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LAND RENTS IN THE MEDITERRANEAN REGION: A SAMPLE STUDY FROM TÜRKİYE

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Abstract

In this study, factors in field crops affecting land rents are examined in the province of Antalya, in the Mediterranean Region of Türkiye. Wheat, barley, cotton and maize are chosen, and production cost data for these crops and land rents for the years 2001-2019 are used in the analyses. It is found that in Antalya, according to the crops selected, land rents are generally at a level which allowed tenants to make a profit, but that in some years, this is not possible because of a reduction in net income. Fluctuations in net income negatively affect the economic sustainability of agricultural farmers. An examination of the factors affecting land rents prices showed that in the short and long terms, diesel fuel or fertilizer support and production costs had a positive effect on land rents. Difference payment support caused an increase in land prices in the short term, and in the long term had a negative effect on rent prices. Net income caused a land rents reduction in the short term, but in the long term it caused an increase.

Key words**:** *land rents, net income, production costs, panel ARDL.*

INTRODUCTION

Land, which is the basic production factor in agricultural production, and rent, the net income from the land, are among the topics most discussed by economists. From the point of view of economics, rent is the share which the soil, as a means of production, takes from production, or the payment for use of the land for a certain time as the price of the land [26; 40]. Rent appears as the net rental payment when a landowner rents his land out, and from the point of view of the person working the land expresses the net income. The net income of the land shows the highest limit which can be paid as rent for the land in order for production to be economically sustainable.

In economics, there are two basic approaches to the source and emergence of rent: the classical and neoclassical approach and the Marxist approach. Many studies have been conducted on the concept of net income and the factors determining land rents and the value of land [11, 12, 14, 15, 18, 19, 21, 22, 23, 28, 29, 32, 33, 40, 44, 47, 48]. Adam Smith says that land rent is set by the landlord, but on the other hand he says that it will be determined by the power to pay of the farmer, and the factor determining the farmer’s power to pay is the average price of the crop. Ricardo emphasizes the fertility of the soil when defining rent. The value of the land is connected to production costs because production is started on less fertile soil as the value of the land cannot be increased [14, 23, 26, 32].

In many studies of production costs, it is seen that land rent has an important share in production costs [1, 5, 10, 20, 41, 42, 45]. The ability of a producer who works the land to make a profit is dependent on his ability to have an income above the cost of production including land rent. For this, unit product prices must be above unit costs. In this way, economic profit will be positive, and what will determine this is that if the net income obtained from the land (rent) is given as land rent, how much greater it is than the rentals payment which the land will bring. If the owner is working the land, the net income passes directly to the landowner, but if the land is rented out, the rental payment is determined by an agreement of the two parties in accordance with supply and demand, and constitutes the rental income obtained by the landowner [29]. Calculation of net income allows the farmer to assess the state of the land, and determines a limit to his offer of a rental price for the land which he can pay [14, 31].

Land rental is significantly different in different countries, and this difference is seen not only in the proportion of rented land, but also in whether whole farms or small plots are rented. In agricultural farms, short and medium term rental decisions are made according to evaluation, and long term decisions are made according to expectations, the opposite of purchasing decisions [28]. In Türkiye, rental agreements are generally made on a plot basis, orally, and for a year, and all the risk is taken on by the tenant. For this reason, the annual net income obtained from land varies, affected by different factors from the point of view of the tenant. In this study, net income on the basis of selected important crops and the development of land rents are examined in Antalya, a province of Türkiye which has important agricultural potential, and an attempt was made to determine the production factors affecting rental.

MATERIALS AND METHODS

The main material for this study consists of the production cost data for wheat, barley, maize and cotton and land rents in the province of Antalya in the Mediterranean Region of Türkiye. The study considered land rents for the years 2001-2019 and cost data from the Provincial Agriculture and Forestry Directorate. First, an investigation was made of the relation between the net income obtained when the landowner worked the land himself and net rental income, and economic profit. Economic profit was found using equation 1, and equation 2 was used to find the net income obtained by the landowner for use of the land (land rent). Because there are no expenses such as property tax to be paid by the landowner, the provision of rent is accepted as the field rent in the direct product cost tables.

