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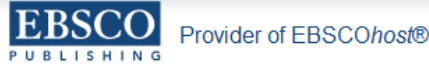
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An Econometric Analysis of Soybean Production in Turkey

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The aim of this study is to analyze the econometric analysis of soybean agriculture in Turkey and the effects of economic crisis on soybean agriculture. The data used in the study includes 1981-2008 years. The dependent variable used in the study is soybean production amount and the independent variables are soybean import amount, soybean import price, soybean oil production amount and soybean yield. Crisis years have been added as dummy variable in order to determine the effect of the crisis. Vector error correction model has been used as an analysis method.

As a result of the statistical analysis, it has been determined that the independent variables are statistically significant. The determination coefficient has been found as 0.61. According to estimated VEC model, a significant relation between crisis and import amount, import price and soybean yield has not been determined. Nonetheless, there seems to be a negative relationship between crisis and soybean production amount and soybean oil production amount. It has been determined that both soybean production amount and soybean oil production amount have decreased in the crisis after 1981.

Key words: soybean, vector error correction, price elasticity, import elasticity

Türkiye’de Soya Üretiminin Ekonometrik Analizi

Bu çalışmanın amacı Türkiye’de soya tarımının ekonometrik analizini ve Türkiye’de yaşanan ekonomik krizlerin soya tarımındaki etkilerini incelemektir. Çalışmada kullanılan veriler 1981-2008 yıllarını kapsamaktadır. Çalışmada kullanılan bağımlı değişken soya üretim miktarı, bağımsız değişkenler soya ithalat miktarı, soya ithalat fiyatı, soya yağı üretim miktarı ve soya verimidir. Krizin etkisini görmek için kriz yılları kukla değişken olarak eklenmiştir. Analiz yöntemi olarak ise VEC modeli kullanılmıştır.

Yapılan istatistik analiz sonucunda, bağımsız değişkenlerin tamamının istatistiksel olarak anlamlı olduğu sonucuna ulaşılmıştır. Determinasyon katsayısı 0.615691 olarak bulunmuştur. Tahmin edilen VEC modeline göre, Türkiye’deki krizlerle ithalat miktarı, ithalat fiyatı ve soya verimi arasında anlamlı bir ilişkiye rastlanmamıştır. Bununla birlikte kriz yılları ile soya üretim miktarı ve soya yağı üretim miktarı arasında ters yönlü bir ilişki olduğu yönünde bulgulara rastlanmıştır. 1981 sonrası yaşanan krizlerde gerek soya gerekse soya yağı üretim miktarlarının düştüğü görülmüştür.

Anahtar Kelimeler: soya, vektör hata düzeltme, fiyat esnekliği, ithalat esnekliği

Introduction

Agriculture sector has important contributions on economic development in terms of meeting raw material and crop requirement and transferring capital and labor force to other sectors. Today, increasing of global warming and decreasing of water sources gradually redoubles the importance of agriculture sector. In order to take place among the countries which are self sufficient on international competition and food area, the necessity of redoubling the efficiency and productivity of agriculture sector appears.

Soybean is an important crop which is used in human and animal nourishment with % 18-20 oil and % 40-45 protein content. This crop has been

accepted as an opportunity crop by countries as it is used in innumerable areas in industry. Besides human nourishment, soybean is important in animal nourishment with its high and qualified protein content. Modern medical science has proved the necessity of soybean usage on prevention-treatment of many illnesses by various scientific experiments. Apart from these utilities, this miraculous crop increases the yield of the crops which will be planted afterwards by giving nitrogen to the soil and it provides nitrogen saving by this way.

Soybean not only takes place as the first crop in terms of oil plants production in the world but

also it acquires the status of the crop which the countries produce or import immensely by its industrial usage area. It can be said that planting areas of soybean increase rapidly but the production in our country is so inadequate that import is necessary (Olgun, 2007).

In this study, the relations between soybean production amounts, soybean oil production amounts, soybean yields, soybean import amounts and soybean import prices of 1981-2008 have been analyzed by vector error correction model (VECM). Besides, the effects of economic crisis after 1980 in our country on soybean have been analyzed. Economic crisis after 1980 have been added as exogenous variable to the model.

