beet and the prices and cost shares of four factors of production such as labor, land, energy and fertilizer. The data related the cost was collected from various

Corresponding Author: Dr. Yasar Akcay, Department of Agricultural Economics, Faculty of Agriculture, Gaziosmanpasa University, 60240-Tokat, Turkey Tel: +90 356 252 16 16 Fax: +90 356 252 14 88

institutions, Turkey Sugar Factories Corporation (TSFC) (Anonymous, 1975-1998) Records, State Institute of Statistics (SIS)(Anonymous, 2005b) and Annual Statistics of Sugar Beet Production Cooperatives (Anonymous, 2002).

The present study assumes that the farmer sugar beet production technology is represented by the following translog cost function (Christensen *et al*., 1973).

$$C = f(Y, P_i, t) \quad (1)$$

where, C is total cost of production; Y is total production and P_i are the prices of inputs. The cost function is a positive and non-decreasing function in Y, linearly homogeneous, concave and continuous in P_i for all positive rates of output and it is twice differentiable with respect to P_i.

The specific functional form all the cost function (1) is expressed in terms of the generalized translog cost function of the form (Mao and Koo, 1997):

$$\begin{aligned} \ln C = {} & \beta_0 + \beta_q \ln_q + \sum_{i=1}^{n} \beta_i \ln P_i + 1/2\alpha_{qq}(\ln_q)^2 + \\ & 1/2\sum_{i=1}^{n}\sum_{j=1}^{n} \delta_{ij}\ln P_i \ln P_j + \sum_{i=1}^{n} \alpha_{qi}\ln Q \ln P_i + \\ & \phi_t T + 1/2\phi_{tt}T^2 + \phi_{tq} T\ln Q + \sum_{i=1}^{n} \phi_{ti} T \ln P_i \end{aligned} \quad (2)$$

Linear homogeneity of degree one of the cost, C, in input prices requires the imposition of the following restrictions on the parameters of (2) (Chambers, 1984; Al-Muttari and Burney, 2002):

$$\sum_{i=1}^{n} \beta_i = 1 \text{ and } \sum_{i=1}^{n} \delta_{ij} = \sum_{j=1}^{n} \delta_{ji} = \sum_{i=1}^{n} \phi_{ti} = \sum_{i=1}^{n} \alpha_{qi} = 0$$

and $\boldsymbol{\delta}_{ij} = \boldsymbol{\delta}_{ji}$ for all i, j is assumed since the Hessian of the twice differentiable cost function is symmetric.

By using Shephard Lemma, which implies that $\partial C/\partial P_i = X_i$, is X_i is the cost minimizing input demand, we find the cost shares of input i, S_i, as:

$$\frac{\partial \ln C}{\partial \ln P_i} = \frac{\partial C}{\partial P_i}\frac{P_i}{C} = \frac{X_i P_i}{C} = S_i \quad (3)$$

and the input demand functions expressed in terms of the cost shares are derived from the translog cost function by differentiating (2) as (Hoque and Adelaja, 1984; Bernt, 1991),

$$\frac{\partial \ln C}{\partial \ln P_i} = S_i = \beta_i + \sum_{j=1}^{n} \delta_{ij} \mathrm{In} P_j + \alpha_{qi} \mathrm{In} q + \phi_{ti} T \quad (4)$$

In the case of translog cost function, the AES are derived in terms of cost shares and the coefficients of the cost function (Binswanger, 1974).

$$\sigma_{ij} = \frac{\delta_{ij} + S_i S_j}{S_i S_j}, \quad \text{for all i and j, } i \neq j;$$
$$\sigma_{ii} = \frac{\delta_{ij} + S_i^2 - S_j}{S_i^2} \quad \text{for all i.} \quad (5)$$

The AES can also be used to obtain price elasticity of input demand (ε_{ij}) by multiplying the AES by the cost shares as

$$\varepsilon_{ij} = \sigma_{ij} S_j \quad \varepsilon_{ii} = \sigma_{ii} S_i \quad \text{for all i and j} \quad (6)$$

At constant output, two factors are termed as substitutes (complements) to each other as $\boldsymbol{\sigma}_{ij}$ is positive (negative).

AES provides no information about the curvature of the isoquant and the relative cost shares, and cannot be interpreted as the marginal rate substitution, and that the AES is completely uninformative. Morishima proposed an alternative measure of the factor substitution, known as the Morishima Elasticity of Substitution (MES). The MES is defined as logarithmic derivative of a quantity ratio with respect to a Marginal Rate of Substitution or a ratio of input prices. It measures the curvature of the isoquant and the effects of changes in price ratios on relative cost shares. MES can be written as (Burki, 2004; Boland and Marsh, 2005),

$$\omega_{ij} = \varepsilon_{ij} - \varepsilon_{ii} \qquad i \neq j \quad (7)$$

In this study, the parameters of the translog cost function and cost share equation are estimated using the Zellner's seemingly unrelated regression technique. Shazam (version 8.0) (White, 1993) were used to estimate the system of equations.

RESULTS AND DISCUSSION

The estimated parameters of the translog cost function are presented in Table 1. Most of the parameters were highly significant at 1% level. The cost shares were all positive indication that the monotonicity of the cost function with respect to input prices were satisfied globally.

With the parameter estimates of the translog cost function, the AES were calculated according to Eq. 5. The positive signs are indicative substitutory relationship while negative signs imply complementary relationship.