Economic profit = Gross Product Value (GPV) – Total expenses

Land net income = GPV – expenses other than land rental payment

Net income, expenses other than land rental and the effect on rent of supports are examined with the panel ARDL model with the aim of determining the factors affecting land rent. In order to examine the possible effects on the rental price of support given to agriculture, the difference payment support paid for the above-mentioned crops and diesel fuel and fertilizer support are used in the analyses.

Cross-sectional dependence test

Among the variables considered in the study, cross-sectional dependence is examined, and advanced econometric methods such as the unit root test, cointegration tests and homogeneity analyses are used. In order to determine whether or not cross-sectional dependence is among the variables, the Breusch and Pagan (1980) [7] CDLM1 test (LM1), the Pesaran (2004) [37] CDLM2 (LM2) test, the Pesaran (2004) [37] CDLM test (CD) and the Pesaran, Ullah and Yamagata (2008) [38] CDLMadj (LMadj) tests are used. This meant that the H0 hypotheses of the tests did not contain cross-sectional dependence between series.

Panel unit root test

In order to determine whether the values considered in the study included unit root, the Im-Pesaran Shin (IPS) unit root test is used. The IPS test is an analysis developed on a hypothesis in which variables taken as panel data have a heterogeneous parameter. The H0 hypothesis of the result of the IPS test states that it is a unit root. The IPS unit root test is as follows (IM et al., 2003) [24]:

$$\boldsymbol{\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{k=1}^{\rho_i} \theta_{i,k} \Delta y_{it-k} + \alpha_{i,t}\delta_t + \varepsilon_{it}}$$

Panel cointegration test

In order to test whether there is co-integration between the variables in the study, the Pedroni and Kao Co-Integration tests is applied to the panel data set. When the panel data set has a heterogeneous structure, Pedroni (1999) [34] recommends various co-integration tests. These models, under the H0 hypothesis that there is no co-integration, present four Panel test statistics and three group test statistics. The Pedroni Co-Integration Test affects multiple explanatory variables. In this way, it is accepted as a powerful method [3]. Kao (1999) [25] created a co-integration test using the co-integration test and the Expanded Dickey-Fuller and Dickey-Fuller tests [2, 46].

Autoregressive distributed lag bound test

In order to be able to estimate models containing time series, the condition is sought that all variables should be stable at the same level. Bringing the variables into a stable state by taking the first rank differences causes a loss of information in the long term.

The model to overcome this is the Autoregressive Distributed Lag Bound (ARDL) Test model. This model has many advantages: it can be applied to stable variables at different levels; it gives the analysis a dynamic quality by including necessary delay lengths in the model; it allows comparison of short and long term parameters of the error correction (VEC) model obtained as a result of ARDL, and because Autocorrelation is kept under control, the problem of endogeneity does not arise.

The panel ARDL model depends on the mean group (MG) estimator and the pooled mean group (PMG) model. The MG estimator takes the unweighted mean of the long term parameters.

The MG estimator places no constraint on ARDL parameters. Not allowing certain variables to be the same among units forming the panel is a shortcoming of the MG estimator. This shortcoming is eliminated by using the PMG estimator. In this way, it can allow the panel ARDL to have homogeneity in the long term and heterogeneity in the short term [4].

Thus, in order to determine which of these two models should be used, it is recommended by Pesaran et al. (1999) [35] that the Hausman test be conducted in order to test the homogeneity of the parameters in the long term.

The basic ARDL model is as follows:

$$\boldsymbol{\Delta lnY_t = \beta_0 + \sum_{i=1}^{p} \alpha_i \Delta lnY_{t-i} + \sum_{j=1}^{q_m} \delta_j^m \Delta LnX_{t-j}^m + \lambda_0\, lnY_{t-1} + \lambda_m X_{t-1}^m + v_t}$$

where: Y is the dependent variable, X is the independent variables, β0 is the constant term, ν is the well-behaved error term (the full random variable), α and δ are short term parameters, λm and λ0 are long term parameters [36].