Bruno and Easterly (1998) have implied that there isn't any relation between inflation and growth in long period and the negative directed relation between these two variables can be possible in the periods that the crisis result in with only high inflation. In the study carried out by Temurlenk (1998), common attitudes between outcomes, unemployment, prices, financial wages and nominal money supply variables of Turkey have been analyzed by VAR model. Graff (2002) has implied that there will be no causality between financial development and economical growth in the case of their growth at the same rate and there will be negative effect of financial development on economical growth as it is not stable in financial crisis environment. Griffith (2004) has considered that research-development (R-D) is statistically and economically significant in both technologic growth and novelty as a result of panel management applications of 12 OECD countries. Korkmaz (2010) has analyzed the relationship between research-development (R-D) expenses and economic growth with co-integration method by using annual datum between 1990 and 2008 periods.

Barro (1990) and Barro (1991) have emphasized that public expenses in internal growing models would make accelerator effect in growing process. Direkçi (2006) has determined that budget deficits have increased but increase per m² has decreased national income. Besides, increases in interest ceiling, exchange rate and current account deficit have affected national income.

The aim of the study carried out by Çetinkaya and Şahin (2009) was to analyze the relationship between public expenses and total production level in Turkey. By this purpose, it has been

benefited from Turkey annual public expenses for 1924 and 2007 and GDP datum set. The relationship between the variables has been expected by generalized impact-response functions which have been obtained from least square method, Johansen co-integration test, Granger causality test and vector error correction model.

Long term relationships and short term dynamics between real exchange rate and short and long maturity capital functions have been analyzed by vector error correction model and vector autoregressive model by considering structural breaks (Kıran, 2007). In the study carried out by Türkekul (2007), inflation growing relation in Turkey has been tested for 1988:1-2005:4 periods.

In the study carried out by Aslan (2008), the role of tourism on long term economic development of Turkey has been studied for 1992:1 and 2007:2 periods. The results show that tourism sustains the economic growth of Turkey approximately for last 15 year period.

In the study which Aktaş et al. (2010) have studied the macro economic effects of economic crisis after 1980 on Turkey agriculture, it has been found that there is a positive relation between real exchange rate and export whereas there is negative relation between agricultural import and comparative prices.

Soybean Production in Turkey

Although Turkey soils are considerably efficient for soybean production, the crop can't be produced enough and only % 5 of consumed soybean can be produced. Although soybean production has increased between 1980 and 1990, production has decreased beginning from 1991 and import has increased. Today, we can produce only 5 percent of 1 million tons of soybean that we import (Şenol, 2006).

When taken into consideration that annual vegetable oil need and import of Turkey is high, including soybean to planting systems in the following years and expanding the production is wanted. Great majority of soybean production (% 78) in Turkey is provided from second crop production in Çukurova region (Tayyar and Gül, 2007).

In Turkey, soybean has started to be planted with kind researches as a main crop in Black sea region during First World War and as a secondary crop in

Mediterranean and Aegean regions (İşler and Coşkan, 2009). Soybean production has reached to 10-12 thousand production levels but it has fallen to 2000 tons at the end of 1970's. As a result of vegetable oil crisis in the mentioned years, significant increases have been noticed in soybean production in 5-6 years by the projects which have come into effect in the scope of second crop research project that has begun to be applied in 1981 by Ministry of Agriculture and Forestry and by the incentives (Nazlıcan, 1988).

It has been noticed that soybean production has steadily increased from 1981 to 1987 but it has decreased in the following years. Although soybean planting area was 112000 ha and production amount was 250000 tons in 1987, planting area and production have decreased to 10 512 ha and 36569 tons (Fao, 2010). In this decrease, some reasons as the storage and financing problems of enterprises, applied price policies, tendency of the producers to different products as maize, etc have been effective (Şenol, 2006). Despite the decreasing production, our soybean import increases rapidly. According to 2008 data, soybean seed import has been as 1 239 970 tons (Fao, 2010). The import numbers show that the demand to soybean is considerably great in our country (Karasu, Öz, Göksoy, 2002). In Table 1, planting area, production amount, yield and import amount of soybean between 1981 and 2009 have been given.