Table 1: Parameter estimates of the translog cost function for sugarbeet production

Variable	Parameter estimate	Standard error	T-ratio
Intercept	0.13128	0.19607E-01	25.071
P_r	0.24255	0.45822E-01	5.2932
P_rP_l	0.24741E-01	0.93870E-03	26.357
P_rP_e	0.23746E-01	0.86196E-03	27.549
P_rP_f	-0.13108E-01	0.30116E-02	-4.3526
P_rQ	0.82724E-02	0.50811E-02	1.6281
P_rt	-0.45576E-02	0.11064E-02	-4.1193
P_r^2	-0.35379E-01	0.31473E-02	-11.241
P_l	0.11328	0.17403E-01	6.5091
P_lP_e	0.19531E-01	0.53925E-03	36.218
P_lP_f	0.20110E-01	0.27931E-02	7.1998
P_lQ	0.36355E-02	0.20619E-02	1.7632
P_lt	-0.18092E-02	0.44493E-03	-4.0663
P_l^2	-0.64382E-01	0.26631E-02	-24.175
P_e	0.18187	0.19685E-01	9.2391
P_eP_f	0.11701E-01	0.23575E-02	4.9633
P_eQ	0.35912E-02	0.22147E-02	1.6215
P_et	-0.19869E-02	0.47451E-03	-4.1872
P_e^2	-0.54978E-01	0.22547E-02	-24.383
P_f	0.46231	0.78794E-01	5.8673
P_fQ	-0.15499E-01	0.93274E-02	-1.6617
P_ft	0.83537E-02	0.20227E-02	4.1301
P_f^2	-0.18703E-01	0.80028E-02	-2.3370

Table 2: Allen Elasticities of Substitutions (AES) of factor demand of sugar beet

Input	Labor	Land	Energy	Fertilizer
Labor	-9.5674			
Land	1.5757	-2.6005		
Energy	2.0242	1.5636	-9.2489	
Fertilizer	1.3136	0.9088	1.1844	-1.2496

Among the positive AES's, AES of labor for energy was found to be the highest as compared to that of land for labor, land for energy, labor for fertilizer and energy for fertilizer (Table 2). The AES between labor and energy is positive and large indicating that they are not only good substitute, but also their demand is very sensitive to changes in factor prices. All these suggested that labor was substitutable for energy, land, fertilizer and the substitutability of labor appeared to be stronger for energy than land. If the price of labor increased than the growers are probably to reduce the use of labor to a reasonable extent. Reduced use of labor might result in lower production. The farmers would be consequently to adjust labor use with energy fertilizer and land. So farmers would respond by switch over to higher use of energy and fertilizer to some extent. In the event of higher labor price, the way followed by farmers may be to increase the use of energy and fertilizer to increase the productivity to compensate the loss of production due to lower use of labor. There was also a substitutory relationship between land and energy. If the unit land rent price increased than the use of land decreases consequently the use of energy might be increases because sugar beet production is highly sensitive to the use of energy in view of intensive farming.

Table 3: Estimated own and cross price elasticities of factor demand of sugar beet

Input	Labor	Land	Energy	Fertilizer
Labor	-0.3260	0.4877	0.2769	0.6075
Land	0.2184	-0.8049	0.2139	0.4203
Energy	0.2806	0.4839	-1.2653	0.5478
Fertilizer	0.1821	0.2813	0.1620	-0.5779

Table 4: Morishima Elasticities of Substitution (MES) of factor demand of sugar beet

Input	Labor	Land	Energy	Fertilizer
Labor		1.8137	1.6029	1.9335
Land	1.0233		1.0188	1.2252
Energy	1.5459	1.7492		1.8131
Fertilizer	0.7600	0.8592	0.7399	

All of the own price elasticities are inelastic as they below one. But the magnitude to own price elasticity of derived demand for energy is the highest (1.2653) compared to those of land (0.8049), fertilizer (0.5779) and labor (0.3260). Within the given inelastic demand for inputs energy, land and fertilizer were relatively more price responsive as compared to labor. The elasticity of energy with respect to its own price (-1.2653) is very high, which indicates that demand for energy was highly responsive to fall in price of energy (Table 3). The cross price elasticities of demand explain the same relationship as AES although the magnitudes are different.

In contrast with the Allen elasticity, which is partial adjustment to the price of one factor, the Morishima elasticity of substitution reflects the adjustment of relative factors in response to a change of relative factor prices.

All Morishima elasticities of substitutions are positive indicating that they are substitutes. These estimates show that the elasticity of substitution between labor and fertilizer is high, followed by labor and land, and labor and energy (Table 4). MES for fertilizer with respect to labor is larger than the elasticity of labor with respect to rental rate of land. This means that an increase (decrease) in the price of labor increases (decreases) the demand for fertilizer relatively more than a similar increase in the price of fertilizer affecting the demand for labor.

CONCLUSIONS

The computed factor demand elasticities show that the demand for the four factor inputs (labor, land, energy and fertilizer) considered in the analysis is inelastic with respect to changes in factor prices. However, the demand for energy and fertilizer are more elastic than for labor in Turkey sugar beet production. As for the nature of relationship between different factors of production, the findings indicate that substitution elasticity between energy, fertilizer and labor is positive, implying that, the two factors of production are substitute. In other words, a rise in the price of one of the factors (energy or labor) is expected to increase the demand for other factor. In the AES, it is found out that labor was substitutable for energy, land and fertilizer, also labor for energy was found to be the highest as compared to that of other inputs for labor in the sugar beet production. In the MES, it is found out that labor was substitutable for energy, land and fertilizer as the same as AES and the elasticity of substitution between labor and fertilizer is high, followed by labor and energy in the MES. These results have shown that sugar beet production has a feature of traditional labor-intensive farming. And also it can be said that sugar beet farmers do not have competition power. Current sugar and sugar beet policy may induce the farmers to adopt more efficient production and management techniques, enabling them to remain viable in a liberalized market setting. However, if the competitiveness is not created in the sugar and sugar beet production, Turkey may be dependent on imported sugar.

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