After solving the ARDL model, the conditional error correction model is estimated for the independent variables X with the help of the following formula:

$$\boldsymbol{\Delta lnY_t = \beta_0 + \sum_{i=1}^{p} \alpha_i \Delta lnY_{t-i} + \sum_{j=1}^{q_m} \delta_j^m \Delta LnX_{t-j}^m + \phi ECT_{t-1} + v_t}$$

The error correction model is calculated with the inclusion again in the model of the calculated errors (ECT) in the previously calculated ASDL model as an independent variable. A negative ECT parameter value (ϕ) indicates a short term balance relationship. Also, ϕ shows long term balance adjustment speed [39]. The half-life value can be calculated with this parameter value:

$$t_{1/2} = \frac{\ln(0.5)}{\phi}$$

RESULTS AND DISCUSSIONS

Net income, land rent and economic profit

The land rents of the crops examined in Antalya province declined in real terms in 2013 and 2016, and their share in costs also fell. Cotton and maize rents also fell in 2019, and between 2001 and 2019, the share of land rents in production costs fell by between 15% and 59%.

It is seen from Figure 1 that land rents in Antalya are generally at a level compared to crops that allow tenants to make a profit, but because net income is reduced in some years, this is not always possible. When the landowner is renting out his land or when the tenant is renting land, it is expected that the capital used in production will leave a share which will allow its protection with an average profit equal to the capital used in the region [40]. Otherwise, it is not possible for there to be a demand for rental of the land. The highest rent that the tenant can pay is as much as net income [30], but in this case the tenant's profit is zero. Therefore, the tenant is obliged to take profit and risk into account when determining the rent [14]. Factors determining supply and demand create the final rent, and the farmer must take this into account and estimate what level of rent his competitors are willing to pay. Calculation of the net income of the land shows the landlord the maximum level in determining rent. However, the effect of an entrepreneurial personality and land with the same characteristics bring about a willingness to pay differently, the tenant does not give the whole of the net income of the land to the landowner, and the distribution of this between tenant and landowner varies according to regions [14].

Fig. 1. The relation between net income, rent and profit
Source: Special calculations from the data of the Directorate of Agriculture and Forestry.

In determining the rental payment, many factors concerning the type of farming and regional competition have an effect. Renting the whole of a farm or just a part of it and the duration of the rental agreement are affecting factors [14, 28, 29]. On the one hand the rental payment is related to the net income to be obtained by the tenant, while on the other it is related to how much other potential tenants will pay according to the competition in the area [23]. In agricultural production, all risks and opportunities in land rental belong to the tenant, and a fall in yield or a strong reduction in crop prices harms the tenant's income and liquidity. When rental prices are set above base values, risks and opportunities which arise because of changes in yield and crop prices are taken on by the tenant and the landowner together [43].

In agricultural production, income is significantly affected by fluctuations in yield and crop prices. When other conditions remain the same, increasing crop prices increase the expectations of income of the producer, and increase readiness to bear high costs [6]. However high income expectation is, demand is just as high, and rental prices increase [11]. Habermann and Breustedt (2009) [22] researched regional rental differences in Germany using Agricultural Structure Questionnaires, and found that the income of a well-run farm raised the rental price by 10%, and that this value affected neighboring farms, so that they also showed an increase of 7%. Regional differences in rent prices are explained by natural conditions and different farming structures and characteristics related to this, and it has been found that regional competition plays an important role. In a study using a regional econometric approach, Habermann and Ernst (2010) [23] concluded that wheat yield, the share of sugar beet and potatoes, the density of cattle, and the share of perennial culture and horticulture had a positive effect on land rent. Doll and Klare (1996) [11] reported that the main determinant of land rents is natural fertility, and that in multiple regression analysis, 70-80% of the variation in land rents is explained by fertility. Garvert (2017) [14] stated that net income had a significant effect on the land rents of farms, and that for this reason, rent variation between farms and developments in rents over time explained price increases. There are many studies showing that there is a significant positive relationship between support and land prices. It is reported that a 10% increase in support creates a 3.3% to 5% increase in land prices, and a 10% increase in support creates a 6% increase in land rents [14, 22].