Material and Method

In this study, the relationships between soybean production amount, soybean production amount,

yield, soybean import amounts and prices have been analyzed for 1981 and 2008 years. Amount and price indexes of these variables have been obtained from FAO. Besides, economic crisis after 1980 have been taken as dummy variable. Logarithms of the variables have been taken in order to provide the direct elasticity of the model coefficients.

Interaction between the variables has been determined by vector error correction model. Before vector error correction model, it has been searched that whether or not the series are stationary by Dickey-Fuller Unit Root Test.

Time Series

Time series can be described as the arrangement of the values which the observed variables take according to time. For example, the series which show the annual import amount, monthly average temperature, daily magazine sale, hourly traffic intensity are qualified as time series. Time series analysis aims to estimate by including the past by the helps of observation values related with late periods. When making such estimates, it is supposed that the movements of the time series in the past will be in the same tendency in the future (Şahbaz, 2007).

Time series separate as stationary and antistatic according to the deviations from the mean. In a stationary time series, the difference between two values one after another in a series results from only time interval, not from the time itself. The practical result of the relation in a stationary series is that the average of the series will not change by passage of time.

Table 1. Soybean Planting Area, Yield, Production Amount and Import Amount in Turkey

Years	Planting area (ha)	Yield (kg/ha)	Production amount (ton)	Import amount (ton)
1981	17000	8823	15000	3725
1985	60225	20755	125000	82399
1990	74000	21891	162000	2374
1995	31000	24193	75000	169392
2000	15000	29666	44500	386708
2005	8600	33720	29000	1154500
2006	11918	39687	47300	1016910
2007	8674	35353	30666	1230910
2008	9444	36489	34461	1239070
2009	10512	36569	38442	-

Source: Fao, 2010, Statistical Database, www.fao.org

If the series is not stationary, autocorrelations considerably deviate from zero or diverge from zero as the arrivals increase or an insincere sample appears. The series have to be stationary in order to place the time series in a suitable model (Kutlar, 2009).

Unit Root Test

The most valid method which is used in order to determine whether or not a variable is stationary or the stagnant degree is unit root test. The most common unit root tests are Dickey Fuller (DF), Augmented Dickey Fuller (ADF) and Phillips-Perron (PP). Standart Dickey Fuller test depends on the assumption that the error terms are independent and distributed similarly. Dickey Fuller test has been changed with two different approaches as the error term distributes as variance or serial correlation. One of these is Augmented Dickey Fuller test which is known as a parametric approach (ADF test). The other one is non parametrical Philips-Perron test. Melson and Plosser (1982) have used the DF test in the analysis of macro economical datum of USA (Kutlar, 2009).

Dickey Fuller unit root test supposes that error terms are statistically independent and have constant variances. Augmented Dickey Fuller test has been corrected against the auto correlation problem of Dickey Fuller test by adding lagged variables to the model. Phillips-Perron unit root test allows the dependence of the error term in a deficient degree and allows its heterogeneous distribution. Thanks to this, an auto correlation problem does not appear (Akıncı, 2008).

In the study, the stationarity analyses of the time series were done with the Augmented Dickey-Fuller (ADF) unit root test, which was developed by Dickey and Fuller (1981). Equation 1 shown below was used in this analysis.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^k \alpha_i \Delta Y_{t-i} + \varepsilon_t$$

(Equation 1)

ΔY_t represents the first difference of the variable, which is analysed for stationarity, t is the general trend variable, and ΔY_{t-i} is the lagged difference terms. The lagged difference terms are used to make the error term consecutive independent. The ADF test is used to determine whether the

coefficient δ is statistically equal to zero. If ADF t statistics are greater than the absolute critical values of MacKinnon (1990), the time series is stationary; otherwise the difference of series should be taken until it provided stationarity.