Panel ARDL findings

Before passing to the analysis stage, we examined the descriptive statistics obtained in the study, the Variance Inflation Factor (VIF), and the Pearson correlation matrix (Table 1; Table 2). In the model, the land rent is taken as the dependent variable, and the independent variables are, in order, net income (n_income), non-land-rent production cost (cost), difference payment support (sup), and diesel fuel and fertilizer support (soilfr). In examining the results of the Variance Inflation Factor (VIF) for each variable in order to test the problem of multicollinearity between the independent variables, it is seen that there is no multicollinearity between the variables, and that the values are much lower than 5. For this reason, the variables given above are indeed independent of each other and can therefore be accepted as independent variables. It may be said that the independent variables have an effect on land rents.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
rent	95.0000	17.4238	9.4279	4.5707	53.8922
net income	95.0000	79.9045	62.3767	1.0000	251.9317
cost	95.0000	113.321	89.9593	17.2032	344.1855
sup	95.0000	38.7938	77.7359	0.0000	561.8029
soilfr	95.0000	3.7650	2.4907	0.0000	11.6385

Source: Authors' statistical analysis results.

Table 2. Variance Inflation Factors of the Variables

Variable	VIF	1/VIF
n_income	1.26	0.7917
cost	1.62	0.6159
soilfr	1.47	0.6789
sup	1.39	0.7183
Mean VIF	1.44	

Source: Authors' statistical analysis results.

The Pearson correlation coefficient relating to the variables evaluates the degree to which the variables considered act together or separately from one another. It is understood that all of the variables had a statistically significant positive relationship with land rent (Table 3). In particular, it is seen that there is a strong 86.22% correlation between land rent and the variable of non-land-rent cost. No statistically significant correlation is found between the variable of net income and the variable of non-land-rent cost and difference payment support. Also, no statistically significant difference is detected between difference payment support and fertilizer and diesel support.

According to the results shown in Table 4, the H0 hypothesis is rejected according to the statistics of each test. Cross-sectional dependence is found between series. In short, an effect emerging in one of the crops considered is reflected in the other crops.

Table 3. Results of Correlation Coefficient between Variables

	Rent	n_income	cost	sup	soilfr
rent	1				
n_income	0.2363*	1			
Pearson corr. Sig.(2-tailed)	0.0212				
cost	0.8622*	0.1582	1		
Pearson corr. Sig.(2-tailed)	0.0000	0.1257			
sup	0.4763*	0.0577	0.5238*	1	
Pearson corr. Sig.(2-tailed)	0.0000	0.5784	0.0000		
soilfr	0.3352*	0.4555*	0.3953*	0.1293	1
Pearson corr. Sig.(2-tailed)	0.0009	0.0000	0.0001	0.2118	

Source: Authors' statistical analysis results.

Table 4. Results of the Cross-sectional Dependence Test of the Variables

	LM1	LM2	LMadj	CD
rent	51.009 (0.000)	9.170 (0.000)	9.031 (0.000)	6.706 (0.000)
n-income	78.128 (0.000)	15.234 (0.000)	15.095 (0.000)	8.421 (0.000)
cost	55.159 (0.000)	10.098 (0.000)	9.959 (0.000)	6.033 (0.000)
sup	96.448 (0.000)	19.330 (0.000)	19.191 (0.000)	8.698 (0.000)
soilfr	151.464 (0.000)	31.632 (0.000)	31.494 (0.000)	12.269 (0.000)

Source: Authors' statistical analysis results.

Firstly, unit root test is performed with regard to the variables considered in the study, as shown in Table 5. The IM-Pesaran-Shine (IPS) unit root test is set up as models including stable and trend. According to the results of the IPS unit test, the net income and sup variables are calculated as static The IPS unit test results are calculated as stationary at the “n_income ” and “sup” adaptations in the relative fixed model. All the shapes considered in the fixed and trend model could not meet the stationarity condition at the level.

It provides integrating the stationarity condition to the I(1) degree in fixed, constant and trend models. This will show that the panel ARDL method can be applied in the analysis of series with different levels of stationarity conditions.

The presence of cointegration between the variables is examined in Table 6 with the help of Pedroni panel Cointregration [34] and Kao Cointregration [2, 3] analyses.

Table 5. Panel Unit Root Test Results

	Individual intercept				Individuel intercept and trend			
	Level		First difference		Level		First difference	
	Statistic	p-value	Statistic	p-value	Statistic	p-value	Statistic	p-value
rent	-0.8831	0.1886	-4.4934	0	-0.003	0.4988	-3.7724	0.0001
net income	-1.6858	0.0459	-5.3322	0	0.6631	0.7464	-4.4906	0
cost	-1.2173	0.1117	-2.8993	0.0019	-0.0219	0.4913	-1.4544	0.0729*
Sup	-2.4466	0.0072	-5.1792	0	-0.8414	0.2001	-5.7953	0
Soilfr	-1.2237	0.1105	-2.8797	0.002	1.4292	0.9235	-2.6756	0.0037

* The first-order difference is stationary at the 10% significance level.
Source: Authors' statistical analysis results.

Table 6. Panel Cointegration Test Results

Petroni		
	Statistic	Prob.
Panel v-Statistic	0.2936	0.3845
Panel rho-Statistic	0.2996	0.6178
Panel PP-Statistic	-1.5881	0.0561
Panel ADF-Statistic	-1.3652	0.0861
	Statistic	Prob.
Group rho-Statistic	1.0122	0.8443
Group PP-Statistic	-2.3001	0.0107
Group ADF-Statistic	-2.4542	0.0071
Kao		
	t-Statistic	Prob.
ADF	-3.89626	0.0000

Source: Authors' statistical analysis results.

According to the results obtained, in Pedroni cointergration analysis, the extra-group PP and ADF test results and also the intra-group PP and ADF test results showed the presence of a long term cointegration. According to Kao Cointegration analysis, it showed the presence of a cointegration at a level of 1% between series.

The parameters relating to the variables considered can be estimated both in the short term and the long term with both the Pooled Mean Group Estimator (PMG) and the Pooled Group Estimator (MG). The Hausman homogeneity test is used to find which model to use for analysis (Table 7). The chi squared value obtained according to the Hausman homogeneity test is calculated to be 2.03. Because the model is not symmetrical, the predictive power of the PMG model is stronger than the estimator of the MG model, and is calculated to give a consistent result.

Table 7. Homogeneity Test Results

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
		Mg	pmg	Difference S.E.
L. n_income	0.009566	0.003837	0.0057286	
L.cost	0.119078	0.076435	0.0426426	0.0532358
L.sup	-0.00392	0.007682	-0.0115989	0.0593037
L.soilfr	-0.33538	0.057062	-0.3924377	0.3088116
chi2(4)				2.03
Prob>chi2				0.73

Source: Authors' statistical analysis results.

Table 8. ARDL Long Term Scaled Coefficient Values

Variable	Coefficient	Standardized Coef.	Elasticity at Means
n_income	0.065	0.430	0.298
cost	0.061	0.578	0.394
sup	-0.045	-0.367	-0.099
soilfr	0.724	0.191	0.156

Source: Authors' statistical analysis results

When the two delayed Panel ARDL models are examined according to the dependent variable of the farms' rental costs as an independent variable in the study (Table 8), it is found that the values of the parameters of long term net farm income, non-land-rent costs, difference payment support and fuel and fertilizer support are significant at a level of 1%. It is calculated according to mean elasticities that net income (0.298%), non-land-rent cost (0.394%), and fuel and fertilizer support (0.156%) increased land rent in a positive direction. It is found that difference payment support fell in the long term (0.999%). It is found that in the short term, net farm income had a negative effect, but that a delayed value of difference payment support and fertilizer and fuel support had a positive effect.

In the ARDL short term error correction model, the ECT value (0.8256) is calculated to be negative and significant (Table 9). This value which is obtained shows that 82.56% of deviation from balance in the short term are eliminated in one year. The half-life of the deviations is 0.8389, and 50% of deviations from balance in the short term (0.8389*12) are eliminated in approximately ten months. It can be said that the effect of a change in independent variables lasted up to ten months. (1. Short term balance relationships relating to the crops considered are given in detail in the Appendix.).