Definition of VAR Model

VAR models are generally defined as the models in which the auto regressive relationship between the economical variables is examined. In a VAR model, there is no necessity to sort out the variables as dependent and independent in the beginning, because an independent variable does not take place in this model. All of the variables are dependent and many dependent variables are discussed together. Each dependent variable is explained with the lagged values of itself and the other dependent variables in the model.

Autoregressive definition in VAR model results from that the lagged values of a variable takes place on the right hand of the equation. Vector term results from that two or more variables are taken up as a vector type. VAR model is an easy applicable model as it is not required whether the variables are dependent or independent in the beginning (Şahbaz, 2007).

Determination of the Lag Number in VAR Model

VAR model is frequently used among the time series models. VAR model which has been developed by Sims (1980), analyzes the current and past values of the selected variables as a whole and together in the system. Besides, VAR model helps to analyze the effects of the shocks on the variables. In order to determine the suitable lag length in VAR models, LR (Log Likelihood), FPE (Final Prediction Error), AIC (Akaike Information Criteria), SIC (Schwarz Information Criteria) and HQ (Hannan-Quinn Information Criteria) criterion is used (Şahbaz, 2007).

Co-integration Analysis

Co-integration concept is widely used in econometrics analyses starting in early 1980. Co-integration analysis is a method which is used in the modeling and estimation of long term relationship between antistatic time series. In other words, it is used in order to search the

balance relation between time series. If there is a co-integration between series, it gives a clue that the model is well determined. If the linear combination of the two or more time series is stationary although they are not stationary themselves, it can be said that these series are co-integrated. Co-integration method has been developed by Granger (1986). Co-integration between variables means real long term relationship. Co-integration analysis is required to understand whether non-stationary time series work with work values level. According to Engle and Granger (1987), the co-integration concept means that linear combinations of variables act together in the long run if there is a co-integration relationship between two non-stationary variables. The coefficients' vectors referring relationship combinations between of variables are known as co-integration vector.

In recent years, Johansen (1988) developed a method based on maximum likelihood estimation is widely used. Two series, such as X and Y, that are non-stationary on the level were undertaken. In this case, the Vector Error Correction model (VEC), as a vector containing Z, X and Y series for creating the Johansen co-integration test, will be used as shown in Equation 2 below:

$$\begin{aligned} \Delta Z_t &= \delta + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \dots \\ &+ \Gamma_p \Delta Z_{t-p+1} + \Pi Z_{t-p} + \mu_t \end{aligned}$$

(Equation 2)

Γ_i ($i = 1, 2, \dots, k-1$) is the parameter matrices of variables, meaning the delay of the first difference of Z_t vector. Π indicates the parameter matrix regarding level of variables. μ_t indicates the error terms of the model. The Johansen co-integration test is based on finding the rank of Π matrix. If the rank of the Π matrix is zero, there is no co-integration relationship between variables forming the Z vector. If Π matrix rank is one, there is a co-integration relationship between series forming the Z vector. In other words, they move together in the long run. If Π matrix rank is greater than one, there exists a co-integration relationship of more than one between the series.

In the Johansen method, co-integration relationships between the non-stationary series can be analyzed using trace statistics. By examining the rank of Π matrix, trace tests help investigate the null hypothesis (the rank is equal to r or smaller than r, r being the number of co-

integration vectors). The null hypothesis is rejected if calculated test statistics are greater than a critical value on a certain significance scale; otherwise, it is accepted.

Vector Error Correction Model

Long and short term balances in the models which involve antistatic variables are determined by a method which is named as error correction technique. If the findings in any co-integration analysis correct the existence of one co-integrated vector, then the degree of co-integration is predicated by the variables which share an appraisal trend vice versa or the variables which have been adhered in common long term balance. If co-integration composed of for one time, then a vector error correction model which shows the long term relationship between the variables can be designed.

The correction coefficient must take a value between -1 and 0 in an error correction model. Correction coefficient shows the scale degree of the amount to long term target point when it diverges from that point. If the correction coefficient is -1, all of the deviations from balance level get better immediately. On the other hand, if the correction coefficient is 0, any error correction can't be done anyway.