Table 9. Panel ARDL/PMG Estimate Results

	LogL	AIC	BIC*	Specification
1	-140.389	4.692	6.387	ARDL(1, 0, 2, 2, 2)
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
n_income	0.065	0.002	27.192	0.000
cost	0.061	0.004	15.058	0.000
sup	-0.045	0.002	-17.970	0.000
soilfr	0.724	0.057	12.614	0.000
Short Run Equation				
ECT	-0.826	0.219	-3.765	0.001
D(n_income)	-0.032	0.009	-3.381	0.002
D(n_income (-1))	-0.038	0.019	-1.955	0.058
D(cost)	0.056	0.029	1.936	0.061
D(cost(-1))	0.004	0.020	0.186	0.854
D(sup)	0.055	0.040	1.376	0.177
D(sup(-1))	0.039	0.023	1.706	0.097
D(soilfr)	0.642	0.475	1.351	0.185
D(soilfr(-1))	1.408	0.747	1.885	0.068
C	6.963	2.630	2.648	0.012
@TREND	-0.505	0.166	-3.042	0.004
Mean depend var	0.140	S.D. dependent var		5.341
S.E. of regress.	4.825	Akaike info crit.		4.198
Sum squard resid	838.152	Schwarz criterion		5.784
Log likelihood	-140.389	Hannan-Quinn crt.		4.839

Source: Authors' statistical analysis results.

There are many investigations in studies in the literature of whether agricultural support affects land prices, and it has been found that the way the supports are applied and the determination of the rules are very important. In particular, it has been seen in many studies that land-based support by the EU and direct payment support have changed the rates of capitalization [8, 9, 16, 17, 27].

Generally in the literature, when land-dependent supports are directed to the landowners rather than the farmers, even though it is said that these do not affect land prices, it has been found that on rented land, the landowners benefit from the supports to different extents [13, 18].

It is seen from the model findings obtained that particularly fuel and fertilizer support raised the land rent in the long and short terms, but that difference payment support caused a rise in rents in the short term but a fall in the long term. Of these two supports which are considered, it is estimated that the application and rules of the fuel and fertilizer support should be reviewed. Correct and effective supports will enable the correct use of government resources.

Worldwide and local changes in agricultural policies also have an effect on land saving structure in agriculture, and these changes take agriculture to a more dynamic structure in the face of competition. In Türkiye, while generally ownerships farms maintains their importance, an increase is seen in the numbers of those farming the land by rental. When it is thought that this increase will continue, rental contracts and rental determination processes will gain more importance in the future. This activity will be greater in areas where agricultural production potential is high and where technology is more widely used. In this study, the province of Antalya is chosen because it has a dynamic structure about agricultural activities, and work is carried out to determine the factors affecting rents by examining the development in land rents. An increase in demand for agricultural crops for food and non-food reasons and stability in land supply generally cause an increase in prices. At the same time, in order for it to be possible to carry out rental economically, it is necessary that both the tenant and the landowner be left with a certain amount of profit. Net income is an important indicator of the growth capacity of an economically sustainable farm level.

The long-term profit amount within the farm strategies determines the growth ability of agricultural enterprises. Fluctuations in net income may create the possibility of reducing the power of economic sustainability. Because in rental all of the risk belongs to the tenant, net income is also important in determining the tenant's profit level.

CONCLUSIONS

In this study, it is found that rents in Antalya province are generally at a level at which the tenant could make a profit. Factors affecting land rent are examined with the panel ARDL model, and according to the results of the analysis, both in the long term and in the short term the variable of fuel and fertilizer support is found to have a positive effect on land rent prices. Producer costs showed a similar characteristic.

However, while difference payment support caused an increase in rental prices in the short term, in the long term it is found to have a negative effect on rental price increases. Net income causes a reduction in rent in the short term, but in the long term it causes an increase in rental prices.

In conclusion, net income determines the tenant's level of profit, and in general rental is seen to be a profitable activity with the crops examined. It is found according to the result of the panel ARDL that net income, of the factors affecting rental, in the long term had a significant and positive (0.298%) effect on land rent, but a negative effect in the short term. It is found that the fuel and fertilizer support also increased land rent in a positive direction (0.156%). The negative effect of net income on rents in the short term may be related to the change in fertility and prices and the fact that crop decisions cannot be changed in the short term. It can be said that in the long term the idea that a good income can be obtained increases rent prices.

According to the results of analysis, fuel and fertilizer support has created an increase in land rent prices in the short and long term, and a need is shown for more research on the application and regulation of support.

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Appendices /Appendix A

Barley				
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
ECT	-0.74419	0.081873	-9.08956	0.0028
D(n_income)	-0.02635	0.001682	-15.6686	0.0006
D(n_income(-1))	-0.06412	0.001536	-41.7313	0.0000
D(cost)	0.01303	0.004285	3.040746	0.0558
D(cost(-1))	-0.06849	0.012842	-5.33283	0.0129
D(sup)	0.034592	0.001591	21.74565	0.0002
D(sup(-1))	0.025559	0.001197	21.34821	0.0002
D(soilfr)	0.002705	0.190452	0.014202	0.9896
D(soilfr(-1))	0.375754	0.504042	0.745483	0.5101
C	5.671884	16.87033	0.336205	0.7589
@TREND	-0.41228	0.126554	-3.25772	0.0472

Wheat (Irrigated land)				
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
ECT	-1.493	0.000	-5930.454	0.000
D(n_income)	-0.055	0.000	-22531.690	0.000
D(n_income(-1))	-0.071	0.000	-47886.550	0.000
D(cost)	0.131	0.000	11937.790	0.000
D(cost(-1))	0.017	0.000	4090.705	0.000
D(sup)	0.096	0.000	8455.230	0.000
D(sup(-1))	0.005	0.000	989.994	0.000
D(soilfr)	0.577	0.004	141.105	0.000
D(soilfr(-1))	2.547	0.005	482.362	0.000
C	12.413	0.307	40.455	0.000
@TREND	-0.993	0.000	-4406.643	0.000

Wheat (Dry land)				
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
ECT	-1.087	0.046	-23.625	0.000
D(n_income)	0.001	0.000	3.317	0.045
D(n_income(-1))	-0.051	0.000	-242.510	0.000
D(cost)	0.121	0.002	57.957	0.000
D(cost(-1))	0.024	0.001	16.379	0.001
D(sup)	0.182	0.005	38.024	0.000
D(sup(-1))	0.129	0.002	65.496	0.000
D(soilfr)	2.177	0.328	6.639	0.007
D(soilfr(-1))	3.695	1.375	2.686	0.075
C	0.694	2.090	0.332	0.762
@TREND	-0.146	0.014	-10.650	0.002

Cotton				
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
ECT	-0.604	0.047	-12.942	0.001
D(n_income)	-0.042	0.001	-59.275	0.000
D(n_income(-1))	-0.038	0.001	-53.417	0.000
D(cost)	-0.002	0.005	-0.306	0.780
D(cost(-1))	0.052	0.003	14.854	0.001
D(sup)	-0.052	0.021	-2.549	0.084
D(sup(-1))	0.018	0.019	0.935	0.419
D(soilfr)	-0.610	0.405	-1.508	0.229
D(soilfr(-1))	-0.377	0.979	-0.384	0.726
C	13.737	55.362	0.248	0.820
@TREND	-0.781	0.466	-1.677	0.192

Mais				
Variable	Coefficient	Std. Error	t-Statistic	Prob. *
ECT	-0.19946	0.006034	-33.0547	0.000
D(n_income)	-0.03866	0.000135	-286.964	0.000
D(n_income(-1))	0.035752	8.49E-05	421.0249	0.000
D(cost)	0.015719	0.000208	75.40692	0.000
D(cost(-1))	-0.00472	0.000195	-24.1821	0.000
D(sup)	0.013045	1.23E-05	1063.839	0.000
D(sup(-1))	0.017593	1.58E-05	1110.413	0.000
D(soilfr)	1.061813	0.089389	11.87855	0.001
D(soilfr(-1))	0.797621	0.074563	10.69726	0.002
C	2.298975	2.783858	0.825823	0.470
@TREND	-0.19035	0.014681	-12.9658	0.001

Source: Authors' statistical analysis results.