Error correction approach is used in order to determine short term dynamics and discriminate between long term balance and short term dynamics among the variables (Direkçi, 2006).

According to Granger (1988), if there is a co-integrated vector between variables, there must be at least one-way causality between these variables. In such a case, making causality analysis by vector error correction model is more suitable. The advantage of the model which is used in order to discriminate between long term balance and short term dynamics is to be able to use short and long term information of the datum between dependent and independent variables.

Research Findings

In the study, soybean production amount, import amount, import price, soybean oil production amount and soybean yield variables are taken up. The logarithms of these variables have been taken and then analyzed. Economic crisis after 1980 has been used as an external variable.

Augmented Dickey Fuller test has been used in order to test the stationary of the series in this study. The test results have been given in Table 2. First degree differences of the variables are stagnant. Suitable lag length which will be used in VEC model has been expected as 1 in terms of information criteria in Table 3. Table 3 introduces the suitable lag length which befits the lowest value of LR, FPE, AIC, SC and HQ information criteria as one or two. For that reason, lag length in VEC model has been taken as two. According to unit root test, it is seen that all the variables are integrated from the same degree. For that reason, it is necessary to determine whether the series are co-integrated or not. The circumstance that the system consisting of antistatic variables will be in a long term balance relationship can be searched by co-integration test developed by Johansen (Johansen, 1988). Johansen Co-

Integration test results used for this purpose have been given in Tables 4 and 5. Eigen value and trace statistic and 5 percent and 1 percent critical values have been given in the table. As the sample value of test statistic is greater than the critical value in each two significance level, zero hypotheses which states that there isn't any co-integration relationship is rejected. Between variables, there is one co-integration in 1 percent significance level and there are two co-integrations in 5 percent significance level. Maximum eigen value test statistic and 5 percent and 1 percent critical values of this have been given in the table besides the characteristic roots named as eigen. Between variables, there is one co-integration in 1 percent significance level and there are two co-integrations in 5 percent significance level.

Table 2. Test Results for Stationary

Variables	ADF (First degree difference values)	Standard error	Probability
LProduction	-4.186653	0.199485	0.0001
Limport	-4.839584	0.333614	0.0001
Limport price	-5.540501	0.328378	0.0000
LOil production	-5.465136	0.238283	0.0000
LYield	-4.673671	0.251043	0.0000

Table 3. VEC Model Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-43.62367	NA	4.26E-05	4.124897	4.608781	4.264238
1	35.04851	114.9824*	7.34E-07*	-0.003731	.689860*	0.483962*
2	62.38232	29.43641	8.35E-07	-0.183255*	2.720044	0.652790

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 4. Rank Test Results

Hypothesized No of CE(s)	Eigen value	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None**	0.907658	99.81773	59.46	66.52
At most 1	0.631368	40.26142	39.89	45.58
At most 2	0.356206	15.31250	24.31	29.75
At most 3	0.141761	4.303072	12.53	16.31
At most 4	0.019066	0.481261	3.84	6.51

** denotes rejection of the hypothesis at the 5% (1%) level

Trace test indicates 2 cointegrating equation(s) at the 5% level

Trace test indicates 1 cointegrating equation(s) at the 1% level

According to the results from two tables, no statistically significant co-integration between variables has been observed. Namely, this means that there isn't any long term relationship between variables.

As all the variables in the model are stagnant on the same degree, vector error correction model has been used and the relationships between the variables have been explicated. All the variables have been taken as endogenous variables and model prediction has been done. Besides, an

exogenous dummy variable has been added to VEC model in order to determine the effects of the crisis. Estimation results of VEC model have been given in Table 6. As a result of statistical analysis, it has been found that all of the independent variables are statistically significant. 10 percent of increase in import amount will provide 6.3 percent of decrease in soybean production amount. 10 percent of increase in import prices will embolden 9.1 percent of increase in production amount.

Table 5. Eigen Value Test Results

Hypothesized No of CE(s)	Eigen value	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None**	0.907658	59.55631	30.04	35.17
At most 1	0.631368	24.94892	23.80	28.82
At most 2	0.356206	11.00943	17.89	22.99
At most 3	0.141761	3.821811	11.44	15.69
At most 4	0.019066	0.481261	3.84	6.51

*(**) denotes rejection of the hypothesis at the 5% (1%) level

Max-eigenvalue test indicates 2 cointegrating equation(s) at the 5% level

Max-eigen value test indicates 1 cointegrating equation(s) at the 1% level

Table 6. VEC Model Results

Cointegrating Eq		CointEq1			
LProduction(-1)		1.000000			
LImport(-1)		0.631465 (0.07329) [8.61560]			
Limport price(-1)		-0.914763 (0.25116) [-3.64216]			
LOil production (-1)		-0.406960 (0.17768) [-2.29045]			
LYield(-1)		-1.972110 (0.19137) [-10.3054]			
Error Correction Term		-0.417121 (0.19018) [-2.19335]			
Adj.R-squared		0.615691			
F-statistic		4.495424			
Log-likelihood		9.630106			
LM		26.45554			
Jarque-Berra		26.66769			
White Chi-square		354.8073			
	LProduction	LImport	Limport price	LOil production	LYield
DProduction	-0.546910 (0.10716) [-5.10377]	-0.080499 (0.38547) [-0.20884]	-0.098927 (0.15124) [-0.65410]	-0.202409 (0.12116) [-1.67061]	0.013889 (0.03767) [0.36874]

Normal bracket indicates standard error and square bracket indicates t-test.

10 percent of increase in soybean oil production amount will cause 4.07 percent of increase in soybean production amount and 10 percent of increase in yield will cause 19.7 percent of increase in soybean production amount.

Determination coefficient (R^2) has been found as 0.6156 and this value means that dependent variable (soybean production amount) is explained in the ratio of 61.56 percent by the independent variables. Other statistical tests show that the model is valid.

As a result of the analysis, error correction term coefficient has been found as (-0.4171) and it has been determined that t test result (-2.1933) is statistically significant. This shows that the deviations of the variables from long term balance values will be balanced over again.

According to the estimated VEC model, a significant relationship between crisis and import amount, import price and soybean yield has not been determined. Nonetheless, there seems to be a negative relationship between crisis and soybean production amount and soybean oil production amount. It has been determined that both soybean production amount and soybean oil production amount have decreased in the crisis after 1981. If a general evaluation is done, it can be said that soybean production hasn't been affected in crisis processes.

Conclusion

Vegetative oil and residue shortage of our country takes place as the problem on the uppermost level and when the world vegetative oil and residue sources and the trade is examined, it is seen that 70 percent of world residue consumption is soybean and it is consumed more than all of the known residue sources. Soybean is the most important and indispensable input of the feed rations used in white meat industry. When the world vegetative oil consumption composition is analyzed, it is seen that soybean has a great

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ratio as a vegetative oil shortage. Soybean, which must take an important role in order to overcome the vegetative oil shortage, can't develop on the desired level.

Generally, Turkey tries to overcome the vegetative oil shortage and although Turkey tries to reach this aim by increasing producer support, the numbers have always been under expectation. The reflection of the increase tendency on the prices of the world oil seed crops to the country and creating a developing incentive on the producers by giving high premium will make a positive effect. Increasing oil seed planting areas in Turkey is possible and for this purpose, support policies based on premium must be applied. Various field crops and especially oil seed crops against cereals must be accepted as strategic crops and for this reason, customs tax equation which will earn income competition must be provided.

At the present day, increase of the prices will decrease the budget burden by decreasing the subvention amount. However, the premium which will be applied must be announced to the producer by taking planting priority decision and amount. The oil seed production must be increased by no means. Otherwise, Turkey will be up against problems on finding oil seed in a short span of time and naturally on obtaining raw oil and will have more difficulty on overcoming the vegetative oil shortage. For this reason, long time strategies and continuous policies must be applied. The attention of the producer to the subjects which increase the production besides price and on this process, encouragement of the contribution and support of the industry must be provided. It will be an appropriate application to benefit from contractual production method on the encouragement of the producers on growing the kinds which are rich in terms of variety and efficiency.

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